Keltic Petrochemicals Inc.
Liquid Natural Gas Facilities and Marginal Wharf
Goldboro, Nova Scotia

Final
Comprehensive Study Report

October 2007

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Proposed Liquefied Natural Gas Facility
and Marginal Wharf
Comprehensive Study Report
Goldboro, Nova Scotia

<u>FINAL REPORT</u>

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LIST OF ACRONYMS

ACCDC	Atlantic Canada Conservation Data Centre
AERMOD	American Meteorological Society Regulatory Model
AMEC	AMEC Earth & Environmental, a division of AMEC Americas Limited
ASU	Air Separation Unit
ATV	All-Terrain Vehicle
BLEVE	Boiling Liquid Expanding Vapour Explosion
BOG	Boil-Off Gas
CCME	Canadian Council of Ministers of Environment
CEA	Cumulative Effects Assessment
CEAA	*Canadian Environmental Assessment Act*
CEPA	*Canadian Environmental Protection Act*
CICS	Canadian Institute for Climate Studies
CL	Carapace Length
CLC	Community Liaison Committee
CMHC	Canadian Mortgage and Housing Corporation
CNG	Compressed Natural Gas
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CPI	Coalescing Plate Interceptor
CSA	Canadian Standards Association
CSR	Comprehensive Study Report
CTA	Chain Transfer Agent
CWS	Canadian Wildlife Service
DDT	Dichlorodiphenyltrichloroethane
DFO	Fisheries and Oceans Canada
DIANA	Department of Indian and Northern Affairs
DNL	Day-Night Average Sound Level
DNV	Det Norske Veritas
DO	Dissolved Oxygen
EA	Environmental Assessment
EC	Environment Canada
ECC	Environmental Components Of Concern
ECM	Environmental Compliance Monitoring
EEM	Environmental effects monitoring
EMP	Environmental Management Plan
EMS	Environmental Management System
EPA	Environmental Protection Agency
EPC	Engineering Procurement and Construction
EPP	Environmental Protection Plan
ESC	Erosion and Sediment Control
ESD	Emergency Shut Down

FEED	Front End Engineering Design
FHCP	Fish Habitat Compensation Plan
GBEP	St. Georges Bay Ecosystem Project
GCIFA	Guysborough County Inshore Fisherman's Association
GCRDA	Guysborough County Regional Development Authority
GHG	Greenhouse Gas
GIS	Geographic Information Systems
GPS	Global Positioning System
HADD	Harmful Alteration, Disruption or Destruction
HAZOP	Hazard and Operability Analysis
HDPE	High Density Polyethylene
IAFU	Induced Air Flotation Unit
IBA	Important Bird Area
IMO	International Maritime Organization
INAC	Indian and Northern Affairs Canada
IPCC	Intergovernmental Panel on Climate Change
ISAR	Interdisciplinary Studies in Aquatic Resources
ISFA	Inverness South Fishermen's Association
ISQC	Interim Sediment Quality Guidelines
KDP	Keltic Development Project
Keltic	Keltic Petrochemicals Inc.
KO	Knock Out
LDPE	Low Density Polyethylene
LLDPE	Linear Low Density Polyethylene
LNG	Liquefied Natural Gas
M&NP	Maritimes and Northeast Pipeline
MARPOL	International Convention for the Prevention of Pollution from Ships
MDO	Maine Diesel Oil
MEK	Mi'kmaq Ecological Knowledge
MFU	Maritime Fishermen's Union
MFWC	Mi'kmaq Fish and Wildlife Commission
MIACC	Major Industrial Accident Council of Canada
MSX	Multinucleate Sphere
Municipality	The Municipality of the District of Guysborough
NAEE	No Adverse Environmental Effect
NBCC	National Building Code of Canada
NFPA	National Fire Protection Association
NO_2	Nitrogen Dioxide
NO_x	Nitrous Oxides
NPRI	National Pollutant Release Inventory
NRCan	Natural Resources Canada
NSDAF	Nova Scotia Department of Agriculture, Fisheries and Aquaculture

NSDE	Nova Scotia Department of Energy
NSDNR	Nova Scotia Department of Natural Resources
NSEL	Nova Scotia Department of Environment and Labour
NSMNH	Nova Scotia Museum of Natural History
NSPI	Nova Scotia Power Inc.
NSRBA	Nova Scotia Road Builders Association
NSUARB	Nova Scotia Utility and Review Board
NWPA	*Navigable Waters Protection Act*
OCIMF	Oil Companies International Marine Forum
OCSG	Offshore Chemical Selection Guidelines
ORV	Open Rack Vaporization
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PEL	Probable Effect Level
PIRI	Partnership in RBCA Implementation
PLC	Programmable Logic Control
PM	Particulate Matter
PM_{10}	Particulate Matter with aerodynamic diameter less than a nominal 10 micrometres
$PM_{2.5}$	Particulate Matter with aerodynamic diameter less than a nominal 2.5 micrometres
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
QRA	Quantitative Risk Assessment
RA	Responsible Authorities
RBCA	Risk-Based Corrective Action
RCMP	Royal Canadian Mounted Police
RMS	Root Mean Square
ROV	Remote Operated Vehicle
S&W	Stone & Webster
SARA	*Species At Risk Act*
SCV	Submerged Combustion Vaporization
SD	Statistical District
SIGTTO	Society of International Gas Tanker and Terminal Operators
SIRE	Ship Inspection Report Programme
SO_2	Sulphur Dioxide
SOEI	Sable Offshore Energy Inc.
SOEP	Sable Offshore Energy Project
SPM	Suspended Particulate Matter
SSP	Steel Sheet Piling
SWMP	Storm-water Management Plan
TC	Transport Canada
TCH	Trans-Canada Highway
TDG	Transportation of Dangerous Goods

TERMPOL	Technical Review Process of Marine Terminal Systems in Transshipment Sites
the Agency	Canadian Environmental Assessment Agency
the Board	Nova Scotia Environmental Assessment Board
the Project	Petrochemical and Liquefied Natural Gas Facility in Goldboro, Nova Scotia
TSP	Total Suspended Particulates
TSS	Total Suspended Solids
UK	United Kingdom
USA	United States of America
UTM	Universal Transverse Mercator
VEC	Valued Environmental Component
VHP	Very High Pressure
VLCC	Very Large Crude Carriers
VOC	Volatile Organic compound
WHMIS	Workplace Hazardous Materials Information System

LIST OF UNITS

%	percent
µg/m^3	micrograms per cubic metre
µm	micrometer
µS	microseimens
µS/cm	microseimens per centimetre
BCM	billion cubic metres
bcm/a	billion cubic metres per annum
BF/P	base flow to precipitation
BTU	British Thermal Unit
BTU/hr	British Thermal Units per hour
cm	centimetre
cm/sec	centimeters per second
dB	decibels
dBA	Decibel measurement using an A weighting filter
dB re1µPa	decibals referenced to 1 microPascal
DWT	dead weight tonnes
g/t	grams per tonne
gal/hr	gallons per hour
gal/yr	gallons per year
ha	hectare
hPa	hectopascal
Hz	hertz
ka	kiloannum
kg	kilogram
kg/hr	kilograms per hour
kg/m^3	kilograms per metres cubed
kHz	kilohertz
km	kilometre
km/h	kilometres per hour
km^2	square kilometre
kTA	kilotonnes per amphere
kV	kilovolts
KVA	kilovolts per annum
kW	kilowatt
L	litre
L/min	litres per minute
lb/hr	pounds per hour
lb/mmBTU	pounds per million British Thermal Units
Leq	equivalent sound level
m	metre
m/s	metres per second
m^2	square metres

m^3	cubic metres
m^3/day	cubic metres per day
m^3/hr	cubic metres per hour
m^3/year	metres cubed per year
mg	milligrams
mg/kg	milligrams per kilogram
mg/L	milligram per litre
mg/m^3	milligrams per cubic metre
ml	millilitre
mm	millimetre
mm/d	millimetres per day
mmcf/hr	million cubic feet per hour
mmcf/yr	million cubic feet per year
mmcfd	million cubic feet per day
mmt	million metric tonnes
MW	megawatt
MWe	megawatts of electricity
Nm^3	normal cubic metres
Nm^3/hr	normal cubic metres per hour
ºC	degrees celsius
ºF	degrees fahrenheit
ppb	parts per billion
ppm	parts per million
ppt	parts per thousand
psig	pound per square inch gauge
QF/P	quick flow to precipitation
t	metric tonne
t/year	metric tonnes per year
tcf	trillion cubic feet
TF-P	total flow to precipitation
W/m^2	watts per square metre

EXECUTIVE SUMMARY

Overview

Keltic Petrochemicals Inc. (Keltic) proposes to construct and operate a Petrochemical and Liquefied Natural Gas (LNG) Facility in Goldboro, Nova Scotia (the Keltic Development Project). The Keltic Development Project components include a LNG regasification facility, a petrochemical complex, a marginal wharf, a marine LNG Terminal, LNG storage and an electric co-generation facility. The Keltic Development Project will be located adjacent to the existing Sable Island natural gas plant and the Maritimes and Northeast Pipeline (M&NP) in the Goldboro Industrial Park. The processing facilities in Goldboro will require approximately 300 hectares (ha) of land zoned for industrial use.

The marine terminal will allow the delivery of LNG and export of product. The co-generation plant will be fuelled by spent LNG with any remaining spent LNG injected into the existing M&NP pipeline in Goldboro. The Keltic Development Project will also require a wastewater collection and treatment system as well as other site infrastructure and maintenance facilities. The dam and impoundment of Meadow Lake required for water supply likely require approvals from Transport Canada (TC) and Fisheries and Oceans Canada (DFO); however, necessary detail for a screening level environmental assessment (EA) and authorizations will be provided in forthcoming applications.

The petrochemical complex will convert liquids extracted from the Sable Offshore Energy Project (SOEP) at Goldboro combined with the liquids extracted from imported LNG to produce ethylene and propylene in order to manufacture polyethylene and polypropylene pellets. These pellets will be used to manufacture plastic products elsewhere in Canada and the United States of America (USA).

The purpose of the Keltic Development Project is to increase petrochemical production in North America. This will help to meet rising demand for polyethylene and polypropylene pellets and provide additional sources of natural gas to the Canadian and Northeastern USA markets in an effort to meet the growing demands for natural gas. The Keltic Development Project will require an investment of approximately $5 billion which will be raised through private-sector investors.

The Proponent, Keltic is a Canadian registered corporation, committed to establishing a petrochemical complex, LNG importing facilities, and a co-generation plant at Goldboro, Guysborough County, Nova Scotia. The head office of Keltic is located in Halifax, Nova Scotia. By assignment and absolute conveyance made as at August 30, 2006, MapleLNG Limited ("MapleLNG") acquired from Keltic the entire LNG portion of the Project including any rights with respect to thereto subsequently acquired by Keltic. Keltic has also entered into an agreement with Shaw Stone & Webster for them to act as the Integrating Contractor from the pre- front end engineering design (FEED) through to the operation phase of the Keltic Development Project.

It is Keltic's corporate commitment to provide an economical and sustainable complex in accordance to the highest level of environmental goals and principles. As the agreements between Keltic and the financial, licensors and petroleum firms are finalized a detailed environmental management system (EMS) will be developed for each component of the Keltic Development Project.

This Keltic Development Project is expected to create several thousand direct jobs at the peak of the Project construction and several hundred direct jobs at the various facilities during operation. Keltic expects that many other economic spin-off opportunities will be created in the area as a result of a world-scale LNG and petrochemical facility being built in Goldboro, Guysborough County. These direct jobs and economic spin-off opportunities will be created in a region of Nova Scotia that has an unemployment rate well above the provincial and national average. Furthermore, the population of Guysborough County has been in steady decline as a result of the employment situation; this trend is expected to be reversed with the establishment of this industry. This Keltic Development Project will improve the overall employment rate from both a local and provincial perspective.

Both TC and DFO declared themselves as responsible authorities (RAs) for this Keltic Development Project. A draft scoping document was prepared by the RAs on May 24, 2005, (Appendix 1) to allow the public to comment upon the proposed scope and factors to be considered in the federal EA. Comments were also invited from the public on the ability of a comprehensive study to address the issues related to the Keltic Development Project as opposed to referral to a mediator or a review panel.

Pursuant to Subsection 21(1) of the *Canadian Environmental Assessment Act* (CEAA), TC and DFO invited the public to comment on this draft scoping document on June 1, 2005 and June 3, 2005. Comments were requested to be provided to the RAs by July 3, 2005.

An EA Track Report was prepared by TC and DFO on October 14, 2005. This report, along with the recommendation to the Minister of the Environment, is intended to assist the Minister of the Environment in making a determination under subsection 21.1(1). On January 5, 2006, the Federal Minister of Environment determined that a comprehensive study is the required level of EA for the proposed Keltic Development Project.

On March 14, 2007, the Provincial Minister of Environment and Labour approved Keltic Petrochemicals' Liquefied Natural Gas and Petrochemicals Facility Project at Goldboro subject to certain terms and conditions (Appendix 2). Since receiving the Environmental Approval Conditions from the Nova Scotia Minster of the Environment, Keltic has been working with the provincial regulators on a practical approach to satisfying the Ministerial Conditions.

A finalized scope for the comprehensive study report (CSR) was provided to Keltic on January 6, 2006. Each of the RAs has scoped different elements of the overall Keltic Development Project; however, both elements as scoped are subject to a comprehensive study EA process. Since the Project, as scoped by DFO, falls within the Project as scoped by TC and both projects require a comprehensive study level EA, it was determined that one CSR would be prepared to meet the requirements under CEAA.

Pursuant to Section 17 of CEAA, the RAs have delegated the conduct of the comprehensive study and preparation of the CSR to the Proponent, Keltic. The departments providing specialist advice have worked together with the Agency and the RAs to provide direction on the federal CSR.

Guidance on the content of the CSR has been provided to Keltic, including provision of a table of contents and comments on draft documents. In addition, TC and DFO have reviewed the provincial EA provided by the Proponent which allowed both RAs to provide additional input regarding their respective content expectations. It was understood that the contents of the provincial EA document were to be used by the Proponent in the preparation of the CSR and subsequent environmental screenings.

DFO and TC will work together to conduct a single federal EA process that will allow both RAs to fulfill their respective responsibilities under CEAA, in a unified non-duplicative manner.

The specific scope of each RA is defined below.

Transport Canada's (TC) Scope of Project

The Project has been scoped by TC to include the construction, operation, maintenance, modification and decommissioning of the following components:

- LNG Terminal;
- marine transfer pipelines;
- LNG storage tanks;
- marginal wharf;
- any temporary marine facilities and structures and equipment that are connected with the movement of goods between ship and shore;
- regasification plant; and
- shipping within 25 kilometres (km) of Country Island.

As outlined in the Scoping Document (May 24, 2005), TC scoped the Project based on the anticipated *Navigable Waters Protection Act* (NWPA) section 5(1)(a) trigger under the Law List Regulations pursuant to CEAA. This initial scope included all of the above components but shipping within 25 km of Country Island. Based on subsequent consultation with the public in accordance with section 21(1) of CEAA and consultation with expert federal authorities, TC amended its original scope to include shipping within 25 km of Country Island.

Fisheries and Ocean Canada's (DFO) Scope of Project

DFO scoped the Project to include:

- Construction and operation of the marginal wharf.

The scope of the marginal wharf operation does not include shipping, but does include docking and deberthing of vessels. This scoping is based on the anticipated *Fisheries Act*, section 35(2) trigger under the Law List Regulations pursuant to CEAA.

Based on consultation with the public in accordance with section 21(1) of CEAA and consultation with expert federal authorities, DFO decided that their scope of Project will remain the same.

Public Consultation by the Proponent

To date, several consultations have occurred. These consultations were designed to provide information about the proposed Keltic Development Project, respond to questions and concerns the public might have, and gather technical information and input into impacts, mitigation, and monitoring that could be incorporated into the EA.

As part of the public consultation process, Keltic Petrochemicals established a Community Liaison Committee (CLC) in August of 2004. The committee was set up voluntarily by Keltic to involve and inform local communities in the Keltic Development Project Area and will be the primary vehicle used for future consultations. The CLC has a two-fold mandate:

- to provide a forum for the representatives of the residents of Guysborough and surrounding communities to offer their input on the Keltic Development Project; and
- to provide a forum for representatives from Keltic to update the community, through the committee, on the various aspects of the Keltic Development Project.

Keltic will liaise with the Guysborough County Regional Development Authority (GCRDA) and the Guysborough Journal as a means of communicating any information. Keltic will also liaise actively with local emergency service providers, such as the Royal Canadian Mounted Police (RCMP), fire, and emergency health response.

In addition, as part of the Provincial EA process, public and regulatory consultation was conducted as part of the review of the Environmental Impact Assessment. Input was gathered through written submission as well as 6 days of public hearings held in Goldboro, St. Mary's, and Antigonish from November 20 – 25, 2006. This input was included in the preparation of the CSR.

CSR Methodology

The CSR is written to reflect a Project description that describes the components described in the federal Scoping Report as well as all associated infrastructure requirements. Consideration has been given to all phases of the Project, including activities associated with construction, operation, maintenance, decommissioning/reclamation, and unplanned events.

The methodology for the preparation of the CSR was focused to provide:

- identification of the environmental and socio-economic components of greatest concern;
- consideration of the issues raised by stakeholders;
- incorporation of environmental management planning into the engineering design process;
- inclusion of cumulative effects in the overall EA process; and
- consideration of all regulatory requirements.

In order to attain the above the assessment approach entailed:

- identification of temporal and spatial boundaries;
- selection and organization of Valued Environmental Component (VECs);
- evaluation of VEC interactions with the Project;
- the methods for prediction and evaluation of environmental effects; and
- the rationale for development of mitigation measures.

VECs "are interpreted as environmental; socio-economic; human health; reasonable enjoyment of life and property; and cultural, historical, archaeological, paleontological, and architectural features that may be impacted, whether positive or negative, by the proposed Project."

For the Project, the VEC selection process involved the following steps and considerations:

- review of requirements of the Terms of Reference and scoping document;
- review of the baseline studies;
- review of Project works and activities;
- consideration of potential Project-environment interactions; and
- identification of public, stakeholder, and government concerns.

The following is a summary of the VECs selected for the Project:

- Hydrology;
- Freshwater Quality/Quantity;
- Groundwater Quality/Quantity;
- Marine Water Quality;
- Soil/sediment Quality (terrestrial and marine);
- Air Quality;
- Climate Conditions;
- Vegetation (terrestrial and marine);
- Species at Risk;
- Fish and Fish Habitat (marine and freshwater);
- Marine Mammals;
- Wildlife and Wildlife Habitat;
- Migratory Birds and Migratory Bird Habitat;
- Wetlands;
- Lighting Conditions;

- Atmospheric and Underwater Acoustic Environment;
- Physical and Cultural Heritage;
- Current Use of Lands and Resources for Traditional Purposes by Aboriginal Persons;
- Structures/Sites of Archaeological, Paleontological or Architectural Significance;
- Navigation;
- Marine Safety and Security;
- Human Health and Safety;
- Fisheries;
- Aquaculture; and
- Tourism.

Potential effects were identified when a pathway or interaction between the Project and a VEC was established. Individual studies were then undertaken to focus on these potential effects. Based on collective knowledge and experience of the EA team and the individual studies and consultations, the following were determined for each predicted effect on a VEC:

- Nature (positive or negative);
- Magnitude;
- geographic extent;
- timing, duration and frequency;
- reversibility;
- ecological and socio/cultural context; and
- probability of occurrence (likelihood).

Positive environmental effects are also identified and explained.

Where an adverse environmental effect has been identified, mitigation has been proposed. Many adverse effects can be avoided through sound engineering design, and timing of Project activities and implementation to the proposed environmental management plans. The general approach taken is to reduce or eliminate the potential negative Project-VEC interactions, if feasible. Where not possible, mitigation measures were incorporated into the design and planned implementation of the Project activities in order to eliminate or reduce potential adverse effects. In some instances, remediation and/or compensation may be required where an adverse effect would jeopardize the implementation of the Project.

Furthermore, the terms and conditions to the Provincial Environmental Assessment Approval that relate to the CSR scoped VECs are identified and will be implemented by the Proponent.

The above approach results in the identification of Residual Effects – those environmental effects predicted to remain after the application of mitigation outlined in this CSR. The CSR considers the predicted residual effects for each Project phase (construction, operation, and decommissioning). In addition, residual environmental effects are also described for potential accidental events.

For adverse residual effects, the evaluation for the individual criteria was combined into an overall rating of significance:

- major;
- medium;
- minor; and
- minimal.

An adverse impact was considered "significant" where its residual effects were classified as major; while they were considered "not significant" where residual effects were classified as medium, minor, or minimal.

Conclusion

In accordance with the requirements of Section 16 (1) and (2) of CEAA and the Terms of Reference, this environmental impact assessment includes:

- A discussion of the alternatives to the Project and the alternative means of carrying out the Project that are technically and economically feasible and the environmental effects of any such alternative means.
- A description of the proposed Project including the purpose, and need, the proposed facilities and activities, and the potential malfunctions or accidental events that may occur in connection with the Project.
- A summary of consultation mechanisms and issues raised during consultation (i.e., issues scoping) as well as a description of the methodological approach to the environmental impact assessment.
- An assessment of the environmental effects of the proposed Project for each of the VECs, including cumulative environmental effects and the significance of the effects.
- An assessment of the effects of the environment on the Project.
- Identification of measures to mitigate adverse environmental effects.
- Recommendations for monitoring and follow-up.

The results of the assessment have been developed and summarized in Section 6.0 of the CSR. This section describes the predicted effect and the identified mitigation or avoidance measures which could reduce or eliminate the predicted effects.

Environmental management practice involving prevention and preparedness training is proposed to reduce the likelihood of unplanned (accidental) events. As well, effective emergency response programs will be developed should an event occur. The Emergency Preparedness planning will include the purchase of required equipment, the careful maintenance of equipment and infrastructure, and the frequent scheduling of training exercises and emergency response simulations. Emergency Preparedness Planning will be integrated into all phases of the Project design, planning, and execution. The objective is to achieve a safety and emergency preparedness level higher than the industry average, and continuously to improve upon this standard.

Through careful design and planning, combined with prudent application of proven mitigation measures, Keltic has identified and addressed all potential adverse environmental effects, and reduced the predicted impacts to their lowest level of significance.

1.0 INTRODUCTION

Keltic Petrochemicals Inc. (Keltic) proposes to construct and operate a Petrochemical and Liquefied Natural Gas (LNG) Facility in Goldboro, Nova Scotia, hereafter referred to as the Keltic Development Project (KDP). The primary facilities proposed by the KDP include an LNG regasification facility, a petrochemical complex, a marginal wharf, a marine LNG Terminal, LNG storage, and an electric co-generation facility.

The KDP will be located adjacent to the existing ExxonMobil natural gas plant and the Maritimes and Northeast Pipeline (M&NP) in the Goldboro Industrial Park. The KDP processing facilities in Goldboro will require approximately 460 hectares (ha) of land zoned for industrial use. The KDP location and basic layout are shown in Figures 1.0-1 and 1.0-2.

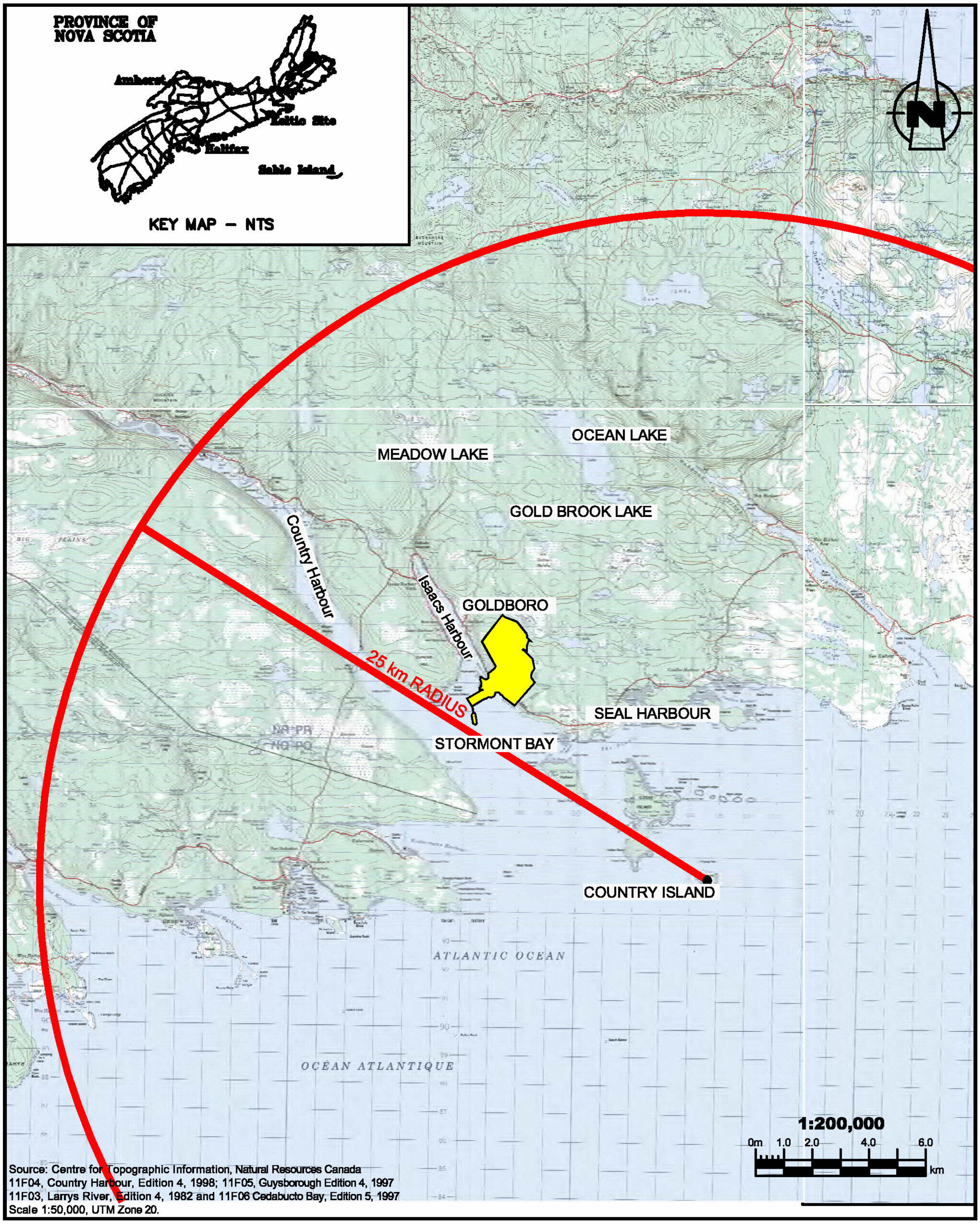
The LNG Marine Terminal will allow for the delivery of LNG and the Marginal Wharf for the import of other feedstock materials and the export of products. The co-generation plant will be fuelled by the natural gas remaining following the extraction of liquids for petrochemical feedstock. The remaining natural gas will be injected into the existing M&NP pipeline in Goldboro. A freshwater supply system is required. This includes the construction of a reservoir at Meadow Lake. A wastewater collection and treatment system, as well as other site infrastructure and maintenance facilities are required for KDP.

The petrochemical complex will convert liquids extracted from the Sable Offshore Energy Project (SOEP) at Goldboro combined with the liquids extracted from imported LNG to produce ethylene and propylene in order to manufacture polyethylene and polypropylene pellets. These pellets will be used to manufacture plastic products elsewhere in Canada and the United States of America (USA).

The purpose of the KDP is to increase petrochemical production in North America and to supply natural gas to markets in Eastern Canada and the Northeastern USA. This will help to meet rising demand for polyethylene and polypropylene pellets as well as that of natural gas to the Canadian and Northeastern USA markets. Development of a petrochemical industry in Nova Scotia is in line with the Nova Scotia Energy Strategy (Nova Scotia Department of Energy (NSDE), 2001) and creates added value to the natural gas found offshore Nova Scotia.

The KDP will require an investment of approximately $5 billion which will be raised through private-sector investors.

This document forms the Comprehensive Study Report (CSR) as required for this Project under the *Canadian Environmental Assessment Act* (CEAA). Under CEAA, a comprehensive study must take place where a project is described in the *Comprehensive Study List Regulations*. A comprehensive study is therefore required for the LNG Terminal and marginal wharf portions of the KDP, hereafter referred to as "the Project," as they will be designed to accommodate vessels larger than 25,000 dead weight tonnes (DWT).



LEGEND

Keltic Development Project

FIGURE No. 1.0-1

KELTIC PETROCHEMICALS INC.

KELTIC DEVELOPMENT PROJECT

LOCATION AND REGIONAL SETTING

JUNE 2007

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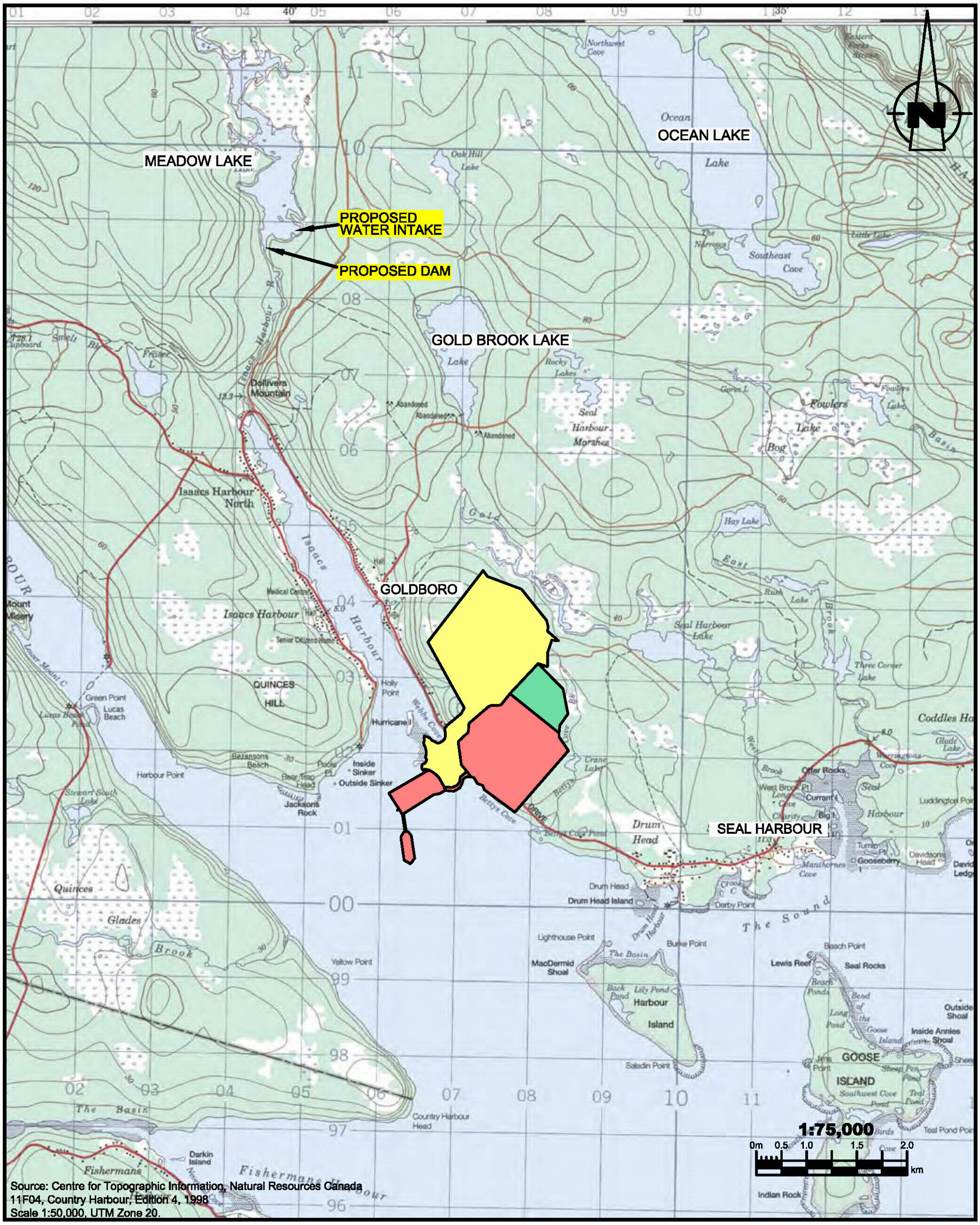

LEGEND

- Co-Generation Power Plant
- Petrochemical Plant
- LNG Plant and Marine Facilities

FIGURE No. 1.0-2

KELTIC PETROCHEMICALS INC.

KELTIC DEVELOPMENT PROJECT LOCATION AND BASIC LAYOUT

JUNE 2007

020714

This CSR report has been coordinated by AMEC Earth & Environmental, a division of AMEC Americas Limited (AMEC), with input from the technical specialists listed below.

- 4Gas;
- Atlantic Road & Traffic Management;
- CEF Consultants Limited;
- Davis Archaeological Consultants Ltd;
- D. Besner & Associates Inc;
- Dillon Consulting;
- Duncan Cameron;
- Earth-water Concepts Inc;
- MacDonnell Group;
- McInnes Cooper;
- Membertou Geomatics;
- Royal Haskoning, Netherlands;
- Shaw Environmental;
- Strait Engineering;
- Stone & Webster (S&W); and
- Tarandus Associates Limited.

1.1 PURPOSE OF THE COMPREHENSIVE STUDY REPORT (CSR)

Under Section 5 (1) of CEAA, an environmental assessment (EA) of a project is required if a federal authority exercises or performs one or more of the following powers, duties, or functions in relation to a project:

- proposes the project;
- grants money or any other form of financial assistance to the project;
- grants an interest in land to enable a project to be carried out; or
- exercises a regulatory duty in relation to a project, such as issuing a permit or license, which is included in the Law List Regulations (Canadian Environmental Assessment Agency (the Agency), 1994).

Transport Canada (TC) and Fisheries and Oceans Canada (DFO), have triggered a requirement to conduct an EA, and as such, will be responsible authorities (RAs) under CEAA as each department will need to issue a regulatory approval for components of the Project, in order for them to proceed. In addition to the RAs, Environment Canada (EC), Natural Resources Canada (NRCan), and Health Canada have provided specialist or expert information and knowledge to support the comprehensive study process.

The purpose of a federal CSR is to:

- Identify the potential environmental effects of a project whether positive or negative, including the environmental effects of any accidents or malfunctions that may occur in connection with the project and any 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.
- Describe measures that are technically and economically feasible to mitigate any adverse environmental effects of the project.
- Report on all public concerns raised in relation to the Project and how they have been addressed.
- Based on the CSR and public comments, provide conclusions with respect to whether the project is likely to result in significant adverse environmental effects.

The scope of the Project to be assessed, as separately determined by DFO and TC in accordance with Section 15(1) of CEAA, is provided in Section 2.3 of this document.

1.2 THE FEDERAL REVIEW PROCESS

1.2.1 Comprehensive Study

A draft scoping document was prepared by the RAs on May 24, 2005, (Appendix 1) to allow the public to comment upon the proposed scope and factors to be considered in the federal EA. Comments were also invited from the public on the ability of a comprehensive study to address the issues related to the Project as opposed to referral of the Project to a mediator or a review panel.

Pursuant to Subsection 21(1) of CEAA, TC and DFO invited the public to comment on this draft scoping document on June 1, 2005 and June 3, 2005. Comments were requested to be provided to the RAs by July 3, 2005.

An environmental assessment Track Report was prepared by TC and DFO on October 14, 2005. This report, along with the recommendation to the Minister of the Environment, is intended to assist the Minister of Environment in making a determination under subsection 21.1(1).

On January 5, 2006, the Minister of Environment determined that a comprehensive study is the required level of EA for the proposed Project. Under CEAA, a comprehensive study must take place where the proposal represents a prescribed project or class of project included in the Comprehensive Study List. A comprehensive study is required for marine terminals designed to handle vessels larger than 25,000 DWT (CEAA Comprehensive Study List Regulation, Sept 2006, Part IX Transportation, 28c). This applies to both, the proposed LNG and the proposed terminal wharf.

A finalized scope for the comprehensive study was provided to Keltic on January 6, 2006. As defined in Section 2.3 of this document, each of the RAs has scoped a different project; however, both Projects are subject to a comprehensive study EA process. Since the Project, as scoped by DFO, falls within the Project as scoped by TC and both Projects require a comprehensive study level EA, it was determined that one CSR would be prepared to meet the requirements under CEAA.

Pursuant to Section 17 of CEAA, the RAs have delegated the conduct of the comprehensive study and preparation of the CSR to the Proponent, Keltic. The departments providing specialist advice have worked together with the Agency and the RAs to provide direction on the federal CSR.

Guidance on the content of the CSR has been provided to Keltic, including provision of a table of contents and comments on draft documents. In addition, TC and DFO have reviewed a provincial EA provided by the Proponent which allowed both RAs to provide additional input regarding their respective content expectations. It was understood that the contents of the provincial EA document were to be used by the Proponent in the preparation of the CSR and subsequent environmental screenings.

The Agency is required to release the CSR for a 30 day public comment period. Following the public review period, the Agency will provide the comments to the RAs for response. The CSR together with public comments and RAs' responses will be provided to the Minister of Environment for review of all the information and subsequent issuance of the EA decision statement in accordance with Section 23 of the Act.

1.2.2 Screenings

The Proponent has been advised that the construction of a dam and impoundment of Meadow Lake for the process water supply for the KDP will likely require approvals from TC under the *Navigable Waters Protection Act* (NWPA), Section 5(1) (a), and DFO under the *Fisheries Act*, Section 35(2).

As the dam and impoundment were not envisaged by the Proponent at the time of the federal Scoping Document (May 24, 2005 with revision January 6, 2006), this component of the KDP was not included in the scope of the Project requiring comprehensive study. As the construction and operation of the dam and impoundment are subject to an EA under CEAA, TC, and DFO will address this component of the KDP as a separate screening level assessment.

The screening for the dam and impoundment will be triggered when applications are made by the Proponent to:

- TC for authorization of the dam under the NWPA; and
- DFO for authorization of the harmful alteration, disruption, or destruction (HADD) of fish habitat under the *Fisheries Act*.

Any watercourse crossings, storm water, sanitary water, process water, cooling water, wastewater outlets and/or infrastructure within the marine environment will be assessed for compliance with applicable federal legislation, which may result in the requirement for additional EAs.

These applications will be made by Keltic separate from this CSR.

1.2.3 Key Federal Legislation

Table 1.2-1 sets out a list of the key legislation relevant to the Project components. The specific requirement and schedule for application of the legislation are also noted.

TABLE 1.2-1 List of Relevant Federal Legislation

Statute/ Regulation	Section Reference	Requirement	Schedule
NWPA	S. 5 (1)	Approval and responsibility of the NWPA program rests with the Minister of TC to construct "work" in navigable waters	Prior to any construction activities below the high watermark.
Fisheries Act	S. 35	Approval required for HADD of fish habitat, specifically the marginal wharf.	Prior to any construction activities below the high watermark.
	S. 22 (1), (2), (3)	Minimum flows must be maintained for fish and fish eggs.	Prior to any construction activities.
	S. 32	Prohibits destroying fish by any means other than fishing. Most relevant if blasting is required in or near waters containing fish or fish habitat.	Should blasting be required, the Proponent will follow DFOs Guidelines for the Use of Explosives In or Near Canadian Fisheries prior to construction activities.
	S. 36	Prohibits deposit of deleterious substance in waters frequented by fish.	Throughout construction, operation, and decommissioning phases
Petroleum Refinery Liquid Effluent Regulation	General	Sets minimum standards for effluent quality from "petroleum refinery" as therein defined.	Throughout construction, operation, and decommissioning phases
CEAA	S. 5(1)	EA required before federal authority may render a decision identified under CEAA.	Prior to any construction activities.
Law List Regulation	S. 6 and 11	S.5 of the NWPA and s. 22 (2), and s.35 of the *Fisheries Act* are "triggers" for application of CEAA.	
Comprehensive Study Regulation		Specifies whether or not a comprehensive study is required.	
Species at Risk Act (SARA).	General	Provides protection to listed species and their habitat.	Throughout construction, operation, and decommissioning phases
Canadian Environmental Protection Act (CEPA)	Part 5	Regulates the manufacturing and handling of "toxic substance."	Notification to EC within 90 days of acquiring a scheduled substance.
Environmental Emergency Regulations	General	Requires notification to EC that Proponent has control of a scheduled substance. Also requires an environmental emergency plan for the facility that stores or uses the substance.	
National Pollutant Release Inventory (NPRI)	General	Keltic will likely be required to report under the NPRI.	

Statute/ Regulation	Section Reference	Requirement	Schedule
Canada Marine Act	General	Regulation of marine transportation.	Throughout construction, operation, and decommissioning phases
Transportation of Dangerous Goods Act	General	Documenting handling and placard requirements for transport of dangerous goods.	see above
Pilotage Act - Atlantic Pilotage Authority Regulations	General	Establishes pilotage authorities and requirements outside areas where pilots are compulsory.	see above
Canada Shipping Act	General	Detailed code for all aspects of shipping in Canada.	see above
Ballast Water Control and Management Regulations	General	Came into force on June 8, 2006.	see above
Canada Transportation Act	General	Applies to transportation matters under federal jurisdiction.	see above
Migratory Birds Convention Act	General	Provides protection for migratory birds and their habitat	see above
Marine Transportation Security Act and Regulations	General	Regulatory measures for marine and port security.	see above

1.2.4 Technical Review Process of Marine Terminal Systems in Transshipment Sites (TERMPOL)

The Technical Review Process of Marine Terminal Systems in Transshipment Sites (TERMPOL) is a voluntary review process of marine terminal systems for transshipment sites and is initiated by the Proponent. The purpose of this review process is to objectively appraise operational ship safety, route safety, management, and environmental concerns associated with the location, construction, and operation of a marine terminal.

The review is coordinated by TC in conjunction with requirements of the *Canada Shipping Act*. The process is not necessarily limited to the scope of the CEAA review and may involve a more detailed assessment of shipping and navigation issues. The *NWPA* review process is not exclusive of the components of the TERMPOL review process.

It is the policy of TC to initiate the TERMPOL upon request of the Proponent and upon initiation of the federal environmental assessment process for the Project. Keltic initiated TERMPOL with a written request on September 12, 2006. This correspondence was followed up on October 11, 2006; with a letter amending the initial request as the Project subsequently involved two Proponents, Keltic and MapleLNG. As explained in this letter, Keltic finalized the sale of assets related to the LNG facility to MapleLNG subsequent to the initial correspondence. A kick-off meeting was held on December 18, 2006, with TC and others to establish communications, initiate sharing of pertinent information, define the scope of the review, and agree on a schedule. Keltic is in the process of assembling information and undertaking studies outlined in the TERMPOL guidance document. In addition, Keltic is preparing a scoping document for TC's review which will outline its approach to the shipping simulation study.

Once TC is in receipt of the findings of these studies and simulations, it will prepare a summary report providing recommendations on navigation, pilotage, communications, and emergency response. Provisions of the review are not mandatory, but criteria are used by TC to determine the need for making or revising specific regulations or for implementing special precautionary measures.

1.3 THE PROVINCIAL REVIEW PROCESS

1.3.1 Provincial Environmental Assessment Process

Under the Environmental Assessment Regulations passed under Nova Scotia's *Environment Act*, the proponent of the undertaking is required to register with the Nova Scotia Department of Environment and Labour (NSEL) before proceeding with the final design of an undertaking or commencing work on an undertaking.

A petrochemical plant is designated as a Class II undertaking under the Environmental Assessment Regulations. As a result, an extensive EA, that included consideration by the Nova Scotia Environmental Assessment Board (NSEAB), was required. The generic steps in the Class II provincial environmental assessment process are described below:

- Before proceeding with the final design of the undertaking or commencing work, the proponent must register the undertaking with the NSEL.
- Within 7 days following the registration, the proponent must publish a notice in the newspaper giving certain prescribed information about the Project.
- Within 12 days of the registration of the undertaking, the administrator is required to publish a notice inviting the public to submit written comments for consideration in preparation of the terms of reference for an EA Report. Comments must be received within 40 days of publication of the notice. The proponent is then given 21 days to respond to any public comments and following the final day for comments from the proponent, the administrator is required, within 14 days, to provide final terms of reference for the EA Report.
- The proponent then must produce an EA Report which addresses all of the issues raised in the terms of reference.
- The EA Report is submitted to the NSEL and the Department either accepts the report or requires additional work following acceptance of a final report, there is a 48 day public review period.
- Within 10 days following receipt of the final report, the Nova Scotia Minister of Environment and Labour is obliged to refer the report to NSEAB for consideration. NSEAB then holds public hearings to receive public comments on the EA Report.
- Following the hearings, NSEAB produces a report and recommendations to the Minister of Environment and Labour. This report is to be generated within 110 days of the referral of the EA to NSEAB.
- Within 21 days after the receipt by the Minister of NSEAB's report and recommendation, the Minister advises the proponent in writing whether the undertaking is approved or rejected.

Keltic registered the KDP Development Proposal with NSEL on January 12, 2005, at which point NSEL released a draft terms of reference for public comment. The terms of reference were finalized by NSEL in April 2005.

Keltic submitted the EA Report to NSEL and it was released on August 22, 2006, for public review. The public had until October 30, 2006, to submit comments to NSEAB, following which hearings were held in November 2006.

Following the hearings, NSEAB requested a 60 day extension to the 110 day period they are provided for the preparation of the report and recommendations. This was granted by the Minister and the report and recommendation was submitted on February 21, 2007. The Minister then approved the KDP Development Proposal, subject to terms and conditions, on March 14, 2007.

Public documents related to the provincial EA review can be found at www.gov.ns.ca/enla/ea/kelticpetro.asp.

1.3.2 Key Provincial Legislation

Table 1.3-1 sets out a list of the key legislation relevant to the Project components. The specific requirement and schedule for application of the legislation are also noted.

TABLE 1.3-1 List of Relevant Provincial Legislation

Statute/ Regulation	Section Reference	Requirement	Schedule
Environment Act	S. 50	Prohibits designated activities without holding appropriate approval.	
Environmental Assessment Regulation	Schedule A	Storage facility for liquid or gaseous substances including hydrocarbons with total capacity greater than 5000 m^3 designed as a Class I undertaking requiring registration for Environmental Assessment.	Prior to construction
Activities Designation Regulations	S.(1)(d)(e) and (o)	The installation of certain culverts, a bridge, or other watercourse alteration requires an approval.	Prior to construction of culvert crossings associated with Highway 316 realignment; send-out gas pipeline crossing of Betty's Cove Brook.
	S. 5(1)(g)	The construction of a wharf requires approval.	Prior to construction.
	S. 10(1)(f)	The construction or operation of a site with a chemical storage tank in excess of 2000 litres (L) or 2000 kilograms (kg) requires approval (anticipated to be combined with industrial approvals for the petrochemical facility and LNG facility).	Prior to construction. Can be staged if required.
	S. 12(f)	The construction or operation of a natural gas processing facility.	

Statute/ Regulation	Section Reference	Requirement	Schedule
Activities Designation Regulations *(Cont'd)*	S. 21	The treatment or processing of wastewater or wastewater sludge is designated as an activity (anticipated to be combined with industrial approvals for the petrochemical facility and LNG facility).	
Air Quality Regulations	General	Establishes maximum permissible ground level concentrations of contaminants.	During all Project phases
Petroleum Management Regulation	S. 11	Storage tank systems must be registered.	Notify NSEL at least 3 days prior to construction of storage tanks. Within 30 days following installation file a report on the installation with NSEL.
Dangerous Goods Management Regulation	S. 6	Written approval required to store waste dangerous goods.	Prior to any construction activities.
Energy Resources Conservation Act – Gas Plant Facility Regulations	S. 6 (1), (2), 7 (1), (2)	Requires a permit to construct and licence to operate to be obtained from the Nova Scotia Utility and Review Board (NSUARB)	Prior to any construction activities.
Pipeline Act – Pipeline Regulations	S. 4 (1), (2)	Requires permit or licence to construct or operate a pipeline. Establishes standards for design and construction.	Prior to any construction activities.
Crown Lands Act	S 5, 13, 16 (1)	Governs the use and activities on lands owned by the province. Through the Act the province can make crown lands available for the Project through the use of easements, conveyances, leases, or licenses.	Prior to any activities on Crown Lands
Forests Act – Forest Protection Regulations	S 6 (1), (2)	Requires fire suppression equipment as per the regulation when operating within 305 metre (m) of the woods.	During construction.

1.4 THE FEDERAL/PROVINCIAL COORDINATION

As the Project is subject to both provincial and federal EAs, the province and the federal government have agreed to coordinate the processes to the extent possible by their respective legislations and processes.

Some components of the KDP reviewed by the provincial environmental assessment process are not within the scope of federal EA, such as the petrochemical facility, co-generation facility and the dam and impoundment. As the scope of the federal EA is a subset of the provincial EA, a separate document was required for the CSR.

Given the differences in federal and provincial scoping, opportunities for coordination were limited to a shared public review period. The Proponent submitted the EA Report in July 2006 which was commented upon by the public. Public hearings were conducted on the Project in November 2006. The 48 day public review period of the provincial EA Report fulfilled the requirements under CEAA Section 21.2.

The Proponent will receive an independent decision from the federal Minister of Environment as the provincial Minister of Environment and Labour issued his decision on March 14, 2007. Since receiving the Environmental Approval Conditions (Appendix 2) from the Nova Scotia Minister of Environment and Labour, Keltic has been working with the provincial regulators on a practical approach to satisfying the Ministerial Conditions. Keltic is currently developing a phased approach to the permits required to ensure that all conditions have been met to satisfy particular permits at the appropriate time.

Keltic recognizes that there will be additional conditions from a federal government perspective and has begun work on only the conditions that will not be impacted by any federal decisions. Keltic will continue to work closely with the provincial regulators to ensure that the scope of work adequately addresses the Ministerial Conditions.

It is of note that the proposed construction and operation of a dam at Meadow Lake (Meadow Lake Dam and Impoundment Project), which represents a component of the KDP, is being evaluated through another, separate EA process. The Meadow Lake Dam and Impoundment Project has been included in the scope of the provincial EA Report but is not within the scope of the federal CSR. Instead, this Project component is subject to a federal screening pursuant to Section 18 of CEAA. The requirement for the screening is triggered by the federal DFO determination that fish habitat may be altered, disrupted, or destroyed as a consequence of the dam construction and operation. It is anticipated that the screening may also be triggered if TC is required to issue an approval for the dam under the NWPA. The RAs for the Meadow Lake Dam and Impoundment Project are DFO and TC. The Meadow Lake Dam and Impoundment Project has also been subject the above mentioned public review and hearings.

2.0 PROJECT DESCRIPTION AND SCOPE OF ASSESSMENT

2.1 THE PROPONENT

The Proponent, Keltic, is a Canadian registered corporation with a head office is located in Halifax, Nova Scotia. The Proponent's coordinates are as follows:

Address: Keltic Petrochemicals Inc.
5151 George Street, Suite 603
Halifax, Nova Scotia
B3J 1M5

Contact: Mr. W. Kevin Dunn, President
Tel: (902) 422 4557
Fax: (902) 422 5980
Email: kevin.dunn@kelticpetrochemicals.ca

As the agreements between Keltic and the financial, licensors and petroleum firms are finalized, a detailed Environmental Management Plan (EMP) will be developed for each component of the Project. Keltic will provide detailed EMPs for the respective Project components in compliance with the environmental impact statement and approvals granted.

Keltic's corporate structure is depicted in Figure 2.1-1 and the Project participants and their roles in major stages of the Project are described in following subsections.

2.1.1 Keltic Development Project (KDP) Participants

MapleLNG

By assignment and absolute conveyance made as at August 30, 2006, MapleLNG Limited ("MapleLNG") acquired from Keltic the entire LNG portion of the Project including any rights with respect to thereto subsequently acquired by Keltic. MapleLNG is owned by 4Gas North America Ltd. and Suntera Canada Ltd. 4Gas operates on a stand-alone basis with a management team dedicated entirely to LNG. 4Gas focuses on developing and operating LNG Terminals around the world, including the Dragon LNG project in Milford Haven, Wales and the LionGas project in Rotterdam, The Netherlands. Both of these projects are currently under development; Dragon LNG is expected to be operational in 2007 and LionGas in 2009.

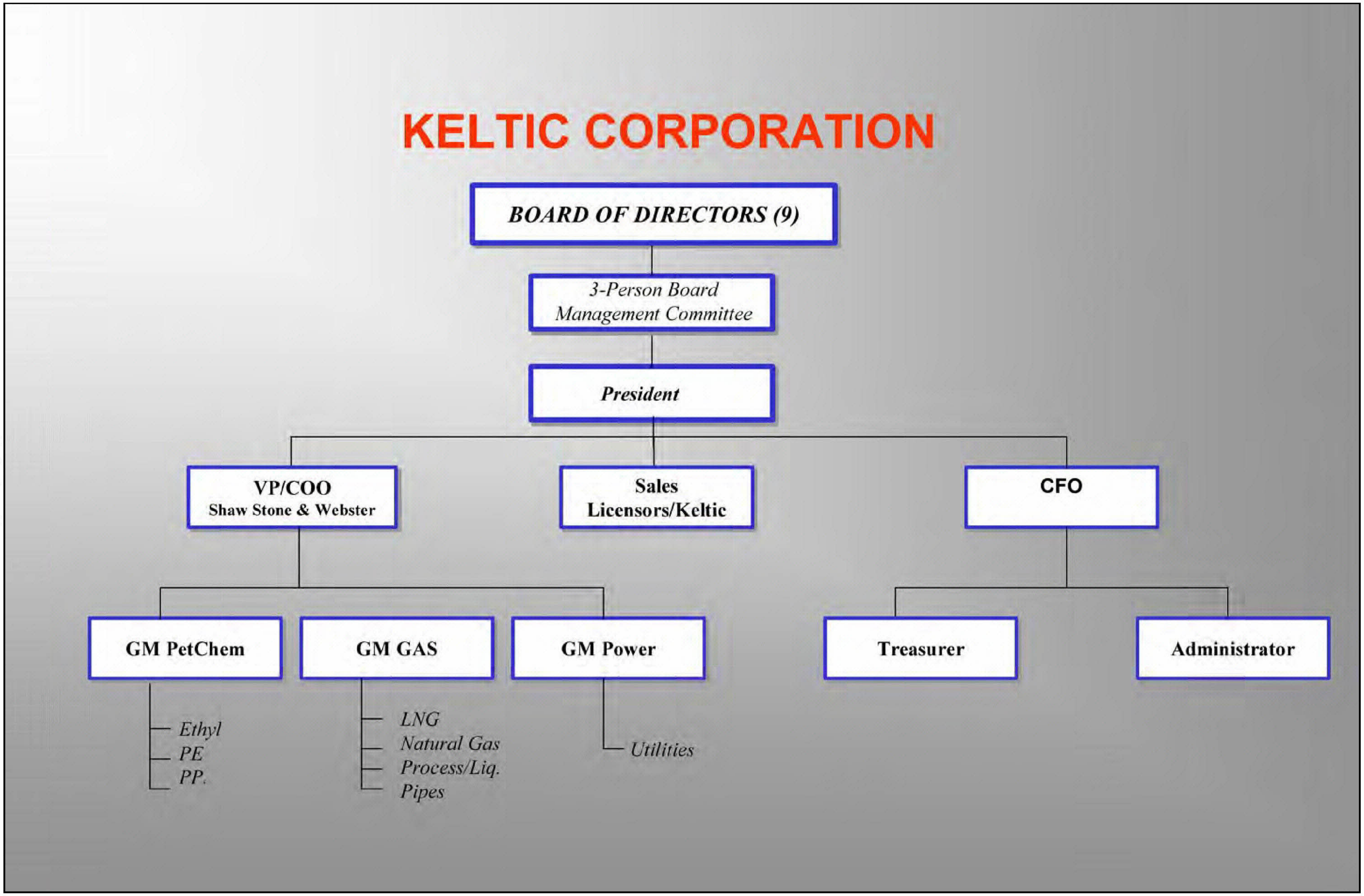

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FIGURE No. 2.1-1
KELTIC PETROCHEMICALS INC.
KELTIC'S CORPORATE STRUCTURE
JUNE 2007

Stone & Webster (S&W) Inc.

Stone & Webster Inc. (S&W), a subsidiary of The Shaw Group Inc., is an engineering construction company that was founded in Boston in 1889. S&W is a multinational corporation and has been responsible for the development, consulting, engineering, and construction of nuclear, fossil-fuelled, geothermal, and hydroelectric power generation projects. The company has supplied the process technology for over 35% of the world's ethylene capacity constructed since 1995.

The Shaw Group Inc.

The Shaw Group Inc. is a provider of consulting, engineering, construction, remediation, and facilities management services to government and private sector clients in the environmental, infrastructure, and emergency response markets, including services to the power and process industries worldwide. Shaw is headquartered in Baton Rouge, Louisiana, USA. Keltic has entered into an agreement with Shaw S&W for them to act as the Integrating Contractor from the Pre Front End Engineering Design (FEED) through to the operation phase of the Project.

2.1.2 Participants' Roles

During the engineering, procurement, and construction phases, S&W will act as overall Project management contractor for the petrochemical component but with specific engineering procurement and construction (EPC) responsibilities for the ethylene unit and power generation plant. S&W EPC activity will be done upon a lump sum basis with schedule compliance. MapleLNG will have overall Project management responsibility for the LNG component of the Project.

During operations and maintenance, S&W will take the responsibility for developing the Keltic organization and for long-term maintenance at the site. The envisaged Keltic organization will be located at the Goldboro site and also in Halifax. MapleLNG will take the overall responsibility for the operation of the LNG facility and the associated marine terminal.

It should be noted that the polyolefin licensors have agreed to participate in operations and maintenance support. Measures to sustain the asset will be incorporated into the licensing agreements with polyolefin licensors and managed by the Keltic organization.

In the event of significant modification or decommissioning, S&W or, for the LNG component, MapleLNG will take the responsibility for integrating these activities into Keltic's organization.

These relationships and roles are laid out in Figure 2.1-2.

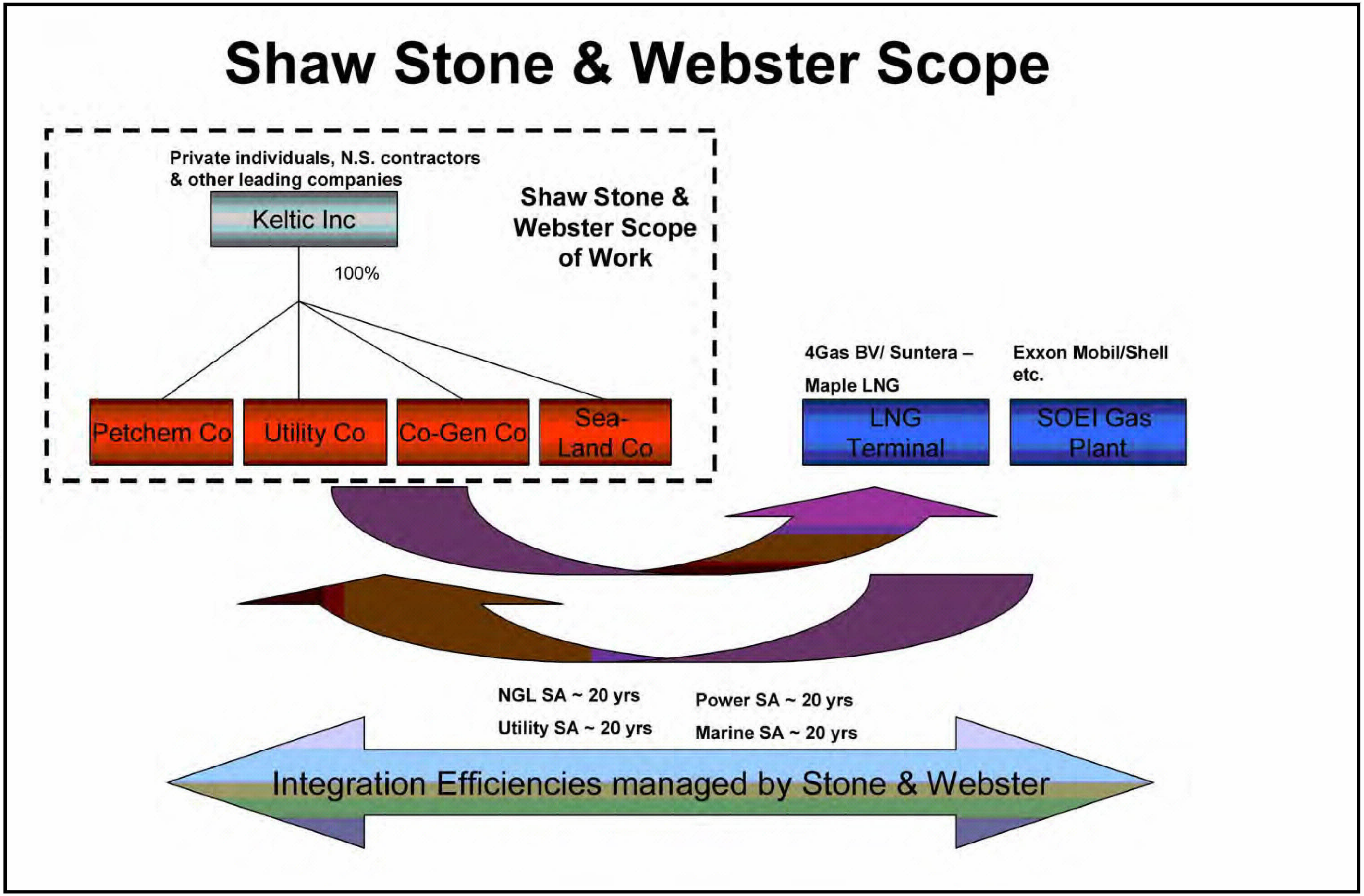

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FIGURE No. 2.1-2
KELTIC PETROCHEMICALS INC.
RELATIONSHIPS AND ROLES OF PROJECT PARTICIPANTS
JUNE 2007

2.2 KELTIC DEVELOPMENT PROJECT (KDP) DEVELOPMENT PROPOSAL OVERVIEW

This section provides a general overview of the KDP Development Proposal, including aspects of the Project outside the federal scope of the EA. The scope of the federal EA is described fully in Section 2.3.

The KDP will be an integrated facility, receiving LNG by ship, for delivery to the M&NP after regasification, and utilizing the natural gas liquids for the production of polyethylene and polypropylene pellets for shipment to customers across North America. A co-generation plant will be included to supply power and process heat. The Project has a completed pre-FEED study to date and will proceed shortly to final FEED. The essential components of the KDP (i.e., the development proposal) are defined under the following five headings:

- LNG facility, including marine terminal and marine transfer pipeline;
- petrochemical facilities;
- marginal wharf;
- co-generation plant; and
- utilities and support facilities.

Each of these five essential components is briefly described in the Section 2.2.2 and summarized in Table 2.2-1. Figures 2.2-1 and 2.2-2 show the overall layout of the site.

Section 2.2 describes the entire KDP development proposal as a whole to demonstrate the integration of the components; however, the assessment has been completed solely on Project components as scoped by the RAs. The scope of the Project being assessed is described in Section 2.3.

As the provincial EA was completed on the whole development proposal, additional detail on Project components and figures can be found in Keltic's EA Report, Section 2.0 Project Description. This document is available for download on the NSEL Environmental Assessment Branch website (http://www.gov.ns.ca/enla/ea/kelticpetro.asp) or can be viewed at NSEL library (5151 Terminal Road, Halifax, Nova Scotia).

The dam and impoundment of Meadow Lake required for water supply likely require approvals from TC and DFO; however, necessary detail for a screening level EA and authorizations will be provided in forthcoming applications.

2.2.1 Location

The KDP Site is located in Goldboro, Guysborough County, Nova Scotia (Figures 1.0-1 and 1.0-2) and is positioned within the Goldboro Industrial Park and other land holdings along the northern shore of Stormont Bay. The associated marine facilities include a marginal wharf and LNG marine terminal to be located on the northeast side of Stormont Bay.

TABLE 2.2-1 Key Characteristics of Essential KDP Components

Component	Description
LNG Facility, including Marine Terminal and Marine Transfer Pipelines	Consists of marine terminal, transfer pipelines, storage, regasification, nitrogen production plant, and extraction facilities, a vapour handling system and associated infrastructure/support facilities including: • LNG marine transfer pipeline; • natural gas pipeline connecting to the MN&P pipeline; • natural gas pipeline connecting to the co-generation plant; • natural gas pipeline connecting to the petrochemical plant; • PLC based control system; • emergency shutdown system; • hazard detection system; • security system and facilities; • fire response system; • natural gas flare; • plant air, instrument air and nitrogen systems; • electric power distribution and control systems; • storm-water system; • control building; • access roadways and service buildings; • fire and emergency access roads; and • other facilities as required to support safe, efficient, and reliable operation. The maximum transfer rate from ships will be at 24,000 cubic metres per hour (m^3/hr) @ 75 pounds per square inch gauge (psig) -160 degrees Celsius (^oC). Storage will be in 3 full containment tanks of 162,500 cubic metres (m^3) each (with future expansion to 6).
Petrochemical Facilities	The facility is fed by ethane and propane obtained from the LNG Terminal and the Sable Offshore Energy Inc. (SOEI) plant. The facility produces primarily ethylene and propylene using steam cracking. Polyethylene and polypropylene pellets are subsequently produced for shipment. The following will be produced as pellets for shipment: • polypropylene; • High Density Polyethylene (HDPE); • Low Density Polyethylene (LDPE);and • Linear Low Density Polyethylene (LLDPE). The petrochemical facilities use power from the co-generation plant.
Marginal Wharf	Products from the petrochemical facilities are stored in silos at the shipping and logistics area near the marginal wharf.
Co-generation Plant	Includes gas turbines and heat recovery steam generators with a capacity of approximately 200 megawatts (MW) to meet Project electrical energy requirements.
Utilities and Common Support Facilities	Common support facilities include raw water supply sourced by way of a dam with a fish-way, raw water intake and pumping infrastructure at Meadow Lake; raw water treatment plant; wastewater collection; treatment and disposal; storm-water management; central administration and maintenance facilities; emergency medical facilities; fire station and helipad; and upgrades to the rural road network.

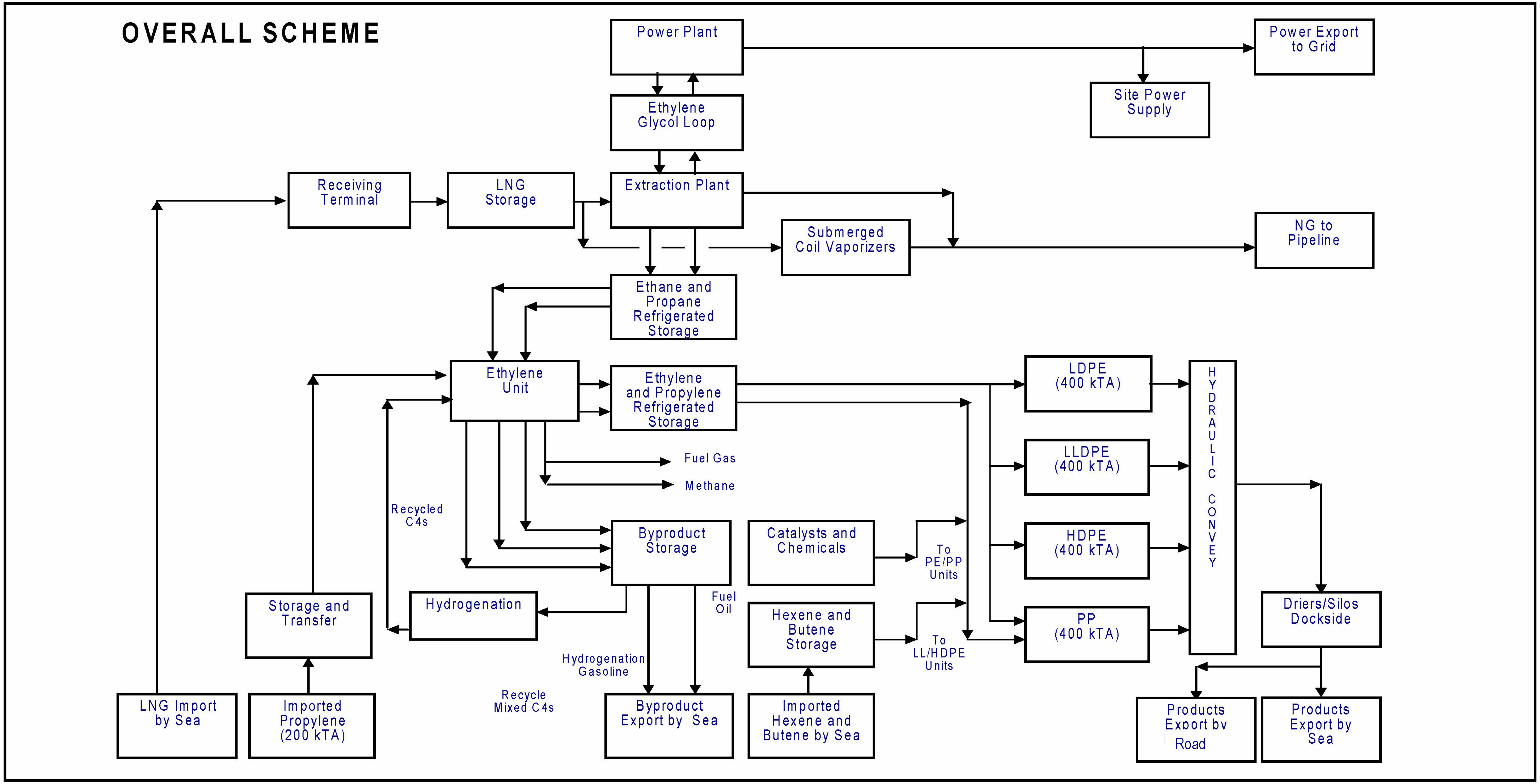

FIGURE 2.2-1
KELTIC PETROCHEMICALS INC.
OVERVIEW OF THE ESSENTIAL COMPONENTS OF THE KELTIC PROJECT
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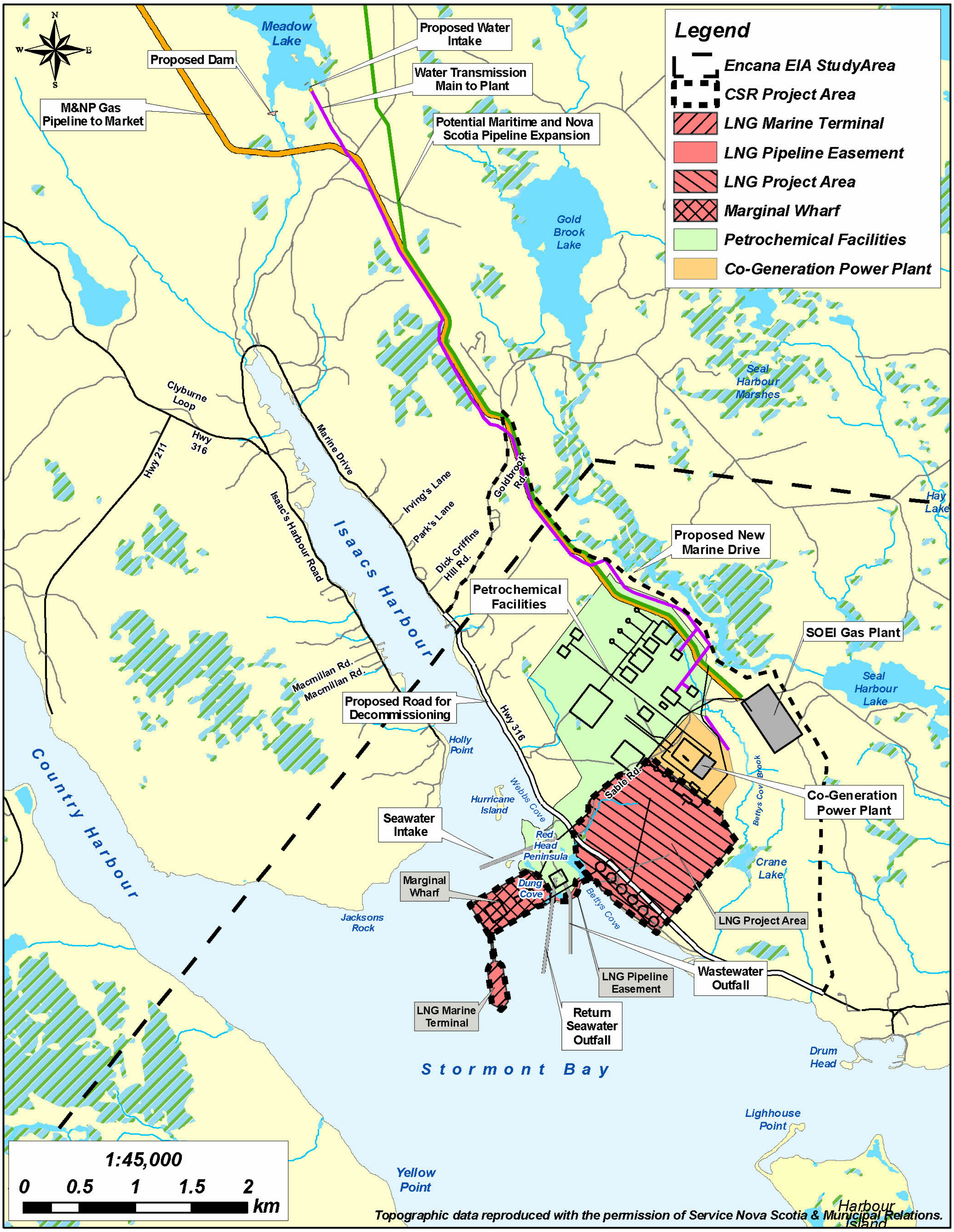

amec

June 2007
Drawn by S. Turner
Projection: NAD83 CSRS UTM Zone 20N
Job No.: TV61029

Figure 2.2-2
KELTIC PETROCHEMICALS INC.
Plan of Essential Components of Keltic Development Project
JUNE 2007

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The 240 ha Goldboro Industrial Park is owned by the Municipality of the District of Guysborough (Municipality). The Goldboro Industrial Park is zoned M-3 heavy industrial. Additional land holdings adjacent to the Industrial Park have been or are in the process of being purchased by the Municipality. These lands have been included in the recent rezoning to M-3 heavy industrial to facilitate the development of this Project and similar projects. Sufficient land has been optioned by Keltic and will be purchased from the Municipality of the District of Guysborough.

The Keltic Project is located in proximity to the SOEI gas plant and M&NP metering station, which are situated in the northeast of the Industrial Park. The M&NP also runs along the north boundary of the Industrial Park.

2.2.2 Key Keltic Development Project (KDP) Components

The five main KDP components are discussed in the following sub-sections.

2.2.2.1 LNG Facility Including Marine Terminal and Marine Transfer Pipelines

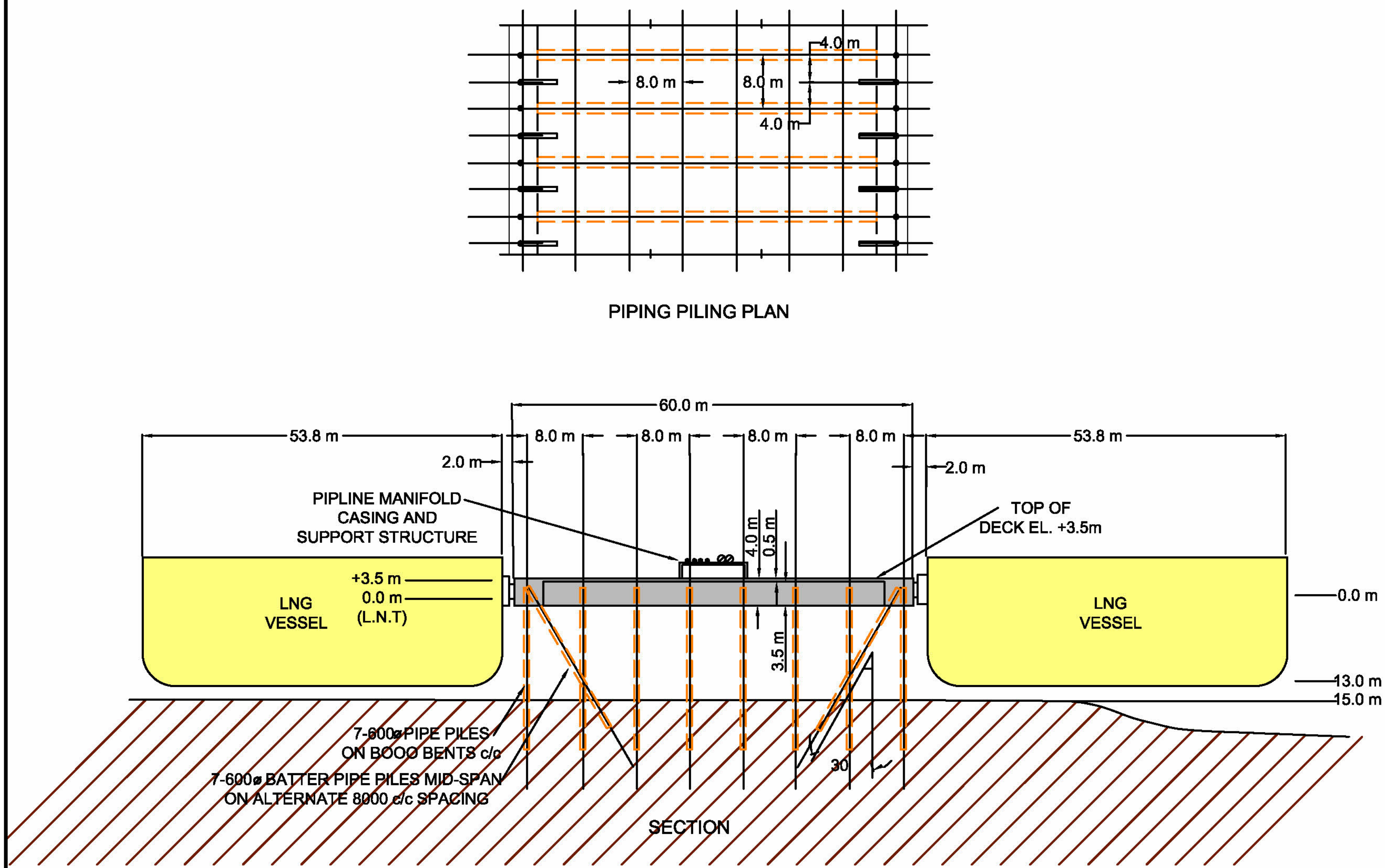
The LNG facility consists of the following six components:

- marine terminal;
- LNG unloading (including marine transfer pipelines);
- LNG storage;
- nitrogen injection;
- LNG regasification; and
- natural gas transport and distribution pipeline to the petrochemical plant, the co-generation unit and to the M&NP.

A two berth piled marine terminal will be connected to a marginal wharf facility by a piled jetty. This marine terminal will be used to receive and transfer product via LNG transfer lines along the jetty and marginal wharf facility to the LNG tanks where it is stored. The jetty location is sheltered within Stormont Bay, and therefore, protected from ocean swells. The terminal will be located such that dredging is not anticipated. A preliminary plan of the marine terminal is shown on Figure 2.2-3.

In the unloading system, the LNG is unloaded from the tanker ships and transported via marine pipelines to the storage tanks. The maximum transfer rate from ships will be at 24,000 m^3/hr at 75 psig -160 ^oC. The storage section consists of three full containment tanks with a gross LNG storage capacity of 162,500 m^3 each (with an aggregate capacity of the facility totalling 487,500 m^3). With future expansion to 6 tanks, the total gross LNG storage capacity will increase to 975,000 m^3. A typical LNG tank design is provided as Figure 2.2-4.

To make the LNG available for use in the M&NP or for direct use in petrochemical facilities, the LNG is extracted of higher hydrocarbons, ethane, and propane which are used in Keltic's petrochemical plant.



Source: MacDonnell Group, Project No. 1080, Nov. 2005

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FIGURE No. 2.2-3

KELTIC PETROCHEMICALS INC.

PRELIMINARY PLAN OF LNG MARINE TERMINAL

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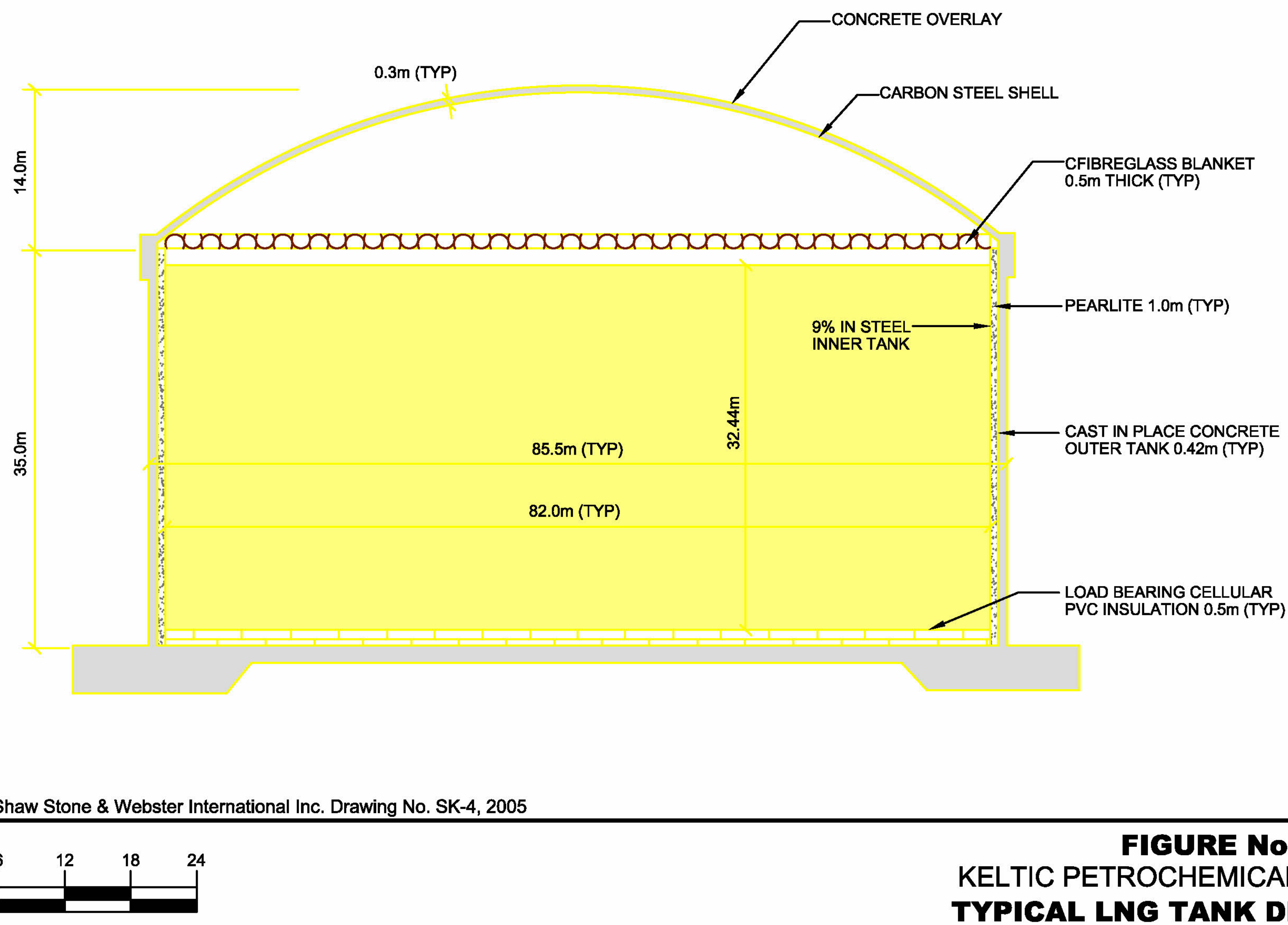

Source: Shaw Stone & Webster International Inc. Drawing No. SK-4, 2005

FIGURE No. 2.2-4
KELTIC PETROCHEMICALS INC.
TYPICAL LNG TANK DESIGN
JUNE 2007

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The heat required for the regasification of LNG is supplied by low-pressure fuel and/or waste heat from the petrochemical plant and the co-generation unit. The low-pressure fuel is taken as a side stream of the vaporized gas and is reduced to the desired pressure by a system of letdown valves.

The product of the regasification section is natural gas, which is transported to the local end-users, the co-generation plant and the petrochemical plant, and the M&NP by pipeline for further distribution to customers.

Besides the LNG facility, the Project also entails a petrochemical plant for production of ethylene and propylene polymers. Feedstock for this plant is ethane and propane. Therefore, the Petrochemical facility includes an LNG extraction plant in which ethane and higher hydrocarbons are separated from the LNG. The extraction process has a dual function:

- providing feedstock for the petrochemical plant; and
- adjustment of the off-specification gas properties to meet the specifications of the gas consumers (petrochemical plant, co-generation plant, and M&NP).

The LNG facility must always be able to deliver on-specification gas quality (gas send-out). This means that a back-up process is needed for those cases in which extraction can not be carried out at the petrochemical plant (liquid storage is full, extraction plant is down, petrochemical plant not running) and off-specification LNG is delivered/stored. This back-up process involves the injection of nitrogen to bring the send-out gas to specifications. The required nitrogen will be produced from air by an ASU.

The LNG facility will have an annual send-out capacity of nominally 18 BCM (billion cubic metre = 109 normal cubic metres (Nm^3)), maximum and peak send out capacity are 140 and 165% of the nominal capacity respectively. This capacity will be realized in two phases of 9 BCM. The extraction plant will have a capacity to provide for 1,480 kTa (kilotonne per annum) ethane and 880 kTa propane (depending on LNG composition) as feedstock for the petrochemical plant. The nitrogen plant will have a capacity to provide for sufficient nitrogen to produce on-specification gas quality at peak send-out based on richest LNG composition.

Three LNG storage tanks each with a gross capacity of 162,500 m^3 are required in order to be able to accommodate the amount of LNG supplied (with future expansion to six).

The distances between process units (i.e., LNG storage tanks and LNG regasification section) as well as distances between process units and site boundaries are mainly limited by: standards such as Canadian Standards Association (CSA) 276-01; land use and further quantified by means of a quantitative risk assessment (QRA) (as described in Section 10.1.1.4 Design and Operational Safeguards). The underlying approach is that the malfunction of a process unit must not result in domino effects to other process units or surrounding areas.

2.2.2.2 Petrochemical Facilities

A pre-FEED study for the petrochemical complex planned for Goldboro has been prepared by S&W. For the study, S&W prepared a definition of equipment sufficient to produce an order of magnitude total installed cost for all process units, and defined a preliminary recommendation for feedstock and product storage. As part of the effort, S&W also prepared a summary of estimated utility consumption and environmental emissions of the complex.

The petrochemical complex is based on the production of olefins, specifically ethylene and propylene, from an ethylene plant. This ethylene plant is based upon S&Ws proprietary Ultra Selective Conversion technology for the steam cracking of hydrocarbons. Cracking is the process whereby complex organic molecules are converted to simpler molecules by the breaking of carbon-carbon bonds in the precursors. The Keltic olefins will be produced from the steam cracking of fresh ethane and propane feedstock.

To augment the propylene produced at the Keltic complex, a refinery grade propylene mix will be imported by sea. Any facilities required to treat the refinery grade propylene for contaminants removal will be provided within the ethylene plant. After treating, the refinery grade propylene stream will be fed to the propane (C3) splitter facilities in the ethylene plant.

The polymer grade ethylene produced from the ethylene plant is the feed to a polyethylene plant with a polymerization train for LLDPE and a train for HDPE and an LDPE plant. Three extruder trains and two mixer/melt pump trains are expected to handle the complex's production of polyethylene and polypropylene respectively. The extruders convey and melt the polymer and a melt pump pressures the polymer melt through a steam-heated die-plate with the strands of polymer being cut into pellets by a pelletizer. The pellets will be hydraulically conveyed to the marginal wharf, where the drying and storage will take place before shipment.

The other co-products of the ethylene plant will be exported for sale or consumed as fuel onsite. A stabilized mixed butane (C4s) stream will be produced by a hydrogenation unit in the ethylene plant treating the raw mixed C4's from the debutanizer. The hydrogenated C4 mix containing predominantly butylenes will then be shipped by sea. A hydrotreated gasoline will be produced from a gasoline hydrogenation unit. The gasoline hydrogenation unit will also be contained in the ethylene plant, treating the raw pyrolysis gasoline produced by the steam cracking process. A pyrolysis fuel oil product will be used as auxiliary/power boiler fuel. A residue gas will be produced in the ethylene plant, which will flow to the central fuel gas mix drum of the complex. Any high purity hydrogen that may be required for the polyethylene and polypropylene plants will be produced in the ethylene plant. Vent streams from the polyethylene and polypropylene plants will be diverted to the ethylene plant for collection.

The following feedstock storage systems will be provided:

- ethylene plant feedstock handling and storage systems;
- ethylene plant product handling and storage systems;
- hexene and pentane storage for polyethylene plants;
- outside battery limit storage for fresh caustic;

- demineralized water for boiler feed; and
- outside battery limited storage for spent caustic treatment and process waste water.

The pellets have to be cooled and dried before storage. The storage facilities will consist of elevated silos situated at the marginal wharf. The pellets will be conveyed to the storage area by a hydraulic conveyor system where they are first dried before storing.

The infrastructure support systems required for the petrochemical process include water / steam system, wastewater management and other infrastructure. These are not detailed in the CSR; however, details can be found in Section 2.0 of the provincial EA Report (AMEC, 2006).

2.2.2.3 Marginal Wharf

The marginal wharf area is required for receipt and shipment of products and by-products in support of the petrochemical plant and for receiving supplies and equipment during construction of the entire complex. It will be constructed as one of the first elements of the Project. It will function as follows:

- dockside space for product container ship(s);
- dockside space for ships delivering operating plant supplies/other feedstocks;
- dock side space for tugs and pilot boats;
- customs and immigration facilities for all shipping;
- roll off dock for unloading of equipment and materials from ships during construction; and
- containment structure for product servicing reclamation area.

A warehouse facility will be located at the wharf. The north and western faces of this facility will be designed for berthing tugs, the pilot boat, supply ships, and product carrying ships. The eastern face will be enclosed behind an armour stone blanket, with the LNG transfer pipeline extending from the service trestle en route to the LNG storage site along its deck. Navigation and berthing aids will be provided.

The land extension and infill area behind the caissons of the marginal wharf will constitute the product service area (i.e., storage shipping and logistics area). Pellets will be transported from the petrochemical plant to the wharf by a hydraulic pipeline for storage in silos prior to shipment. The excess water will be removed, and the pellets dried using a centrifuge prior to storage. Water used for transporting the pellets to the wharf will be recovered and returned to the petrochemical plant for reuse. A schematic of the transport and storage system is provided as Figure 2.2-5. The pellets will be stored in multiple silos north of the wharf face with load out facilities for bulk shipment on vessels or on railcars and/or trailers that would be transported by ship. A typical arrangement of the storage silos is shown as Figure 2.2-6.

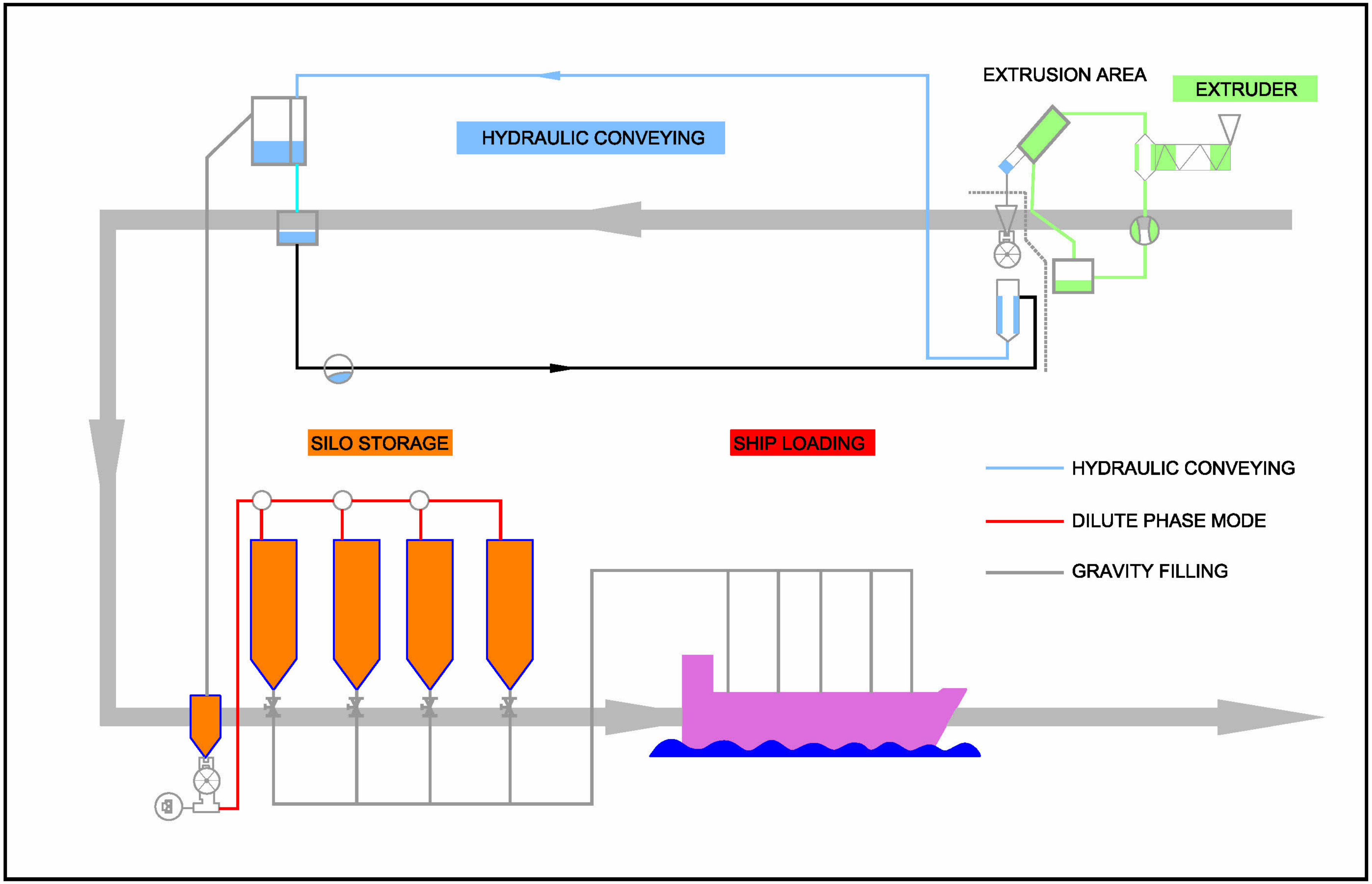

FIGURE No. 2.2-5
KELTIC PETROCHEMICALS INC.
SCHEMATIC OF PELLET TRANSFER TO THE WHARF AND STORAGE
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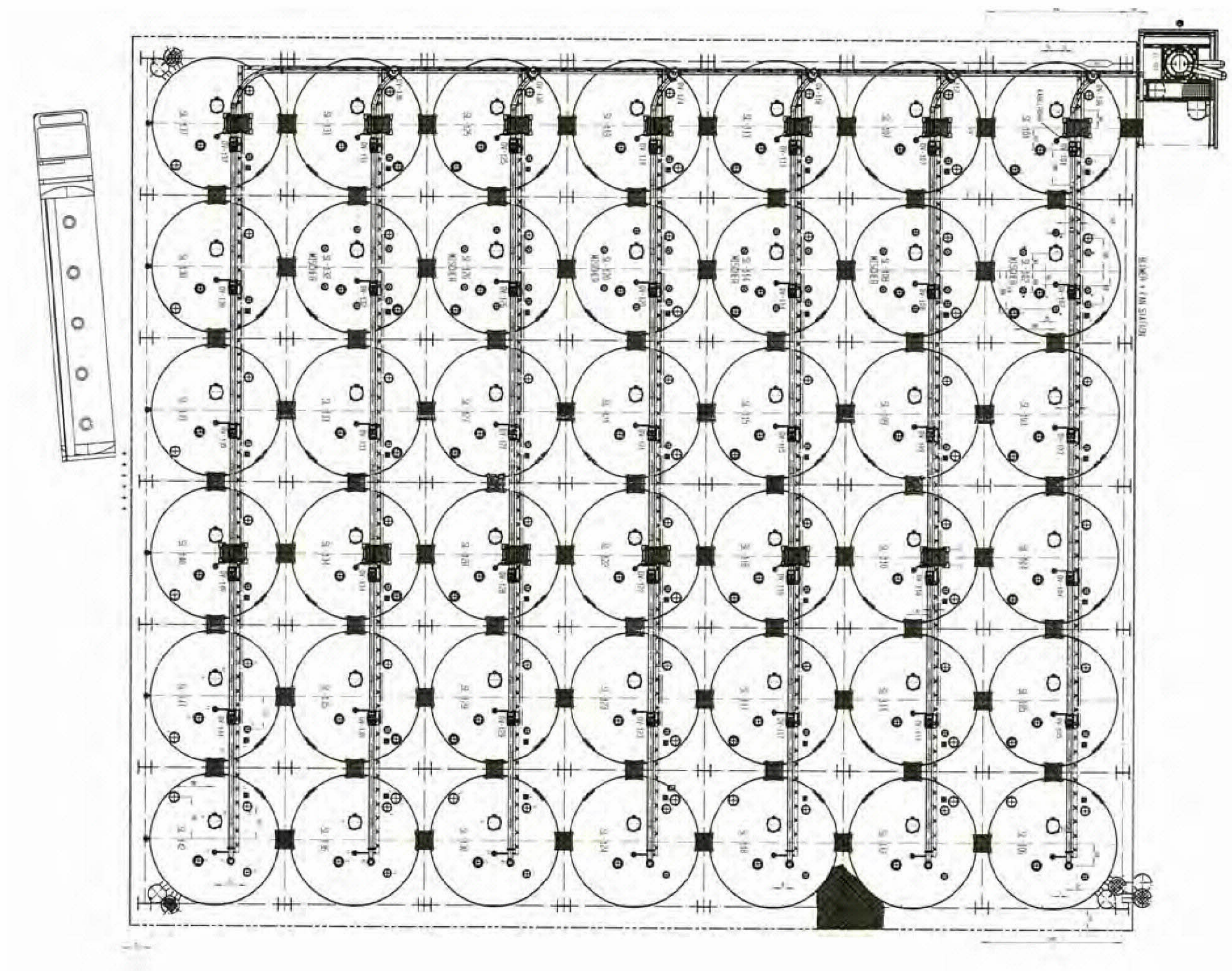

FIGURE 2.2-6
KELTIC PETROCHEMICALS INC.
TYPICAL ARRANGEMENT OF PRODUCT STORAGE SILOS
JUNE 2007
Source:Zeppelin

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The wharf will also be used for receiving propylene and for shipping co-products of the ethylene plant such as hydrogenated C4 mix and refinery grade propane.

2.2.2.4 Co-generation Plant

A power plant incorporating gas turbines and heat recovery steam generators will be constructed to provide power to the facility. The LNG Terminal and regasification will have a power demand of 16 megawatts of electricity (MWe). The mature facility (LNG Terminal and petrochemical plant) will have an estimated power demand of 180 MWe. Approximately 40% of this is associated with the LDPE unit compression system.

The Project provides an opportunity for export of surplus power to the Nova Scotia grid. Although this is not part of the current Project, should additional power supplies be required by the province, the Keltic site could be considered as potential source of cleaner energy.

As the installation of the LNG Terminal will precede development of the petrochemical plant, the power plant will be developed in 2 phases:

- Phase I – to meet LNG Terminal and regasification power demand of 16 MWe; and
- Phase II - to meet total facility, power demand of 180 MWe.

The power generation concept is based upon this phased expansion with the following units:

- Phase I (16 MWe) – Two GE LM2500 gas turbines units will most likely be used. These will be simple cycle gas turbines with the addition of a heat recovery steam generation for steam. In the mature facility, these turbines will be used for emergency/back-up power supply.
- Phase II (180 MWe) – The configuration could be 4 x GE6000 or 2 x GE Frame 7 turbines.

2.2.2.5 Utilities and Site Support Facilities

As part of the Keltic Project, there is a need for utilities and common support facilities. These include:

- plant water supply;
- sanitary wastewater;
- storm-water;
- central administration and maintenance facilities;
- emergency medical facilities;
- fire station;
- helipad; and
- upgrades to rural road network.

These are not described in detail in the CSR; however, more information can be found in Section 2.0 of the provincial EA Report (AMEC, 2006).

2.2.3 Applicable Project Design Codes, Standards and Guidelines

Codes, standards, regulations and guidelines relevant to the construction of those components of the KDP that are addressed in this CSR (see Section 2.3.1 and 2.3.2) are listed in Table 2.2-2.

TABLE 2.2-2 List of Environmental Permits, Approvals, and Relevant Legislation

Statute/Regulation Requiring Approval/Compliance	Section Reference	Requirement
I. Provincial Legislation		
Environment Act	S. 50	Prohibits designated activities without holding appropriate approval.
Environmental Assessment Regulation	Schedule A	Storage facility for liquid or gaseous substances including hydrocarbons with total capacity greater than 5000 m^3 designated as a Class I undertaking requiring registration for Environmental Assessment. Petrochemical Plant designated as Class II undertaking requiring a full EA. Project cannot proceed without Minister's approval under this Regulation.
Activities Designation Regulation	S.(1)(d)(e) and (o)	The installation of certain culverts, a bridge, or other watercourse alteration requires an approval.
	S. 5(1)(g)	The construction of a wharf requires approval.
	S. 10(1)(f)	The construction or operation of a site with a chemical storage tank in excess of 2000 L or 2000 kg requires approval.
Air Quality Regulation	Generally	Establishes maximum permissible ground level concentrations of contaminants.
Petroleum Management Regulation	S. 11	Storage tank systems must be registered.
Dangerous Goods Management Regulation	S. 6	Written approval required to store waste dangerous goods.
National Building Code of Canada (NBCC)	Generally	Applied by municipality.
Beaches Act	S.6	Construction activities including trenching and infilling below the ordinary high water mark require permission (permit) from the Nova Scotia Department of Natural Resources (NSDNR).
Crown Lands Act	S 5, 13, 16 (1)	Governs the use and activities on lands owned by the province. Through the Act the province can make crown lands available for the Project through the use of easements, conveyances, leases, or licenses.
Nova Scotia Endangered Species Act	Generally	This Act protects species in Nova Scotia that have been assessed and determined to be at risk of extinction.
II Federal Legislation Requiring Approvals/Assessments		
NWPA	S. 5	Approval of Minister of TC to construct "work" in navigable waters.

Statute/Regulation Requiring Approval/Compliance	Section Reference	Requirement
Fisheries Act	S. 35	Approval required for HADD of fish habitat.
	S. 32	Prohibits destroying fish by any means other than fishing. Most relevant if blasting is required in or near waters containing fish or fish habitat.
	S. 20	Fish passage must be maintained
	S. 22	Minimum flows must be maintained for fish and eggs
CEAA	S. 5(1)	EA required before federal authority may issue "approval"/transfer land.
Law List Regulation	S. 6 and 11	S.5 of the NWPA and s.35 of the *Fisheries Act* are "triggers" for application of CEAA.
Comprehensive Study Regulation		A comprehensive study is required for this Project for both the LNG Terminal and marginal wharf, as it will be designed to accommodate vessels larger than 25,000 DWT
Marine Transportation Security Act and Regulations	Generally	Post Facility Security Assessment and Facility Site Security Plan required.
III Other Federal Legislation to note		
Fisheries Act	S. 36	Prohibits deposit of deleterious substance in waters frequented by fish.
Petroleum Refinery Effluent Regulation	Generally	Sets minimum standards for effluent quality from "petroleum refinery" as therein defined.
CEPA	Part 5	Regulates the manufacturing and handling of "toxic substance."
Canada Marine Act	Generally	Regulation of marine transportation
Transportation of Dangerous Goods Act	Generally	Documenting handling and placard requirements for transport of dangerous goods
Pilotage Act	Generally	Establishes pilotage authorities and requirements
Canada Shipping Act	Generally	Detailed code for all aspects of shipping in Canada
Ballast Water Control and Management Regulations	Generally	Addresses potential for introduction of invasive species.
Canada Transportation Act	Generally	Applies to transportation matters under federal jurisdiction
Aviation Safety Regulations	Generally	Sets requirements for lighting flare stacks, exhaust stacks, etc.
Migratory Birds Convention Act	Generally	Enacts international treaty for protection of migratory birds
Species at Risk Act	Generally	Protects the wildlife found on federal lands as well as their critical habitat.

In addition to complying with all regulatory requirements, the Project will also be developed in accordance with all applicable international, federal, and provincial guidelines, industry standards, and codes of practice.

The following guidelines, standards, and codes are potentially applicable to the Project:

- Canada – Wide Standards for Particulate Matter (PM) and Ozone, Canadian Council of Ministers of the Environment (CCME), June 2000;
- CSA, Document Z276-01 LNG – Production, storage and handling;
- National Ambient Air Quality Objectives, *CEPA*, S.C. 1999 c. 33;
- International Maritime Organization (IMO), Industrial Shipping Port Facility Security Code, July 2004;
- British Standard Code of Practice for Marine Structure s- Parts 1-6. BS6349: British Standards Institution;
- Society of International Gas Tanker and Terminal Operators (SIGTTO): Site Selection and Design for LNG Ports and Jetties, Information Paper No. 14;
- Oil Companies International Marine Forum (OCIMF): Mooring Equipment Guidelines;
- OCIMF and SIGTTO: Prediction of Wind Loads on Large Liquefied Gas Carriers;
- OCIMF: Prediction of Wind and Current Loads on very large crude carriers (VLCCs) (current forces only);
- LNG Operations in Port Areas: Recommendations for the Management of Operational Risk Attaching to Liquefied Gas Taker and Terminal Operations in Port Areas, SIGTTO, 2003; and
- Canadian Environmental Quality Guidelines, (PN 1299) Update 5.0 – CCME.

2.2.4 Environmental, Health and Safety, and Communications

2.2.4.1 Environmental Management Plan (EMP)

An EMP will be developed to communicate to all KDP participants and stakeholders the commitment and efforts to be undertaken to prevent, manage, and minimize any potential environmental impacts related to the development proposal. The EMP is the principal vehicle for ensuring that mitigation is implemented as directed by all applicable regulatory requirements and provides an opportunity to outline responsible environmental management practices. The EMP is the overarching document under which are the site specific Environmental Protection Plans (EPPs).

The EMP will address the key elements of environmental management for each component of the KDP, including the LNG facility, the co-generation plant, the petrochemical facility, and support systems. The EPPs will address all stages of these components, i.e., construction, operation, maintenance and modification, and decommissioning. Performance criteria for all elements will be determined in the process of EMP development.

The purpose of this EMP is to:

- support the corporate commitments to minimize environmental effects;
- document environmental concerns and appropriate protection measures; and
- provide instructions to relevant Project personnel regarding procedures for protecting the environment and minimizing environmental effects, thereby supporting the Project goal of zero incidents.

The KDP development proposal will involve a wide range of activities necessitating the implementation of environmental management measures that will be developed as the KDP proceeds. All mitigation recommended in the CSR and the provincial EA Report, as well as any regulatory requirements, or conditions of permits/approvals, will be implemented via the mechanisms outlined in the EMP. It also provides implementation guidelines to help ensure compliance with the mitigation, monitoring, and follow-up commitments and requirements identified through the environmental assessment processes.

The EMP will include (at a minimum) the following components:

- establishment of agreed performance criteria and objectives in relation to environmental and social impacts. These should include measurable indicators and standards;
- detailed prevention, minimization and mitigation strategies or action programs (including design standards) for controlling environmental impacts at specific sites;
- details of the proposed monitoring of the effectiveness of mitigative measures against the agreed performance criteria in consultation with relevant government agencies and the community;
- details of implementation responsibilities for environmental management;
- timing (milestones) of environmental management initiatives;
- reporting requirements and auditing responsibilities for meeting environmental performance objectives;
- corrective actions (as options) to rectify any deviation from performance standards; and
- scheduled review (audit) and periodic updates to ensure plan relevance.

Keltic will require all contractors to work in compliance with the EMP. A response and follow up procedure will be included in the EMP to manage any complaints. A proposed table of contents for the EMP is contained in Appendix 3 of this CSR.

2.2.4.2 Environmental Protection Plan (EPP)

The EPPs represent the specific environmental action plans for construction and operation activities. These are specific environmental protection measures, procedures, and mitigations related to a specific activity or area of the development proposal. They are used during all Project stages, but mainly are used in the field as practical reference documents during construction, operation, and maintenance activities, to help ensure environmental commitments are met.

The approach to development of the EPPs will involve:

- A review of all related documentation, such as CSR, Provincial EA Report Conditions of Approval, and any supporting documentation.
- Define the requirement for EPPs based on the review of the above information, including the rationale and intent of each EPP.
- Development of specific environmental protection measures to help ensure the environment is protected.
- Work with the Project design team to ensure proposed environmental protection measures can be coordinated with the Project activities, and conversely, to ensure the design meets environmental protection expectations.
- Input into the plans will be sought from regulatory agencies.
- Update the EPPs as necessary.

Both the generic and the site-specific EPPs will be developed following the provincial and federal environmental assessment reviews for the Project. The EPPs will be finalized as part of subsequent permitting and approvals before the onset of site activities. The plans must be prepared before Project activities commence to allow for training of appropriate personnel. The EPPs will prescribe environmental management measures, mitigation measures, spill prevention protocols, contingency measures, responsibilities, supervision, and reporting measures necessary to ensure the least impact to the environment during Project construction and operation.

As such, the EPPs will specify and detail the provisions of the EMP for which a draft Table of Contents has been provided in Appendix 3 of this CSR.

2.2.4.3 Monitoring

Compliance and effects monitoring programs will be designed and implemented in order to determine the effectiveness of implemented mitigation measures envisaged throughout the life of the KDP. The format of these monitoring programs and reporting methods will be developed to ensure consistency, accuracy, and expediency in report delivery. The effectiveness of the program will depend on ensuring that the workforce can identify and address potential impacts during construction and operation. This will be accomplished through continuous on site training and orientation programs given to employees during construction and operations of the facility.

Through the EMP, the Proponent will provide a site-wide monitoring network to ensure all site activities are regulated and monitored so that the environment is protected. Performance standards will be established for the valued environmental components (VEC), where appropriate. Specifications and standards will be identified against which the various monitoring programs will be validated and measured. Based on the results of the monitoring programs, the Proponent will make necessary modifications to mitigation plans and/or operations, to prevent continued unacceptable environmental effects, to the satisfaction of regulatory agencies.

Typical monitoring activities would include, but are not limited to: effluent monitoring; surface water monitoring; well water survey; groundwater quality monitoring; air quality monitoring;

noise monitoring; and other components as will be identified in the EPP. The program will be maintained, as required, over the lifetime of the Project.

2.2.4.4 Health and Safety

As part of facility management and in compliance with NSEL Occupational Health and Safety Division requirements, a health and safety program will be initiated in order to promote a safe and healthy workplace (Section 28 of the *Occupational Health and Safety Act*). As a means to maintaining a safe and healthy environment and reducing the number and severity of workplace injuries and illnesses, this will include management of a system of ongoing: training, procedural documentation, inspections, reporting, safety record management, and evaluation.

This will cover the full range of on-site and off-site activities accomplished to fulfill the implementation of the development proposal. Each contract/subcontract entity and employee will be held responsible in compliance with safety policy and procedures.

2.2.4.5 Training

A framework will be developed for providing training and orientation to on-site employees. This training addresses environmental, health, and safety aspects and will generally involve:

- Promoting the primary responsibility of employers and employees to create safe and healthy workplaces through the use of safe work practices and suitable equipment.
- Training and education of workers engaged in activities related to hazardous materials and waste generation, removal, containment, transportation and emergency response in compliance with the *Occupational Health & Safety Act* (i.e., Workplace Hazardous Materials Information System (WHMIS) worker training program).
- Educating of the workforce in identifying potential environmental effects during the various stages of construction and operations, as well as effects monitoring, under the Environmental Management System (EMS) and associated EPPs.
- Utilizing the Workers' Compensation Board On-the-Job Programs offering training for workers that have been injured on the job.

2.2.4.6 Best Management Practices

Where possible, eco-efficiency principals were and will be applied to the design. Generally, these include:

- using waste heat from the co-generation plant and/or petrochemical plant as a heat source for the regasification of LNG;
- supply of natural gas to the co-generation plant as fuel for electricity production; and
- supply of natural gas to the petrochemical plant as fuel for heating purposes.

In the design, provisions will be incorporated to make this integration possible. This means that the regasification unit will be designed with the ability of using waste heat from the co-generation plant and/or petrochemical plant as the heat source. The optimal design for this heat integration is not yet determined. The natural gas pipeline will have at least two additional valved tie-ins with blinds to the natural gas transport pipeline of the co-generation plant and the petrochemical plant. Additional information can be found in Section 2.5.2 of the provincial EA Report (AMEC, 2006).

Where it is feasible to do so, the Proponent will incorporate other eco-efficiency practices into the design, construction and operation of the facility (i.e., application of the Project's LNG "cold potential" in context of the power generation or the extraction of ethane and propane) (Cote and Wright, 2006).

2.2.4.7 Public Information / Community Liaison

Records were retained of the results of public consultation and information sessions, detailing comments and concerns that were raised, how they were addressed, and what commitments were made by Keltic. The records also document the dates and formats for public consultation undertaken, the material presented to the public, and the opportunity provided for receiving public input. The summary tables provided in Appendix 4 shows how the input from consultations was used in the EA and what changes to the development proposal were made as a result of comments provided.

Keltic will develop a public information and communications plan to provide ongoing Project information to area residents, First Nations, businesses, and users of Stormont Bay, including other individuals or groups that express a specific interest in the Project. The program will include an active website, community newsletters, and open houses at key Project milestones as well as designated communications officials within Keltic and an information booth at the facility upon completion.

Consultation with the public has been a significant component of this comprehensive study. More discussion is included in Section 3.2 within this document.

2.2.5 Construction

The sequence of construction would see the overall site activities start with the general site preparation, marine construction, and site utilities. Subsequently, the LNG facilities and the petrochemical construction would start followed by construction of the co-generation plant and the storage and shipping areas. The construction schedule is given on Figure 2.2-7.

All construction activities will be preceded by full construction planning, including FEED, the EMP (including specific EPPs), and health and safety plans, as well as obtaining all necessary approvals and permits from regulatory agencies. Necessary pre-construction surveys and baseline monitoring will also be completed prior to construction.

The following sub-sections briefly outline the general activities associated with construction of the development proposal. Environmental management is integral to each activity and will be managed under the EMP. More detail on the proposed construction activities can be found in Section 2.4 of the provincial EA Report (AMEC, 2006).

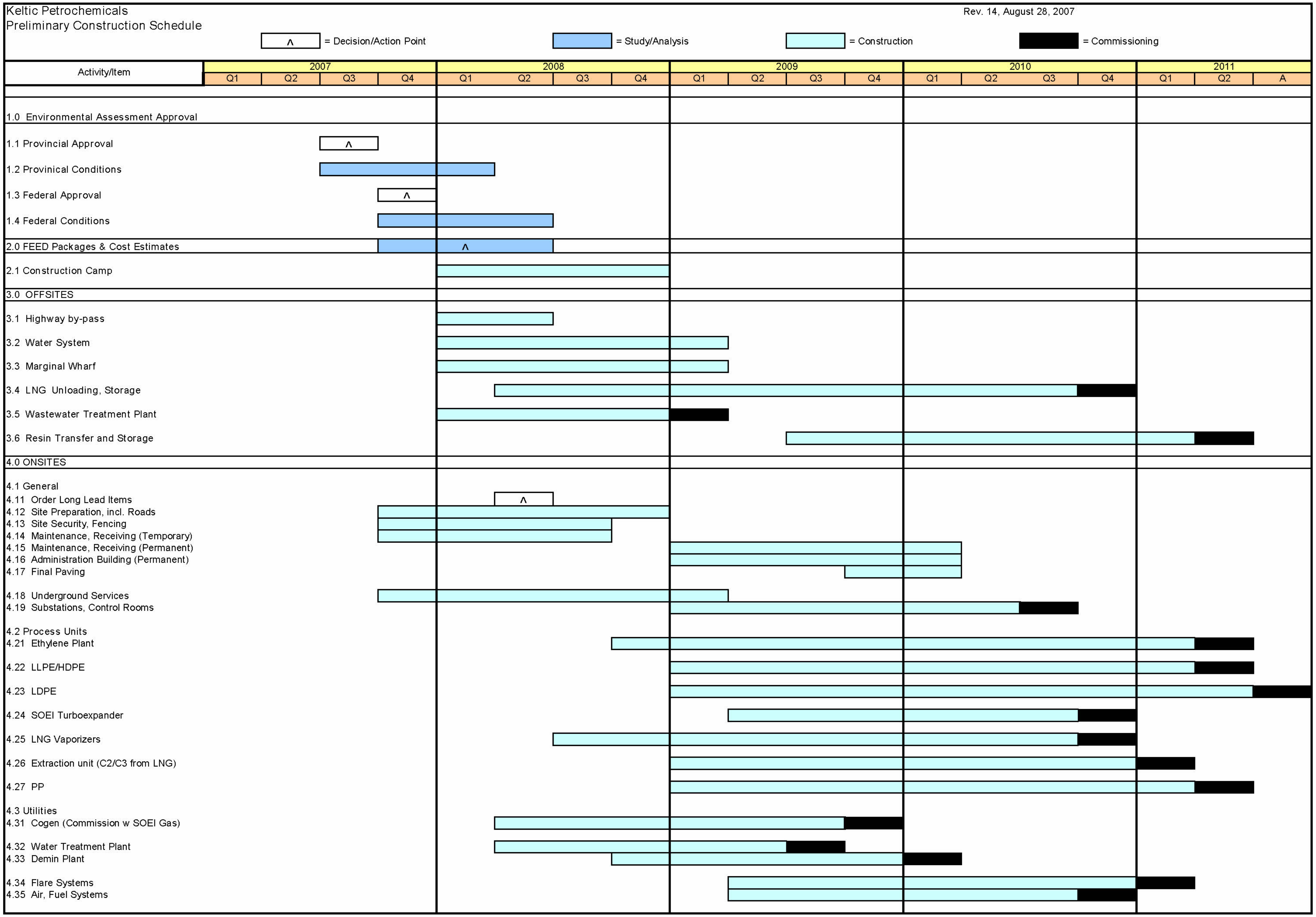

FIGURE 2.2-7
KELTIC PETROCHEMICAL INC.
CONSTRUCTION SCHEDULE
AUGUST 2007

020748

2.2.5.1 General

Prior to construction of any specific components of the KDP, several common features need to be constructed. These are supporting pieces of infrastructure to facilitate the Project being completed. They include:

- An access road to the KDP site via rerouting of Highway 316, upgrading of Gold Brook Road and construction of roadways and parking areas within the KDP site.
- A temporary construction work camp, if required, as well as an administration centre to be provided on-site with temporary power, water, wastewater, and solid waste facilities.
- Material storage locations will be provided for materials, including concrete, steel, specialized metal products, electrical wiring and mechanical process piping, as well as diesel, gasoline and fuel.
- Construction staging areas will be prepared on-site within the site boundary or off-site on approved suppliers' property.
- Temporary site services, including power, storm-water management, wastewater, and waste management.

2.2.5.2 LNG Facility Including Marine Terminal

The construction of the LNG facility and the associated marine terminal includes the following major components:

- Designated temporary material storage and laydown areas established within a secure development envelope.
- Security and safety measures associated with ports and marine facilities, including fencing, gates, signage, and lighting.
- Activities associated with site preparation within the development envelope, including storm-water management, clearing, grubbing, and buffering of the small intermittent watercourse in the northeast corner of the site.
- Levelling and grading the site within the development envelope, including earth moving, blasting, crushing, and screening of rock, and backfilling.
- Installation of foundations for major equipment and buildings with associated underground services.
- Marine construction of LNG Terminal constructed of pipe pile mooring piers and berthing dolphins (does not involve dredging).
- Installation of pipe lines associated with the facility.
- Stabilization of shoreline with a blanket of armour stone above the high water mark, as required based on geotechnical investigation, for the placement of the LNG tanks.
- Installation of equipment, storage tanks, pipelines, and all ancillary equipment, that will be delivered by marine or road transport as appropriate given its weight and volume.
- Erection of buildings for site administration, maintenance, and processing.

- Management of wastewater and wastes, including any hazardous material, such as petroleum, oil, and lubricants.
- Management of any contaminated soils and/or acid producing rock, if any, as determined by EMP.
- Rehabilitation of temporarily used sites, including dismantling, removal and proper reuse/disposal of temporary facilities and wastes, and the stabilization of exposed surface by landscaping.

2.2.5.3 Petrochemical Facilities

Commencement of construction of the petrochemical complex will follow that of the LNG complex; however, both will proceed in parallel for some duration. After site preparation for the petrochemical / LNG complex, the activities will shift to the fabrication and erection of the major industrial components and steel framed buildings.

Key construction and site development activities are similar to many of those for the LNG facility and generally include: site clearing and grading; establishing construction laydown areas; major foundation and underground utilities installation; equipment installation; and commissioning and testing.

2.2.5.4 Marginal Wharf

No dredging is anticipated in the construction of the marine facilities. Cranes fixed atop floating or spudded barges will be used for site preparation for the marginal wharf. The storage area at the marginal wharf will be formed by backfilling rock excavated from the Project site area. Rock sources on site will be tested for acid generating potential and metals that may be considered deleterious to water quality and fish habitat.

Construction of the facility will be with pre-cast concrete caissons. The first phase of their construction will take place at a temporary location, most likely on land at an existing launching yard in the Strait of Canso. Partially completed caissons will be floated into place where the top lifts will be completed. Their placement will be on a granular mattress placed on the seabed at such location to provide the required draft for vessels. This will eliminate the need to dredge and dispose of seabed materials.

The area behind the cribs will be filled with filter layers of granular material (stone). The stone will range from coarse at the bottom to a smaller size at top to above the tidal zone. This material will be placed from land, working seaward to the cribs. Due to the heavy loading from the storage facilities, the subgrade needs to be well constructed. Till may be used for fill up to the top of subgrade at the inland area. The subgrade will be followed with base material before asphalt paving.

A section and profile of the wharf construction is shown in Figure 2.2-8.

The environmental and socio-economic issues associated with construction of the marginal wharf are those typically associated with working in a marine environment, including potential effect on water quality and disruption to fish or fish habitat.

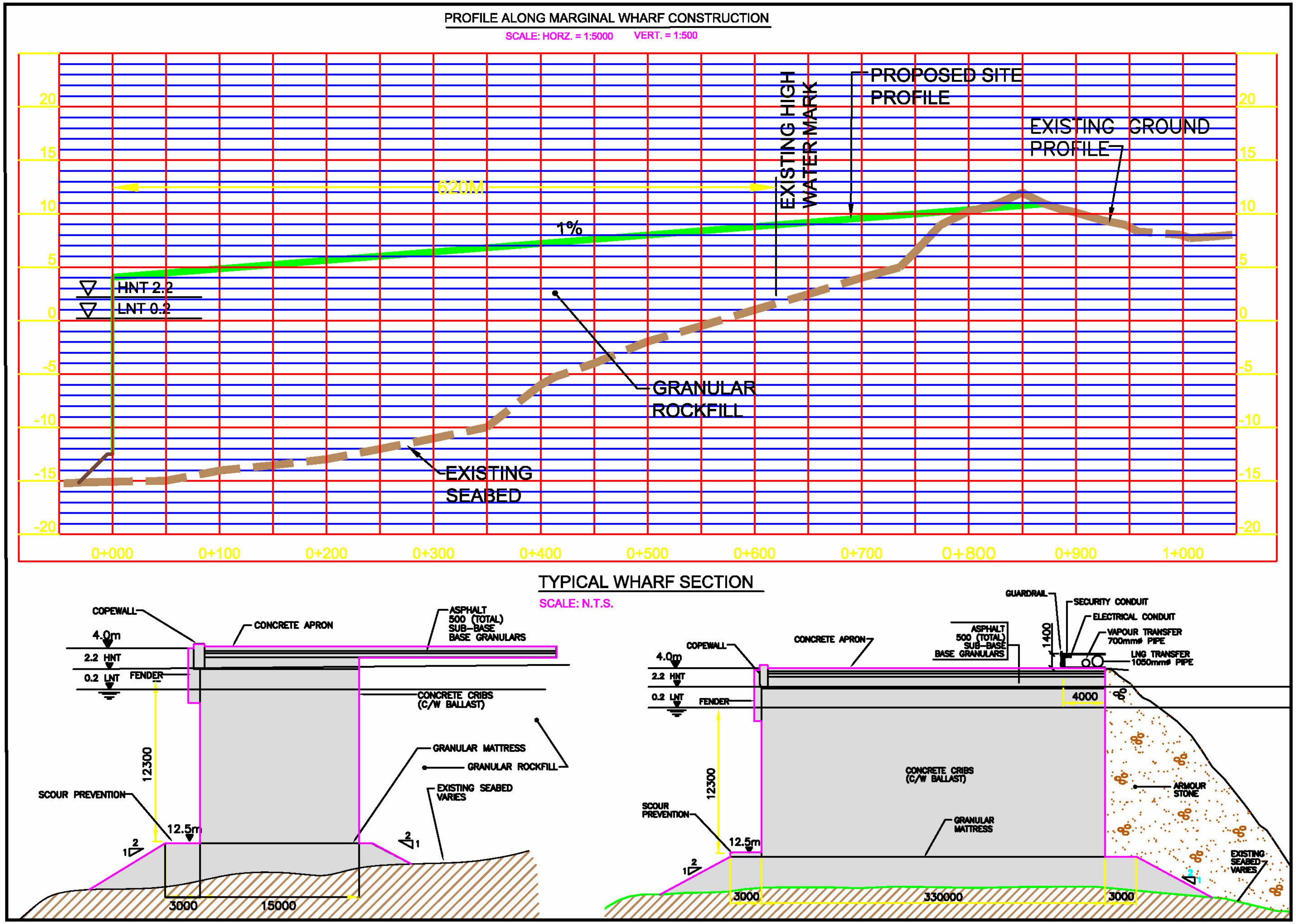

FIGURE No. 2.2-8
KELTIC PETROCHEMICALS INC.
A SECTION AND PROFILE OF THE MARGINAL WHARF CONSTRUCTION
JUNE 2007

020751

2.2.5.5 Co-generation Facilities

This is a power plant incorporating gas turbines and heat recovery steam generators that will be constructed to provide power to the facility. Key construction and site development activities are similar to many of those for the LNG facility and generally include: site clearing and grading; establishing construction laydown areas; major foundation and underground utilities installation; equipment installation; and commissioning and testing.

The environmental and socio-economic issues associated with construction of the co-generation facilities are generally the same as those for construction of the petrochemical facility.

2.2.5.6 Utilities and Support Facilities

Utilities, infrastructure, and support systems dedicated for the KDP will consist of: PLC based control system; emergency shutdown system; hazard detection system; security system and facilities; fire response system; natural gas flare; plant air, instrument air and nitrogen systems; electric power distribution and control systems; storm-water system; two control buildings, one for the process and one for berthing of tankers; access roadways and service buildings; fire and emergency access roads; service water and drinking water systems (Meadow Lake Impoundment); administration and service buildings; and sanitary wastewater system. The process buildings that will be provided on site include: boil-off gas (BOG) compressor shelter; main electrical substation building; jetty electrical substation building; and firewater pump house.

The environmental and socio-economic issues associated with construction of the utilities and support facilities are generally the same types as those for construction of the Project and the overall KDP.

2.2.6 Operation and Maintenance

The following sub-sections briefly outline the operations and maintenance for the main components of the KDP.

Environmental management is integral to each activity and will be managed under the EMP. More detail on the proposed operation and maintenance activities can be found in Section 2.5 of the provincial EA Report (AMEC, 2006).

2.2.6.1 LNG Facility Including Marine Terminal

LNG is unloaded from dedicated LNG carriers at one of the two berths on the jetty via a set of unloading arms. Next, the LNG is transferred via LNG transfer lines along the jetty to the LNG storage tanks. LNG is then transferred to the process area using in tank pumps. At the process area, the pressure of the LNG is increased to the required pressure level for send-out purposes and the LNG is vapourized to the gaseous state by submerged combustion vapourizers. Part of the LNG will be extracted for the generation of ethane and propane as feedstocks for the adjacent petrochemical plant. Additionally to feedstock generation, extraction results in a modification of the quality of LNG. Depending on the sources of LNG, LNG can be rich in liquids or lean. For some LNG cargoes, this modification (i.e. extraction of ethane and propane) is required to meet the M&NP pipeline quality requirements. However, with lean cargoes, no adjustment may be required. An alternative to extracting the liquids, such as in the case when the petrochemical facility cannot accept the liquids, is that the LNG can be brought to pipeline specification by means of nitrogen injection.

LNG delivery will be via LNG tankers. At the two-vessel proposed output scenario assuming a lower end of tanker capacity of 160,000 m^3, one LNG tanker will arrive at the LNG Terminal every 3.5 to 1.8 days. This will result in a total of 105 to 210 LNG tankers per year. This number can be marginally reduced if larger capacity LNG tankers (250,000 m^3) are made available. (5.4 to 2.7 days).

The arrival and departure of LNG vessels will be compliant with the Atlantic Pilotage Authority Regulations. Tugboats, a pilot boat and navigation and berthing aids will be used, as appropriate. Refuelling of tankers and other transport and support vessels will not be done at the proposed Keltic facilities, or within the area of Stormont Bay.

LNG facilities are classified as industrial sites and must meet applicable standards, codes, and regulations, which are enforced by federal, provincial and municipal jurisdictions. The CSA, a national standards organization for developing public safety standards in Canada, has a specific standard for LNG Production, Storage and Handling (*CSA Standard CAN/CSA Z276-01*). The Standard establishes essential requirements and minimum standards for the design, installation, and safe operation of LNG facilities.

Additionally, the LNG industry follows regulations, codes and standards established by other organizations such as the SIGTTO, the Gas Processors Association, the National Fire Protection Association (NFPA), and the IMO.

All ballasting activities will be accomplished in accordance with the Ballast Water Control and Management Regulations, the US Coast Guard requirements and with the International Convention for the Control and Management of Ship's Ballast Water and Sediments. LNG vessels will be brought in fully loaded and reballasted offshore.

2.2.6.2 Petrochemical Facilities

The overall scheme of the petrochemical facilities is depicted in Figure 2.2-1. This schematic indicates the interface between the petrochemical plants and the LNG Terminal, LNG storage, extraction plant and power plants.

As explained in Section 2.2.2.2, the petrochemical complex is based on the production of olefins, specifically ethylene and propylene, from an ethylene plant. This ethylene plant produces olefins from the steam cracking of fresh ethane and propane feedstocks. Specific components of the petrochemical complex include:

- cracking of ethane and propane via an ethylene unit with the associated feed preparation, cracking furnaces and intermediate storage;
- production of LLDPE and HDPE pellets;
- production of LDPE pellets;
- production of polypropylene pellets;
- flare and thermal oxidizer;

- sea water cooling system;
- water and steam supply;
- air emissions control system to address nitrous oxides (NO_x), carbon monoxide (CO) and volatile organic compounds (VOCs) emissions;
- wastewater treatment, including such wastes as sanitary wastewater, oily wastewater, benzene and toluene contaminated wastewater, spent caustic effluent and non-oily process water; and
- incineration of wastes, including waste stream spent caustic, slop oil from ethylene unit, spent gasoline wash from ethylene unit, tars from ethylene unit, flare knock out (KO) drum blowdown, waste polymeric materials, dewatered biological sludge; and laboratory wastes.

Import of the majority of catalysts and chemicals and export of majority of products will be done via the marginal wharf.

2.2.6.3 Marginal Wharf

Materials handling and logistics for the marginal wharf facilities will cover a variety of activities in support of the petrochemical operations and continuing site activities.

Activities planned for the marginal facility include as a minimum the following:

- a dewatering and drying facility for the polyethylene and polypropylene pellets that were slurried from the polyethylene and polypropylene production plants;
- pneumatic conveying system to transfer dried pellets into blenders and storage silos;
- storage silos for the polyethylene and polypropylene resins – quantity of 160 shown on the conceptual layout;
- pneumatic conveying systems to unload the silos;
- traveling conveying lines to bulk load the polyethylene and polypropylene resins into container ships;
- operations centre/control room/substation for all marginal wharf operations and security;
- utilities area for fire water pumps, plant and instrument air;
- waste water treatment facility;
- warehousing facility (marine, safety and process support equipment & consumables); and
- miscellaneous support facilities to be determined during the FEED phase.

Other products will also be maintained through the product storage and shipping logistics area including production byproducts, feedstocks and catalysts. Handling of the liquids and gases will be through a designated loading arm transfer station situated on the marginal facilities. The product transfer and storage process (which will be developed through the FEED phase) will include as a minimum:

- ethane and propane refrigerated and regasification storage;
- ethylene and propylene refrigerated storage;
- hexene and butene storage and feed systems for LLDPE and HDPE units;
- chemicals and catalyst storage; and
- byproduct storage including fuel oil, hydrogenerated gasoline and mixed C4s.

The marginal wharf is required for receipt and shipment of products and by-products in support of the petrochemical plant and for receiving supplies and equipment during construction of the entire complex. It will be constructed as one of the first elements of the KDP. It will function as follows:

- dockside space for product container ship(s);
- dockside space for ships delivering operating plant supplies/other feedstocks;
- dock side space for tugs and pilot boats;
- customs and immigration facilities for all shipping;
- roll off dock for unloading of equipment and materials from ships during construction; and
- containment structure for product servicing reclamation area.

The north and western faces of this facility will be designed for berthing tugs, the pilot boat, supply ships, and product carrying ships. The eastern face will be enclosed behind an armour stone blanket, with the LNG transfer pipeline extending from the service trestle enroute to the LNG storage site along its deck. Navigation and berthing aids will be provided.

In support of the product output, marine traffic for the proposed Keltic facility will include the transshipment of feedstocks, product components, and byproducts. These shipments will increase traffic levels by approximately 200 additional vessels entering the port per year. This means a yearly traffic flow into the harbour of 300 to 400 LNG and product carriers. The total number of ships accessing the zone equals approximately half the number of moves presently managed through the pilot authority. This number does not include the movement of harbour tug, offshore and inshore fisheries vessels or vessels of less than 100 m length overall.

2.2.6.4 Co-generation Facilities

The electric power for the Keltic Facility will be generated in the central utility area using a combined cycle arrangement and will have a nominal rated capacity of 200 MW. The electricity will be generated at 35 kilovolt ampere (KVA), three phase and 60 hertz (Hz). This will enable possible connection to the Nova Scotia Power Inc. (NSPI) grid for purchase of incremental power required by the site and to provide some backup. This will be further investigated during the FEED phase. As the FEED phase is initiated, it is likely that power and process steam efficiency gains will be realized as the overall use in the various plants is integrated. This may result in some modifications to the co-generation design.

In addition, sufficient supply water will be required to meet the process requirements of four heat recovery steam generators with an expected output of approximately 60 metric tonnes (t) of steam per hour each. Water input to support this process will be taken from a closed looped water cooling system. Water make-up required to support this system and provide daily industrial needs will be drawn from the Meadow Lake impoundment.

2.2.6.5 Utilities and Support Facilities

The operation and maintenance of utilities and common support facilities is integral to the ongoing activity of the KDP. The primary activities include:

- operation of dam and intake at service water supply (Meadow Lake) and general monitoring and management;
- wastewater and storm-water management and treatment;
- municipal solid waste, construction and demolition debris and hazardous waste management;
- maintenance of road network;
- specific support systems to petrochemical plant and LNG facilities;
- maintenance shops, receiving and stores;
- plant security and communications;
- administration and laboratory facilities;
- custody metering stations;
- shipping and receiving terminals (i.e., marginal wharf and LNG Terminal); and
- activities associated with emergency medical facilities, fire house and fire truck, and helipad.

Specific support systems to the petrochemical plant and LNG facilities include:

- Plant air flows from the plant air receiver to the utilities area plant air distribution header. Plant air is distributed to users and utility stations within the utilities area and also connects to the interconnecting piping plant air header to the rest of the complex.
- Nitrogen is supplied to the utilities area distribution network from the interconnecting piping distribution header. Nitrogen is distributed to users and utility stations within the utilities area.
- Very high pressure (VHP) steam is distributed within the utilities area.
- Low pressure steam is distributed within the utilities area.
- Instrument air flows from the instrument air receiver to the utilities area's instrument air distribution header, where it is distributed to users within the area and also connects to the interconnecting piping instrument air header for distribution to the rest of the complex.

- Demineralized water is supplied to the utilities area distribution network from the demineralized water tanks. The demineralized water is distributed to users within the utilities area and to the rest of the complex.
- The main source of fuel gas for the site will be natural gas provided by the pipeline network and also the olefins unit. During normal operation, the fuel gas users will be from various buildings, polyethylene unit, flare, incineration unit and the boilers in the utilities area.
- Caustic soda solution is provided to the utilities header from storage within the utilities area.

All chemical and petrochemical storage activity will be accomplished in accordance with the guidelines set-out in CSA Z276-01, 'Liquefied Natural Gas (LNG)s – Production, Storage, and Handling and in compliance with NSDE Code of Practice – LNG Facilities.

2.2.7 Future Modifications and Decommissioning

The nominal design life of the process facilities will be twenty years. It is customary that with maintenance, technical upgrading, and replacement, these facilities continue to operate well beyond the initial design life.

Should any part of the KDP become obsolete, be decommissioned or taken out of service for whatever reason, decommissioning and reclamation of the site and facilities would be undertaken in accordance with the regulatory process at the time. At that time, a site reclamation plan would be developed and regulatory approval obtained before work would commence. The reclamation plan would consider any ongoing or future industrial use to which the site may be useful for or dedicated to and consider the baseline conditions that existed before site development took place. Any portion of the decommissioned facility or part thereof that may be of subsequent use for industrial development will be taken into consideration in the decommissioning plan.

Decommissioning and disposal of all equipment, material, and process units will consider environmental procedures for such disposal. A plan complete with schedule for dismantling and disposal, including location of disposal will be provided for approval at that time.

The plan will specify decommissioning objectives, approach, activities, schedules, and site rehabilitation and will be developed in consultation with the municipality and regulatory agencies. In particular, objectives of the decommissioning plan will be to:

- identify applicable municipal, provincial, and federal regulations and standards;
- identify and consider objectives of local municipality and adjacent landowners;
- define the decommissioning objective;
- protect public health and safety;
- rehabilitate the plant site in accordance with regulatory standards;
- reduce or eliminate potential adverse environmental effects beyond decommissioning; and

- develop a material management strategy to maximize reuse/recycling options on and off-site or via a material processing facility, and to avoid/minimize disposal in approved landfills.

As a minimum, the plan objectives will define the removal of all hazardous substances, production equipment, and storage tanks. Should the plan objective be the complete decommissioning of the plant site, activities will include the removal of all buildings, roads, storage facilities, and site services. Upon removal of all infrastructures, the site will be rehabilitated. Disposal of waste will be to NSEL and regulations at that time and place of disposal.

Prior to removal of the buildings and facilities, all remaining products and stored materials will be removed from the site in accordance with provincial and federal regulations and guidelines pertaining to handling of hazardous and non- hazardous materials. Materials will be sold to markets or properly disposed of through licensed waste operators.

If no suitable after use is identified, removal of all buildings and infrastructure will be undertaken in full compliance with existing regulatory standards. A demolition permit will be obtained from the municipality. Contractors will be required to follow applicable regulations for material separation, disposal at licensed waste sites, and sales to recycling markets.

The removal of products and storage materials, the demolition of the buildings and removal of infrastructure will be subject to environmental supervision and inspection for compliance with decommissioning plan and regulatory standards.

2.3 SCOPE OF PROJECT

DFO and TC each have a responsibility to ensure that an EA is conducted in accordance with CEAA. As outlined in the Act, Section 15(1), the scope of the Project to be assessed is determined by the RA.

Each of the two RAs has scoped a different Project; however, both Projects are subject to comprehensive study EA processes. As defined in the following sub-sections, the Project scope identified by DFO falls within the Project scope identified by TC.

DFO and TC will work together to conduct a single federal environmental assessment process that will allow both RAs to fulfill their respective responsibilities under CEAA, in a unified non-duplicative manner.

The specific scope of each RA is defined below.

2.3.1 Transport Canada's (TC) Scope of Project

The Project has been scoped by TC to include the construction, operation, maintenance, modification and decommissioning of the following components:

- LNG Terminal;
- Marine transfer pipelines;

- LNG storage tanks;
- Marginal wharf;
- Any temporary marine facilities and structures and equipment that are connected with the movement of goods between ship and shore;
- Regasification plant; and
- Shipping within 25 kilometres (km) of Country Island.

As outlined in the Scoping Document (May 24, 2005), TC scoped the Project based on the anticipated NWPA section 5(1)(a) trigger under the Law List Regulations pursuant to CEAA. This initial scope included all of the above components but shipping within 25 km of Country Island. Based on subsequent consultation with the public in accordance with section 21(1) of CEAA and consultation with expert federal authorities, TC amended its original scope to include shipping within 25 km of Country Island.

2.3.2 Fisheries and Ocean Canada's (DFOs) Scope of Project

DFO scoped the Project to include:

- Construction and operation of the marginal wharf.

The scope of the marginal wharf operation does not include shipping, but does include docking and deberthing of vessels.

This scoping is based on the anticipated *Fisheries Act*, section 35(2) trigger under the Law List Regulations pursuant to CEAA.

Based on consultation with the public in accordance with section 21(1) of CEAA and consultation with expert federal authorities, DFO decided that their scope of Project will remain unchanged.

2.4 PROJECT NEED / ALTERNATIVES ASSESSMENT

Consideration of the purpose and need for the Keltic Project is a requirement under CEAA. Similarly, the Proponent is required to demonstrate an assessment of alternatives to the Project itself and assessments of the means of carrying out the Project. The Proponent has used these as decision-making tools from the Project's inception; that is, it has been used as a Project planning tool as opposed to an impact assessment tool.

As defined by the Agency in their October 1998 Operational Statement, consideration of need/purpose, alternatives to and alternative means of the Project will also help the RAs "to establish the conditions under which certain effects may or may not be justified under the circumstances, should such a determination be subsequently required."

Consideration of the need/purpose and the alternatives were made for the KDP development proposal as a whole, whereas alternative means of carrying out the Project were assessed within the scope of this comprehensive study as defined by the RAs.

2.4.1 Project Need / Purpose

Forecasts indicate that natural gas demand in eastern Canada and the Northeastern USA will grow over the next several years and that LNG will be an important part of the energy supply chain. Similarly, the demand for petrochemical products, such as polyethylene and polypropylene, continues to grow in North America as the use of plastic in many industries increases. This provides a need or opportunity for development of an industrial complex that provides both natural gas as well as petrochemical products to satisfy future market demands.

As natural gas is a cleaner burning fuel than some other fossil fuels, an LNG regasification terminal in Nova Scotia will provide supply options to existing energy consumers in Nova Scotia and elsewhere in North America to help reduce air pollution.

The primary purpose of developing a world class petrochemical industry in Nova Scotia is to create added value to the natural gas found offshore Nova Scotia. In fact, the Nova Scotia Energy Strategy (NSDE, 2001) outlines a number of objectives that are addressed by this Project:

- to set the stage of petrochemical industrial development by ensuring natural gas and natural gas liquids supplies are available on a commercially competitive basis;
- to set the stage for expanded industrial, commercial, and residential use of gas and gas liquids in Nova Scotia;
- to create a world-class energy sector that achieves sustainable economic development with high social and environmental standards; and
- the energy needs of the Nova Scotia marketplace are best served by having a diversity of reliable energy sources.

The joint Federal Provincial Environmental SOEP Panel felt that the significant long-term impact of that Project for Nova Scotia and Canada would be found in the area of “other benefits” rather than in direct expenditures for labour and material. The obvious sources are derived from use of other products. The liquids alone could form the base for a provincial petrochemical industry. The SOEP Panel recommended that the Province examine options for an industrial strategy that would include hydrocarbon-based development saying that “if SOEP is truly a seed project for the petrochemical industry then all of the available physical and human resources have to be brought together to make the seed grow.”

To meet the growing demand for natural gas, polyethylene, and polypropylene, Keltic proposes to import LNG, extract the natural gas liquids from the LNG (primarily ethane and propane), convert the liquids into various grades of polyethylene and polypropylene, and export the residual natural gas, polyethylene and polypropylene to customers in Eastern Canada and the Northeastern USA. Keltic will require a co-generation plant to provide power to the Project. Additional utilities and common support facilities will also be required, including a process water supply reservoir in Meadow Lake, a water treatment plant, a wastewater/storm-water collection & treatment system, central administration/maintenance buildings, and emergency medical facilities/fire station/helipad.

The KDP development proposal is expected to create several thousand direct jobs at the peak of Project construction and several hundred direct jobs at the various facilities during operation.

Keltic expects that many other economic spin-off opportunities will be created in the area as a result of a world-scale LNG and petrochemical facility being built in Goldboro, Guysborough County. These direct jobs and economic spin-off opportunities will be created in a region of Nova Scotia that has an unemployment rate well above the provincial and national average. Furthermore, the population of Guysborough County has been in steady decline; the establishment of the KDP is expected to contribute to a reversal of this trend and to improve the overall employment rate from both a local and provincial perspective.

2.4.1.1 Conclusion

Based on above discussion, it can be concluded that the KDP development proposal responds to a public need and market opportunity and follows a defined purpose. The need for long-term hydrocarbon-based development with the development of a petrochemical industrial complex has been identified by the Province of Nova Scotia in the 2001 Energy Strategy and in the SOEP Panel (1997), as well as welcomed by the public and municipalities for its economic benefit and supporting infrastructure. Creation of a value-added industry utilizing the existing offshore infrastructure and supplementing with LNG imports creates long-term sustainable economic benefits to the local area of Goldboro and the Province.

Each component works together to make the development proposal technically and economically viable. The primary purpose for each of the four main components is summarized as follows:

LNG regasification facility:

- Allows natural gas to enter North American market and meet strong demand for cleaner energy sources.
- Provides critical mass of feedstock to petrochemical plant.

Petrochemical plant:

- Allows the creation of value-added product from the offshore industry via output of polyolefins.
- Satisfies a key strategy objective of the Nova Scotia Energy Strategy (2001).
- Meets global demand for plastic resins, such as polyethylene and polypropylene.

Electrical co-generation plant:

- Provides sufficient magnitude of power supply and allows backup power.
- Uses principles of eco-efficiency by integrating components to produce electricity at lower economic and environmental costs.

Utilities and common support facilities:

- Support the requirements of all other Project components, including water demand.

2.4.2 Alternatives to the Project

The purpose of the Project as defined by the scope of this CSR is directly linked to the overall KDP. The proposed development of a world class petrochemical industry in Nova Scotia was based on the goal of creating added value to the natural gas found offshore Nova Scotia. The Keltic petrochemical plant would require a natural gas supply that could provide sufficient feedstock needs such as ethane, propane, and butane. In addition, the natural gas source would be used to fire the various petrochemical processes, such as cracking of hydrocarbons under VHP and heat as well as firing a co-generation plant to produce the electrical energy requirements for the development proposal.

2.4.2.1 Alternatives to LNG and LNG Importation

The alternative to importation of LNG would have been to continue to develop and export the natural gas which was expected to be available offshore Nova Scotia at the height of exploratory work being undertaken in the late 1990s. The Pre-Feasibility Study carried out for the petrochemical plant identified the potential for offshore Nova Scotia natural gas resources to provide the total required feedstock for 500,000 metric tonnes per year (t/year) of both ethylene and polyethylene. The constraint was the time required to develop those offshore resources.

In the absences of a sufficient supply of feedstock from the Nova Scotia offshore, a source of feedstock would be to import LNG by special vessels designed for this purpose. It is estimated that the Project will utilize between 25 and 150 million cubic feet per day (mmcfd) (about 0.7 to 4.3 million cubic metres per day (m^3/day)) of natural gas and natural gas liquids obtained from the imported LNG in its proposed petrochemical plant, co-generation electrical power plant, and supporting infrastructure, thus overcoming the current shortfall. During normal operating conditions consumption would be in the 125 to150 mmcfd range and during periods of petrochemical plant shutdown, 25 mmcfd would be consumed by the supporting infrastructure.

The potential to use compressed natural gas (CNG) was considered as an alternative to LNG; however, CNG is stored at VHP and for reasons of safety would require a much more stringent inspection and maintenance regime. Also, CNG requires greater storage area since it cannot be compressed to the same extent as LNG, although major technical research is ongoing to improve CNG storage options. One of the potential benefits of using CNG is that the regasification process would not be required to produce natural gas for market.

2.4.2.2 Alternatives to the Marginal Wharf

There are several alternatives to transporting feedstock to, and product from, the marginal wharf.

Road

Although possible in other settings, the use of road transport for product shipment is not feasible from Goldboro due to the distance from the markets for the product; the volume of product to ship; and the capacity of the local road infrastructure.

Rail

The area is not served by rail. A dedicated rail option was examined in the early stages of the Project but the capital cost estimated for construction of a new railway was considered high. As such, this alternative is not considered feasible.

Ship

Given the technical and economic constraints associated with road and rail shipment to and from the site, shipment of feedstock and product to and from the facility was deemed the most economically feasible alternative as it permits more direct transportation of products to the markets. The alternative considered that a marginal wharf structure would be required for the site. This is considered feasible from technical and cost perspectives.

The use of shipping to transport the majority of the product was determined to be the only feasible method for transport and was forwarded for detailed EA in the CSR. The major portion of the petrochemical facility production will thus be shipped out from the marginal wharf. The wharf is also the site of the storage of the resins. The resins that will be shipped by highway will also originate from the storage at the marginal wharf.

Further details on shipping are provided in relevant sections of the provincial EA Report (AMEC, 2006).

2.4.2.3 Conclusions

Based on the above discussion, it is concluded that the identified alternatives to the Project do not meet the objective(s), are not economically feasible, are less preferred from an environmental perspective, or are outside of the Keltic's corporate mandate. The "Do-Nothing" or "Null-Alternative" to the development proposal would be to continue to export natural gas presently available from offshore Nova Scotia, as well as any new sources developed offshore. Without the importation of LNG and the petrochemical plant, Nova Scotians will not see any value added to its natural gas industry.

Offshore Nova Scotia natural gas projects have and can create considerable economic benefit to Nova Scotia during development and production. Similarly, the overall KDP development proposal will create significant economic benefits during construction of the components and provide sustained economic benefits during operations. The petrochemical component of this development proposal provides new value added industry to Nova Scotia and is a long term alternative to Nova Scotia being solely an exporter of natural gas.

2.4.3 Alternative Means of Carrying Out the Project

This section provides a discussion of other methods that may be used to implement the Project. This involved the identification and evaluation of alternatives to specific Project components within the scope of the comprehensive study. Additional information on assessment of alternatives outside of the RA defined scope can be found in Section 6.0 of the provincial EA Report (AMEC, 2006).

The alternatives discussed in the following sections were initially assessed for technical and economic feasibility. For the alternatives that were determined to be feasible, the environmental effects were reviewed and compared.

The technical and the economic feasibility evaluations, as well as the identification of environmental effects, were conducted on a qualitative level by environmental specialists based on professional judgement. Technical and economic feasibility were employed as screening criteria. Alternative methods that were identified to be technically and economically feasible were subsequently evaluated with respect to their potential environmental effects.

Alternative methods that were considered to have the obvious potential for greater adverse environmental impacts than other alternatives were eliminated from further assessment. In situations where no such decision could be made without further investigations, the methods in question were carried through the comprehensive study.

2.4.3.1 LNG Marine Terminal

Two methods of construction were evaluated for the LNG marine terminal, which will be designed for future berthing of two LNG tankers simultaneously.

Alternatives

Pipe Piling Construction

One alternative for the LNG Terminal construction utilizes pipe piling driven into the seabed. Marine habitat effects are limited with this type of construction. For this alternative, the berthing draft is available at the site without requiring dredging and sea disposal of dredged spoils. This alternative is technically suitable and costs are considered high.

Concrete Caissons on Granular Fill

Another alternative would be placing engineered fill on the seabed with the terminal constructed of concrete caissons. Placement of granular fill on the seabed would result in a larger area of marine habitat disturbance in comparison to pipe piles. Similar to pipe piling, this alternative would not require dredging. This alternative is technically suitable and costs are considered high.

Environmental Effects

Environmental effects associated with the pipe piling construction are considered to be less than that of Concrete Caissons on Granular fill. While both options are similar in technical and cost considerations, there is less area of marine floor disruption required. As such, construction of LNG marine terminal using pipe piling construction was carried forward for detailed EA in the CSR.

Summary

The LNG marine terminal is proposed to be constructed of pipe piling construction. The superstructure will consist of a combination of structural steel and concrete. Further details of the preliminary design and conceptual plans are provided in relevant sections of the provincial EA Report (AMEC, 2006).

2.4.3.2 LNG Storage Tanks

There are three types of LNG storage tanks are used in the industry. These were investigated as alternatives.

Alternatives

Single Containment

This type involves a single primary container designed to contain the LNG with a secondary outer shell to contain the insulation but not the refrigerated liquid if there is a failure of the inner tank. These tanks are surrounded by a dyke designed to contain 100% of the tank volume in the event of a spill and are most suitable where there is a large area of available land. This alternative is technically suitable and costs are considered moderate. This alternative requires a large thermal exclusion zone which may have restrained the area available for the petrochemical plant and co-generation facility.

Double Containment

A double containment tank is designed such that both walls are capable of containing the refrigerated liquid. A secondary containment is provided by a reinforced concrete wall. The space between the tank and concrete containment presents safety and maintenance issues. This alternative is technically suitable and costs are considered moderate. This alternative requires a large thermal exclusion zone which may have restrained the area available for the petrochemical plant and co-generation facility.

Full Containment

A full containment tank is designed such that both inner and outer tanks are capable of containing the refrigerated liquid. The advantage of full containment is that the outer concrete wall has a higher structural integrity and is able to contain the full capacity of the tank. This alternative is technically suitable and costs are considered high, however, the thermal radiation and vapour dispersion exclusion distances are considerably reduced.

Environmental Effects

The risk to failure and spillage is the highest for single containment LNG tanks as the secondary outer shell does not contain the refrigerated liquid. While there is less risk with the double containment alternative, it is substantially reduced with the full containment option. As such, the thermal radiation and vapour dispersion exclusion distances are the lowest with this option as it provides the least risk of malfunction; therefore, this option was carried forward for detailed EA in the CSR.

Summary

The use of tanks with a steel outer wall would negatively affect the achievable unloading rate resulting in LNG tankers being berthed longer and therefore reducing cost effectiveness. The use of concrete tanks would address this issue. Also, the structural integrity of a concrete outer tank is substantially higher than with a steel tank. In the case of concrete, potential failure of the outer wall due to accidental spillage is not an issue. The codes controlling LNG plants recognize this fundamental difference between the two types of tanks, although tanks with a concrete outer wall are treated more favourably than tanks with steel walls. Therefore, Keltic has optioned for the full containment tank although costs are higher. Further details on full containment tanks are provided in relevant sections of the provincial EA Report (AMEC, 2006).

2.4.3.3 LNG Regasification Facilities

For the vaporization, i.e., changing the LNG from a liquid state back into a natural gas, two principally different alternative methods are available.

Alternatives

Open Rack Vaporization (ORV)

This alternative is common worldwide and uses seawater to heat and vaporize the LNG; however, if the seawater temperature is below approximately 5°C, Open Rack Vaporizations (ORVs) are usually not practical because of seawater freezing within the vapourizing unit. Due to the high cost of the seawater ORV, installations also tend to have a higher installed capital cost.

Given the potential for prolonged winter weather resulting in local seawater temperatures below 5°C, ORV technology at the proposed LNG facility is not considered technically feasible.

Submerged Combustion Vaporization (SCV)

Submerged Combustion Vaporizers are also widely applied in LNG vaporization in the USA, Europe, and Asia. It is often selected for its inherent safety and high operating efficiency. Submerged combustion vaporizers send out gas as a fuel for the combustion that provides vaporizing heat. The submerged combustion vaporizer installations tend to have a higher operating cost because of the fuel charge which in the case of this Project has been assessed in terms the potential revenue loss from not selling the send out gas versus the efficiencies gained in using the gas on site.

The SCV system does not require on-going water requirements with the exception of an initial fill. In addition, submerged combustion vaporizers have a quick start up ability, tolerance for load fluctuations, fuel flexibility, and high thermal efficiency.

Environmental Effects

ORV technology was deemed neither technically nor economically feasible and as a result, the potential environmental effects were not assessed. The submerged combustion vaporizer technology was determined to be the only method for vaporization and was forwarded for detailed EA in the CSR.

Summary

The proposed Project will utilize submerged combustion vaporizer technology in the regasification facilities. Further details of the regasification are provided in relevant sections of the provincial EA Report (AMEC, 2006).

2.4.3.4 Marginal Wharf

Two methods of construction are being evaluated for the marginal wharf, which will provide area for receipt and shipment of products and by-products in support of the petrochemical process.

Alternatives

Wharf Construction with Precast Concrete Caissons (also known as Concrete Cribs)

The currently presented construction method involves a rock mattress comprised of rock removed from the plant site will be laid on the existing seabed along the periphery of the wharf as shown in Figure 2.2-8. The rock will be deposited at the desired locations by means of bottom discharge barges. Another alternative will be to deposit rock by means of grab buckets. In this operation, the grab bucket will be lowered to the sea bottom and the rock deposited at the desired location. The use of grab buckets will cause the least disturbance to surrounding marine environment, it is also extremely slow and may not be feasible for the entire area. Its use will be limited to the stretches of the mattress close to the shoreline. The caissons will most likely be precast on-shore at an existing facility in the Strait of Canso and floated to the site or precast on floating barges positioned close to the wharf. Subsequently, the caissons will be moved to their final location above the rock mattress, aligned and flooded gradually to ensure that they settle on the rock mattress at their intended positions.

Backfilling will commence after the installation of the caissons has sufficiently progressed. Beginning from the shoreline, the area enclosed within the caissons will be gradually backfilled in layers up to the elevation shown in using excess rock and other suitable back fill material produced from the grading of the plant site. The voids within each caisson will also be filled in with rock and other suitable material.

Silt curtains and debris booms will be deployed, if feasible and necessary, during wharf construction to minimize silting and turbidity in the surrounding marine environment.

Wharf Construction with Steel Sheet Piling (SSPs)

Steel sheet piles will be driven along the periphery of the wharf from shore based cranes as well as floating platforms as necessary.

Beginning from the shoreline, the area enclosed within the steel sheet piles will be gradually backfilled in layers to the required elevation using surplus rock and other suitable fill material produced from the grading of the plant site. As the filling behind the sheet pile progresses, tie back anchors will be installed to restrain the sheet piles against lateral deformation.

Silt curtains and debris booms will be deployed, if feasible and necessary, during wharf construction to minimize silting and turbidity in the surrounding marine environment.

It is noted that the final decision on the type of wharf construction will be based on the outcome of the geotechnical investigation for the proposed wharf site that will be undertaken during the planning stage.

Environmental Effects

The concrete caissons on granular mattresses construction alternative would result in the destruction and alteration of fish habitat in the footprint of the marginal wharf that will be addressed through a Fish Habitat Compensation Plan (FHCP) as required by DFO. Appendix 5 of this CSR contains a Draft FHCP. The SSP methodology does not require a rock mattress on the seabed and would have less fish habitat implications. No dredging, or disposal at sea is required for the marginal wharf as the location of the crib berthing face would be such that dredging and sea disposal of spoils would not be required.

Summary

In order to reflect a cautionary approach to the construction of the marginal wharf, the concrete caissons on granular mattresses method has been carried forward in the CSR. This approach would have the larger impact on fish habitat of the options examined. The potential to employ the sheet piling method, which would result in less disturbance of fish habitat, will be evaluated by the Proponent after further geotechnical investigations. Further details of the preliminary design and conceptual plans are provided in relevant sections of the provincial EA Report (AMEC, 2006).

2.5 SCOPE OF ASSESSMENT

2.5.1 Factors to be Considered

The RAs are required to consider the factors as defined in Section 16(2) of CEAA as part of this EA.

16. (1) Every screening or comprehensive study of a project and every mediation or assessment by a review panel shall include a consideration of the following factors:

(a) 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;

(b) the significance of the effects referred to in paragraph (a)

(c) comments from the public that are received in accordance with this Act and the regulations;

(d) measures that are technically and economically feasible and that would mitigate any significant adverse environmental effects of the project; and

(e) 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.

(2) In addition to the factors set out in subsection (1), every comprehensive study of a project and every mediation or assessment by a review panel shall include a consideration of the following factors:

(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.

Additionally, the RAs will consider the meaning of "environmental effect" under 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 SARA,
(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.

2.5.2 Scope of Factors to be Considered

In order to obtain a good prediction of the effects of a project on the environment, it is important to focus the assessment. "Environmental components" is a term used to describe various aspects of the biological, physical, and social environment. Environmental components can be something physical, such as vegetation; a process, such as biodegradation; or a condition, such as biodiversity.

Environmental components of concern (ECC) are the environmental components that exist in the area, and therefore, could be possibly impacted by the Project scope as identified in Section 2.3. They have been identified via regulatory, stakeholder and public consultations, as well as identified by the Proponent in the process of preparing the CSR.

2.5.2.1 Boundaries

Temporal

Project timelines are based on an expectation of approximately three years to achieve regulatory approval for Project construction and commissioning. Construction activities will consume nearly three years (33 months). The nominal operating life of the Project is 20 years. Closure, decommissioning, and post-decommissioning would be protracted, and the timing of this Project phase is uncertain.

While the nominal design life of the process is twenty years, given normal maintenance, refinement, and re-investment, the operation and maintenance activities will likely extend well beyond the 20-year timeframe. As portions of the Project become obsolete over time they will be removed from service, and the Proponent will undertake decommissioning and reclamation for such portions of the Project as per the legislation and guidelines of the time. For the purposes of this comprehensive study, an operating life of 50 years has been assumed.

Temporal boundaries define the duration over which the Project activities and phases interface with each environmental component. Specific aspects of temporal boundaries are addressed as part of the scope definition for each component, as appropriate, or within individual sections for each ECC in Section 5.0 of this CSR.

Spatial Boundaries

The general study bounds of the comprehensive study have been defined as comprising:

- Project development site situated on the eastern side of Stormont Bay in Goldboro, Nova Scotia;
- area and properties within the community of Goldboro in central Guysborough County, Nova Scotia;
- waters and shore of Isaac's Harbour and its extension into the area of Stormont Bay and beyond up to a 25 km radius of Country Island; and
- any area defined as being potentially within an air emission plume originating from the Project site or other Project related facilities.

It is of note that Meadow Lake, Gold Brook Lake, and Ocean Lake including their respective catchment areas is within the spatial boundaries of the EA for the entire KDP and has been addressed in the provincial EA Report (AMEC, 2006). However, these components are not within the scope of this CSR and therefore are not included within the spatial boundaries applied by the CSR.

Spatial boundaries establish the limits within which the Project interacts with the surrounding environment. The zone of influence reflects an area beyond the Project footprint and incorporates aspects which can act to expand the physical area over which Project features interact with the receiving environment. The spatial boundaries will vary in accordance with each component. Such variations are discussed in the following sub-section, and defined more precisely as needed, within individual sections for each ECC in Section 5.0 of this CSR.

2.5.2.2 Methods

The EA of the Project has been undertaken in a comprehensive manner, with the analysis quality assurance /quality control (QA/QC) focused on those ECCs that are of legal, scientific, ecological, human health and safety, community, and cultural value. These are referred to as the VECs and are the focus of the comprehensive study.

It is widely recognized that there is a need to focus on those environmental components, known as VECs, which have the greatest relevance to the final EA decision (the Agency, 1996; Beanlands and Duinker, 1983). VECs are generally defined as environmental attributes or components of the environment that are valued by society as identified through issues scoping. They are determined on the basis of perceived public concerns. For this Project, VECs were selected from the issues identified and intended to reflect the concerns expressed by regulators, technical specialists, stakeholders, and the interested public.

For the CSR Project, the VEC selection process involved the following steps and considerations:

- review of requirements of the federal scoping document;
- review of the baseline studies;
- review of Project works and activities;
- consideration of public concerns, as well as those of stakeholders and government;
- consideration of potential Project-environment interactions; and
- consultation with public, government department and agencies, stakeholder groups, and First Nations.

The identified VECs are presented in Table 2.5-1. The “X” in the table identifies the values and environmental features that the individual VEC represents. The table also includes a brief listing of plausible potential interactions of the Project with the VEC through direct effects and/or effect pathways.

2.5.2.3 VEC Description

The following is a summary of the scope of each VEC, and a rationale for selection. VECs as presented are not ranked by importance. A total of 25 VECs have been identified. It is of note that the rationale for the selection of the VECs focuses on the Project scope as outlined in Sections 2.3.1 and 2.3.2.

Hydrology

The distribution of the earth’s water is important to the quantity and quality of groundwater, freshwater and marine water. In particular, effects to surface water management may impact hydrologic cycles and groundwater levels. The Project has potential to change the hydrology in the local area with site development.

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TABLE 2.5-1 Basis for Selection of VECs

VEC	Relevance to Values (as per federal Scoping Document)						Potential Interaction of the Project with the VEC
	Legal	Scientific	Ecological	Human Health	Community / Recreation	Cultural	
Hydrology		X	X		X		• Potential for effects on localized hydrology due to development of the Project site.
Freshwater Quality/Quantity	X	X	X	X	X		• Potential surface water quality effect as a result of acid generating rock or contaminated soils (construction phase). • Potential sedimentation of surface water due to erosion (construction phase).
Groundwater Quality/Quantity	X	X	X	X	X		• Potential for groundwater quality impairment from effect on any surface water effects or risk of spills or leaks. • Potential for effects on local water supply wells due to any effect on freshwater quality.
Marine Water Quality	X	X	X		X		• Potential for water quality impairments in marine environment due to storm water discharges and/or re-suspension of contaminants from sediments during marine works.
Soil/sediment Quality (terrestrial and marine)		X	X				• Potential for alteration of sediment transport and beach formation and/or erosion. • Potential for effect on quality of soil and sediment via air quality pathway. • Potential for disposition of impacted sediment via disturbance of contaminated soil or leaching of metals via acid generating rock.
Air Quality	X			X	X		• Potential for air quality impairments via construction vehicles' combustion exhaust or dust during earth works (construction phase). • Potential for air quality impairments via emissions from plant or combustion exhaust from vehicles, vessels and equipment (operations phase).
Climate Conditions	X				X		• Potential for localized changes to climatic conditions. • Potential for contributions to global climate change via emission of greenhouse gases (GHG).
Vegetation (terrestrial and marine)					X		• Potential for vegetation removal during site preparation and construction of facilities. • Potential for effect on vegetation from construction and operations via pathways, such as air and water.

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VEC	Relevance to Values (as per federal Scoping Document)						Potential Interaction of the Project with the VEC
	Legal	Scientific	Ecological	Human Health	Community / Recreation	Cultural	
Species at Risk	X	X	X			X	• Potential for effect on species at risk via disturbance of habitat or individuals. • Potential disturbance in marine, terrestrial, freshwater or wetland habitat.
Fish and Fish Habitat (marine and freshwater)	X		X		X		• Potential for HADD due to construction of structures interfacing with fish habitat or storm water discharge to marine and freshwater environments. • Potential for adverse effects on fish species and populations as a result of HADD.
Marine Mammals			X		X		• Potential for effects on marine mammal as a result of construction of marine structures. • Potential for effects on marine mammal as a result operation of marine structures, shipping, and discharge to marine environment.
Wildlife and Wildlife Habitat			X		X		• Potential for wildlife habitat removal and/or alteration during site preparation and facility construction. • Potential for adverse effects on wildlife species as a result of effects on changes in terrestrial habitat. • Potential disruption of individuals during construction or operation.
Migratory Birds and Migratory Bird Habitat	X		X		X		• Potential for migratory bird's habitat removal and/or alteration during construction. • Potential for adverse effects on migratory bird's species as a result of effects on changes in terrestrial habitat. • Potential effects of facility lighting on migrating birds during construction or operation.
Wetlands	X		X		X		• Potential for adverse effects on extent and functions of local wetland habitat due to site development. • Potential for adverse effects on wetlands as a result of effects on changes in hydrology or freshwater/groundwater quality/quantity.
Lighting Conditions	X		X		X	X	• Potential for changes in the existing ambient lighting conditions related to operation of the facilities, including the necessary lighting at the wharf. • Potential for adverse effects on migratory birds and visual aesthetics.

VEC	Relevance to Values (as per federal Scoping Document)						Potential Interaction of the Project with the VEC
	Legal	Scientific	Ecological	Human Health	Community / Recreation	Cultural	
Atmospheric and Underwater Acoustic Environment	X		X	X	X		• Potential for changes in existing ambient acoustic environment relating to both construction and operation stages. • Potential for changes in existing underwater acoustic environment relating to both construction of marine structures and shipping.
Physical and Cultural Heritage					X	X	• Potential for disturbance of resources related to physical and cultural heritage during construction activities.
Current Use of Lands and Resources for Traditional Purposes by Aboriginal Persons	X					X	• Potential for conflict with traditional land uses and land claims during site preparation and construction of the facility.
Structures/Sites of Archaeological, Paleontological or Architectural Significance	X					X	• Potential for disturbance of site(s) and resources during construction of the facility.
Navigation	X			X	X		• Potential for the shipping activity (including tugs) to affect the navigability.
Marine Safety and Security	X			X	X		• Potential for the shipping and associated port activities to have an adverse effect on marine safety and security (including perception).
Human Health and Safety	X			X	X		• Potential effects on health of workers involved in construction and operation. • Potential effects on residents (as a consequence of water and/ or air quality impairments) or malfunctions/accidents.
Fisheries		X			X		• Potentially reduced (local) production rates/ sales volumes as a consequence of adverse effects on resource (changes in habitat, water quality). • Potential for impaired marketability (perception of product quality).
Aquaculture					X		• Potentially reduced (local) production rates/ sales volumes as a consequence of adverse effects on facilities. (i.e., malfunctions/accidents resulting in changes in water quality). • Potential for impaired marketability (perception of product quality).

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VEC	Relevance to Values (as per federal Scoping Document)						Potential Interaction of the Project with the VEC
	Legal	Scientific	Ecological	Human Health	Community / Recreation	Cultural	
Tourism					X		• Potential for effects on attractiveness for wilderness/nature oriented tourism (change in visual characteristics, increased emissions). • Potential for improved economics (employment, spin off effects, demographics, tax revenues) leading to improvement of tourism infrastructure.

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Freshwater Quality/Quantity

Freshwater in form of surface water such as lakes, creeks and wetlands provides drinking water, as well as habitat for a wide variety of species – aquatic vegetation, plankton, fish, waterfowl, and furbearers. Human uses include such activities as recreation, hunting, and fishing. The quality and quantity of surface water is an important ingredient in ecosystem health. Contaminated storm-water run off from the Project site could discharge to surface water. Airborne dust and contaminants could become transported to enter the surface waters surrounding the site during construction and, to a lesser extent, during operations. Resource management of freshwater is a provincial responsibility.

Groundwater Quality/Quantity

Groundwater is important for drinking water and as a recharge source for surface water. The Project will involve extractions, diversions, effluent discharge, and modification to groundwater flow. In addition to its use as drinking water and as habitat, water is a pathway for contaminant transport to the food chain and therefore, relevant for human health. Groundwater quality and quantity is regulated by the province.

Marine Water Quality

Marine water quality including sediment quality is of concern with respect to marine biota and coastal fisheries. Sediment transport is of significance from a navigational point of view and for coastal protection. The construction of the marginal wharf and the LNG Terminal has the potential to affect water and sediment quality through disturbance of contaminated near-shore marine sediments. During operation, spills and other accidental events can lead to temporary water impairment. Marine resources and navigable waters are protected by federal legislation.

Soil/Sediment Quality (terrestrial and marine)

Contaminated sites are known to occur within the Project footprint. Such areas can contain soil contaminated with heavy metals from mining and waste production (tailings). Other contaminants which are typical of mineral extraction activity can be present. In addition, there is a potential for acid generating rock. In some cases, sites may have been improperly de-commissioned; alternately the standards for de-commissioning may not reflect current standards or knowledge. During construction, there is potential to disturb contaminated sites and mobilize contaminants. Depending on land ownership, both the federal and provincial levels of government have regulatory control over contaminated sites.

Air Quality

The quality of our atmosphere is important for the health and safety of people living and working near the Project site, as well as to local wildlife and vegetation. The Project will produce air emissions such as oxides, PM, and VOCs. These discharges will include exhaust from engines and ventilation, as well as dust from blasting, excavation, processing, vehicle operation, road use, and other Project activities. The atmospheric environment is a pathway for contaminants to the food chain due to the transport of particles to the surrounding vegetation and water. Air quality is important to overall ecosystem health and to other VECs. Air emissions are regulated federally and provincially.

Climate Conditions

Climate change has become an important consideration in both the comprehensive study and as part of Project planning. Design criteria based on a calculated return period for natural events may be suspect if the underlying assumptions about climate prove to be inaccurate. Conversely, the reduction and control of air emissions has become one ingredient of a needed effort to address global warming and GHG emissions.

Vegetation (terrestrial and marine)

The Project is a green field development (i.e., the site is primarily undisturbed). Terrestrial vegetation will be disturbed with site preparation for facility construction; similarly, marine vegetation will be disturbed with construction of the marginal wharf, and less so with construction of the LNG Terminal.

Species at Risk

Work associated with this comprehensive study has determined some species at risk that have potential for effect from the Project. Project development may disrupt freshwater, terrestrial (including wetland) or marine habitat and could affect species at risk that may utilize these habitats. Species at risk are defined by provincial and federal governments.

Fish and Fish Habitat (marine and freshwater)

Aquatic species and habitat are important since many aquatic species, especially fish, provide food for people and wildlife. The Project will alter freshwater habitat and construction of a marginal wharf and LNG Terminal may be a harmful or destructive alteration to marine fish habitat. Marine and freshwater fish and fish habitat are addressed by federal legislation.

Marine Mammals

Marine species and habitat are important since many species support commercial, subsistence, and recreational fisheries. During construction, marine habitat will be disrupted as a consequence of wharf construction and associated marine traffic. During operations, marine traffic and cargo transfer at dockside will interact with the marine environment. Marine fish and habitat is regulated by the federal government.

Wildlife and Wildlife Habitat

Wildlife and wildlife habitat are primarily of concern as a food source and as a recreational resource. Project development will diminish or eliminate the productive capacity of some wildlife habitat in the Project footprint. Other indirect interactions (airborne dust, emissions, noise, vibration, light, water extraction, and consumption) may affect species and habitat within the zone of influence of the Project. Most wildlife species and habitat are regulated by the province.

Migratory Birds and Migratory Birds Habitat

Migratory birds and their habitat are an important part of the ecosystem and have legal, scientific, and community resource value. Interactions with the Project may occur during site preparation (i.e., destruction of nests or habitat) or from operational issues, such as light, sound, air emissions or moving vehicles or vessels. The protection of migratory birds is addressed by federal legislation.

Wetlands

Wetlands act as a source of water and moderate hydrological conditions within watersheds. They provide valuable habitat for waterfowl, furbearers, and other aquatic species. Project construction may interact directly (through removal) and indirectly (through altered surface and groundwater flows) with wetlands. The province has regulatory responsibility for wetlands.

Lighting Conditions

Changes in the ambient lighting environment can affect wildlife by disturbing natural cycles and areas used for travel ways or feeding/foraging. Specifically, birds are known to be sensitive to lighting. The visual landscape characteristics may be altered through lighting schemes associated with large scale developments and may affect the attractiveness of a rural area for wilderness and natural environment oriented tourism. Both Project construction and operation require use of lighting as required by standards for worker safety.

Atmospheric and Underwater Acoustic Environment

Changes in the acoustic environment (i.e., changes in noise levels) can affect humans as well as wildlife. Human responses to changes in noise levels can include general disturbance phenomena, reduced enjoyment of property, disruption of sleep, and health effects. Wildlife can be affected through daily activities such as resting and feeding/foraging. Similarly, underwater noise can impact marine mammals and fish. Acclimation can occur in cases of constant, steady-state levels. In other cases, an avoidance response is elicited such that exclusion occurs from habitat which would otherwise be suitable for occupancy. Noise is regulated by the province.

Physical and Cultural Heritage

Physical and cultural heritage features are resources valued by society for reasons of cultural identity and historic research. Project development could result in the loss or alteration of physical or cultural heritage resources. Historic resources are protected under provincial legislation.

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

Aboriginal culture is valued greatly in Nova Scotia. Many Aboriginal people continue to pursue elements of a traditional lifestyle, spending time in the country harvesting resources such as fish, game, berries, and firewood. Aboriginal land/resource use and culture could be affected by the Project development through such effects as the loss or alteration of harvesting areas and reduced access to traditionally used lands. Aboriginal land claims can affect the establishment of clear title for land designated for industrial development and exclusive use. Both federal and provincial governments have responsibilities with respect to aboriginal peoples and the settlement of outstanding land claims.

Structures/Sites of Archaeological, Paleontological or Architectural Significance

Archaeological, paleontological, and architectural resources are important because of the information they reveal about past and contemporary ways of life, cultural identity, and relationships and interactions with other cultures and with the biophysical environment. Project development could result in the loss or alteration of historic resources. Historic resources are protected under provincial legislation.

Navigation

Construction of the LNG Terminal and the Marginal Wharf, as well as shipping of LNG, catalysts / chemicals and products from the petrochemical plant are large components of this Project. These have the potential to affect navigability within Stormont Bay and into Isaac's Harbour. A spatial area of 25 km within Country Island is the zone of influence to be assessed for navigability. Navigation is under federal jurisdiction. Additionally, discharge infrastructure in the marine environment, such as outlet pipes for wastewater, storm-water, process water or cooling water, will be required to comply with the NWPA.

Marine Safety and Security

The operation of an LNG Terminal and marginal wharf and associated ocean going traffic has the potential to affect existing marine safety and security. Marine traffic for the facility will include the transshipment of feedstocks, product components, and by-products. Marine safety and security is handled under federal legislation.

Human Health and Safety

Protecting human health and safety is a priority for this Project. Humans that may be potentially affected by construction, routine facility activities, as well as accidents, malfunctions, and unplanned events are primarily those that work at the facility or live in or near the Study Area. Through pathways, human health and safety is also potentially affected by Project-related changes to other VECs, such as air quality, groundwater, and surface water quality.

Fisheries

An important, sustainable resource use in the region is fisheries. An industrial activity will affect an area of shoreline as represented by the Marginal Wharf and LNG Terminal. Marine traffic has the potential to interact with harvesting activities. In addition, less direct interactions can occur. Planned and unplanned discharges to the aquatic environment can alter water quality and physical habitat characteristics, which in turn can affect life-cycle stages of target species and their food supply. Increased employment opportunities can produce a shift in labour away from fisheries. Commercial fish harvesting is regulated by the Federal Government under the *Fisheries Act*.

Aquaculture

Aquaculture is an established industry in the region. Based on mapping by the Province of Nova Scotia, Aquaculture Sites of Nova Scotia, there are 5 sites located in County Harbour directly across from Isaac's Harbour (Province of Nova Scotia). Similar to commercial fisheries, aquaculture may be affected via water quality changes. In particular, aquaculture enterprises require pristine water quality in order to establish or maintain operations. Aquaculture operations are regulated by the province. Both federal and provincial government carry out research to support the industry.

Tourism

Tourism is a component of the local economy and has been identified as an issue of concern through consultation. The Project may adversely affect tourism as a result of changes in the visual characteristics of the local landscape and emissions (i.e., noise, air pollutants). Tourism is administered by the provincial government.

2.5.2.4 Strategy for Determining VEC – Project Interaction

Project- environment interactions include direct and indirect effects of the Project. Determining these interactions involved:

- review of Project works and activities;
- analysis of direct effects;
- identification of pathways; and
- assessment of effects through pathways.

Plausible Project-environment interactions were identified based on professional judgment and a preliminary knowledge of the Project and the environmental characteristics of the site and the surrounding areas. These considerations contributed to the determination of the VECs. Subsequently, as part of the effects assessment and for each VEC, these interactions were analyzed in detail. For example, it is plausible to assume that terrestrial habitat is affected by the Project as a consequence of habitat removal on site. During the effects assessment, this interaction was analyzed in detail and the type and geographic extent of the affected habitat specified.

In a subsequent step for each VEC, the potential for Project-related effects through pathways was analyzed. VECs are typically interacting via pathways. Air quality, for example, represents a pathway in that it provides a link between a source (i.e., an exhaust stack) to a receptor (i.e., flora, wildlife, and human). Some VECs can function as both a pathway and a receptor. For example, soil quality can be affected by the Project via air quality (deposition of air-borne contaminants). Soil quality also becomes a pathway through contaminant uptake via plant roots and subsequent human or animal consumption.

This understanding of the links between sources for environmental change and VECs as pathways and receptors was the basis for the assessment of effects associated with pathways. It required that the effects assessment for each VEC also reviewed and incorporated the effect predictions established for other VECs.

The approach to the actual effects assessment is described in the following section.

2.5.2.5 Effects Prediction

In accordance with the provisions of the federal scoping document (TC and DFO, 2005a; amended, 2006; provided in Appendix 1) the environmental effects assessment was conducted in a step-wise fashion involving:

- prediction and evaluation of Project-related environmental effects;
- identification of necessary avoidance, mitigation, remediation, and/or compensation; and
- determination of residual effects and their significance.

Environmental Effects Assessment

The potential effects resulting from interactions with the Project, either directly or indirectly via pathways, were investigated in detail for each VEC. This effects assessment involved qualitative and, where possible, quantitative analyses using existing knowledge, professional judgment, and computer modeling where appropriate and feasible.

Mitigation

Where an adverse environmental effect was identified, mitigation was proposed. Where possible, mitigation measures were incorporated into the Project design and implementation in order to eliminate or reduce potential adverse effects. Mitigation at the receptor end was considered if avoidance and mitigation at the source of the effect was deemed not feasible or not sufficiently effective.

In those instances where an adverse effect is unavoidable and cannot be mitigated to insignificant levels, options for remediation and/or compensation were investigated.
For interactions where positive effects are anticipated, opportunities were determined for maximizing the positive effects.

Residual Effects and Determination of Significance

Residual effects refer to those environmental effects predicted to remain after the application of all proposed mitigation measures. The predicted residual effects are considered for each Project phase (construction, operation, decommissioning) and for potential accidental events.

In accordance with the Canadian Environmental Assessment Agency guidelines (1994, 1997), the significance of the residual effects is evaluated for each VEC. For adverse effects, significance is determined based on the following criteria:

- magnitude;
- geographic extent;
- timing, duration and frequency;
- reversibility; and
- ecological and socio/cultural context.

For magnitude, a relative rating was established as defined in Table 2.5-2. The evaluation applied absolute values for the geographic extent, frequency, and duration. Reversibility was considered as the ability of a VEC to return to an equal or improved condition once the interaction with the Project has ended. The judgment about the reversibility was based on previous experience and research and stated as "reversible" or "irreversible." Subsequently, those effects considered significant would undergo an additional consideration of the likelihood of their occurrence and the level of confidence underlying the effects prediction.

TABLE 2.5-2 Definitions for Levels of Magnitude

Rating	Magnitude
High	An environmental effect affecting a whole stock, population, or definable group of people, or where a specific parameter is outside the range of natural variability determined from local knowledge over many seasons.
Medium	An environmental effect affecting a portion of a population, or one or two generations, or where there are rapid and unpredictable changes in a specific parameter so that it is temporarily outside the range of natural variability determined from local knowledge over many seasons.
Low	An environmental effect affecting a specific group of individuals in a population in a localized area, one generation or less, or where there are distinguishable changes in a specific parameter; however, the parameter is within the range of natural variability determined from local knowledge over many seasons.
Nil	No environmental effect.
Unknown	An environmental effect affecting an unknown portion of a population or group or where the changes in a specific parameter are unknown.

For adverse residual effects, the evaluation for the individual criteria was combined into a rating of significance:

- Major: Potential effect could jeopardize the long term sustainability of the resource, such that the effect is considered sufficient in magnitude, aerial extent, duration, and frequency, as well as being considered irreversible. Additional research, monitoring, and/or recovery initiatives should be considered.
- Medium: Potential effect could result in a decline of a resource in terms of quality/quantity, such that the effect is considered moderate in its combination of magnitude, aerial extent, duration, and frequency, but does not effect the long term sustainability (that is, it is considered reversible). Additional research, monitoring, and/or recovery initiatives may be considered.
- Minor: Potential effect may result in a localized or short-term decline in a resource during the life of the Project. Typically, no additional research, monitoring, and/or recovery initiatives are considered.
- Minimal: Potential effect may result in a small, localized decline in a resource during the construction phase of the Project, and should be negligible to the overall baseline status of the resource.

An adverse effect was considered "significant" where its residual effects were classified as major; while they were considered "not significant" where residual effects were classified as medium, minor, or minimal.

3.0 INFORMATION DISTRIBUTION AND COORDINATION

Public consultation is a key component of a comprehensive study and is regulated under CEAA. It provides a means to integrate citizens into the environmental decision-making process and to provide proponents and regulators with the information they need for good decision-making. Specific consultations focus on stakeholders and are meant to gather relevant information and opinions at various stages of the comprehensive study process.

Keltic's consultation plan specifies the goals of the EA consultation process, describes the relevant communities, identifies which elements are to be carried out by whom, and how results are going to be integrated with the information provided by Keltic's public communications work. A liaison committee was established by Keltic to provide information to stakeholders and the public, and also to provide feedback from the local community about concerns and advice for consultations.

3.1 FEDERAL COORDINATION

On October 26, 2004, the Agency forwarded the federal departments' responses pursuant to the Regulations Respecting the Coordination by Federal Authorities of Environmental Assessment Procedures and Requirements. These determinations were made by all departments to which the Project description (dated August 30, 2004) was circulated. EC subsequently revised its determination and is participating in the process as an expert department based on additional information provided by Keltic.

A listing of responses from these federal departments is provided in Table 3.1-1.

TABLE 3.1-1 Summary of Federal Departments' Responses

Department	Response
EC	Likely to require an environmental assessment; and is in possession of specialist or expert information
DFO	Likely to require an environmental assessment; and is in possession of specialist or expert information
Health Canada	In possession of specialist or expert information
Indian and Northern Affairs Canada (INAC)	Not likely to require an environmental assessment
Industry Canada	Not likely to require an environmental assessment
National Energy Board	Not likely to require an environmental assessment
NRCan	In possession of specialist or expert information
Parks Canada	Not likely to require an environmental assessment
TC	Likely to require an environmental assessment; and is in possession of specialist or expert information

3.2 PUBLIC CONSULTATION IN ACCORDANCE WITH THE CANADIAN ENVIRONMENTAL ASSESSMENT ACT (CEAA)

At the federal level, public participation in conducting comprehensive studies is one of the core objectives under CEAA. RAs are expected to understand and address the range of public concerns about a project. The Agency emphasizes that the public is not a single entity but comprised of varied interests (i.e., local residents, environmental groups, business owners), and requires that proponents provide a variety of opportunities for consulting with interested parties. The RAs (i.e., DFO and TC) are also free to request specific consultations to satisfy their requirements under the Act.

These requirements are broad and do not stipulate precisely how consultation should proceed; however, some general themes have developed in terms of expectations for EA consultations:

- Participants should be involved at all stages of the comprehensive study process, from issues scoping onward.
- The public must have enough time to digest information and prepare comments, but the process must stay within a reasonable time frame.
- Different techniques should be used to encourage the widest possible range of stakeholder participation.
- The public consultation program must be well planned and documented.
- Regulators must be satisfied that the Proponent preparing the CSR has made a reasonable effort to incorporate stakeholder information and public concerns into issue scoping, technical analysis, and conclusions.

Further, pursuant to the CEAA, the RA must ensure that public consultation is conducted at the required three points during a comprehensive study. These are:

- during the preparation of the Scoping Document [subsection 21(1)];
- during the preparation of the CSR [section 21.2]; and
- during a review of the completed CSR prior to the Minister's issuance of an EA decision statement (section 22).

3.2.1 Section 21 – Public Participation Regarding Proposed Scope of Project

Public consultation for a comprehensive study is required under Subsection 21(1) of CEAA as follows:

"Where a project is described in the comprehensive study list, the responsible authority shall ensure public consultation with respect to the proposed scope of the project for the purposes of the environmental assessment, the factors proposed to be considered in its assessment, the proposed scope of those factors and the ability of the comprehensive study to address issues relating to the project."

This involves the preparation of a scoping document by the RAs (May 24, 2005) that was posted on the Canadian Environmental Assessment Registry website on June 6, 2005, for review by the public. The RAs posted a notice with respect to the availability of the scoping document for public review on the Canadian Environmental Assessment Registry website on June 1, 2005. The RAs also gave notice in local newspapers on June 1, 2005, (Chronicle-Herald and Guysborough Journal) and June 3, 2005, (Le Courrier de Nouvelle-Ecosse). All notices stated the availability of the document for public review at four community accessible locations. Comments were requested by July 3, 2005.

The results of this public consultation were provided in the Environmental Assessment Track Report completed by the RAs on October 14, 2005. Based on the comments that were received from the public and expert departments and Addendum was issued on January 5, 2006 which stated that; two additional "Possible Environmental Components of Concern" would have to be considered in the EA - aquaculture and tourism. The RAs required that the species at risk environmental component refer specifically to the roseate tern. Contaminants in the environment would have to be quantified by the Project Proponent during the collection of baseline information.

3.2.2 Section 21.2 – Public Participation in Comprehensive Study

Public consultation for a comprehensive study is required under Subsection 21.2 of CEAA as follows:

"Where a project has been referred to a responsible authority under paragraph 21.1(1)(a), the responsible authority shall ensure that the public is provided with an opportunity, in addition to those provided under subsection 21(1) and section 22, to participate in the comprehensive study, subject to a decision with respect to the timing of the participation made by the federal environmental assessment coordinator under paragraph 12.3(c)."

Public consultation activities undertaken by the RAs and related to Section 21.2 of CEAA (i.e., consultation during the preparation of the CSR) involved:

- the release of a draft report to the general for public;
- solicitation of public comment through a formal public review period;
- review and discussion of the Project through a public hearing (under the *Nova Scotia Environmental Assessment Act*).

A draft report was released to the public on August 22, 2006 in the form of a draft EA Report generated pursuant to the Nova Scotia Environmental Assessment Regulations under the *Nova Scotia Environmental Assessment Act*. The RAs notified the public of availability of the report for public review via the CEAA Registry (Notice of 14 September).

During the public review period for the Provincial EA Report (August 22 to October 30, 2006) the public had an opportunity to review and comment on the EA. The EA Report was made available in several locations, including:

- The Municipality of Guysborough, Guysborough;
- Sherbrooke Library, Sherbrooke;
- Clean Nova Scotia, Dartmouth;
- NSEL, Antigonish; and
- NSEL, Halifax.

In addition, the report was available on the Nova Scotia government EA website at www.gov.ns.ca/enla/ess/ea.

Further opportunity for review and discussion was provided through the Provincial EA hearings, which were held between November 20 and 25, 2006 in Guysborough, Sherbrooke and Antigonish, Nova Scotia. Stakeholders and the general public were invited to provide/present submissions on the Project during the hearing. The general public and stakeholders who wished to provide written or oral presentations to the Environmental Assessment Board were able to do so until November 13, 2006.

Questions, concerns, and comments received by the RAs during the public review process of the EA Draft Report were placed on the public registry and provided to Keltic for response. In addition, further public comments were received during the open sessions of the public hearings.

3.2.2.1 Issues Raised During the Public Review

Key issues identified through the public review included:

- Project sustainability and need;
- facility operation;
- ground water, fresh water, and marine water quality;
- fish habitat and fisheries;
- wildlife;
- birds;
- marine safety;
- human health and safety;
- accidental events; and
- cumulative effects.

The issues raised during consultations or received by mail from non-governmental stakeholders and that are within the scope of this CSR are listed by topic in Table 3.2-1 (Appendix 4, lists issues and concerns raised during the open house sessions).

Federal and provincial authorities also provided comments on the Provincial EA Report. These are addressed in Section 3.5.

TABLE 3.2-1 Topics Raised Through Nova Scotia EA Board and Public Review

Category	Topics Raised	Addressed in CSR Section
Project Description	• Project sustainability • Exclusion zone • Power supplies • Use of LNG onsite & for export • Noise	2.1,/2.1.2/2.4.1/2.4.1.4/2.4.2 2.4.3.2/2.5.2.3 2.2/2.2.1/2.2.2.4/2.2.5.1/ 2.2.5.5/ 2.2.6.4/2.4.1/2.4.1.4/2.4.2.2/ 2.4.2.2 (Alternatives) 2.2.2.1/2.4.1 2.2.4.3 (Monitoring) 2.5.2.3 (Description VEC's)
Project Description: Construction	• Liquid and solid waste • % of site to be cleared • Management of mine tailings • Nature of bedrock • Foundation construction methods	2.2.2.2/2.2.2.5/2.2.4.5/2.2.5.1/ 2.2.5.2/ 2.2.5.6/2.2.6.2/2.2.6.3/2.2.6.5/2.2.7/2.4.1/2.5.2.3 2.2.5.3/ 2.5.5.3 5.1.2.1/ 5.1.2.2/5.1.4.2/5.1.5.1/ 5.1.5.2/5.1.10.2/5.1.22.1/5.1.22.2/5.2.4.2/5.3.5.2/5.3.11.1 4.1.3.1/4.1.3.4/4.1.8/ 2.2.5.2/ 2.2.5.3/ 2.2.5.5
Project Description: Operation	• Discharges to the environment • Storm-water contamination • Wastewater effluent • Air emissions • Waste product transport • Port operation • Storage & containment of fuel • Flare emissions	2.5.2.3 2.2.6.5 2.2.3/2.2.4.3 / 2.2.6.2 / 2.5.2.3 2.2.4.3 / 2.5.2.3 2.24.5 2.2.3 2.2.5.1/2.2.6.3 2.2.3/2.2.6.2/2.2.6.5
Project Need/Purpose	• Project justification • Project sustainability	2.4 2.1,/2.1.2/2.4.1/2.4.1.4/2.4.2
Alternatives to the Project	• Extent of consideration of alternatives	2.4
Project boundaries	• Temporal & spatial boundaries of assessment	2.5.2.1
Freshwater Quality/Quantity	• Discharges to freshwater	5.1.1.2/5.1.2/5.1.10.1/5.1.14.1/5.1.22.1/5.2.4.2
Groundwater Quality/Quantity	• Impacts on local wells	5.1.3/5.1.3.1/5.1.3.2/5.1.22.1
Marine Water Quality	• Effect of marginal wharf on marine circulation • Effect from leaching from contaminated sediment • Effect of emissions	5.2.14 5.1.2.2/5.1.4.1/5.1.4.2 /5.1.4.4/5.1.5.1/5.1.5.2/ 5.1.10.2/5.2.4 .1/5.2.4.2/5.2.5.2/ 5.2.8.1/5.2.10.1/5.3.4..3.5/5.3.5.1/5.3.11.1 5.1.4.

Category	Topics Raised	Addressed in CSR Section
Air Quality	• Odour • Air emissions – Project and cumulative • Health risk assessment • Baseline data • Disturbance of mine tailings	5.1.6, 5.3.6 5.1.6 / 5.2.6 / 5.3.6 5.1.6 / 5.2.6 / 5.1.22 4.1.6/5.1.6.1 5.1.5.2/5.1.22.1/
Climate Conditions	• Extreme weather • Climate change • Vessel specifications	4.1.7/9.1 / 9.2.3 / 9.2.4 /9.2.5/ /9.2.7 / 9.3.3 / 9.3.4 / 9.4.6 5.3.7/9.2.7 5.3.7.2/9.3.5
Vegetation	• Significance of impacts	5.1.8 / 5.2.8 / 5.3.8
Species at Risk	• Roseate Tern, Greater Yellowlegs, boreal felt lichen	5.1.9 / 5.2.9 / 5.3.9
Fish and Fish Habitat	• Construction of wharf and vessel operation • Spills • Ballast water • Habitat Compensation Plan and timing	5.2.10 / 5.3.23 5.2.10 / 5.3.10 5.3.24 5.2.10 / 5.2.23
Marine Mammals	• Increase in ship traffic	5.3.11
Wildlife and Habitat	• Significance of impacts • Site fencing • Prey/predator balance • Biodiversity • Species at Risk • Mainland moose • Alteration of coastline • Lights & noise	5.1.12/ 5.2.12/ 5.3.12/ Section 6.0 2.2.5.2 5.1.11.1/ 5.2.9.1/ 5.2.11.1/5.1.12.1/5.2.10.1 5.1.13 5.1.9/ 5.2.9/ 5.3.9/ 6.1-8/ 8.2.1.9/ 8.3.1.9 4.2.3.4/4.2.5/5.1.9 5.1.1/ 5.1.13.1/ 4.2.2.1/ 9..2 5.1/ 5.3.16/ 8.2.1.13/8.1.1.2/5.2.15
Migratory Birds and Habitat	• Foraging sea birds • Birds • Biodiversity • Loss of habitat • Contamination of food chain • Shipping and accidents	4.2.3.3 / Table 4.2-14 /5.2.9/5.3.9/5.3.15/ 6.1.8/6.2.6,/6.3.5 4.2.3.3/5.1.13/5.2.13/5.3.13/6.1.1/6.1.12 / 4.3.5.1 5.1.1.4/5.1.14.1 5.1.13. / 6.1.12/6.2.10 10.1.1.3 6.3.8 / 6.3.7 / 5.1.12.1
Wetlands	• Disposal of removed organics • Cultural value of wetlands (medicinal plants) • Extent of wetland loss	5.1.14 5.1.14 5.1.14
Lighting Conditions	• Effects on visual (light) landscape	5.1.15

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Category	Topics Raised	Addressed in CSR Section
Atmospheric and Underwater Acoustic Environment	• Noise • Effects on visual landscape • Vibration	5.1.16/5.2.16./5.3.16/6.1.15/ 6.2.13/6.3.10 5.1.16/6.1.15/6.2.13
Physical and Cultural Heritage	• Heritage & cultural legacy • Marginal wharf site is important to Black Loyalists • Visual impacts on coastline & local community	5.1.17 5.2.19 5.2.19
Traditional Aboriginal Use	• Impacts beyond Project site	5.1.19
Navigation	• Use & access of Country Harbour, Isaac's Harbour & Stormont Bay	2.2.2/2.2.6/2.4.3/ 5.2.20.1
Marine Safety and Security	• Risk to fishermen during storms from LNG vessels • Safety for LNG vessels • History of shipwrecks • Security	5.2.23/5.3.20/5.2.20 5.3.21/5.3..20/5.3.22 5.2.21/5.3.22/5.3.21
Human Health & Safety	• Vehicle collisions • Traffic impacts • Health risk assessment • Air emissions • Communication of health risks • Bio-accumulation of chemicals • Wastewater • Risk from terrorist attacks • Lights & noise • Contaminated sediment	8.2.1.22 5.1.22.1 5.1.22.1/5.1.22.2/ 5.1.22.3 / 5.2.22 / 5.3.22 5.1.6.1/5.1.6.2/5.1.6.3/5.1.6.4/5.1.22.1/5.2.22.1 10.1.1.3 5.1.22 TERMPOL & QRA Noise: 5.1.16 Light: 5.2.15 / 5.1.15 5.1.22 / 5.2.5 / 5.2.8 / 5.2.10
Fisheries	• Consultation with local fishers • Habitat loss • Interference with inshore fisheries & recreational boating • Loss of access • Fisher compensation	5.1.16.2 / 5.2.23 5.1.10 / 5.2.10 / 5.3.10/5.3.23.2 5.3.23/5.3.20/5.2.23 5.2.23 5.2.10/5.3.23
Aquaculture	• Limitation on current and future development	5.1.24
Tourism	• Impact on natural attributes of area	5.1.25 / 5.2.25
Decommissioning & Reclamation	• Bonding • Decommissioning plan and responsibility • Bankruptcy of Proponent	Undertaking EAB11 - Provincial EA Hearing Process 2.2.7 Undertaking EAB11 – Provincial EA Hearing Process

Category	Topics Raised	Addressed in CSR Section
Accidents & Malfunctions	• LNG leaks and results • Risk of Boiling Liquid Expanding Vapour Explosion (BLEVEs) • Specific health and safety analyses to be used • Trucking of liquid wastes • Spill Response Strategy • Communication of risks • Thermal radiation & exclusion area • Footprint for Thermal Exclusion Area • Explosion and fire • Emergency response • Fire fighting capacity and responsibilities • Financial responsibility	10.1.1.2 10.1.1.2 2.2.4.4/2.2.4.5/10.1 10.1.1.1 10.1.1.4/ 10.1.1.5 10.1 10.1.1.3 2.4.3.2/2.5.2.3 10.1.1.4/ 10.1.1.5/10.1.2 10.2.1.3 10.1.1.4/ 10.1.1.5/ 10.1.2
Effect of Environment on Project (LNG)	• Effect of wave action, storm surge, fog & severe storms on terminal & vessels	Waves: 9.2.5/9.3.5/9.4.4 Surges, Fog: 9.2.3/9.3.3/9.4.2 Storms: 9.2.3/9.2.5/9.2.7.2/9.3.3/9.3.7.1/9.3.5
Cumulative Effects	• Time period assessed • Cumulative effects level of detail • GHG • Marine operations • Surface water quality and fish habitat • Health impacts • Proposed expansion of Goldboro Industrial Park • Black Loyalist heritage • Mi'kmaq heritage & harvest • Deep Panuke and other offshore/onshore developments	8.1 8.0 8.3.1.7/8.1.1.2/8.1.1.6 8.2.1.20/8.2.1.21/8.3.1.20/8.3.1.21 Water: 8.1.1.2 Fish: 8.1.6.10/8.2.1.10/8.3.1.10 8.2.1.22/8.3.1.22 8.1.1 8.3.1.18 8.2.1.17/8.2.1.18/8.3.1.17/8.3.1.18/8.3.1.19 8.1.1.6
Monitoring	• Performance standards for VECs • Actions to be taken if monitoring demonstrates change in condition • Communications between Project Proponents • Monitoring should include surrounding communities • Fish catch	7.0 7.2.14 7.2.12 7.2.12/7.2.14 7.2.8

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Category	Topics Raised	Addressed in CSR Section
Public Consultation	• Lack of awareness	3.0
	• Communications between Fishers	3.0
	• Role of Community Liaison Committee (CLC)	3.3.2.1
	• Technical language	3.0
	• Community information office during construction	
	• Community involvement in EMP	7.2.14
	• Nova Scotians should be informed and able to provide comment	3.2.2

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3.2.3 Section 22 – Public Review of the Comprehensive Study Report (CSR)

Public consultation for a comprehensive study is required under Subsection 22 of CEAA as follows:

"(1) After receiving a comprehensive study report in respect of a project, the Agency shall, in any manner it considers appropriate to facilitate public access to the report, publish a notice setting out the following information:

> *(a) the date on which the comprehensive study report will be available to the public;*
>
> *(b) the place at which copies of the report may be obtained; and*
>
> *(c) the deadline and address for filing comments on the conclusions and recommendations of the report.*

(2) Prior to the deadline set out in the notice published by the Agency, any person may file comments with the Agency relating to the conclusions and recommendations and any other aspect of the comprehensive study report."

This review is coordinated by the Agency and allows people to submit comments on the conclusions and recommendations of the report. These comments will be taken into account when the Minister issues a decision.

3.3 CONSULTATION MEASURES UNDERTAKEN BY THE PROPONENT

To date, the Proponent has undertaken several consultations during preparation of the EA. These consultations were designed to provide information about the proposed Project, respond to questions and concerns the public might have, and gather technical information and input into baseline data, impacts, mitigation, and monitoring that could be incorporated into the EAs – both federal and provincial.

The following sub-sections outline the various public consultation activities that have been undertaken by the Proponent and the results of these activities. Most of the consultation activities were not specific to either the federal comprehensive study process or the provincial environmental assessment process. Unless, specifically mentioned, the following descriptions therefore, relate to both assessments.

Also included in the following is information on the underlying objectives of the program and the initial steps taken to identify communities, stakeholders, and interest groups.

3.3.1 Goals

Underlying goals of the public consultation for the Keltic EA process have been:

- to ensure that issues are correctly identified and defined, and that matters of interest to the affected communities are adequately covered in the studies. This scoping is critical to the efficient completion of the comprehensive study;

- to assist in judging the intensity of Project benefits or impacts;
- to ensure that the opinions of key stakeholders have been elicited;
- to provide the EA team with accurate local information or expert opinions not available through published sources; and
- to fulfill regulatory requirements.

3.3.2 Approaches to Public Consultation

The consultation program of the Keltic Project has applied a combination of activities. Key program components include:

- defining communities, stakeholders, and the public;
- project/scoping backgrounder (hand out material);
- public meetings/ open houses; and
- continued consultation.

3.3.2.1 Defining Communities, Stakeholders and the Public

Geographically, communities affected by the Project broadly fall into those in the immediate vicinity of the proposed plant and wharf, and those further along the coasts to either side of the Project site. More specifically, they include:

- the communities on the shores of Country Harbour and Stormont Bay, including Drum Head, Goldboro, Isaac's Harbour, and Country Harbour;
- the communities on either side of Stormont Bay from Port Hilford through Port Bickerton to the west, and Coddles Harbour to Tor Bay to the east (in the Municipality of the District of Guysborough);
- the area around Erinville and Salmon River Lake (in the Municipality of the District of Guysborough); and
- the area around Fraser Mills and Lower Springfield (in the Municipality of the County of Antigonish).

Further, given the economic characteristics of the proposed Project, the following economic interest groups were identified at the start of the Project as having a potential interest in the proposal:

- Guysborough County Regional Development Authority (GCRDA);
- Goldboro-Isaac's Harbour Community Development Authority;
- Guysborough County Inshore Fisherman Association (GCIFA);
- Eastern Shore Fishermen's Protective Association;
- individual fishers and aquaculture interests in the Keltic Study Area;
- The Antigonish Area Partnership;

- Antigonish Chamber of Commerce; and
- Antigonish Regional Development Authority.

Groups with an environmental and community focus that may have an interest in the proposed Project were considered to include such organizations as:

- Goldboro and Area Marine Protection Society;
- Ecology Action Centre, particularly their Coastal Issues and Marine committees;
- Canadian Parks and Wilderness Society, Nova Scotia Chapter;
- Nova Scotia Bird Society;
- The Aquaculture Association of Nova Scotia;
- Eastern Mainland Field Naturalists (based in Antigonish);
- The Sierra Club, Nova Scotia Chapter;
- Coastal Communities Network (based in Pictou); and
- Nova Scotia Salmon Association.

Communities, interest groups, and the public at large were approached via mail and/or media advertisements. Issues raised have been recorded and documented together with the responses provided by the Proponent (see Section 3.3.3).

As a proactive approach, Keltic established a CLC in August of 2004. The committee was set up by Keltic, voluntarily, to involve and inform local communities in the Project and will be the primary vehicle used for future consultations. The CLC has a two-fold mandate:

- to provide a forum for the representatives of the residents of Goldboro and surrounding communities to offer their input on the Keltic Project; and
- to provide a forum for representatives from Keltic to update the community, through the committee, on the various aspects of the Project.

Keltic held a number of open houses and asked attendees if they would be interested in sitting on the committee as a representative. A public meeting chaired by Councillor Derek Hayne was used to select committee members. The committee is structured as follows:

- Goldboro - 2 members;
- Isaac's Harbour – 2 members;
- Drum Head - 1 member;
- Coddles Harbour - 1 member;
- New Harbour - 1 member;
- Stormont - 1 member;
- African Nova Scotian Community - 1 member;

- Municipal Councillor - 1 member; and
- Keltic – 2 members.

3.3.2.2 Project/Scoping Backgrounder

A Project/scoping backgrounder was prepared for the consultation process and was handed out during the open houses. The backgrounder included:

- definition of the EA;
- Provincial and Federal requirements;
- summary of the Project description; and
- a summary of the major environmental issues regarding the proposed plant site and socio-economic conditions.

3.3.2.3 Public Meetings / Open Houses

Consultation with the general public through public meetings/Open House events commenced in 2004 and involved a series of public meetings:

- Country Harbour (July 6, 2004; 30 Nov. 2004);
- Lincolnville (Guysborough), July 7, 2004);
- Antigonish (July 8, 2004);
- Goldboro (Sept. 27, 2004); and
- New Harbour (Nov. 15, 2004).

Purpose of the meetings was generally to introduce participants to the Project and the planning process, and to identify public concerns and obtain input to the baseline studies. Other issues discussed included such topics as materials handling, insurance considerations, and job and training opportunities.

The public meetings were supported by presentation material, Project information pamphlets, and questionnaires. In addition to general advertising on the local radio and in local newspapers such as the Casket (Antigonish) and the Guysborough Journal, direct contacts were made by the consulting team during the preparation of the EA. Large public open houses were held in targeted venues for both the general public and stakeholders. Also, small focus group meetings were held with:

- GCIFA; and
- individual fishermen and stakeholders of the aquaculture industry in the Keltic Study Area.

Subsequently, Keltic held a number of additional public meetings. These meetings/Open House events were in some of the previous locations and in new locations:

- New Harbour (February 21, April 11, May 9; and June 20, 2005);

- Erinville (October 4, 2005);
- Antigonish (October 5, 2005);
- Port Bickerton (October 27, 2005); and
- Goldboro (October 3, 2006).

These meetings were themed to provide information about various aspects of the Project. Emphasis was placed on soliciting public input on key concerns, the scope of the Project and the EA, and to provide a general up date on progress. Events at these five locations are briefly characterized below.

New Harbour

A number of meetings were held by Keltic at the New Harbour School, prior to its closing during the summer of 2005. One meeting focused on socio-economic concerns and the consultation process and was held on February 21, 2005. Over 400 people attended the meeting. A community information session was held at New Harbour School on April 11, 2005. This meeting was an information session to provide an overview of the community consultation process and the economic and social impact analysis process associated with the preparation of the EA. Approximately 100 people attended this session.

The public consultation plan was reviewed, noting that although NSEL had finalized its provincial terms of reference for the EA, the Agency had not yet finished its internal federal department issue scoping at the time. Most of the formal public consultation process that followed occurred after the draft federal scope was released. The socio-economic assessment was discussed, and the data requirements stated.

Following the overview presentations, people in attendance were asked to brainstorm what issues related to the Project are of interest to them. Key issues raised related to such topics as community benefits, employment and training opportunities, transportation, community health and safety, consultation process, land values, property taxes, and Project schedule.

Erinville

The open house held in the Erinville Fire Hall on Tuesday October 4, 2005, provided background information on the environmental setting (including the marine, terrestrial, and socio-economic components) and allowed attendees an opportunity to respond to a short survey.

Erinville was chosen due to its central location between Goldboro and Antigonish. 34 people attended this open house.

Appendix 4, Table 4-1 summarizes the main concerns highlighted during the open house.

Antigonish

This open house, held at the Antigonish Green Way Claymore Inn on Wednesday October 5, 2005, was a companion to the Erinville open house and provided background information on the environment and allowed attendees an opportunity to respond to a short survey.

Antigonish was chosen due to its prominence as a major population and service centre in the region. 16 people attended this open house. Appendix 4, Table 4-2 summarizes the main concerns highlighted during the open house.

Port Bickerton

This open house, held at the Port Bickerton Community Centre on Thursday, October 27, 2005, focused on the proposed FHCP (Appendix 5) being presented by Keltic. Fisherman's Harbour has been proposed as a compensation site for habitat lost due to construction of the Marginal Wharf in Goldboro. The intent of this session was to review the proposed Habitat Compensation Plan with fishers, answer questions, and gather input that could be used to refine the proposal. Port Bickerton was chosen due to its proximity to the Goldboro area and because it is a fishing community. Six people attended this open house, several of which actively fish in Stormont Bay. Appendix 4, Table 4-3 summarizes the main concerns highlighted during this session.

Previous meetings that had been held with fishers who fished specifically within Stormont Bay focused on financial compensation in the event of accidents or disruption to traditional fishing practices within the bay. Concerns had focused on interference from large vessel traffic, loss of access to the marginal wharf area, and potential environmental damage from an accidental spill of hydrocarbons.

Goldboro

The most recent Open House was held at the Goldboro Interpretive Centre in Goldboro on October 3, 2006. Purpose of this Open House was to provide an update on the Project development and environmental assessment process. The meeting was attended by about 150 participants. Key topics discussed with the public related to the Project schedule and upcoming employment and training opportunities. No new issues and concerns beyond those obtained through earlier meetings and Open Houses were identified.

Outcome of Public Meetings and Open House Events

Comments and questions received during the consultation process generally reflected regional economic concerns. For example, most issues raised at the Erinville consultation related to the proposed road alignment and job creation. The Antigonish open house focused more on the regional economic implications of the Project. At the Port Bickerton open house, the focus was the commercial lobster fishery and other marine related issues. The New Harbour open house attracted the most people, and therefore captured a greater variety of issues.

Input from the consultations was used to identify and refine VECs to focus the environmental assessment process. Table 3.3-1 is a summary of the VECs that were captured during the public consultation process. It is of note that the list includes all VECs identified. The subsequent sections of this CSR only address those VECs relevant to the report's scope (see Section 2.5.2.3).

TABLE 3.3-1 Valued Ecosystem Components Identified during Public Consultation Process

Consultation Group	VECs Identified	
CLC	All VECs	
Antigonish	Quality of life Transportation Existing and planned land uses	Human health and safety Community resources
Erinville	Quality of life Existing and planned land uses Human health and safety	Transportation Acoustic environment Community resources
New Harbour	Human health and safety Existing and planned land uses Community resources Fish and fish habitat (marine)	Quality of life Transportation Commercial fisheries
Port Bickerton	Fish and fish habitat (marine) Commercial fisheries Human health and safety	Marine safety and security Navigation Quality of life
Mining Industry	Transportation (Orex requested that the road alignment be shifted to avoid possible land use conflicts)	

3.3.2.4 Continued Consultation

In addition to the above mentioned review of the CSR, the Proponent has indicated they will continue with a number of consultation activities.

The CLC meets regularly with Keltic and will continue to be used as a sounding board for any issues that arise such as safety, environmental concerns, employment, etc. Keltic will maintain its Project-specific website. This provides for dissemination of information on the progress of the Project and the release of further studies. The web page will inform about upcoming events, employment opportunities, and procurement of goods and services.

Further, Keltic will continue to liaise with the GCRDA and the Guysborough Journal as a means of communicating any information. Keltic will also liaise actively with local emergency service providers, such as Royal Canadian Mounted Police (RCMP), fire and emergency health response.

3.3.3 Overview Provincial EA Process and Associated Key Consultation Activities

The following Table 3.3-2 summarizes the milestone dates and activities as they relate to the public consultation process as implemented by the Nova Scotia provincial government (NSEL) and the Proponent. The dates are provided here for overview purposes and to provide an understanding of the comprehensiveness of the consultation activities undertaken to date. Notices have all been posted and documents been made available through the Nova Scotia government EA website at www.gov.ns.ca/enla/ess/ea. In addition, local media were used for notification purposes as discussed in earlier sections.

TABLE 3.3-2 Provincial EA Process and Milestone Dates Related to Public Consultation

Date	Milestone
January 12, 2005	Registration Document for Class II Undertaking
January 2005	Notice of Registration of Class II Undertaking and Preparation of Terms of Reference for EA Pursuant to the *Nova Scotia Environment Act*
April 8, 2005	Terms of Reference As Required by the *Environment Act* For Preparation of an Environmental Assessment Report
June 20, 2006	Project Status Update - notice of intention to exclude the construction of a 54km 2 lane highway from the Project.
August 2006	Release of EA Report Notice of the Minister of Environment and Labour's receipt of the EA Report from Keltic Petrochemicals and invitation for written comments on or before October 30, 2006.
October 20, 2006	Notice of Hearing
November 14, 2006	Notice of Revised Hearing Dates
November 20-25, 2006	Public Hearings in Guysborough, Sherbrooke, and Antigonish.
December 7, 2006	Notice of request for extension from the Nova Scotia Environmental Assessment Board (NSEAB) being granted, with a new deadline of February 21, 2007.
February 21, 2007	Completion of NSEAB's review and submission to the Minister of Environment and Labour.
March 14, 2007	Notice of Ministers Decision: Approval of LNG and Petrochemicals Facility Project subject to terms and conditions.

3.3.4 Consultation Summary

As part of the EA process, the Proponent has implemented a consultation program. The consultation activities undertaken involved various activities including numerous public meetings, open house events, and meetings with a number of interest groups. The key issues raised during the consultation process encompassed a wide variety of socio- cultural, economic, and environmental topics, such as quality of life, human health and safety, commercial fisheries, marine safety, and road transportation. A summary listing of topics addressed during the process is provided in Section 3.2.2.1. Additional information on concerns raised during the consultation activities is provided in Appendix 4, Tables 4-1 to 4-3. The input received from the general public, stakeholders, and interest groups has been incorporated into the provincial EA Report and this federal CSR document where appropriate.

First Nation communities, and Federal and provincial authorities also provided comments on the Project proposal and the EA process. These are addressed in Section 3.4 and 3.5 respectively.

3.4 FIRST NATION ENGAGEMENT

Communication and engagement with First Nation's groups is on-going and has involved:

- communication with relevant government agencies (INAC, Nova Scotia Department of Aboriginal Affairs);
- meetings with representatives of the Native Council of Nova Scotia;
- a Mi'kmaq Ecological Knowledge (MEK) Study; and
- communication with representatives of the Assembly of Nova Scotia Mi'kmaq Chiefs.

3.4.1 RA Engagement with First Nations

On August 30, 2004, the Agency distributed the Keltic Project description to INAC who reviewed the document and advised the agency that they were not likely to require an EA (as outlined in Section 3.1, CSR).

On September 13, 2006, CEAA mailed out notifications on of the federal EA (i.e., the CSR) and the availability of the provincial EA Report for public review and comment to:

- Nova Scotia First Nation communities;
- the Union of Nova Scotia Indians;
- the Confederacy of Mainland Mi'kmaq; and
- the Mi'kmaq Environmental Resources Development Secretariat at the Native Council of Nova Scotia.

3.4.2 Engagement with First Nations by the Proponent and the Provincial Government

3.4.2.1 Initial Communication, Engagement, Meetings

In January 2005, the provincial government distributed the Registration Document to the Nova Scotia Department of Aboriginal Affairs for their consideration. In April 2006, a draft provincial Environmental Impact Statement was distributed by NSEL to a number of provincial government departments including the Nova Scotia Department of Aboriginal Affairs for their review and comment (see comments/responses provided in Section 3.5).

Additionally, in February 2005, Keltic met with Mr. Roger Hunka and Mr. Tim Martin, who are members of the Native Council of Nova Scotia, to discuss the Project.

3.4.2.2 Mi'kmaq Ecological Knowledge (MEK) Study

To further determine potential interactions of the Project with past and present aboriginal land use, a MEK Study was conducted. Keltic engaged Membertou Geomatics to conduct an MEK Study in the summer and fall of 2005. The purpose of the study was to identify Mi'kmaq land and resource use activities that have been or continue to be pursued by Mi'kmaq in the geographical areas being considered for Project development activities. The study included consultation with First Nation community members and considered surrounding lands within a 10 km radius.

The MEK Study consisted of three major components:

- historical review regarding past Mi'kmaq occupation and use of the area in question;
- assessment of Mi'kmaq traditional land and resource use activities, both past and present; and
- analysis of Mi'kmaq significance species considering the resources that are important to Mi'kmaq use.

The study found that Mi'kmaq continue to undertake traditional activities throughout the Study Area. While some of the reported hunting and fishing areas will be impacted by the construction of the LNG Terminal, most of the areas that will be affected are smaller hunting areas that either encompass large areas of land, or are located throughout areas of the various waterways. The construction activities will only take place on portions of the identified hunting areas and should result in minimal impacts to the land and resources. As well, the data gathered regarding the various resources which are harvested by Mi'kmaq found that although these resources play an important role to Mi'kmaq, the high majority of them are found in other areas either within the Study Area, or in other areas of Nova Scotia.

During the hearings for the Nova Scotia EA process, the Confederacy of Mainland Mi'kmaq provided comments to the Nova Scotia EA Board on the limitations to the completed MEKS. As a condition of the Nova Scotia EA Approval the proponent is required to comply with the following two conditions:

- Prior to construction, the Proponent shall develop a Mi'kmaq Communication Plan for the Project which will include but not be limited to:
    - Processes for communicating Project details and seeking input from the Mi'kmaq community.
    - Plans for Mi'kmaq involvement in environmental effects monitoring (EEM) and other Project aspects. The plan shall be developed in cooperation with the Mi'kmaq Community.
- Prior to application(s) for Part V Approval under the *Environment Act*, the Proponent shall take steps to further assess traditional Mi'kmaq use of the Project site lands. The Proponent shall develop the proposed steps in cooperation with the Mi'kmaq Community and shall submit the results to NSEL.

3.4.2.3 Communication and Engagement with Assembly of Nova Scotia Mi'kmaq Chiefs

In October 2006, Keltic was sent a copy of a letter written to the provincial Environmental Assessment Board from Chiefs Lawrence and Terrence Paul, Co-Chairs of the Assembly of Nova Scotia Mi'kmaq Chiefs regarding a unanimous resolution that was passed by their organization to "call upon the Crowns in the right of Nova Scotia and Canada to consult with the Mi'kmaq about the proposed Liquid Natural Gas Project proposed by Keltic."

Keltic responded with a letter dated November 6, 2006, to the Honourable Jim Prentice, Minister of Indian Affairs and Northern Affairs and The Honourable Michael Baker, Q.C., provincial minister responsible for Aboriginal Affairs and copied to Chiefs Lawrence and Terrence Paul. In that letter, Keltic advised the Ministers of the importance of the matters raised by the Assembly and offered to participate in and support any process they deemed necessary to satisfactorily resolve outstanding issues. Keltic asked the Ministers for information on how they plan to move forward. On December 13, 2006, a response was received from the Honourable Jim Prentice advising Keltic that TC and DFO have been identified as the RA in Canada's EA of this Project.

During the provincial EA hearings, representatives from the Assembly of Nova Scotia Mi'kmaq Chiefs made a presentation to the Provincial EA Board. During this presentation, they acknowledged the receipt of Keltic's letter and were encouraged by Keltic's willingness to meet. They further requested consultation with the Crown in the right of Nova Scotia and Canada to consult with the Mi'kmaq about Keltic's proposed Project. In December 2006, the RAs sent a letter to the 13 Nova Scotia Mi'kmaq Chiefs and Councils and the Native Council of Nova Scotia inviting them to discuss the Project and how they would like to consult on any potential impacts.

3.4.2.4 Continued Communication and Engagement with First Nations by the Proponent

The Terms and Conditions for the Environmental Assessment Approval (NSEL March 14, 2007) that were established by the Nova Scotia Minister of the Department for Environment and Labour include terms and conditions for the Proponent to engage with the Mi'kmaq community prior to construction. In particular, this requires the development of a Mi'kmaq Communication Plan, which will include but not be limited to:

- Processes for communicating Project details and seeking input from the Mi'kmaq community.
- Plans for Mi'kmaq involvement in EEM and other Project aspects. The plan shall be developed in cooperation with the Mi'kmaq community.

Further, in accordance with the terms and conditions, Keltic will take steps to further assess traditional Mi'kmaq use of the Project lands and will develop a proposal for steps to cooperate with the Mi'kmaq community. The results of this will be submitted to NSEL. Also, an archaeology and heritage resources monitoring and contingency plan will be developed in consultation with, Mi'kmaq and other stakeholders.

3.5 CONSULTATION WITH EXPERT FEDERAL AND PROVINCIAL DEPARTMENTS

3.5.1 Consultation with Expert Federal Departments

As discussed in Section 3.1, five federal agencies indicated that they have specialist or expert information relevant to the Project:

- EC;
- DFO;
- Health Canada;
- NRCan; and
- TC.

The above agencies and CEAA reviewed the Provincial EA Report and provided comments and questions. The input received from the agencies was documented in Table 3.5-1 together with the review comments received from the provincial agencies. All questions and comments were reviewed and responses provided. Where applicable, the CSR was generated to reflect the input provided.

3.5.2 Comments by Federal and Provincial Authorities on the Provincial EA

Similarly to the federal agency review of the Provincial EA Report, provincial agencies with an interest in the EA reviewed the document, formulated questions, and provided comments. Input was received from:

- NSEL;
- Nova Scotia Department of Tourism, Culture, and Heritage;
- NSDNR;
- Nova Scotia Department of Agriculture, Fisheries, and Aquaculture (NSDAF); and
- Nova Scotia Health Promotion and Protection.

Table 3.5-1 summarizes the input received together with a reference to the corresponding sections of the CSR that discuss the issues addressed in the review comments. Comments were incorporated into the final version of the Provincial EA Report where applicable and feasible.

TABLE 3.5-1 Input Received from Federal and Provincial Governments on the Provincial EA Report

Category	Topics Raised	Addressed in CSR Section
Project Description: Construction	• Duration	2.2.5
Project Description: Written Report	• Suggested mitigation	5.0
	• Eco-efficiency	2.2.4.6/ 2.4.1.3/ 2.4.2.2
	• Cumulative Effects	8.0
	• Meteorological and climatological effects on Project	5.0 and 9.0
	• VEC concerns	2.5, 3.0 and section 5.0
	• Errors in legislation	1.0
	• Many section descriptions outside federal scope	Throughout CSR
	• Needs objectivity	Throughout CSR
	• Format changes	Throughout CSR
	• RA input	Throughout CSR
	• Specify habitat impacts to each source in Project	5.0
Additional Documents Requests	• EMP	2.1/ 2.2.4.1/ 2.2.4.2
	• EPP	2.2.4.2/ 2.2.4.1
	• EMS	2.2.4.5
	• FEED	2.1.1/ 2.2/ 2.2.2.2/ 2.2.5/ 2.2.6.3/2.2.6.4
Alternatives to the Project	• Extent of consideration of alternatives	2.0
	• Written Format	2.4/ 2.4.2
Land Use	• Licenses, easements and permits for Construction of facilities and Highway 316	2.2.3
	• Habitat displacement (mapping requested)	5.1.10/5.1.12.2/ 5.1.14.1/ 5.2.10/5.2.12/5.2.13/5.2.14.3
Population, Economic Conditions, Employment, Tourism	• Age of educational attainment statistics	
	• Training requirements and institutions	Sections 2.2.4.2/2.2.4.5/
	• Employment opportunities to Guysborough residents	Sections 2.4.1 and 7.0
	• Inconsistencies between training and construction duration	2.2.4.5
	• Number employed per phase	
	• Impacts to property values	2.5.2.3/ 3.232.2
Fisheries, Aquaculture, and Harvesting	• Impact of mercury tailings disturbance to recreational fisheries	4.2.2.1
	• Compensation to fishermen (earnings)	5.1.23/5.2.10.2
	• Invertebrates harvesting	5.1.2.3/ 5.2.2.3/ 5.3.2.3
Human Health & Safety	• Mercury tailings disturbance and management	Throughout section 5.0

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Category	Topics Raised	Addressed in CSR Section
Air Quality and Climate	• Emissions characterization and monitoring • Ambient air quality • Emissions from vehicles and cargo ships • Effects of emissions on surface waters • Legislation • Dust • Odour • Mercury tailings disturbance (volatization)	5.1.2.2/ 5.1.6.1, 7.2.1 4.1.6/ 7.2.1/ 5.3.6.3 5.1.6.1 2.2.4.3/ 6.1.6 2..2.3/ 8.2.1.6 5.1.6/5.1.22.1/ 7.2..1 7.2.1.2 5.1.22.1/ Table 5.1-8/ 7.2.5
Noise	• Frequency, Duration, Limits • Guidelines • Cumulative effects • Monitoring • Receptors	4.2.6/ 5.1.11.1/ 5.1.11.2/ 5.1.12.2/ 8.2.1.16/ 8.4.1.13 6.0 8.0 2.0, 7.0 5.1.16
Light	• Effects of sky-glow to human health • Flare stacks and aviation safety • Impacts to birds • Monitoring and mitigation	8.2.1.15 8.2.1.15 6.1.14 7.2.2/ 7.2.2.1/ 8.2.1.15, Table 8.2-10
Chemicals	• Inventory of imported, stored and produced chemicals • Containment concerns • Dangerous goods • Federal identifications and recognitions	2.0 2.0/ 5.0/ 6.0 Table 1.3-1/ 2.2-2 1.0/2.0
Solid Waste Management	• Characterization • Potential impacts	2.2.5.1/ 2.2.6.6 5.1.22
Surface Water	• Mercury characterization and monitoring in sediments and waters • Mitigation and protection • Fisheries resources • Acid leaching from rocks • Blasting impacts • Flow peaks	5.1.5.1 / 5.1.22.1 / 5.2.5.1 5.1.1.2 / 5.1.2.2 5.1.23 / 5.2.10.1 / 5.2.23 5.1.2.2 / 5.1.3.1 / 5.1.5.1 / 5.1.5.2 5.1.3.1 / 5.1.3.2 / 5.1.3.4 5.1.12 / 5.1.1.3 / 5.1.2.3

Category	Topics Raised	Addressed in CSR Section
Groundwater	• Mitigation and protection	5.1.3.2
	• Awareness of nearby resident well-owners	5.1.3.4 / 5.1.3.2
	• Contingency plans	5.1.3.4
	• Guidelines	5.1.3.2
	• Lab analysis	5.1.3.2 / 5.1.3.4
	• Temporary on-site water use approval	5.1.3.4
Geology, Soil	• Soil and marine sediments survey	5.1.5.2 / 5.1.10.1 / 5.2.10.1
	• Soil and sediments pollution	5.1.5 / 5.2.5 / 5.3.5
	• Underlying rock groups	5.1.10.1 / 5.2.10.1
Watercourses	• Existing uses	4.2.2.2 / 4.2.3.3 / 4.3.8.1 / 4.3.8.2
	• Crossings and alterations permits	5.1.10.4 / 5.2.10.4
	• Mapping	4.1.2 / 4.1.1.1 / 4.2.2.1
	• Protection	5.1.2.2
Freshwater Aquatic Species and Habitat	• Mercury characterization and monitoring in waters and sediments	5.1.5.1 / 5.1.22.1 / 5.2.5.1
	• Risk assessment of mercury exposure to fish	4.1.2 / 4.1.4 / 4.1.5.2 / 4.2.2.1
	• Maps of nearby mercury exceedances	Not available
	• Pond habitat loss	5.1.10.1 / 5.2.10.1
	• Maintenance stream flows	5.1.1.1 / 5.1.1.4 / 5.1.2.2 / 5.1.2.4 / 5.1.3.1 / 5.1.14.2
	• Wetland habitat loss	5.1.14.1 / 5.2.14.1
	• Wetland protection and mitigation measures	5.1.14.2 / 5.2.14.2
Effluent Management	• Characterization and monitoring	5.1.2.1 / 5.1.14.2
	• Treatment	5.1.2.2
	• Disposal location	5.1.2.2
	• Impacts to fish	Outside scope of CSR
	• Cooling water and hydrostatic test water releases	5.1.2.2
	• Protection of facilities access from birds	Outside scope of CSR
Marine Use	• Public right of navigation assessment	TERMPOL
	• NWPA	2.0
	• TERMPOL	5.1.9.2 / 5.2.20.2 / 5.2.21 / 5.3.9.1 / 5.3.21
	• Meteorological and climatological impacts on navigation	5.3.9.1
	• Wave propagation and shoreline impacts	4.2.2.1
	• Seabed characteristics	4.2.2.1
	• Fuel tanks	5.1.3.4
	• Permit for infilling during wharf construction	5.2.14.2
	• Disposal at sea permits if dredging becomes necessary	will be addressed through permitting if required

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Category	Topics Raised	Addressed in CSR Section
Marine Species and Habitat	• Compensation plan for wharf infill and construction impacts	5.2.14.2 / 5.2.10.1/Appendix 5
	• Habitat loss	5.1.10 / 5.1.23.1 / 5.2.10
	• Effects of wharf construction on siltation, erosion, aquaculture and migration	5.2.10.1 / 5.2.24
	• Time of year construction will occur	2.2.5
	• Benthic studies	4.2.2.1
	• Shoreline stabilization	5.1.10.4 / 5.2.10.4 / 5.2.19.2
	• Impacts of disturbing contaminated marine sediment	5.2.8.2 / 5.2.5 / 5.2.8
	• Biota analyses	5.1.10 / 5.1.11 / 5.2.10 / 5.2.11 5.3.10 / 5.3.11
Birds and Wildlife	• Data collection methods of wildlife and bird surveys	4.2.3.3 / 4.2.3.4
	• Mitigation and protection	5.1.9.2 / 5.1.13.2 / 5.2.9.2 / 5.2.13.2 / 5.3.9.2 / 5.3.13.2
	• Previous survey reports	4.2.3.3 / 4.2.3.4
	• Abundance and fecundity	4.2.3.3
	• Distance of known colonies from Project Area	5.3.9.1
	• Breeding season disturbances	5.2.16 / 5.1.12.1 / 5.1.13.1
	• Sensitive bird habitat disturbances	5.3.9.1 / 5.1.9.1
	• Migratory birds	5.1.9 / 5.1.13 / 5.2.9 / 5.2.13 / 5.3.9 / 5.3.13
	• Habitat restoration and relocation	5.1.9.4 / 5.1.10.2 / 5.2.8.4 / 5.2.10.2
	• SARA	4.2.5 / 5.1.9
	• Cumulative Effects with nearby Project Areas	8.0
	• Species mentioned include deer, Rusty Blackbird, Northern Commandra, Blue Heron, Roseate Terns, Greater Yellowlegs, Common Loon, Short-eared Owl, and Wood Turtle.	4.2.3 / 4.2.5 / 5.1.12 / 5.1.13 / 5.2.9 / 5.2.12 5.2.13 / 5.3.9 / 5.3.13
Vegetation	• Rare species	4.1/ 4.2.4/ Table 4.2-13, 4.2.5.3
	• Surveys and monitoring	4.2.5/ 7.2.6.2
	• Effects of air emissions on boreal felt lichen	5.1.9.1/ 6.1.8/ Table 6.1-8
	• Species at risk area	4.2.5/ 6.1.8/ 8.2.1.8/ 8.3.1.9
	• Field expertise	1/4.1
	• Area loss	5.1.8
	• Invasive species avoidance during reclamation	5.1.14.1/ 5.1.14.2

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Category	Topics Raised	Addressed in CSR Section
Accidents & Malfunctions: Spill Control	• Spill control plan, including equipment and employee training • Well monitoring • Protection of birds • Environmental Contingency Plan • Clean-up and disposal procedures • LNG release modelling	10.1.1.3/ 10.1.1.4 6.0/ Table 6.1-3 7.0 10.1.1.5 10.1.1.5 10.1.1.2
Accidents & Malfunctions: Other	• Deluge system • Extreme weather and climate change • Containment • Seismic activity • Power failure • Port and Marine Safety	5.0/ 10.0 9.0/ 9.2.7 10.1.1.1 9.0/ 9.2.2 Table 2.5-1/ 6.0/ 6.2.16/ 6.3.10
Public Consultation	• Responses in public meetings • Table of Public Consultation • Fishermen: Awareness of impacts and compensation	3.1/3.3.2/3.5 Tables 3.2-1/ 3.2-2/Appendix 4 3.3.2/ 5.0/ 5.2.23.1
First Nation Consultation	• Method of consultation • Impacts on aboriginal land use • Mitigations concerning artifact discovery	3.4 3.4.2 6.0/ Tables 6.1.6/6.1-18/ 6.2-14
Report Editorials	• Specific text re-writes • Rename Section Heading • Areas with Redundancy • Errors in Tables • Info irrelevant to Federal Scope or CEAA • Requested Text Deletions • Info in wrong section of report or wrong context • Typos • Incorrect References present	Throughout CSR Report

4.0 DESCRIPTION OF THE EXISTING ENVIRONMENT

4.1 DESCRIPTION OF THE BIOPHYSICAL ENVIRONMENT

Information provided in this section was derived from the broader biophysical description provided in Keltic's provincial EA (NSEL Environmental Assessment Branch website (http://www.gov.ns.ca/enla/ea/kelticpetro.asp) and studies conducted for other developments within the proposed project site (i.e., SOEP, and Deep Panuke Offshore Gas Development Project). Figure 4.1-1 depicts the interrelation of the Deep Panuke Study Area and this Project's Study Area.

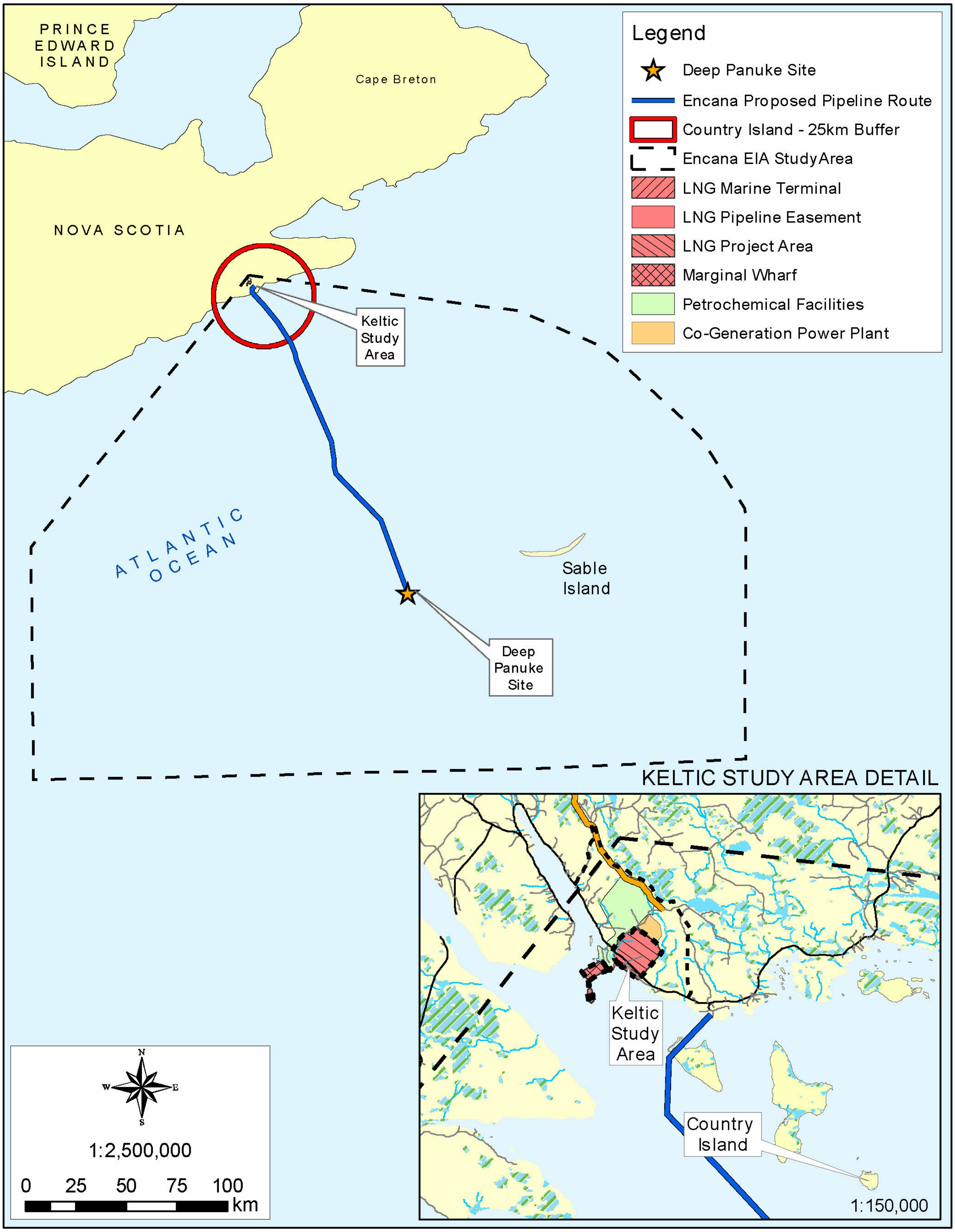
This section focuses, to the extent possible, on the elements of the Project within the scope of this CSR namely the LNG Facilities; the marginal wharf; and marine environment within 25 km of Country Island. Some of the data is more sub-regional in scope and applies to the complete Project including the LNG facilities and marginal wharf. Where this is the case it is noted accordingly. Information in this section is a synthesis of the results of approximately two years of field data collection; observations; and research with special attention being paid to the possible presence of rare or otherwise unique species, populations, and assemblages. Data collection and research was conducted by discipline specialists, who in addition to their own knowledge of their respective fields, also relied on others with specific expertise and local knowledge. These experts included:

- Mark Pulsifer, Regional Biologist, NSDNR, Antigonish;
- Randy Lauff, Dr. Barry Taylor, and Dr. Norman Seymour, St. Francis Xavier University, Antigonish;
- Dr. Graham Forbes, University of New Brunswick;
- Andrew Boyne, Canadian Wildlife Service (CWS), Dartmouth;
- Dr. Hugh Broders, St. Mary's University;
- Dr. Alan Hanson, CWS, Sackville, New Brunswick;
- Andrew Hebda, Alex Wilson, and John Gilhen, Nova Scotia Museum of Natural History (NSMNH), Halifax;
- Richard Hatch and Fulton Lavender, knowledgeable birders and naturalists in general, Halifax;
- Richard Morash, NSDNR Resources, Truro; and
- Frank Manthorne, Joey Manthorne, and Brian Fanning, knowledgeable and observant local residents of Seal Harbour and Drum Head.

Specific citations have been made at appropriate places in the following text.

4.1.1 Hydrology

The proposed Keltic Project will require approximately 1,200 m^3/hr of water to operate the plants. This water will be supplied from surrounding three main watersheds and associated sub-watersheds.



amec

June 2007
Drawn by S. Turner
Projection: NAD83 CSRS UTM Zone 20N
Job No.: TV61029

Figure 4.1-1
KELTIC PETROCHEMICALS INC.
Keltic Study Area in Relation to the Deep Panuke Study Area
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Hydrological studies were originally conducted for the purpose of the Provincial EA Report (AMEC, 2006) and included all Project components as well as the petrochemical and co-generation facilities. Therefore the information presented below provides some reference to all watersheds when applicable to the entire KDP but attempts to focus on the coastal watershed (1EP-SD1 and 1EQ-SD32) as it pertains to the LNG Facility (Figure 4.1-2).

Table 4.1-1 presents a summary of basic known and assumed water uses for these waterbodies. In addition to the natural waterbodies listed in Table 4.1-1, within the marginal wharf area, the second pond south of the lane way to the existing home on the peninsula is a dug pond that was once utilized by cattle.

TABLE 4.1-1 Known, Assumed, and Possible Water Uses of Waterbodies in the Project Area

Water Body	Past Uses						Current Uses					
	Commercial Fishing	Recreational Fishing	Other Recreation	Mining	Drinking Supply	Industrial (Other)	Commercial Fishing	Recreational Fishing	Other Recreation	Mining	Drinking Supply	Industrial (Other)
Dung Cove		x		x				x				
Red Head Ponds												
Betty's Cove Brook		x						x				
Unnamed tributary to Dung Cove				x		x						

Note: Industrial (other) implies use for logging or as energy to run small mills.

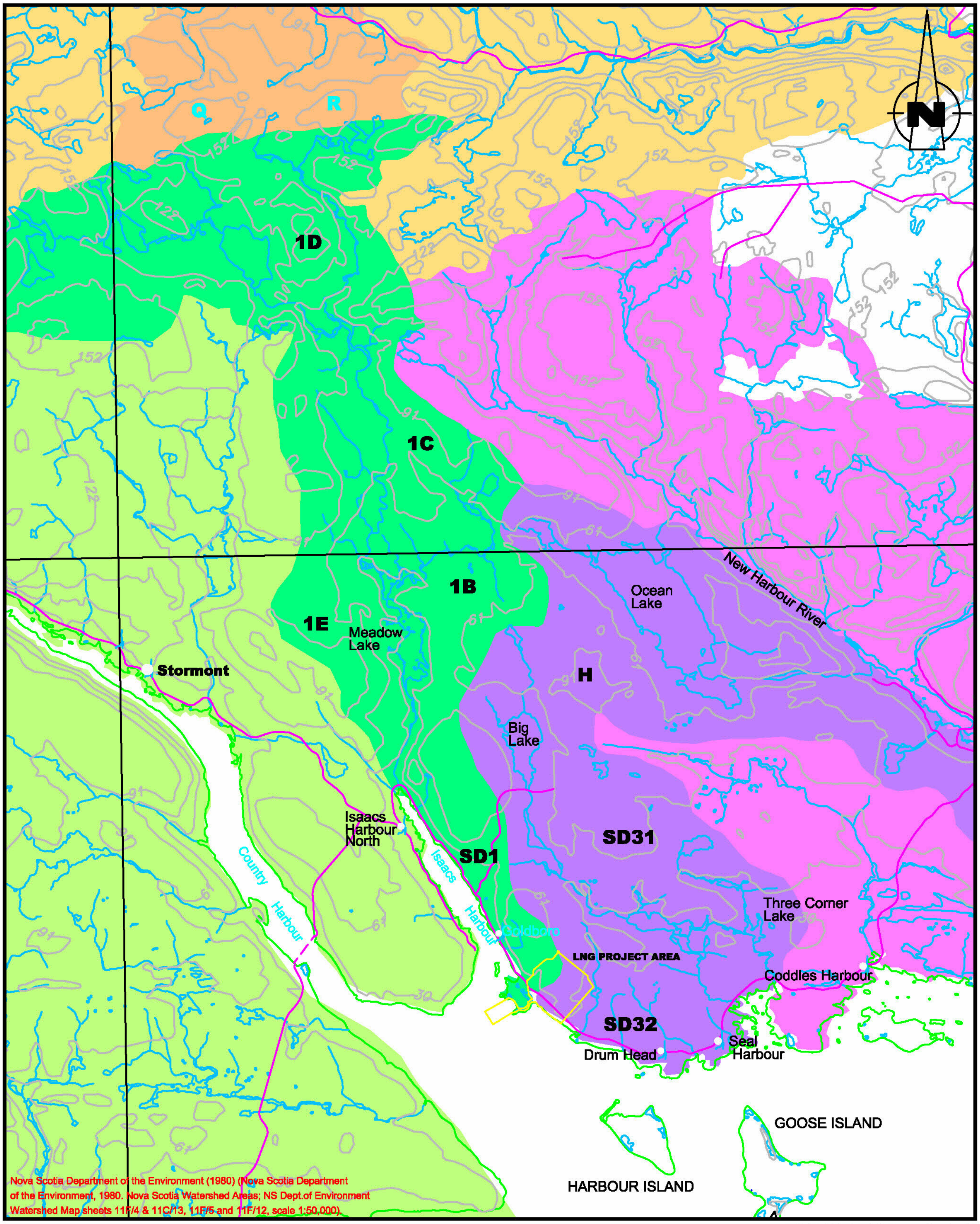
4.1.1.1 Stream Flow Data

The nearest two established hydrological stations on the Eastern Shore are on Little Sackville River in Middle Sackville, and on St. Mary's River at Stillwater. Rain gauges were installed in Goldboro and at Salmon River Lake and four hydrometric stations (GB1, GB2, GB3, and ML1) were installed at the locations shown in Figure 4.1-3. Data was collected for a period of 20 months from October 1, 2001 to May 23, 2003. A description of the data, corrections applied, station calibration and other details of the hydrologic assessments of the Gold Brook sub-watershed are provided in Appendix 3 of the Provincial EA Report (AMEC, 2006).

Stream-flow data collected from the study-area hydrometric stations is presented in Tables 4.1-2 to 4.1-6.

TABLE 4.1-2 Statistics of 2002 Flows (m^3/hr) for ML1, GB1, and GB2

Station	Total Outflow	Mean	Mode	Minimum	25th Percentile	Median	75th Percentile	Maximum
ML1	118,752,483	13,895	11,033	156	3,262	10,286	20,176	79,755
GB1	3,712,699	424	196	37	187	279	490	10,445
GB2	23,098,767	2,637	1,139	216	1,177	2,136	3,258	10,850



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Road

River/Streams

Contours

1EQ–1

1EP

1EQ–4

LNG Project Area

FIGURE No. 4.1-2

KELTIC PETROCHEMICALS INC.

KELTIC STUDY AREA WATERSHEDS

JUNE 2007

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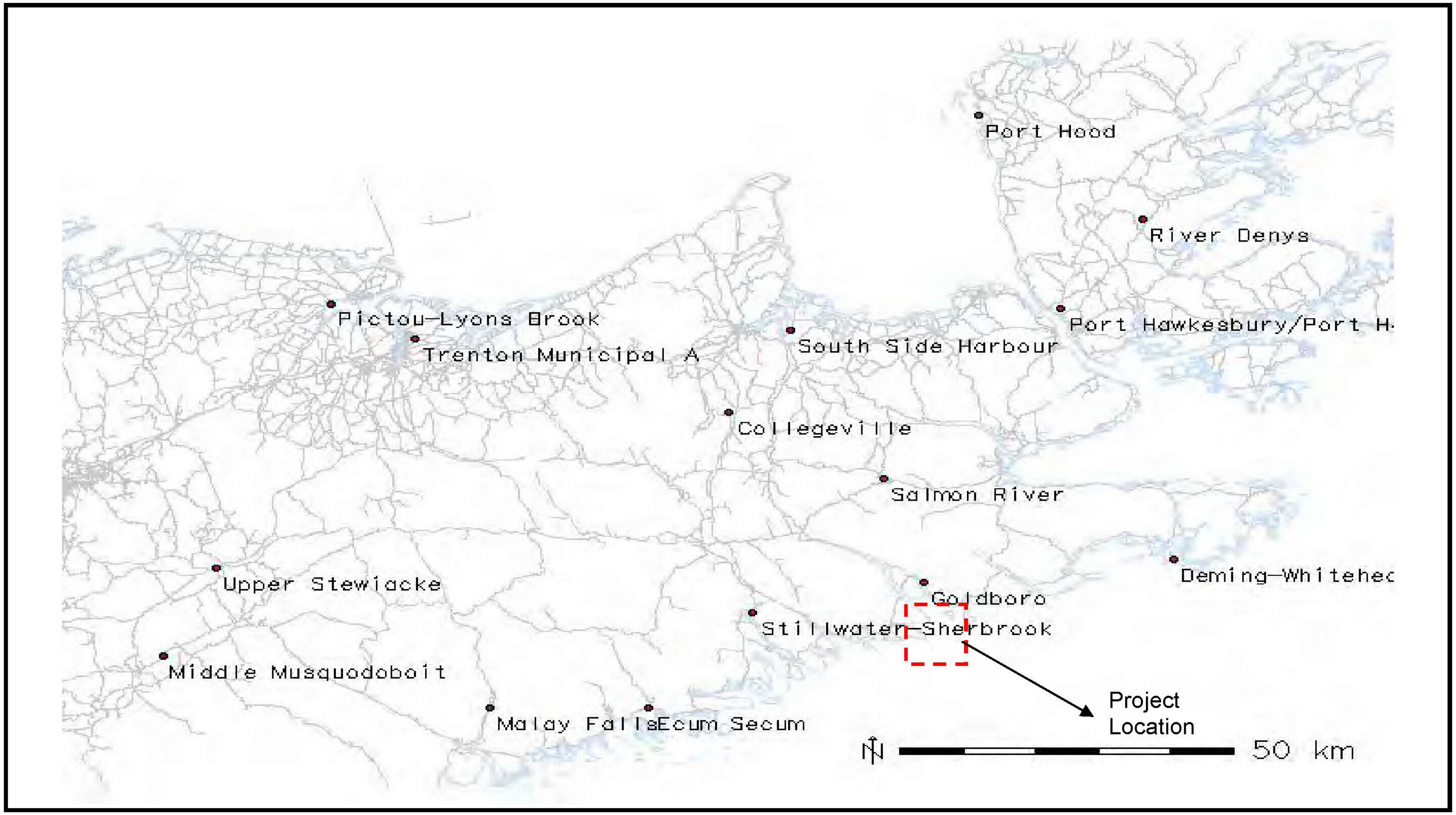

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FIGURE 4.1-3
KELTIC PETROCHEMICALS INC.
LOCATION OF THE STUDY RAIN GAUGES AND ENVIRONMENT CANADA CLIMATE STATIONS
JUNE 2007
Source: ewC (2005)

TABLE 4.1-3 Monthly Summary Statistics of Flow Values for ML1, October 2001 to May 2003 (m^3/hr)

Month	Mean	Mode	Minimum	Median	Maximum
October 2001	2,038	295	233	1,285	12,075
November 2001	4,274	917	698	3,508	13,961
December 2001	11,445	10,189	1,597	10,078	34,043
January 2002	14,117	16,291	2,475	12,907	45,360
February 2002	16,550	3,679	2,651	18,455	54,126
March 2002	32,783	18,123	9,167	34,171	79,755
April 2002	27,282	20,736	8,401	23,348	64,959
May 2002	13,473	11,406	3,174	12,152	30,812
June 2002	1,353	552	156	1,027	4,582
July 2002	3,905	2,533	1,225	2,683	12,899
August 2002	5,297	1,027	705	1,601	34,357
September 2002	3,560	3,537	323	2,840	13,272
October 2002	11,588	5,575	2,461	9,540	36,783
November 2002	26,021	11,033	6,724	19,430	61,414
December 2002	16,572	7,868	5,443	15,511	37,529
January 2003	6,699	6,129	2,320	4,817	25,401
February 2003	20,274	5,575	4,817	17,004	56,562
March 2003	15,708	12,899	3,632	12,152	78,394
April 2003	20,746	5,575	3,352	10,846	65,705
May 2003	11,186	12,152	1,357	12,339	27,640

TABLE 4.1-4 Monthly Summary Statistics of Flow Values (m^3/hr) for GB1 (October 2001 to May 2003)

Month	Mean	Mode	Minimum	Median	Maximum
October 2001	278	235	132	235	1,195
November 2001	383	302	246	315	913
December 2001	452	235	215	368	1,531
January 2002	528	235	215	441	2,238
February 2002	836	279	246	490	10,445
March 2002	638	279	37	382	5,887
April 2002	607	659	179	474	4,710
May 2002	362	215	187	302	790
June 2002	253	162	126	215	701
July 2002	261	196	106	225	618
August 2002	173	126	50	119	1,164
September 2002	179	50	43	126	723
October 2002	330	154	119	225	2,192
November 2002	640	279	162	382	4,867
December 2002	320	196	154	235	1,019
January 2003	239	179	95	162	1,226
February 2003	578	279	132	327	3,637
March 2003	560	196	89	246	6,839
April 2003	149	79	46	119	1,047
May 2003	111	65	22	106	279

TABLE 4.1-5 Monthly Summary Statistics of Flow Values (m^3/hr) for GB2 (October 2001 to May 2003)

Month	Mean	Mode	Minimum	Median	Maximum
October 2001	704	283	260	604	1,745
November 2001	1,009	566	530	943	1,769
December 2001	1,752	2,164	656	1,672	4,113
January 2002	2,168	2,000	740	1,895	5,427
February 2002	2,345	994	784	2,404	6,610
March 2002	5,161	6,873	1,488	5,033	10,324
April 2002	4,119	2,667	1,139	3,456	10,225
May 2002	2,119	1,625	617	1,895	4,770
June 2002	948	1,065	441	960	2,601
July 2002	2,167	2,277	861	2,164	3,488
August 2002	1,642	579	316	994	6,150
September 2002	1,261	316	216	1,083	3,423
October 2002	2,625	2,000	1,139	2,306	5,657
November 2002	4,609	1,973	1,555	3,390	10,850
December 2002	2,464	1,158	1,065	2,404	4,836
January 2003	1,128	1,236	484	994	3,225
February 2003	3,251	960	799	2,601	9,272
March 2003	2,004	894	670	1,745	11,507
April 2003	4,981	2,930	1,870	3,439	11,934
May 2003	3,283	3,488	815	3,521	5,789

TABLE 4.1-6 Monthly Summary Statistics of Flow Values (m^3/hr) for GB3 (October 2001 to March 2002)

Month	Mean	Mode	Minimum	Median	Maximum
October 2001	1,190	849	481	1,068	3,375
November 2001	1,331	810	771	1,192	2,735
December 2001	2,061	2,185	810	2,033	4,620
January 2002	2,589	2,970	870	2,690	5,385
February 2002	3,785	1,324	1,117	3,875	16,206
March 2002*	5,147	4,053	2,345	4,753	9,339

4.1.1.2 Stream-Flow Amounts Greater than Total Precipitation Catchment

Total monthly precipitation for the period October 2001 to May 2003 for the nearest three EC climate stations located at Collegeville, Deming, and Sherbrooke, and the two study rainfall gauges at Goldboro and Salmon River Lake, are presented in Table 4.1-7.

TABLE 4.1-7 Total Monthly Precipitation (millimetre (mm)) for October 2001 to May 2003

Date	Deming	Sherbrooke	Goldboro	Collegeville	Salmon River
Oct-01	99	53	36	69	-
Nov-01	124	84	89	80	99
Dec-01	118	90	122	64	101
Jan-02	131	102	174	106	94
Feb-02	158	146	148	75	108
Mar-02	179	87	247	78	60
Apr-02	191	62	230	52	-
May-02	100	89	117	55	-
Jun-02	100	71	104	92	14
Jul-02	129	103	-	81	25
Aug-02	104	61	-	44	34

Date	Deming	Sherbrooke	Goldboro	Collegeville	Salmon River
Sep-02	119	123	-	107	5
Oct-02	178	155	67*	127	77*
Nov-02	235	254*	305	150	-
Dec-02	98	101*	93	98	-
Jan-03	144	128	83	40	-
Feb-03	131	206	135	52	40*
Mar-03	88	92	110	131	142
Apr-03	206	127	197	104	102
May-03	96	98	105	79	65

* indicates a month for which the full month of data is not available.

4.1.1.3 Drought and Flood Frequency Forecasting

Drought frequency analyses were performed on total summer (June, July, plus August) precipitation values for the three nearest EC stations (Collegeville, Deming-Whitehead, and Stillwater-Sherbrooke) to determine the limiting factor to the proposed water withdrawal. Results are summarized in Table 4.1-8. Storm frequency analysis for 100, 200, and 500 year storms was done for 24, 48, and 72 hour precipitation events for the EC climate stations at Collegeville, Deming-Whitehead, and Stillwater-Sherbrooke. The EC data used for the Tables in question include, Collegeville: 01 June 1916 to 31 May 2003, Deming-Whitehead: 01 December 1883 to 31 May 2003 and Stillwater-Sherbrooke: 01 December 1915 to 31 May 2003. The data for Deming-Whitehead represents the entire period of record available for the two individual climate stations located at Deming and at Whitehead, the data for these two stations was combined to expand the period of record for the general area of the stations. EC ceased to collect data at one climate station and at roughly the same time began to collect data at the other, with a bit of overlap in the data collection periods between the two stations. Where there was overlap in the data, a simple mean of the data from both stations was employed. This new, greater period of data was used in calculations (R. Gagne pers.comm.., May 2007). The results are summarized in Tables 4.1-9 to 4.1-11. The typical precipitation event to hydrograph peak delays (i.e., storm response times) for the Gold Brook system is shown in Table 4.1-12.

TABLE 4.1-8 Summer (June, July, August) Drought Estimates (mm)

Station Name	50-year	100-year	200-year	500-year
Collegeville	110-115	85-95	65-77	25-55
Deming-Whitehead	100	70-75	37-50	0-15
Stillwater-Sherbrooke	120	85-92	53-70	15-28

TABLE 4.1-9 100-year Storm Events (mm)

Station Name	24-hour Event	48-hour Event	72-hour Event
Collegeville	150-204	176-240	180-250
Deming-Whitehead	135	170	185-188
Stillwater-Sherbrooke	145-150	185-192	208-213

TABLE 4.1-10 200- year Storm Events (mm)

Station Name	24-hour Event	48-hour Event	72-hour Event
Collegeville	164-212	186-258	196-270
Deming-Whitehead	138-142	179-185	194-202
Stillwater-Sherbrooke	155-162	200-210	222-230

TABLE 4.1-11 500-year Storm Events (mm)

Station Name	24-hour Event	48-hour Event	72-hour Event
Collegeville	184-220	204-280	210-300
Deming-Whitehead	144-153	191-204	208-220
Stillwater-Sherbrooke	171-179	220-230	242-251

TABLE 4.1-12 Typical Event-to-Peak Delay (time in hours) between Precipitation Events and Stream-flow Peak on Hydrographs

Station Name	Fall	Winter	Spring	Summer
GB1	6 – 18	24 - 48	6 – 12	6
GB2	48	48 – 72	24 - 36	36 – 48
GB3	18 - 42	24 - 48	24	-

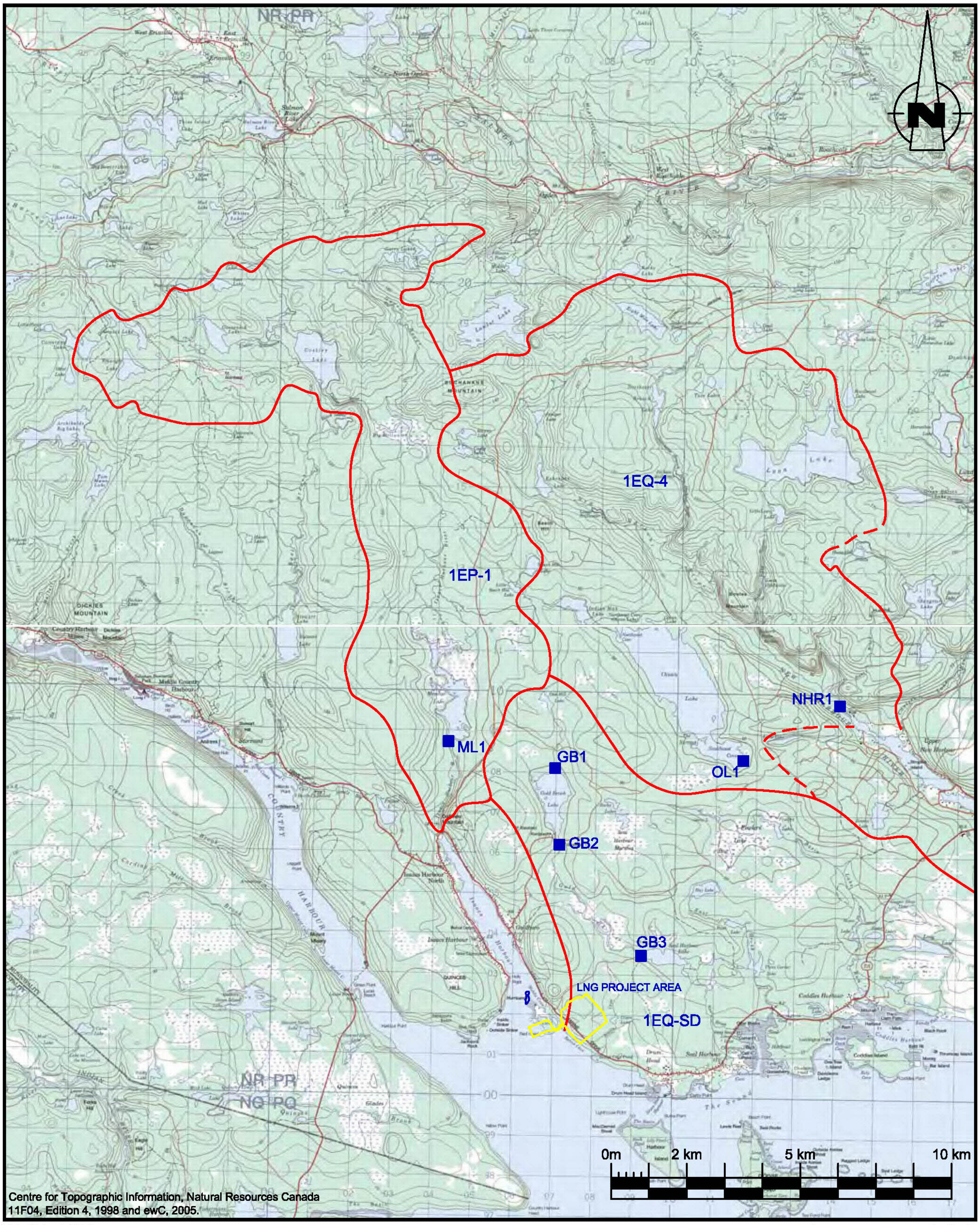
4.1.2 Freshwater Quality

As part of the aquatic-biology surveys completed in the Keltic Project Study Area during 2001, 2004, and 2005, evaluation of selected water quality parameters were undertaken (Figure 4.1-4). In 2005, key aquatic features were again surveyed. Basic water quality parameters measured during these surveys included temperature, dissolved oxygen (DO), pH, conductivity, and salinity where applicable.

Lab analyses included general chemistry, dissolved metals, and, for some samples, mercury. All parameters were determined with the use of a Yellow Springs Instrument 650 Multi Parameter Display System that was calibrated daily with the use of standard and accepted methods. Lab analyses used the following protocol:

- General chemistry samples collected in 200 millilitre (ml) polyethylene bottles with no preservatives.
- Dissolved metals samples field filtered to 0.45 micrometre (µm) using millipore Luer-Lok filters attached to a new (sterile) 60 ml syringe for each water sample. Raw water was used to rinse the syringe twice before attaching the filter. Filtered samples were placed into 50 ml polyethylene bottles, to which nitric acid was added for sample preservation.
- Mercury samples were collected by syringe and then transferred into 100 ml amber glass bottles with Teflon-lined cap; potassium dichromate in nitric acid was added as a preservative before sample collection. Each bottle was filled to zero head space but not allowed to overflow so as to not lose preservative.

Samples were immediately stored in coolers with ice packs until delivery to Maxxam Analytics Inc. in Bedford, Nova Scotia. Maximum sample storage time was seven days. Samples were analyzed using the lab protocol summarized in Table 4.1-13.



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Project Location

GB1 Hydrometric Station Locations

FIGURE No. 4.1-4

KELTIC PETROCHEMICALS INC.

WATERSHEDS STUDIED

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TABLE 4.1-13 Lab Analytical Protocol Used for Surface and Groundwater Sample Analyses

Analysis	Maxxam Laboratory Method	Method Reference
Alkalinity	2015-1-2	Based on EPA* 310.2
Chloride	2045-1-2	Based on SM4500-Cl-
Colour	2156-1-1	Based on EPA 110.2
Conductance – water	1013-1-2	Based on SM2510B
TEH in Water (Atlantic Partnership in Risk-based Corrective Action (RBCA) implementation (PIRI))	9025-1-5	Based on Atl. PIRI
Mercury (Total)	3425-1-2	C V A A
Metals in water ICP-OES	3120-2-1	Based on EPA 200.7
Elements by ICPMS - dissolved (FIAS)	3013-1-1	Based on EPA 6020A
Nitrogen Ammonia - water	2105-1-2	Based on USEPA 350.1
Nitrogen - Nitrate + Nitrite	2115-1-2	Based on EPA 353.1
Nitrogen – Nitrite	2125-1-1	Based on USEPA 354.1
Nitrogen - Nitrate (as N)	SOP 2130-1-1	Based on ASTMD3867
pH	1007-1-1/1011-1-2	Based on USEPA150.1
Phosphorus – ortho	2165-1-1	Based on USEPA 365.1
VPH in Water (PIRI)	9120-1-5	Based on Atlantic PIRI
Reactive Silica	2185-1-1	Based on USEPA 366.0
Sulphate	4065-1-2	Based on USEPA 375.4
Organic Carbon – Total	2020-1-3	Based on SM 5310C
Mod Total Petroleum Hydrocarbons (T1) Calc. for Water	--	Based on Atlantic PIRI
Turbidity	1040-2-4	based on USEPA 180.1
VOCs in Water	9615-1-3	Based on USEPA624

Note: *EPA – Environmental Protection Agency

A summary of water quality results collected during the on-site water sampling surveys is presented in Table 4.1-14. A summary of the lab analytical results is presented in the Provincial EA Report (AMEC 2006).

TABLE 4.1-14 Water Chemistry in Red Head Ponds

Location	Survey Dates	Temperature (°C)	Conductivity μS/cm[1]	Dissolved Oxygen (mg/L[2])	pH	Salinity (ppt[3])
Pond 1	Spring, 2005 0606793 E 5002155 N	19.69	85.0	9.44	6.35	0.04
Pond 2	Spring, 2005 0606799 E 5002068 N	19.32	27.0	8.65	6.14	0.01
Pond 3	Spring, 2005 0606618 E 5001904 N	22.41	2326.0	9.05	7.50	1.20
Pond 4	Spring, 2005 0606814 E 5001577 N	16.59	38880.0	10.03	8.46	24.83
Pond 5	Spring, 2005 0606952 E 5001553 N	18.75	25120.0	9.34	7.43	15.32
Pond 6	Spring, 2005 0606932 E 5001957 N	14.93	75.0	8.36	6.49	0.03

Notes:
1. μS/cm – microseimen per centimetre.
2. mg/L - milligrams per litre.
3. ppt – parts per thousand.

4.1.2.1 Red Head Ponds

Ponds 1, 2, and 6 are fresh-water; Pond 3 is slightly brackish; and Ponds 4 and 5 are saline (Table 4.1-14; Figure 4.1-5). Pond 6 is the only one which has input from a freshwater stream. All parameters in all ponds are within ranges considered normal although pH levels were higher than in other Keltic Study Area waters and were generally close to neutral. All ponds support at least one species of fish.

4.1.2.2 Betty's Cove Brook and Other Surface Samples

All parameters in Betty's Cove Brook and other surface samples were within normal ranges for the area with low values for pH and elevated levels of colour and aluminum.

It should be noted that Betty's Cove Brook originates within a wet forested area north of the proposed Project boundaries. Although the other "surface water" samples summarized in Table 4.1-15 are not "true" spring or stream samples, they are representative of these wet area sources – with general chemistries similar to that from Betty's Cove Brook.

4.1.3 Groundwater Quality/Quantity

Groundwater has a dynamic relationship with surface water, and provides a potable water supply to all of the un-serviced residences adjacent to the proposed Keltic Project Site. Obtaining a proper understanding of groundwater also requires having a clear understanding of the soil and bedrock through which it flows. Soil and sediment quality is discussed in Section 4.1.5 of this report.

A description of the hydrogeology within the LNG Facility Site was documented by conducting:

- a review of all available published maps and reports;
- reconnaissance-level and detailed geologic assessments of the hydrogeologic areas;
- monitoring well installations, slug hydraulic testing and groundwater sampling to help characterize the hydrogeology and to provide baseline groundwater quality data;
- a reconnaissance-level survey of all homes and wells present within 1 km of the proposed Keltic Project Site; and
- a door-to-door well survey with water sampling within 1 km of the proposed Keltic Project Site boundaries to further assess the hydrogeology of the area and to provide baseline information.

Reconnaissance-level geologic assessments of the greater Keltic Project Site were also done by a geoscientist during the periods May 31 to June 6, 2004 and June 24-25, 2004. Due to the industrial nature of the site, more detailed field mapping of specific areas, monitoring well installations, hydraulic testing at those wells, and groundwater sampling were carried out during the period from April 4 to May 3, 2005.

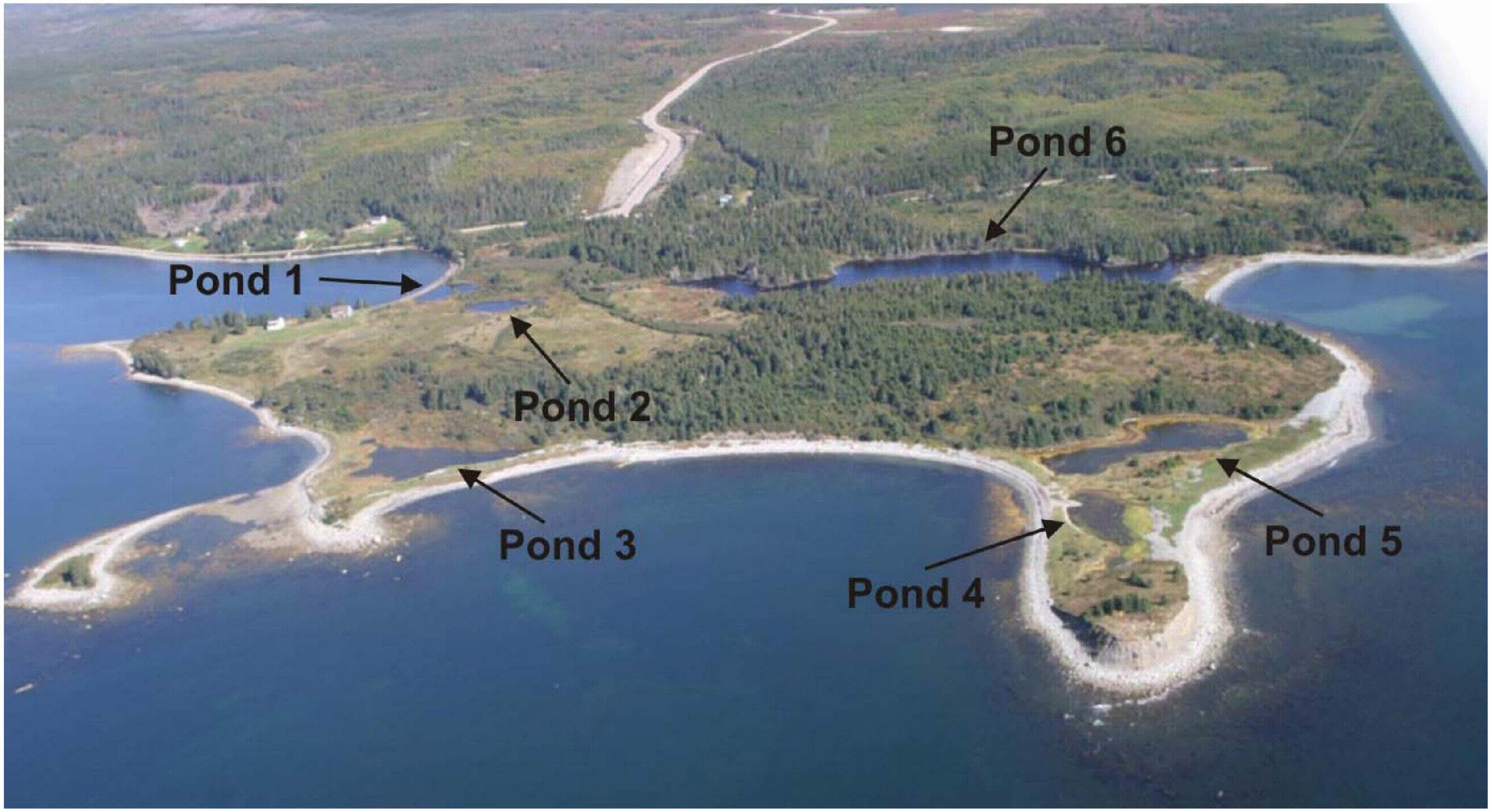

FIGURE 4.1-5
KELTIC PETROCHEMICALS INC.
RED HEAD PENINSULA STUDY AREA
JUNE 2007

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TABLE 4.1-15 Monitoring Well Construction and Development Details

Well I.D.	Depth (m)		Elevation (m)		Well Development	
	To Bedrock	Well Total	Ground Surface	Top of Piezometre	Volume Removed (L)	Number of Casing Volumes
MW05-1a	2.29	17.68	74.73	75.28	1000	31.5
MW05-1b		8.54	74.66	75.18	828	62.5
MW05-2a	17.45	24.31	56.47	56.91	1449	32.0
MW05-2b		11.59	56.46	56.96	1536	79.0
MW05-3a	2.44	17.38	37.44	38.16	1207	38.7
MW05-3b		8.23	37.49	38.21	1173	92.9
MW05-4a	5.49	19.21	35.19	35.66	1035	29.7
MW05-4b		10.08	35.17	35.72	844	51.5
MW05-5a	0	17.68	34.86	35.41	1035	32.6
MW05-5b		8.54	33.30	33.82	862	65.0
MW05-6a	5.49	20.73	16.83	17.43	780 (dry 1x)	20.6
MW05-6b		7.01	16.79	17.25	186 (dry 2x)	18.3
MW05-7a	4.57	20.73	9.37	10.03	138 (dry 2x)	3.6
MW05-7b		11.59	9.24	9.78	855 (dry 2x)	44.0

Well Construction	3 m of 50 mm schedule 40 threaded poly vinyl chloride (PVC) 0.020 slot screen (pointed cap) at the bottom by schedule 40 threaded PVC casing to surface.
Annular Packing Material	No. 2 silica sand to about 1m above the top of screen, followed by 1m of betonies chips, then more sand to surface.
Water used for Drilling	Snow-melt from pools at root-ball of fallen trees, ditches, steams.
Well Protection	100 x 100 mm x 1.24 m lockable steel protectors with brass locks.
Sampling Apparatus	Dedicated 13 mm diametre high-density polyethylene Waterra® tubing with Delrin® foot valves.
Well Development	Soloinst Hydrolift® pump powered by 1 Kilowatt (kW) generator (kept a minimum 10 m downwind) to actuate the Waterra tubing. MW05-7a may have been underdeveloped as only 3.6 casing volumes were recoverable.

4.1.3.1 General Hydrogeology

The physical and general chemical hydrogeology of the various hydrostratigraphic units underlying and within 1 km of the Keltic Project Site in Goldboro are presented below. Reference is made to the NSEL well log database during this review to give insight on typical well depth and yield for each of the hydrostratigraphic units described.

Meguma Group (Halifax and Goldenville Formations)

Due to the lithologic composition and degree of metamorphism, the Goldenville Formation, Halifax Formation, and granitic plutons of the Meguma Group contain no primary permeability so well production from these bedrock units is nearly entirely dependent on fracture flow. Wells drilled into Meguma Group bedrock may be expected to yield anywhere from less than 1 litre per minute (L/min) to as much as 400 L/min, depending on location and fracture frequency, aperture size and interconnectedness. However, well yields in the order of 4 to 18 L/min are more the norm. A search of the NSEL well log database returned the data presented below in Table 4.1-16.

TABLE 4.1-16 Average Well Data (NSEL Well Log Database, Goldenville, and Halifax Formations)

Community	No. of Wells	Average Depth (m)	Average Yield Well (L/min)	Extreme Yields (L/min)	
				Low	High
Country Harbour	31	63	21	1.1	68
Isaac's Harbour	10	57	16.5	2.3	55
Goldboro	8	73	10.5	2.3	23
Drum Head	4	55	3	2.3	4.5

The data returned for the community of Country Harbour included the hamlets of Country Harbour, Middle Country Harbour, Country Harbour Mines, and Cross Roads Country Harbour. Within the Goldenville and Halifax Formations, calcium bicarbonate type waters appear to be most common, but calcium sulphate, calcium chloride and sodium chloride waters are also common. Waters from the Goldenville and Halifax Formations are typically only slightly hard to moderately hard with low to moderate concentrations of total dissolved solids, neutral to slightly acidic pH and low alkalinity. Iron and manganese concentrations often exceed their respective guidelines, arsenic concentrations can at places be elevated, and elevated values for uranium have also been reported.

The granites generally produce calcium bicarbonate type waters, although sodium chloride type waters can be found. The granites generally yield waters that are very soft to only slightly hard, with low pH, low alkalinity and low total dissolved solids. Iron, manganese, and uranium concentrations often exceed their respective guidelines, as can radon.

4.1.3.2 Groundwater Flow Direction

Local and intermediary groundwater flow direction may be controlled by a number of factors, including piezometric or water table hydraulic gradient, hydraulic conductivity, and fracture orientation where there is fracture flow through bedrock or fractured soils. Some often attempt to predict (while assuming a fair degree of accuracy) local groundwater flow direction on the belief that the water table in unconfined aquifers is a subdued replica of the local topography, but that may not always be the case (Haitjema and Mitchell-Bruker, 2005) and so defining groundwater flow direction solely based on surface topography may not be accurate. However, groundwater is expected to follow general relief on a regional or macro-scale.

Notwithstanding the generalities noted above, subsurface assessments were possible on the proposed Project Site and immediate surrounding areas, and the local groundwater flow direction details are understood in that part of the Keltic Project Area. That information is presented in Section 4.1.3.4 of this report.

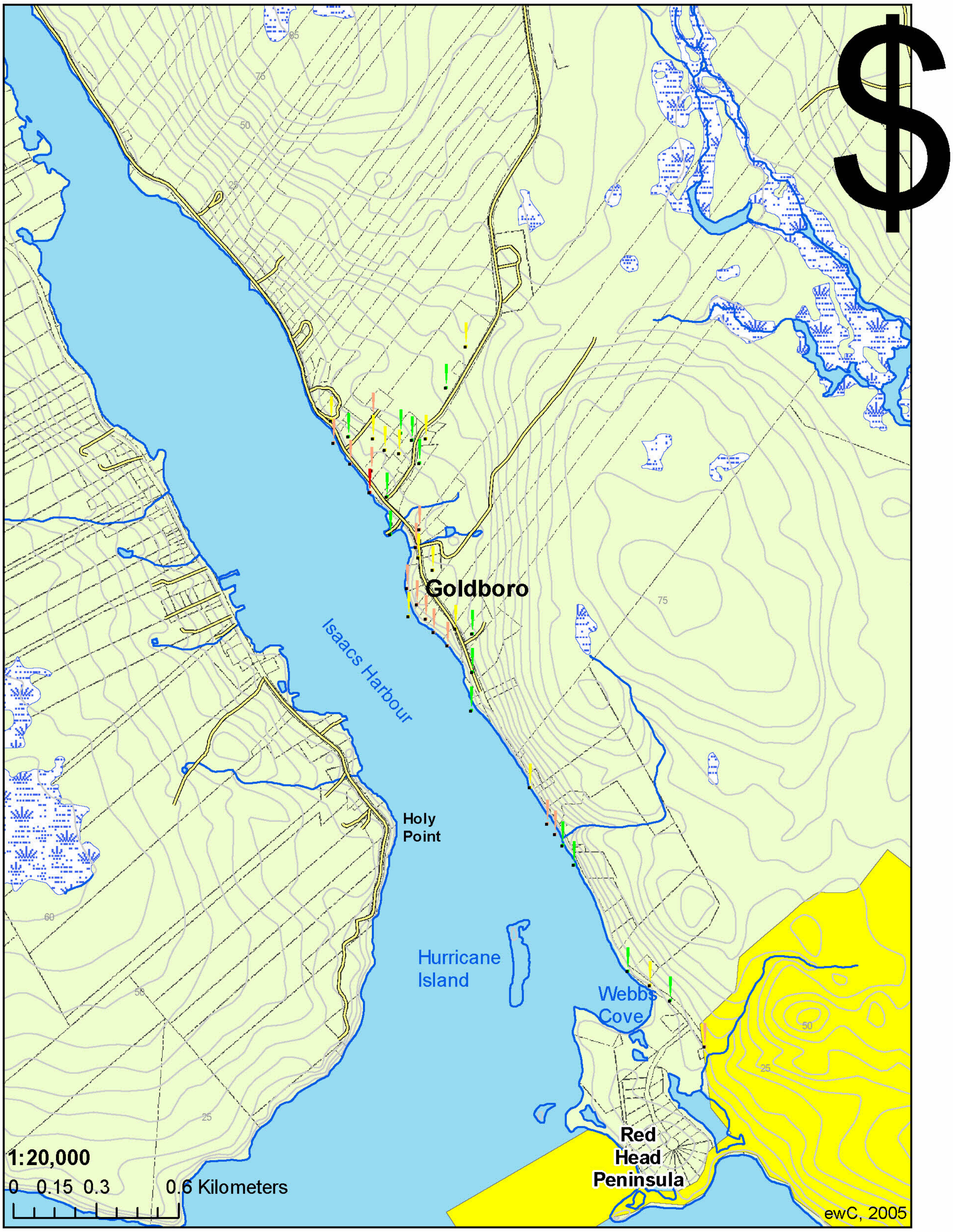
4.1.3.3 Local Well Survey

A door-to-door survey of the water supply wells located within 1 km of the proposed Keltic Project Site boundaries was carried out. Up to 40 wells were identified in the community of Goldboro (Figure 4.1-6), most of which are dug wells. There are only about eight drilled wells in the community.

Fourteen of the approximately 40 wells identified in the survey area were sampled for general chemistry, total metals, and coliform analysis. One homeowner refused to allow their well to be sampled. Twelve others whose homes appeared to be occupied (outside lights were on, outside plantings maintained) could not be contacted during the three-day survey or during subsequent visits to the site. Thirteen other homes and/or businesses appeared to be abandoned and/or used only seasonally. A newly drilled well located off-site was also sampled to serve as a groundwater quality benchmark.

Well owners agreed to participate in the sampling program on condition that identities would not be revealed. Thus the Table does not give sample locations. Well owners have been advised where results showed possible health concerns. Lab certificates of analysis are provided in Appendix 5 of the Provincial EA Report (AMEC, 2006). The following protocol was used to sample the water supply wells:

- Samples collected for general chemistry and total metals were taken directly from most commonly used faucet if no treatment was present or from the boiler valve on pressure tank upstream of any treatment, after purging the well and plumbing system for a minimum five minutes.
- Samples were collected in 200 ml polyethylene bottles directly from source for both general chemistry and total metals, without preservatives added.
- Samples collected for coliform analysis were taken directly from most often used faucet (aerators removed) into sterile (sealed) 100 ml bottles after purging wells and plumbing system for a minimum of five minutes. Sodium thiosulphate (to neutralize chlorine) was used as sample preservative.
- All samples were stored on ice in coolers immediately after collection until return to field office daily, then (except for coliform analysis) refrigerated until returned to coolers with ice packs for delivery to the lab. The maximum sample storage time was seven days.
- Samples collected for coliform analysis were delivered to the lab daily.
- All samples collected for general chemistry, total metals and some of the coliform analysis were analyzed at Maxxam Analytics inc. in Bedford, Nova Scotia, except for coliform samples 102F01-5-1 through 102F01-5-11, 102F01-5-13 and 102F01-5-15, which were analyzed daily at St. Martha's Hospital in Antigonish, Nova Scotia.
- Analytical results for the survey and benchmark well samples are provided in the Provincial EA Report (AMEC 2006).
- The lab analytical protocol used for general chemistry and metals is the same as for surface water and is shown in Table 4.1-13 above. Samples collected for coliform were analyzed using the Colilert (presence/absence) method.



Legend

- Homes Occupied, Owner not Contacted
- Home Refused to be Sampled
- Home Samples
- Seasonal Home
- LNG Project Area

FIGURE No. 4.1-6
KELTIC PETROCHEMICALS INC.

DUG AND DRILLED DOMESTIC WELLS WITHIN 1km SITE BOUNDARIES

June 2007

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The dug wells generally produce water classed as soft, sodium-chloride type waters with low total dissolved solids, low alkalinity and low pH. The relative proportions of sodium and chloride appear to increase with increased total dissolved solids concentration, suggesting a possible road salt (less likely) and/or sea spray (more likely) influence on these wells. The values for pH and aluminum are generally outside of acceptable guideline limits. Nearly all of the dug wells showed positive for total coliform. This is likely a function of well construction in many cases: most wells are old, some consisting of nothing more than a cover placed over surface springs, others had holes and water pooling near them, and nearly all had poor fitting covers and vents with no screens. Many wells showed signs of containing insects.

Drilled wells sampled inside the survey area generally produce soft to only slightly hard, calcium-bicarbonate type waters with low total dissolved solids, low alkalinity, and neutral to just below neutral pH. Aluminum, iron, and manganese concentrations were found to be outside of acceptable guideline limits. Only one well indicated the presence of coliform. The chemistry for water from drilled wells inside the survey area was in general very similar to that of the off-site benchmark well.

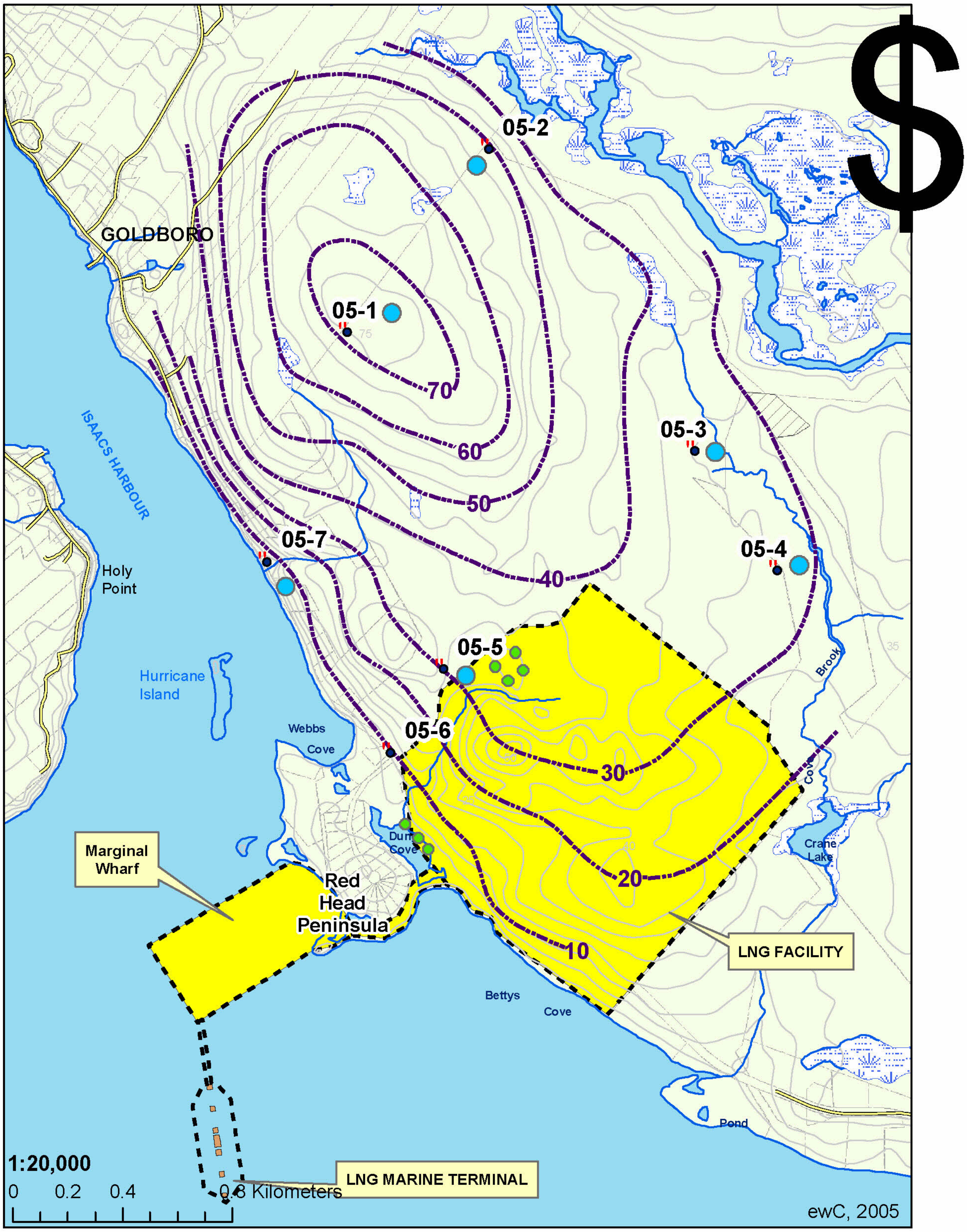
Mercury was not included in the residential wells sample for the following reasons:

- The Project does not involve mercury, and the Proponent does not plan to disturb any former mill tailings areas which may contain mercury. As such, mercury was not a concern for the purpose of the initial well survey as might relate to background conditions versus possible accidental spills or releases at the plant during construction or operation.
- Not all well were available to be sampled at the time of this initial sampling. More detailed follow-up surveys and sampling with a more comprehensive suite of parameters will be undertaken to provide a complete baseline once plant design details are known and before construction begins.
- Keltic intends to drill dedicated and secure groundwater monitoring stations within the community from which to obtain a better control over the data on local physical and chemical hydrogeology. For example, to avoid any possible bias induced by well owners who may have added liquid bleach (sodium hypochlorite) to their wells. Some domestic bleaches are manufactured using the mercury cell method, therefore may contain trace amounts of mercury. Some of these will be sampled for mercury.

4.1.3.4 Hydrogeology at the Proposed Keltic Project Site

The hydrogeology of the proposed Keltic Site, including the LNG Facility Area, was evaluated via the construction of 14 monitoring wells, installed as piezometre pairs at seven locations. Six piezometre pairs are located inside the proposed Keltic Site boundaries (two of which are located on the western edge of the LNG Facility), and one was installed outside the boundaries between the site and Isaac's Harbour (Figure 4.1-7).

The predominance of secondary permeability within the bedrock of the Goldenville Formation, and the large number of shear zones known and thought to be present at the site (especially those in the southwest part of the site) in conjunction with the large number of possibly extensive abandoned underground workings, can be expected to have a significant influence on groundwater flow pathways and on overall groundwater flow velocity within and beyond the site.



Legend

- Monitoring Well Locations
- Piezometric Contours
- LNG Project Area
- Soil Sample Location
- Surface Water Sample Location

FIGURE No. 4.1-7
KELTIC PETROCHEMICALS INC.
MONITORING WELL LOCATIONS AND PIEZOMETRIC CONTOURS
June 2007

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Therefore, the monitoring wells were located where they might best explain these underground phenomena and provide broad coverage and even distribution in areas where process infrastructure and thus, possible material spills might occur at some time in the future. The intent of the monitoring well program was to help characterize the site through definition of its baseline physical and chemical hydrogeology. As such, the hope is that these wells will not be disturbed during construction, so they may continue to serve as long-term groundwater monitoring stations.

Monitoring Well Design, Construction and Development

The monitoring wells were installed employing the services of Lantec Drilling from Dieppe, New Brunswick. The boreholes were advanced using augers and split spoon samplers where possible, advancing into bedrock with HQ-size diamond equipment. Due to the great depth to bedrock, monitoring well MW05-2b was screened in soil just above bedrock. All other monitoring wells were screened in bedrock. Details are provided in Table 4.1-15.

Hydraulic Conductivity (Slug) Testing

Hydraulic conductivity (slug) testing was carried out on each monitoring well after allowing at least 24 hours for water levels to recover following well development and groundwater sampling. The exception to this was MW05-1a and MW05-1b where due to the long distance in from the road and the need to carry well development and testing equipment in on foot, hydraulic testing was done prior to, and on the same day as, well development and sampling.

Slug testing was done using a 1 L aluminum slug on a rope, an electronic data logger, and electronic water level tape. At least two drawdown and recovery tests were carried out on each monitoring well. Presence or absence of response in the neighbouring well-pair was noted during each test. The field data was interpreted using the Hvorslev Method. Results are summarized in Table 4.1-17. Details of the analysis are provided in Appendix 6 of the Provincial EA Report (AMEC, 2006).

Groundwater Sampling

Groundwater samples were collected from the monitoring wells for analysis for general chemistry, dissolved metals, mercury, total petroleum hydrocarbons, and VOC. The water samples were collected directly from the end of the Waterra tubing installed at each well. Table 4.1-18 summarizes the protocol used for sample collection.

All groundwater sample collection was done in fair weather conditions. The generator used to power the Hydrolift pump was kept at least 10 m downwind of the monitoring wells during sample collection. The sampling QA/QC program included the following:

- sample and analyze all water sources used to drill during monitoring well construction;
- carry a field blank to all sampling locations;

TABLE 4.1-17 Hydraulic Conductivity Results at Monitoring Wells (cm/sec[1])

Location	Test 1		Test 2		Test 3		Mean	Standard Deviation
	Falling	Rising	Falling	Rising	Falling	Rising		
MW05-1a	$2.98x10^{-3}$	$2.63x10^{-3}$	$4.47x10^{-3}$	$3.73x10^{-3}$	$3.44x10^{-3}$	$3.73x10^{-3}$	$3.50x10^{-3}$	$6.44x10^{-4}$
MW05-1b	$3.31x10^{-3}$	$4.06x10^{-3}$	$3.73x10^{-3}$	$4.06x10^{-3}$	$3.89x10^{-3}$	$4.26x10^{-3}$	$3.89x10^{-3}$	$3.34x10^{-4}$
MW05-2a	$8.60x10^{-4}$	$9.94x10^{-4}$	$8.60x10^{-4}$	$8.94x10^{-4}$	--	--	$9.02x10^{-4}$	$6.33x10^{-5}$
MW05-2b	$7.45x10^{-4}$	$1.28x10^{-3}$	$7.45x10^{-4}$	$8.28x10^{-4}$	--	--	$8.99x10^{-4}$	$2.55x10^{-4}$
MW05-3a	$3.58x10^{-3}$	$5.26x10^{-3}$	$4.97x10^{-3}$	$5.96x10^{-3}$	$4.26x10^{-3}$	$5.96x10^{-3}$	$5.00x10^{-3}$	$9.48x10^{-4}$
MW05-3b	$8.94x10^{-3}$	$6.88x10^{-3}$	$9.94x10^{-3}$	$8.94x10^{-3}$	$2.63x10^{-2}$	$5.96x10^{-3}$	$1.12x10^{-2}$	$7.56x10^{-3}$
MW05-4a	$5.73x10^{-3}$	$4.86x10^{-3}$	$5.59x10^{-3}$	$6.12x10^{-3}$	$6.58x10^{-3}$	$6.39x10^{-3}$	$5.88x10^{-3}$	$6.24x10^{-4}$
MW05-4b	$1.02x10^{-2}$	$1.24x10^{-2}$	$1.12x10^{-2}$	--	--	--	$1.13x10^{-2}$	$1.13x10^{-3}$
MW05-5a	$4.97x10^{-4}$	$4.97x10^{-4}$	$3.99x10^{-4}$	$5.26x10^{-4}$	--	--	$4.80x10^{-4}$	$5.54x10^{-5}$
MW05-5b	$5.96x10^{-4}$	$1.28x10^{-3}$	$6.77x10^{-4}$	--	--	--	$8.50x10^{-4}$	$3.72x10^{-4}$
MW05-6a	$3.44x10^{-4}$	$4.06x10^{-4}$	--	--	--	--	$3.75x10^{-4}$	$4.42x10^{-5}$
MW05-6b	$3.89x10^{-5}$	$2.37x10^{-5}$	--	--	--	--	$3.13x10^{-5}$	$1.08x10^{-5}$
MW05-7a	$8.94x10^{-4}$	$2.03x10^{-3}$	--	--	--	--	$1.46x10^{-3}$	$8.05x10^{-4}$
MW05-7b	$5.81x10^{-4}$	$3.58x10^{-4}$	--	--	--	--	$4.69x10^{-4}$	$1.58x10^{-4}$

1. cm/sec – centimetres per second

TABLE 4.1-18 Summary of Protocol Used for Sample Collection

Sample	Bottle Type	Sample Filtered	Preservative	Additional Comments
General Chemistry	200 ml polyethylene	No	No	None
Dissolved Metals	50 ml polyethylene	Yes Millipore Luer-Lok filters to 0.45 µm with sterile syringe (new) for each sample	Nitric acid	None
Mercury	100 ml amber glass with Teflon lined cap	No	Potassium dichromate in nitric acid	Preservative added prior to sample collection. Bottle filled to zero headspace without overflow.
Total Petroleum Hydrocarbon	2 – 250 ml clear glass with Teflon lined cap	No	No	None
	3 – 40 ml amber glass with Teflon lined septum caps	No	Copper sulphate	Preservative added prior to sample collection. Bottle filled to zero headspace without overflow
VOC	3 – 40 ml clear glass with Teflon lined caps	No	Sodium bi-sulphate	Collected directly from open end of Waterra tubing. Preservative added prior to collection. Bottle filled to zero headspace without overflow.

- collect one full suite of duplicate samples at MW05-6a;
- do an air-transfer blank at MW05-7a while maintaining a 5 centimetre (cm) gap between lab-prepared distilled water bottle and sample collection bottles (handled as per Table 4.1.18), for VOC analysis;
- sample (directly from the grease tube) and analyze the lubricant used on drilling equipment;
- all samples were immediately stored in coolers with ice packs after collection until return to the field office daily, where they were kept refrigerated until return to coolers with ice pack for delivery to Maxxam Analytics Inc. in Bedford, Nova Scotia. Maximum sample storage time was seven days; and
- samples were analyzed using the lab protocol summarized in Table 4.1-13 above.

Physical Site Hydrogeology

With the exception of MW05-1a and MW05-1b, static groundwater depths were measured at the monitoring wells on two occasions during the field program – once just before commencing well development and a second time at the start of the hydraulic testing. The measurement dates and calculated groundwater elevations are summarized in Table 4.1-19 below.

TABLE 4.1-19 Groundwater Elevation at Monitoring Wells (elevations reference mean sea level)

Location	Measurement Event 1			Measurement Event 2		
	Date	Elevation (m)	h* (m)	Date	Elevation (m)	h* (m)
MW05-1a	16/04/05	73.27	+0.05	na	na	na
MW05-1b		73.21			na	
MW05-2a	10/04/05	54.19	-1.2	14/04/05	54.36	-0.81
MW05-2b		55.39			55.17	
MW05-3a	11/04/05	37.01	+0.07	14/04/05	36.90	+0.08
MW05-3b		36.94			36.82	
MW05-4a	13/04/05	34.97	-0.05	14/04/05	35.00	0
MW05-4b		35.02			35.00	
MW05-5a	17/04/05	33.88	+0.95	18/04/05	33.85	+0.95
MW05-5b		32.93			32.90	
MW05-6a	18/04/05	na	na	19/04/05	14.54	+0.53
MW05-6b		14.47		19/04/05	14.01	
MW05-7a	21/04/05	6.17	+0.05	03/05/05	6.65	+0.09
MW05-7b		6.12		03/05/05	6.56	

Note: * (+) and (-) values designate groundwater recharge and discharge conditions, respectively.

Measurements were taken only once at MW05-1a and MW05-1b because well development and hydraulic testing there were done the same day. Measurements were taken at MW05-6a on two separate occasions. However, it was found that bentonite had fallen into the monitoring well during construction and water was used to wash it out. Due to a slow water level recovery time, an accurate measurement was not possible before commencing well development. It was not possible to measure groundwater levels at all wells on the same day due to field schedules and long distances between stations.

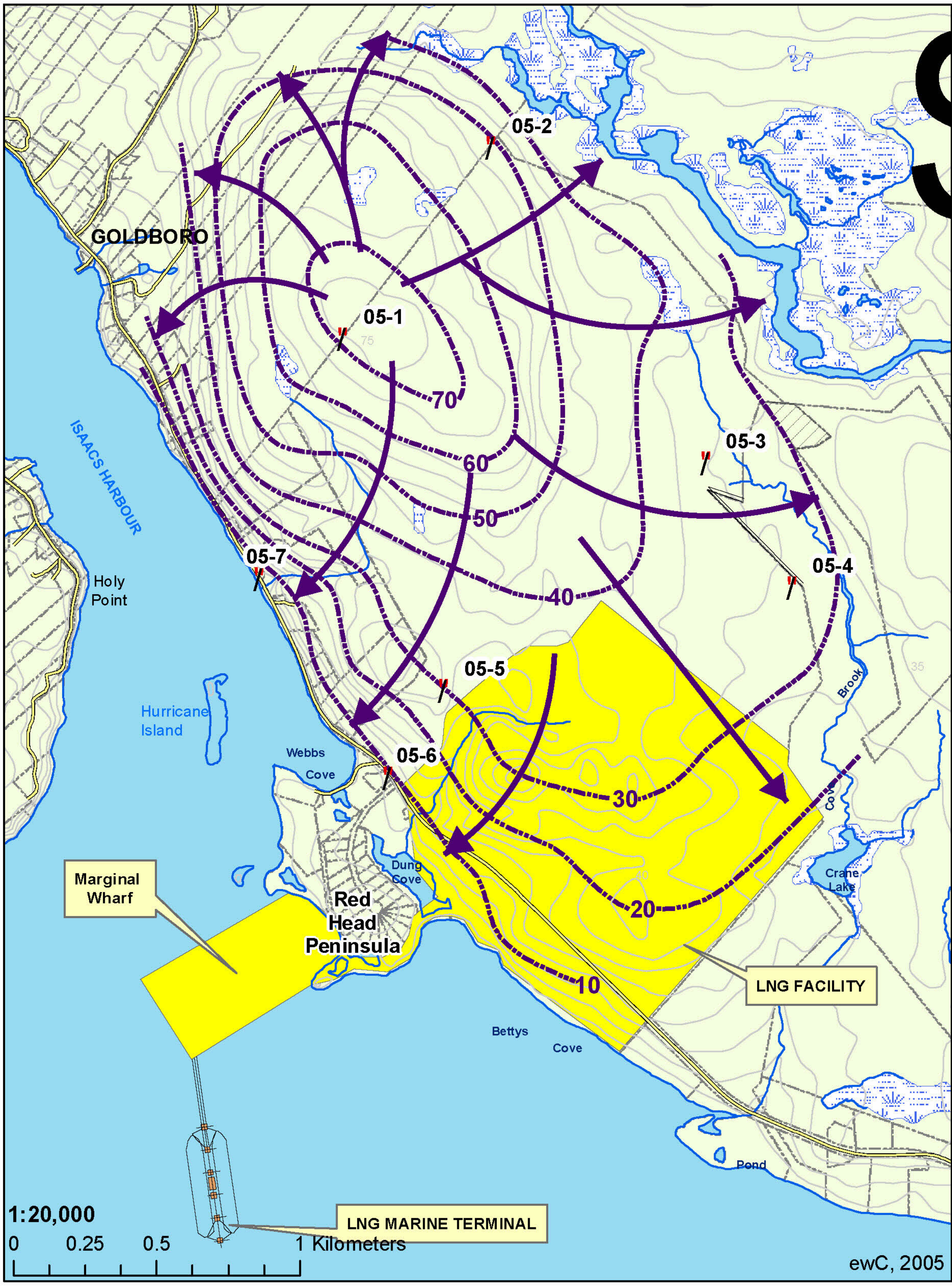
Groundwater level fluctuations were found to range from about 3 cm at most wells, to 48 cm at MW05-7a. Water level fluctuations in the order of 2 m to 3 m might be expected seasonally, with the greatest fluctuations occurring at station MW05-7 based on currently available information.

Based on .h values (difference in water elevation between shallow and deep well pair) in Table 4.1-19, most areas of the proposed Keltic Site would be considered to be groundwater recharge zones (groundwater recharge conditions are considered present when piezometric levels for shallow horizons are higher than for deeper horizons). Hydraulic communication was found to exist between many of the monitoring well pairs during hydraulic testing (suggesting both vertical and lateral bedrock fracturing), and so the relative differences in magnitude for .h values from one monitoring well station to the other are likely as much a function of the communication that exists between well pairs, as it is to the relative degree of recharge or discharge at any location.

Figure 4.1-8 is a piezometric contour map of the site drawn using the second set of groundwater level measurements for the “a” (deeper) well series. The piezometric contours for the “b” (shallow) well series would be similar. From this, groundwater would be expected to flow in a radial direction (dark blue curved arrows) from around the northwest boundary of the site toward Gold Brook and Betty’s Cove Brook to the east, southeast and south, the hamlet of Goldboro to the north and northwest, and the ocean to the west and southwest. However, there are also possible groundwater flow paths of potential least resistance that must be taken into consideration, as indicated from the current knowledge of faults, shear zones, and abandoned underground workings on the proposed Keltic Project Site. These are expected to have a significant influence on the actual routes groundwater would flow underground – some components of flow could parallel the shore of Isaac's Harbour, while others are deflected east and west just above the proposed marginal wharf area. However, some faults are also known in other places to not allow groundwater to migrate along or across them. Additional monitoring wells are needed to help better characterize this situation.

The results of the hydraulic (slug) conductivity testing are summarized in Table 4.1-17. The overall average value obtained for hydraulic conductivity at the proposed Keltic Site is $3.30 \times 10^{-3} \pm 3.83 \times 10^{-3}$ cm/sec, with the lowest of 3.13×10^{-5} cm/sec being at MW05-6b, and the highest value of 1.13×10^{-2} cm/sec at MW05-4b. The norms for fractured and un-fractured metamorphic rock are in the order of 7×10^{-7} to 5×10^{-2} cm/sec, and $< 1 \times 10^{-12}$ to 1×10^{-8} cm/sec, respectively (Freeze and Cherry, 1979). The hydraulic conductivity values obtained at the Keltic Project Site are within the upper end of the generally recognized spectrum for fractured metamorphic bedrock.

There was a response at the shallow monitoring wells when testing the deeper ones, and vice-versa at nearly all of the monitoring well pairs. These usually rapid water fluctuation responses ranged from 1 cm at the monitoring well pairs where the hydraulic conductivity values were generally lower, to 8 cm at other well pairs – a significant water level change considering the relatively small (maximum 49 cm) displacement actually created by dropping a 1 L slug into the well being tested.



Legend

- Monitoring Well Locations
- Piezometric Contours
- Probable Gravitational Flow Direction
- LNG Project Area

FIGURE No. 4.1-8
KELTIC PETROCHEMICALS INC.
PIEZOMETRIC CONTOUR MAP SHOWING PROBABLE GRAVITATIONAL FLOW DIRECTION
June 2007

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The distribution of values throughout the proposed Keltic Site suggests that hydraulic conductivity in the vicinity of MW05-3 and MW05-4 are highest. This is consistent with the understanding that the lineaments defined by Betty's Cove Brook may represent bedrock faults which no one has yet been able to otherwise map.

The hydraulic conductivity values obtained at the deep and shallow piezometres at each monitoring well pair are for the most part quite similar. The hydraulic conductivity values obtained for the shallower wells are general slightly higher than those for the neighbouring deeper well. This is likely a function of the greater degree of bedrock weathering expected at the shallower depths. The reverse appears to be the case at MW05-6 and MW05-7 where hydraulic conductivity for the deeper bedrock horizon was found to be greater than in the shallower horizons. The overall hydraulic conductivity at these wells was lower than in other places. This reverse relationship may suggest a greater relative degree of bedrock fracturing at depths below the wells at those locations.

Table 4.1-20 lists average values (shallow and deep wells for two monitoring well locations) for hydraulic conductivity, and estimated average groundwater flow velocities between various monitoring stations using hydraulic gradients from Figure 4.1-5.

With few exceptions, the glacial till appears to be relatively thin throughout the proposed Keltic Project Site and as such, the low permeability till is expected to influence only very local groundwater flows at the site. The more intermediary to regional groundwater flows present within bedrock should be considered as the more significant flow components at this site.

TABLE 4.1-20 Groundwater Flow Velocity Estimates at the Proposed Keltic Project Site

From – To		Average K (cm/sec)	Average Groundwater Flow Velocity (m/yr)
MW05-1	MW05-2	2.30×10^{-3}	21.0
MW05-1	MW05-7	2.33×10^{-3}	51.7
MW05-1	MW05-3	5.90×10^{-3}	53.0
MW05-3	MW05-4	8.35×10^{-3}	9.5
MW05-1	MW05-4	6.14×10^{-3}	43.6
MW05-1	MW05-5	2.18×10^{-3}	22.6
MW05-5	MW05-6	4.34×10^{-4}	6.0
MW05-1	MW05-6	1.95×10^{-3}	24.6
MW05-5	MW05-7	8.15×10^{-4}	9.1

Chemical Hydrogeology

The analytical results for the samples of surface water used to drill and for the groundwater samples collected from the monitoring wells installed during the 2005 field season are summarized in the Provincial EA Report (AMEC 2006).

The Piper diagram in Figure 4.1-9 shows the relative distribution of major ions in water and gives a comparison of the groundwater samples collected from the monitoring wells to other groundwater samples collected from dug and drilled water supply wells located within 1 km of the proposed Keltic Site, and surface water samples taken from local streams (Gold Brook, Isaac's Harbour River) and on- or near-site surface water used for drilling (from local ditches, snow melt and Betty's Cove Brook, which originates within the Keltic Site boundaries).

The major ion chemistry is similar for most of the monitoring well samples as well as for all of the drilled water supply wells sampled, being mostly calcium bicarbonate type waters. There are generally no significant differences in major ion concentration among the deeper and shallower monitoring wells. Two notable exceptions, however, are at the north edge of the Keltic Site at MW05-1a, MW05-1b, MW05-2a, and MW05-2b, where samples from the deeper wells contained sodium bicarbonate type waters and samples from the shallow wells contain sodium chloride- type waters. The sample from MW05-6b is a sodium-bicarbonate type water, and that from MW05-7b is borderline between calcium-bicarbonate and sodium-chloride type water. These are likely showing a certain degree of surface water influence (recharging waters with lower residence times). The dug water supply wells in Goldboro are similar to these, but exhibit a greater range in relative amount of chloride versus bicarbonate.

The surface waters are distinct from groundwater in that they are predominantly sodium sulphate type waters from Gold Brook and Isaac's Harbour River (waters from off the Keltic Project Site), and sodium chloride type waters used for drilling (waters originating at the Keltic Project Site). The Gold Brook and Isaac's Harbour River waters also contain a slightly higher proportion of magnesium than the other surface waters (those used for drilling), whereas the relative proportion of magnesium is roughly the same for all water supply wells and monitoring well waters.

The monitoring wells generally produce soft to only slightly hard waters with low total dissolved solids, low alkalinity, and generally near neutral pH. The Langelier Index calculations for waters from the monitoring wells are all slightly negative – these are all under saturated with respect to calcium carbonate. A few monitoring wells have elevated aluminum concentrations, several have iron and manganese concentrations that exceed guideline values, and arsenic concentrations were elevated at MW05-5a, MW05-5b, MW05-6a and MW05-6b, all of which are located within or near highly mineralized areas.

As relates to the organic parameters, all concentrations are generally below the lab's detection levels, except chloroform, which is above the fresh water aquatic guideline value at MW05-1a, MW05-1b, MW05-2b, and present (but below the guideline value) at MW05-7a, as well as in the air transfer blank. This suggests either analytical problems (unlikely based on the lab's QA/QC data), or airborne contributions during sampling (sampling at these locations was done near/under conifers).

4.1.4 Marine Water Quality

The chemical composition of seawater is complex; nevertheless the relative concentrations of the major ions are generally constant throughout the oceans (Culkin, 1965). Some differences in water quality occur as deeper more nutrient rich waters mix with surface waters, which are in turn influenced by major outflows, such as the St. Lawrence River and the Nova Scotia Current.

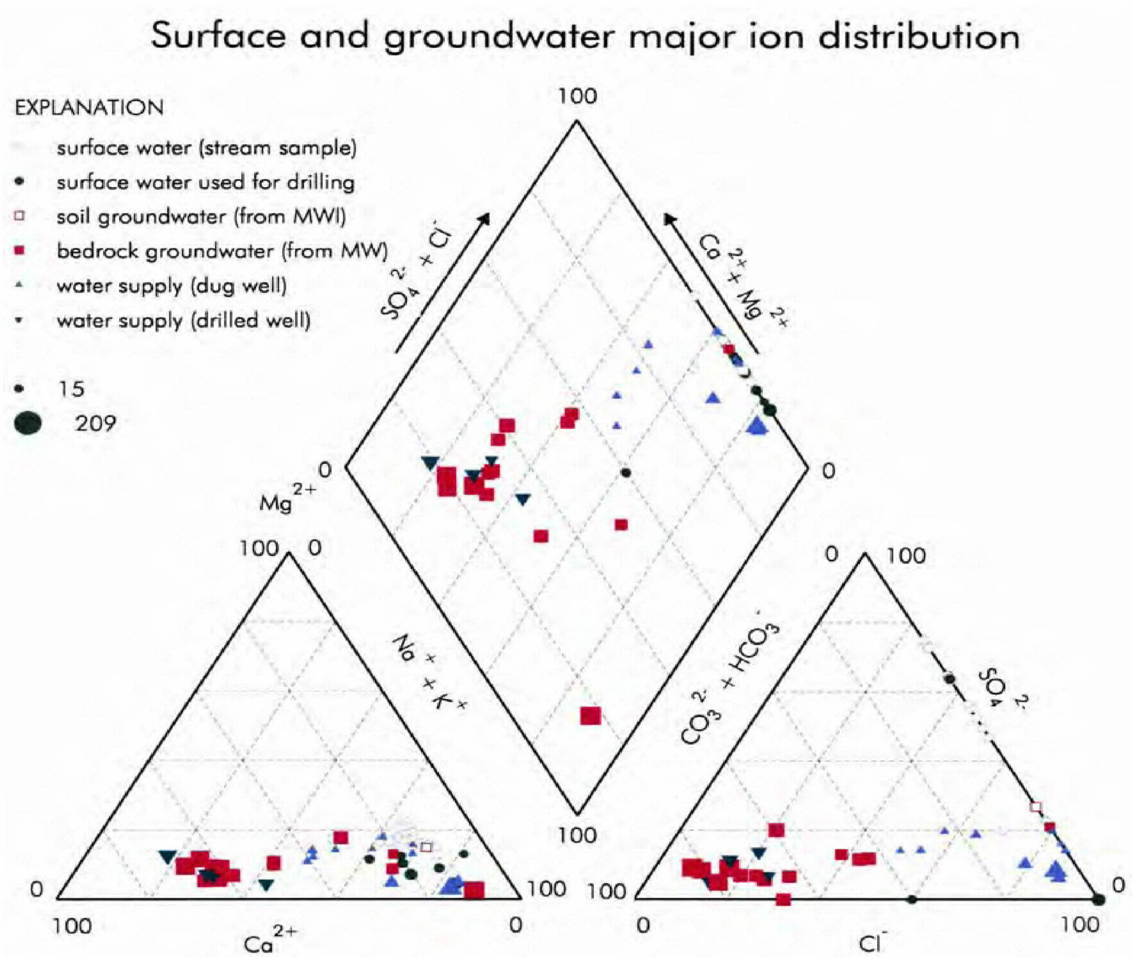

FIGURE 4.1-9
KELTIC PETROCHEMICALS INC.
PIPER DIAGRAM FOR THE WATER SAMPLES IN THIS STUDY
JUNE 2007
ewC, 2005

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Approximately 86% of the total salt content of seawater is due to sodium and chloride ions, with magnesium and sulphate ions contributing an additional 11%. Other ions are present in much lower concentrations.

Seawater also has a high buffering capacity of acids and bases. During periods of high phytoplankton production, the uptake of carbon dioxide (CO_2) can cause localized changes in ionic balance. The water quality near the Keltic Project Site is also influenced by freshwater discharge, primarily from the Isaac's Harbour and Country Harbour Rivers. During the low flow summer months, this influence is minor.

The pH of seawater is relatively constant throughout the oceans with values ranging from 7.5 to 8.4 (mean = 7.8) (Wilson, 1975). Measured values for pH in surface waters in the region of the Keltic Project range from 8.05 to 8.11. DO is essential for the respiration of aquatic life. The solubility of oxygen in seawater is a function of salinity, temperature, and pressure. The major sources of DO in seawater are attributed to exchange with the atmosphere and production by marine plants. Although the waters in the Keltic Project Area are thermally stratified from May to October, the depths are shallow (Petrie et al. 1996). Consequently DO concentrations are likely to be at or near saturation with values in the order of 8 to 10 mg/L.

There are limited published suspended particulate matter (SPM) values for the Sable Bank area. Data collected from Emerald Bank in 1970 indicated a variation of 5.5 mg/L at the surface, increasing to 10.1 mg/L at 20 m and then decreasing to 4.0 mg/L below this depth. The data reflect the strong influence of biological activity during and after spring bloom. However, observations suggest that concentrations of SPM on Sable Bank are much lower than those measured on Emerald Bank (SOEP, 1996).

Regional data are available for nutrient concentration as a result of the Scotian Shelf Icthyloplankton Project and other programs (O'Boyle et al., 1982; Petrie et al., 1996). Concentrations of nitrite (as NO_2-N/L) in the euphoric zone have been observed to range from 5.0 to 10.0 milligrams (mg) in the early spring, dropping and remaining low at 0.5 to 1.5 mg during the summer, before rising slowly through the autumn from 0.5 to 10.0 mg. Phosphate concentrations (as PO_4-P/L) ranged from 0.6 to 0.9 mg in the early spring, dropping through the summer to 0.1 to 0.2 mg range and remaining at or about this level through the fall.

Trace metal inputs to the area are a function of the natural and human inputs from Nova Scotia, the Gulf of Saint Lawrence, and, to a limited extent, from atmospheric transport from central and eastern North America. Predicted trace metal concentrations from the SOEP area range from 0.002 Fg/L (mercury) to 25 Fg/L (barium).

Like temperature, salinity is an important parameter of marine water quality. Data provided in Petrie et al. (1996) shows that the average surface salinity ranges from a low of 31.30 microseimens (µS) in December to a high of 32.34 µS in April. At 10 m depth average salinity is lowest in November (30.96 µS) and peaks in April at (32.30 µS). In deeper waters of about 50 m the average salinity is least in February (31.69 µS) and greatest again in April at (32.65 µS) (Petrie et al., 1996).

Hydrocarbons arising from both recent biogenic processes and petrogenic sources are ever present in the marine environment. It is reasonable to assume that concentrations in the water column will be at the threshold of detection because of the large distance from any highly populated and heavily industrialized centres. However, infrequent detectable amounts may be found due to illegal discharge of bilge water by vessels within the region.

Temperature affects almost every property of seawater, as well as many chemical and biological processes. The annual sea temperature in the vicinity of the Keltic Project ranges from a low of 1.55°C in February to a high of 16.36°C in September at a depth of 10 m (Petrie et al., 1996).

Although the presence of polychlorinated biphenyls (PCBs) and various organohalogen pesticides (particularly DDT (Dichlorodiphenyltrichlorethane)) has been widely studied, there are no data on these compounds available for the waters of the area offshore of the planned Keltic Project. Nevertheless, there is no reason to expect significant concentrations of these related compounds in the region.

4.1.5 Soil/Sediment Quality

4.1.5.1 Terrestrial

Most of the immediate area around Goldboro is underlain by stony, silty sand till of the Quartzite Till sheet. The thickness of this ground moraine lodgement till typically averages 3 m, but may reach over 20 m. The shoreline from Webbs Cove to Drum Head is pebble-cobble beach with a short section (200 m) of boulder beach occurring just prior to Drum Head (EnCana Corporation, 2002). Beyond Drum Head the shoreline consists mostly of bedrock and human made-structures (wood and stone) (EnCana Corporation, 2002). The lower intertidal zone in the area consists of mixed coarse (no sand) beach material and bedrock resistant platforms with a wharf and breakwater in Drum Head Harbour (EnCana Corporation, 2002).

Three major soil series occur within the Study Area, Halifax; Aspotogan; and Organic. Halifax soils are associated with the gently undulating to hilly topography of the Project Area. These soils are well drained and support fair to good stands of mixed forest (Hilchey et al., 1969). Aspotogan soils are shallow, poorly drained soils located in lower areas of the Project Area landscape. They are derived from a sandy to gravelly sand quartzite till, which is often exceedingly stony.

Organic soils occur in very poorly drained areas of the Study Area either adjacent to water or in depressions in the landscape. Profiles consist of brown semi-decomposed fibrous material consisting mainly of sphagnum moss. Depth of the organic material may be as great as 2 m (EnCana Corporation, 2002).

The soils of the Keltic Project Site and surrounding regions were mapped by Cann and Hilchey (1954), Hilchey et al (1969), Stea and Fowler (1979) and Stea et al (1992).

A and B Soil Horizons

In Guysborough County, variably distributed Riverport, Thom, Halifax, Danesville, and Aspotogan series soils, and peat are present throughout the Keltic Project Site and in large portions of the watersheds studied. Figure 4.1-10 shows the distribution of these soil types.

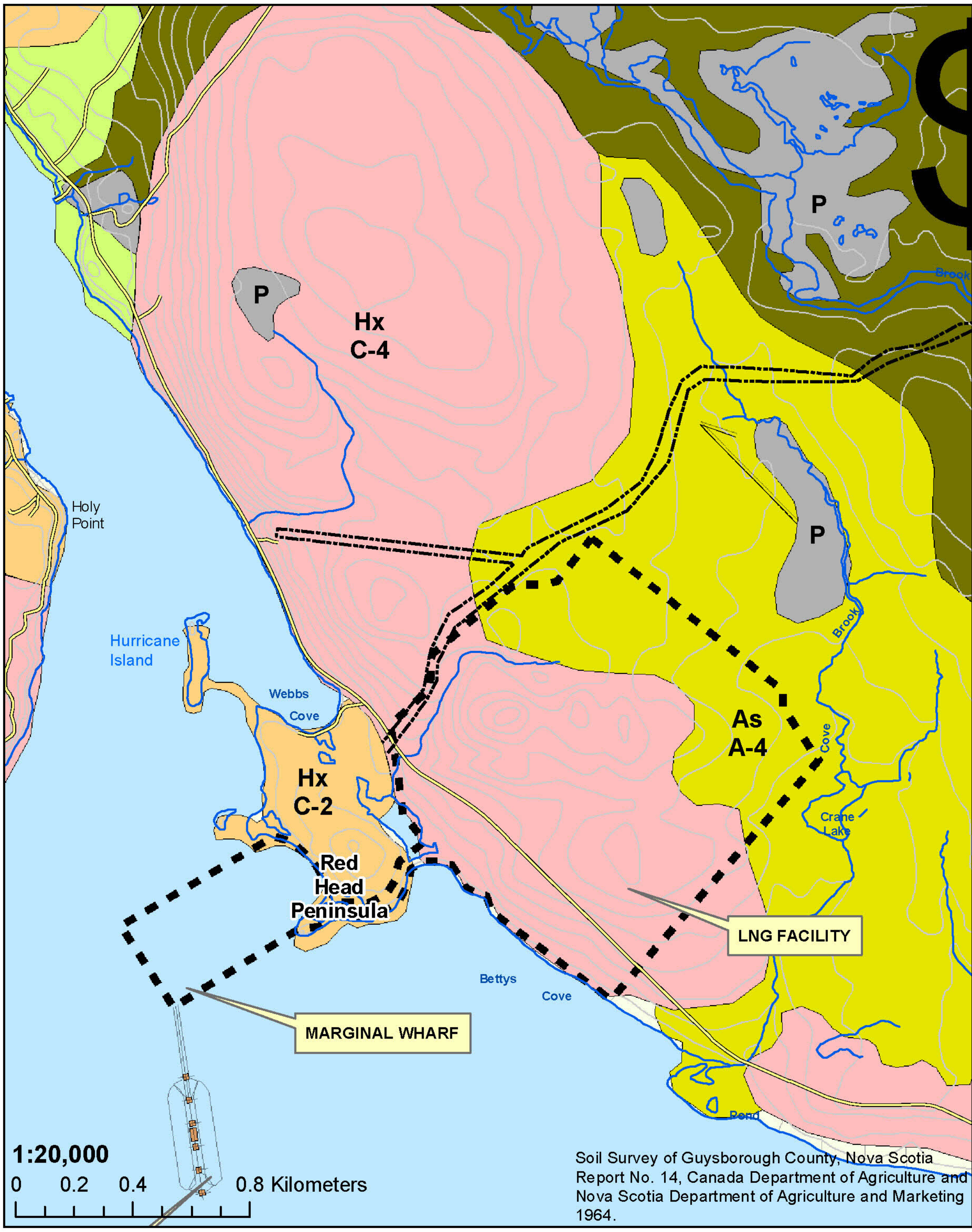

FIGURE No. 4.1-10

KELTIC PETROCHEMICALS INC.

SOIL TYPE DISTRUBUTION (A AND B HORIZONS)

June 2007

Legend

- ! Mine or Open Cut
- Other Roads
- LNG Project Area
- Peat
- Hebert
- Springhill
- Dansville
- Halifax
- Aspotogan

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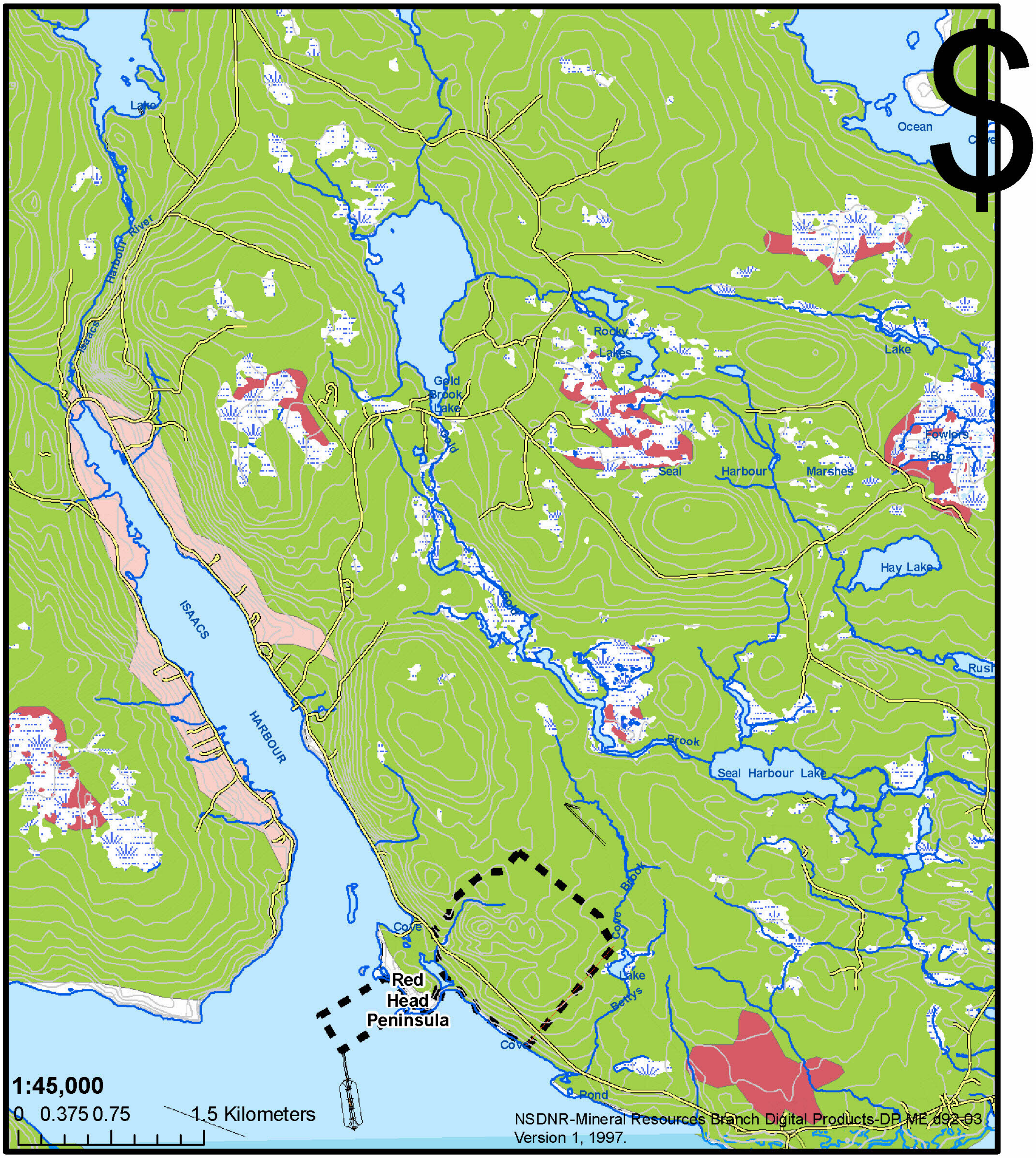
Description of the different soils is as follows:

- Queens Series: light brown clay loam over reddish-brown clay loam.
- Millbrook Series: light brown loam over reddish-brown gravely clay loam.
- Stewiacke Series: reddish-brown silty clay loam over reddish-brown silt loam.
- Woodborne Series: reddish-brown gravely loam to sandy loam over dark reddish-brown gravely clay loam.
- Kirkhill Series: light brown loam over yellowish brown shaley sandy loam.
- Riverport Series: brown shaley loam over grayish brown shaley loam.
- Thom Series: dark, reddish brown, friable sandy loam over dark, reddish-brown gravely sandy loam.
- Danesville Series: dark reddish brown mottled gravely sandy loam over dark-brown mottled gravely sandy loam.
- Aspotogan Series: mottled dark-brown sandy loam over olive-gray strongly mottled gravely sandy loam.
- Halifax Series: dark reddish brown friable sandy loam over strong-brown friable sandy loam.
- Most are generally well-drained soils, for which parent materials are generally the bedrock that underlies them, and are fairly well suited for various types of agriculture, although the relative shallowness of the Kirkhill Series soils makes it less suitable for agriculture than the others. The Riverport Series has imperfect drainage and is limited for agricultural use due to the stoniness, drainage, and shallowness and the Thom Series has rapid drainage and is unsuitable for agriculture but suitable for forestry (Cann and Hilchey, 1954). The Danesville and the Aspotogan Series have imperfect and poor drainage, respectively. Both soils are derived principally from quartzite glacial till parent material. The Halifax Series is rapid draining and is derived principally from gravely sandy quartzite glacial till.

C Soil Horizon

Beneath the A and B soil horizons, the C horizon materials or “mineral soil” consists generally of quartzite till and/or stony till plain deposits in Guysborough County. Glacial-age kame fields and esker systems, and post-glaciation alluvial deposits, are present at various locations throughout the Keltic Project Site (Figure 4.1-11).

The ground moraine till material is comprised of a mixture of gravel, sand, and mud of direct glacial origin, which was released from the top or within, stagnant ice masses by melting. It is variable in thickness from 2 m to 25 m and forms local ridges, depressions or pits (kettles). The stony till unit consists of material released at the base of ice sheets and is described by Steam (1979) as a bluish-greenish-grey, loose, cobbly, silt-sand till that will grade into a sandier, coarser till, sometimes with red clay inclusions. This till is generally thin (less than 10 m), and in general, the matrix is made up of 80% sand, 15% silt, and 5% clay derived of locally eroded quartzite and slate bedrock.



Legend

LNG Project Area

Bedrock

Glaciofluvial

Stony Till

Orangic Deposits

FIGURE No. 4.1-11

KELTIC PETROCHEMICALS INC.

SURFICIAL GEOLOGY

June 2007

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Quartzite till is shown by Stea (1979) and Stea et al (1992) to extend northward along the eastern half of the Isaac's Harbour River watershed. Granite ablation till, or silty till plain deposits, are present along the western periphery in the upper reaches of the Isaac's watershed. These deposits are described by Stea (1979) as yellow-grey, bouldery sand till. A drumlin field is shown present south of the Antigonish-Guysborough County border. Locally at and around the Keltic Project Site, topographic features suggest that there may be a few low-lying drumlins. However, maps by Stea (1979), and Stea et al (1992) do not show any drumlins at the LNG Facility Site.

4.1.5.2 Past Mining

The greater Goldboro area has been the subject of gold mining activities during the late 1800's and early 1900's. Mines were established within the proposed Project Site boundaries including the McMillan Mine, west of Dung Cove, and the Mulgrave and Giffin Mines (also known as the Hattie Belt, Skunk Den Mine, or the Malloy, Eureka, Economy or Bluenose properties) (Figure 4.1-12).

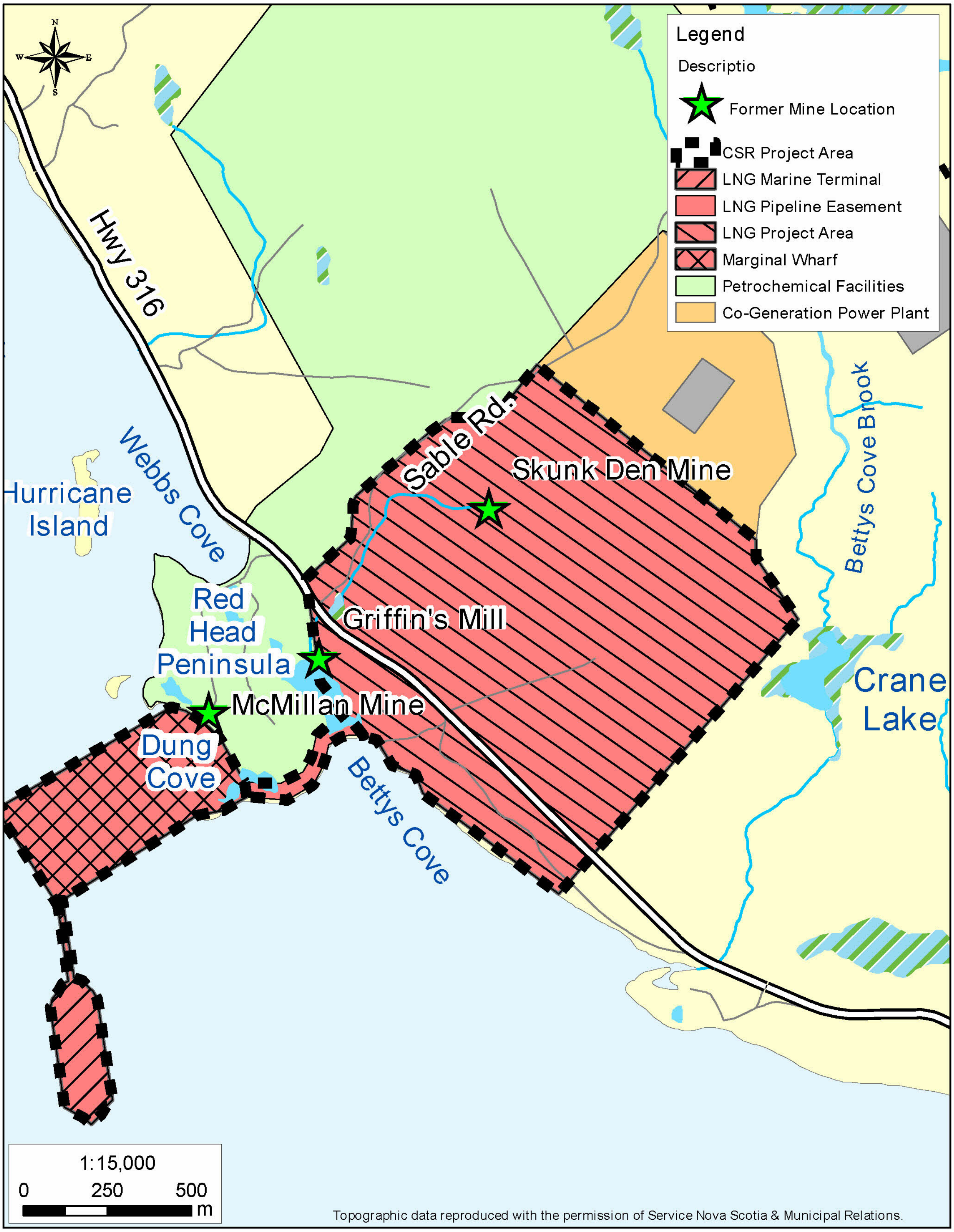
Very little information exists in the way of maps or cross sections of underground mine workings, of the actual quantities of ore removed from the underground, and gold recovered. Prior to about 1930, production statistics for Isaac's Harbour Gold District were recorded collectively with those from other nearby gold producing areas under the general heading "Stormont Gold District" (Tilsley, 1988). Included, in addition to Isaac's Harbour, were Forest Hill, Upper Seal Harbour, Lower Seal Harbour and Country Harbour areas. In addition, there is a general suspicion by geoscientists familiar with the area that as much as 50 percent of the total gold recovered from the region may have been removed by interveners – production which would not have made it to the records.

<u>**Old Mine Workings**</u>

Figure 4.1-13 is a map of the proposed Project Site that shows the location of former mine and associated workings inside the proposed Project boundaries as identified from an NSDNR Mines Branch database of mine workings and from direct observations in the field.

There is very little information on the underground workings in the area, although it is expected that workings inside the proposed Keltic Site boundaries may be up to 30 m or 45 m deep. Some of the old shafts and trenches are extremely dangerous, and some are known to be in direct hydraulic communication with the ocean (P. Smith, pers. comm., 2001).

In addition to digging into rock for gold, it is known that placers were explored, to a limited extent at least, off the shore of Red Head (Barrett, 1981), where some gold values and sulphide minerals were identified, albeit perhaps not in economic quantities.



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June 2007
Drawn by S. Turner
Projection: NAD83 CSRS UTM Zone 20N
Job No.: TV61029

Figure 4.1-12
KELTIC PETROCHEMICALS INC.
Location of the McMillan, Mulgrave and Griffin Mines
JUNE 2007

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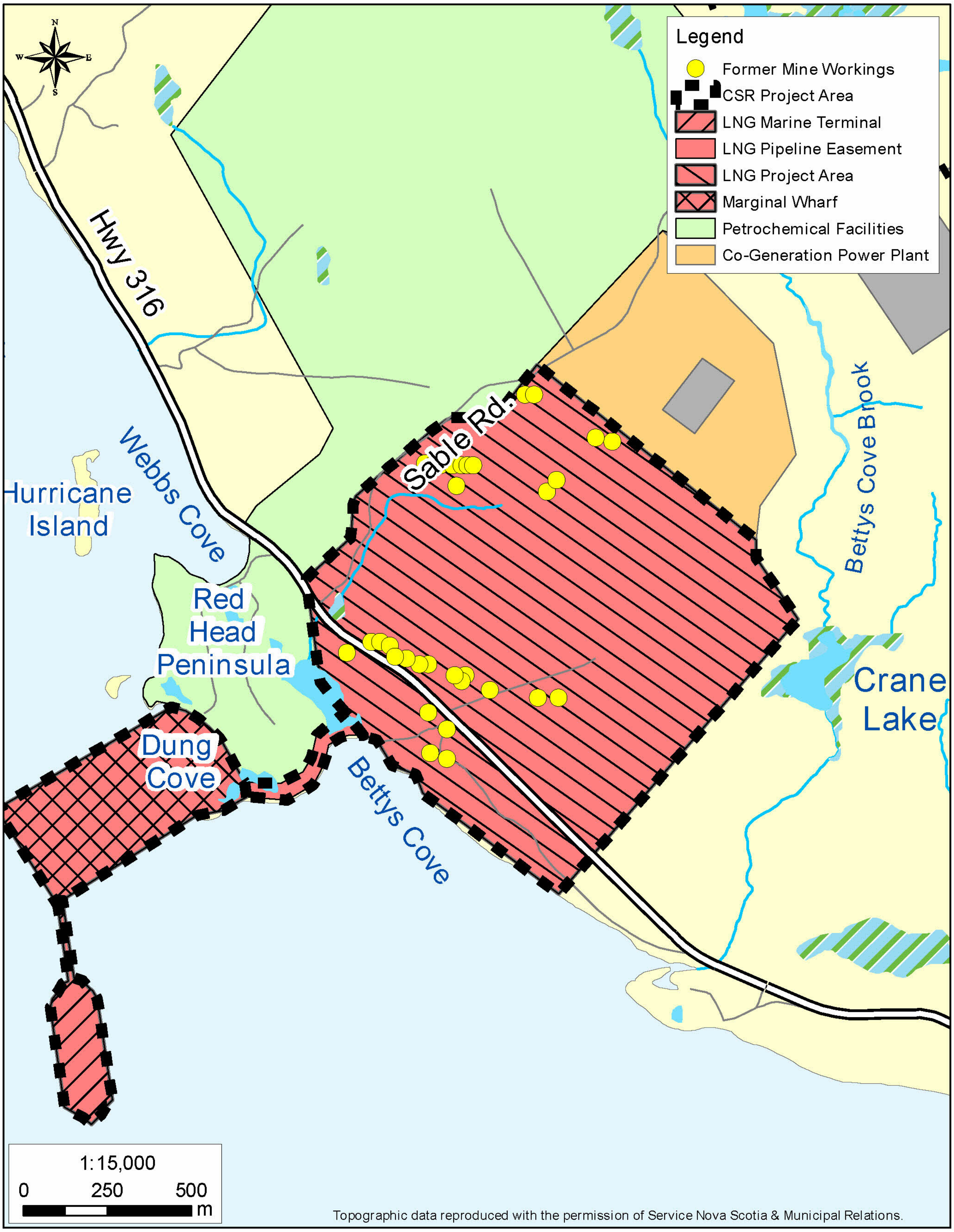

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Projection: NAD83 CSRS UTM Zone 20N
Job No.: TV61029

Figure 4.1-13
KELTIC PETROCHEMICALS INC.
Location of Former Mine Works in the Project Site
JUNE 2007

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Ore Mineralogy

The geology and mineralogy of the area was described in detail by Corey (1992). Gold in the area is commonly found in nugget form, as flakes of visible gold, or as gold associated with arsenopyrite and to a lesser degree, pyrite. Locally, arsenopyrite is the predominant metallic mineral, usually making 65% to 75% of the total. Pyrite accounts for most of the remainder. Galena, sphalerite, and chalcopyrite may, together, be 2% of the total sulphides (Tilsley, 1996a).

Inactive Tailings Disposal Sites

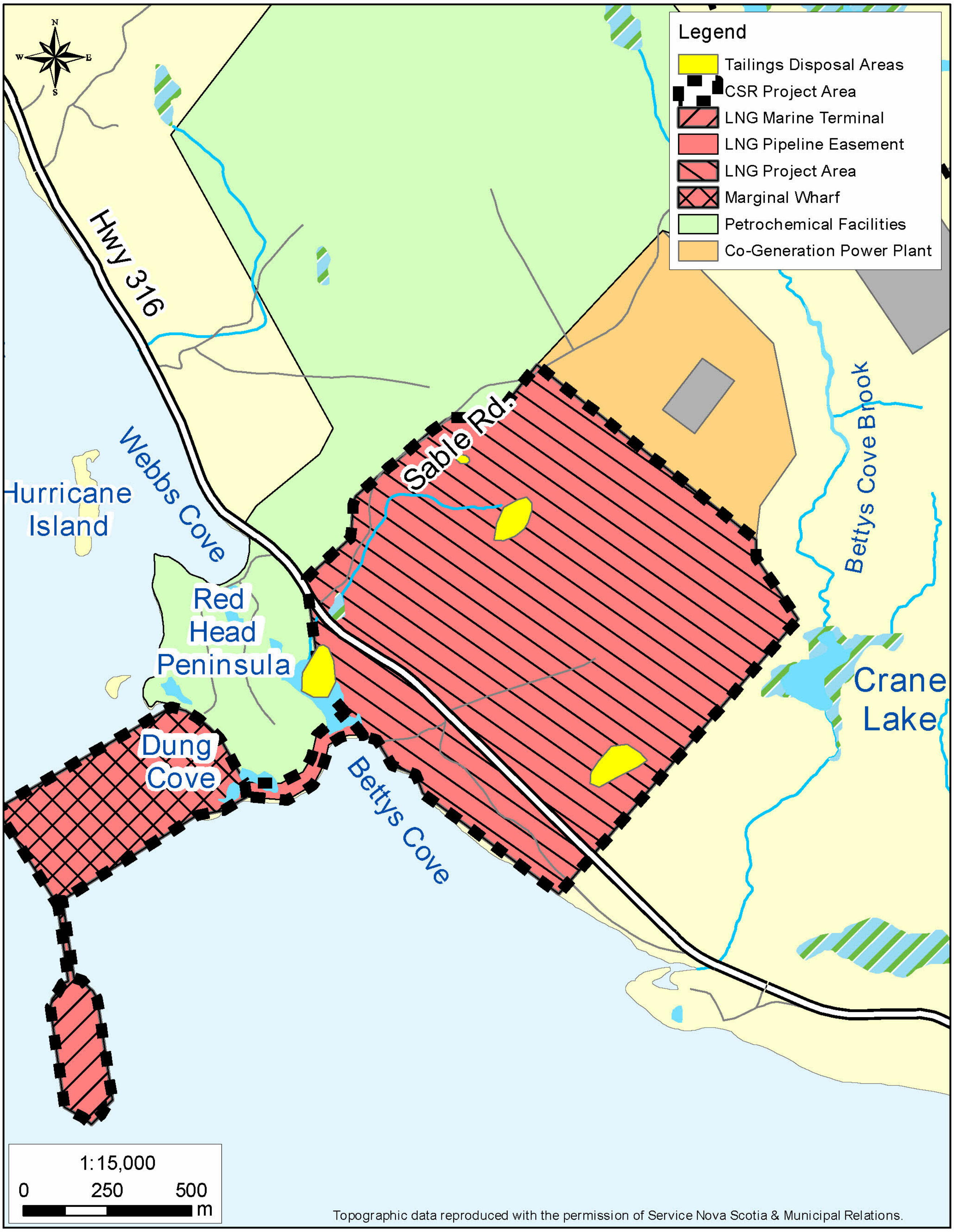
Gold mill tailings deposits remain as a legacy of the past mining activity in the area. Stamp milling and mercury amalgamation were the primary methods used for gold extraction in Nova Scotia and in the Goldboro area, much of which was done on-site; although there are reports that some sulphide mineral concentrate may have also been taken off site by boat to be processed elsewhere.

The stamp milling process involved crushing ore to sand or silt-size material, then washing the pulp over mercury-coated copper plates. Some of the free gold would combine with the mercury to form an amalgam, which was periodically scraped off the plates and heated in a retort to recover the gold. As a general rule of thumb, one ounce (oz) of mercury was used for each ounce of gold in the ore to obtain satisfactory recovery rates. At most stamp mills, 10-25% of the mercury used in the process was lost to the environment by loss with tailings, by evaporation during heating to recover gold, or by direct spillage (Smith, pers. comm. 2005; Parsons and Percival, 2005). Historical records of mercury loss from several gold districts range from 0.07 - 0.177 oz (5.5 grams) of mercury per tonne of ore crushed.

Recent investigations by Parsons et al. (2004) just outside the proposed KDP boundaries and at other sites in Nova Scotia have documented high concentrations of mercury (up to 350 milligram per kilogram (mg/kg)) and arsenic (up to 31% by weight) in mine wastes. The map in Figure 4.1-14 shows the location of tailings disposal areas identified by a geoscientist in the field within the proposed Keltic Site boundaries.

The remains of three former gold mills and three (possibly four) tailings disposal areas were found within the proposed Project boundaries during the field work. All that remains of the two steam-operated and one water-operated stamp mills today are the stone and concrete foundations.

One mill was located at Universal Transverse Mercator (UTM) 5001788N/606744E on the peninsula (proposed marginal wharf area) west of Dung Cove a short distance north of Red Head. The foundation remains suggest that this mill was small. It appears that tailings from it were disposed of directly into the ocean as no traces of any tailings could be found on land.



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Drawn by S. Turner
Projection: NAD83 CSRS UTM Zone 20N
Job No.: TV61029

Figure 4.1-14
KELTIC PETROCHEMICALS INC.
Location of Tailings Disposal Areas within the Project Area
JUNE 2007

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Another mill foundation was located at UTM 5001948N/607073E, about mid-way between Route 316 and Dung Cove. The remains suggest that it may have been a small-to medium-size, water-powered mill. Tailings from it were disposed of directly into Dung Cove, and are easy to identify along a 50 m to 75 m stretch of the north shore of the cove, extending what appears to be some distance under water. Four samples were taken of these tailings for mercury and arsenic analysis as part of this EA; the results are presented in Table 4.1-21.

The third mill, a part of the Giffin Mine, was found at UTM 5002393N/607577E a short distance southeast of the SOEI gas plant road. Based on the foundation and boiler remains, this appears to have been the largest of the three mills. Tailings from it were disposed of in a 50 m by 30m area located a short distance down gradient and northwest of the mill (UTM 5002529/607507). This former tailings disposal area was assessed for possible gold reserves by Newbury (1974), and again about ten years later by Seabright Resources Inc. (1984). Seabright identified it as having an area of 1,584 metres squared (m^2), a tailings thickness of 0.70 m, and a volume of 1,113 m^3, containing 1,570 tonnes of tailings grading 0.70 grams per tonne (g/t) gold. Nine samples were taken of the tailings for this assessment for mercury and arsenic analysis – the results are in Table 4.1-21.

TABLE 4.1-21 Tailings Sample Results from Giffin Mine and Dung Cove Areas

Sample ID	Mercury		Arsenic		Location (UTM)	
	mg/kg	Detection Limit	mg/kg	Detection Limit	Easting	Northing
102F01-GMA1	24	1	1600	2	607496	5002544
102F01-GMA2	30	2	6700	2	607500	5002527
102F01-GMA2 Dup			6100	2		
102F01-GMA3	13	0.4	8000	2	607503	5002510
102F01-GMA4	11	0.2	2600	2	607516	5002513
102F01-GMA5	9.9	0.2	1100	2	607528	5002515
102F01-GMA6	19	1	2200	2	607525	5002527
102F01-GMA7	21	1	1600	2	607523	5002539
102F01-GMA8	26	1	1300	2	607510	5002541
102F01-GMA9	31	1	3400	2	607512	5002529
102F01-T1	4.7	0.1	1700	2		
102F01-T2	3.1	0.1	150	2	607056	5001928
102F01-T2 Dup			160	2		
102F01-T3	8.1	0.1	14	2	607069	5001912
102F01-T4	6.4	0.1	1100	2	607046	5001941
CCME*						
soil – agricultural	6.6		12			
soil – residential/parkland	6.6		12			
soil – commercial	24		12			
soil – industrial	50		12			
sediment – fresh water (ISQC)	0.170		5.900			
sediment – fresh water (PEL)	0.486		17.000			
sediment – marine (ISQC)	0.130		7.240			
sediment – marine (PEL)	0.700		41.600			

* December 2003. ISQC = interim sediment quality guidelines. PEL = probable effect level.

A fourth (possible) former tailings disposal area is present a short distance southeast of the third area. Based on Newbury (1974), and on the presence of healthier-looking vegetation than at the other sites, this was thought to be a water supply pond built for the mill described above, and thus no samples were collected. However, it was discovered after the field session that Seabright Resources Inc. (1984) had sampled this 65 m by 15 m pond and found gold to be present in it, thus suggesting that it was a tailings disposal pond and that it is likely to contain mercury and arsenic. Seabright identified this tailings pond as having an area of 1,026 m^2, thickness of 0.43 m and volume of 438 m^3 containing 617 tonnes of tailings grading 2.00 g/t gold.

All of the tailings samples collected during the assessment field session for which results are shown in Table 4.1-21 exceed the CCME guideline values for mercury for sediments in fresh water and marine environments. All of the samples exceed the CCME guideline values for arsenic for sediments in all aquatic environments and for soil under all land uses (agricultural, residential/parkland, commercial and industrial).

4.1.5.3 Marine

Information regarding the marine environment was also derived from the CSR submitted by the EnCana Corporation in 2002 for the Deep Panuke Offshore Gas Development Project. The EnCana sub-sea pipeline crosses the Keltic Project Study Area to deliver market-ready gas to the M&NP main transmission line through Goldboro, Nova Scotia (Figure 4.1-1) and contains extensive environmental studies for this area.

According to the EnCana Corporation, 2002 Deep Panuke Offshore Gas Development Plan Application document, the bottom substrate of the nearshore region is composed mostly of rocks ranging from gravel to boulders interspersed with bands of sandy substrate (EnCana Corporation, 2002). Carbon concentrations are consistent throughout the area. The trace metals in the nearshore area with the highest concentrations are aluminum, barium, chromium, strontium, vanadium, zinc, and manganese (EnCana Corporation, 2002). Biogenic and petrogenic sources contribute to hydrocarbons in marine sediments (EnCana Corporation, 2002). With the exception of one sample, the petroleum hydrocarbon concentrations in the nearshore area are under the laboratory detection limit (Jacques Whitford Environmental Limited, 2002).

In May and August 2004, NRCan and DFO carried out a collaborative field program to determine impacts of historical mine tailings disposal on marine sediments and water in the Isaac's and Seal Harbour areas. Although these findings have yet to be published, consultation with NRCan has revealed some sampling sites in Isaac's Harbour show sediments containing elevated levels of arsenic and mercury that are in excess of the CCME Interim Marine Sediment Quality Guidelines (EnCana Corporation, 2006). These guidelines stipulate that concentrations of arsenic and mercury in sediments should not exceed 7.24 parts per million (ppm) and 130 parts per billion (ppb), respectively (CCME, 2005).

4.1.6 Description of Existing Ambient Air Quality

In general, the offshore areas of Nova Scotia have excellent air quality. Except for isolated sources, such as engine emissions from vessels transiting the area and a few exploration rigs and production platforms, there are no local sources of air pollution. The low-level air pollutants observed in the Study Area can be attributed to long-distance transport from cities along the Atlantic coast and in the northeast United States (EnCana Corporation, 2002).

It is likely that air quality in the Study Area falls within the desirable objectives of the federal classification and well within provincial limits, as evidenced by the results of the SOEI Onshore EEM air monitoring program at the gas plant in Goldboro (SOEI, 2001). These results show some detectable, and some non-detectable NO_x concentrations when the wind direction was from the gas plant toward the monitoring station. The magnitude of these concentrations was generally similar to the magnitude of NO_x from other wind directions; that is, very low, and likely due to vehicular traffic on the local road.

The specific air contaminants that are of most interest relative to the impact of the Keltic Facility operations, including the LNG Facilities, consist of the following:

- sulphur dioxide (SO_2), formed when fuel containing sulphur, such as coal and oil, is burned, and when gasoline is extracted from oil, or metals are extracted from ore;
- NO_x, generated when fuel is burned at high temperatures as in a combustion process;
- CO, formed from the incomplete combustion of carbon-containing fuel;
- total suspended particulates (TSP), PM with aerodynamic diametre less than a nominal 10 micrometres (PM_{10}) and less than 2.5 micrometres ($PM_{2.5}$), terms for particles found in the air, including dust, dirt, soot, smoke, and liquid droplets; and
- VOCs.

According to a 2003 emissions inventory reported by EC, the only other significant source of air contaminants emissions within 25 km of the Keltic Project Site is the adjacent SOEP gas plant and metering station. As a result of the lack of industry in the Project Area, the only available background air quality data consist of short-term monitoring data collected by ExxonMobil at their Goldboro Gas Plant as that facility is the primary contributor to ambient concentrations of most air contaminants in the area. Background ozone concentrations are primarily the result of long range transport of ozone and its precursors (i.e., NO_x and VOC) from upwind regions, primarily from the south and west.

Continuous monitoring for nitrogen dioxide (NO_2) and SO_2 near the Goldboro plant was conducted in Seal Harbour from June 10, 2004, through August 10, 2004. There are no other longer term background air quality data available that are representative of this area. The highest monitored 24-hour NO_2 concentration during this 2 month period was approximately 2.0 ppb and the highest SO_2 value was 4.0 ppb. Monitoring for TSP and $PM_{2.5}$ at Seal Harbour was conducted for three 24-hour periods in each of July, August, and September of 2004. The highest monitored 24-hour TSP concentration during this 3 month period was 19.8 micrograms per metre cubed (μg/m^3) and the highest $PM_{2.5}$ value was 4.0 μg/ m^3.

4.1.7 Climatic Conditions

Nova Scotia has a “temperate continental” climate (Rudloff, 1981) marked by relatively large daily and day-to-day ranges of temperature, especially during the spring and fall, and moderate rainfall. This area lies in the "prevailing westerlies" that are characteristic of mid-latitudes in the northern hemisphere. Within this general circulation are embedded air masses originating at higher or lower latitudes that interact to produce storm systems. Nova Scotia experiences a relatively large number of storm systems that contribute to a roughly twice-weekly shift between fair and cloudy and stormy weather.

The continental climate is modified by Nova Scotia's surrounding waters (EC, 2005a). The Atlantic and Bay of Fundy waters are relatively cold (8-12°C) which helps to keep the air temperature over southwestern Nova Scotia on the cool side in spring and summer. In January, when water temperatures are between 0 and 4°C, winter temperatures become moderate. Farther offshore to the east, southeast, and south are the comparatively warm 16°C waters of the Gulf Stream that are credited with prolonging warm weather well into October. Ice conditions in the Gulf of St. Lawrence retard the arrival of spring. Cool summer seas also help stabilize overriding air masses, thus suppressing local storm development. In addition, the merging of contrasting ocean currents (i.e., warm Gulf Stream and the cold Labrador Current) produces a great deal of sea fog that often moves far inland.

4.1.7.1 Temperatures

Winter temperatures are moderate along the coast. Yarmouth's average January temperature of -2.7°C is the highest of any mainland station in the Maritimes. Inland, January means are between -4°C and -6°C. The most significant aspect of winter is the marked day-to-day variation caused by the alternation of Arctic and maritime air (EC, 2005b).

Summers are relatively cool in Nova Scotia. Afternoon summer temperatures reach 25°C in the interior, but along the coast are frequently 4°C to 6°C cooler. At night the ocean remains a cooling source, keeping minimum temperatures along the coast about 2°C to 3°C below those inland. Halifax has a July mean temperature of 17.4°C, while Yarmouth's mean July temperature is 16.3°C.

4.1.7.2 Winds

Winds blow predominantly from the south or southwest in the summer with an average speed of about 10 to 15 kilometres per hour (km/hr). In the coldest months, the predominant direction is from the west and northwest with an average speed of 22 km/hr (EC, 2005b).

The wind at any given location is often quite different from the wind conditions which prevail even a short distance away. The variations that occur in both wind direction and speed results from the characteristics of natural and man-made obstructions, topography, and surface cover. Along the coast, an onshore sea breeze circulation often sets up, particularly during a warm, sunny afternoon in the spring or early summer (EC, 2005b).

Wind statistics taken between 1988 and 1999 from Beaver Island at the mouth of Country Harbour showed average monthly nearshore wind speeds between 19 and 31 km/hr. Extreme average hourly wind speeds ranged between 65 and 98 km/hr. Westerly winds predominated, with stronger winds more from the northwest (November to January) than the southeast (Meteorological Service of Canada, 2000).

4.1.7.3 Precipitation

Nova Scotia is wettest over the highlands of Cape Breton Island, where over 1600 mm of precipitation fall in an average year. The southern coast experiences almost as much, with totals of 1500 mm. By contrast, the north shore along the Northumberland Strait has less than 1000 mm a year (EC, 2005b).

Precipitation is slightly greater in the late fall and early winter because of the more frequent and intense storm activity. In most years there is a good supply of rain during the growing period. However, drought is not unknown in Nova Scotia.

On average, only about 15% of Nova Scotia's total annual precipitation originates as snow. Snowfall is relatively light near the warm Atlantic shore and near the entrance to the Bay of Fundy, where less than 150 cm may fall in one winter. Here, copious rain and freezing rain make up for the scanty snowfalls. Inland, the yearly snowfall increases to 250 cm. As a rule, elevated areas receive the greatest snowfall and have the longest snow cover season (EC, 2005b). The snow-cover season, that is, the period when there is at least 2.5 cm of snow on the ground, varies considerably. Usually its duration extends from about 110 days a year along the southern coast to 140 days inland and in areas adjacent to the frozen seas. In coastal areas the snow-cover may come and go.

4.1.7.4 Fog

Each year there is an average of 101 days with fog at Shearwater, although on most days fog persists for less than 12 hours. The period from mid-spring to early summer is the foggiest time. Bands of thick, cool fog lie off the coast, produced where the chilled air above the Labrador Current mixes with warm, moisture-laden air moving onshore from the Gulf Stream. With onshore winds these banks of fog move far inland. Sea fog often affects the headlands by day, moving inland and up the bays and inlets at night. At other times of the year fog is much more transient and local in nature (EC, 2005b).

Due to the extensive fogs, as well as mists, low cloud, and smog, sunshine amounts throughout the province are usually less than half the total possible. Sunshine totals range from 1700 to 1969 hours a year. July is the sunniest month inland, and August is the sunniest along the coast. Sunless days (days with less than 5 minutes of bright sunshine) amount to between 75 and 90 a year, with a marked seasonal high from November to February. Sunny days, on which less than 70% of the sky is covered with cloud in the early afternoon, amount to between 130 to 160, with a peak from July through October (EC, 2005b).

4.1.7.5 Severe Weather

Storms frequently pass close to the Atlantic coast of Nova Scotia and cross the southern part of Newfoundland, producing highly changeable and generally stormy weather. This region has more storms over the year than any other region of Canada. With a variety of weather conditions from hurricane-force winds to heavy precipitation, they can pass rapidly through or stall and batter the region for several days. Other conditions associated with these storms include freezing spray, reduced visibility in snow, rain, or fog, and numbing wind chills, especially in the storm's wake.

In late summer and fall the remnants of a hurricane or tropical storm are felt at least once a year in Nova Scotia. For example, on August 15-16, 1971, Hurricane Beth brought 296 mm of rain to Halifax, enough to wash away several bridges, damage buildings, and flood farmland (EC, 2005b).

Nova Scotia is not known for frequent thunderstorms but this type of weather condition occurs about 10 days of the year, about half the number that occur in northern and central New Brunswick. Tornadoes have been recorded but are rare. Reports of waterspouts over near-shore waters are received yearly (EC, 2005b).

Other severe weather phenomena include ice storms and blizzards. Each year one or two 25 cm snowfalls occur in Nova Scotia. When combined with strong winds, they can cause property damage and loss of life.

4.1.7.6 Normals and Extremes

The climate of the Keltic Project Site is best characterized by long-term meteorological data collected by EC at Stillwater-Sherbrooke (Table 4.1-22) and at Halifax-Shearwater station (Table 4.1-23). Stillwater-Sherbrooke is located approximately 25 km west of the Keltic Project Site. The Halifax-Shearwater station is located approximately 160 km southwest of the Keltic Project Site and is included for its wind speed and direction data and other parameters that are not available from Stillwater- Sherbrooke. These distances from the site support the spatial representation since they place them in the same general synoptic flow regime as well as most mesoscale systems. The Stillwater-Sherbrooke and Halifax-Shearwater stations are also located in a similar geographic setting as the Keltic Project Site and provide the commonly observed meteorological parameters.

Normal monthly precipitation is fairly uniform throughout the year at both stations with the larger amounts generally occurring in the fall and early winter months (90-148 mm per month) and the least amounts in the summer (97-112 mm per month). The annual average rainfall amount at Stillwater-Sherbrooke is 1,517 mm per year while at Halifax-Shearwater, it is 1,421 mm per year. Record 24-hour rainfall amounts of 142.6 mm and 184.9 mm have been recorded at Stillwater-Sherbrooke and Halifax-Shearwater, respectively. The average annual snowfall amounts at Stillwater-Sherbrooke and Halifax-Shearwater are 172.1 cm and 176.4 cm per year, respectively. Specific precipitation data for the Goldboro Region itself is explored in more detail in Section 4.1.1, where some 20 months of monthly precipitation is documented for Sherbrooke, Deming, Collegeville, Goldboro, and Salmon River, during the period from October 2001 through May 2003. Further details are provided in Figure 4.1-2 (Section 4.1.1), which indicates the location of study rain gauges and EC Climate Stations.

TABLE 4.1-22 Stillwater-Sherbrooke Climate Normals (1971-2000) and Extremes (1967-2001)

Temperature	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily Average (°C)	-6	-5.7	-1.2	4	9.2	14.4	18.3	18.4	14.3	8.8	3.8	-2.2
Daily Maximum (°C)	-0.9	-0.5	3.6	8.4	14.6	20.3	24	23.9	19.8	13.9	7.8	2.2
Daily Minimum (°C)	-11	-10.8	-6	-0.5	3.8	8.5	12.7	12.9	8.7	3.7	-0.3	-6.5
Extreme Maximum (°C)	17.5	14.5	25.5	23.3	32	35	34	32.5	32.2	26.7	18.5	15.5
Date (yyyy/dd)	1995/16	1981/23	1998/31	1973/18	1992/22	1976/24	1999/18	1991/14	1969/01	1968/02	1983/05	1998/01
Extreme Minimum (°C)	-31	-39	-29	-12.5	-6.1	-2.2	3.5	1.7	-3	-7	-15.5	-32.5
Date (yyyy/dd)	1993/31	1985/07	1985/07	1986/05	1972/14	1969/01	1993/18	1968/20	2000/30	1993/11	1989/25	1989/29
Precipitation												
Rainfall (mm)	94.5	72.9	97.9	102.1	126.1	112.5	97.1	109.9	122.9	141.5	149	118.9
Snowfall (cm)	42.6	41.8	29.2	14.2	0.5	0	0	0	0	0	9.1	34.7
Precipitation (mm)	137	114.7	127.1	116.2	126.6	112.5	97.1	109.9	122.9	141.5	158.1	153.6
Extreme Daily Precipitation (mm)	96	71.2	80	85	105.9	78.7	75	134.8	142.6	81.3	89.6	114.3
Date (yyyy/dd)	1990/26	1988/16	1972/23	1982/28	1972/16	1970/27	1983/22	1990/01	1996/14	1967/10	1983/16	1975/10
Days with												
Maximum Temperature > 0 °C	14	14.3	24.5	29.5	31	30	31	31	30	31	28.8	20.9
Measurable Rainfall	6.2	5.4	7.2	9.4	11	9.9	8.5	8	9	10.9	11.4	8.4
Measurable Snowfall	7.3	6.7	4.3	2.3	0.15	0	0	0	0	0.08	2.2	5.7
Measurable Precipitation	11.6	10.5	10.2	10.9	11	9.9	8.5	8	9	10.9	12.4	12.4

EC, 2005b.

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TABLE 4.1-23 Halifax-Shearwater Climate Normals (1971-2000) and Extremes (1944-2001)

Temperature	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Daily Average (°C)	-4.7	-4.5	-0.8	4.2	9.2	14.2	17.8	18.2	14.7	9.1	4.2	-1.6	6.7
Daily Maximum (°C)	-0.2	-0.2	3.2	8.1	13.6	18.7	22.1	22.4	18.9	13.1	7.8	2.6	10.9
Daily Minimum (°C)	-9.2	-8.8	-4.8	0.2	4.7	9.6	13.5	14	10.4	5.1	0.5	-5.7	2.5
Extreme Maximum (°C)	14.3	16.2	21.8	27.8	32	33	33.3	32.4	33.3	27.8	22.2	15.6	
Date (yyyy/dd)	1995/16	1994/20	1998/31	1945/11	1977/23+	1983/23	1963/26	1995/01	1945/08	1946/06	1956/01	1957/10	
Extreme Minimum (°C)	-26.5	-25.7	-22.2	-12.2	-3.3	2	6.7	5.6	-0.5	-5.6	-11.4	-23.5	
Date (yyyy/dd)	1994/26	1993/07	1948/06	1946/01	1945/03	1982/12	1946/04	1965/31	1980/29	1974/22	1978/27	1989/29	
Precipitation													
Rainfall (mm)	95.5	69.3	97.2	97.9	110.8	107.8	107.4	96.9	100.1	124.9	129	117.6	1254.3
Snowfall (cm)	43	40.3	30.9	15.6	2.3	0	0	0	0	1.6	9	33.6	176.4
Precipitation (mm)	134.7	107.4	127.3	114.3	113.5	107.8	107.4	96.9	100.1	126.6	137.1	148.3	1421.4
Extreme Daily Precipitation (mm)	78.2	87.9	70.4	96.9	91.4	80	131.6	184.9	90.8	78.2	70	111.3	
Date (yyyy/dd)	1958/16	1958/08	1972/23	1982/28	1947/01	1944/21	1954/20	1971/15	1996/02	1967/10	1991/11	1946/21	1254.3
Wind Speed													
Speed (km/hr)	18.1	17.7	17.8	16.9	14	12.8	11.3	11.1	12.8	14.8	16.5	17.7	15.1
Most Frequent Direction	W	NW	NW	N	S	S	S	SW	SW	W	NW	W	W
Maximum Hourly Speed	83	97	78	85	72	77	87	60	97	80	89	89	
Date (yyyy/dd)	1990/30	1963/20	1986/07	1962/13	1961/20	1964/12	1975/28	1956/08	1954/11+	1962/07	1958/29	1956/30+	
Maximum Gust Speed	127	146	148	122	106	111	114	93	126	132	121	150	
Date (yyyy/dd)	1960/03	1976/02	1976/17	1962/13	1961/03	1964/12	1975/28	1986/09	1958/29	1963/29	1963/08	1956/30	
Direction of Maximum Gust	S	S	SW	NE	W	NW	S	SW	N	S	NE	SW	SW
Days with													
Maximum Temperature > 0 °C	15.9	14	24.2	29.7	31	30	31	31	30	31	28.7	22.1	318.5

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Temperature	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Measurable Rainfall	9.2	7	10	12.7	14.5	13.1	12.2	10.8	11.8	12.6	13.3	11.5	138.6
Measurable Snowfall	11.3	9.7	8.1	4.5	0.5	0	0	0	0	0.3	2.7	8.8	45.9
Measurable Precipitation	16.7	13.4	14.7	14.5	14.7	13.1	12.2	10.8	11.8	12.6	14.7	16.5	165.7
Other													
Sunshine Hours	111.7	127.5	143.1	155.4	195.9	221	227.8	229.6	181.9	157.2	113.3	100	1964.6
Daytime Relative Humidity (%)	76.3	73.4	72.7	69.3	69.8	69.5	71.2	69.5	66.8	67.7	72.3	76.6	71.2

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The range of temperatures at the site is rather large from winter to summer. Summers are relatively cool, for example, the warmest average daily maximum temperature recorded at either station from June to August was 24°C. The record high temperature at Stillwater-Sherbrooke is 35°C in the month of June and is 33.3°C at Halifax-Shearwater occurring in July and September. The average daily maximum temperature at Stillwater-Sherbrooke for July and at Halifax-Shearwater for August is 24°C and 22.4°C, respectively. Winters are cold with average daily minimum temperatures in January at Stillwater-Sherbrooke and Halifax-Shearwater of -11.0°C and -9.2°C, respectively. The lowest recorded temperature at Stillwater-Sherbrooke is -39°C and at Halifax-Shearwater, it is -26.5°C.

Winds at Halifax-Shearwater are fairly light with the highest speeds occurring in the winter with an average of 17.8 km/hr for those months. A peak gust of 150 km/hr was recorded in December 1956. The lightest winds occur in summer with a monthly average wind speed of 11.1 km/hr in August. The mean wind speed for the year is 15.1 km/hr. The prevailing wind direction at Halifax-Shearwater is from the south or southwest from May through September and from the west or northwest from October through April. There are no wind data available from Stillwater- Sherbrooke.

4.1.8 Marine Biophysical Environment

The Project (LNG facility including the marginal wharf and marine LNG Terminal area) is located near the coastal waters of Stormont Bay, Country Harbour, and Isaac's Harbour (Figure 1.0-1). This area is located within the Guysborough Harbours Unit, a coastal ecological zone characterized by long, narrow inlets with steep valley sides. The coastline is submerged, with parallel inlets and estuaries separated by headlands typically composed of greywacke or granitic bedrock covered with a thin layer of quartzite till. Glaciofluvial deposits of coarse sand and gravel are found in many of the river valleys, while the coastline is generally rockier with few sand beaches (NSMNH, 1996a).

Stormont Bay is predominantly covered with fine sand and silt with scattered rock shoals. The subtidal zone, generally extending to depths of about 15 m below mean low water, has a predominantly sand and gravel bottom (NSMNH, 1996a). The near-shore marine habitat at Red Head has a substrate of boulders, cobbles, and pebbles, with finer materials such as sand and gravel in more protected bays.

The Goldboro area was historically a site of active gold mining. Evidence of this activity can still be seen in the form of abandoned mine sites and tailings dumps. Gold mine tailings tend to be high in arsenic and mercury as a result of the gold extraction process. Several tailings sites have been identified near the main Keltic Project Site both on land and in the harbour. Sediment samples taken from the proposed wharf site do not show elevated mercury or arsenic levels and the terrestrial sites appear to be well contained.

A recent joint study by NRCan and DFO examined mercury and arsenic contamination levels in Isaac's Harbour and found that while there is a layer within the near surface sediment with an elevated metal content, the concentrations are within acceptable limits (Parsons, pers. comm., 2005). The sampling site nearest to Red Head shows almost no change in arsenic levels throughout the sediment column with a slight elevation of mercury near the surface of the sea bottom.

4.1.8.1 Wave Climate

Stormont Bay and the estuarial heads of Country Harbour and Isaac's Harbour are relatively open to the ocean and are therefore exposed to significant wave action. Although inner landmasses (such as Harbour Island) offer some protection from wave action, most shoreline in Stormont Bay is exposed and unsheltered. The predominance of large, cobbled beaches is indicative of this high-energy wave environment. Finer substrates, including silts, sands, and smaller pebbles, have been eroded or washed away. Coastline in the vicinity of the proposed Keltic wharf follows this pattern with rocky, coarse substrates dominating the shoreline.

There is little fetch and hence limited opportunity for coastal wind driven current to develop except in storms. Offshore wave statistics (AES40) show that most wave energy comes from the southern quadrant with the largest storms and waves occurring during winter months. Wave energy near the Project Site will be attenuated by the protection afforded by Country Harbour Head, other local protuberances, and by the effects of shoaling. However, it is expected that annual storm conditions may occasionally result in seas of 1-2 m in the deeper water near the face of the wharf and the LNG Terminal.

4.1.8.2 Currents

Ocean currents transport water from one region to another region, generally within an organized geographical flow (pathway) over a period of time. Currents are influenced by large global phenomenon (such as the Coriolis Effect), wind, tidal action, and also differences in pressure or density gradient caused by salinity, temperature, and water pressure. Tidal flow is the most dominant component affecting currents along inshore coastal regions (Cooperative Institute for Marine Atmospheric Studies, 2006).

Major currents on the Scotian Shelf are the Labrador Current and the Cape Breton current (which is the outflow of the Gulf of St. Lawrence). Mixing of these currents with more saline water from offshore creates the Nova Scotia Current, a southwesterly flow that predominates in Nova Scotia's nearshore areas year round. In more localized coastal areas such as Stormont Bay, tidal currents are forced back and forth parallel to the shoreline. In addition, freshwater inflows from Country Harbour River and Isaac's Harbour River contribute to increased circulation of water within the marine environment.

Current energy in this area is dominated by tidal flows. Some 'freshet' flow, primarily from Isaac's Harbour and Country Harbour Rivers, may have an influence in the spring. Relatively strong tidal streams of the order 10 cm/sec are predicted for near the proposed marginal wharf by simple models (i.e., based on the tidal prism) in response to the need for water to be transported upstream into Isaac's Harbour.

4.2 DESCRIPTION OF THE BIOLOGICAL ENVIRONMENT

An environmental evaluation was completed for the entire site of the KDP to document biological conditions including vegetation, fish and fish habitat, terrestrial wildlife and habitat, migratory birds, wetlands, and species at risk (Figure 4.2-1). This information is provided in Section 8.0 of the Provincial EA Report (AMEC, 2006). The description of the biological environment contained in this CSR is applicable to the Project as defined by the scope of the CSR, i.e., the LNG Facility, the LNG marine terminal the marginal wharf, and the marine environment potentially affected by the Project-related marine transport within a 25 km radius around Country Island.

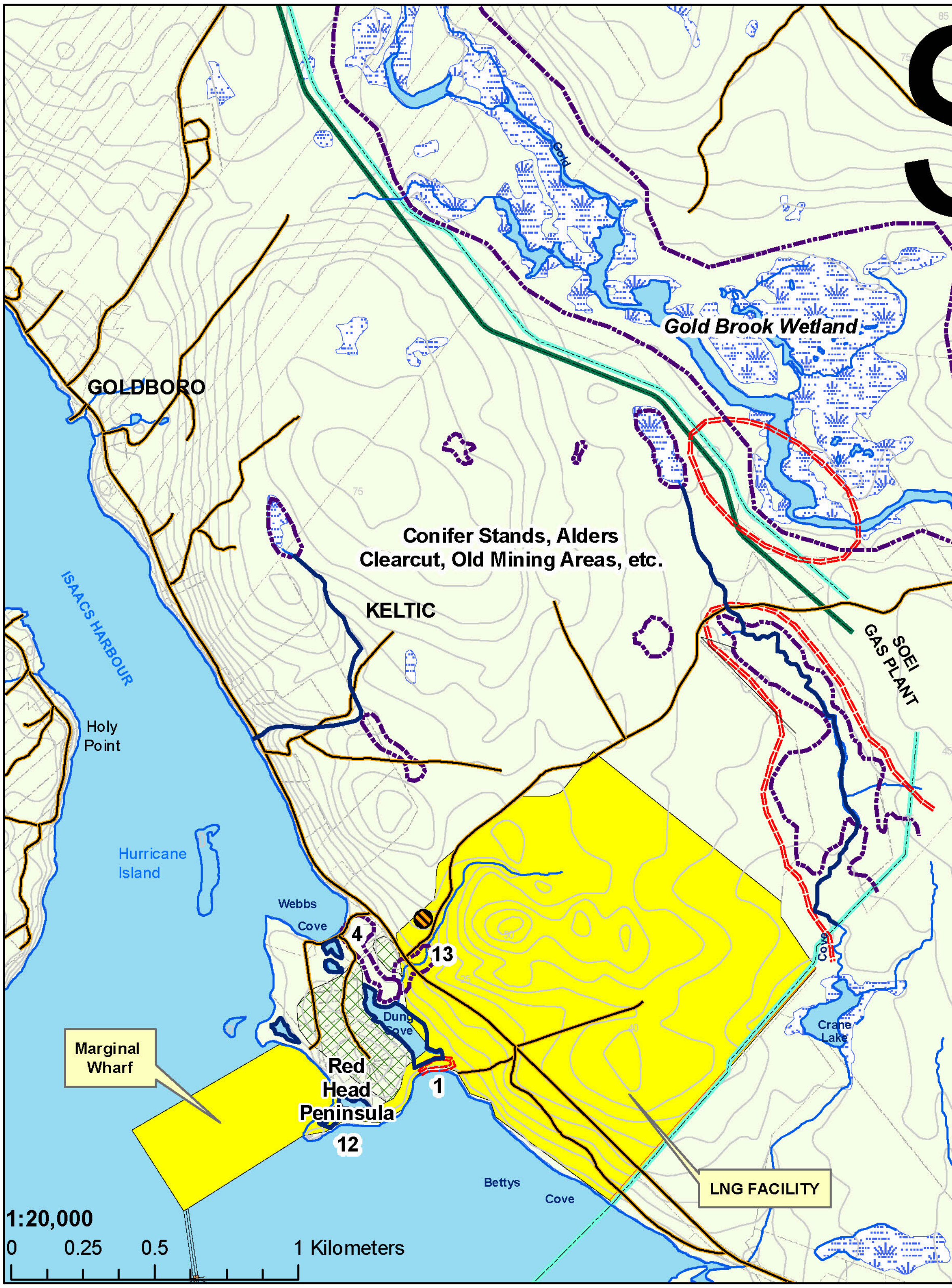
4.2.1 Vegetation

4.2.1.1 Terrestrial

The proposed LNG Facility Site lies within the East Atlantic Shore Section of the Acadian Forest Region (Rowe, 1972) which is essentially the Atlantic Coast Terrestrial Theme Region described in The Natural History of Nova Scotia, Vol. 2, Theme Regions (NSMNH, 1996a). This region is characterized by stands of black spruce (*Picea mariana*), balsam fir (*Abies balsamea*), white spruce (*Picea glauca*), and larch (*Larix laricina*) in the wetter areas. Immediately north and parallel to the coast line is the Atlantic Uplands Region (Rowe, 1972), which effectively is also the Atlantic Interior Terrestrial Theme Region (NSMNH, 1996a). Different authors (i.e., Rowe, 1972; Loucks, 1962; and NSMNH, 1996a) ascribe different terminology and locations to the vegetation between the Atlantic Uplands and the area of Antigonish. Nonetheless, the basic pattern is that on the higher, better drained areas to the north, deciduous species become more common, especially red and sugar maples (*Acer rubrum and Acer saccharum*), white and yellow birches (*Betula papyrifera and Betula alleghaniensis*), and beech (*Fagus grandifolia*).

The LNG Terminal area is located on a peninsula (approximately 35 ha). Much of the peninsular area reflects past farming activity as indicated by the presence of old-field. The southern half of the peninsula contains a mosaic of white spruce that has colonized the previously open old-field. Also, heath vegetation and alder (*Alnus sp.*) are dominant in much of this area. The southwestern tip of the peninsula is an exposed promontory known as Red Head. The three-toothed cinquefoil (*Potentilla simplex*), was found in one area; a species common to exposed sites. A portion of the terminal area from the base of the peninsula southeast to the site boundary is forested by mosaics of black spruce, balsam fir, and some white spruce. Much of this area has been clear cut. The vegetation assembly present in the area is identified in Figure 4.2-2.

Field studies on vascular plants were carried out in June, August, and early September, 2004, with a focus on the lake basins, New Harbour River, and the Keltic Project Site area. Additional field studies in June, July, and August, and early September, 2005, were carried out to complete the full season evaluations of vascular plants in all relevant areas, and to complete the evaluation of the Keltic Project Site proper.



Legend

- Roads
- Wetland Areas
- Sensitive Areas-Birds
- LNG Project Area
- Deer Wintering Areas
- Ponds/Streams
- Rare Plant Lcoation

FIGURE No. 4.2-1
KELTIC PETROCHEMICALS INC.
KELTIC PLANT SITE AND TERMINAL
June 2007

Note: See Text for Numbered Map Site Designations

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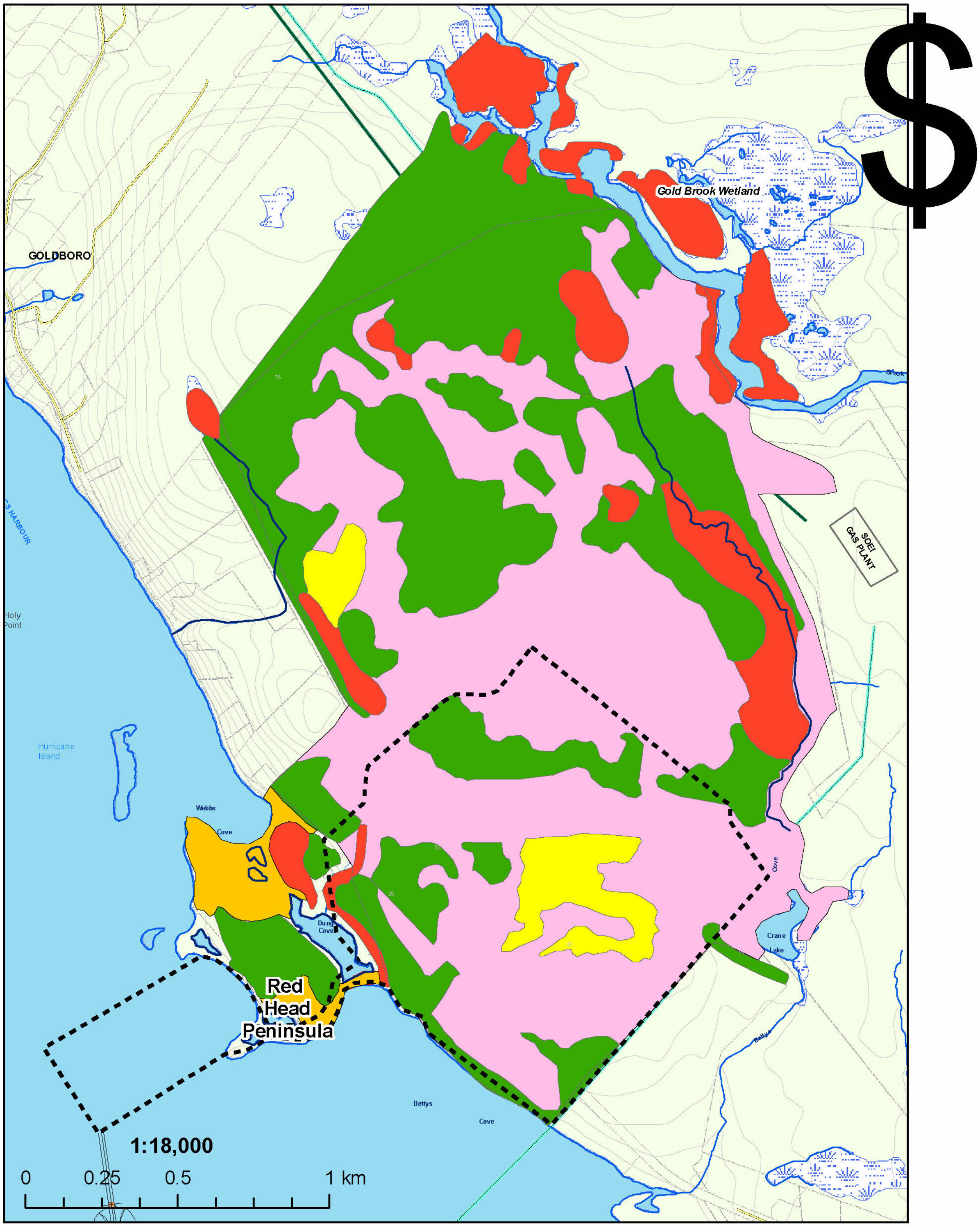

Legend

LNG Project Area

Vegetation Type

- Clearcut, Brush, Barrens, and unclassified species
- Conifer Stand
- Intolerant HW/ Mixed Conifer
- Old Agricultural Fields
- Wetland, Fens and Treed Bogs

FIGURE No. 4.2-2
KELTIC PETROCHEMICALS INC.
VEGETATION TYPES
June 2007

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The complete list of vascular plants noted for all sites is provided, for comparison and to contribute to the regional context, in Appendix 7 of the Provincial EA Report (AMEC, 2006). A total of 305 vascular plants were noted in all sites combined of which 259 (85%) are native plants (AMEC, 2006). The number of species found at Gold Brook Lake and on the Keltic Project Site proper, including the LNG Facility Area, is shown in Table 4.2-1.

TABLE 4.2-1 Number of Vascular Plant Species

Study Site	# Native (%)	# Introduced (%)	Total Number
Keltic Site Proper	189 (80)	46(20)	235

*These values are greater than the total number in the overall Study Area as some will occur in more than one study site.

Not surprisingly the largest number of introduced species occurs in the Keltic Project Site/ LNG Terminal area. These are the areas that have been exposed to the greatest amount of human activity which introduces non-native species into an area, often inadvertently, and creates disturbances such as farming activity and road building where introduced species are at a competitive advantage. The Keltic Project Site is the most diverse, due especially to the LNG Terminal area with its marine influence and the greater number of introduced species.

No plant species observed is reported nationally rare or at risk, but one species, a horsetail (*Equisetum variegatum*), rare in Nova Scotia, (Zinck, 1998; Pronych and Wilson, 1993) was found on the LNG Site proper. The on-site location is shown in Figure 4.2-1.

Additional information regarding riparian vegetation is provided in Section 4.2.4 (Wetlands).

There are no terrestrial plant species of special status within the LNG Facility Area.

4.2.1.2 Aquatic (Vascular)

During the field surveys conducted in 2004 and 2005 fourteen aquatic vascular plants were identified. Aquatic vascular plants are defined as plants which reside within shallow to deep waters. Six species were found on the Keltic Project Site proper and are indicated in Table 4.2-2.

TABLE 4.2-2 Aquatic Vascular Plant Species at the Keltic Project Site

Family Scientific Name	Common Name	Habitat Requirements*
APIACEAE *Sium suave*	Water-parsnip	Wet meadows, shores, swamps, and shallow water.
HIPPURIDACEAE *Hippurus vulgaris*	Mare's-tail	Along damp shores and in shallow waters.
LENTIBULARIACEAE *Utricularia cornuta*	Horned Bladderwort	Acid peat bogs and on boggy shores.
HYDROCHARITACEAE *Vallisneria americana*	Water Celery	Shallow calm waters.
ACORACEAE *Acorus americanus*	Sweetflag	Marshes and shallow water.
SPARGANIACEAE *Sparganium angustifolium*	Bur-reed	Acid waters.

*Source: Zinck, 1998

Additional information regarding aquatic vegetation is provided in Section 4.2.2.2 (Freshwater Fish and Fish Habitat).

There are no vascular vegetative species of special status within the LNG Facility Area.

4.2.1.3 Plankton and Marine Plants

Plankton includes two groups of generally free-floating, microscopic plants (phytoplankton) and animals (zooplankton). These species are an integral component of the ocean food chain as they are the major food source for many larger animals. Therefore, plankton is a major factor influencing overall ecological productivity of marine habitats.

Marine plants, including algal and flowering species and phytoplankton are the primary producers in the ocean. In addition to being a major source of food energy in the ocean, marine plants also provide shelter and habitat for a variety of other marine animals. Major algal groups include encrusted algae and seaweeds, such as kelp. Marine algae generally require hard substrates to which to attach. Due to their requirement for sunlight, most marine algae are restricted to depths to which light can penetrate. Flowering plants include eelgrasses and coastal marsh grasses and are generally restricted to habitats with finer substrates, often within protected bays and inlets.

A shoreline survey conducted in November 2004 observed the presence of typical coastal intertidal communities dominated by rockweed (*Ascophyllum nodosum*) and bladder wrack (*Fucus sp.*). Kelp and other seaweeds are generally abundant in all nearshore areas of Stormont Bay. The marginal wharf is located on a peninsula (approximately 35 ha) where there are several small scattered ponds (Map Site 12, Figure 4.2-1), mostly near the shore line, and most of which are brackish to some degree. The shoreline vegetation is outlined in Table 4.2-3 and is typical of marine shores in this area of Nova Scotia.

TABLE 4.2-3 Marine Shoreline Plant Species Identified in the Peninsular Area

FAMILY Scientific Name	**Common Name**	**Habitat Requirements***
RANUNCULACEAE *Ranunculus cymbalaria*	Seashore Buttercup	Scattered along the coast in marshes, shores, and inland to salt springs.
CHENOPODIACEAE *Atriplex cf. patula*	Spreading Orach	Uppermost beach margins and on fallen soil bank.
CHENOPODIACEAE *Sueda maritima*	Sea-blite	Coastal sandy shores and in salt marshes.
BRASSICACEAE *Cakile edentula*	Sea Rocket	Coastal beaches.
FABACEAE *Lathyrus maritimus*	Beach Pea	Coastal areas on sandy or gravely beaches.
BORAGINACEAE *Mertensia maritima*	Sea Lungwort	Sandy or gravely sea beaches.
CHENOPODIACEAE *Salicornia europea*	Glasswort	Salt marshes and near inland salt springs.
CHENOPODIACEAE *Chenopodium album*	Lamb's Quarters	Cultivated and disturbed ground.
PLUMBAGINACEAE *Limonium carolinianum*	Sea Lavender	Coastal salt marshes and upper areas of sea beaches.
PRIMULACEAE	Seal Milkwort	Coastal salt marsh.

FAMILY Scientific Name	**Common Name**	**Habitat Requirements***
Glaux maritima		
APIACEAE *Ligusticum scothicum*	Scotch Lovage	Coastal headlands, margins of salt marshes and ledges.
PLANTAGINACEAE *Plantago maritima*	Seashore Plantain	Coastal areas in salt marshes, sands and ledges.
POACEAE *Elymus mollis*	American Dune Grass	Sea beaches and sands.
POACEAE *Elymus virginicus*	Wild Rye Grass	Open wet woods and on gravel strands.

*Source: Zinck, 1998

Significant seasonal fluctuations in biomass and productivity of nutrients, phytoplankton, zooplankton, and fish occur within the nearshore and estuarine habitats of Stormont Bay. Studies conducted for the SOEP showed a temporal relationship between primary and secondary producers and predator species, as phytoplankton concentrations are controlled by zooplankton predation in the spring and fall, and zooplankton populations are controlled by fish predation. This results in productivity pulses and population peaks, including a fall phytoplankton bloom.

Many of these ecological dynamics are emulated in Stormont Bay and the estuarial environments of Country Harbour and Isaac's Harbour. Higher levels of phytoplankton exist in the mouth of Country Harbour compared to Stormont Bay, which coincides with higher nutrient levels found in estuarial habitats (SOEI, 2000). Zooplankton concentrations show three seasonal peaks in St. Georges Bay- in early summer, for fish eggs, in mid-summer for copepods, and in late summer for larger copepods. Larger-bodied zooplankton is more prevalent in colder months, and smaller-bodied in warmer months (Davis et al., 2000). Kelp beds are known to provide important lobster (*Homarus americanus*) habitat and are a source of food for sea urchin (*Strongylocentrotus droebachiensis)*. Seaweed density in the Red Head area is variable. To the east, seaweed abundance is moderate and is restricted to lower intertidal and upper subtidal zones. Productivity northwest of Red Head was significantly lower (Envirosphere Consultants Limited, 2004). Other vegetated habitats, such as eelgrass beds, are also important and have a much higher abundance and diversity of species than adjacent non-vegetated areas.

There is no plankton or marine plants species of special status within the LNG Facility Area.

4.2.2 Fish and Fish Habitat

4.2.2.1 Marine Fish and Fish Habitat

In response to proposed and constructed industrial projects in recent years, several EAs and other studies have been completed over the past decade in order to assess the habitat of the area. These studies have led to an increased knowledge of the marine environment and a better understanding of fisheries capability. Results from these studies, in addition to other relevant marine and ecological research from elsewhere in the province, support general observations of the biophysical environment of Stormont Bay and surrounding areas.

Information has been compiled in order to help assess the habitat and biological productivity of Stormont Bay and surrounding areas, particularly in terms of its relevance to the proposed Keltic Facility. The types of studies carried out for each of these Projects are described below.

Previous Studies and Methodology

Habitat Surveys

Between 1995 and 1997, the Guysborough County Coastal Resources Mapping Project mapped the fish habitat of coastal Guysborough County (including Stormont Bay, the Keltic wharf area, and adjacent areas) based on traditional knowledge of fishers and other local residents and boaters. Areas of important fish habitat, including fishing areas for scallop (*Placopecten magellanicus*), lobster, and sea urchin were identified.

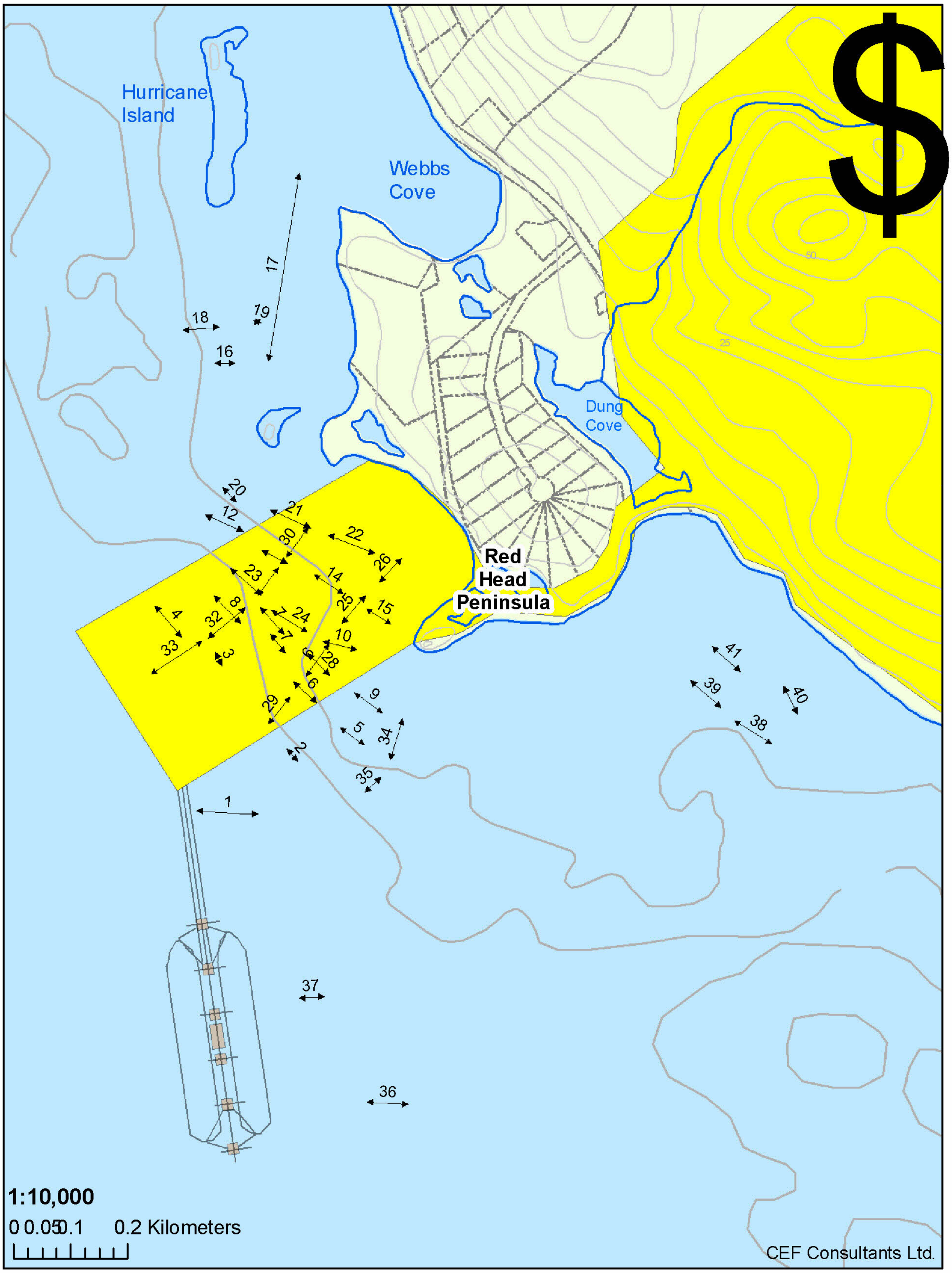
Between 1996 and 2000, studies were carried out during the planning, design, and construction phases of the SOEP, which was constructed to bring offshore gas into Goldboro near the proposed Keltic Facility. Biophysical studies included plankton surveys, sediment transport studies, and habitat assessments for species such as lobster and urchin.

EnCana Corporation's Deep Panuke Project also proposed bringing offshore natural gas to shore in a marine pipeline near Goldboro. Fieldwork for an environmental impact assessment was conducted in 2001, and updated in 2005, and included an offshore benthic habitat and community survey.

Between 1996 and 2000, Canadian Seabed Research collected bathymetric and geological data within Country Harbour and Stormont Bay using sonar and seismic sounding equipment.

In 2004, Keltic initiated studies on the proposed marginal wharf and LNG Terminal site. These studies included a Remote Operated Vehicle (ROV) video survey (Figure 4.2-3) of marine habitat in the proposed site, a detailed intertidal habitat study of the surrounding shore, and a benchmark quadrat survey of selected sites in the vicinity.

Sampling and analysis of ocean floor sediments in Isaac's Harbour was conducted by the Geological Survey of Canada (in association with the DFO) in May and August 2004. Work was performed to measure contaminant levels of mercury and arsenic in sediments associated with gold mine tailings. Due to the location of sampling sites, the work will not provide much information to characterize sediments in the area where Keltic is proposing to construct a marginal wharf. However, the collected information can be used to support broader inferences of ocean floor contaminants within the larger estuarial and bay ecosystems based upon biophysical factors such as sediment type and ocean currents.



Legend

LNG Project Area

41 ROV Transects

FIGURE No. 4.2-3
KELTIC PETROCHEMICALS INC.
REMOTE OPERATED VEHICLE TRANSECT LOCATIONS
June 2007

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St. Georges Bay

The St. Georges Bay Ecosystem Project (GBEP) (Kellman et al, 2000) is a DFO supported initiative to gather existing information related to various biophysical and human use components of the estuarial and coastal zones in the St. Georges Bay area. The research was designed to improve overall understanding of abiotic and biotic ecological functions of the St. Georges Bay Ecosystem. This knowledge can be used to complement research in other marine environments in Nova Scotia, such as the estuarial and bay habitats in the area of the proposed Keltic Facility.

Past surveys have shown that the area of fish habitat in the eastern part of Stormont Bay is relatively consistent between the proposed Keltic facilities and Harbour Island – a mix of rock, boulder, kelp, and patches of sand. In deeper areas, outside Country Harbour Head and past Harbour Island, habitat is patchier, related primarily to water depth and substrate.

According to the St. George's Bay Ecosystem Project website, "The GBEP is a collaborative partnership between the Interdisciplinary Studies in Aquatic Resources programme (ISAR), the following marine harvesters organizations in the Gulf of St. Lawrence: Gulf Bona Fide Fishermen's Association, Maritime Fishermen's Union (MFU), the Inverness South Fishermen's Association (ISFA), the Mi'kmaq Fish and Wildlife Commission (MFWC), and the Maritimes Region Fisheries Science Branch of the Department of Fisheries and Oceans (DFO). The GBEP is focused on St. Georges Bay, located in the Gulf Region of Northeast Nova Scotia, Canada. The intent of the project is to document and conduct applied analyses of the marine and human ecology of St. Georges Bay."

This project intends to bring government scientists, resource harvesters, and university-based researchers together in a long-term cooperative, collaborative, and interdisciplinary research project that emphasizes the development of working relationships and capacity. This interdisciplinary and inter-agency project will provide the foundation for new understandings respecting marine resources, the management of harvesting activities, and the development of sustainable marine resource harvesting livelihoods. It is also hoped that the Project will foster debate, education, and discussion with regards to public policy initiatives focused on the fisheries. ISAR and St. Francis Xavier University, through GBEP, will act as facilitator for this process. Keltic can gain a large amount of insight and information from the research that has been done and is currently on-going within St. George's Bay Ecosystem Project.

Nova Scotia Museum of Natural History (NSMNH)

The NSMNH issued a two-volume publication in 1996 entitled, "The Natural History of Nova Scotia". Volume I describe general habitat types found within Nova Scotia, including typical coastal and benthic habitats that occur along the Guysborough coastline. Volume II contains more detailed information specific to the region surrounding the proposed Keltic Facility that can provide a more complete picture of the region's ecology, including oceanography, climate, landforms, coastal regimes, geology, plants, and animals.

<u>Marine Habitat</u>

There is a diversity of marine habitats in Stormont Bay and surrounding area that includes freshwater, estuarial, nearshore, and deepwater environments. These habitats are defined by vegetation, type, and variability of ocean substrate, and shoreline and bottom topography. Habitat type is influenced by a number of factors including nutrient input, water temperature and salinity, depth and stability of the water column, tidal action, and wave action caused by wind and currents.

Freshwater inflow to Stormont Bay from the Country Harbour and Isaac's Harbour watersheds gives the harbours estuarial characteristics. The entrance to these harbours is unimpeded by the thick, glaciofluvial deposits (sills) found in many other inlets in the area, so water flow and mixing is less restricted (NSMNH, 1996a). This results in greater circulation of water and nutrients between Stormont Bay and the estuarine heads of the Harbours. The estuarine environment also receives greater saltwater inflow due to its openness to Stormont Bay. Country Harbour River and Isaac's Harbour River watersheds, in addition to smaller tributaries along the coastline, supply most of the freshwater to Stormont Bay. Freshwater inflow is highest in spring and winter, with peak flows occurring in April. In estuarial headwaters, freshwater will layer overtop of the deeper saltwater column beneath. The degree of mixing and circulation that occurs depends upon a number of factors including tidal influences, freshwater inflows, storm conditions, and saltwater inflow characteristics. Therefore, circulation patterns can vary seasonally and annually. The complex interaction between freshwater, tides, and geology creates a number of different estuarine habitat types, resulting in a greater diversity of species and higher productivity in this environment.

The Guysborough County Coastal Resources Mapping Project (GCIFA, 2001) mapped habitat types that support specific benthic invertebrates (such as lobster and scallop) in Stormont Bay and surrounding areas. Significant variation in the marine habitat occurs at water depths of less than 20 m and up to one kilometre from shore. The near-shore marine habitat at Red Head, the site of the proposed marginal wharf, has a substrate of boulders, cobbles, and pebbles, with finer materials such as sand and gravel prevalent in more protected bays. A narrow band of coarser sediment with relatively sparse macro algae cover stretches from the shoreline seaward for approximately 50 m. Marine plants such as kelp are associated with rockier areas, while eelgrass beds occur on sandy substrates (Figure 4.2-4). These habitat variations are similar to what predominates in nearshore coastal areas elsewhere in Stormont Bay.

Stormont Bay is open to the ocean and is not as influenced by fresh water inflows as Country and Isaac's Harbours; however, it is more susceptible to wave and ice action along its coastline (NSMNH, 1996a). Stormont Bay is predominantly covered with fine sand and silt with scattered rock shoals. The subtidal zone, generally extending to depths of about 15 m below mean low water, has a predominantly sand and gravel bottom (NSMNH, 1996a). Water depth is significantly greater towards the central part of the bay, and the ocean floor here is covered in soft, silty mud. This area is not considered significant lobster habitat but it does support a herring (*Clupea harengus harengus*) and mackerel (*Scomber scombrus*) fishery. Shallow, sandier shoals occur on either side of the entrance to Stormont Bay, the largest of these occurring near Harbour and Goose Islands and in the vicinity of Country Harbour Head see (Figure 4.2-5).

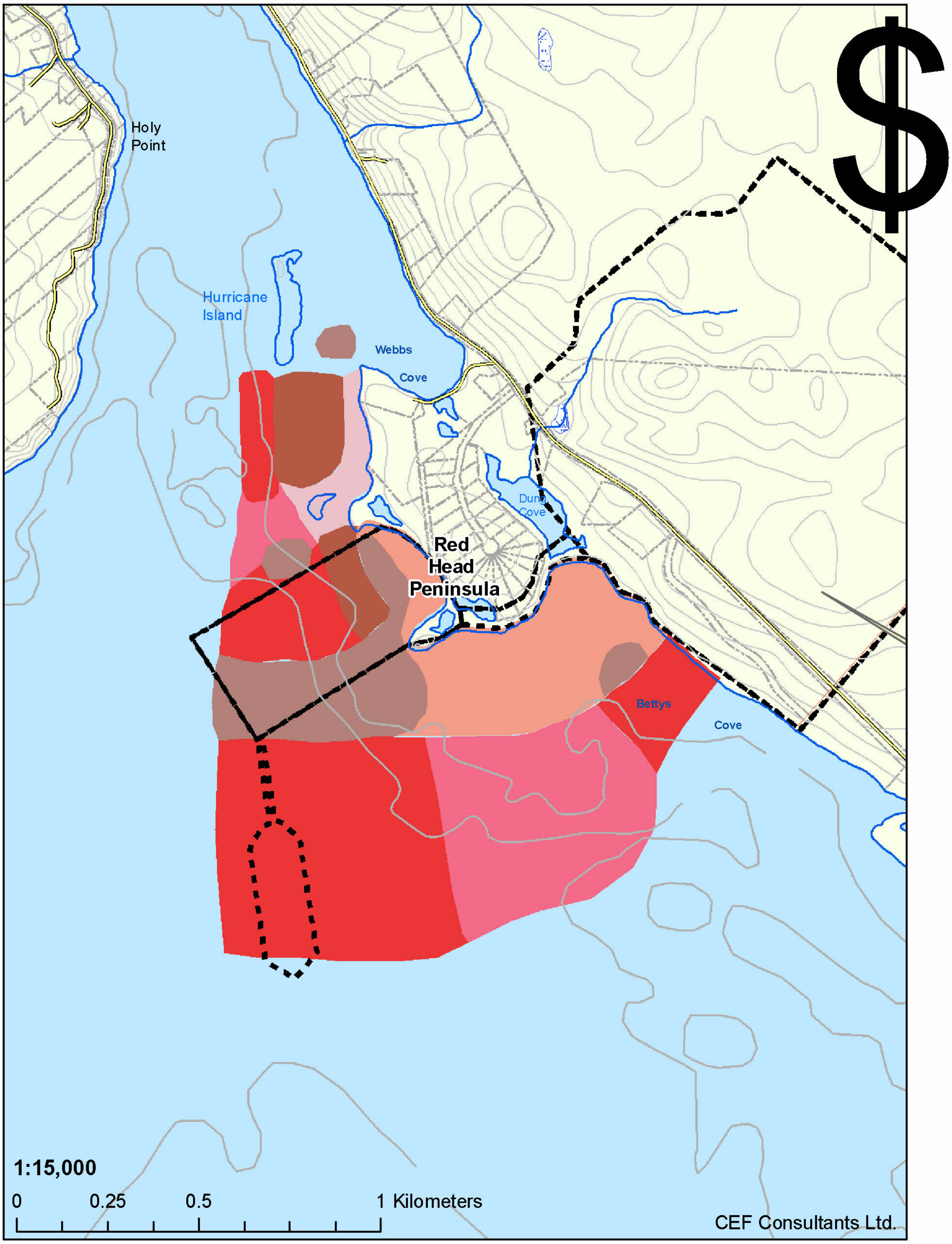

FIGURE No. 4.2-4
KELTIC PETROCHEMICALS INC.
FISH HABITAT IN THE VICINITY OF KELTIC FACILITIES
June 2007

Legend

- LNG Project Area
- Approximate Rock and Kelp Area
- Approximate Sand and Silt Area
- Inferred Sand and Silt Area
- Approximate Eelgrass and Sand Area
- Inferred Eelgrass and Sand Area
- Inferred Rock and Kelp Area

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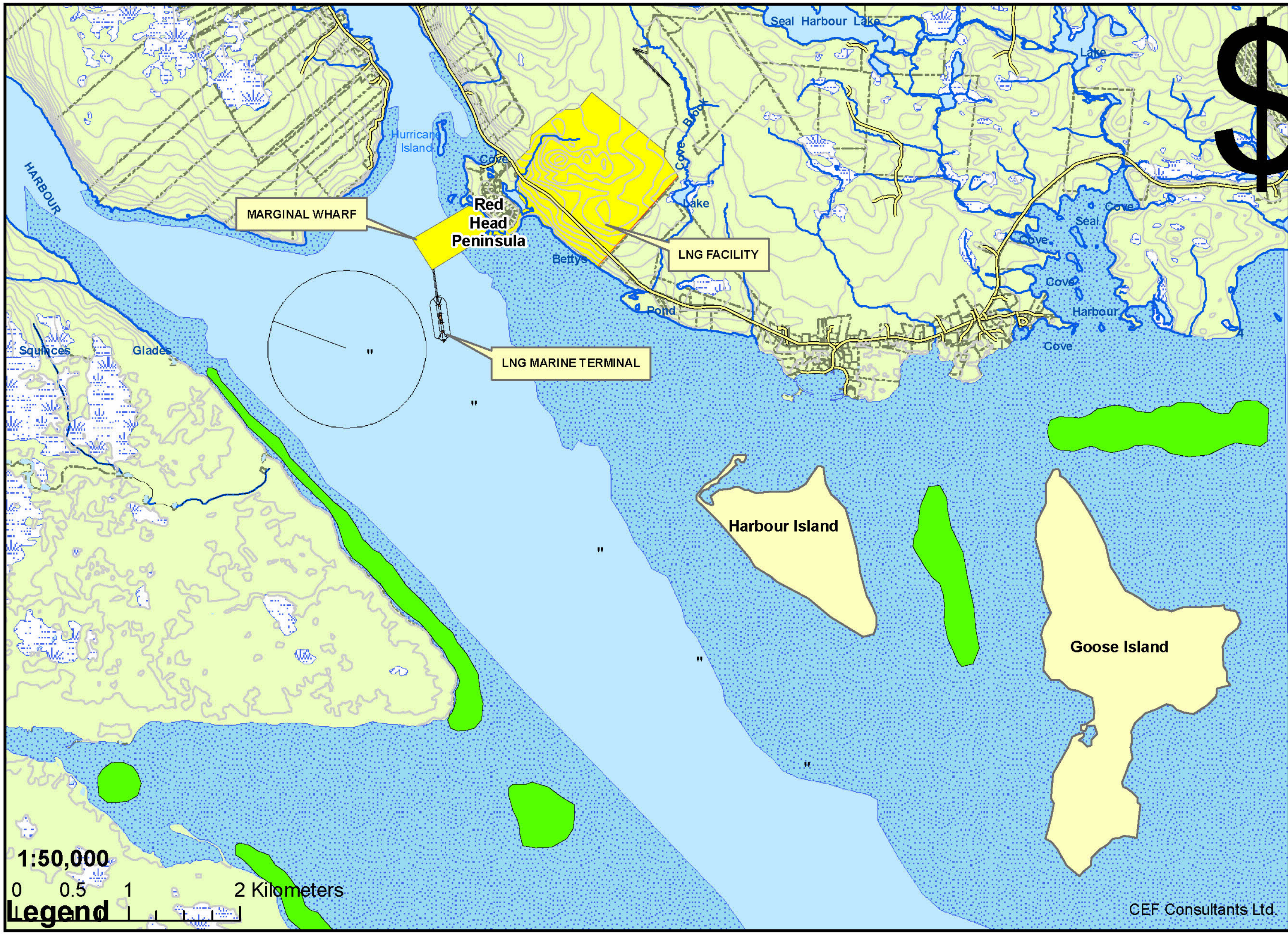


Legend

- " Ship Path
- LNG Project Area
- Lobster and Urchin Habitat Region
- Lobster Habitat Region

FIGURE No. 4.2-5
KELTIC PETROCHEMICALS INC.
FISH HABITAT IN STORMONT BAY AND ADJACENT AREAS
June 2007

The nearshore marine habitats of Stormont Bay and the estuarial habitats of Country Harbour and Isaac's Harbour (Figure 1.0-1) support a variety of marine organisms. Species include algae, phytoplankton, zooplankton, marine invertebrates, and estuarial, freshwater, and pelagic fish (Tables 4.2-4 and 4.2-5). Although overall species diversity is limited by the cold water, the variety of seabed habitats in the nearshore and estuarial environments somewhat offsets this limitation. Additional nutrient inputs from coastal salt marshes, eel grass beds, and freshwater tributaries increases the area's biological production, abundance, and diversity (NSMNH, 1996a).

TABLE 4.2-4 Marine Plant and Benthic Invertebrate Habitat

Group	Species	Habitat
Marine Plants	Irish Moss (*Chrondrus crispus*)	Sublittoral zone; rocky shores and tide pools, estuaries
	Sea kelp (*Laminaria longicruris)*	Below low tide mark; shallow sub-tidal to deep water; source of food for sea urchin
	Eelgrass (*Zostera marina*)	Sandy substrate; denser growth in shallow, clear water; location and abundance change over time
Benthic Invertebrates	Blue Mussel (*Mytilus edulis*)	Attach to rocks, wooden structures below low tide line; brackish, shallow estuaries and bays with elevated nutrient levels and increased phytoplankton levels
	Lobster (*Homarus americanus*)	Inhabit shallow to deep water with rocky bottoms; usually associated with kelp beds
	Rock crab (*Cancer irroratus*)	Inhabit shallow water with sandy bottom
	Sea urchin (*Strongylocentrotus droebachiensis*)	Prefers shallow (0-10 m), cooler water with high salinity, with hard to rocky substrates; associated with algae (especially kelp) as preferred food source
	Softshell Clams (*Mya arenaria*)	Settle in sandy or mud bottom substrate of bays and inlets; highest densities in shallow water
	Sea Scallop (*Placopectuun magellanicus*)	Found in sand or gravel substrate; water depths to 20 m

TABLE 4.2-5 Fish Habitat

Species	Habitat
Blueback Herring (*Alosa aestivalis*)	Anadromous (i.e., enters fresh water to spawn)
Mackerel (*Scomber scombrus*)	Juveniles in Stormont Bay throughout year, adults only spring/summer
Pollock (*Pollachius virens*)	Young (0-1 years old) move inshore during summer;
American Eel (*Anguilla rostrata*)	Catadromous (i.e., spawn at sea), lives most of life in freshwater as juveniles until spawning
Gaspereau (*Alosa pseudoharengus*)	Anadromous, enters fresh water to spawn in spring and leaves afterwards; inhabits bays, estuaries, and fresh water
Salmon (*Salmo salar*)	Anadromous; inhabits fresh water for first 2 or 3 years; prefers large, cool rivers with gravel bottom headwaters; present in Stormont Bay throughout summer
Cunner (*Tautogolabrus adspersus*)	Nearshore inhabitant; bottom /near bottom; shallow coastal waters; often around wharves, eelgrass, submerged seaweed; avoids brackish water
Tomcod (*Microgadus tomcod*)	Nearshore, shallow water; brackish or fresh water in estuaries and rivers
Winter flounder (*Pseudopleuronectes americanus*)	Nearshore inhabitant; shallow water, mud or sand; with or without vegetation; will feed in estuaries
Smelt (*Osmerus mordax*)	Anadromous; enters estuaries in fall and winter; present in Stormont Bay year round; spawns in freshwater in spring

EnCana conducted benthic sampling in 2002 within the Keltic Study Area, to characterize the benthic habitat along the nearshore sections of the Deep Panuke pipeline route to shore. There data is extremely relevant to the environmental effects of pipeline on nearshore environment.

They identified several macrobenthos species including: *Fucus vesiculosis*, *Laminaria* sp., blue mussels, *Corallina officinalis*, barnacles (*Balanus sp.*), amphipods, isopods, periwinkles (*Littorina littorea*) and, sea stars (*Asterias forbesi*). Rocky substrate in the nearshore is important for seaweed habitat, which is dominated by barnacles, whelks, hermit crabs, sea urchins, lobsters, rock crabs (*Cancer irroratus*), blue and hore mussels, small crustaceans, polychaetes, bryozoans, sponges, tunicates and other invertebrates. Marine algae are limited to relatively shallow depths by light availability. These are all species pervasive to the coastal rocky intertidal zone. In-depth surveys along the nearshore environment of the pipeline corridor determined that the most common macrofauna were sea stars and bivalves (EnCana Corporation, 2002).

Some species of marine fish found within proximity of the Project Area have special status and are discussed further Section 4.2.5.

<u>Marine Fish</u>

Fish are the most abundant and diverse group of vertebrates in the ocean, with 538 species recorded in the Canadian Atlantic Region alone. Three main groups of fishes are represented in Nova Scotia waters: jawless; cartilaginous; and bony fishes (NSMNH, 1996a, and b).

The familiar commercial species of marine fish in Nova Scotia make up only a small proportion of the total number of species. Numerous lesser-known, but in some cases abundant, species inhabit the different marine and estuarine habitats. Changes in the species assemblages have resulted in the following trends over the last two decades (EnCana Corporation, 2002):

- groundfish resources have declined precipitously;
- invertebrate stocks have increased; and
- overall shifting to harvesting the lower trophic levels (i.e., invertebrates).

<u>Habitat and Occurrence</u>

The marine fish likely to be found in the waters off Nova Scotia may be divided into five groups:

- estuarial and coastal species;
- groundfish (demerasal);
- pelagic species;
- mesopelagic (intermediate depth) species; and
- exotic warm-water and eastern-arctic species.

Shallow-water environments offer more opportunities for specialization and therefore have high species diversity. Further offshore, species diversity is lower but the biomass is high (NSMNH, 1996a and b).

Estuarine and Coastal Species

Up to twenty fish species are commonly found in estuaries around the coast of Nova Scotia. They include species that remain in estuaries for their entire life cycle or migrate into fresh water for short periods to spawn. Anadromous fish that pass through estuaries on their way to spawning grounds in freshwater include gaspereau (*Alosa pseudoharengus*), Atlantic salmon (*Salmo salar*), Atlantic smelt (*Osmerus mordax*), and American shad (*Alosa sapidissima*). Species, such as brown trout (*Salmo trutta*), brook trout (*Salvelinus fontinalis*), and four species of stickleback (*Gasterosteus sp.*), which typically live in fresh water, often feed in coastal estuaries during parts of the year because of the abundance of food and favourable temperatures. The juveniles of many demersal (bottom) and pelagic fishes (open ocean), such as cod (*Gadus morhua*), pollock (*Pollachius virens*), and herring, also feed in coastal environments (NSMNH, 1996a and b).

Groundfish (Demersal) Species

Groundfish occur both offshore and in coastal inlets and estuaries. They live close to the bottom for much of their adult life. The shallow waters close to Sable Island are an important nursery area for many juvenile fish. Sand lance and juvenile groundfish also provide food for seals and seabirds.

Studies on the Scotian Slope have placed fish within various assemblages. In the shallow slope waters (>200 m), redfish (*Sebastes sp.*) predominate. White (*Urophycis tenuis*), red (*Urophycis chuss*), and silver hake (*Merluccius bilinearis*), American plaice (*Hippoglossoides platessoides*), witch flounder (*Glyptocephalus cynoglossus*), and Atlantic argentine (*Argentina silus*) also occur in these waters. Fish, more characteristic of slope waters, occur deeper than 800 m (Markle et al., 1988).

Pelagic Species

Pelagic fish travel mostly in large schools, feeding primarily in surface waters or middle depths. Key commercial species on the Scotian Shelf include Atlantic herring, Atlantic mackerel (*Scomber scombrus*), tuna, swordfish (*Xiphias gladius*), and porbeagle shark (*Lamna nasus*). Other pelagic species include capelin (*Mallotus villosos*), which appear to have increased in abundance during the recent period of declining water temperature, as have many coastal and estuarine species.

Mesopelagic Species

Mesopelagic species, including lanternfish (myctophids), live on the Continental Slope and are unlikely to be seen in inshore waters. Many of these deepwater species migrate vertically towards the surface at night and toward the bottom by day.

Data on mesopelagic species in the Study Area were compiled from surveys along the Scotian Slope from 1984 to 1989 by Halliday et al. (1995). More than 200 species of mesopelagic fish were found. Many have a predominately southern distribution, with a large number of expatriates from tropical waters. Lanternfish dominated; other predominant species included lightfish (Gonostomatidae), viperfish (Chauliodontidae), silver hatchetfish (Sternoptychidae), scaled dragonfish (Stomiidae), sawpalate (Serrivomeridae), snipe eel (Nemichthyidae), dogfish shark (Squalidae), longneck eel (Derichthyidae), and gulper (Eurypharyngidae).

Exotic and Transient Species

The diversity of the coastal fish fauna off Nova Scotia is increased by a number of exotic visitors brought in by warm water currents from the continental slope. Studies in St. Margaret's Bay and Prospect Bay yielded 31 species from warmer waters, including flying fish, seahorses (*Hyppocampus sp.*), Priacanthids, and mullet (*Mugilidae sp.*). Several species of shark are also found in the warm waters of the Gulf Stream. In addition, several species of eastern origin, such as Greenland cod (*Gadus ogac*), mailed sculpin (*Triglops murrayii*), and Arctic eelpout (*Lycodes reticulatus*), have been recorded from cold-water areas on the banks and eastern shore.

Transient species, typically with a southern distribution, that migrate seasonally to or through the Study Area include species such as bluefin tuna (*Thunnus thynnus*), swordfish, sunfish (*Mola mola*), and basking sharks (*Cetorhinus maximus*). There are occasional inshore species, such as salmon, sturgeon (*Acipenser sp.*), and species from deep water such as grenadiers (Macrouridae). These occasional visitors are not of local commercial importance.

Seasonal Occurrence

The following discussion on movements of major fish species within the Study Area has been largely adapted from the EnCana Corporation reports (2002 and 2006), and from SOEP (1996).

Major seasonal movements of fish include the shift of many groundfish species, including cod and haddock, from deeper warmer waters around the edges of the banks in winter, to the surface of the banks in the summer. Herring and mackerel also show major spring and fall movements, with major concentrations of herring overwintering in Chedabucto Bay. Shark also move onto the Scotian Shelf as waters warm in the spring, returning south in the fall. Large pelagics, tuna, and swordfish, show migration patterns also related to water temperature, with fish following the Gulf Stream in spring and then moving towards the Shelf Slope in summer. The distribution of the fisheries can provide a good indication of areas where fish may be found at different times of the year.

During winter, most groundfish species move off the tops of the banks to deeper, warmer waters along the bank edges and in the adjoining basins (Scott and Scott, 1988). These include cod, haddock, silver hake, mackerel, American plaice, redfish, wolffish (*Anarhichas lupus*), and argentine. Other species more tolerant of colder temperatures, including yellowtail and most skate species, remain on the banks during the winter. Of particular note is the presence of winter flounder on Sable Island Bank. Witch flounder, wolffish, and monkfish (*Lophius americanus*) appear to remain in the same general location throughout the year (Kulka and Stobo, 1981). Reports from the winter herring fishery indicate that fish have shifted from the traditional wintering grounds in Chedabucto Bay to an area off Halifax (Stephenson et al., 1995). The winter months are peak spawning periods for several species including American sand lance and pollock. Migratory species such as tuna and swordfish are not found in the Study Area in winter.

As surface waters warm in the spring, groundfish such as Atlantic cod, haddock, silver hake, and American plaice move into shallower water on the banks. Deeper water species, such as Atlantic argentine, white hake, and redfish, remain in the deeper areas along the Shelf edge. In the spring, many species migrate over the Scotian Shelf on the way to summer feeding or spawning grounds. Spring is a peak spawning period for species such as herring, haddock, American plaice, argentine, and redfish. In recent years, the traditionally significant spring spawning of Atlantic cod has all but disappeared.

In summer, most groundfish species are dispersed over the tops of the banks. Species found on the banks include: Atlantic cod, haddock, silver hake, winter flounder, American plaice, thorny skate, and wolffish, yellowtail, halibut, winter skate, barndoor skate (*Dipturus laevis*), sand lance, mackerel, and squid.

In early fall, migratory species present on the Scotian Shelf move offshore, to the south. Atlantic mackerel migrate south through the area to wintering areas along the Shelf off Sable Island Bank, beginning in October. Tuna, swordfish, and shark leave the Shelf by November. Squid move offshore toward the Gulf Stream in October and November. In late fall, as the surface temperature drops, adults of most groundfish species move into deeper waters along the bank edges and the basins. Atlantic cod move to the Sable Island/Western Bank area for spawning. Haddock range over the Middle, Western, and Sable Island Banks. Redfish move to the southern edges of Sable Island Bank. Juvenile fish (i.e., silver hake, haddock) move to deeper waters. Winter flounder remain in the shallow areas of Sable Island and Western Banks.

Some species of marine fish found within proximity of the Project Area have special status and are discussed further in Section 4.2.5.

<u>Benthic Invertebrates</u>

Benthic organisms are the main food source for commercial fish species and are extremely diverse. The settlement and survival of marine benthic community assemblages in the Project Area are largely dictated by the nature of the substrate types that occur there, as well as additional factors such as currents, sediment type, temperature, salinity, and quality and quantity of the food supply. The success of settlement is dependent upon physical factors, such as temperature, level of biological productivity in overlying waters, bottom current, wave energy, and seabed stability. In the nearshore subtidal environments, diverse marine algae and associate fauna can occur, for example, sea urchins, mussels, gastropods, starfish (*Asterias sp.*), and barnacles.

Off the Nova Scotia coast, the rocky subtidal zone typically extends to about 15 m below the mean low water mark and grades into sand/gravel sedimentary bottom. Coastal marine habitat in Stormont Bay can be divided into intertidal (littoral) and subtidal (sublittoral) zones. The littoral zone, which exists between high and low tide, contains habitat for invertebrates adapted to growing on rocky surfaces that are able to withstand tidal and/or wave action. These include a variety of species from microscopic zooplankton, grazers such as chitons and limpets, filter feeders like barnacles (*Semibalanus balanoides*) and blue mussels, and larger crustaceans, such as rock crabs. Rockier areas within the sublittoral zone, which exists beneath mean low tide, support mussels, rock crab, lobster, sea urchin, and sea stars (McLaren, 1996). Other marine organisms typical of these areas include periwinkles (*Littorina littorea*, *L. saxatilis*, and *L. obtusatus*) and amphipods such as *Hyale nilssoni* and *Gammarus* species (Envirosphere Consultants Limited, 2004).

There are no benthic invertebrates of special status within the marginal wharf and LNG Terminal area.

Marine Mammals

Whales and seals are found throughout the Scotian Shelf, with fewer species in inshore waters. NSMNH (1996a) listed 21 species of whales, dolphins and porpoises in Nova Scotian waters, and 6 species of seals (NSMNH, 1996a and b).

Stormont Bay/Country Harbour is not an important area for cetaceans (NSMNH, 1996a). Whales or seals may enter the area following schools of herring or mackerel from spring to fall and seals frequently haul out on the shoreline (NSMNH, 1996a).

Whales

The general distribution of whales on the Scotian Shelf defines important areas of marine production, areas that are often associated with the edges of banks, the slope of the Shelf, and inlets or canyons (Sutcliffe and Brodie, 1977). The ocean dynamics associated with these bottom features result in higher levels of biological production. Filter-feeding baleen whales are attracted to areas with high densities of large copepods and euphausiids that can be efficiently harvested (Brodie et al., 1978). The larger copepods (McLaren et al., 2001) and euphausiids (Herman et al., 1981) are known to become concentrated in deeper waters of the Scotian Shelf basins and off the Shelf break through advection and vertical (including seasonal) migration.

Most baleen whales that occur in the northern hemisphere feed in higher latitudes in summer, exploiting biologically productive areas in the northwest Atlantic and the Gulf of St. Lawrence and moving south for the winter; mating and calving usually take place on the winter grounds (NSMNH, 1996b). Nonetheless, some individuals could be found throughout the year, albeit in lower numbers in winter than in summer. The Scotian Shelf has is a region of high diversity of prey items, and baleen whales have adapted their seasonal feeding strategies, as well as fat storage, accordingly (Brodie, 1975). Small toothed whales, dolphins and porpoise, occur on the Scotian Shelf year round. In general, most species appear to frequent the Shelf during summer and early fall, moving to the southwest as winter approaches (Kenney, 1994). This probably coincides with seasonal distributions of favoured prey.

The larger toothed whales (sperm and northern bottlenose) are associated with deeper waters, inlets, and canyons, where they feed on deepwater squid and fish. The association of the bottlenose whale with the Gully (a large submarine canyon located near Sable Island) is well known, although recent work (Gowans, 1999) indicates that only about one-third of the population of 130 is present in the Gully at any given time; presumably others are dispersing north and south along the Shelf slope. Sperm whales (*Physeter macrocephalus*) are more likely to venture out of the deep water than bottlenose, sometimes moving onto the banks of the Scotian Shelf (Sutcliffe and Brodie, 1977). The pilot whale (*Globicephala melaena*), a medium-sized toothed whale, feeds over a wide range of the Scotian Shelf, as evidenced by their status as the most abundant whale in Sable Island strandings (Lucas and Hooker, 2000). During spring and summer, this species feeds on squid and fish along the shelf break, but are often found over banks, and may move across the Shelf to the nearshore by late summer (Kenney, 1994). Pilot whales are observed in large numbers on both coasts of Cape Breton Island, following shoals of mackerel, and occasionally stranding in groups (EnCana Corporation, 2002).

Dolphins can range throughout the Scotian Shelf, over deep water on the Shelf break, and into coastal inlets and harbours. Groups of Atlantic white-sided dolphins (*Lagenorhynchus acutus*) occasionally enter Bedford Basin during the summer, feeding for several weeks (EnCana Corporation, 2002).

Reasonably reliable whale catch and sighting data are available from Sutcliffe and Brodie (1977) based on the former commercial whaling operation out of Blandford, Nova Scotia. Whaling data are biased by effort, and are limited by poor spatial and temporal coverage. Few records exist for the eastern portions of the Scotian Shelf and Slope, or in the winter. These data were re-plotted by Kenney (1994) with additional data.

Intensive surveys for whales occurred during the Department of National Defence frigate shock trials at latitude 42° 05' N, longitude 61° 20' W in November 1994 and provide additional information to Kenney (1994). The Department of National Defence survey location was chosen for low overall marine productivity (i.e., to reduce the chance of impacts), in areas not known to be attractive to marine mammals (i.e., 4100 m deep water and low bottom relief).

Atlantic harbour porpoise (*Phocoena phocoena*) are widely distributed in cold-temperate coastal waters of the Northern Hemisphere. They are nearly always found in relatively shallow water, less than 125 m deep on the continental shelf (Gaskin, 1992). They often come close to shore and into estuaries or harbours in the summer in pursuit of their favoured prey of herring, as well as mackerel, capelin, hake, pollock, and squid (Brodie, 1995). The harbour porpoise is at risk throughout its range, primarily as a result of bycatches in fisheries. The species was downlisted by Committee on the status of Endangered Wildlife in Canada (COSEWIC) from Threatened to Special Concern (COSEWIC, 2003). The long-finned pilot whale (*Globicephala melaena*), often traveling in herds of several hundred, is the whale most likely to occur in numbers on the Scotian Shelf throughout the year (Lucas and Hooker, 2000).

The minke whale (*Balaenoptera acuterostrata*) is the smallest baleen whale on the Scotian Shelf. It is widespread and seasonally abundant in the Northwest Atlantic. It has been identified in late spring and the summer months across the Shelf, with a preference for water less than 200 m deep (Hooker et al, 1999a).

Some species of whales found within proximity of the Keltic Project Site/LNG Terminal Area have special status and are discussed further in Section 4.2.5.

<u>*Seals*</u>

The grey seal (*Halichoerus grypus*) and harbour seal (*Phoca vitulina*) are routinely present on the Scotian Shelf. Grey seals disperse widely after breeding on Sable Island in December and January. Harbour seals tend to remain in the vicinity of Sable Island year round, although young may disperse more widely.

The total population of grey seals in Atlantic Canada is about 174,000 individuals (Hammill and Stenson, 2000). Approximately 25,000 pups were produced on Sable Island in 1997 (Bowen et al., 1999), and possibly 30,000-35,000 in 2000, compared with approximately 500 pups in the early 1960s (EnCana Corporation, 2002). The size of the harbour seal population in Atlantic Canada is much less certain, but is estimated to have increased from about 13,000 individuals in the early 1970s to about 32,000 in 1996 (Hammill and Stenson, 2000). The population breeding on Sable Island, however, has declined recently from a level of pup production of approximately 600 in 1989 to approximately 40 in 1997.

There are no seal species of special status within the marginal wharf and LNG Terminal area.

<u>Habitat Use and Productivity</u>

The various habitat types of Stormont Bay and the surrounding areas support a diversity of organisms from phytoplankton to smaller benthic invertebrates to large commercial fish species. Seasonal fluctuations in habitat quality and use also occur resulting in highly variable diversity and abundance of species at certain times of the year. Fish species, depending upon their lifecycle and activities, often require a diversity of habitat types to provide food, cover, and other requirements.

Stormont Bay supports several local fisheries, one of the most important of which is the commercial lobster fishery. The value of these fisheries is linked to the productivity of the area which is influenced by the habitat quality of the marine environment that supports primary producers, prey, and predatory species. Changes to the marine environment, particularly within the vicinity of the proposed wharf, will have adverse effects upon habitat and productivity. Although the productivity of the Lobster Fishing Area that encompasses the proposed marginal wharf and LNG Terminal is relatively low compared to other areas in Nova Scotia, lobster is the dominant species of concern.

In general, the coastal plant and animal communities were more productive in rockier areas than in beach areas that had finer substrates. Along the coastline near Red Head, the most productive intertidal habitats were generally the mid to low intertidal and upper subtidal zones on partially exposed rocky shoreline (Envirosphere Consultants Limited, 2004).

<u>Invertebrate Production</u>

Studies completed in the area have identified important lobster habitat. In the shallower waters of eastern Stormont Bay, between Red Head (the site of the proposed wharf) and Harbour Island, there is a consistent mix of rock, boulder, kelp, and sand. In the outer, deeper areas (outside Country Harbour Head and past Harbour Island) lobster habitat is patchier. The Black Ledges area, a shoal on the western entrance to Stormont Bay (shown as a large stippled blue patch off country Harbour Head in Figure 4.2-5) is considered good lobster habitat/urchin habitat with shoals surrounded by large sandy mud areas.

Habitat requirements for lobster, changes according to its various life stages. Lobster productivity depends upon a number of density independent factors such as temperature, time of hatching, predation, wind direction, and food supply. These factors have the greatest effect on larval survival and consequently lobster populations and area productivity. Optimal habitat for lobster changes as they grow. Smaller postlarval lobsters prefer to live in tunnels or in natural crevices and then, as they grow larger, move to habitats with coarser substrates and a suitable amount of cover. Juvenile lobsters prefer areas with algae, stones, and large crevices. Some larger lobsters have been observed on compact sand or mud bottoms consolidated by eelgrass. All sizes of lobster have been observed co-existing in areas with large stone size and heavy algal cover. Sand covered in eelgrass had a low abundance of juveniles and adults, while on bare sand bottoms no resident lobsters were observed (National Oceanographic and Atmospheric Association, 1994).

Lobster production is influenced by local factors more so than external ones and is therefore area specific depending upon the local habitat and conditions. The amount of postlarvae that settle in an area is the overriding factor in determining an area's productivity. Postlarvae in their burrows feed on plankton and may also prey on small benthic organisms. Density independent factors such as starvation, predation, and offshore winds transporting larvae out to sea and away from suitable habitat can play a large role in larval mortality (Miller, 1997).

Factors that most influence lobster productivity are habitat and food supply (Cobb et al., 1999). The type of fish habitat preferred by lobster, however, changes with the age of the animal.

Post-larval lobsters live in burrows until they reach about 25 mm carapace length (CL). For lobsters between 25-50 mm CL a coarse substrate and a suitable amount of cover is necessary. Lobsters with a CL of >50 mm prefer areas with algae, stones, and large crevices. Some larger lobsters have been observed on compact sand or mud bottoms consolidated by eelgrass. All sizes of lobster have been observed co-existing in areas with large stone size and heavy algal cover. Sand covered in eelgrass had a low abundance of juveniles and adults, while on bare sand bottoms no resident lobsters were observed (National Oceanographic and Atmospheric Association, 1994).

Post-larval lobsters spend a few years "in self-dug tunnels or in the natural crevices under cobble" (Harding, 1992). Post-larvae, in their burrows, feed on plankton and may also prey on small benthic organisms. This habitat provides shelter from potential predators when the post-larval lobsters are still small and quite vulnerable. This part of the life cycle is critical to recruitment to the fishery, and the amount of post-larvae that settle in an area is directly proportional to the number of fishery recruits to that area (Miller, 1997). At the same time, the numbers of post-larvae that settle in an area is an overriding factor in determining an area's productivity.

Rock crabs inhabit intertidal zone to depths of up to 40 m. Rock crabs often spend winters in shallower waters on softer sand and mud substrates and then migrate to deeper waters during the spring and summer. Larvae float freely in the water column between mid-June to and mid-September until they settle on the ocean floor.

Sea urchins rely upon seaweed as their primary food source with the highest concentrations of urchins located near kelp beds. In Stormont Bay, kelp has increased in areas where urchins have formerly grazed. Management measures have recently been instituted to manage this fishery in Guysborough County.

Fish

Most of the year fish inhabit offshore waters, migrating to inshore areas in spring to spawn. Mackerel are a highly migratory, pelagic fish species and are present in Stormont Bay year round with juveniles present throughout the year and adults in spring and summer. In winter, adult mackerel generally move to feed grounds on the Scotian Shelf southwest of Sable Island (Scott and Scott, 1988).

Several anadromous fish species migrate upriver at different times of the year. Gaspereau (alewives) begin their migration in early spring and are followed by smelt, eel, trout, and Atlantic salmon. Salmon and gaspereau begin to migrate up Country Harbour and Isaac's Harbour Rivers by April. Elvers migrate upstream in May and June (Miller, 1997) while sea-run brook trout migrate during July and August. Gaspereau and smelt leave freshwater after spawning in early spring.

Salmon and brook trout spawn in freshwater burying their eggs in gravel to cobble-size material. Atlantic salmon spawn between late October and mid-November. Atlantic salmon generally hatch in the spring and emerge from the gravel by early June. Atlantic salmon smolts migrate to the sea from mid-May to mid-June (Scott and Crossman, 1973). Adult salmon downstream migration is also variable. In some river systems, populations remain over winter; while in others; downstream migration takes place directly after spawning. Brook trout begin spawning by mid-to-late September and generally hatch and emerge from the gravel in late March or early April.

Blueback herring is an anadromous fish entering freshwater inlets and estuaries to eventually spawn in lakes, ponds, and rivers above the tide head. After spawning, adults return to sea where they spend most of their adult life. In Stormont Bay and surrounding areas, herring are thought to be present between June and October. Blueback herring is similar to alewife and the two are often fished together sometimes being referred to collectively as gaspereau (Scott and Scott, 1988).

4.2.2.2 Freshwater Fish and Fish Habitat

Studies for freshwater fish species and fish habitat applicable to the LNG Facility pertains only to the Red Head Peninsula Ponds, located on the peninsula area where the marginal wharf and LNG Terminal site has been proposed, and Betty's Cove Brook. Additional studies of freshwater fish species and fish habitat were conducted for the purpose of the Provincial EA Report (AMEC, 2006) for lakes that were identified as candidates for sources of cooling or process water or as potential receiving waters for the plant discharge, and are not covered in this document. This information is available in the Provincial EA Report (AMEC, 2006).

Red Head Peninsula Ponds

As mentioned above, there are several ponds on the peninsula area where the marginal wharf and LNG Terminal is located, near the entrance to Isaac's Harbour. (Figure 4.1-5). Some are fresh water and some are brackish, and all ponds had fish - ranging from one to five species.

The largest pond, not brackish, is Dung Cove Pond which provides breeding habitat for waterfowl species such as black duck (*Anas rubripes*) and for semi-aquatic mammals such as muskrat (*Ondatra zibethica*), otter (*Lutra canadensis*), and beaver (*Castor canadensis*). The southeast end of Dung Cove Pond is separated from the marine waters of Betty's Cove by a cobble dike and beach (Map Site 1, Figure 4.2-1) on the Betty's Cove side. This dike, and especially the beach, is important habitat for migrating shore birds.

Pond 1

Pond 1 is located on the northwest side of Red Head (Figure 4.1-5). Aquatic substrates are dominated by organic silt. Stumps, woody debris, and overhanging vegetation provide some structural habitat for aquatic biota. Vegetation associated with this pond includes tapegrass (*Vallisneria Americana*), Richardson's pondweed (*Potamogeton richardsonii*), sweetflag (*Acorus americanus*), broad-leaved arrowhead (*Sagittaria latifolia*), rushes (*Juncus* sp.), grasses, cinnamon fern (*Osmunda cinnamomea*), caraway (*Carum carvi*), cow vetch (*Vicia cracca*), lily of the valley (*Maianthemum canadense*), wild strawberry (*Fragaria virginiana*), wild red raspberry (*Rubus idaeus*), sweet gale (*Myrica gale*), marsh cinquefoil (*Potentilla palustris*), Canada thistle (*Cirsium arvense*), Canada goldenrod (*Solidago canadensis*), tall meadow rue (*Thalictrum pubescens*), mountain holly (*Nemopanthus mucronata*), rhodora (*Rhododendron canadense*), leatherleaf (*Chamaedaphne calyculata*), speckled alder (*Alnus incana*), common juniper (*Juniperus communis*), tamarack, and white spruce. No aquatic species of concern have been found during any survey at this site.

A total of five fish species were collected in this pond during the fall of 2004 and spring of 2005; American eel, banded killifish (*Fundulus diaphanous*), brook trout, mummichog (*Fundulus heteroclitus*), and ninespine stickleback.

Pond 2

Pond 2 is situated immediately south of Pond 1 on the northwest side of Red Head (Figure 4.1-5). Pond substrates are predominantly organic silt with cobble patches along the margins. Aquatic and riparian vegetation consists of tapegrass, yellow pond lily (*Nuphar variegate*), sweetflag, grasses, cinnamon fern, cow vetch, wild red raspberry, wild strawberry, sweet gale, Canada goldenrod, rhodora, speckled alder, smooth serviceberry (*Amelanchier cf. laevis*), and white spruce. American eel was the only species found in this pond. No aquatic species of concern have been found during any survey at this site.

Pond 3

Pond 3 is located on the western side of Red Head (Figure 4.1-5). Substrates in the pond consist of organic silt with small areas of cobble and gravel at places around the pond shoreline. Aquatic and riparian vegetation within the pond include wild rice (*Zizania aquatica*), grasses, beach pea, sea lungwort, common dandelion (*Taraxacum officinale*), grass leaved stitchwort (*Stellaria graminea*), cow vetch, garden lupin (*Lupinus polyphyllus*), greater arrowgrass (*Triglochin maritima*), wild strawberry, cinnamon fern, Canada goldenrod, sweet gale, leather leaf, speckled alder, and white spruce.

Three fish species were collected in this pond during the spring 2005 surveys; ninespine stickleback, threespine stickleback, and banded killifish. No aquatic species of concern have been found during any survey at this site.

Pond 4

Pond 4 is located southwest of Pond 5, and is the southernmost pond on Red Head (Figure 4.1-5). Pond substrates are dominated by cobble and gravel overlain by organic silt. A thick mat of filamentous algae were noted throughout the pond. Aquatic and riparian vegetation in the vicinity of the pond includes slender naiad (*Najas flexilis*), grasses, wild raspberry, sea lavender, lovage, common dandelion, thistle, beach pea, speckled alder, smooth serviceberry, and white spruce.

A total of three fish species were collected from this brackish pond in 2004 and 2005; threespine stickleback, fourspine stickleback, and ninespine stickleback. No aquatic species of concern have been found during any survey at this site.

Pond 5

Pond 5 is situated immediately to the north of Pond 4 (Figure 4.1-5). Substrates in this pond are dominated by cobble and gravel overlain by organic silt. The margins of the pond have cobble and boulder with occasional woody debris. Thick stands of filamentous algae were noted during the 2004 and 2005 surveys. Aquatic and riparian vegetation in the vicinity of the pond consists of fucus, slender naiad, grasses, wild raspberry, sea lavender, lovage, common dandelion, thistle, beach pea, speckled alder, smooth serviceberry, and white spruce. No aquatic species of concern have been found during any survey at this site.

Three fish species were found in this brackish pond; threespine stickleback, fourspine stickleback, and ninespine stickleback.

Pond 6 (Dung Cove)

Pond 6 is located on the northeast side of Red Head near its junction with the mainland (Figure 4.1-5). Aquatic substrates are dominated by organic silt with scattered boulders around the perimeter of the pond. The shoreline is dominated by woody debris and grasses, with the exception of the eastern shore which is dominated by gravel, cobble, and boulder. Aquatic and riparian vegetation consist of common mare's tail (*Hippurus vulgaris*), tapegrass, yellow pond lily, common cattail (*Typha latifolia*), sweetflag, grasses, marsh cinquefoil, cinnamon fern, sheep laurel *(Kalmia angustifolia*), smooth serviceberry, speckled alder, tamarack, white spruce, and black spruce.

This is a freshwater tea-coloured pond. A total of five fish species were collected here during the fall 2004 and spring 2005 fisheries surveys; American eel, ninespine stickleback, banded killifish, mummichog, and juvenile and adult brook trout.

Betty's Cove Brook

A first-order headwater tributary of Betty's Cove Brook originates in the northeast corner of the Keltic Project Site. This drainage feature flows in a southeasterly, then off-site in a southerly direction to Crane Lake, which discharges to the Atlantic Ocean at Betty's Cove Pond.

This tributary supports a fish community consisting of brook trout, American eel, and nine spine stickleback. Brook trout and nine spine stickleback likely spawn in this watercourse. It also provides feeding and migratory habitat for American eel.

Although there is no indication that there is a fishery in the on-site reaches of this watercourse, the headwaters no doubt contribute to the fishery which exists further downstream, and which includes species such as brook trout, and American eel. The eel is listed as 'special concern' by COSEWIC.

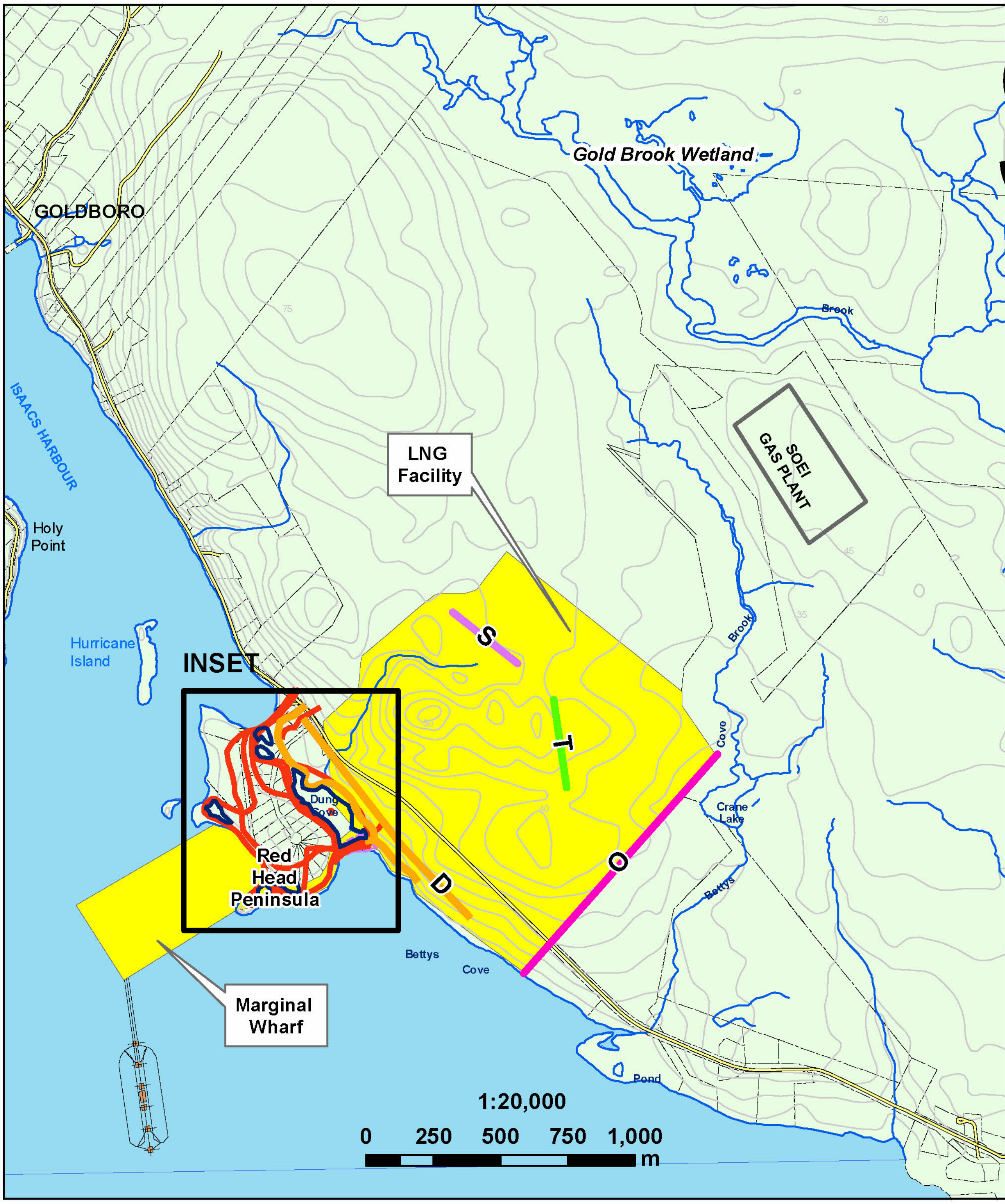
4.2.3 Terrestrial Wildlife and Wildlife Habitat

Field studies on terrestrial wildlife and habitat were carried out in June, August, and early September, 2004. A winter study directed primarily toward mammalian activity, especially white-tailed deer, took place in February 2005 by fixed wing airplane and on the ground. Additional field studies in June, July, and August, and early September, 2005, were carried out to complete the full season evaluations of wildlife in all relevant areas, and to complete the evaluation of the Project Site (Figure 4.2-6 and 4.2-7).

The complete list of common and scientific names of vertebrate wildlife species observed for the four terrestrial vertebrate groups at all sites are presented, for comparison and to contribute to the regional context, in Appendix 8 of the Provincial EA Report (AMEC, 2006). Wildlife in the general region is abundant and diverse. Species designated red (thought to be at risk) or yellow (sensitive to human activities) by NSDNR (2002), and/or having an S-rank of S3 or less (Atlantic Canada Conservation Data Centre (ACCDC), 2004) or other special status will be so indicated in the following text. See also Section 4.2.5 for further information.

4.2.3.1 Amphibians

American toad (*Bufo americanus*), green frog (*Rana clamitans*), pickerel frog (*Rana palustris*), mink frog (*Rana septentrionalis*), and wood frog (*Rana sylvatica*) were observed directly. Green frogs were especially abundant in all permanently wet habitats. The spring peeper (*Pseudacris crucifer*), leopard frog (*Rana pipiens*), and bull frog (*Rana catesbiana*) were not observed, but have ranges that may encompass the LNG Facility Area. No salamanders were observed, including the four-toed salamander (*Hemidactylium scutatum*) listed as yellow by NSDNR and S3 by ACCDC. It should be noted that the Nova Scotia Museum and NSDNR have indicated that the four-toed salamander is more abundant and widespread than previously thought and status re-assessment will likely result in it being assigned a status of "green" (not believed to be sensitive or at risk). COSEWIC (2002) has designated the four-toed salamander as "not at risk"



Legend

Bird Sensitive Habitat	C - Sept. 2004
Wetland	D - Sept. 2004
LNG Project Area	O - June 2005
Bird Observation Transects	S - June 2005
See Figure 4.2-8	T - June 2005

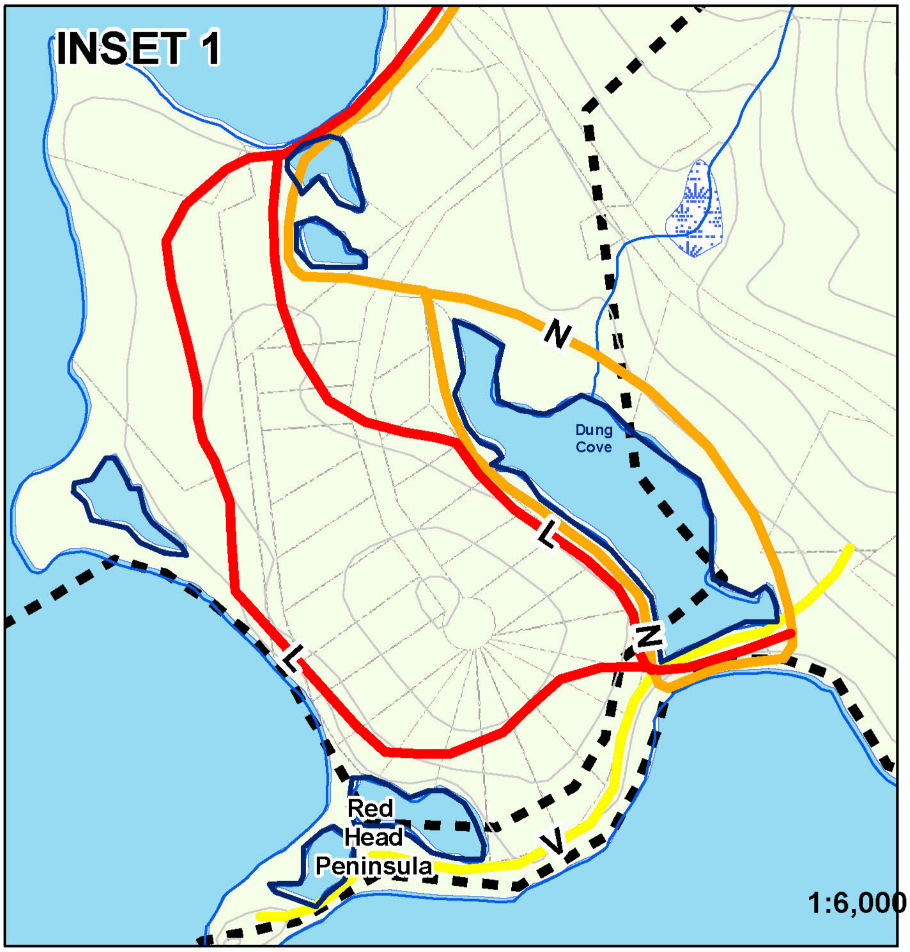
Figure 4.2-6
KELTIC PETROCHEMICALS INC.
Bird Observation Sites (2004 & 2005)
LNG Facility
June 2007

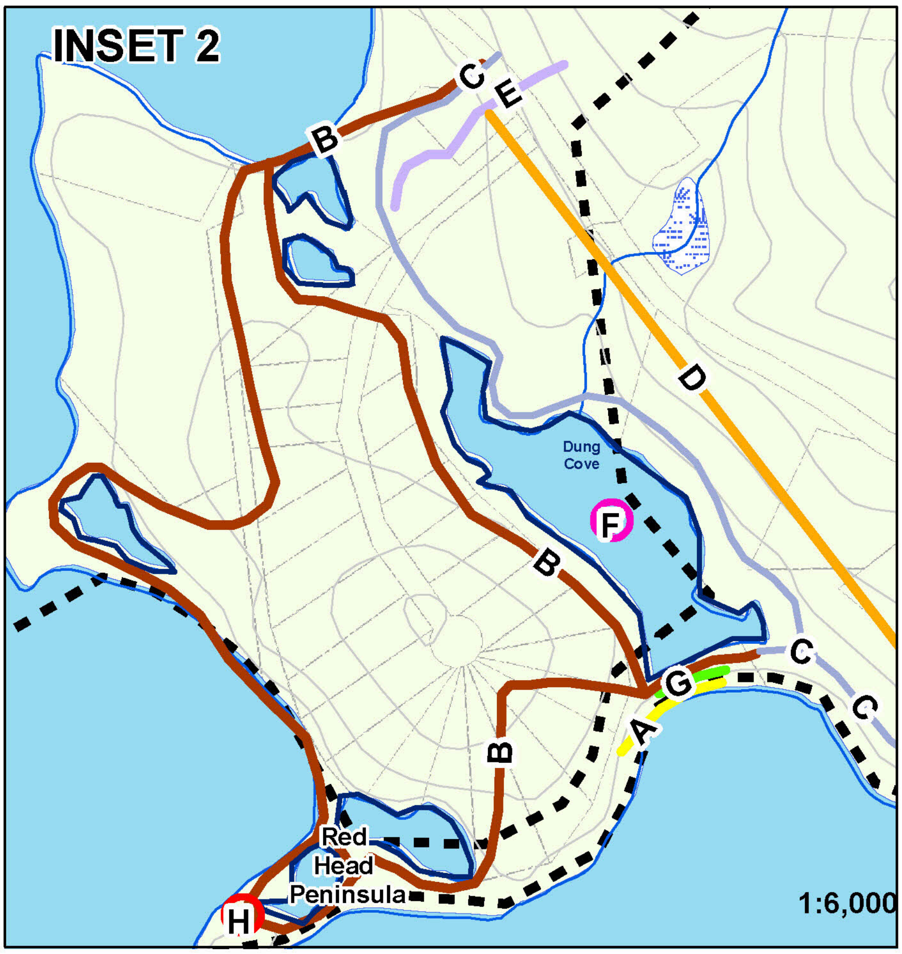
Figure 4.2-7

KELTIC PETROCHEMICALS INC.

Bird Observation Sites (2004 & 2005) LNG Facility

June 2007





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in Nova Scotia. In addition to the four-toed salamander, eastern newt (*Notophthalmus viridescens*), spotted salamander (*Ambystoma maculatum*), redback salamander (*Plethodon cinereus*) and blue spotted salamander (*Ambystoma laterale*) and/or its hybrid with Jefferson salamander (*Ambystoma lateralejeffersonianum*) are expected to be in parts of the larger Study Area.

4.2.3.2 Reptiles

Two species of snakes were observed on the Keltic Site; i.e., eastern garter snake (*Thamnophis strialis strialis*) and red-bellied snake (*Storeria occipitomaculata*). Ring-necked snake (*Diadophis punctatus*), though not observed is probably present. Three turtle species that were not observed may also be in the Study Areas. Snapping turtle (*Chelydra serpentina*) is expected in all lakes and permanent streams and may also be in Dung Cove Pond in the LNG Terminal area. Similarly, painted turtle (*Chrysemys picta*) would be expected in bodies of permanent water where they often bask on old logs, rocks, and open shores. Wood turtle (*Clemmys insculpta*) (yellow; S3), the most terrestrial of the three species, is also possibly present. Surveys for wood turtles were conducted coincident with other wildlife surveys.

4.2.3.3 Birds

Within the 149 ha of the Project Site there are numerous locations for various types of bird habitat and, consequently, various types of bird species. Bird surveys were conducted with the following objectives:

1. to determine which bird species were on or adjacent to the Study Sites; and
2. to characterize the avian communities with respect to breeding activity, seasonality, location, and habitat use.

A series of bird surveys were conducted in the field by one individual over the course of six months (from June, partly August, September, October, November) in 2004. Data acquired included bird species, estimated abundance, breeding status, and habitat for each species. In 2005, in order to complete full season evaluations, field work was carried out in June, July, August and early September with most observations made in June and several in July and September. Due to poor weather conditions, field surveying was completed during the day, not necessarily during optimal early morning time windows for certain species. It is doubtful that species were missed, but numbers may be disproportionate. An attempt was made to cover all habitat types throughout the surveys. Land uses have undergone considerable changes over time, and remain continuous. The most recent clear cutting activities at the site have resulted in a collection of changing mosaical habitats; i.e., the site was manifestly different in 2005 than in 2004. It was felt that by varying the location and duration of observation over time that the objectives would better be met.

Identification of bird species were concluded by song for up to an estimated 100 m from the site boundary, and visually to an estimated 500 m. As well distance from transects or point locations is estimated at 100 m. Birds were identified to species, numbers estimated up to a distance of approximately 100 m, with no distance limit on visual identification. In some cases, only presence was documented, but these were few and did not alter any conclusions.

Observations were made from continuous transects and/or from point locations where more intense observation was deemed to yield more information. There was no set duration of observation at either type of location. Transects were walked slowly with occasional stopping, moving on when it seemed no additional significant information was forthcoming. Transects and point locations for the surveys completed on the Keltic Site, including the LNG Facility Area, are shown in Figures 4.2-6 and 4.2-7, respectively. As well, point locations were used as were selected continuous transects.

Migratory birds and habitat were assessed during field visits that were made in October and November, respectively, to assess the fall migration of waterfowl and marine birds.

A rough count indicated that ± 104 species (using the Atlas of Breeding Birds of the Maritime Provinces, Erskine, 1992) were likely to breed in the general area. A total of 95 (91%) of these, were observed along with three breeding species not designated as breeding in the area, plus 18 non-breeding migrants.

A total of 116 bird species was observed in all sites combined. Total bird observations for each study site are presented in Appendices 8 and 10 along with spring and fall presence (note that these values are averages for all observations at a given study site) of the Provincial EA Report (AMEC, 2006). The number noted at Gold Brook Lake, offshore sites, and the Keltic Project Site proper, including the LNG Facility Area, and the number confirmed/probably and possibly breeding are shown in Table 4.2-6.

Overall, 62 (53%) of the 116 species were deemed at least possibly breeding (AMEC, 2006). Birds were considered breeding on the basis of the number and temporal pattern of observations, type of habitat, courtship, and nesting behaviour, and/or the presence of young. Habitat types identified were based mainly on structural criteria (i.e., tall shrub vs. low shrub) and species composition. Except in the obvious cases (i.e., BF = Open Bog/fen) wetland characteristics are not used because of the wide variation of wet substrates in almost every habitat category.

TABLE 4.2-6 Number of Bird Species Observed

Study Site	Observed[1]	Breeding or Possibly Breeding (%)[2]	Migrants[3]
LNG Area	73	26(36)	7
Offshore	17	7(41)	4

1. These values exceed the total number in the overall Study Area as some species will occur in more than one study site.
2. These percentages are relevant to each study site total, not to the overall area total observed.
3. Migrants are those species that do not breed in the maritime provinces, Nova Scotia (water pipet), mainland Nova Scotia (i.e., golden-eye) or probably not locally (i.e., hooded merganser) (Erskine, 1992).

Breeding estimates are probably low partly because there are 18 migrant species that by definition do not breed in any of the Study Areas. Also, a subjectively conservative application of breeding criteria played a role in the low estimates and some events may simply not have been observed. Nonetheless, species diversity appears to be high and populations robust.

For purposes of discussion birds have been divided into four groups including: Woodland/ Shrubland and Woodland/Edge Birds, Shorebirds, Raptors, and Seabirds and Waterfowl. These are discussed separately below for the Keltic Site Proper, including the LNG Facility site, and offshore areas "Wetland" was not included as a category because most wetlands have a woodland/shrubland/edge component to them. Waterfowl by definition may be in the open water wetlands and/or nest in wetland areas, and certainly raptors forage in wetlands. Strictly wetland birds such as bitterns (*Botaurus lentiginasus*) were not observed, with the exception of great blue heron (*Ardea herodias*).

Woodland, Shrubland, and Woodland Edge Birds

Warblers and related birds were abundant in all woodland and woodland edge habitats at all sites. Thirteen species of warblers, two vireos, two kinglets, and two chickadees were noted and deemed breeding in most woodland areas. These are shown in Table 4.2-7.

TABLE 4.2-7 Warblers and Related Birds

Species Scientific Name	Species Common Name
Regulus satrapa	Golden-crowned Kinglet
Regulus calendula	Ruby-crowned Kinglet
Vireo solitarius	Solitary Vireo
Vireo olivaceus	Red-eyed Vireo
Parus atricapillus	Black-capped Chickadee
Parus hudsonicus	Boreal Chickadee
Vermivora ruficapilla	Nashville Warbler
Dendroica petechia	Yellow Warbler
Dendroica pensylvanica	Chestnut-sided Warbler
Dendroica magnolia	Magnolia Warbler
Dendroica castanea	Bay-breasted Warbler
Dendroica coronata	Yellow-rumped Warbler
Dendroica virens	Black-throated Green Warbler
Dendroica fusca	Blackburnian Warbler
Dendroica palmarum	Palm Warbler
Dendroica tigrina	Cape May Warbler
Mniotilta varia	Black-and-white Warbler
Setophaga ruticilla	American Redstart
Geothlypis trichas	Common Yellowthroat
Wilsonia canadensis	Canada Warbler

Other woodland/shrubland species present include ruffed and spruce grouse (*Bonasa umbellus* and *Dedragapus canadensis*), thrushes (veery (*Catharus fuscescens*), Swainson's (*Catharus ustulatus*), hermit (*Catharus guttatus*) and American robin (*Turdus migratorius*)), downy and hairy woodpeckers (*Picoides pubescens* and *Picoides villosus*), winter wren (*Troglodytes troglodytes*), flycatchers (yellow-bellied (*Empidonax flaviventris*), alder (*Empidonax alnorum*), and least (*Empidonax minimus*)), sparrows (savannah (*Passerculus sandwichensis*), song (*Melospiza melodia*), swamp (*Melospiza Georgiana*), white-throated (*Zonotrichia albicollis*)), red and white-winged crossbills (*Loxia curvirostra* and *Loxia leucoptera*), purple finch (*Carpodacus purpureus*), American goldfinch (*Carduelis tristis*), and pine siskin (*Carduelis pinus*).

A comparison (refer to Appendix 8 of the Provincial EA Report (AMEC, 2006)) of June and post-August presence results in some not unexpected patterns. In 2004, insectivorous birds such as flycatchers, swallows, and most warblers were absent. Common yellowthroat, palm, and yellow-rumped warbler were exceptions. A number of types are resident the year-round, including corvids (jays, crows, and ravens), chickadees, and woodpeckers. Woodland/shrubland birds were observed most often in mature and immature mixed forest. Table 4.2-8 shows the distribution within the six most used wooded habitats. The mixed forest habitats were used by both the greatest number of species and the greatest number of birds. Though not evaluated quantitatively, it is reasonable to assume that mixed forests have the greatest number of plant species and the greatest foliage-height-diversity. MacArthur and MacArthur (1961) demonstrated that bird diversity in deciduous forests correlated positively with these two parameters.

TABLE 4.2-8 Comparison of Habitat Use by Woodland/Shrubland Birds at the Keltic Site

Habitats	Keltic Site			
	No. species	Rank[2]	No. Birds[1]	Rank
Mature Coniferous Forest	6	6	29	6
Immature Coniferous Forest	12	3	72	3
Mature Mixes Forest	22	1	155	1
Immature Mixed Forest	17	2	98	2
Tall Shrub	11	4	60	4
Low Shrub	8	5	34	5

1. The sum of the maximum number of birds per species at any one habitat type at any one time.
2. Rank within the six habitat types.

Shorebirds

Shorebirds, both resident and migrating, were observed frequently in the LNG Terminal area. The cobble dike and beach area on the Betty's Cove side of the LNG Terminal area is important habitat for migrating and other shore birds. Birds that use this area are shown in Table 4.2-9.

TABLE 4.2-9 Shorebirds Observed in Dike/Beach Areas at Betty's Cove

Species Scientific Name	Species Common Name
Charadrius semipalmatus	Semipalmated Plover
Catoptrophorus semipalmatus	Willet
Calidris minutilla	Least Sandpiper
Tringa melanoleuca	Greater Yellowlegs
Calidris alba	Sanderling
Anthus spinoletta	Water Pipit (technically not a shore bird)
Plectrophenax nivalis	Snow Bunting (technically not a shore bird)
Numenius phaeopus	Whimbrel

These species with the exception of willet and greater yellowlegs were observed in the fall only, obviously during fall migration. Spring migration had likely occurred prior to June. Greater yellowlegs (S2B: rare provincially) (ACCDC, 2004) was observed exhibiting breeding behaviour at the edge of the cobble beach at Map Site 1, Figure 4.2-1.

The willet was a common breeder near Betty's Cove and along the shore southeast of the LNG Terminal area and the semipalmated plover was observed on the shores of the LNG Terminal area. Spotted sandpiper (*Actitis macularia*) was observed during the spring on the marine shore of the Keltic Site, and was observed breeding on the shores of fresh water streams in the area.

Raptors

Birds of prey observed are shown in Table 4.2-10.

TABLE 4.2-10 Raptors Observed in the Study Area at the Keltic Site

Species Scientific Name	Species Common Name
Pandion haliaetus	Osprey
Haliaeetus leucocephalus	Bald Eagle
Circus cyaneus	Northern Harrier
Accipiter striatus	Sharp-shinned Hawk
Buteo platypterus	Broad Winged Hawk
Buteo jamaicensis	Red-tailed Hawk
Falco sparverius	American Kestrel
Flaco columbarius	Merlin
Asio flammeus	Short-eared Owl

Osprey was observed near the LNG Terminal area. No nests were observed on or adjacent to either site, but one is near Highway 316 northwest of Stormont Bay. Bald eagles were seen several times at the Keltic site, but no nests were located. Local sources indicate that bald eagle is commonly seen on Harbour Island, but no nests have been found.

Red-tailed, broad-winged, sharp-shinned hawks and merlins were seen occasionally. One kestrel and one broad-winged hawk were observed near the heliport on the Keltic Site, and over the peninsular area, respectively. Northern harrier was noted on several occasions over the Keltic Site. Northern goshawk (*Accipiter gentilis*) (yellow, S3B) is known in the general area, but was not observed in this study.

At least one pair of short-eared owls and a northern harrier foraged in the wetlands along Betty's Cove Brook and down to Drum Head. Short-eared owl is designated a "species of special concern" by COSEWIC (2005), and is protected under SARA (2005). Other owls were not observed but great horned owl (*Bubo virginianus*) and northern saw-whet owl (*Aegolius acadicus*) are in the general area (Erskine, 1992).

Migratory Birds and Migratory Bird Habitat

The Atlantic coast line near the proposed Keltic Site and proposed LNG Terminal Site provides feeding and breeding habitat for a number of migratory waterfowl, shorebirds, and sea birds.

Seabirds, Waterfowl, and Shorebirds

Birds that nest and forage along the coastal shore, of which the LNG Terminal area is part, and on the off-shore islands (i.e., Country, Harbour and Goose), as well as waterfowl that breed inland but usually spend some time along the marine shore are considered in this category. Also included are migratory birds that stage in Stormont Bay.

Seabirds

Over 25 species of seabirds have been observed on the Scotian Shelf, their distribution depending on availability and distribution of preferred prey and the breeding status of the species (EnCana Corporation, 2006). Some, like cormorants and gulls, are largely found in inshore waters, however most species in offshore waters are truly pelagic, spending no time ashore. The Study Area includes both offshore and coastal marine habitats inhabited by a wide range of migratory and resident bird species. The offshore Study Area is dominated in the summer by non-breeding seabirds from the northern and southern hemisphere, and in the winter by seabirds that breed in the eastern Canadian Arctic and West Greenland (Lock et al., 1994).

Common eider (*Somateria mollissima*) and great black-backed (*Larus marinus*) and herring gulls (*Larus argentatus*) are common along the shore. Double-crested cormorants (*Phalacrocorax auritus*) were very common in Stormont Bay. Three species (all considered yellow by NSDNR, 2005) of terns, common (*Sterna hirundo*), arctic (*Sterna paradisaea*), and roseate (*Sterna dougallii*), forage along the coast. Only one roseate tern was observed. Arctic and common terns are designated S3B (uncommon breeder) and roseate S4B (extremely rare breeder) (ACCDC, 2004).

Country Island is of special interest because of the presence of a roseate tern colony. Roseate terns are at low numbers in Canada, with 95% restricted to a few coastal islands in Nova Scotia (Leonard et al., 2004). In 2003, only one other location in Nova Scotia had more roseate terns than Country Island. CWS carries out a program of non-lethal control of predators on Country Island in a successful effort to maintain tern numbers. Common and arctic terns and Leach's storm-petrel (*Oceanodromo leucorhoa*) nest here as well. See also Section 4.2.5.

A radio-tracking study (Rock, 2005) revealed that the roseate tern was not foraging in any section of the Keltic foot print (Figure 4.2-8). The closest foraging site was Harbour Island. Within the potential LNG shipping route, the bird was not tracked in any of the shallow ledges Local sources report that herring and great black-backed gulls and cormorant nest on Goose Island.

A number of migrants were observed and reported to occur in Stormont Bay and off-shore around the islands. Those observed are red-necked grebe (*Podiceps grisegena*), white-winged scoter (*Melanitta fusca*), surf scoter (*Melanitta perspicillata*), common scoter (*Melanitta nigra*), oldsquaw (*Clangula hyemalis*), and black guillemot (*Cepphus grylle*). Local residents reported dovekie (*Alle alle*), king eider (*Somateria spectabilis*), murres (*Uria sp.*), and northern gannet (*Morus bassanus*) as migrants.

The offshore seabird community of the Scotian Shelf consists primarily of shearwaters and storm-petrels during the summer months, and, in winter, kittiwakes, fulmars, and alcids such as: dovekie (*Alle alle*), common (*Uria aalge*) and thick-billed murres (*Uria lomvia*), razorbill (*Alca torda*), Atlantic puffin (*Fratercula arctica*) and, least commonly far offshore, the black guillemot (Lock et al., 1994). Large numbers of Leach's storm- petrels arrive in Canadian waters in May, breeding on coastal islands and remaining abundant there until migrating south in autumn.

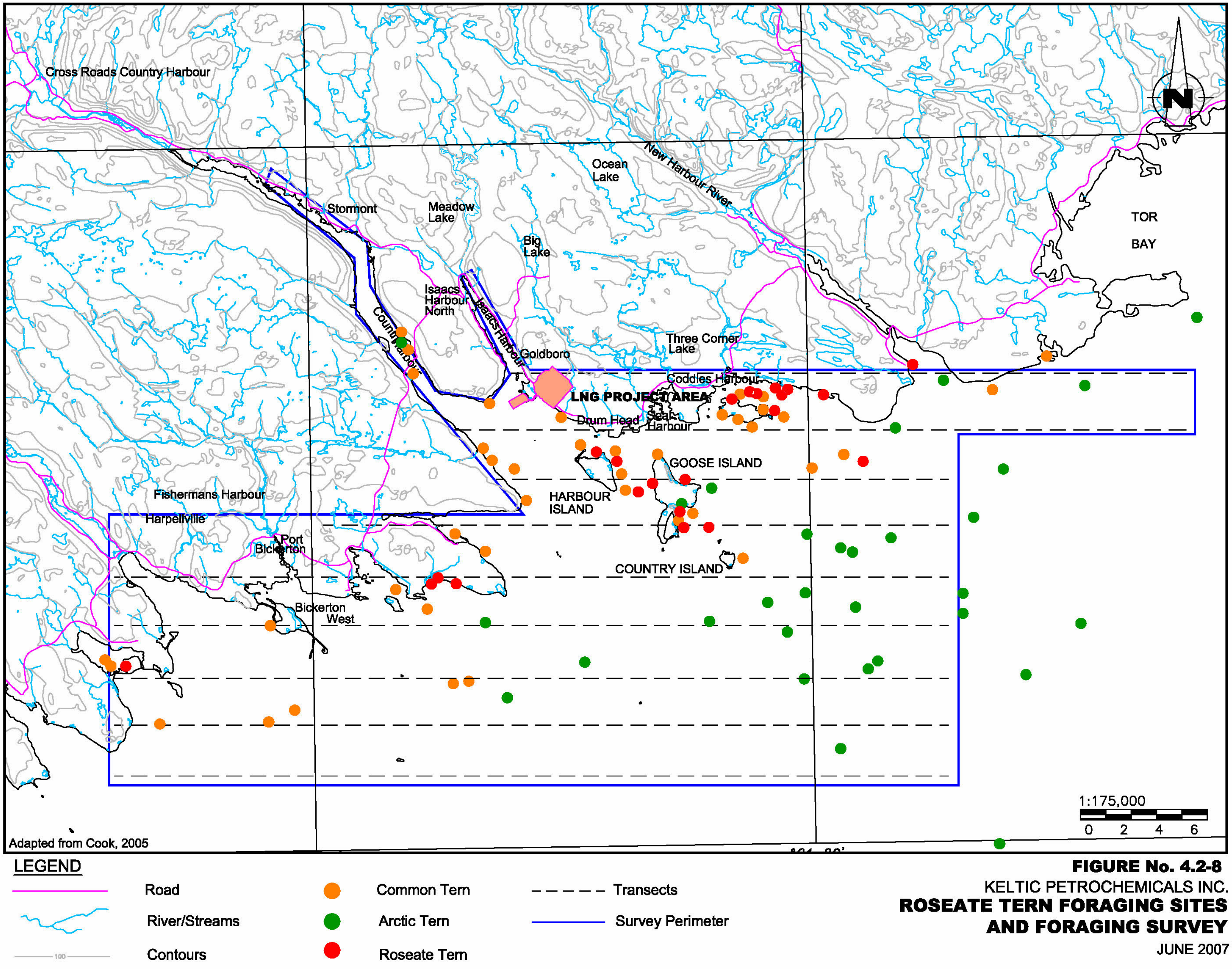

FIGURE No. 4.2-8

KELTIC PETROCHEMICALS INC.

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Large numbers of these birds nest on Country Island and other small islands in the vicinity, and a few have recently nested on Sable Island (EnCana Corporation, 2006). The more abundant Wilson's storm-petrel breeds in the southern hemisphere on Antarctica and adjacent islands, spending the austral winter in the northern hemisphere.

Great black-backed gulls and herring gulls are the most abundant breeding seabirds in the Project Area. These species are present year-round, but are most abundant from April to September when they are present at breeding colonies on Sable Island (EnCana Corporation, 2002). Black-legged kittiwakes (*Rissa tridactyla*) are common in the area from October through April, but are scarce from May to September when they move to breeding colonies north of the Study Area (EnCana Corporation, 2006). Common and Arctic terns breed widely along the coast of Nova Scotia, including Country Island and Sable Island and are present in the Study Area during the breeding season from May through August, after which their young fledge and begin to migrate out of the Study Area.

Waterfowl and Shorebirds

The inland lakes are not very productive for waterfowl (Seymour, pers. comm.), a point that is reinforced by the observations in this study. Ring-necked duck (*Aythya collaris*), loon (yellow) (*Gavia adamsii*), and common merganser (*Mergus merganser*) were noted in small numbers. American black duck and green-winged teal (*Anas crecca*) breed in wetland areas such as the Gold Brook wetland immediately north of the LNG Facility site. An adult red-breasted merganser (*Mergus serrator*) and young were seen once at Dung Cove Pond and Canada goose was observed occasionally at the LNG Terminal area. Common loon (*Gavia immer*) is on all lakes in the original Keltic Study Area, with a nest observed directly in Gold Brook Lake. It is not known whether the young hatched or otherwise survived. Common loon was noted in small numbers along the marine shore of the Keltic Site in both spring and early fall, with a flock of about twenty individual's off-shore on November 7, 2004.

Whereas most shorebirds in the Study Area are autumn transients, the killdeer (*Charadrius vociferus*), willet, and spotted sandpiper breed along the mainland coast; least and spotted sandpipers breed on Sable Island. Transient shorebirds may migrate up to 12,000 km from breeding to wintering grounds, intensively foraging at traditional stopover sites to meet their high-energy requirements. Most migrant shorebirds in coastal Nova Scotia frequent salt marshes and mudflats. Sanderlings are more common on sandy beaches. Purple sandpipers (*Calidris maritima*) commonly occur in winter along rocky, exposed shorelines, and massive flocks of red phalaropes (*Phalaropus fulicaria*) have been seen off Sable Island in spring (McLaren, 1981a and b).

Great blue heron, though neither seabird nor waterfowl, was seen frequently on the LNG Terminal area and the shoreline to the south and were frequently observed feeding in all ponds. A heronry was reported to be near the northwest shore of Gold Brook Lake (NSDNR, pers. comm.), but both aerial and ground level searches failed to locate it.

4.2.3.4 Mammals

A total of 21 mammalian species were observed directly or by signs (i.e. tracks, scat etc.) in all areas combined. Mammal observations for each Study Area are presented in Appendix 8 in the Provincial EA Report (AMEC, 2006). The species noted are shown in Table 4.2-11.

TABLE 4.2-11 Mammals Observed in the Study Area at the Keltic Site

Species Scientific Name	Species Common Names
Canis latrans	Coyote
Vulpes fulva	Red Fox
Ursus americanus	American Black Bear
Procyon lotor	Raccoon
Mustela erminea	Short-tailed Weasel (Ermine)
Mustela vison	American Mink
Mephitis mephitis	Striped Skunk
Lutra canadensis	River Otter
Lynx rufus	Bobcat
Halichoerus grypus	Grey Seal (See Appendix 8*)
Phoca vitulina	Harbour Seal (See Appendix 8*)
Odocoileus virginianus	White-tailed Deer
Tamias striatus	Eastern Chipmunk
Marmota monax	Woodchuck
Tamiascuirus hudsonicus	Red Squirrel
Castor canadensis	Beaver
Ondatra zibethica	Muskrat
Microtus pennsylvanicus	Meadow Vole
Clethrionomys gapperi	Red-backed Vole
Erethizon dorsatum	Porcupine
Lepus americanus	Snowshoe Hare

* - Appendix 8 from the Provincial EA Report (AMEC, 2006)

Compatible habitat at various places in the Study Sites is present for a range of Nova Scotia mammals not observed directly or by sign. These include:

- Masked Shrew (*Sorex cinereus*);
- Smokey Shrew (*Sorex fumeus*);
- Arctic Shrew (*Sorex arcticus*) aka Maritime Shrew (*Sorex maritimensis*) (Stewart et al., 2002);
- Water Shrew (*Sorex palustris*);
- Pigmy Shrew (*Sorex hoyi*);
- Short-tailed Shrew (*Blarina brevicauda*);
- Hoary Bat (*Lasiurus cinereus*);
- Red Bat (*Lasiurus borealis*);
- Northern Long-eared Bat (*Myotis septentrionalis*);
- Little Brown Bat (*Myotis lucifugus*);
- Northern Flying Squirrel (*Glaucomys sabrinus*);

- Deer Mouse (*Peromyscus maniculatus*);
- Southern Bog Lemming (*Synaptomys cooperi*);
- Meadow Jumping Mouse (*Zapus hudsonius*); and
- Woodland Jumping Mouse (*Napaeozapus insignis*).

Two other species of shrew, the Gaspé shrew (*Sorex gaspensis*) and long-tailed shrew (*Sorex dispar*) both COSEWIC (2005) "Species of Concern" are in Nova Scotia, but have been found only on Cape Breton Island and the Cobequid Mountains, respectively (Dr. G. Forbes, pers. comm.).

No bats were observed but seven species are known from Nova Scotia, all of which are considered sensitive (yellow) by NSDNR (2004). These are:

- Little Brown Bat (*Myotis lucifugus*);
- Northern Long-eared Bat (*Myotis septentrionalis*);
- Eastern Pipistrelle (*Pipistrellus subflavus*);
- Silver-haired Bat (*Lasionycteris noctivagans*);
- Red Bat (*Lasiurus borealis*);
- Hoary Bat (*Lasiurus cinereus*); and
- Big Brown Bat (*Eptesicus fuscus*).

Broders et al (2003) suggest that significant populations of only little brown bat, long-eared bat, and eastern pipistrelle occur in the province. Red, hoary, and silver-haired bats are migratory species represented by only a small amount of records, but red and hoary bats may be widespread in spite of seemingly low numbers. Big brown bat has been tentatively identified as being in the province, but it is unlikely to be in the area of and of the Study Sites. Most records of the eastern pipistrelle are from western and central mainland Nova Scotia (Scott and Helda, circa, 2005). Broders (pers. comm.) is of the opinion that most of the bats in the general area of the Keltic Site are little brown and long-eared with little brown bats being most numerous. Little brown bats were most active over water, with long-eared bat being more of a forest interior species (Broders et al 2003).

Furbearer data were not gathered in 2004-2005 but the harvest numbers from 1994 (MacLaren Plansearch, 1996) are assumed to be a general reflection of the present circumstance. These are shown in Table 4.2-12. The presence of these furbearers, except striped skunk, was noted on the LNG Terminal area at some time during the course of the field studies. The four aquatic species were observed in association with Dung Cove Pond.

TABLE 4.2-12 Furbearer Harvest in Guysborough County in 1994

Species Common Names	Number Harvested
Aquatic Furbearers	
Muskrat	323
Beaver	237
Otter	83
Mink	127
Terrestrial Furbearers	
Short-tailed Weasel	139
Bobcat	58
Red Fox	10
Raccoon	85
Skunk	5
Red Squirrel	187
Coyote	87
Snowshoe Hare	13,992

Snowshoe hare populations fluctuate dramatically, usually over an approximately 10-year period, with 2005 being a very high year providing an abundance of prey for coyotes, bobcats, and raptors. A raptor kill and a bobcat kill, respectively, were observed on the LNG Terminal area. Coyote populations appeared to be high throughout the Keltic Study Area, perhaps in response to the abundance of snowshoe hares.

Meadow vole populations also fluctuate with a roughly 3-5 year periodicity. High population densities evidenced by numerous freshly used runways were noted in both 2004 and 2005. Meadow vole is the primary prey for short-tailed weasels and many raptors including shorteared owl, northern harrier, and red-tailed hawk.

The range of Canada lynx (*Lynx canadensis*) (COSEWIC, 2002, status “Endangered”) is restricted to Cape Breton Island (NSDNR, pers. comm.). Eastern cougar (*Felis concolor*) (COSEWIC, 2005; status “Data Deficient”) has been reported in Nova Scotia, but with little substantial evidence corroborating its presence.

White-tailed deer were sighted frequently in all Study Sites during the summer. A deer herd estimated by local sources to be about 50 in number is between the LNG Terminal area and Drum Head. During the February 2005 winter survey, at least 35 deer were counted in this area. Nova Scotia Natural Resources (NSDNR, 2005) indicates deer wintering areas near Drum Head. The greatest area of winter concentration noted in February 2005 was at the LNG Terminal site (Figure 4.2-1). This was corroborated by local residents, but the NSDNR (2005) website data do not indicate this.

Moose (*Alces alces*) in mainland Nova Scotia has been designated as “Endangered” (COSEWIC, 2005). It is reported to concentrate in the bogs just south of Ocean Lake (NSDNR, pers. comm.). This area was examined from the air during summer and winter and at ground level during summer, with no sign of moose, tracks, or droppings. No moose sign was noted anywhere at any time during field studies. One moose was reported by a local resident to have been seen near the mouth of New Harbour River during the late fall of 2004.

4.2.4 Wetlands

Wetlands are common in both the Atlantic Coast Terrestrial Theme Region and the Atlantic Interior Terrestrial Theme Region, and include marshes, bogs, and fens of various sizes and floristic composition. Barrens and areas of shrub species such as speckled alder, withered (*Viburnum nudum*), and various woody heath plants (Family Ericaceae) are relatively common. These heaths include rhodora, sheep laurel, lowbush blueberry (*Vaccinium angustifolium*), huckleberry (*Gaylussacia baccata*), mountain cranberry (*Vaccinium vitis-idaea*), and checkerberry (*Gaultheria procumbens*).

The major types of wetlands, according to the Canadian Wetland Classification System (1997) that are encountered on or functionally associated with the site of the KDP are:

- Bogs – peatlands with water from precipitation and not influenced by groundwater, peatmoss (*Sphagnum sp.*) is dominant vegetation.
- Fens – peatlands influenced by groundwater relatively rich in nutrients with vegetation dominated by graminoid species.
- Swamps – dominated by woody plants and may occur on peatland or mineral substrate; in the latter case free surface water may persist for considerable periods.
- Marshes – periodic or persistent standing water, usually dominated by graminoids and/or emergent forbs.
- Shallow water wetlands – free surface water up to 2 m deep at less than 25% cover by standing emergent or woody plants.

The wetlands identified to occur within the footprint of Project Site (the LNG Facility and Marginal Wharf), are presented in Table 4.2-13. Information for this Table was derived from several sources including:

- Canadian Wetland Classification System, Second Edition (Warner and Rubec, 1997);
- CWS Wetland Mapping (Hanson and Calkin, 1996);
- Wetlands Data Base Specification Draft (NSDNR, 1999);
- Nova Scotia Forest Cover Type Mapping (NSDNR, 2002);
- vertical black and white aerial photography;
- oblique colour photography;
- aerial reconnaissance; and
- ground level field work.

TABLE 4.2-13 Wetland Types and Area (ha) for the Project Site

Wetland Number[1]	Wetland Type[2]	Area (ha)
1	Coastal (Saline) Pond – vegetated (Pv)	2.4
12	Coastal (Saline) Ponds - vegetated (Po)	0.8
13	Swamp/marsh	2.0

1. Wetland Number: Keltic Site, see Figure 4.2-1.
2. Wetland type (see text).

It should be noted that there is some variability in the wetland surveys; i.e., not all were surveyed at ground level. This variability is explained further in the following sections pertaining to individual wetlands.

As of March 1, 2006, wetlands are protected in Nova Scotia by the Wetlands Designation Policy, which replaces the Wetlands Directive from 1995. Alteration of a wetland may remove or interrupt the ability of the wetland to continue to support the same level of pre-development functions.

There is some difference in terminology between Hanson and Calkins (1996), Warner and Rubec (1997), NSDNR (1999), and NSDNR 2002; i.e., only NSDNR (2002) uses the term "treed bog," and Hanson and Calkins (1996) CWS wetland mapping, revised 1988, do not use the term "fen." The wetland types presented in Table 4.2-13 do not follow any particular nomenclatural method, but rather are often descriptive modifications of the basic Canadian Wetland Classification System; i.e., "treed bog" instead of simply "bog." CWS terminology where available is also included, as described below:

- Coastal Saline Ponds – P;
- Po – pond open bottom undetermined; and
- Pv – pond vegetated.

Specific vegetation characteristics are presented here for each wetland. As noted above most have a significant component of heath shrubs; i.e., eriaceous (Family Ericaceae). Rather than identify these each time for each wetland, their presence may be noted as "heath shrubs" including the following species: Labrador tea, rhodora, sheep laurel, bog laurel (*Kalmia polifolia*), bog-rosemary (*Andromeda glaucophylla*), leather-leaf, lowbush blueberry, mountain cranberry, small cranberry (*Vaccinium oxycoccus*), large cranberry (*Vaccinium macrocarpon*), huckleberry, and bog huckleberry (*Gaylussacia dumosa*). Other shrubs not in the Family Ericaceae but often associated with heath shrub vegetation include sweet gale, black crowberry, black chokeberry (*Aronia melanocarpa*), bunchberry (*Cornus canadensis*), false holly (*Nemopanthus mucronata*), and witherod.

No rare plant or animal species was found in any wetland on the Project Site. Within the envelope of the overall KDP four-toed salamander (yellow; NSDNR, 2005) is probably in some wetlands, but none was observed within the Project Site. Meadow vole and common shrew are likely common inhabitants of most open wetlands within the envelope of the overall KDP and likely inhabitants of the wetlands within the Project Site. The sporadically occurring southern bog lemming (*Synaptomys cooperi*) may occur in bog/fen wetlands within the site of the KDP. The wetlands within the Project Site however, do not fall within this category. Evidence of use by white-tailed deer and snowshoe hare are nearly always present.

A wetland area (Map Site 4, Figure 4.2-1) is at the base of the peninsula between the entry road and Dung Cove Pond. This is mostly a marsh dominated by several sedge (*Carex sp.*) and rush (*Juncus sp.*) species. Local residents constructed a now un-used hockey rink several years ago in the midst of this marsh area. A wetland area that is in the Project Site (Map Site 13, Figure 4.2-1) is associated with a drainage that runs southwest to Dung Cove Pond with an extension into Betty's Cove.

Of the 3 wetlands identified within the footprint of the Project Site (Figure 4.2-1), No. 13 is primarily swamp, and the No. 1 and 12 are designated Coastal Saline Ponds by CWS mapping (Hanson and Calkins, 1996). The area of the Coastal Saline Ponds on the Project Site totals only 3.2 ha. These specific wetlands have been discussed below.

4.2.4.1 Wetland No.1

This is Dung Cove Pond, which CWS mapping refers to as (Pv), Vegetated Coastal Saline Pond, at 2.4 ha in area. This is Pond 6, discussed further in Section 4.2.2.2, Red Head Ponds. It is not saline.

The pond is relatively narrow with the long axis oriented Northwest-Southeast. The southeast end is contained by a cobble dike and beach and the northwest end grades into swamp/marsh/fen habitat. The pond appears to be fed by a stream associated by other off-site wetlands. Some of the shoreline vegetation and aquatic vegetation has been described (Pond 6) in Section 4.2.2.2. Additional shoreline plants include marsh St. John's wort (*Triadenum fraseri*), turtle head (*Chelone glabra*), blue flag (*Iris versicolor*), soft rush (*Juncus effusus*), small bedstraw (*Galium tinctorium*), blue-joint (*Calamagrostis canadensis*), and other rushes and sedges. Plants on the dike and beach include lamb's quarters, hemp-nettle (*Galeopsis tetrahit*), American dune grass, common ragweed (*Ambrosia artemidiifolia*), wild-rye grass, witch grass (*Elymus repens*), and swamp rose (*Rosea nitida*).

Red squirrel inhabits the coniferous forest along the edges of the pond, and meadow vole runways were observed near the northwest end. Muskrat, mink, and beaver were observed along the shore or swimming in the pond. River otter tracks were abundant during winter of 2005. White-tailed deer winter activity was considerable in the coniferous edges on both sides of the pond. Red-breasted merganser, green-winged teal, black duck, herring gull, and great black-backed gull were seen on the surface of the pond, with black duck and red-breasted merganser possibly breeding here. Great blue heron was observed feeding here and kingfisher (*Ceryle alcyon*) is present.

Northern harrier foraged near the northwest end where old-field is in proximity of the pond. Spotted sandpiper was observed along the shore. The dike and beach at the southeast end is an important migratory stopover for several shorebirds including semi-palmated plover, semi-palmated sandpiper, least sandpiper, whimbrel, and sanderling, as well as snow bunting and water pipet. Willet is here as well and breeds on the shoreline of Betty's Cove to the southeast. Greater yellowlegs probably breeds here, as it was observed exhibiting distress behaviour at the south end of the cobble dike.

Most woodland birds listed for the site at large were associated with the shoreline vegetation.

No reptiles were observed in this wetland, although some turtles may be here. Green frog and wood frog were the only amphibians recorded.

Fish species are reported in Section 4.2.2.2, Red Head Peninsular Ponds.

No evidence of contemporary commercial or recreational use of this wetland was noted.

4.2.4.2 Wetland No. 12

Wetland No. 12 is a complex of small coastal ponds that CWS mapping refers to collectively as Pv, Vegetated Coastal Saline Ponds, 0.8 ha in total area. These are Ponds 1-5, discussed in Section 4.2.2.2, on Red Head Peninsular Ponds (for locations refer to Figure 4.1-5). Ponds 1 and 2 are not saline, Pond 3 is slightly brackish, and Ponds 4and 5 are saline. Ponds 1 and 2 are located to the west, with Pond No. 2 the smaller of the two. This pond is a manmade pond dug to provide water for cattle when much of the peninsula was under agricultural land use. The aquatic and shoreline vegetation has been described in Section 4.2.2.2.

Additional shoreline plants for Pond 2 include leather-leaf, soft rush and lowbush blueberry and blackberry (*Rubus allegheniensis*) on the slopes west of the pond. Plants associated with Pond 1, in addition to those listed in Section 4.2.2.2, include meadow rue and common, seashore and narrow-leaved plantains (*Plantago major, Plantago maritima, and Plantago lanceolata*). While Pond 1 is not saline, there is some evidence of marine influence. The Pond empties through a culvert under the lane way into Webbs Cove. Sometimes, after strong winds, seaweed (*Fucus sp.*) can be found in the pond. Also, arrow-grass and seashore plantain are on the north shore of the pond close to the laneway.

Ponds 4 and 5 are at the base of, and northeast of, the Red Head promontory. Pond 5 is the more northeasterly of the two. The pond edge vegetation includes a number of marine shore species in addition to those mentioned in Section 4.2.2.2 (see Table 4.2-3, Marine Shoreline Plant Species Identified in Peninsular Area).

Pond 3, approximately 300 m north of Pond 5 is similar to Ponds 4 and 5 with respect to vegetation, but with a greater abundance of graminoids on the shoreline. These include spike rush (*Eleocharis palustris*), sedges (*Carex canescens* and *C. hormathodes*) and rushes (*Juncus effuses*, *J. arcticus*, and *J. canadensis*).

Great blue heron was observed feeding in these ponds. Gulls, crow, and raven were observed occasionally.

Fish species are reported in all ponds in Section 4.2.2.2, Red Head Peninsular Ponds.

No evidence of current commercial use of the wetland was noted, but as indicated above Pond 2 was used to provide water for cattle in the past. In early September 2004, a number of local people picked blackberries and blueberries on the slopes west of Pond 2.

4.2.4.3 Wetland No.13

Wetland No. 13 contains a drainage that begins on the northeast side of Highway 316 and flows into Dung Cove Pond. Spatially associated with this is a low linear area that runs parallel to the northeast shore of Dung Cove pond, but separated from it by a forested ridge. The area is best designated as a swamp, but there are marsh elements at both ends, respectively. This swamp/marsh is 2.0 ha in area. This portion of the wetland drains into Betty's Cove south of the Keltic Site footprint.

Tree species associated with the wetland include black and white spruce, white birch, American mountain ash, and trembling aspen. Shrub species include mostly speckled alder along with pussy, Bebb's, and bog willows (*Salix discolour, Salix bebbiana, and Salix pedicellaris*), and dwarf raspberry (*Rubus pubescens*). The southern more marsh-like portion contains scattered broad-leaved cattail, blue-joint, creeping bent grass (*Agrostis stolonifera*), and fowl meadow grass (*Poa palustris*). Other herbaceous plants include turtlehead, cinnamon fern, sensitive fern (*Oncolea sensibilis*), bog willow-herb (*Epilobium leptophyllum*), sedge (*Carex exilis*), soft rush, and field horsetail (*Equisetum arvense*).

Green frog was the only amphibian observed. No reptiles were noted. Deer tracks, snowshoe hare scat, and muskrat and meadow vole runways were in evidence. Coyote scat was seen, and during February 2005 a snowshoe hare kill by a bobcat occurred on the edge of the wetland.

On June 8, 2005, the following bird species were noted in or adjacent to the wetland: purple finch, American goldfinch, yellow-rumped warbler, white-throated sparrow, dark-eyed junco (*Junco hyemalis*), American robin, pine grosbeak (*Pinicola enucleator*), magnolia warbler, Swainson's and hermit thrushes, black capped and boreal chickadees, black-throated green, black and white, and yellow warblers, downy woodpecker, golden and ruby-crowned kinglets, ruffed grouse, yellow-bellied fly-catcher, and herring gull and tree sparrow (*Spizella arborea*) as fly-overs.

This is an area where there was a lot of mining activity and presently clear-cutting is occurring close to the edge of the wetland. A path from Highway 316 crosses the wetland on to the dike at the end of Dung Cove Pond. Fishers and hunters may use the path, but none were seen during the course of field work in this area.

4.2.5 Species at Risk

Species at risk are defined as: "native wildlife species that are—or have become—most sensitive to human activity due to their rare occurrence, restricted range in Canada, dependence on specialized habitats or declining population or distribution" (CWS, 2004). These may include federal listed species (SARA, COSEWIC) and/or provincial listed species (NSDNR, *Nova Scotia Endangered Species Act*).

Information on "Species-at-Risk" and "Rare" species was obtained from:

- NSDNR, Wildlife Division;
- the ACCDC;

- EC;
- NSMNH;
- COSEWIC; and
- Atlas of Breeding Birds in the Maritime Provinces (Erskine, 1992).

The EC SARA website (EC, 2005c) lists plants and animals designated "at risk" by virtue of being "Extinct, Extirpated, Endangered, Threatened, or of Special Concern." COSEWIC determines whether a species is at risk, following which the federal Cabinet will determine whether the species in question will be protected under SARA. It then becomes illegal to kill, harass, capture, or harm individuals of the species; their critical habitats are also protected from destruction.

Other organizations apply their own criteria to species thought possibly to be threatened by human activity. These include species designated "red" by NSDNR (NSDNR, 2002) that are "known to be or thought to be at risk." Those designated "yellow" are "sensitive to human activities or natural events." Those designated "green" are "not believed to be sensitive or at risk." ACCDC (2004) designates "S-Ranks" as follows:

- S1 = extremely rare;
- S2 = rare;
- S3 = uncommon;
- B = if breeding;
- S4 = usually widespread; and
- S5 = demonstrably widespread, abundant.

Over 350 species at risk were identified by ACCDC (2006) to occur within 100 km from the site of the Project Site, with the majority located greater than 5 km from the site. Table 4.2-14 summarizes those ACCDC listed species of special status known to occur <u>within</u> 5 km of the Project Site as well as species at risk observed during site field surveys. These species have designations under SARA, COSEWIC, NSDNR status, and/or the *Nova Scotia Endangered Species Act*. Although similar, each ranking applies specific criteria to species potentially threatened by human activity. It is important to note that four of the twenty species in the table are considered "at risk" under SARA criteria. Information and status listing for specific species is discussed in the following sections.

4.2.5.1 Terrestrial Species

In the area of the Project Site there are four terrestrial species possibly affected by the Project and classified "at risk" under SARA. These include: roseate tern (endangered), piping plover (*Charadrius melodus*) (endangered), mainland moose (endangered), and wood turtle (special concern). A Newfoundland sub-species of red crossbill is also listed as "endangered," but the Nova Scotia sub-species is not. There was no plant species reported as rare or at risk but reference to one provincially rare and/or possibly rare species is discussed further in Section 4.2.5.3.

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TABLE 4.2-14 Summary of Species of Special Status for the Project Site

Species	Required Habitat	Habitat Present in Project Site	
		Yes	No
Fish			
Atlantic salmon (*Salmo salar*)	Nearshore and offshore while at sea	Anadromous: nearshore and offshore while at sea.	
American eel (*Anguilla rostrata*)	Freshwater streams and lakes, offshore while at sea	Catadromous (i.e., spawn at sea), lives most of life in freshwater as juveniles until spawning	
Birds			
Boreal chickadee (*Parus hudsonicus*)	Conifer forests	Yes-uncommon breeder, usually widespread	
Red crossbill (*Loxia curvirostra*)	Coniferous forests (pine, fir, spruce and tamarack) and urban parks.	Yes-as a winter resident, uncommon breeder, usually widespread, observed on main Keltic Site.	
Black guillemot (*Cepphus grylle*)	Rocky seacoasts, open sea, margins of landfast ice; seldom far from shore	Yes-uncommon, off shore migrant	
Common loon (*Gamia immer*)	Wooded lakes, tundra ponds, coastal waters	Yes- widespread as a breeder, frequents shore at LNG Terminal area	
Red-breasted merganser (*Mergus serrator*)	Estuaries, sheltered bays, less frequent on large inland bodies of water	Yes-rare as a breeder, seen with young at Dung Cove Pond terminal area	
Merlin (*Falco columbarius*)	Marshes, deserts, seacoasts, near coastal lakes and lagoons, open woodlands, fields	Yes-uncommon, widespread breeder, observed several times in flight	
Short-eared owl (*Asio flammeus*)	Prairies, marshes (fresh and salt), dunes, tundra	Yes-rare, one pair was observed summer 2005 foraging in a large wetland that extends from the Keltic site to Drum Head	
Semipalmated plover (*Charadrius semipalmatus*)	Shores, tidal flats	Yes-rare as a breeder, migratory non-breeder, observed on both marine and freshwater shorelines as a migrant	
Least sandpiper (*Calidris minutilla*)	Wet meadows, mudflats, flooded fields, shores of pools and lakes, narrow channels, edges of salt marshes, river sandbars, sometimes sandy beaches	Yes-extremely rare breeder, widespread migrant, shoreline migrant	
Solitary sandpiper (*Tringa solitaria*)	Streamsides, wooded swamps and ponds, fresh marshes	Yes- extremely rare breeder, probable migrant observed along fresh water streams	
Arctic tern (*Sterna paradisaea*)	Open oceans, rocky coasts, islands, tundra lakes (summer)	Yes-uncommon breeder, breeds on off-shore islands, but forages mainly away from shore	
Common tern (*Sterna hirundo*)	Lakes, ocean, bays, beaches, nests, colonially on sandy beaches and small islands	Yes-uncommon breeder, breeds on off-shore islands, may forage in LNG Terminal area	

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Species	Required Habitat	Habitat Present in Project Site	
		Yes	**No**
Roseate tern (*Sterna dougallii*)	Coastal islands and nearshore	Yes-extremely rare, a colony exists on Country Island about 9 km from the proposed LNG site and one roseate tern was observed flying near the shore south of the area. Foraging occurs along the mainland and island shores, predominantly on sand lance (A. Boyne, CWS, pers. comm.; Rock, 2005). No foraging site is known to be in or directly adjacent to the LNG site area. The closest site is on the shore of Harbour Island about 3 km from the proposed LNG Terminal area (Figure 4.2-6).	
Greater yellowlegs (*Tringa melanoleuca*)	Open marshes, mud flats, streams, ponds; in summer, wooded muskegs, spruce bogs	Yes-rare as a breeder, otherwise widespread as a migrant, observed exhibiting breeding behavior at three sites	
Red phalarope (*Phalaropus fulicaria*)	Migratory in Nova Scotia found at lakes and large wetlands; breeds in arctic but congregates at Bay of Fundy upwellings in early spring/summer and late summer/early fall, common to abundant at sea in early spring, and early July to November.	Yes-but unlikely and only during migration if individuals come close to shore.	
Nelson's sharp-tailed sparrow (*Ammodramus nelsoni*) (Subspecies *subvirgatus*)	Uncommon to locally common summer breeder in Nova Scotia in coastal sedge and salt marshes; rare in winter and as a migrant in early spring and fall in marshlands with tall, emergent vegetation, shorelines, coastal salt marshes and dunes.	Yes-but only during summer breeding	
Fea's petrel (*Pterodroma feae*)	Globally threatened species (no COSEWIC or provincial designation), migrant	Yes-but highly unlikely, may be present in the Study Area (one record for the Gully) (Hooker and Baird, 1999).	
Flora			
Slender cotton-grass (*Eriophorum gracile*)	Peat bogs, fens, boggy ditches	Yes-several wetlands, have been identified on the Keltic site including the LNG Terminal area, many are peatland systems, with a combination of bog or fen	
Northern burreed (*Sparganium hyperboreum*)	Peaty pools		No- species is located 1 km from site, habitat unlikely to be present

Species	Required Habitat	Habitat Present in Project Site	
		Yes	No
Fauna			
Four-toed salamander (*Hemidactylium scutatum*)	Bogs, forested wetland, riparian areas, scrub-shrub wetlands, abundant sphagnum moss, sedgy pools for larval habitat.	Yes-major types of wetlands encountered in the Study Area, bogs, fens, swamps, marshes and shallow water wetlands	
Moose (*Alces alces americana*)	Second-growth forest, openings, swamps, lakes, wetlands. Requires water bodies for foraging and hardwood-conifer forests for winter cover.	Yes-extremely rare, though no evidence of moose presence was encountered, it has been reported in the general vicinity	
Wood turtle (*Clemmys insculpta*)	Streams, roam widely overland, terrestrial habitats, adjacent to streams, deciduous woods, cultivated fields, and woodland bogs, marshy pastures.	Yes-uncommon, potentially associated with the Dung Cove Pond, in summer may be found well away from the rivers and streams where hibernation takes place in winter, no report of wood turtles are known from the vicinity of the study site	

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The Roseate tern, designated as "Threatened" under SARA; red; S1; extremely rare is located within 25 km of the proposed Project. The proposed Recovery Strategy for the roseate tern identifies "critical habitat" as defined in SARA and recommends that critical habitat be identified as:

- sites that currently support more than 15 pairs of roseate terns (The Brothers, Nova Scotia and Country Island, Nova Scotia); and
- tern colonies in areas that have supported small but persistent numbers of nesting roseate terns for over 30 years (Sable Island, Magdalen Islands, Chenal Island).

This designation includes the entire terrestrial habitat of all islands as well as aquatic habitat out 200 m seaward from the mean high tide line of each island.

Roseate Tern forage in areas within 25km of Country Island colony where shallow water (<5 m deep) occurs and where sand lance are found. The location of the proposed marginal wharf and marine terminal is within this defined area of foraging habitat and within the area described in the Recovery Strategy as requiring study (Environment Canada, 2006).

The other two terrestrial species considered "at risk," but not observed at the Project Site are:

- Moose – Endangered (SARA, 2005; COSEWIC, 2005); red; S1; extremely rare.
- Wood turtle – Special concern (COSEWIC, 2005); yellow; uncommon.

The following species should also be noted:

- Piping plover (considered endangered under SARA) formerly nested on Sable Island (McLaren, 1981a), however there are no published reports of transients in the mainland Study Area in the regional journal for Nova Scotia Birds. Burrows (2002) notes that piping plovers utilize the shoreline area near the LNG Facility for summer breeding purposes on sandy beaches backed by dunes and close to shallow tidal flats.
- Harlequin duck (*Histrionicus histrionicus*), which are designated as a species of special concern (COSEWIC, 2005), were not detected near Country Harbour during a 1997 winter waterfowl survey conducted by NSDNR (EnCana Corporation, 2002). However, Harlequin ducks undoubtedly migrate through the area in small numbers, as there are wintering and staging areas on the outer coast (Burrows, 2002).
- Ivory gull (Atlantic population) (*Pagophila eburnean*) has been designated as endangered by COSEWIC (2005) but remains as special concern under SARA. No traditional nesting grounds have been identified in the Study Area and the presence of this species in the Study Area is expected to be incidental as individuals may arrive on ice flows; therefore limited interaction with LNG Facility activities is predicted (EC, 2006a).
- Barrow's goldeneye (Eastern population) (*Bucephala islandica*) is considered by both SARA and COSEWIC as a species of special concern. This species is a diving duck that breeds and winters in Canada (Burrows, 2002). Small numbers of this population (about 400) winter in the Maritime Provinces and along the northern Atlantic coastline in the United States (Burrows, 2002). Migratory routes pass within the LNG Facility Study Area, however, limited interaction with Facility activities is predicted.

Other species observed in the area of the Project Site that are not protected by SARA, but designated to be sensitive in some respect by NSDNR (2002) or ACCDC (2004), include:

- Northern goshawk (*Accipiter gentillis*) – yellow; S3B – uncommon breeder – not observed; most other raptors were observed.
- Boreal owl (*Aegolius funereus*)– S1B – rare breeder; not observed but reported for New Harbour River system.
- Eastern phoebe (*Sayornis phoebe*) – S2S3B – rare to uncommon breeder; not observed; not likely present.
- Vesper sparrow (*Pooecetes gramineus*) – yellow; S2S34 – rare to uncommon breeder; not observed; not likely present; very little habitat available in the Study Area.
- Bobolink (*Dolichonyx oryzivorus*) – yellow; S3B – uncommon breeder; observed near Antigonish but not on site; little available habitat.
- Rusty blackbird (*Euphagus carolinus*) – S3S4B – uncommon, widespread breeder; not observed, in spite of high probability it is in or near the Study Area.
- Baltimore oriole (*Icterus galbula*) – S3B – uncommon breeder; observed near Antigonish, but not on site.

Other coastal birds in the Study Area that are sensitive to human disturbance include Great blue heron, osprey, and belted kingfisher. All of these species normally migrate south for the winter. Loons, grebes (*Podiceps sp.*), cormorants and bald eagles are resident year round.

4.2.5.2 Aquatic

<u>Marine Fish</u>

There are only two marine fish species found in the general area of the Scotian Shelf are currently listed by COSEWIC. These are Atlantic cod, categorized as a species of special concern, and Atlantic whitefish (*Coregonus huntsmani*), listed as endangered (COSEWIC, 2002).

Atlantic whitefish is an anadromous fish occupying estuarine and freshwater areas of the Tusket River drainage in southwestern Nova Scotia. There is no evidence that this species migrates to, or through, the marginal wharf and LNG Terminal area (Atlantic Whitefish Recovery Team, 2006).

<u>Sea Turtles</u>

Three species of sea turtle are known to occur off the Atlantic Canadian coast, including the leatherback (*Dermochelys coriacea*), Atlantic loggerhead (*Caretta caretta*), and Kemp's ridley (*Lepidochelys kempii*). A fourth species, the green turtle (*Chelonia mydas*) is a wide-ranging species and may be an occasional visitor to the area, but has yet to be positively identified.

The Kemp's ridley turtle, and, to a lesser extent, the loggerhead turtle, are generally confined to more southern waters and are not found on the Scotian Shelf as frequently as the leatherback turtle, due to the fact that Kemp's ridley and loggerhead turtles largely lack the counter-current biophysical flow mechanism that allows active leatherback turtles to keep warm in very cold water. The average northern occurrence of loggerheads was thought to be much further south (38E 20'N), than for leatherbacks (40E 05'N) (Shoop and Kenney, 1992). However, recent accidental catch rates by pelagic longline operations in Atlantic Canadian waters indicate that loggerheads are, at least in some years, more common than previously thought (Smith, 2001; cited in Breeze et al., 2002). The American longline fleet reported catching 3,000 loggerheads off of Newfoundland from 1992 to 1995 (McAlpine, 2001; cited in Breeze et al., 2002).

Being land-nesters, sea turtles are particularly vulnerable to disturbance by human activities. Along with natural predation, the nesting success of sea turtles has been diminished by various anthropogenic factors, including egg collection, loss of nesting beaches to commercial development, illumination of nesting beaches, shoreline pollution, ingestion of plastic and other debris, illegal hunting, and entanglement in fishing gear. Turtles, particularly sea turtles, mature slowly and exhibit moderate reproductive effort. Considerable natural mortality occurs on eggs and small juveniles. Any loss of breeding adults, above that caused through natural predation and disease, can lead to profound declines in population sizes, and possibly extirpation and/or extinction.

In Nova Scotian waters, adult and larger juvenile turtles feeding in the area may be affected by entanglement in and ingestion of debris. Entanglements in fishing line, lobster pot lines, nets, and other fishing gear have been reported. Sea turtles are caught with some regularity on longlines targeting tuna, swordfish, or other large pelagics. Often these turtles have mistakenly swallowed the bait, as opposed to being foul hooked, and although are cut loose while still alive, the rate of survival after being caught and released is unknown (Breeze et al. 2002).

<u>Leatherback Turtles</u>

The leatherback turtle is listed as endangered by COSEWIC (2002). The United States National Marine Fisheries Service and United States Fish and Wildlife Service list the leatherback and Kemp's ridley turtles as endangered and the loggerhead turtle as threatened (National Marine Fisheries Service and United States Fish and Wildlife Service, 1991; United States Fish and Wildlife Service and National Marine Fisheries Service, 1992). In 2006, a proposed recovery strategy for leatherback sea turtle was proposed that provided an outline of the basic biology, recovery goals, objectives, and performance indicators, identifies knowledge gaps, discusses permitted activities, and anticipated challenges for recovery of this species (Atlantic Leatherback Turtle Recovery Team, 2006).

The recovery strategy acknowledges that the population likely exceeds several hundred thousand individuals and model results suggest that the population can sustain human induced mortality up to about 1%. A review by DFO concluded that there was scope for human-induced mortality without jeopardizing survival or recovery of the species (Atlantic Leatherback Turtle Recovery Team, 2006).

The primary threat to leatherback turtles in Canadian waters is entanglement in fishing gear. There is little risk for entanglement with subsurface infrastructure associated with the Keltic Project as the structures are placed far enough apart such that there are few, if any spaces for head or flipper entanglement.

Peak leatherback occurrences in Canadian waters are during August-September but there are records for leatherbacks in Canadian waters for most months of the year primarily for feeding purposes (McAlpine et al., 2004; cited in Atlantic Leatherback Turtle Recovery Team, 2006). James et al. (2006) reveals a broad distribution of leatherbacks on the Scotian Shelf throughout the foraging seasons with most reported sightings occurring inshore from the continental shelf break. This recent study suggests that coastal and slope waters of the western Atlantic should be considered critical foraging habitat for adults of the species.

Whales

There are three endangered marine mammal species that could potentially be present in the Study Area: blue whale (*Balaenoptera musculus*), North Atlantic right whale (*Eubalaena glacialis*), and northern bottlenose whale (*Hyperoodon ampullatus*).

There is no reliable population estimate for the blue whale population in the western North Atlantic, however, it is thought to be in the low hundreds. The biggest factor responsible for low numbers of blue whales is the historical take in commercial whaling. Threats since the end of commercial whaling include ship strikes, disturbance from increasing whale watch activity, entanglement in fishing gear, and pollution. They may also be vulnerable to long-term changes in climate change as a result of change in abundance of prey (i.e., zooplankton) (Sears and Calambokidis, 2002).

The North Atlantic right whale also suffered high mortality due to whaling. The total population is currently estimated to be about 322 individuals and continues to experience high mortality from ship strikes and entanglement in fishing gear. It has been estimated that the population could become extinct in about 200 years (COSEWIC, 2003).

The COSEWIC Assessment Summary for Northern bottlenose whale (Scotian Shelf Population) (COSEWIC, 2002) states the reason for elevating this population to endangered status is primarily due to the threat of oil and gas development in and around the prime habitat (i.e., the Gully). It does, however, acknowledge there is little information as to how this species is, or is not, affected by oil and gas development activities. The COSEWIC assessment states that noise, chemical pollution and other disturbance of oil/gas exploration and production activities might lead the whales to abandon the Gully, potentially endangering the population.

The Atlantic populations of the fin whale (*Balaenoptera physalus*) and Sowerby's Beaked whale (*Mesoplodon bidens*) are designated as species of special concern by COSEWIC (2005).

4.2.5.3 Vegetation

No plant species observed is reported nationally rare or at risk, but one species, a horsetail (*Equisetum variegatum*), rare in Nova Scotia, (Zinck, 1998; Pronych and Wilson, 1993) was found in two places; i.e., near the shore of Gold Brook Lake (Keltic, 2002) and on the Keltic Site proper. The on-site location is shown in Figure 4.2-1.

A concerted effort was made to find rare and otherwise significant species; i.e., at risk (red), and sensitive to human activities or natural events (yellow) (NSDNR, 2004). Northern commandra (*Geocaulon lividum*) considered rare in Nova Scotia (Pronych and Wilson, 1993) is purported to be in the general area, but it was not observed in this study.

It has been suggested by the Protected Areas Branch of the Nova Scotia Government that the Endangered (COSEWIC, 2005) boreal felt lichen (*Eriodermea pedicellatum*) may be in the Keltic Study Area, and therefore the LNG Facility Area, as the area lies within the historical range of this small lichen. At present it has been known only from a single site in Halifax Regional Municipality (Conversation and Recovery of Nova Scotia Species at Risk, Municipal, and Community Stewardship, undated). Recently a second location in Nova Scotia has been reported (Cameron, 2004). The likelihood of this lichen being in the Study Area would seem remote. It is known from only two small areas in the province, and it is thought to be threatened by forestry activities, of which there has been considerable in the two Study Sites, especially the Keltic Site proper.

Plants are designated "rare" because it is presumed there are not very many of them. An extensive and intensive survey was carried out in this study, as evidenced by the finding of 305 species over a relatively comprehensive taxonomic range. Species known to be rare and the habitats in which they were likely to be found were given special attention. It is, of course, possible that there are other rare species in the LNG Facility Area that were not detected. The Bear Head LNG Terminal EA (Access Northeast Energy Inc., 2004) was carried out in roughly similar terrain and vegetation. Only two "rare" species were found; i.e., Northern commandra and Southern twayblade (*Listera australis*), but not *Equisetum variegatum*. This would seem to reinforce the point that "rare species" may indeed be rare.

4.2.5.4 Special Places

Country Island

Country Island is a 19 ha island located approximately 8 km offshore from Drum Head, Nova Scotia. The Island hosts a sizeable breeding colony of Common and Arctic terns. In addition, it is one of the few remaining Canadian breeding sites for the roseate tern. The use of Country Island by this species is discussed in Section 4.2.5.

There are currently no formal restrictions on travel to Country Island. The Country Island complex has been designated internationally as an Important Bird Area (IBA) and a proposal to designate Country Island as a Migratory Bird Sanctuary under the *Migratory Bird Convention Act* has been prepared. As mentioned above and in Section 4.2.5 the island is considered critical habitat for the roseate tern

4.2.6 Atmospheric Acoustic Environment

The general locale of the proposed facility is semi-rural in nature. However, its actual location is in an industrial park which is currently the site of the SOEI Gas Plant (Figure 1.0-1).

In September 2004, noise monitoring was conducted in the vicinity the SOEI gas plant at four locations (northeast, southeast, southwest, and northwest corners) within the property bounds.

The monitoring was conducted over a period of 24 hours (Sept.15-16, 2004), with measurements being taken once per minute in decibals (dBA). Given the limited noise sources in the area, this sample can be considered representative of typical noise levels in the area of the Project. The results are reported as equivalent sound level (Leq). Leq is the level of a constant sound which, in a given situation and time period, has the same sound energy as does a time-varying sound. Technically, Leq is the level of the time-weighted, mean square, A-weighted sound pressure. Typical noise guidelines are usually related to time of day, since noise impacts are generally perceived as being of the nuisance variety in terms of human activity, which also varies by time of day. The results of this monitoring are summarized in Table 4.2.15 below.

TABLE 4.2.15 Hourly Leq Range (dBA) SOE Gas Plant, Sept. 15-16, 2004

Time Period	Leq Range	Guideline Value*
14:00-18:00	45.5-63.7	65
18:00-23:00	38.6-54.8	60
23:00-07:00	38.5-52.7	55
07:00-14:00	39.1-61.4	65

The 'Guideline Values' are the criteria established by the Nova Scotia Department of the Environment in 1991, and are intended to reflect the effect that noise has on man. The Guideline states that "Noise legislation should be designed primarily to protect public health and within reasonable economic restraints provide a quiet and restful environment in which to live, work and play."

The context for noise assessment may be assisted by an understanding of typical noise levels for a variety of scenarios/activities. These are exemplified in Table 4.2-16 below.

TABLE 4.2.16 Typical Noise Values (dBA)

Sound Level (dBA)	Descriptor
0-25	Threshold for Normal Hearing
10	Normal Breathing
40 (generally lower limit of ambient sound)	Quiet Office, Quiet Residential Street
50	Rainfall
50-60	Typical Office
60-95	Typical Household Appliances
80-120	Typical Construction Equipment
110	Jet Takeoff

4.3 DESCRIPTION OF THE SOCIO-ECONOMIC AND CULTURAL ENVIRONMENT

Prior to the Keltic Project, the Municipality of Guysborough County was instituting an industrial strategy for the region. Construction of the SOEP gas plant in the Goldboro Industrial Park has spurred expansion of the current industrial site to include land for the proposed Keltic development.

The proposed Marginal Wharf is located on Red Head and is a marine facility. Although other aspects of the Project Area covered under the District 7 Planning Strategy and Land Use Bylaws the proposed Keltic Site was previously zoned M- 2 (Industrial Resource) and Residential R-1. The M-2 zoning permitted uses, such as quarry development, that were not deemed suitable for extension to shoreline properties. Zoning has been amended to an M-3 designation that targets the marine aspect of the Keltic development.

This designation encompasses an area between 2833 and 3238 ha, of which approximately 460 has been allocated to Keltic. The area includes the shoreline of Red Head to Betty's Cove, including the existing pipeline, and NSPI line corridors. The adjoining Sable gas complex has a footprint between 40.5 and 48.6 ha, of which 20.2 ha has been fenced (G. Cleary, pers. comm., 2005).

4.3.1 Current Use of Lands and Resources for Traditional Purposes by Aboriginal Persons

A MEK Study was developed by Membertou Geomatics Consultants for Keltic. The purpose of the study was to identify Mi'kmaq land and resource use activities that have been or continue to be pursued by Mi'kmaq in the geographical areas being considered for development.

The MEK study consisted of a historical review of Mi'kmaq occupation and use of the area, Mi'kmaq traditional land and resource use activities, and a Mi'kmaq significant species analysis. The MEK study was completed by conducting interviews, reviewing archival information, and site visits. Numerous interviews with Mi'kmaq individuals from Paq'tnkek, Pictou Landing, and Millbrook were conducted by using maps of the Study Area and asking questions about the Mi'kmaq use activities. Archival documents and published works including Census Records and Nova Scotia Legislative Council records were reviewed for information on Mi'kmaq occupation of the Study Area. Site visits were taken to the Study Area with the Ecological Knowledge holder from Paq'tnkek. The site visits helped to familiarize the ecological knowledge holder with the areas of planned development and to further identify traditional Mi'kmaq plant resources that may be in the Study Area. The area studied for the MEK report encompassed the lands of the KDP including the inshore area proposed for the marginal wharf and LNG marine terminal, and surrounding lands within a 10 km radius. The full report is provided in Appendix 2 of the Provincial EA Report (AMEC, 2006).

The Mi'kmaq people have occupied various lands located throughout Antigonish and Guysborough counties since contact. The area surrounding Antigonish Harbour and the present town site was an important site for fishing, hunting, gathering of medicinal plants, as well as encampment. One of the most significant historical Mi'kmaq communities appeared to be at St. Mary's, which for the purpose of this study, is outside of the Keltic Study Area, and located about 30 km southeast of Goldboro. However, it is clearly an important historical area, as there are reported to be Mi'kmaq burial sites here, and the St. Anne's Chapel was constructed here in the early 19th century.

The Town of Guysborough was also found to be a significant historical area to the Mi'kmaq, with various archival references to Mi'kmaq petitions and grants during the 19th century. As well, the study also found various references to a burial ground at Isaac's Harbour and Upper Country Harbour.

Data collected from interviews with Mi'kmaq hunters, fishers, and plant gatherers is mapped in the full MEK report is provided in Appendix 2 of the Provincial EA Report (AMEC, 2006).

Results identified various hunting areas for small game, deer, and areas where these animals have been harvested previously. Medicinal plant gathering sites and areas were also identified. The most significant data appeared to be fishing activities that are pursued on many of the key rivers and waterways which are found throughout the counties. This included many species, such as trout, eels, salmon, tuna, and urchins.

The study found that Mi'kmaq continue to undertake traditional activities throughout the Keltic Study Area. Some of the reported hunting and fishing areas occur within the site of the KDP, including the area of the LNG Facility, marginal wharf, and marine terminal. However, most of the potentially affected hunting areas are relatively small compared to the other hunting areas which cover extensive tracks of land and are located at a significant distance from the Project Site (Schedule C in Appendix 2 of Provincial EA Report - AMEC, 2006). Similarly, traditional fishing areas are located at and nearby the Project Site. They too represent a very small portion of extensive fishing areas located away from the Project Site (Schedule B in Appendix 2 of Provincial EA Report - AMEC, 2006). No medicinal plant gathering sites were identified within the area of the Project evaluated in the CSR.

Davis Archaeological Consultants Ltd. identified the South River, Isaac's Harbour and Isaac's Harbour River, Gold Brook, and the Salmon River/Erinville areas as key resource and land use sites using a predictive model (Appendix 13 of the Provincial EA Report - AMEC, 2006). The MEK Study and archaeological predictive modelling provided similar results and were performed independently of one another.

4.3.2 Physical and Cultural Heritage

Historical research was conducted at Nova Scotia Archives and Records Management (Halifax), NSDNR, the NSMNH Heritage Division, and local libraries. Historic maps, manuscripts, land grants and deeds, archaeological reports, and published sources were consulted. This background study revealed a long settlement history pre-dating the arrival of Europeans to the province.

Before the arrival of European settlers to Goldboro in the nineteenth century, the area was home to at least two Mi'kmaq encampments, at Schoolhouse Brook and at the head of the harbour on Isaac's Harbour River. Local residents have also indicated the possibility of a third encampment at Webb's Cove. The district was known to the Mi'kmaq as "Eskegawagik" meaning "skin-drying place" (Cook, 1976). In the seventeenth and eighteenth centuries, this area was visited by the French and English although there is no documented European settlement in Isaac's Harbour prior to 1817.

In about 1817, a Black Loyalist settler, Isaac Webb, moved his family from County Harbour to the east side of Isaac's Harbour (then known as Port Hinchingbrook) which was unsettled save for the few Aboriginal encampments. Webb built a large white farmhouse there (Hart, 1975). In 1831 some fishers from the western end of the province settled on the west side of the harbour and the community became known as Isaac's Harbour after the pioneer the settlers found there. Several families of Black Loyalists settled around what is now known as Webb's Cove. Most of these early Black Loyalists were fishers (Cook, in Public Archives of Nova Scotia, undated).

The Black Loyalist settlers were buried in a cemetery at Red Head on the east side of the harbour. No burial records for the cemetery at Red Head have been located and only one headstone was ever known in the cemetery, although an archaeological excavation in 2001 (NSMNH, 2001) resulted in the discovery and removal of 24 burials. The single carved headstone in the cemetery was that of Henry Webb who died in 1935 and was the last surviving descendent of the original settlers remaining in Isaac's Harbour East (Niven et. al., 2001).

On March 11, 1898, Isaac's Harbour East was renamed "Goldboro" by an act of Legislature, due to the discovery of gold there in the mid-nineteenth century (Statutes of Nova Scotia, 1898).

Historic maps reveal little about the settlement history of the Keltic Study Area. Land was not granted by the province until the late nineteenth century. The 1776 Atlantic Neptune does not show any settlement on Isaac's Harbour (Port Hinchingbrook), nor does the 1834 Great Map of Nova Scotia, although the main road along the shore is shown. Ambrose F. Church's map of Isaac's Harbour, published in 1876, shows several wharves and stores along the shore, along with a lobster factory and an "old crusher" just north of Webb's Cove. A cookhouse, blacksmith shop, "old mines" and a few residences are situated within the Keltic Study Area on the east side of the main road (Church, 1876).

Gold was first discovered on the west side of Isaac's Harbour on September 14, 1861. It was discovered a short time later on the east side of the harbour by two Aboriginal persons, on what became known as the Mulgrave lead. By 1862, several leads had been discovered and were in operation throughout the district including the Mulgrave and Victoria leads in Goldboro. The Mulgrave lead continued to be mined at varying rates and under various management firms well into the twentieth century (Malcolm, 1912).

In 1887, a quartz vein was discovered on Hurricane Island and three shafts were sunk and worked by the Island Mining Company. A gold lead was discovered in the Skunk Den in 1890 and was being mined by 1892 (Hunt, 1868). Mining in Goldboro halted for the last time in 1943 (Hunt, in Malcolm, 1912).

4.3.2.1 Recreational Opportunities and Aesthetics

The proposed location of the Keltic Site offers a variety of non-formal recreational opportunities such as hiking, boating, fishing, camping, scuba diving, etc. However, in terms of formal recreation the area has limited parks and campgrounds, such as the picnic area at the Goldboro community centre.

4.3.2.2 Tourism

The Guysborough County Heritage Association works to promote tourism, heritage, and culture in the region. The Association is currently developing a marketing strategy which includes a website, brochures, and signage, to increase the profile of the region and highlight its heritage resources.

The Guysborough County Heritage Association has several active members and community groups in Guysborough County, including the Goldboro/Isaac's Harbour Development Association, the United Empire Loyalists' Association of Canada, Port Bickerton and Area

Planning Committee, Lincolnville Community Development Society and the Tor Bay Acadian Society. These groups seek to preserve particular aspects of the region's heritage through promotion and/or interpretive services.

Most cultural and heritage activity appears to be associated with coastal communities. Interior communities (such as Erinville) do not currently have any active membership promoting local cultural or heritage resources (K. Avery, pers. comm., 2006). Cultural and heritage resources include the Goldboro Interpretive Centre, Port Bickerton Lighthouse Interpretive Centre, and Country Harbour Cultural Centre. Community halls exist in Goshen, Port Bickerton, and Erinville (firehall).

Specific heritage projects include the exhumation and relocation of a former black settlement cemetery on Redhead, which was within one kilometre of the proposed Keltic site. The Lincolnville Community Development Society was instrumental in this Project, and the gravesites have now been moved to another cemetery on Gold Brook Road (L. Hayne, pers. comm., 2006). Another project is the United Empire Loyalists' Municipal Park, which is a small seaside park (approximately 1 ha) in Country Harbour. First opened in 1983 and neglected for years, the park was recently reopened in 2006. This park can be accessed via a 2.2 km walking trail leased from the NSDNR off of Highway 316, just north of the intersection with Highway 211. There is a memorial cairn and planned interpretive signs that will describe the cultural and natural history of the area (D. Hayne, pers. comm., 2006).

Guysborough County's natural heritage is also protected in numerous provincial parks and natural areas. In the Goldboro area, Salsman Provincial Park is located off Highway 316, eight km north of Isaac's Harbour, on a peninsula on the east side of Country Harbour. The park is open during the summer months (June to September) and has campground facilities. The Fraser Mills fish hatchery is located on Route 7, west of Erinville. This hatchery raises approximately 500 000 fish annually, including four different salmonid species. The facility also includes an interpretive centre.

Antigonish is the major cultural centre in the County of Antigonish. The Heritage Association of Antigonish operates the Antigonish Historical Museum as the main vehicle to promote and preserve the region's cultural and historical heritage.

4.3.3 Structures/Sites of Archaeological, Paleontological or Architectural Significance

An archaeological resource impact assessment of the Study Area for the KDP, was conducted under Heritage Research Permit A2004NS76. An assessment including a historical background study and field survey were conducted that resulted in the discovery of twelve previously unrecorded archaeological sites, at least three of which are expected to be impacted by construction of the Project assessed in this CSR (i.e., the LNG facility and the marginal wharf). A copy of the impact assessment is provided in Appendix 13 of the Provincial EA Report (AMEC, 2006).

4.3.3.1 Archaeological Field Survey and Reconnaissance

Prior to the field survey of the proposed Project Site, two archaeological sites were recorded during previous archaeological assessments. Archaeologist Laird Niven recorded the remains of the late nineteenth century Skunk Den Mine located on the south side of Sable Road within the Keltic Study Area. The site includes the remains of several stone crusher piles and irregularly-shaped depressions likely associated with open-pit mining.

In response to concern by citizens of the Lincolnville community, in 2000 and 2001, a crew of archaeologists and community members, lead by archaeologist Laird Niven, conducted an excavation of the cemetery at Red Head. The purpose of the excavation was to identify and remove burials which were being impacted by severe erosion of the table land on which the cemetery was located. Twenty-four burials were encountered over the two seasons and the skeletal remains were moved to a laboratory where forensic analysis and identification (gender, age, and pathology) was conducted before the remains were reburied at the Goldboro Baptist Cemetery.

No additional burials were encountered at Red Head during subsurface testing for the proposed Keltic Facility. Twelve archaeological sites were encountered during the survey of the remainder of the Project Site including eight sites on the peninsula, one on Hurricane Island, and the remaining three within the Industrial Park (Figure 4.3-1).

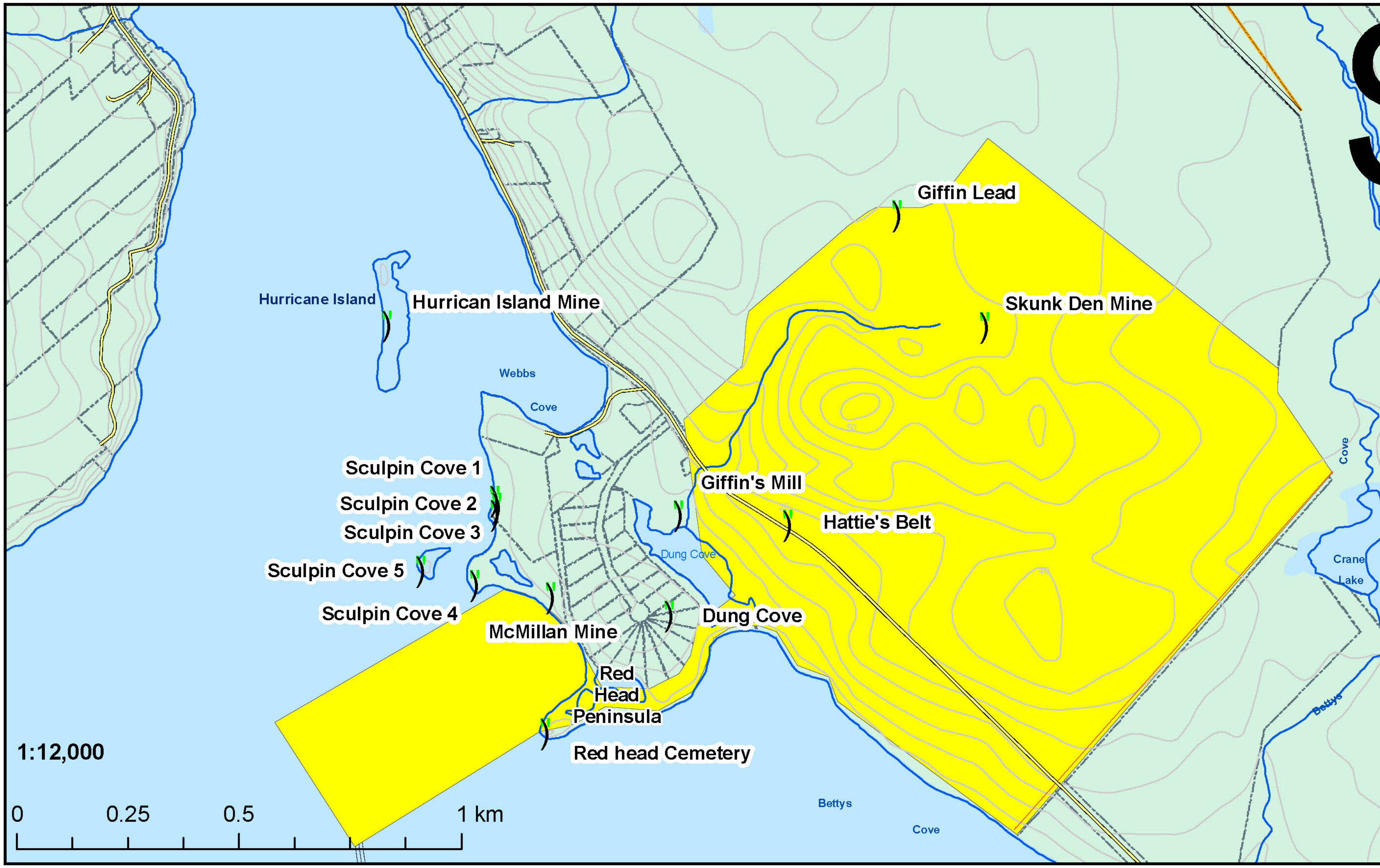
Five unidentified features were discovered and recorded at Sculpin Cove north of Red Head. All five features are comprised of irregularly-shaped depressions with no structural elements or associated artifacts visible on the surface. The age and function of these features is not known.

On Hurricane Island, at the mouth of Isaac's Harbour, archaeologists discovered and recorded the remains of a late nineteenth century gold mining operation. The site is very extensive and includes numerous mine-related features spread out over the island including several irregularly shaped depressions associated with air shafts or surface prospecting. There are also several large deep rectangular depressions which may be related to open-pit mining, a possible powder magazine, a stone-lined well, and numerous other unidentified features.

The site is associated with the Hurricane Island Mine which was opened in 1887 by the Island Mining Company. The McMillan Mine is located north of Red Head and appears to be relatively modern (early twentieth century) as the main feature is comprised of a square footing of stone and concrete construction with wooden block supports inside. To the south of the main feature is a mine shaft adjacent to the shoreline.

Above Dung Cove, archaeologists discovered a site likely associated with settlement which includes a rectangular stone-lined feature. The feature is obscured by low tree cover and is surrounded by three stone piles resulting from field clearing. The land appears to have been cultivated at some point. The age of this site is not known but given its proximity to Webb's Cove, it may be associated with Black Loyalist settlement.

The Giffin's Mill site is located above Dung Cove on the north side of an old roadway that runs south-westward from Highway #316. The site is comprised of a shallow rectangular depression which is bounded on the east by a wooden structure of vertical posts and on the north and south by a mortared stone wall. A sluice runs parallel to the old roadway from the highway and leads to the feature. This area is marked on historic maps as "Giffin's Mill" (Geological Survey of Canada, 1904).



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Heritage Resources

LNG Project Area

FIGURE No. 4.3-1

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LOCATION OF HERITAGE RESOURCES

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The Hattie's Belt site is located adjacent to Highway #316 on the east side, south of Sable Road. The site encompasses an area approximately 50 m by 50 m and includes several stone crusher piles, air shafts, and/or open pits associated with gold mining. At the west end of the site immediately adjacent the highway is a surface tunnel which is marked on the 1904 gold district map for Isaac's Harbour (Geological Survey of Canada, 1904).

The Giffin Lead is located on the south side of Sable Road which consisted of more than a dozen water-filled depressions possibly related to open-pit mining. Several stone crusher piles were also observed in the surrounding area. This site stretched a radius of approximately 50 m. The South Mulgrave lead is located on the north side of Sable Road adjacent to an old roadway that runs northwest from Sable Road out to Highway #316. This site stretches for approximately 100 m along the old roadway and consists of several stone crusher piles, those on the east end of the site having been recently levelled. On the west side of the site are a stone crusher pile and open mine shaft with wooden structural remains. This site is likely the "old crusher" indicated on Church's 1876 map.

In addition to those archaeological sites that were recorded, several areas of cultural activity were noted. At the head of Betty's Cove, mining activity likely associated with surface prospecting was encountered. Several depressions were noted but no open mine shafts or structural remains were found.

On the north side of Sable Road approximately 350 m east of the South Mulgrave lead site, seven air shafts were discovered which are likely associated with the Mulgrave lead. Additional air shafts were discovered at the west end of the industrial park approximately 100 m east of the highway and 50 m north of Sable Road.

On the north side of Sable Road, west of the old roadway leading to the South Mulgrave lead, a linear stone alignment was discovered oriented north-northeast by south – southwest adjacent to a NSDNR Survey marker (#4447). No other heritage features were found in the surrounding area.

Two areas of recent dumping were encountered near the east end of the Keltic Study Area on the north side of Sable Road along a recently abandoned roadway opposite the Sable Offshore helipad. Midden materials included a wood stove, tires, a chemical storage drum, vinyl miniblinds, tar paper, mechanical parts, plastic containers, and plastic buckets. Newspapers dated March 1995 were also found among the refuse.

Finally, an early- to mid- twentieth century midden was found approximately 30 m south of Sable Road behind a standing abandoned house on Highway #316. The house is built on a fieldstone foundation which has been mortared in spots to repair it, and later boarded over. The house is likely of late nineteenth-century vintage. Across the highway opposite the house is a poor-grade concrete foundation with cast iron pipe running through it. Behind the foundation is a 1930s truck and scattered remains of other early automobiles, suggesting this may have been a commercial garage or a garage associated with the house across the street. Fifteen metres northeast of this feature is a mine air shaft.

4.3.4 Shipping and Navigation

The current marine activity within the Isaac's Harbour and Country harbour are basically those activities supporting the inshore fishery as discussed further in Section 4.3.8.2.

Current marine traffic also includes a monthly passage of a shrimp trawler to the Stormont facility in Country Harbour (a wharf located approximately 10 km north of the Project Site in Country Harbour. An approximation of the current harbour traffic scheme is provided in Figure 4.3-2.

4.3.4.1 Current Shipping Routes

Atlantic shipping routes cross north to south into the Chebucto Bay and Halifax Harbour from the seaward traffic lanes well outside the proposed entrance to Country Harbour. Marine traffic traveling along the Nova Scotia coastline generally chart a strait line route port to port at a distance of roughly 16 km+ off the coast to avoid coastal land extensions and small ships traffic.

4.3.4.2 Regulatory Environment

The *Canada Shipping Act* and Regulations, the *Oceans Act*, and the *Canadian Marine Act* all govern the movement of vessels in Canadian waters. Movements and routing of vessels in Canadian waters is monitored by the Marine Communications and Traffic Services. Marine Communications and Traffic Services provides the Eastern Vessel Traffic System, assisted by Pilots and as permitted by Customs and Port Authorities. The local fisheries activities are managed under the guidance of DFO with regulations pertaining to specific species pursued.

4.3.5 Lighting

The Project Site currently has virtually no artificial lighting sources. The surrounding community has artificial lighting sources consistent with those found in sparsely populated rural communities but in general the night sky is typically dark.

Existing ambient light levels were not monitored; however, as with noise levels, they would be typical of a semi-rural environment, with some slight impacts from the flare stack at the SOEI Gas Plant.

4.3.6 Marine Safety and Security

Ocean-going tanker transportation of LNG has a long record of safe operation. Few accidents have occurred since the first converted freighter delivered a Lake Charles, Louisiana cargo of LNG to the United Kingdom (UK) in January 1959, none involving a fatality or major release of LNG. The outstanding LNG shipping safety record is attributable to continuously improving tanker technology, tanker safety equipment, comprehensive safety procedures, training, equipment maintenance, and effective government regulation and oversight.

LNG ships are well-built, robust vessels with a double-hull design built to withstand the low-energy impacts common during harbour and docking operations.

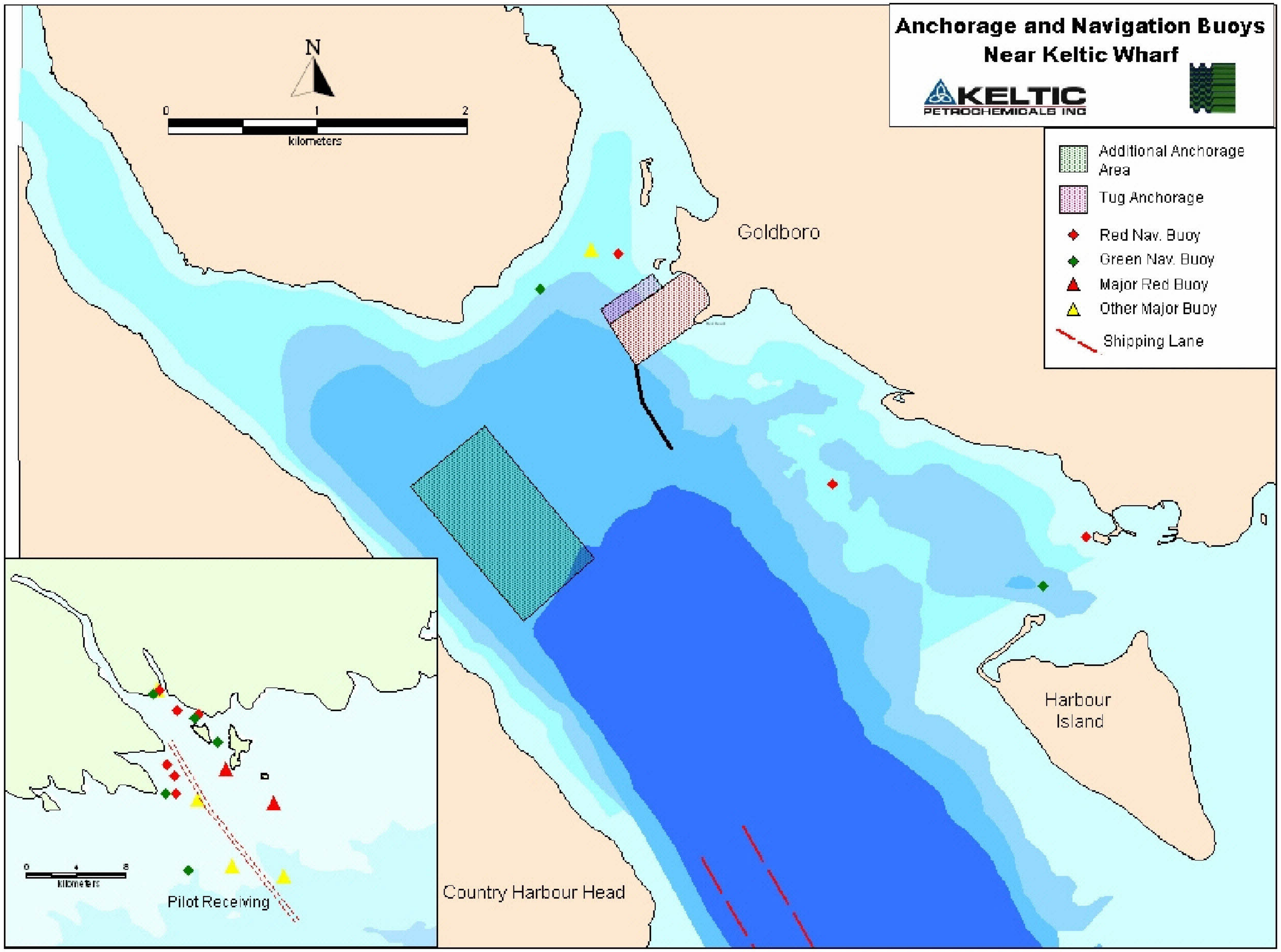

Figure No. 4.3-2
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Shipping and Navigation
June 2007

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Currently, the only wharf in the vicinity of the LNG Facility is the single wharf structure utilized by the SOEI project. A port structure with formal marine security and safety policies and regulations is not available.

4.3.7 Human Health and Safety

No assessment of existing human health and safety was undertaken to record baseline conditions. Human health and safety will be addressed based on anticipated Project-related effects and a QRA.

4.3.7.1 Seismic Considerations

Eastern Canada is located within a stable continental part of the North American tectonic Plate and as such has a relatively low rate of earthquake activity. Nevertheless, within Canada's eastern seismic region, large earthquakes have occurred in the past and will inevitably occur in the future. The Eastern Seismic Region of Canada includes Northeastern Ontario, Southern Great Lakes, Western Quebec, Charlevoix-Kamouraska, Lower St. Lawrence, Northern Appalachians, and the Laurentian Slope (see web site of NRCan Earth Science Sector: http://earthquakescanada.nrcan.gc.ca/zones/eastcan_e.php).

Each year, approximately 300 earthquakes occur in the eastern seismic region, of which perhaps four will exceed magnitude 4, thirty will exceed magnitude 3, and about fifteen will be reported felt (Geological Survey of Canada, 2003). A decade will, on average, include three events greater than magnitude 5 (generally the threshold of damage).

The known earthquake seismic source zones of most concern to the populated areas of eastern Canada are the Charlevoix, Passamaquoddy and offshore Laurentian Slope seismic zones where major earthquakes of magnitudes 7.0, 5.7 and 7.2 occurred in 1925, 1869 and 1929, respectively. The Passamaquoddy area experienced a 5.9 event in 1904 and the Charlevoix area a 6.0 event in 1988 with the Laurentian Slope having had about nine events 5.0 or greater since 1929 up to 1977 (Ruffman, 1995). In 1929 a magnitude 7.2 earthquake on the Laurentian Slope (known also as the Grand Banks earthquake of 1929) triggered a large submarine slump, which ruptured 12 transatlantic cables and generated a tsunami that was recorded along the eastern seaboard as far south as South Carolina and across the Atlantic Ocean in Portugal, and caused the loss of 28 lives on the Burin Peninsula in Newfoundland. This represents Canada's largest documented loss of life directly related to an earthquake.

The causes of earthquakes in eastern Canada are not well understood: unlike at plate boundary regions where the rate and size of seismic activity is directly correlated with plate interaction, seismic activity seems to be related to the regional stress fields (Ruffman, 1994), with the earthquakes concentrated in regions of crustal weakness (Bent, 1995) at depths varying from surface to 30 km (Geological Survey of Canada, 2003).

4.3.7.2 Tsunamis

Ruffman and Tuttle (2005) have noted that written history of tsunami by European settlers on the western side of the Atlantic Ocean is relatively short and little oral history from first nations peoples or Viking visitors survives. The following is summarized from their work:

- The first known historic local tsunami is that caused by the November 1, 1755, Lisbon offshore earthquake.
- Tele-tsunami is known on September 24, 1848, from Fishing Ships Harbour, southern Labrador, to St. John's.
- A local tsunami was noted on June 27, 1864, at St. Shotts on the southwest extremity of the Avalon Peninsula, Newfoundland.
- On November 17, 1872, tide gauges on the Fox Islands in Penobscot Bay and in North Haven, Maine registered a train of tsunami-like waves for about six hours.
- On August 10, 1884, a magnitude 5.6 earthquake in southern New York State created a tsunami that was observed in Philadelphia, along the coast at Trenton and Highlands, New Jersey, and through to New York Harbour.
- On October 4, 1884, three trans-Atlantic cables south of the Tail of the Banks broke at the same time over a down-slope distance of 10 nautical miles suggesting a slump; a possible tsunami may have resulted, however no tsunami reports are presently known.
- On January 9, 1926, an apparent tsunami was seen at Bernard, in Bass Harbour on Mount Desert Island, and at Corea in Maine.
- On November 18, 1929, the magnitude 7.2 "Grand Banks" earthquake (epicentre of 44.5°N, 56.3°W) triggered a large submarine slump that generated the tsunami described in Section 4.3.7.2.
- In 1940, a small tsunami-like event observed on the Island of Saint-Pierre may have been associated with the Laurentian Slope Seismic zone.

Other tsunami which preceded these is known from studies of the offshore geologic record (Campbell et. al., 2003; Bornhold et. al., 2004; Finea et. al., 2005).

The tsunami that is most relevant to the proposed Keltic plant site is that of 18 November 1929, in which a magnitude 7.2 earthquake occurred along the southern edge of the Grand Banks (epicenter of 44.5°N, 56.3°W) that was felt as far away as New York and Montreal (Geological Survey of Canada, 2005). On land, damage due to earthquake vibrations was limited to Cape Breton Island, where chimneys were overthrown or cracked, and where some highways were blocked by minor landslides. However, the earthquake triggered a large submarine slump that generated a tsunami that was seen in Cape Breton Island, where it did minor damage; it was physically seen as far southwest as Lunenburg, Nova Scotia, and in Bermuda. It was recorded on tide gauges as far south as Charleston in the US, in the Azores, and across the Atlantic Ocean in Portugal (Ruffman, 2001).

The tsunami traveled at speeds up to about 500 km/hr through deep water, and over the continental shelf at about 205 km/hr toward Halifax and 140 km/hr toward Newfoundland, where two-and-a-half hours after the event, three main pulses arrived along the coast of the Burin Peninsula with amplitudes of 3 to 8 m (Finea et. al., 2005) and a run-up that rose 13 m (Ruffman, 2001) above sea level and perhaps as much as 27 m (Geological Survey of Canada, 2005) above sea level in narrow bays. It claimed a total of 28 lives in Newfoundland, one life in Cape Breton, Nova Scotia, and caused more than $1 million (1929 dollars) damage (estimated as nearly $20 million 2004 dollars).

The proposed Keltic plant site was shown by the Geological Survey of Canada (2005) to be just at the edge of the "minor damage" zone for the 1929 tsunami.

4.3.8 Fisheries

4.3.8.1 Freshwater

Nova Scotia is divided into six Recreational Fishing Areas; Guysborough County is located within Recreational Fishing Area 2, along with Antigonish and Pictou Counties. There were 1,632 fishing licenses sold in the County in 2000. Of these, 87 were non-resident and the rest resident. Overall, 2.5% of the 64,078 provincial licenses sold in 2000 were in Guysborough County (NSDAF, 2001a). Approximately 2000 licenses were sold in 2005 (O'Neil, pers. comm., 2005).

Seventy-five logbooks were returned from Guysborough County license-holders in 2000. The logbooks showed that the primary fish species targeted was brook trout, making up 98% of the reported catch. Catch per unit effort (fish caught versus hours spent fishing) was 0.77 in the County, compared to the provincial average of slightly over one fish per hour. Within the Keltic Study Area, anglers reported fishing on various parts of the watersheds of the St. Mary's, Country Harbour, and Isaac's Harbour rivers. All catch was brook trout, with an average length of 24 cm and a catch per unit effort of 0.58. Many rivers in Guysborough County support sea-run trout; however a license is not required if caught in salt water (NSDAF 2001a).

Atlantic salmon (*Salmo salar*) are managed on a river-specific basis within nine management areas in the Maritimes. The Keltic Study Area is in Salmon Fishing Area 20. Watersheds and rivers within the Keltic Study Area that supported salmon runs in the past decade include:

- Country Harbour River;
- Gaspereau Brook;
- Guysborough River;
- Isaac's Harbour River;
- New Harbour River; and
- St. Marys River.

Since 1996, the rivers have been open to catch and release only, and were closed altogether in 2000. In 1999, only six grilse and one adult salmon were caught on the St. Marys River. No salmon were caught on other rivers. In general, salmon returns to all rivers along the Atlantic Coast of mainland Nova Scotia were insufficient to meet conservation requirements in 2000, including those receiving hatchery stocking. Currently there is a hook-and-release salmon fishery on only the St. Marys River.

4.3.8.2 Marine

Stormont Bay (Figure 1.0-1) and adjacent areas (including Country Harbour, Isaac's Harbour, and Red Head) support a diverse local fishery. Aquaculture, commercial and recreational shellfish harvesting and inshore fishing activities occur in the area.

Non-Commercial Species

Stormont Bay and the surrounding areas including Country Harbour and Isaac's Harbour support a diversity of fish species, some of which contribute to an active recreational fishery. Common fish species in Stormont Bay include demersal fish (groundfish that tend to be associated with the seabed) such as tomcod, cunner, wolffish, and sculpins, as well as pelagic species (fish usually found inhabiting the water column), such as herring and mackerel (Scott and Scott, 1988; Gilhen, 1974; SOEI, 1999).

Estuarine habitats of Country Harbour support a variety of estuarial, freshwater, and pelagic fish species during their various life stages. These include Atlantic salmon, winter flounder, American eel, gaspereau (alewife), smelt, and trout in addition to juvenile cod, pollock, and herring (Scott and Scott, 1988; Gilhen, 1974; SOEI, 1999).

Salmon are likely present in Stormont Bay throughout summer, while smelt are found in coastal and estuarine waters in the area throughout the year. In addition, six other species of fish are reported to be common in the estuarial habitats and the lower reaches of rivers. These species include Atlantic silverside, backspotted stickleback, northern pipefish, windowpane, smooth flounder, and winter flounder (Gilhen, 1974).

Several species of non-migratory fish are expected to be in the area including creek chub, white sucker and various species of dace and stickleback (Gilhen, 1974). While not considered commercial species, they can, however, provide important sources of food for larger fish.

Commercial Species

A 1995 study done for the SOEP on the winter distribution of selected species of adult fish in the vicinity of Stormont Bay showed congregations of cod and herring. Summer surveys showed the presence of adult cod. Inshore areas around and including Stormont Bay support small commercial herring and mackerel fisheries.

Lobster and rock crab are currently fished in Stormont Bay and surrounding areas. Lobster in this area is managed under Lobster Fishery Area 31B, one of three Lobster Fishery Areas covering the Eastern Shore. Stormont Bay supports a small rock crab fishery with a limited number of licensees. Generally, rock crab is managed as a by-catch associated with lobster. Until recently, the green sea urchin (*Strongylocentrotus droebachiensis*) was also a major commercial species on the Eastern Shore of Nova Scotia; however, the Guysborough fishery has been traditionally underdeveloped in comparison. A significant decrease in sea urchin abundance occurred throughout most of the Eastern Shore of Nova Scotia, including Stormont Bay, in 1999, due to spread of Sea Urchin Disease (*Paramoeba invadens*) (DFO, 2000). Few, if any, urchins are now located within Stormont Bay or in the vicinity of the proposed Marginal wharf and LNG Terminal.

Inshore Fishery

Information about inshore fisheries and aquaculture in the Keltic Study Area is available from the GCIFA website, http://www.gcifa.ns.ca. GCIFA has partnered with St. Francis Xavier University, the Gulf Nova Scotia Bonafide Fishers Association (Lakevale), the MFWC, and the

ISAR (Antigonish) in a cross-Nova Scotia collaborative effort to build participatory research capacity related to coastal communities and sustainable fisheries. As part of this effort, a profile of the Guysborough County Inshore Fisheries was prepared in 2001 (Boudreau and Social Research for Sustainable Fisheries, 2001). Much of the following information in this section is drawn from that comprehensive report, however, catch and effort statistics have been updated with more recent information from DFO.

Most of the relevant available fisheries data is aggregated for Guysborough County as a whole, or the DFO statistical districts (SD) that border the county. The inshore fisheries Study Area was selected to include the region that could potentially be affected by Project activities, such as accidental releases from an LNG carrier or cargo vessel. Modeling carried out for the Deep Panuke Environmental Impact Assessment indicated that a slick dispersed to a concentration of 0.1 ppm would extend approximately 20 km from the point outside the approaches to Country Harbour in winter and 19.5 km in summer. Based upon this analysis, the coastal Study Area for the Keltic Project was delineated to extend approximately 30 km on either side of the proposed Project Site in Goldboro, i.e., from Berry Head to the St. Mary's River estuary. This Study Area is within DFO SDs 16 and 17.

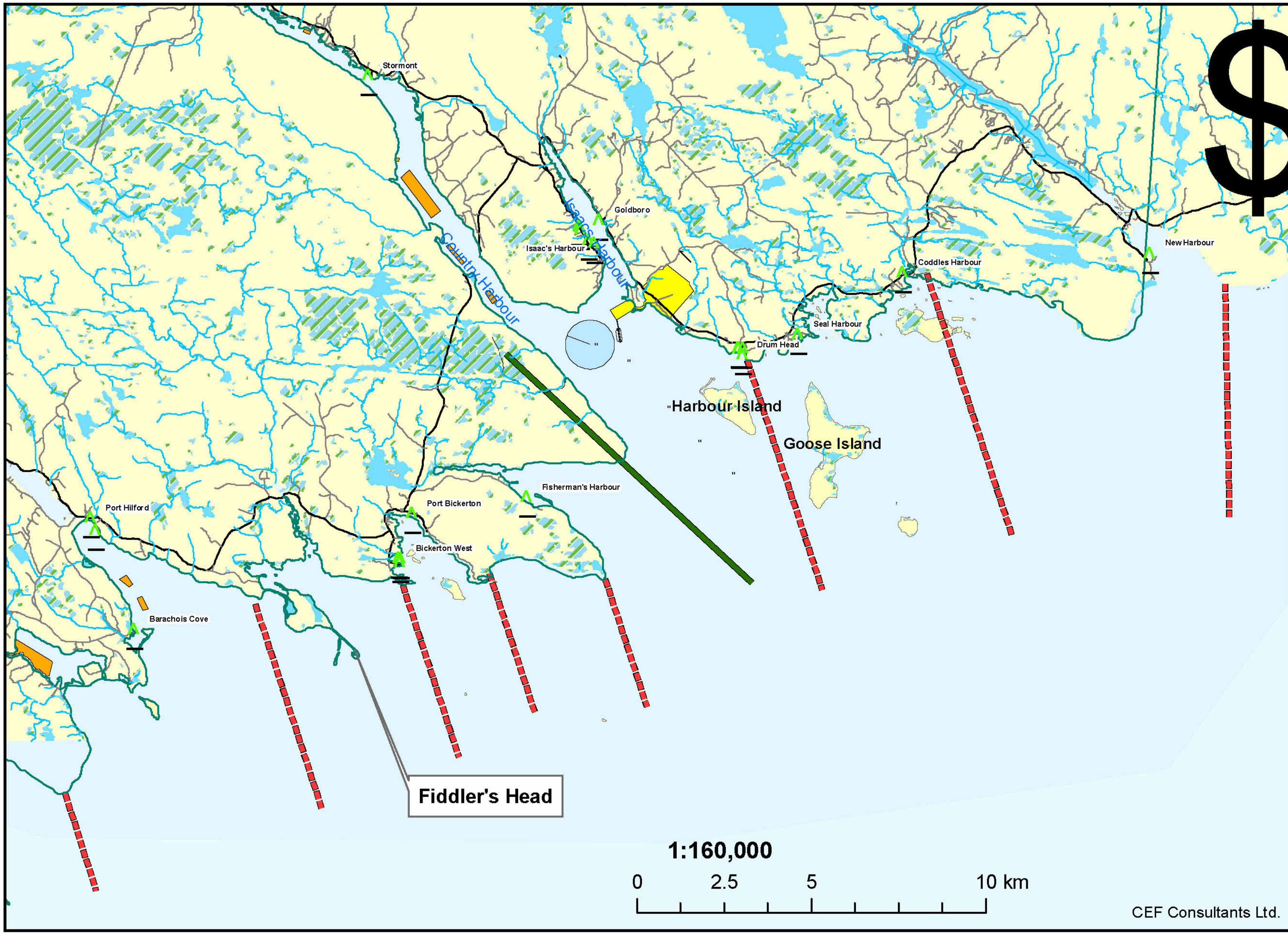
Official data on catch and effort are based on two systems: reports of catches made by vessels and reports of purchases by buyers. Small vessels, common in inshore fisheries, are not required to supply log-books of catch or effort, so information is only available on sales made at a port of landing. Information on catches made by individual fishers is confidential, so data are usually pooled by port of landing or by SD.

Fishing effort in the lobster fishery is regulated by limiting the number of traps allowed per vessel, the type of license (full or part-time), and length of season. Other inshore fisheries, such as that for herring, are regulated by gear type, license, season, and quotas. The sea urchin fishery is different in that licensed fishermen are allocated a specific area to which they have exclusive fishing rights, coupled with an obligation to manage the urchin resource within their fishing area. SDs, lobster fishing areas, and sea urchin lease areas are shown on Figure 4.3-3.

Home Ports, Numbers of Fishers and Vessels

In 1999, Guysborough County had 257 registered fishing vessels ranging from 18 to 64.9 feet; twenty-five of these vessels were in the 35-44.9 foot class, and five were in the 45–64.9 foot class. All other boats were smaller, measuring less than 34.9 feet in length. The fishery directly employed 598 people of whom 345 were full-time and 253 part-time (Boudreau and Social Research for Sustainable Fisheries, 2001; DFO, 2001).

Under the *Fisheries Organizations Support Act* of Nova Scotia, core fishers, holding licenses for limited-entry fisheries such as lobster, groundfish, and scallops, can vote for an accredited organization of choice to which they agree to pay annual dues. In 1998, the GCIFA was accredited by the province to represent Region 3, the Eastern Shore (from Canso Causeway to Halifax Harbour) (GCIFA, 2001). Table 4.3-1 provides the number of core and non-core fishers for Guysborough County from 2000 to 2002.



Legend

Wharf

Urchin Lease Boundaries

LNG Project Area

Aquaculture Facility

Statistical District Boundary

FIGURE No. 4.3-3

KELTIC PETROCHEMICALS INC.

Fisheries Off Nova Scotia from 2001 - 2003

June 2007

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TABLE 4.3-1 Number of Inshore Fishers, Guysborough County

	2000			2001			2002		
	Core	Non-Core	Fishers Total	Core	Non-Core	Fishers Total	Core	Non-Core	Fishers Total
District 16	13	43	56	13	37	50	13	41	54
District 17	56	119	175	56	128	184	56	123	179

Source: GCIFA, 2001

Table 4.3-2 lists ports in the Study Area in 1999, with the number of registered vessels, and full-time, part-time, and core fishers in each. Responsibility for port and wharf management has devolved from the federal government to local Harbour Authorities. In the Keltic Study Area, these include:

- Harbour Authority of Port Bickerton;
- Harbour Authority of Drum Head; and
- Harbour Authority of New Harbour.

TABLE 4.3-2 Numbers of Fishers by Port (1999)

Port	Vessels (<34.9 feet, unless otherwise noted)	Full-time	Part-time	Core
Bickerton West	2	3	1	1
Coddles Harbour	3	5	2	2
Country Harbour	2 (<34.9 ft), 1 (45-64.9 ft.)	17	2	1
Drum Head	5	8	1	3
Fisherman's Harbour	3	5	5	3
Isaac's Harbour	3	3	1	1
New Harbour	5 (<34.9 ft), 1 (35-44.9 ft)	9	5	
Port Bickerton	5 (<34.9 ft), 2 (35-44.9 ft)	16	11	9
Port Hilford	2	3	0	2
Seal Cove		2	1	
Sonora	9	11	29	6
Stormont		3	0	
Wine Harbour	3 (<34.9 ft), 1 (35-44.9 ft)	3	2	3
Total	**49**	**88**	**60**	

(Source: DFO, 2001; Boudreau and Social Research for Sustainable Fisheries, 2001)

Landings and Values

The coastal waters of Guysborough County support fisheries for groundfish, small pelagic species, and invertebrates. Groundfish were historically important, but the stock collapses of the late 1980s and early 1990s, and the resulting moratoria, have largely eliminated those fisheries. However, with the collapse of the ground fishery, the inshore fleet shifted primarily into invertebrate fisheries like lobster and sea urchin (Boudreau and Social Research for Sustainable Fisheries, 2001).

The most recent data on the value of landings in the Keltic Study Area are available by SD (Table 4.3-3). Species include lobster, shrimp, and snow crab. Sea urchins are not included at present due to the recent collapse of this fishery. It is of note that a gradual recovery of urchins in the nearshore area around the Project Site could occur over time; however, urchins in the area were seeded by an urchin harvester a few years prior to the first survey of the area in 1996. The urchin distribution observed during frequent surveys for the Sable Gas project suggested that the urchin spread gradually from the seed location and were not otherwise in commercial numbers in the area. It is likely that urchin are not normally present in these shallow shoreline areas because water temperatures too often reach conditions favourable for spread of the parasite that kills them. Urchins in other areas more outside Stormont Bay were not affected by the recent die off. While the shoreline area near the Project Site is suitable for the growth of sea urchin, it is not likely a natural sea urchin area and repopulation in commercial quantities may not occur without seeding.

Landings of shrimp are from the offshore fleet, which are generally caught near Greenland and landed in Country Harbour.

Without groundfish, the total landed weight in the fishery dropped dramatically. However, the overall value of the Guysborough County commercial fishery is worth much more than it was in 1990 because of the high value per kilogram fetched for most invertebrates (Boudreau and Social Research for Sustainable Fisheries, 2001).

TABLE 4.3-3 2000-2003 Value of Landings by Statistical District (SD) in Thousands of Dollars

Species or Group	2000		2001		2002		2003	
	SD 16	SD 17	SD 16	SD 17	SD 16	SD 17	SD 16	SD 17
Halibut	0	35	8	83	1	70	1	75
Other Groundfish	120	29	61	31	1	14	149	5
Total Groundfish	**120**	**64**	**68**	**114**	**2**	**84**	**150**	**80**
Alewives	0	1	0	1	0	1	0	1
Mackerel	0	1	0	0	0	1	0	0
Eels	7	21	16	17	15	82	2	35
Smelts	1	4	1	6	1	4	1	0
Tuna, bluefin	52	0	120	11	16	0	54	0
Total Pelagic/Estuarial	**59**	**27**	**137**	**35**	**31**	**87**	**57**	**37**
Lobster	570	1792	709	1888	823	1813	943	2478
Shrimp	15516	0	14307	0	14192	0	17775	0
Crabs, Snow	0	6219	102	3579	0	5275	0	3075
Other Shellfish	9	24	5	13	5	4	2	60
Total Shellfish	**16180**	**8147**	**15122**	**5481**	**15020**	**7092**	**18720**	**5613**
District Total	**16359**	**8240**	**15327**	**5630**	**15052**	**7263**	**18928**	**5729**

Lobster

The inshore lobster fishery has been a limited entry fishery since 1968 and is the most consistent of the Guysborough County fisheries. The majority of licenses are Class A with a 250 trap limit, but there are some Class B licenses with a limit of 75 traps. Class B licenses cannot be sold or transferred.

Lobster season opens April 19^{th} and closes on June 20^{th} in the Keltic Study Area. Although landings have decreased by more than 50% over the past decade, the total landed value in SDs 16 and 17 increased to almost $3.5 million in 2003, and lobster landings in Lobster Fishing Area

31B has increased six times from 1997-2006. Lobster fishers in Guysborough County have actively participated in resource conservation focused on increasing egg production in Eastern Nova Scotia.

Sea Urchin

The sea urchin fishery developed in response to demand from the Japanese market. Shoreline areas are divided into leases assigned to individual operators who hire urchin divers and have a responsibility to adequately manage the resource. Management can include seeding urchins in new areas within their lease. Sea urchins are harvested for their roe.

Harvesting is not restricted by season, but generally occurs from October to March. The legal minimum size limit for harvest is 50 mm. In the 1999-2000 season, there were 10 active and 5 inactive licenses in Guysborough County. Lease areas within the Keltic Study Area are illustrated in Figure 4.3-3.

The 1994 to 2000 landings for eastern Nova Scotia (from Halifax east to Guysborough) are shown in Table 4.3-4.

TABLE 4.3-4 Sea Urchin Landings (t) for Eastern Nova Scotia from 1994 to 2000

Area	Year					
	94-95	95-96	96-97	97-98	98-99	99-00[1]
Eastern Nova Scotia	709	658	915	700	605	324

[1]Preliminary (Source: DFO, 2000)

Sea urchins are susceptible to parasitic amoebal infection. This infection spreads when waters remain unusually warm for a couple of weeks. Therefore, deeper water areas are less prone to infection and catch can be maintained (at least initially) by shifting the areas of harvest. Depopulated areas can also be reseeded from areas less affected. In the fall of 1999, large numbers of urchins died from parasitic amoebal infection and total landings fell 30% from the previous year. By 2000, the sea urchin fishery had collapsed and has not yet recovered.

Snow (Queen) Crab

Snow crab is a deep water, cold temperature species. They are fished on muddy or sand-mud bottoms at temperatures ranging from –1.0 to 6.0 °C and at depths ranging from 60 m to 300 m. Typical fishing depths off eastern Nova Scotia are 130 m to 250 m (DFO, 2005). The 2003 value of snow crab landings allocated to the inshore was $3,075,000 in SD 17. No landings were recorded in District 16.

Finfish

Swordfish and shark licence holders are based in Guysborough County. The majority of these catches occur in the Country Harbour and Ecum Secum areas. Other finfish such as mackerel, alewives, and herring are fished opportunistically along the coast, primarily for bait.

Other Species

Other invertebrate fisheries now exist for species traditionally considered a nuisance (such as rock crab), or for species that were once supplements to the traditional fishers' family diet. Additional fisheries have developed following exploration for underutilized species. Species such as crab, shrimp, scallop, and soft-shell clams have all contributed to an increase in the value of the invertebrate fishery.

Seasonality

Most inshore fisheries in the Keltic Study Area operate between April and October. The coast of the Keltic Study Area falls within Lobster Fishing Districts 31b and 32. The season opens April 19 for Districts 32 and 31b. Both close on June 20 (DFO, 2004). The rock crab season usually opens the week after lobster season closes and ends one week before it begins.

Historically, the inshore fleet's season began on July 1. Since a quota system is in place, most boats finish well before the formal end of the season. In 2001, for example, 80% of the quota for the temporary inshore associations off Guysborough County had been caught by early September (M. Eagles, pers. comm., 2001).

The inshore herring and mackerel fisheries are open throughout the year. A commercial herring roe fishery occurs in the fall on the Eastern Shore. Its location is dependent on where herring spawn. A review of landed values from 1996 onward showed almost no commercial landings in either District 16 or 17. Effort in the bait fishery for herring and mackerel is highest in the month before lobster season opens. Mackerel migrate out of the area in June, into the Gulf of St. Lawrence, and return in the fall on their way further south. Mackerel migration routes can change which can result in large variations in catch between years.

The inland waters sport-fishing season for speckled (brook) trout, brown trout, rainbow trout, landlocked salmon, chain pickerel, white perch, and yellow perch generally runs from April 1 to September 30 in the Keltic Study Area. The tidal waters season is from April 15 to September 30, to protect sea-run speckled trout, brown trout, and Atlantic salmon populations (NSDAF 2001b).

Revenues and Earnings

Inshore Fishery

Revenues from the Guysborough County inshore fisheries were $30 million in 1999, compared to $12 million from the offshore fleet. These proportions were roughly equivalent to the split between the inshore ($418 million) and offshore ($175 million) fisheries throughout the Scotia Fundy management region of that year (Boudreau and Social Research for Sustainable Fisheries, 2001).

Table 4.3-5 presents inshore landings in kilograms at the larger ports in the Keltic Study Area for 1999 and 2000. Data from adjacent communities was aggregated to preserve confidentiality. The Table highlights the near-absence of groundfish in the area compared to the high landings of lobster and sea urchin (prior to this fishery's collapse).

TABLE 4.3-5 Inshore Fish Landings (kilograms) by Community in the Study Area (1999 and 2000)

Community	Year	Groundfish	Lobster	Sea Urchin	Pelagic Species	Other Invertebrates
Drumhead, Isaac's Harbour, Stormont	2000	–	17,612	19,303	–	4,886
	1999	–	8,291	82,690	–	2,855
Coddle Harbour, New Harbour, Seal Cove	2000	–	19,702	28,284	1,216 (bluefin tuna)	5,795 (scallop)
	1999	–	14,644	30,481	828 (bluefin tuna)	13,521 (scallop)
Country Harbour	2000	–	1,744	–	–	–
	1999	–	1,230	–	–	–
Port Bickerton, Bickerton West, Fisherman's Harbour	2000	6,186	38,680	24,768	–	–
	1999	1,952	24,244	26,926	771 (mackerel)	24,622 (queen crab)
Port Hilford, Wine Harbour, Sonora	2000	676	13,995	23,762	–	6,422
	1999	1,377	7,100	74,516	–	1,722

(Source: DFO, 2001)

First Nations Fisheries

First Nations peoples have historically harvested fish and wildlife resources in the Keltic Study Area. Recently, however, little Aboriginal use of fish resources has been documented. The Millbrook First Nation has two commercial urchin leases in the vicinity of Country Harbour. One is located east of Port Bickerton, south of Cape Macodome, and the other to the west of Port Bickerton, south of Fiddlers Head (Figure 4.3-3). The Afton First Nation has a lease near Indian Harbour/Wine Harbour. Licenses that once belonged to a recently retired Country Harbour fisherman have been reissued to a First Nations band. These licenses are applicable in the area from Ecum Secum to White Head.

4.3.9 Aquaculture

Locally, there are five aquaculture sites in Country Harbour and two in Indian Harbour. The two in Indian Harbour are the furthest from the proposed Keltic site at a distance of 17 km. The Country Harbour aquaculture leases are all held by Atlantic Aqua Sea Farms (registered as 2382144 Nova Scotia Limited or Country Harbour Sea Farms Limited) of Prince Edward Island and range in distance from the Keltic site from 4.3 km to 12 km (Figure 4.3-3). The licensed species are blue mussel and sea scallops, but only mussels are cultivated currently. Licenses for other species, including sea scallop salmon and trout, have been issued historically within Stormont Bay, but no continued aquaculture for these species has occurred in the local area. The aquaculture industry generally relies on harvesting of seed spat (larvae) from Country Harbour and Stormont Bay in the summer.

4.3.9.1 Revenues and Earnings

The GCRDA has targeted aquaculture as a key factor in regional economic development. A Regional Aquaculture Development Advisory Committee was established to review applications for coastal resources and resolve potential conflicts among resource users. Active growers produce blue mussels and blue mussel spat for sale to other growers. Scallops, and steelhead salmon are also farmed, but not within Stormont Bay (Boudreau and Social Research for Sustainable Fisheries, 2001). Table 4.3-6 shows aquaculture production and employment for Guysborough County and Nova Scotia as a whole in 2000. Aquaculture sites within County Harbour are shown on Figure 4.3-3.

TABLE 4.3-6 2000 County and Provincial Production Statistics for Aquaculture Tourism

Area	Weight (kg)	Value	Full-time jobs	Part-time Jobs (< 6 Months Duration)	Part-time Jobs (> 6 Months Duration)
Guysborough	325,842	$351,209	31	21	12
Nova Scotia	11,618,948	$50,469,494	361	504	194

(Source: NSDAF, 2001b)

Cultivation of blue mussels is the most successful form of aquaculture in Guysborough County. Most shellfish farming in Guysborough County is done by suspension cultivation from longlines, as is the case with Country Harbour Sea Farms operating in Country Harbour. Cultures are hung at intervals along a longline, which is anchored at each end. Buoys and concrete blocks are tied along the line to provide mooring and regulate the overall height of the longline in the water. Growers sometimes sink the longlines at least one metre below the ice cover for the duration of the winter to avoid contact with surface ice (Boudreau and Social Research for Sustainable Fisheries, 2001). Most large-scale operations use a boat with a power-operated winch to lift, tend, and harvest the lines. SCUBA divers are also used, especially when the longlines are below the ice (Boudreau and Social Research for Sustainable Fisheries, 2001). Aquaculture operations in Country Harbour are relatively small scale; employment varies seasonally, with a small core staff of less than five people. Cultivation of finfish and scallops has been considered and attempted in some areas, but none of these species are currently produced within Stormont Bay.

5.0 ENVIRONMENTAL EFFECTS, MITIGATION, RESIDUAL ENVIRONMENTAL EFFECTS AND FOLLOW UP

This section is organized by the three main components of the Project scope as defined by the RAs and as presented in Section 2.3 of this CSR. For each main Project component, the VECs are assessed for each Project phase in terms of environmental effects, mitigation, residual effects, and follow up. Cross-referencing occurs where appropriate to reduce repetition.

Pursuant to the CEAA, public consultation was conducted during the comprehensive study. The public consultation that occurred in accordance with the CEAA is discussed in Section 3.2. The issues raised during consultations or received by mail from non-governmental stakeholders and that are within the scope of this CSR are listed by VEC in Table 3.3-1 (Appendix 4, Table 4-4 lists those issues raised by the public that go beyond the scope of this CSR).

Residual effects refer to those environmental effects predicted to remain after the application of mitigation outlined below. The predicted residual effects are assigned a significance rating. The criteria used to define this rating are described in Section 2.5.

5.1 ENVIRONMENTAL EFFECTS OF THE LNG MARINE TERMINAL, MARINE TRANSFER PIPELINES, LNG STORAGE TANKS AND THE REGASIFICATION FACILITIES

5.1.1 Hydrology

5.1.1.1 Environmental Effects Prediction

<u>**Construction**</u>

The construction of the LNG facility will alter the hydrology of two coastal watershed areas. Clearing and contouring of the Project Site could result in temporary changes in surface water run off volumes and flows and potentially decreased water quality in receiving water courses. Storm-water management practices during construction could result in high volume flushing of watercourses during high rainfall events (i.e., Betty's Cove Brook, and unnamed tributary to Dung Cove).

<u>**Operation and Maintenance**</u>

The management of storm-water during operation and maintenance of the facility may impact the hydrology of the area. It is anticipated that treated storm-water will be discharged to both Betty's Cove Brook and Stormont Bay.

Controlled drainage from a large land development such as this Project could periodically generate large amounts of storm-water discharge to Betty's Cove Brook. Flushing of the watercourse may occur as a result of the more severe flows experienced during and immediately after storms although the wetland associated with Betty's Cove Brook will likely have an ameliorating effect on the flows.

Reduced groundwater recharge in paved areas (thus, reduced stream base flow) may cause drier conditions and longer dry periods between flow events in streams. The storm-water management system could limit base flows in watercourses if a substantial percentage of storm-water runoff is redirected from the freshwater system and discharged to Stormont Bay.

Modifications and Decommissioning

Significant changes to storm-water management via both discharge locations and discharge volumes could occur during changes to the facility and during decommissioning. This could affect base flows in watercourses as described above.

5.1.1.2 Mitigation Measures and Monitoring

Construction

Depending on final site grading plans and construction staging, there may be periodic storm-water discharges to Betty's Cove Brook from one or more temporary sediment ponds during plant site construction. While minor sediment and erosion events may be reversible, heavy precipitation events may lead to scouring, which has the potential to alter fish habitat. To avoid and minimize any adverse effects, a site –specific storm-water management plan (SWMP) will be implemented during construction. This includes the establishment of storm-water retention ponds, which will be sized to accommodate flows from the exposed areas upstream of the ponds during the construction phase. Peak flows discharged will not exceed existing peak flows.

Operation and Maintenance

Storm-water management planning will consider the natural flows to each catchment area and discharge collected storm-water within respective watershed, where possible, to maintain base flows. The SWMP will be a distinct component of the EMP.

Hydrologic modeling will be completed as part of the SWMP. The model will be used to design peak flows attenuation via retention ponds and groundwater recharge. This system will be designed to maintain sufficient base flows in watercourses.

Though a large component of the site footprint will be impervious surfaces where possible, consideration will be made for pervious surfaces for recharge areas.

Process areas will generally have paved (i.e., impervious surfaces) and will be curbed to direct runoff to one or more collectors. The SWMP envisages the use of large fire ponds as the primary means to control runoff from the facility prior to being discharged to Betty's Cove Brook and Stormont Bay. Based on the preliminary layout of the facilities, it is expected that much of the storm-water will be directed to Isaac's Harbour; however, the system will be designed to maintain base flows in Betty's Cove Brook.

Monitoring and follow up are required to provide feedback into ongoing storm-water management. This is described in subsection 5.1.1.4.

Modifications and Decommissioning

Similar to other project phases, storm-water management will ensure that base flows in watercourses during any future modifications or decommissioning will be maintained.

5.1.1.3 Residual Effects

Construction

On-site storm-water management will mitigate excessive flows to watercourses (i.e., Betty's Cove Brook) during construction. Residual effects have been determined not significant based on the small magnitude and infrequency of large runoff flows, and storm-water management measures employed to minimize the effect. Residual effects on hydrology will be temporary and reversible (Table 6.1-1). In accordance with Item 2.4 of the NSEL EA approval conditions (NSEL, 2007), a detailed erosion and sedimentation control (ESC) plan, including a monitoring program for site runoff will be prepared. The plan will be reviewed and approved by NSEL. Based on the results of the monitoring program, Keltic will make necessary modifications to the ESC plans and/or operations to prevent any unacceptable environmental effects, to the satisfaction of NSEL.

Operation and Maintenance

Mitigation measures will be used to attenuate peak flows to watercourses and maintain base flows in watercourses. SWMPs will be designed and dimensioned with the help of site-specific hydrologic modeling. Any residual effect environmental effects are considered minor (not significant). No down gradient effects will occur in the watershed as the sub-watersheds directly impacted are coastal. Any effects are temporary and reversible (Table 6.1-1). In accordance with Item 2.4 of the NSEL EA approval conditions (NSEL, 2007), a detailed ESC plan, including a monitoring program for site runoff will be prepared. The plan will be reviewed and approved by NSEL. Based on the results of the monitoring program, Keltic will make necessary modifications to the ESC plans and/or operations to prevent any unacceptable environmental effects, to the satisfaction of NSEL.

Modifications and Decommissioning

Similar to other project phases, mitigation measures will be applied to attenuate peak flows and maintain base flows in receiving waters. Where a residual effect occurs, it is minor (not significant) as noted above (Table 6.1-1).

5.1.1.4 Follow Up

Construction

Stream flow will be monitored as part of the EPP for construction. The flows during the construction period will be compared to baseline conditions. The comparison of flows will provide feedback to the storm-water management system. The collection system and attenuation ponds will be altered, as necessary, to mitigate effects on local hydrology.

Operation and Maintenance

Monitoring of the flows in the watercourses and the discharge-volume curve of the attenuation ponds will serve to calibrate the model used in the SWMP and provide feedback into mitigation measures. Should base flow in watercourses be determined as unseasonably low compared to baseline conditions and considering weather, adjustments will be made including changes to the SWMP to address the effect on local hydrology.

Modifications and Decommissioning

As with other project phases, monitoring of discharge and flow will occur during any future modifications and decommissioning. The results of the monitoring will influence SWMP and implementation if required.

5.1.2 Freshwater Quality/Quantity

5.1.2.1 Environmental Effects Prediction

Construction

The principal interaction between the Project activities and surface waters is associated with land disturbance during construction and commissioning of the Project. The LNG pipeline will be built on a trestle, with footings that may be placed within the Dung Cove Pond buffer zone boundary. The exact spacing of these footings is not currently designed, but will be confirmed during the FEED process.

The Project will not physically impinge on any of Ponds 1, 2, 3 and all required buffer zones will be maintained during construction.

The design of the proposed marginal wharf is not connected to the marine shoreline adjacent to the southeast corner of Pond 3. Pond 3 is a brackish water pond, which implies that there is a hydrologic connection between this pond and Stormont Bay / Isaac's Harbour. The channel of the inlet stream to Dung Cove will be avoided.

The greatest potential for impact to surface waters is expected to be during construction via discharge of storm-water. It is currently the intention of Keltic not to disturb tailings during construction activities. The concerns and potential effects to freshwater quality associated with disturbance of tailings during construction are discussed below in Section 5.1.5

There is a potential for construction activities to disrupt historic gold mine tailings which could enter waterbodies. This is discussed further in Section 5.1.5 Soil/Sediment Quality.

The three principal types of water discharge expected at the site during construction are:

- clean and possibly sediment-laden storm-water;
- construction wastewater (hydrostatic test waters, concrete wash water, storm-water that has been in contact with uncured concrete); and
- sanitary wastewater (worker sites and field offices).

The possible effects of runoff during construction have the highest potential to impact surface water as construction will result in exposing soil to potential erosion. If unmanaged, erosion of site soils can lead to sedimentation of watercourses. During construction, total suspended solids (TSS) concentrations in storm-water, residual hydrocarbons, and/or metals in hydrostatic test waters, or the concentration of lime in concrete production wastewaters, could exceed the water quality guidelines for the protection of aquatic life published by the CCME (1999). Runoff may also have an adverse effect on the flow to nearby watercourses.

The potential for adverse effects on- and off-site watercourses during construction are discussed below.

<u>Betty's Cove Brook</u>

Depending on final site grading plans and construction staging, there may be periodic storm-water discharges to Betty's Cove Brook from one or more temporary sediment ponds during construction. Also the Project is within Betty's Cove Brook catchment area, and therefore, sediment laden storm-water could drain to this watercourse.

<u>Unnamed Tributary to Dung Cove</u>

The footprint of the Project does not impinge on this tributary; however, the Project is within its catchment area. As such, sediment laden storm-water has potential to drain to this tributary.

<u>Operation and Maintenance</u>

The principal interactions between the Project activities and surface waters during the operation phase of the Project are associated with wastewater and storm-water discharges. The largest discharge component by volume is expected to be storm-water.

The principal types of water discharge expected during operations for the component of the Project include:

- potentially oily storm-water from some process complexes (paved or hard surfaces), process water, cooling water blow down;
- clean, (i.e. not contaminated with hydrocarbons or having high levels of suspended solids) storm-water from some process complexes and general areas, either paved (hard surface) and unpaved (soft surface); and
- domestic-type or sanitary waste water (some from process complexes and some from common-user utilities).

As described in Section 2.0, the wastewater streams identified will be treated in a number of ways depending on the source and characteristics of the wastewater stream. At this stage of the Project design, the treated and untreated effluent quality and quantity have not been specifically determined for the LNG facility. Following treatment, process and sanitary wastewater will be discharged to Stormont Bay. Runoff may also have an adverse effect on the flow to nearby watercourses.

Modifications and Decommissioning

Some disturbance of soils will likely occur during decommissioning of the facility. As during the construction period, a range of mitigation measures will be used to control erosion and sedimentation and to minimize potential effects of storm-water discharges to surface waters.

5.1.2.2 Mitigation Measures and Monitoring

Construction

Site preparation will occur within tributary area of several watercourses. These include Betty's Cove Brook and the unnamed tributary to Dung Cove.

The guiding document regarding the mitigation of potential effects on surface water will be "Erosion and Sedimentation Control Handbook for Construction Sites" (Nova Scotia Department of the Environment, 1988).

Once final site layout is determined, if tailings disturbance is required, a tailings management strategy, likely including encapsulation, will be developed in concert with regulatory authorities.

Sanitary wastewater will be stored and hauled off site during early construction and then treated on-site using approved sanitary wastewater treatment methods. Wastewater generated from Project operations will be treated to comply with NSEL and EC criteria prior to discharge as described in Section 2.0. A SWMP will be developed to reduce the total amount of storm-water discharge generated and to prevent sediment-laden runoff from the site from entering surface waters during Project operation.

While minor sediment and erosion events may be reversible, heavy precipitation events may lead to scouring, which has the potential to alter fish habitat. Sediment ponds will be used to control and treat storm-water during construction period. These will be discharged to Betty's Cove Brook. The sediment ponds will be sized to accommodate flows from the exposed areas upstream of the ponds and allow for sufficient settling time for sediments. If necessary, flocculant may be added to the pond to enhance settlement prior to discharge.

To mitigate possible effects of runoff altering flow to watercourses a SWMP will be implemented. This will include a flow measurement analysis and hydrologic modeling to design peak flow attenuation and groundwater recharge.

Routine air emissions from the facility are not expected to cause any degradation in surface water quality.

In accordance with Item 1.5 in the NSEL EA approval conditions (NSEL, 2007), a plan to mitigate the human health and environmental impacts of the contaminated mine tailings and/or soils and sediments on the Project Site, via remediation or risk management will be developed and implemented. This plan will be consistent with the Nova Scotia Guidelines for the Management of Contaminated Sites. The Remedial Action Plan and/or Risk Management Plan will be approved by NSEL prior to commencement of construction. Upon completion of the remediation or risk management work, including any required monitoring, Keltic will submit a

Certificate of Compliance to NSEL to demonstrate that the remediation work has been completed and/or the Risk Management Plan is effective (NSEL, 2007).

Also, in accordance with Item 1.10 in the NSEL EA approval conditions, baseline data collection for all relevant chemical parameters which are expected to enter the environment or be remobilized as a result of Project activities in all receiving environments will be collected. Assimilative capacity of all receiving environments for all relevant chemical parameters will then be predicted (NSEL, 2007). Surface water quality monitoring programs will be established in consultation with regulatory agencies and as part of the permitting process through the Conditions of Approval.

Additional mitigation measures include:

- establishment of a buffer zone around watercourses (Betty's Cove Brook; Unnamed tributary to Dung Cove);
- preparation and implementation of a spill prevention and response plan;
- establishment of designated fuelling and material storage sites; and
- all rock excavation will be tested for acidic conditions and any found to exceed regulatory levels will be disposed of in accordance with the Sulphide Bearing Materials Disposal Regulations (NSDE, 1995) and Guidelines for Development on Slates in Nova Scotia (NSDE, 1995).

Operation and Maintenance

Mitigation measures for the protection of freshwater quality/quantity are summarized below:

- Industrial Site Wastewater Management - Storm-water runoff from uncontaminated areas will be segregated from potentially contaminated areas and discharged through a storm-water outfall. These uncontaminated areas generally include roads, building roof drains, undeveloped areas, and uncontaminated areas in the utility and offsite units. The non contaminated runoff will generally flow through open site ditches with final disposal in Stormont Bay. Ditch checks, vegetation, and siltation ponds will be utilized to treat the storm-water before discharge.

  A first flush approach will be utilized in handling potentially contaminated storm-water. Under this approach the initial 25 mm of rainfall is diverted to storm-water ponds. Rainfall in excess of 25 mm is considered to be clean and is diverted to the storm-water outfall. Water from the storm-water pond will be transferred at a controlled rate to the onsite wastewater treatment system.

  Oily water will be collected in the oily water system and pumped to the Coalescing Plate Interceptor (CPI) separator, where initial separation of oil and water takes place. Water effluent from the CPI separator flows to the Induced Air Flotation Unit (IAFU) for further removal of any remaining free and/or emulsified oils. In the IAFU, oil, suspended solids, and grease adhere to bubbles and are floated to the surface. This froth then overflows to a collection point while the water from the IAFU is pumped to the equalization basin. In the equalization basin, the IAFU water combines with non oily wastes and potentially contaminated storm-water.

Recovered oil from both the CPI separator and the IAFU is collected and pumped to the recovered oil tank. This oil will be disposed of off site by a licensed contractor. Solids removed by the CPI separator will collect in the bottom of the separator and will be removed periodically via vacuum truck for disposal off site.

- A biological treatment unit consisting of an extended aeration and activated sludge system will be utilized for further treatment of wastewater. Effluent from the equalization basin is sent to the bioreactor basin and is contacted with activated sludge. The activated sludge permits natural biological reactions to further treat the wastewater. The mixed biological slurry overflows to the secondary clarifier where the biological solids are removed and recycled back to the bioreactor. The effluent from the biological treatment unit will be of sufficient quality to be discharged to the environment.

  Wastewater generated from Project operations will be treated to comply with regulatory requirements prior to discharge. Sanitary wastewater will be stored and hauled off site during early construction and then treated on-site using approved sanitary wastewater treatment methods. A SWMP will be developed to reduce the total amount of storm-water discharge generated and to prevent sediment-laden runoff from the site from entering surface waters during Project operation.

- Storm-water Management (Plant Site Operation) - Process areas will be paved and curbed to direct runoff to one or more collectors equipped with a sump and oil and water separator to ensure that runoff not meeting regulatory criteria is treated or disposed in accordance with requirements. A SWMP will be developed incorporating the use of large fire ponds to prevent sediment-laden runoff from the facility from entering streams, Isaac's Harbour, and Stormont Bay. The plan will include hydrologic modelling to design peak flows attenuation and groundwater recharge and a flow measurement analysis will be undertaken. Peak flows will be attenuated where possible.

- Storm-water Management (Plant Site Operation) - Reduced groundwater recharge in paved areas (thus, reduced stream base flow) can cause drier conditions and longer dry periods between flow events in streams. The net result can be an increase in stream erosion and channel straightening over time, accompanied by reduced water and aquatic habitat quality. To mitigate Keltic intends to retain as much vegetated (natural or replanted) and porous (unpaved parking areas and walkways) “soft surface” as possible and reduce the amount of paved or “hard surface” needing controlled drainage. This can help to maintain existing water balances and status-quo conditions regarding net overland flow and infiltration to groundwater recharge and base flow to receiving watercourses.

Inter-Watershed Transfers - All storm-water collected within the plant site will be disposed of within each respective watershed. As such, there will be no inter-watershed transfers during the construction, operation, or decommissioning of the KDP.

- Monitoring for the operation phase of the Project will consist of annual qualitative/quantitative sampling of the benthic-invertebrate community at one station on both Betty’s Brook and the unnamed tributary to Dung Cove during post construction years 1, 2, 3, and 5, and every 5 years thereafter. Annual reports based on survey results (ephemeroptera/ plecoptera/ trichoptera index, taxon dominance, density, species diversity, hilsenhoff biotic index, etc.) will be prepared and the results compared with previous years.

- In accordance with Item 1.5 in the NSEL EA approval conditions (NSEL, 2007), a plan to mitigate the human health and environmental impacts of the contaminated mine tailings and/or soils and sediments on the Project Site, via remediation or risk management will be developed and implemented. This plan will be consistent with the Nova Scotia Guidelines for the Management of Contaminated Sites. The Remedial Action Plan and/or Risk Management Plan will be approved by NSEL prior to commencement of construction. Upon completion of the remediation or risk management work, including any required monitoring, Keltic will submit a Certificate of Compliance to NSEL to demonstrate that the remediation work has been completed and/or the Risk Management Plan is effective (NSEL, 2007).

Modifications and Decommissioning

Mitigation presented for the construction phase is sufficient for the decommissioning phase as well.

5.1.2.3 Residual Effects

The impact of the Project on the quality and quantity of freshwater is not expected to be significant since the magnitude of the effects is low, the geographic extent is only at Betty's Cove and Dung Cove, the duration is for a short term, and the effects are reversible. The following subsections provide a summary of this residual effects determination by Project phase. A summary of residual effects and determination of significance is presented in Section 6.0, Table 6.1-2).

Construction

Mitigation of sedimentation and excessive flows to effected watercourses (i.e., Betty's Cove Brook and unnamed tributary to Dung Cove) during construction will limit any adverse effect to minor (not significant) based on the small magnitude and infrequency of large runoff flows. Any effect will be temporary and reversible.

Operation and Maintenance

Mitigation measures will be used to attenuate peak flows to watercourses and maintain base flows in watercourses. Proper modeling and design of the storm-water management system will ensure maintenance of flows in watercourses. Any residual effect is minor (not significant). The relative size of the footprint compared to the watersheds is negligible. No downgradient effects will occur in the watershed as the sub-watersheds directly impacted are coastal. Any effects are temporary and reversible.

Modifications and Decommissioning

Similar to other project phases, mitigation measures will be implemented which will attenuate peak flows and maintain base flows. Where a residual effect occurs, it is minor (not significant) as noted above.

5.1.2.4 Follow Up

Construction

Mitigation measures proposed to protect watercourses will be checked regularly during construction as required in the EPP for construction. There will be a feedback mechanism to repair, replace, or improve any deficient mitigation measure.

Sampling and analysis of water quality and flow measurements will be completed in Betty's Brook as it will likely receive treated storm-water discharge. Benthic invertebrate surveys will also be completed for effected watercourses.

These flow, benthic community, and water quality data will be compared with baseline values. As per the construction specific EPP, mitigation measures will be evaluated and adjusted as necessary.

Operation and Maintenance

No follow up monitoring is anticipated. For monitoring that will occur during the operational phase of the Project see Section 5.1.2.2.

Modifications and Decommissioning

No monitoring programs have been planned for decommissioning at this time.

5.1.3 Groundwater Quality/Quantity

The issues regarding the quality and quantity of groundwater are the effects that the plant construction and operation may have on water supply wells, and the effects that changes to the groundwater regime may have on surface water bodies, streams, and wetlands adjacent to the Project.

Groundwater quality or quantity effects may often be of long duration. Unlike surface water, where sun, exposure to air, wind, and wave action may help to break down or disperse deleterious substances introduced to a stream or lake, the dark and cold conditions present in the subsurface are generally conducive to the long-term preservation of many substances. Thus, deleterious materials introduced into the subsurface aquatic environment may remain there for long periods of time, and once adsorbed to soil and rock, may serve as a long-term source of material to be dissolved into groundwater. These dissolved materials may in turn be introduced to surface waters via base flow and discharge to wetlands, thus possibly affecting these environments as well.

The field reconnaissance indicates that there are approximately 40 wells located within 1 km of the site boundaries of the KDP. There are also two streams within the site boundaries (Betty's Cove Brook and the unnamed tributary to Dung Cove) which may have groundwater supplies interrupted by excavation associated with site preparation and construction.

Based on the projected gravitational groundwater flow lines shown in Figure 4.1-6, possible surface water receptors include Betty's Cove Brook, and associated wetlands, the unnamed tributary to Dung Cove, Dung Cove, and Stormont Bay. Possible receptor wells, depending upon the final site configuration, are likely to include wells west of the site within a zone that extends along Highway 316 between Webbs Cove and Dung Cove, the degree and significance of which would depend on the exact locations and nature of the source, well type, nature of the surficial and bedrock geology present between the source and the well, and distance to the well. Depending upon facilities locations, other wells north of this zone could, to a lesser degree, also become receptors.

5.1.3.1 Environmental Effects Prediction

Construction

The main considerations with respect to impacts on water supply wells from the Project during construction include:

- blasting and vibration damages, with consequent temporary siltation (for dug and drilled wells) and possible permanent reduction in well yield (for drilled wells) during construction;
- trenching, site drainage, and large cuts or changes in surface topography, could result in water level reductions during and after construction (dug well effects); and
- accidental release of fuel chemicals due to equipment failure during site preparation and construction.

Major excavations through glacial tills and bedrock could potentially lead to a drop in groundwater table elevation in proximity to the excavation. This could possibly affect wells and streams.

The degree of water level lowering will be proportional to the depth of the excavation below natural water table level, the distance between the well or stream and the excavation, and the hydraulic properties of the earth materials. Dug wells in close proximity to an excavation which, in Nova Scotia, are already susceptible to seasonal water-level fluctuations of 2 m to 4 m may become dry. Drilled wells may experience similar water-level drops, although because of the larger water column of drilled wells, they are not likely to be adversely affected by average overburden or bedrock cuts.

The severity of the water supply well impacts are expected to be a function of well type (spring, dug well, drilled well), age of the well, well construction method, distance from the site boundaries, overburden thickness and the hydraulic properties of the soil and bedrock.

With respect to groundwater quantity, the main concerns related to plant site construction are:

- potential loss of well yield or lowered water level in dug wells (this is not expected to be significant due to the relative distance and small number of wells involved);
- possible damage to, or loss of drilled wells during blasting operations; and
- possible reduction in base flow at on-site streams and reduced (or increased) discharge at wetlands.

With respect to groundwater quality, the main concerns related to plant site construction are:

- chemistry changes in down-gradient wells due to uncontrolled runoff;
- temporary siltation of dug wells during heavy equipment operations; and
- accidental release of hazardous materials up-gradient of wells or streams.

There are locations within the proposed site, which may, or are known to contain, sulphide mineralization, particularly along the lower part of the SOEI gas plant access road and in the southwest and northeast portions of the KDP boundaries. Contamination of wells and/or on-site streams from acidic drainage due to the exposure of acid generating rock may be a concern in these areas. Keltic will be undertaking an assessment of the bedrock as part of the geotechnical site investigation.

The effects of groundwater on surface water bodies and streams adjacent to the Project include stream dewatering which may be caused by deep and/or large-scale site drainage. See Section 5.1.3.2 for a discussion of proposed groundwater mitigation measures and Section 5.1.3.4 for the groundwater monitoring program.

<u>Operation and Maintenance</u>

The main considerations with respect to impacts on water supply wells from the Project during operation include:

- salt contamination from on-site roadways; and
- accidental (acute) and chronic spills and release of chemicals, and possible releases due to fires, during plant operation.

As with the construction phase, the severity of the water supply well impacts will be a function of well type, age of the well, well construction method, distance from the Project Site boundaries, overburden thickness, and the hydraulic properties of the soil and bedrock. With regard to groundwater quantity, the main concern is potential loss of well yield or lowered water level in dug wells. With respect to groundwater quality, the main concerns related to the operation of the plant include:

- chemistry changes in down-gradient wells due to uncontrolled on-site road runoff; and
- chronic and acute accidental release of hazardous materials up-gradient of wells or streams.

The potential for well contamination from acidic drainage should be considered low so long as measures are taken to prevent exposure to water or oxygen if acid bearing slate is present. Preliminary geotechnical testing has not shown the presence of sulphide bearing minerals on the Site.

The effects of groundwater on surface water bodies and streams adjacent to and within the site boundaries, which include stream dewatering (caused by deep and/or large-scale site drainage during construction), are not expected to change from conditions possibly arising from the construction phase.

Modifications and Decommissioning

Potential effects to groundwater resources during the decommissioning phase include possible disruptions to groundwater flow, the temporary siltation of dug wells during heavy equipment operations, and the accidental release of contaminants to the environment.

5.1.3.2 Mitigation Measures and Monitoring

Construction

Petroleum hydrocarbons other than LNG (i.e. diesel fuel for back up generators) and other chemicals will be stored in a manner that will prevent spills from getting into the environment. This may include storage within a containment area and the use of double walled tanks. As well, all site personnel will be trained in use handling of hydrocarbons and chemicals as appropriate. A groundwater monitoring program for the particular chemical(s) of concern will be implemented in accordance with Item 2.6, of the NSEL EA approval conditions.

Blasting has the potential to affect adjacent wells, with possible impacts ranging from minor temporary turbidity to damage to well crocks or casing and loss of water. Eight wells are situated within 800 m of the plant site boundaries may be affected. The severity of the effect being proportional to separation distance, physical properties of the bedrock being excavated, age and construction method of the well, well yield, and blast magnitude. “Natural” mitigating factors include thick overburden and ‘soft’ bedrock.

Based on the detailed design of the plant site grading plans, a detailed survey of homes and wells located within 800 m of the blast areas will be undertaken following the NSEL guidelines for blasting at quarries. The pre-blast survey includes: an inspection of all buildings located with the boundaries of the pre-blast survey area; inventory of wells including water sampling for general chemistry, metals, and bacteria; and short-term pumping tests (where wells are accessible), to determine the capacity of individual wells and nearby aquifers. The Proponent will deliver an arbitration and resolution document to all owners of water supply wells located within 800 m of the proposed plant site boundaries. The Proponent is prepared to provide temporary water supply during construction should existing supplies be disrupted. Additionally, in the event that wells are adversely or permanently affected by plant-site preparation or construction the Proponent will repair or replace any affected wells.

Mitigation measures will be implemented on the basis of the pre-blast survey. The Proponent is prepared to provide temporary water supply during construction should existing supplies be disrupted. Additionally, in the event that wells are adversely or permanently affected by plant-site preparation or construction the Proponent will repair or replace any affected wells

In the south half of the KDP Study Area where the tanks are proposed to be located (areas underlain by bedrock of the Meguma Group), overburden is expected to be relatively thin to non-existent. The bedrock is also hard and topographic relief is severe. These conditions suggest a higher need for blasting in this area. As a mitigation consideration, the Project design will be modified where possible to reduce the need for such blasting.

Design and construction engineers and hydrogeologists will work closely to identify grading requirements and areas at the plant site where water levels in wells and streams may be vulnerable to grade changes. Monitoring and implementation of appropriate mitigation measures (i.e., deepening of drilled wells, replacement of dug wells with drilled ones, design change, etc.) will make it possible to minimize and likely avoid adverse potential effects on groundwater in the Project Area.

Operation and Maintenance

Proper precautions such as secondary containment, leak detection systems, and monitoring alarms will be incorporated into the plant design and processes as appropriate. The potential effects of chronic and accidental spills of deleterious materials on groundwater will be reduced through spill prevention planning, vigilant monitoring and rapid cleanup response. Details of these plans will be provided in the EMP.

In the event that wells are adversely or permanently affected by plant operation the Proponent will repair or replace any affected wells.

Modifications and Decommissioning

Mitigation presented for the construction phase will be sufficient for the modification/ decommissioning the LNG facility.

5.1.3.3 Residual Effects

Provided the proposed mitigative measures are implemented as suggested, the environmental effects are considered to have low magnitude and occur within 1 km of the site. Therefore no significant adverse residual environmental effects on groundwater resources are likely to occur (Table 6.1-3).

5.1.3.4 Follow Up

Construction

As construction work progresses, follow-up well sampling will be done, as required, to adequately assess general groundwater and specific well water supply quality.

The exact nature and location of on-site storage has not yet been determined, and thus detailed groundwater monitoring requirements have not been finalized. Once the design of the plant site, facilities locations, and storage criteria have been completed, a groundwater monitoring well system will be designed and installed to expand upon the existing seven monitoring wells stations installed on-site during spring 2005. Some of the wells will be installed before any site preparation or construction activities begin while others will be completed once the storage systems are in place.

The plant site groundwater monitoring system will be designed, constructed, and maintained in accordance with Conditions of Approvals (NSEL EA approval conditions 1.2, and 2.5), where applicable. The system will also be used to augment current baseline data, to monitor early site preparation and construction effects and assist the Proponent and the neighbouring community for the duration of plant operation. The intent is to incorporate data collected from groundwater monitoring stations, in conjunction with other data which may become available on the abandoned mine workings, into groundwater models so as to allow for more comprehensive groundwater flow migration forecasting. This information will form part of the spill response and contingency plan.

The plant site monitoring system sampling schedule will include:

- a sufficient number of monitoring stations to provide full (both background or up-gradient and down gradient) on-site and nearby off-site coverage;
- multi-level and multi-well stations at key locations;
- proximal and distal monitoring capability for all fuel/chemical storage;
- timely response to any spill event; and
- four-season and longer temporal coverage.

This will include installations inside and at plant-site boundaries, outside plant-site boundaries (particularly in the east and south between the plant and Betty's Cove Brook, west between the plant site and the ocean, and north and northwest between the plant site and the community of Goldboro). Infill monitoring stations will be installed as suggested by early monitoring results and data collected.

In addition to the on-site and site-perimeter monitoring stations, groundwater monitoring stations will be installed at select locations within the community of Goldboro so as to allow uninhibited and unbiased collection of groundwater quantity and quality data (i.e. to simulate water supply wells).

It is expected that key monitoring stations will be assessed regularly for vapours that are relevant to storage and plant operations, and for water levels (data loggers). At others, groundwater levels will be measured and water samples collected regularly for general chemistry, metals, total petroleum hydrocarbons, and VOCs analysis. A protocol will be established to enable the program to be modified to optimize the use of monitoring resources, scientific data quality, and knowledge of on site hydrogeological characteristics.

The main potential adverse effects on groundwater quality during the construction of the plant are expected to be from accidental spills and siltation from vibration. The EPP will address the issues related to the containment and clean-up from spills. Wells located near the plant site which may be susceptible to siltation from vibration or erosion runoff during construction will be inspected and inventoried for possible future reference. In accordance with Item 2.4, an ESC plan will be developed and implemented. A monitoring program to determine the potential for and extent of sulphide bearing material will also be implemented with a plan to manage any exposed acid generating material and associated drainage. The sulphide monitoring program and management plan will be developed in accordance with Item 2.8 of the NSEL EA approval conditions.

Operation and Maintenance

During plant operation, there will be regular monitoring of well water quality at key wells located near the plant site. A post construction report will identify these wells (selected on the basis of possible exposure to detrimental effects, if any, from plant operations, and on the basis of providing optimum scientific information), other possible future monitoring needs, and protocol for modifying the proposed monitoring program so as to continually optimize scientific data quality and resource utilization. Sampling at these wells will include analysis for general chemistry, metals, coliform, petroleum hydrocarbons, VOCs, and others as deemed necessary based on plant site operations and monitoring results. Keltic will provide sampling results to individual well owners.

The groundwater monitoring system described above in the construction section will continue to serve as a monitoring system during plant operation. To meet the requirements of Item 2.4, in the NSEL EA approval conditions, an ESC Plan will also be developed and implemented. The ESC Plan will include a monitoring program for site runoff and will be reviewed and approved by NSEL. A monitoring program to determine the potential for and extent of sulphide bearing material will also be implemented with a plan to manage any exposed acid generating material and associated drainage. The sulphide monitoring program and management plan will be developed in accordance with Item 2.8 of the NSEL EA approval conditions.

Modifications and Decommissioning

No monitoring programs have been developed at this time. These will be developed in accordance with the regulatory requirements applicable at the time of decommissioning.

5.1.4 Marine Water Quality

5.1.4.1 Environmental Effects Prediction

Potential impacts to marine water quality from storm-water have been discussed in Section 5.1.2. At maximum capacity (18 billion metres cubed per year (m^3/year)) the LNG facility will discharge approximately 490,000 m^3/year of purge water from Submerged Combustion Vaporizers and cooling water from the BOG compressor. There is also the potential for re-suspension of contaminated sediments due to propeller wash and construction activities. Only other potential sources for effects on the marine water from the LNG facility may result from accidental spills of contaminated material. Potential effects from accidental events and malfunctions are described in Section 10.0.

5.1.4.2 Mitigation Measures and Monitoring

Construction-related mitigation measures have been discussed under 5.1.2.2. Mitigation measures during operation and maintenance involve the operation of a non-contact water cycle, which will avoid release of any contaminants to the marine environment. While thermally altered water may be discharged from the Project if the seawater option is exercised, the temperature difference within 100 m of the diffuser is expected to be within 3°C of ambient temperature. This is within natural variation within the water column in the Strait (Stewart and White, 2001) and is not anticipated to cause significant effects. However, thermal pollution models will be run during the FEED process to identify if any further mitigation measures are required. In order to prevent re-suspension of contaminated sediments from propeller wash large vessels are to be berthed with the assistance of tugs.

In accordance with Item 1.5 in the NSEL EA approval conditions (NSEL, 2007), a plan to mitigate the human health and environmental impacts of the contaminated mine tailings and/or soils and sediments on the Project Site, via remediation or risk management will be developed and implemented. This plan will be consistent with the Nova Scotia Guidelines for the Management of Contaminated Sites. The Remedial Action Plan and/or Risk Management Plan will be approved by NSEL prior to commencement of construction. Upon completion of the remediation or risk management work, including any required monitoring, Keltic will submit a Certificate of Compliance to NSEL to demonstrate that the remediation work has been completed and/or the Risk Management Plan is effective (NSEL, 2007).

No particular mitigation measures beyond those applied during construction and operation have been developed for Project modifications and decommissioning.

5.1.4.3 Residual Effects

Upon implementation of the mitigation measures, the residual environmental effects are expected to be low in magnitude, intermittent and short term, and be reversible. The geographical extent will be Stormont Bay. Therefore, residual adverse environmental effects of the Project on marine water quality is expected to be minor (i.e., not significant) during all Project phases.

5.1.4.4 Follow-up

To ensure the adequacy of the mitigation measures and the proper functioning of the process water treatment, monitoring of effluent quality (including temperature) and quantity at the point of discharge will be conducted. Details of the program will be established in consultation with the provincial regulator during the permitting stage and detailed design.

Thermal pollution models will be run during the FEED process to identify if any further mitigation measures are required.

NSEL EA approval condition 1.5 commits Keltic to develop a plan to mitigate the human health and environmental impacts of contaminated mine tails and/or soils and sediments on the Project Site, via remediation or risk management. Furthermore, NSEL EA approval condition 1.10 commits the Proponent to 1) modelling to predict the assimilative capacity of all receiving environments for all chemical parameters which are expected to enter the environment as a result of Project activities, and 2) baseline data collection for all relevant chemical parameters which are expected to enter the environment or be remobilized as a result of Project activities in all receiving environments.

5.1.5 Soil/Sediment Quality (terrestrial and marine)

5.1.5.1 Environmental Effects Prediction

There are two types of geologically related features in proximity to the KDP area, all of which pre-exist the development of the KDP, and which have the potential to cause environmental impact, namely:

- the abandoned mine workings that are located predominantly in the southwest portions of the proposed site; and
- the tailings areas on site, which remain as a legacy of past gold mining activities in the area.

There are a number of abandoned mine workings on the KDP site, particularly in the southwest portions of the proposed site; including south and west of Route 316 generally coinciding with the proposed LNG facilities. Some of the abandoned mine workings are known to be quite extensive, some are several hundred metres long, and workings in the area are known to have gone to depths that exceed 70 m. Some workings are also believed to have moved upward from greater depth to surface either through the historic mining activity or through progressive collapsing of the underground workings. They are also known to be in direct contact with the ocean.

The exact location and character of these old workings are either poorly documented or undocumented. These workings in the southwestern part of the KDP Site are difficult to find because they have become overgrown and, in some instances, plugged at the surface with debris.

There are three tailings disposal areas within the Project and one located just outside of the Site boundaries. The floor of Dung Cove is believed to have been totally, or nearly totally, flooded with tailings and therefore is perhaps of greater concern than the other tailing sites because of possible exposure to storm surges.

Based on currently available information, with the exception of the local mine dumps and a few localized highly mineralized bedrock zones which have not yet been worked, there appears to be little risk of encountering large amounts of acid generating material within the boundaries of the proposed plant site, if any.

Construction

The old mine workings are of concern from a health and safety and environmental perspective during construction. The locations of the openings are difficult to see through the vegetation on site and workings close to the surface may pose a safety concern for heavy equipment operations.

Construction above undiscovered underground mine workings poses potential long-term structural issues including deformation and collapse.

The tailings areas could become disturbed during plant site preparation or plant construction increasing the potential for arsenic- and mercury-bearing dust and sediment to be released by wind or via the watercourses that originate from or run through them. The airborne particles can be inhaled directly or migrate downwind to be deposited elsewhere. The mercury may also volatilize, to be introduced in downwind environments as mercury vapour.

Marine sediment may be impacted by the introduction of contaminants in runoff as a result of accidental spills and malfunctions (refer to Section 10.0).

Operation and Maintenance

The greatest concern regarding the mine workings relates to site operation and the possibility of accidental spills. The old mine workings may serve as rapid pathways, or "highways," for spills or other groundwater contaminants from the Project toward soils and to marine sediments in Stormont Bay.

As during construction, should the tailings located on-site or at Dung Cove become disturbed during operation, arsenic- and mercury-bearing sediments and dust could be released via the wind or in streams, to be deposited elsewhere on and off site. The possible release of mercury vapours through volatilization could also pose a concern to plant site worker health.

With respect to acid drainage generation, the Project operation is considered to have minimal effects on the environment, since all surfaces affected by the construction will be stabilized and rehabilitated, where applicable. In addition, it is anticipated that with the implementation of an acid generating rock management plan, if required, there is not expected to be any on-going environmental concerns.

There is potential for re-suspension of contaminated sediments due to propeller wash.

Marine sediment may be impacted by the introduction of contaminants in runoff as a result of accidental spills and malfunctions.

Modifications and Decommissioning

Potential effects to soil/sediment quality during the decommissioning phase are identical to those associated with the construction phase.

5.1.5.2 Mitigation Measures and Monitoring

Construction

Some mapping of the old mine workings in the KDP Study Area has been completed, but additional surveys will be required to identify all former mine sites in areas of concern and to make the proposed plant site safe to workers and/or structures.

Additional surface mapping (Global Positioning System (GPS) and surveyed locations) will be done prior to site development and during the site-preparation and re-grading operations. Those workings believed to be shallow will be pumped out for direct observation to confirm depth, and subsequently filled with stone from the site.

Tailings disposal areas will be fenced and avoided where feasible. In the event that this is not possible, tailings sites will be encapsulated to prevent the emanation of dust, sediment, surface water, or groundwater.

The tailings present at the bottom on Dung Cove will not be disturbed during construction. The pipeline to be developed at the southeastern end of Dung Cove will be constructed on a trestle and the pond footprint will not be disturbed.

Based on the results of the field surveys, the greatest potential for acid drainage is situated at the northern boundary of the proposed petrochemical plant site. Based on current conceptual plans, no excavation into Halifax Formation in that area is proposed.

The Project's engineers and Project geologist/hydrogeologists will work closely together to:

- more clearly define those areas which might become a concern for acid drainage based on preliminary grading design;
- test bedrock in those areas where there might be acid drainage potential and where excavation for grading is deemed necessary, or where new sources of borrow material are likely to be obtained on-site; and
- where acid drainage potential is confirmed based on the testing, change the grading design so as to minimize or avoid excavation of potentially acid generating rock.

In those areas where bedrock is to be tested, the testing work would consist of:

- grab samples of bedrock during preliminary and detailed geotechnical investigations on the site;
- advancing angled bore holes (as near perpendicular to bedrock dip as possible) where equipment allows (vertical bore holes where equipment does not allow), with continuous bedrock coring, to 1.5 m beyond grading design depth; and
- splitting of the core along its axis, with retention of half for future reference, the other half sent for laboratory determination of total sulphide content, acid generation, and acid consumption (net acid production) potential.

It is of note that in compliance with EA approval conditions (Item 1.5) established by NSEL (NSEL, Environmental Assessment Approval. March 14, 2007 - http://www.gov.ns.ca/enla/ea/kelticpetro/KelticPetro_Conditions.pdf), Keltic will generate a plan to mitigate human health and environmental impacts of contaminated mine tailings and/or soils and sediments on the Project Site, via remediation or risk management. This will be consistent with the Nova Scotia Guidelines for the Management of Contaminated Sites. The Remediation Action Plan and /or Risk Management Plan will be approved by NSEL prior to commencement of construction. Upon completion of the remediation or risk management work, Keltic will submit a certificate of Compliance to NSEL to demonstrate that the work has been completed and/or the Risk Management is effective. In addition, as per Item 2.8 of the approval conditions a detailed monitoring plan, in consultation with NSEL, will be developed determine the potential for and extent of sulphide bearing material and to manage any exposed acid generating material and associated drainage.

Also, in accordance with Item 1.10 in the NSEL EA approval conditions, baseline data collection for all relevant chemical parameters which are expected to enter the environment or be remobilized as a result of Project activities in all receiving environments will be collected. Assimilative capacity of all receiving environments for all relevant chemical parameters will then be predicted (NSEL, 2007).

Mitigation for accidental spills and malfunctions is presented in Section 10.0.

Operation and Maintenance

The greatest concern regarding the mine workings relate to site operation and the possibility of accidental spills. The old mine workings may serve as rapid pathways, or "highways," for the large-scale and direct migration of spills or other groundwater contaminants from the proposed petrochemical plant toward neighbouring residential wells and into the ocean. Storage of materials that could result in spills should be located away from areas with mine workings that could provide a preferential flow pathway to surface water or groundwater. Where feasible, tailings areas will be fenced and avoided. Many of the spill containment measures in terms of facility design and component siting are described in Section 2.0.

In addition, all old mine workings that could pose a risk to the integrity of the proposed facilities and infrastructure will be filled or avoided through adjustments in the site design (refer to the mitigation presented for construction). A plan to mitigate the human health and environmental impacts of contaminated mine tailings and/or soils and sediments on the Project Site via remediation or risk management will be developed. This plan shall be consistent with the Nova Scotia Guidelines for the Management of Contaminated Sites. The Remedial Action Plan and/or Risk Management Plan will be approved prior to commencement of construction. Upon completion of the remediation or risk management work, including any required monitoring, Keltic will submit a Certificate of Compliance to NSEL to demonstrate that the remediation work has been completed and/or the Risk Management Plan is effective. The Certificate of Compliance shall be submitted no later than 3 years after completion of construction of the land-based components of the Project. In addition, as per Item 2.8 of the approval conditions a detailed monitoring plan, in consultation with NSEL, will be developed determine the potential for and extent of sulphide bearing material and to manage any exposed acid generating material and associated drainage.

In order to prevent re-suspension of contaminated sediments from propeller wash large vessels are to be berthed with the assistance of tugs.

Modifications and Decommissioning

Refer to the mitigation presented for construction.

5.1.5.3 Residual Effects

Provided the proposed mitigative measures are implemented, the magnitude and geographic extent of the environmental effects will be low (Table 6.1-5, Section 6.0). Therefore, no significant adverse residual environmental effects on soil and sediment quality are likely to occur.

5.1.5.4 Follow Up

Construction

In accordance with Item 2.10 in the NSEL EA approval conditions, a plan will be developed and implemented to monitor environmental effects for all relevant chemical and biological parameters that are expected to enter the environment or be remobilized as a result of Project activities in all receiving environments, including those which may impact human health and/or organisms (NSEL, 2007).

Operation and Maintenance

Any follow-up monitoring required will be identified and implemented as per Condition 2.1 of the Nova Scotia Part V Approval within the EEM Plan. Additional monitoring, as per the NSEL EA is outline in Section 5.1.4.4.

Modifications and Decommissioning

No follow up monitoring is anticipated.

5.1.6 Air Quality

Air quality was originally conducted for the purpose of the provincial environmental report (AMEC, 2006) and included all KDP components as well as the petrochemical and co-generation facilities. This information is presented below. It is considered to represent the worst case scenario as additional facilities outside of the scope of this document are included in the modelled scenarios.

5.1.6.1 Environmental Effects Prediction

Construction

Air quality related impacts associated with the construction of the facility will be comprised mainly of emissions from diesel-powered construction equipment and from marine vessels used to deliver equipment and materials to the site. There will also be emissions from private vehicles driven by the construction labour force (i.e. approximately 900 vehicles per day over the entire construction period). These emissions include NO_x, SO_x, particulates, and GHGs; however, these sources are relatively minor and will be of short duration.

Fugitive dust emissions will be generated as a result of excavation and earth moving activities as well as construction equipment traveling on paved and un-paved roads (i.e. dump trucks, cement trucks, watering trucks, bulldozers, graders, scrapers, compactors, front end loaders, and back hoes). A concrete batch plant will also be a source of fugitive dust emissions. These types of emissions will occur over a relatively brief period of time and will have only very localized impacts with the dust settling out generally within a few hundred metres of the activity.

As the site is fairly isolated from the residents, schools, and businesses of the area, the impacts to the public are expected to be insignificant, approaching background concentrations at off-site locations. Mitigation for impacts on air quality in all phases is described in Section 5.1.6.2. A discussion of the monitoring program for air quality can be found in Section 5.1.6.4.

Operation and Maintenance

The KDP will consist of the following major elements:

- LNG facility – LNG Extraction Unit, LNG storage; metering stations; marine terminal, marginal wharf, tugs, and berthing facilities, LNG transfer, vessel movement, storage and vaporization facilities; vapour handling system and associated infrastructure/support facilities; including emergency shutdown system, hazard detection system, security system and facilities, and fire response system.
- Shipping and receiving facilities, including marginal wharf; and associated support facilities, including laboratories, administrative buildings, and security.
- Shipping, including vessel types and sizes, frequency of shipping and planned routes.
- Service water and drinking water systems.
- Administration and service buildings.
- Sanitary wastewater system.

Other components outside the scope of this document, but included in the air quality modelling include:

- Petrochemical facilities –Ethylene, Ethylene and Propylene storage (refrigerated), By-product storage, Derivative units of Polypropylene, High Density Polypropylene, Low Density Polypropylene, and Linear Low Density Polypropylene; fuel gas and liquid systems; water and steam system.
- Electrical co-generation plant (i.e. nominal 200 MW) and associated support facilities, which will be integrated with the LNG Extraction Unit and possibly the LNG vaporization facilities.

The conceptual facility layout showing the locations of these units is provided in Section 2.0, Figures 2.2-1 and 2.2-2.

The specific sources of continuous and intermittent air contaminant emissions from the LNG facility during routine operation and malfunctions include the following:

- LNG tanker (intermittent – 24 hours per delivery);
- Submerged Combustion Vapourizers (continuous);
- simple cycle combustion turbine for power supply (intermittent);
- flare (at start up and at emergencies);
- gas vent stacks (intermittent - malfunction only);
- LNG extraction plant fugitive emissions (continuous); and
- marine transportation equipment other than LNG tankers (intermittent).

Other components outside the scope of this document, but included in the air quality modelling include:

- co-generation facility:
  - simple cycle combustion turbine for power supply (intermittent).
- petrochemical facility:
  - ethylene plant.
- cracking furnaces (continuous);
- hydrogenation units (intermittent);
- process vents (intermittent);
- fugitive emissions from equipment leaks (continuous); and
- flare (emergency operation only).

Linear LDPE plant:

- feed unit treater vents (intermittent);
- catalyst activation off-gas vents (intermittent);
- finishing area pelletization, driers, hoppers, silos, etc. (intermittent);
- emergency releases to the main flare (intermittent) and low capacity process vents to cracking furnaces (intermittent); and
- fugitive emissions from equipment leaks (continuous):
  - Polypropylene Plant vents (intermittent);
  - LDPE plant vents; and
  - HDPE plant vents.

The specific air pollutants emitted from some or all of these units that have been evaluated for their impacts consist of the following:

- SO_2, formed when fuel containing sulphur, such as coal and oil, is burned;
- NO_x, generated when fuel is burned at high temperatures as in a combustion process;
- CO, formed from the incomplete combustion of carbon-containing fuel;
- TSP, PM with PM_{10} and $PM_{2.5}$, terms for particles found in the air, including dust, dirt, soot, smoke, and liquid droplets; and
- VOCs.

Preliminary estimates of the emissions of these pollutants from the KDP components are summarized in Table 5.1-1. The emission rates are based either on equipment vendor information or AP-42 emissions factors (US EPA, 2005). The maximum heat input rates to the combustion units and maximum operating capacity of process units are assumed in these emissions estimates along with estimates of operating hours. The PM_{10} and $PM_{2.5}$ emission rates include both filterable and condensable fractions. Table 5.1-2 gives further information on

TABLE 5.1-1 Air Emissions Inventory

Process ID	Emission Point Description	Source Pollutant[1]	Emissions lb/hr[2]	Emissions t/year	Emission Factor Source	Emission Factor lb/MMBtu[3]
Combined Cycle Plant	Gas Turbines (4)	SO_2	0.4	1.7	AP-42, Sec 3.1	0.0003
	Max. Gas Heat Input (Btu/hr[4]): 4.08E+08	TSP	10.8	42.8	AP-42, Sec 3.1	0.007
	Max. Gas Usage (MMcf/hr[5]): 0.40	$PM_{2.5}$	10.8	42.8	AP-42, Sec 3.1	0.007
	Max. Gas Usage (MMcf/yr[6]): 3504.0	NO_x	212.2	843.1	AP-42, Sec 3.1	0.130
	Hours of Operation per Year: 8,760	CO	49.0	194.5	AP-42, Sec 3.1	0.030
		VOC	3.4	13.6	AP-42, Sec 3.1	0.002
LNG Facility	Simple Cycle Gas Turbine	SO_2	0.05	0.004	AP-42, Sec 3.1	0.0003
	Max. Gas Heat Input (Btu/hr): 1.88E+08	TSP	1.24	0.08	AP-42, Sec 3.1	0.007
	Max. Gas Usage (MMcf/hr): 0.184	$PM_{2.5}$	1.24	0.08	AP-42, Sec 3.1	0.007
	Max. Gas Usage (MMcf/yr): 27.6	NO_x	13.9	0.94	Solar (25 ppm)	0.074
	Hours of Operation per Year: 150	CO	5.64	0.38	AP-42, Sec 3.1	0.030
		VOC	0.39	0.03	AP-42, Sec 3.1	0.002
LNG Facility	LNG Tanker	SO_2	82.6	142.1	Bergessen Worldwide	2.12
	Max. Heat Input (Btu/hr): 3.90E+07	TSP	12.1	20.8	AP-42	0.31
	Max. Oil Usage (gal/hr[7]): 286.4	$PM_{2.5}$	12.1	20.8	AP-42	0.31
	Max. Oil Usage (gal/yr[8]): 1,086,056	NO_x	82.6	142.1	Bergessen Worldwide	2.12
	Hours of Operation per Year: 3,792	CO	37.0	63.7	AP-42	0.95
		VOC	13.6	23.5	AP-42	0.35
Ethylene Plant	Flare (emergency only)	SO_2	0	0	Estimate	N/A
	Max. Gas Heat Input (Btu/hr): 1.76E+05	TSP	1.5	0.0	Estimate	N/A
	Hours of Operation: emergency/start up	$PM_{2.5}$	1.5	-	Estimate	N/A
		NO_x	339.7	-	Estimate	N/A
		CO	62.1	-	Estimate	N/A
		VOC	9.8	-	Estimate	N/A
Ethylene Plant	Cracking Furnaces (7 on-line, 1 decoking)	SO_2	24.2	93.5	NOVA Chem E3 Env. Permit Appl.	N/A
	Flue Gas Flow (NM^3/hr[9]): 1.23E+06	TSP	17.6	68.0	"	N/A
	Hours of Operation: 8,520	$PM_{2.5}$	17.6	68.0	"	N/A
		NO_x	268.7	1038.5	"	N/A
		CO	17.6	68.0	"	N/A
		VOC	8.8	34.0	"	N/A

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Process ID	Emission Point Description	Source Pollutant[1]	Emissions		Emission Factor	
			lb/hr[2]	t/year	Source	lb/MMBtu[3]
Ethylene Plant	Gasoline Hydrogenation	CO_2	0.0	0.0		N/A
	Flue Gas Flow (NM^3/hr): 1,500					
	Hours of Operation: 64					
	Routed to furnaces					
Ethylene Plant	Mixed Hydrogenation	CO_2	0.0	0.0		N/A
	Flue Gas Flow (NM^3/hr): 1,500					
	Hours of Operation: 48					
	Routed to furnaces					
Ethylene Plant	Process Vents	VOC	0.0	0.0		N/A
	Flue Gas Flow (NM^3/hr): 500					
	Hours of Operation: 50					
	Routed to furnaces					
LLDPE Plant	Purification - Butene-1/ICA Degassing	VOC	0.0	0.0	Univation Technologies	N/A
	Flue Gas Flow (kg/hr[10]): 5					
	Hours of Operation: 8,000					
	Routed to furnaces					
LLDPE Plant	Purging & Vent Recovery	VOC	0.0	0.0	Univation Technologies	N/A
	Flue Gas Flow (kg/hr): 1,290					
	Hours of Operation: 8,000					
	Routed to furnaces					
LLDPE Plant	Pelleting Section	VOC	0.0	0.0	Univation Technologies	N/A
	Flue Gas Flow (kg/hr): 2.2					
	Hours of Operation: 8,000					
	Routed to furnaces					
LLDPE Plant	Fugitive Emissions	VOC	0.0	0.0	Univation Technologies	N/A
	Flue Gas Flow (kg/hr): 1.5					
	Hours of Operation: 8,000					
	Routed to furnaces					
LDPE Plant	Reactor Dumps and Purging	VOC	0.0	0.0	ExxonMobil LDPE	N/A
	Flue Gas Flow (t/hr): 50					
	Hours of Operation: 8,000					
	Routed to furnaces					

Process ID	Emission Point Description	Source Pollutant[1]	Emissions		Emission Factor	
			lb/hr[2]	t/year	Source	lb/MMBtu[3]
LDPE Plant	Purge Gas/Primary Compressor	VOC	0.0	0.0	ExxonMobil LDPE	N/A
	Flue Gas Flow (t/hr):4.0					
	Hours of Operation: 8,000					
	Routed to furnaces					
LDPE Plant	LDPE Finishing Section	VOC	0.0	0.0	ExxonMobil LDPE	N/A
	Flue Gas Flow (t/hr): 100					
	Hours of Operation: 8,000					
	Routed to furnaces					
LDPE Plant	Fugitive Emissions	VOC	6.9	24.9	ExxonMobil LDPE	N/A
	Flue Gas Flow (t/hr): 25					
	Hours of Operation: 8,000					
Polypropylene Plant	Reaction Fugitive Emissions	VOC	3.6	13.0	DOW Unipol polypropylene	N/A
	Flue Gas Flow (kg/hr): 1.6					
	Hours of Operation: 8000					
Polypropylene Plant	Purging & Vent Recovery	VOC	0.0	0.0	DOW Unipol polypropylene	N/A
	Flue Gas Flow (kg/hr): 449					
	Hours of Operation: 8000					
	Routed to furnaces					
Polypropylene Plant	Pelleting - to Flare	VOC	0.0	0.0	DOW Unipol polypropylene	N/A
	Flue Gas Flow (kg/hr): 21.0					
	Hours of Operation: 8000					
	Routed to furnaces					
Polypropylene Plant	Pelleting - to Atmosphere	VOC	41.0	147.0	DOW Unipol polypropylene	N/A
	Flue Gas Flow (kg/hr): 18.4					
	Hours of Operation: 8000					
HDPE Plant	Purification - Butene-1/ICA Degassing	VOC	0.0	0.0	Univation Technologies	N/A
	Flue Gas Flow (kg/hr): 1					
	Hours of Operation: 8,000					
	Routed to furnaces					

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Process ID	Emission Point Description	Source Pollutant[1]	Emissions		Emission Factor	
			lb/hr[2]	t/year	Source	lb/MMBtu[3]
HDPE Plant	Purging & Vent Recovery	VOC	0.0	0.0	Univation Technologies	N/A
	Flue Gas Flow (kg/hr): 1,120					
	Hours of Operation: 8,000					
	Routed to furnaces					
HDPE Plant	Pelleting Section	VOC	0.0	0.0	Univation Technologies	N/A
	Flue Gas Flow (kg/hr): 2.2					
	Hours of Operation: 8,000					
	Routed to furnaces					
HDPE Plant	Fugitive Emissions Incl. Analyzer Vents	VOC	3.3	12.0	Univation Technologies	N/A
	Flue Gas Flow (kg/hr): 1.5					
	Hours of Operation: 8,000					
Keltic Facility	All Sources	SO_2	107.25	237.304	N/A	N/A
		TSP	43.24	131.68	N/A	N/A
		$PM_{2.5}$	43.24	131.68	N/A	N/A
		NO_x	917.1	2024.6	N/A	N/A
		CO	171.34	326.58	N/A	N/A
		VOC	90.49	268.03	N/A	N/A
SOEP Gas Plant	Flare	SO_2	0.0	0.0	EC	N/A
	Flue Gas Flow (NM^3/hr): 6.20E+09	TSP	1.5	6.0	EC	N/A
	Hours of Operation: 8,760	$PM_{2.5}$	1.5	6.0	EC	N/A
		NO_x	339.7	1349.8	EC	N/A
		CO	62.1	246.6	EC	N/A
		VOC	9.8	38.8	EC	N/A

Notes:

1. Typically $PM_{2.5}$ is a subset of TSP, however for the purpose of this study, we have considered the TSP and $PM_{2.5}$ to be equal.
2. lb/hr – pounds per hour - lb/hr is a maximum rate, since not all units operate 8760 hours per year (i.e. LNG tankers, emergency flares, etc.)
3. lb/mmBTU – pounds per million British thermal units
4. BTU/hr – British thermal units per hour
5. mmcf/hr – million cubic feet per hour
6. mmcf/yr – million cubic feet per year
7. gal/hr – gallons per hour
8. gal/yr – gallons per year
9. NM^3/hr – normal cubic metres per hour
10. kg/hr – kilograms per hour

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TABLE 5.1-2 Air Emission Inventory – Additional Information On Parameters

Process ID	Source ID	Emission Point Description	Source Type	No. of Sources	Source Location	Source Pollutant	Potential Emissions lb/hr	Potential Emissions TPY	Emission Factor (lb/MMBtu)		Air Pollution Controls
Combined Cycle Plant	101 - 104	**Combined Cycle Gas Turbine (each)**	Stack	4	Combined Cycle Plant	SO_2	4.24E-01	1.86E+00	AP-42, Sec 3.1	2.60E-04	Natural Gas
		Max. Gas Heat Input (Btu/hr):				TSP	1.08E+01	4.72E+01	AP-42, Sec 3.1	6.60E-03	Natural Gas
		4.08E+08				PM-10	1.08E+01	4.72E+01	AP-42, Sec 3.1	6.60E-03	Natural Gas
		Max. Gas Usage (MMcf/hr):				NOx	2.12E+02	9.29E+02	AP-42, Sec 3.1	1.30E-01	Water Injection
		0.400				CO	4.90E+01	2.14E+02	AP-42, Sec 3.1	3.00E-02	Natural Gas
		Max. Gas Usage (MMcf/yr):				VOC	3.43E+00	1.50E+01	AP-42, Sec 3.1	2.10E-03	
		3504.0									
		Hours of Operation:									
		8760.0									
		Heat Content (Btu/cf):									
		1020									
		Stack Height (m): 18.29									
		Exit Diameter (m): 3.05									
		Exit Temperatue (K): 720									
		Exit Velocity (m/sec): 30									
		UTM(m): N 5002850; E 607200									
		Elev (m): 45									
LNG Facility	201	**Simple Cycle Gas Turbine**	Stack	1	LNG Facility	SO_2	4.89E-02	3.67E-03	AP-42, Sec 3.1	2.60E-04	Natural Gas
		Max. Gas Heat Input (Btu/hr):				TSP	1.24E+00	9.31E-02	AP-42, Sec 3.1	6.60E-03	Natural Gas
		1.88E+08				PM-10	1.24E+00	9.31E-02	AP-42, Sec 3.1	6.60E-03	Natural Gas
		Max. Gas Usage (MMcf/hr):				NOx	1.39E+01	1.04E+00	Solar (25 ppm)	7.40E-02	Water Injection
		0.184				CO	5.64E+00	4.23E-01	AP-42, Sec 3.1	3.00E-02	Natural Gas
		Max. Gas Usage (MMcf/yr):				VOC	3.95E-01	2.96E-02	AP-42, Sec 3.1	2.10E-03	
		27.6									
		Hours of Operation:									
		150.0									
		Heat Content (Btu/cf):									
		1020									
		Stack Height (m): 18.29									
		Exit Diameter (m): 3.05									
		Exit Temperatue (K): 720									
		Exit Velocity (m/sec): 30									
		UTM(m): N 5002125; E 608075									
		Elev (m): 35									
LNG Facility	202	**LNG Tanker**	Stack	1	LNG Facility	SO_2	8.26E+01	1.57E+02	Bergessen Worldwide	2.12E+00	None
		Max. Heat Input (Btu/hr):				TSP	1.21E+01	2.29E+01	AP-42	3.10E-01	
		3.90E+07				PM-10	1.21E+01	2.29E+01	AP-42	3.10E-01	
		Max. Diesel Usage (gal/hr):				NOx	8.26E+01	1.57E+02	Bergessen Worldwide	2.12E+00	
		286.4				CO	3.70E+01	7.02E+01	AP-42	9.50E-01	
		Max. Diesel Usage (gal/yr):				VOC	1.36E+01	2.59E+01	AP-42	3.50E-01	
		1086056.2									
		Heat Content (Btu/gal):									
		136065									
		Hours of Operation:									
		3792									
		Stack Height (m): 36.7									
		Exit Diameter (m):1.3									
		Exit Temperatue (K): 413									
		Exit Velocity (m/sec): 20									
		UTM(m): N 5000800; E 606350									
		Elev (m): 0									

TABLE 5.1-2 Air Emission Inventory – Additional Information On Parameters

Process ID	Source ID	Emission Point Description	Source Type	No. of Sources	Source Location	Source Pollutant	Potential Emissions lb/hr	Potential Emissions TPY	Emission Factor (lb/MMBtu)	Air Pollution Controls
Ethylene Plant	301	**Flare (emergency only)**	Flare	1	Ethylene Plant	SO_2	2.42E+01	1.21E-02	NOVA Chem E3 Env. Permit Appl.	None
		Max. Gas Heat Input (Btu/hr):				TSP	1.50E+00	7.50E-04	Estimate	
		1.76E+05				PM-10	1.50E+00	7.50E-04	Estimate	
		Hours of Operation:				NOx	3.40E+02	1.70E-01	Estimate	
		8760.0				CO	6.21E+01	3.11E-02	Estimate	
		Heat Content (Btu/cf):				VOC	9.80E+00	4.90E-03	Estimate	
		Stack Height (m): 31.4								
		Exit Diameter (m): 1.22								
		Exit Temperatue (K): 1000								
		Exit Velocity (m/sec): 33								
		UTM(m): N 5003600; E 606750								
		Elev (m): 65								
Ethylene Plant	302 - 309	**Cracking Furnaces (7 on-line, 1 decoking)**	Stack	8	Ethylene Plant	SO_2	2.42E+01	1.03E+02	NOVA Chem E3 Env. Permit Appl.	None
		Flue Gas Flow (NM^3/hr):				TSP	1.76E+01	7.50E+01	"	
		1.23E+06				PM-10	1.76E+01	7.50E+01	"	
		Hours of Operation:				NOx	2.69E+02	1.14E+03	"	
		8520.0				CO	1.76E+01	7.50E+01	"	
		Stack Height (m): 71				VOC	8.80E+00	3.75E+01	"	
		Exit Diameter (m): 2.64								
		Exit Temperatue (K): 448								
		Exit Velocity (m/sec): 10.5								
		UTM(m): N 5003375; E 607000								
		Elev (m): 65								
Ethylene Plant	311	**Gasoline Hydrogenation**	Stack	1	Ethylene Plant	CO_2	0.00E+00	0.00E+00		
		Flue Gas Flow (NM^3/hr):								
		1.50E+03								
		Hours of Operation:								
		64.0								
		Routed to furnaces								
Ethylene Plant	312	**Mixed Hydrogenation**	Stack	1	Ethylene Plant	CO_2	0.00E+00	0.00E+00		
		Flue Gas Flow (NM^3/hr):								
		1.50E+03								
		Hours of Operation:								
		48.0								
		Routed to furnaces								
Ethylene Plant	313	**Process Vents**	Stack	1	Ethylene Plant	VOC	0.00E+00	0.00E+00		
		Flue Gas Flow (NM^3/hr):								
		5.00E+02								
		Hours of Operation:								
		50.0								
		Routed to furnaces								
LLDPE Plant	401	**Purification - Butene-1/ICA Degassing**	Stack	1	LLDPE Plant	VOC	0.00E+00	0.00E+00	Univation Technologies	
		Flue Gas Flow (kg/hr):								
		5.0								
		Hours of Operation:								
		8000								
		Routed to furnaces								

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TABLE 5.1-2 Air Emission Inventory – Additional Information On Parameters

Process ID	Source ID	Emission Point Description	Source Type	No. of Sources	Source Location	Source Pollutant	Potential Emissions lb/hr	Potential Emissions TPY	Emission Factor (lb/MMBtu)	Air Pollution Controls
LLDPE Plant	402	**Purging & Vent Recovery**	Stack	1	LLDPE Plant	VOC	0.00E+00	0.00E+00	Univation Technologies	
		Flue Gas Flow (kg/hr):								
		1.29E+03								
		Hours of Operation:								
		8000								
		Routed to furnaces								
LLDPE Plant	403	**Pelleting Section**	Stack	1	LLDPE Plant	VOC	0.00E+00	0.00E+00	Univation Technologies	
		Flue Gas Flow (kg/hr):								
		2.20E+00								
		Hours of Operation:								
		8000								
		Routed to furnaces								
LLDPE Plant	404	**Fugitive Emissions**	Fugitive	1	LDPE Plant	VOC	0.00E+00	0.00E+00	Univation Technologies	
		Flue Gas Flow (kg/hr):								
		1.50E+00								
		Hours of Operation:								
		8000								
		Routed to furnaces								
LDPE Plant	501	**Reactor Dumps and Purging**	Stack	1	LDPE Plant	VOC	0.00E+00	0.00E+00	ExxonMobil LDPE	None
		Flue Gas Flow (t/hr):								
		5.00E+01								
		Hours of Operation:								
		8000								
		Routed to furnaces								
LDPE Plant	502	**Purge Gas/Primary Compressor**	Stack	1	LDPE Plant	VOC	0.00E+00	0.00E+00	ExxonMobil LDPE	None
		Flue Gas Flow (t/hr):								
		4.00E+00								
		Hours of Operation:								
		8000								
		Routed to furnaces								
LDPE Plant	503	**LDPE Finishing Section**	Stack	1	LDPE Plant	VOC	0.00E+00	0.00E+00	ExxonMobil LDPE	None
		Flue Gas Flow (t/hr):								
		1.00E+02								
		Hours of Operation:								
		8000								
		Routed to furnaces								
LDPE Plant	504	**Fugitive Emissions**	Fugitive	1	LDPE Plant	VOC	6.90E+00	2.75E+01	ExxonMobil LDPE	None
		Flue Gas Flow (t/hr):								
		2.50E+01								
		Hours of Operation:								
		8000								
Polypropylene Plant	601	**Reaction Fugitive Emissions**	Stack	1	Polypropylene Plant	VOC	3.60E+00	1.43E+01	DOW Unipol PP	
		Flue Gas Flow (kg/hr):							Strm #12 (ave.)	
		1.60E+00								
		Hours of Operation:								
		8000								

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TABLE 5.1-2 Air Emission Inventory – Additional Information On Parameters

Process ID	Source ID	Emission Point Description	Source Type	No. of Sources	Source Location	Source Pollutant	Potential Emissions lb/hr	Potential Emissions TPY	Emission Factor (lb/MMBtu)	Air Pollution Controls
Polypropylene Plant	602	**Purging & Vent Recovery**	Stack	1	Polypropylene Plant	VOC	0.00E+00	0.00E+00	DOW Unipol PP	None
		Flue Gas Flow (kg/hr):							Strm #12 (ave.)	
		4.49E+02								
		Hours of Operation:								
		8000								
		Routed to furnaces								
Polypropylene Plant	603	**Pelleting - to Flare**	Stack	1	Polypropylene Plant	VOC	0.00E+00	0.00E+00	DOW Unipol PP	
		Flue Gas Flow (kg/hr):							Strm #12 (ave.)	
		2.10E+01								
		Hours of Operation:								
		8000								
		Routed to furnaces								
Polypropylene Plant	604	**Pelleting - to Atmosphere**	Stack	1	Polypropylene Plant	VOC	4.10E+01	1.62E+02	DOW Unipol PP	
		Flue Gas Flow (kg/hr):							Strm #12 (ave.)	
		1.84E+01								
		Hours of Operation:								
		8000								
HDPE Plant	701	**Purification - Butene-1/ICA Degassing**	Stack	1	HDPE Plant	VOC	0.00E+00	0.00E+00	Univation Technologies	None
		Flue Gas Flow (kg/hr):								
		1.00E+00								
		Hours of Operation:								
		8000								
		Routed to furnaces								
HDPE Plant	702	**Purging & Vent Recovery**	Stack	1	HDPE Plant	VOC	0.00E+00	0.00E+00	Univation Technologies	None
		Flue Gas Flow (kg/hr):								
		1.12E+03								
		Hours of Operation:								
		8000								
		Routed to furnaces								
HDPE Plant	703	**Pelleting Section**	Stack	1	HDPE Plant	VOC	0.00E+00	0.00E+00	Univation Technologies	None
		Flue Gas Flow (kg/hr):								
		2.20E+00								
		Hours of Operation:								
		8000								
		Routed to furnaces								
HDPE Plant	704	**Fugitive Emissions Incl. Analyzer Vents**	Fugitive	1	HDPE Plant	VOC	3.30E+00	1.32E+01	Univation Technologies	
		Flue Gas Flow (kg/hr):								
		1.50E+00								
		Hours of Operation:								
		8000								
Total/ Combustion	All	**Turbines/Furnaces**	Stack		Keltic Petrochemicals	SO_2	1.07E+02	2.62E+02		
Sources						TSP	4.17E+01	1.45E+02		
						PM-10	4.17E+01	1.45E+02		
						NOx	5.77E+02	2.23E+03		
						CO	1.09E+02	3.60E+02		
						VOC	3.51E+01	1.16E+02		

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TABLE 5.1-2 Air Emission Inventory – Additional Information On Parameters

Process ID	Source ID	Emission Point Description	Source Type	No. of Sources	Source Location	Source Pollutant	Potential Emissions lb/hr	Potential Emissions TPY	Emission Factor (lb/MMBtu)		Air Pollution Controls
All Fugitive	All		Fugitive		Keltic Petrochemicals	VOC	5.48E+01	2.17E+02			
All VOCs	All		All		Keltic Petrochemicals	All VOCs	8.99E+01	3.33E+02			
SOEI Gas Plant		Max. Gas Heat Input (Btu/hr):				SO_2	0.00E+00	0.00E+00	EC		
		6.20E+09				TSP	1.50E+00	6.60E+00	EC		
		Hours of Operation:				PM-10	1.50E+00	6.60E+00	EC		
		8760.0				NOx	3.40E+02	1.49E+03	EC		
		Heat Content (Btu/cf):				CO	6.21E+01	2.72E+02	EC		
		1020				VOC	9.80E+00	4.28E+01	EC		
		Stack Height (m): 65									
		Exit Diameter (m): 6.0									
		Exit Temperatue (K): 1,000									
		Exit Velocity (m/sec): 0.1									
		UTM(m): N 5003300; E 608800									
		Elev (m): 45									

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the parameters used for air quality modeling purposes. Stack heights for the KDP facilities are from ground level at the particular source location, and elevation relative to sea level is also indicated. The model can be used to account for building downwash as the design for the building structures matures.

Furthermore, it should be noted that the air quality modeling impacts are, of necessity, based on conceptual design data which has been generated at this time. As more information evolves, further information will be delineated, including, but not limited to:

- building layouts and roof heights;
- unit process details, including additional process components; and
- emission control improvements.

For example, given the cooling water requirements for the petrochemical facility, it has been determined that a forced draft cooling tower will be needed, giving rise to potential particulate emissions, as well as vapour plumes. As the design progresses, specific dispersion modeling techniques will be used to determine the impact(s) of the tower. If required, the KDP's EMP, will include provisions to mitigate any potential adverse effects associated with the operation of such tower. This typically includes such items as monitoring weather conditions and operation of a fog warning system along potentially affected roads. In addition, the need for a number of SCV is documented in Section 2.0, and when emission parameters are established, the air quality model will incorporate these units. The modeling will also establish the need for emission control systems and its specifications.

The air quality dispersion modeling results presently available provide a contextual appreciation for the potential impacts of the facility. Keltic will, as part of its environmental permit application process, provide a full air quality modeling report based on the final facility design.

Impact Analysis

A dispersion modeling analysis has been conducted to estimate the impacts of the KDP criteria air contaminant emissions on ambient air quality levels and sensitive receptors in the KDP Area. This dispersion modeling analysis covers routine emissions during normal operation of the units at the facility as well as emissions associated with equipment malfunctions and mobile source emissions. It is noted that the potential emissions from the cargo vessels which will be tied up on occasion at the Marginal Wharf have not been included in the modeling analysis, since their sizes, configurations, and fuel types are unknown at present. However; estimated emissions from the LNG vessels while hoteling and unloading have been included. The impacts of their boiler emissions are not considered to have a significant impact on the dispersion results; however, the models will be run again when further information becomes available through the FEED process.

The US EPA "Guideline on Air Quality Models" (US EPA, 2004) was consulted for guidance in selecting the appropriate methodology for this analysis. The assessment includes the following steps:

- meteorological data selection, review and processing;
- land use analysis and receptor grid development;
- emissions inventory development;
- background air quality evaluation; and
- refined modeling to estimate air quality impacts in the KDP Area and at sensitive receptors.

Modeling was performed with the KDP at full capacity operation for the combustion turbines and cracking furnaces, as well as for expected mobile source activity. According to a 2003 emissions inventory reported by EC, the only other source of air pollutant emissions within 25 km of the site is the SOEP gas plant and M&NP metering station that is adjacent to the KDP Site. Therefore, the KDP Site and SOEP gas plant emissions are both included in the modeling analysis to demonstrate compliance with Nova Scotia Air Quality Regulations and CEPA Ambient Air Quality Objectives as shown in Table 5.1-3. The SOEI gas plant emissions are included in Table 5.1-2.

TABLE 5.1-3 Nova Scotia Air Quality Regulations (*Environment Act*) and *Canadian Environmental Protection Act* (CEPA) Ambient Air Quality Objectives

Contaminant/Units	Averaging Period	Nova Scotia Maximum Permissible	Canada National Ambient Air Quality Objectives & Guidelines		
			Maximum Desirable	Maximum Acceptable	Maximum Tolerable
NO_2 µg/m^3 (ppb)	1 hour	400 (213)	-	400 (213)	1000 (532)
	24 hour	-	-	200 (106)	300 (160)
	Annual	100 (53)	60 (32)	100 (53)	-
SO_2 µg/m^3 (ppb)	1 hour	900 (344)	450 (172)	900 (334)	-
	24 hour	300 (115)	150 (57)	300 (115)	800 (306)
	Annual	60 (23)	30 (11)	60 (23)	-
Total Suspended Particulate (µg/m^3)	24 hour	120	-	120	400
	Annual	70	60	70	-
$PM_{2.5}$ (µg/m^3)	24 hour	30[1]	-	-	-
CO mg/m^3 *(ppm)	1 hour	34.6 (31)	15 (13)	35 (31)	-
	8 hour	12.7 (13)	6 (5)	15 (13)	20 (17)
Ozone µg/m^3 (ppb)	1 hour	160 (82)	100 (51)	160 (82)	300 (153)
	24 hour	-	30 (15)	50 (25)	-
	Annual	-	-	30 (15)	-
Hydrogen Sulphide µg/m^3 (ppb)	1 hour	42 (30)	-	-	-
	24 hour	8 (6)	-	-	-

Note: Canada Wide Standard
*mg/m^3 - milligrams per cubic metre

Refined dispersion modeling for the criteria air contaminant emissions utilizes the USEPA American Meteorological Society/ EPA Regulatory Model (AERMOD) model with topographic considerations along with five years of hourly surface meteorological data collected at Halifax-Shearwater and twice-daily upper air data collected at Yarmouth. KDP impacts on ozone concentrations are assessed by comparing the total KDP ozone precursor emissions (i.e. NO_x

and VOC) with the regional precursor emissions that contribute to the ambient ozone concentrations in the District of Guysborough.

AERMOD modeling options are specified as follows in accordance with the USEPA guidance (USEPA, 2002). The options include:

- use of the elevated terrain algorithms requiring input of terrain height data;
- use of stack tip downwash (except for building downwash cases);
- use of the calms processing routines;
- use of the missing data processing routines; and
- no exponential decay of SO_2 for rural sources.

Building downwash effects are not considered in the impact analysis due to the lack of specific information on building dimensions at this time. However, building downwash effects are more important at close-in distances and would have no meaningful effect on the estimated impacts of the KDP given the relatively large distances from low level sources to off-site areas.

Meteorological Data Selection, Review, and Processing

AERMOD requires hourly surface meteorological data and twice-daily upper air data for calculating downwind concentrations. The data required for each simulation are:

- wind speed;
- wind direction;
- dry-bulb temperature;
- cloud cover;
- ceiling height;
- station pressure; and
- vertical profiles of temperature, pressure, and relative humidity.

The proposed facility site does not have an on-site meteorological station. Therefore, meteorological data used in the analysis consists of 2000 - 2004 hourly surface observations taken at Halifax-Shearwater along with concurrent twice-daily upper air data collected at Yarmouth. Halifax-Shearwater is located approximately 160 km southwest of the KDP Site. This distance from the site supports its spatial representativeness since it places it in the same general synoptic flow regime as well as most mesoscale systems. The Halifax-Shearwater station is also located in a similar geographic setting as the KDP Site being situated on the northeast portion of an inlet and about 5 km north of the southeast coastline. This is the station closest to the KDP Site that monitors all of the meteorological parameters required for the AERMOD model. Other possible sources of the required meteorological data in the area, at Beaver Island and Hart Island, were found to have significant amounts of missing data that precluded their use. The monitoring locations are also islands that have localized microclimates caused by sea breeze circulations that are not particularly representative of the Goldboro site. A wind rose depicting the frequency of occurrence of the Halifax-Shearwater winds from each of

16 directions and frequency of wind speed ranges for each direction is provided in Figure 5.1-1 for the 2000 – 2004 time period.

The aforementioned meteorological data are processed using the AERMET pre-processor program along with the definition of the surface characteristics within the modeling domain. These surface characteristics of albedo (i.e. ratio of reflected to incident solar radiation), Bowen ratio (i.e. ratio of sensible to latent heat fluxes from the earth's surface), and surface roughness length (i.e. height above the ground at which the mean wind speed becomes zero) are specified by season as a function of distance and direction from the KDP Site based on land use information and the AERMOD User's Guide recommended values of these parameters.

Land Use Analysis and Receptor Grid Development

The area surrounding the site can be characterized as rural in nature with very little industrial activity with the exception of the SOEP gas plant and metering station. The KDP Site terrain elevations vary from sea level to about 75 m above sea level. Nearby hills are most prominent to the northwest and north of the site while areas to the east, southeast, south, and southwest are generally flat to gently rolling that do not exceed 60 m above sea level. The terrain elevations reach 100 m at a distance of about 5,000 m from the site to the north, 120 m at a distance of approximately 8,000 m to the northwest, and 150 m at a distance of approximately 12,000 m to the northwest and north. The highest elevation within 20 km of the station is 200 m at a distance of approximately 20 km to the northwest.

The modeling domain in terms of the receptor grid development is selected such that the impacts of both low level and elevated source facility emissions are correctly estimated and are relevant for the analysis. Topography of the KDP Site and the modeling domain are obtained using digital topographic data for the site region.

The UTM coordinate system is used to generate a Cartesian receptor grid starting at the petrochemical facility extending out to a distance as needed such that the maximum air quality impacts are captured in the model runs. A 100 m grid spacing is used from the KDP property boundary out to a distance of 2 km. The property boundary is specified as discreet receptors in order to provide the proper detailed coverage in the receptor grid. A grid spacing of 200 m is used from 2 km to 4 km followed by 1 km grid spacing from 4 km to 10 km to ensure that the maximum impacts are obtained. Receptors are also placed at sensitive receptors such as the Isaac's Harbour Villa Senior Apartments.

The topographic elevations for the receptors in the modeling domain are developed using the AERMAP pre-processor along with Digital Elevation Model equivalent terrain files covering the modeling domain.

Modeling Results

The AERMOD modeling is performed for the KDP facility sources along with the SOEP gas plant emissions to estimate total air quality impacts of the KDP. These impacts are used to

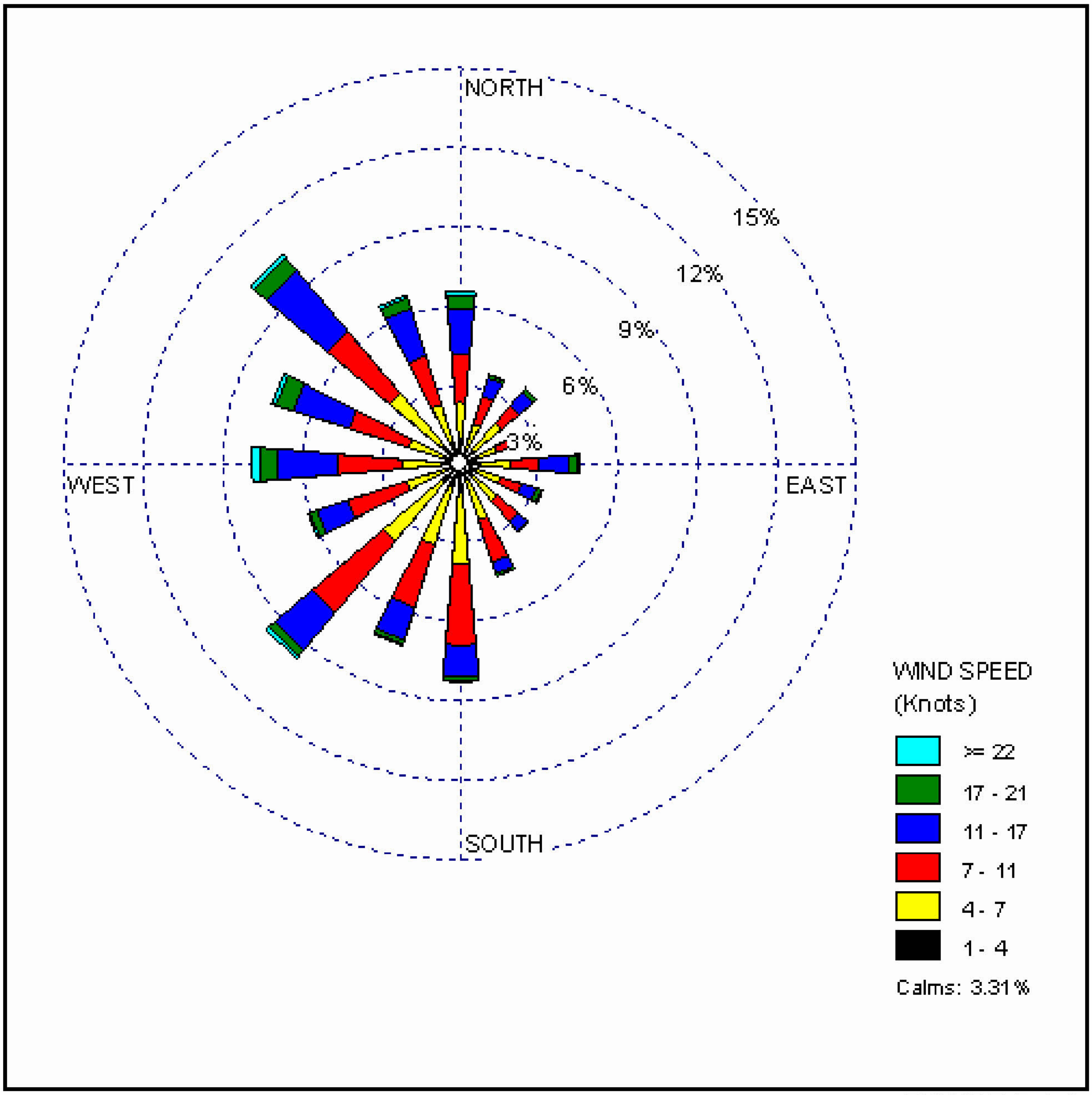

FIGURE 5.1-1
KELTIC PETROCHEMICALS INC.
HALIFAX SHEARWATER WINDROSE
(2000-2004)
JUNE 2007

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verify that the Nova Scotia Air Quality Regulations and CEPA Ambient Air Quality Objectives would be met, along with consideration of the appropriate background air quality data. It is noted that the VOC emissions are not modeled, since no criteria are available for comparison, nor is information on the specification of the VOCs available. Odourous compounds will be modeled when further design emission rates/compound information become available. The distance to receptors will undoubtedly mitigate odours. However, it cannot be stated with any certainty that the odours will be completely eliminated. In general, increasing distance from a source of odour will result in a greater opportunity for atmospheric dispersion to reduce the component's concentration in air and thus reduce its odour potential. The specific meteorological condition at any given time will determine the degree of atmospheric dispersion and the reduction in concentration with distance. The least dispersive conditions (i.e., stable conditions) resulting in the lowest reduction in concentration versus distance occur in the night time and early morning hours. The most dispersive conditions (i.e., unstable conditions) resulting in the highest reduction in concentration versus distance occur during the afternoon hours with clear skies and light winds. Strong winds or cloudy skies result in intermediate dispersion conditions (i.e., neutral stability). The detectable odour thresholds for the contaminants in Table 5.1-4 are as follows:

TABLE 5.1-4 Odour Thresholds

Contaminant	Odour Threshold (ppm)
SO_2	0.33
TSP	N/A
$PM_{2.5}$	N/A
NO_2	0.05
CO	Odourless
Ozone	0.00076

N/A – not applicable

The background air quality used in the EA is based on short-term monitoring data collected by ExxonMobil at their Goldboro Gas Plant. Continuous monitoring for NO_2 and SO_2 near the Goldboro plant was conducted in Seal Harbour from June 10, 2004, through August 10, 2004. There are no other longer term background air quality data available that are representative of this area. The highest monitored 24-hour NO_2 concentration during this 2 month period was approximately 2.0 ppb and the highest SO_2 value was 4.0 ppb. Monitoring for TSP and $PM_{2.5}$ at Seal Harbour was conducted for three 24-hour periods in each of July, August, and September of 2004. The highest monitored 24-hour TSP concentration during this 3 month period was 19.8 $\mu g/m^3$ and the highest $PM_{2.5}$ value was 4.0 $\mu g/m^3$.

The results of the modeling analysis are summarized in Table 5.1-5 showing the overall highest predicted pollutant concentrations due to the routine operation of the KDP facility and the SOEP gas plant separately. The total impacts reflect the highest combination of Keltic and SOEP impacts from among all off-site receptors, along with the background concentrations. The impacts during start-up/upset conditions with the ethylene flare operating on an emergency basis are also shown in this Table. Maximum sensitive receptor impacts are summarized in Table 5.1-6. Also, the NO_2 impacts are assessed by applying the empirically derived NO_2/NO_x ratio of 0.75 (i.e. annual national default) to the maximum predicted NO_2 impacts, as recommended in the USEPA "Guideline on Air Quality Models" (USEPA, 2004).

TABLE 5.1-5 Maximum Predicted Overall Facility Impacts vs. Nova Scotia Air Quality Regulations and National Ambient Air Quality Objectives

Contaminant/Units	Averaging Period	Maximum Predicted Impacts				Nova Scotia Maximum Permissible	Canada National Ambient Air Quality Objectives & Guidelines		
		Keltic	SOEP	Total[1]	Upset[2]		Maximum Desirable	Maximum Acceptable	Maximum Tolerable
NO_2 μg/m^3	1 hour	155.9	274.1	274.5	276.2	400	-	400	1000
	24 hour	72.2	114.5	118.4	119.0	-	-	200	300
	Annual	4.7	17.7	19.1	20.2	100	60	100	-
SO_2 μg/m^3	1 hour	74.9	0.0	74.9	90.0	900	450	900	-
	24 hour	42.6	0.0	53.1	62.4	300	150	300	800
	Annual	5.3	0.0	5.3	6.1	60	30	60	-
TSP μg/m^3	24 hour	5.3	0.6	25.1	25.1	120	-	120	400
	Annual	0.8	0.1	0.3	0.8	70	60	70	-
$PM_{2.5}$ μg/m^3	24 hour	0.8	0.1	10.2	10.2	30[3]	-	-	-
CO mg/m^3	1 hour	0.048	0.067	0.067	0.067	34.6	15	35	-
	8 hour	0.031	0.052	0.052	0.052	12.7	6	15	20
Ozone μg/m^3	1 hour	N/A[4]	N/A	N/A	N/A	160	100	160	300
	24 hour	N/A	N/A	N/A	N/A	-	30	50	-
	Annual	N/A	N/A	N/A	N/A	-	-	30	-

Notes:

1. Total impacts reflect the highest combination of Keltic and SOEP impacts from among all off-site receptors and includes background concentrations (24-hour NO_2 of 3.8 μg/m^3, 24-hour SO_2 of 10.5 μg/m^3, 24-hour TSP of 19.8 μg/m^3 and 24 hour $PM_{2.5}$ of 4.3 μg/m^3).
2. Reflects impacts during start-up/upset condition with ethylene flare in operation on emergency basis.
3. Canada Wide Standard assumes all particulate emitted by Keltic and SOEP is $PM_{2.5}$.
4. N/A = Not available

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TABLE 5.1-6 Maximum Predicted Sensitive Receptor Impacts vs. Nova Scotia Air Quality Regulations and National Ambient Air Quality Objectives

Contaminant/ Units	Averaging Period	Maximum Predicted Impacts (Keltic + SOEP)			Nova Scotia Maximum Permissible	Canada National Ambient Air Quality Objectives & Guidelines		
		Goldboro Interpretive Centre	Isaac's Harbour Villa Senior Aprts	Isaac's Harbour Medical Centre		Maximum Desirable	Maximum Acceptable	Maximum Tolerable
NO_2 µg/m^3	1 hour	87.5	73.4	79.2	400	-	400	1000
	24 hour	19.2	19.3	13.1	-	-	200	300
	Annual	1.7	1.4	1.1	100	60	100	-
SO_2 µg/m^3	1 hour	11.1	12.0	9.3	900	450	900	-
	24 hour	2.4	2.1	1.6	300	150	300	800
	Annual	0.4	0.3	0.2	60	30	60	-
TSP µg/m^3	24 hour	1.1	0.8	1.0	120	-	120	400
	Annual	0.1	0.1	0.09	70	60	70	-
$PM_{2.5}$ µg/m^3	24 hour	1.1	0.8	1.0	30[1]	-	-	-
CO mg/m^3	1 hour	0.014	0.013	0.013	34.6	15	35	-
	8 hour	0.005	0.003	0.005	12.7	6	15	20
Ozone µg/m^3	1 hour	N/A	N/A	N/A	160	100	160	300
	24 hour	N/A	N/A	N/A	-	30	50	-
	Annual	N/A	N/A	N/A	-	-	30	-

Notes:

1. Assumes all particulate emitted by Keltic and SOEP is $PM_{2.5}$.
2. Canada Wide Standard

The highest NO_2 and CO offsite concentrations tend to occur to the southwest of the co-generation plant near the property boundary due to the combined cycle gas turbine emissions. The highest SO_2, and TSP concentrations occur near the LNG tanker and in the area northwest of the ethylene unit near the property boundary. Figures 5.1-2 through 5.1-11 show the spatial distribution of the maximum KDP facility NO_2, SO_2, TSP, and CO impacts for the various averaging times. The KDP property boundary is outlined in black east of Stormont Bay and the SOEP boundary is just east of the KDP Site.

The results indicate that the Nova Scotia Maximum Permissible Concentrations and Canada National Ambient Air Quality Objectives & Guidelines will be met in all cases.

KDP impacts on ozone concentrations are assessed by comparing the total KDP ozone precursor emissions (i.e. NO_x and VOC) with the regional precursor emissions that contribute to the ambient ozone concentrations in the KDP Area. From Table 5.1-1, the total annual KDP emissions of NO_x and VOC are estimated to be approximately 2,000 t and 270 t, respectively. According to EC's NPRI, the total NO_x and VOC emissions for the Province of Nova Scotia for the year 2003 were 70,749 t and 56,082 t, respectively. Therefore, the KDP emissions of NO_x and VOC are estimated to be approximately 2.8 and 0.5%, respectively, of the total province emissions. Such a small contribution to the regional emissions of ozone precursors will result in a negligible contribution to ozone concentrations in the KDP Area, particularly since it has been estimated that 60-80% of the ozone found in Nova Scotia is due to long range transport.

As was noted above (Table 5.1-2), lakes in this area typically exhibit fairly low pH values (4.3-5.5), which is not uncommon for Nova Scotia. These low values are likely the result of a number of factors, including the underlying geology of the area, the disposal/runoff with regard to past mining activities, and acid precipitation. The total release of SO_2 in Nova Scotia is estimated to be approximately 166,000 t/year according to the NPRI. The relevant emissions from the KDP operations would only constitute a small percentage of the total for Nova Scotia with respect to SO_2 (0.14%), and 2.8% with respect to NO_x. Furthermore, it is generally well-accepted that more than half of the acid deposition in eastern Canada originates from emissions in the USA as well as from Ontario and Quebec.

The wind rose shown in Figure 5.1-1 indicates that the winds in the region predominate from the northwest through the southwest, meaning that the emissions will most often be carried offshore. Since the chemical reactions that change SO_2 and NO_x to acid rain can take from several hours to several days, it is expected that the emissions will most often be carried well offshore before contributing to acidic precipitation.

Regasification of LNG will be a source of GHG emissions. GHG emission estimates from similar projects are the following: 329,694 tonnes per year for a facility with a 1,000 million standard cubic feet per day send out capacity (Irving Oil Limited, LNG Marine Terminal/Multi-purpose Pier Project, Environmental Impact Statement 2004); 325,761 tonnes per year for a facility with 610 million standard cubic feet per day send out capacity (Kitimat LNG Terminal Project Assessment Report/CSR 2006). The Keltic send out rate is approximately 1,829 million standard cubic feet per day.

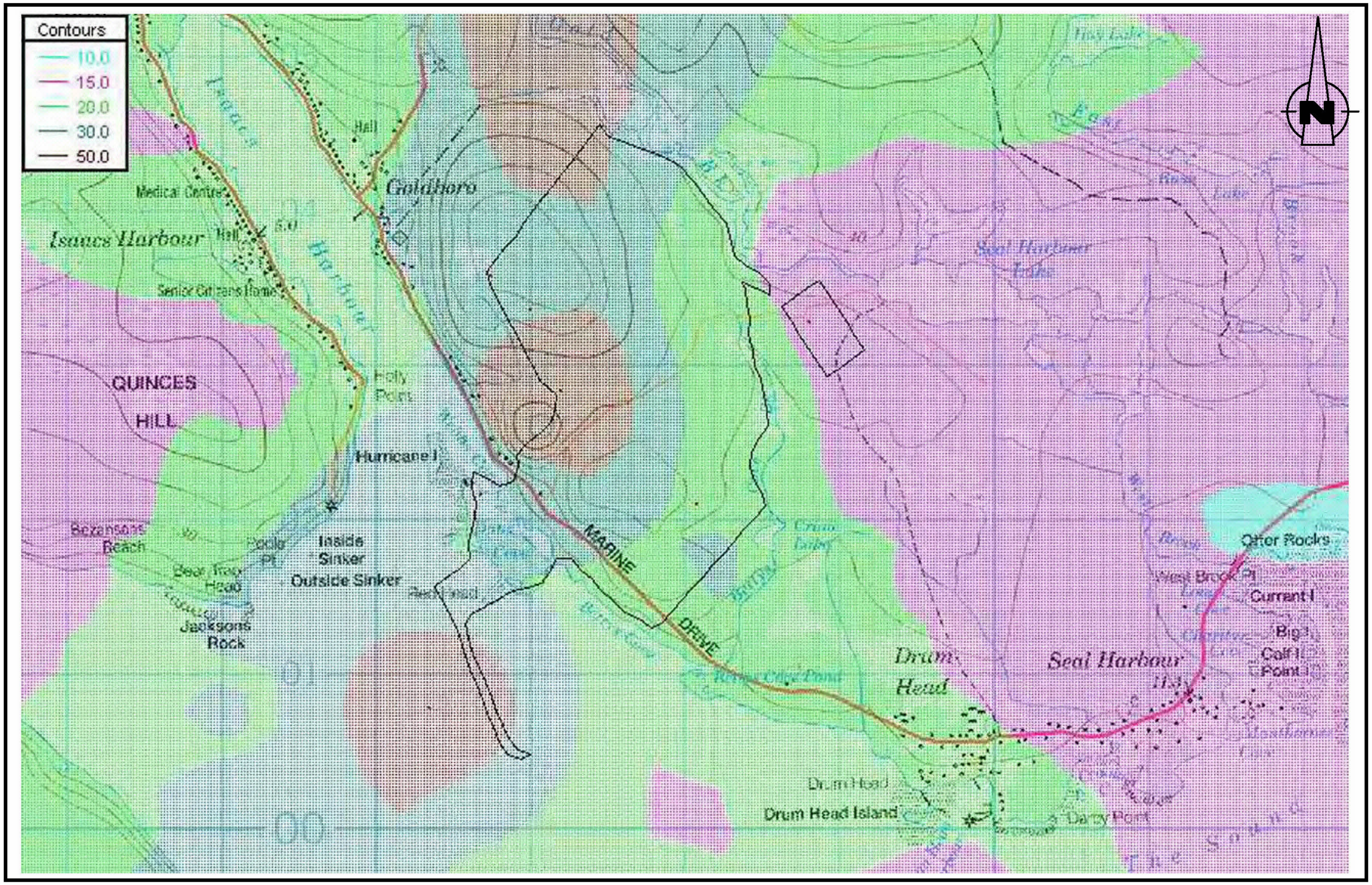

FIGURE No. 5.1-2
KELTIC PETROCHEMICALS INC.
MAXIMUM 1-HOUR NO_2 IMPACTS
JUNE 2007

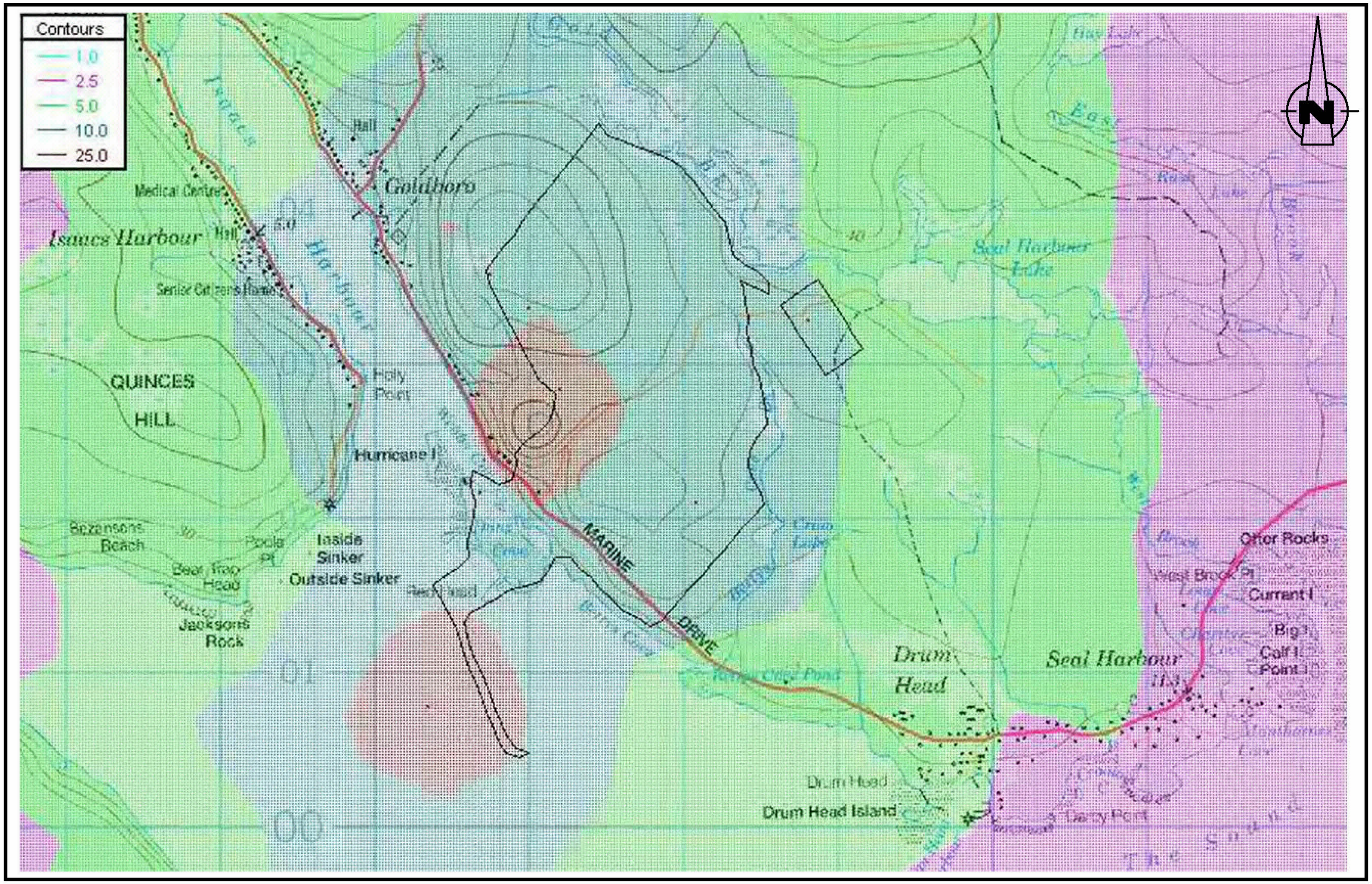

FIGURE No. 5.1-3
KELTIC PETROCHEMICALS INC.
MAXIMUM 24-HOUR NO_2 IMPACTS
JUNE 2007

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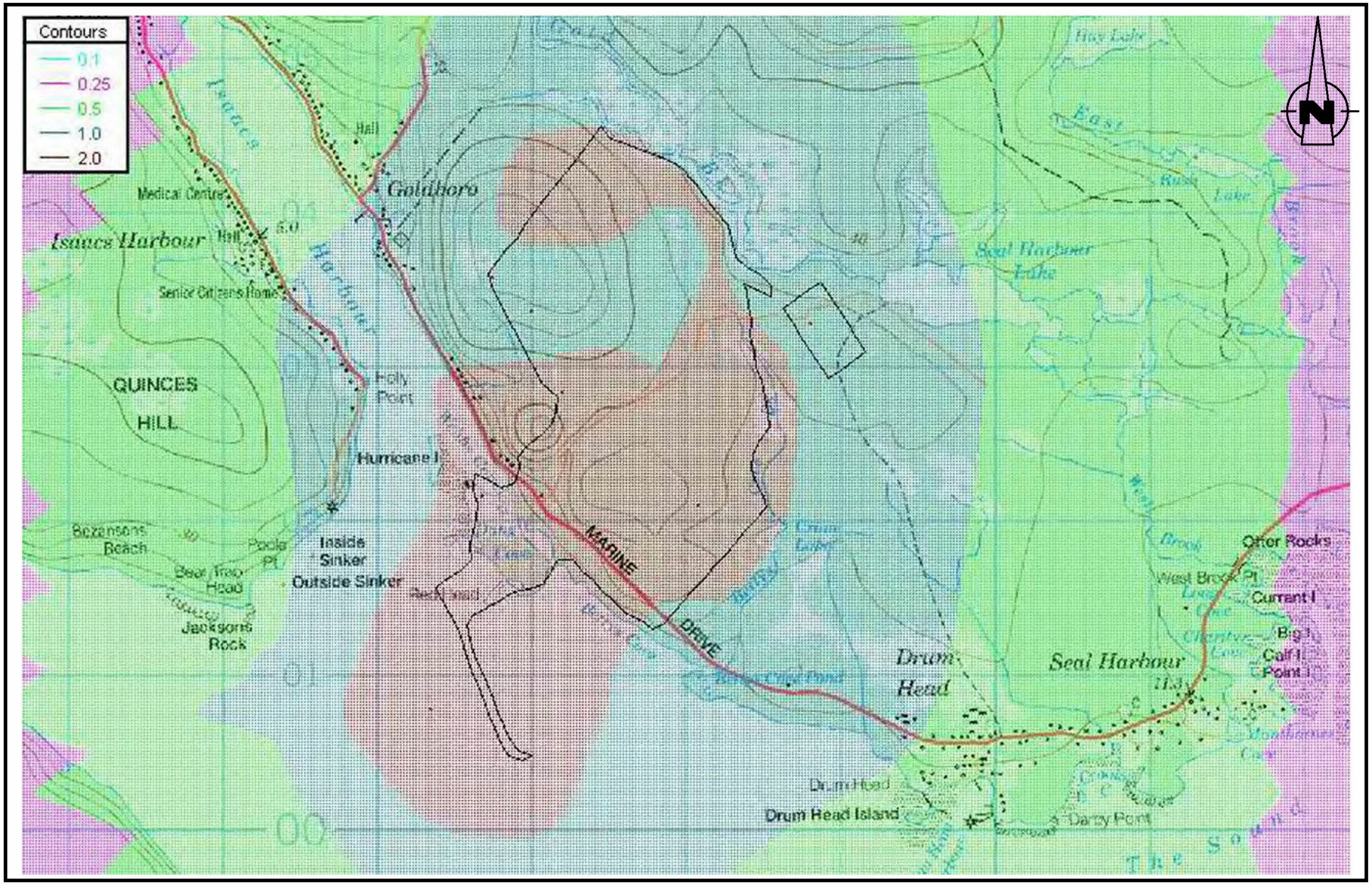

FIGURE No. 5.1-4
KELTIC PETROCHEMICALS INC.
ANNUAL AVERAGE NO_2 IMPACTS
JUNE 2007

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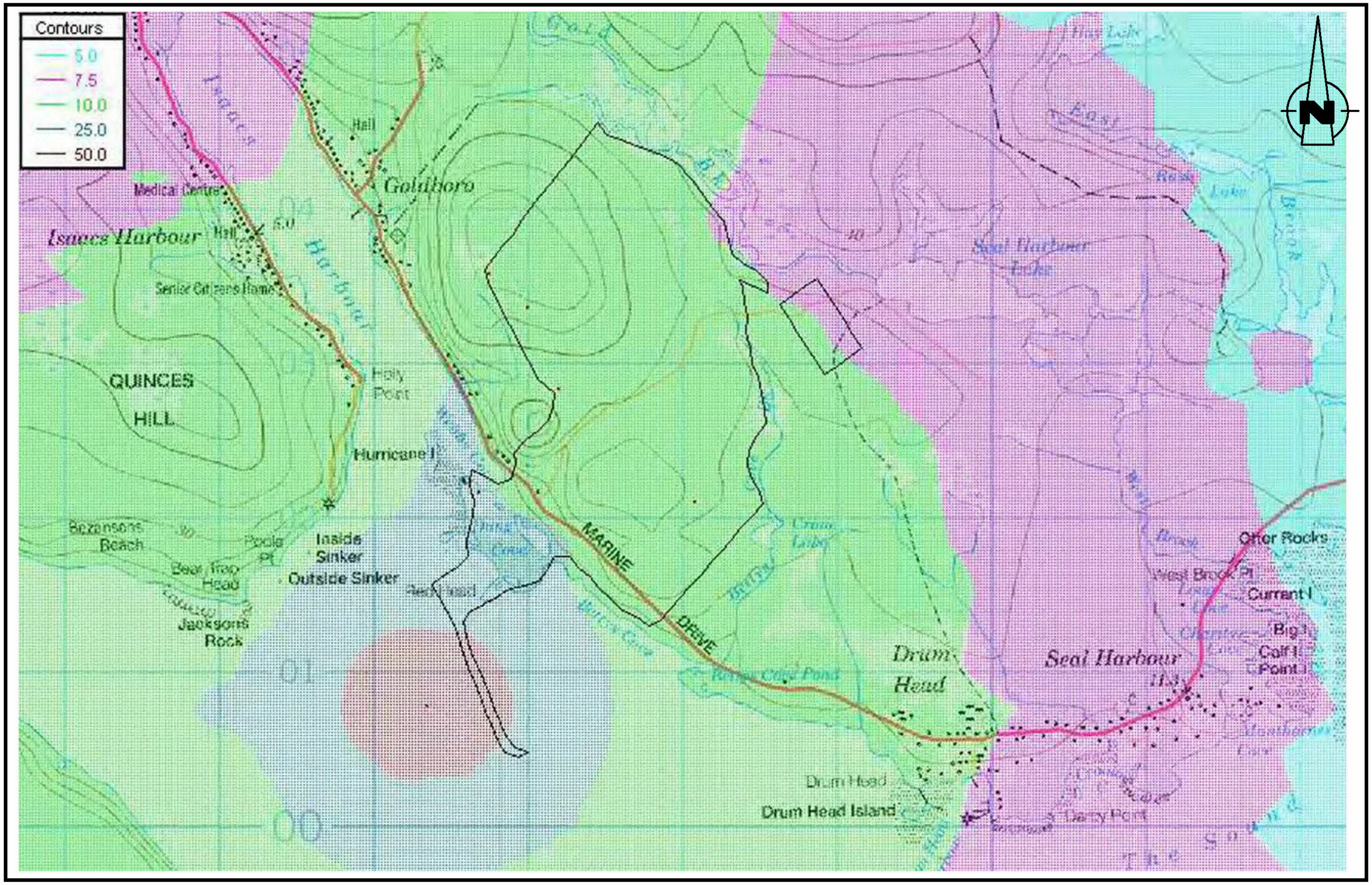

FIGURE No. 5.1-5
KELTIC PETROCHEMICALS INC.
MAXIMUM 1- HOUR SO_2 IMPACTS
JUNE 2007

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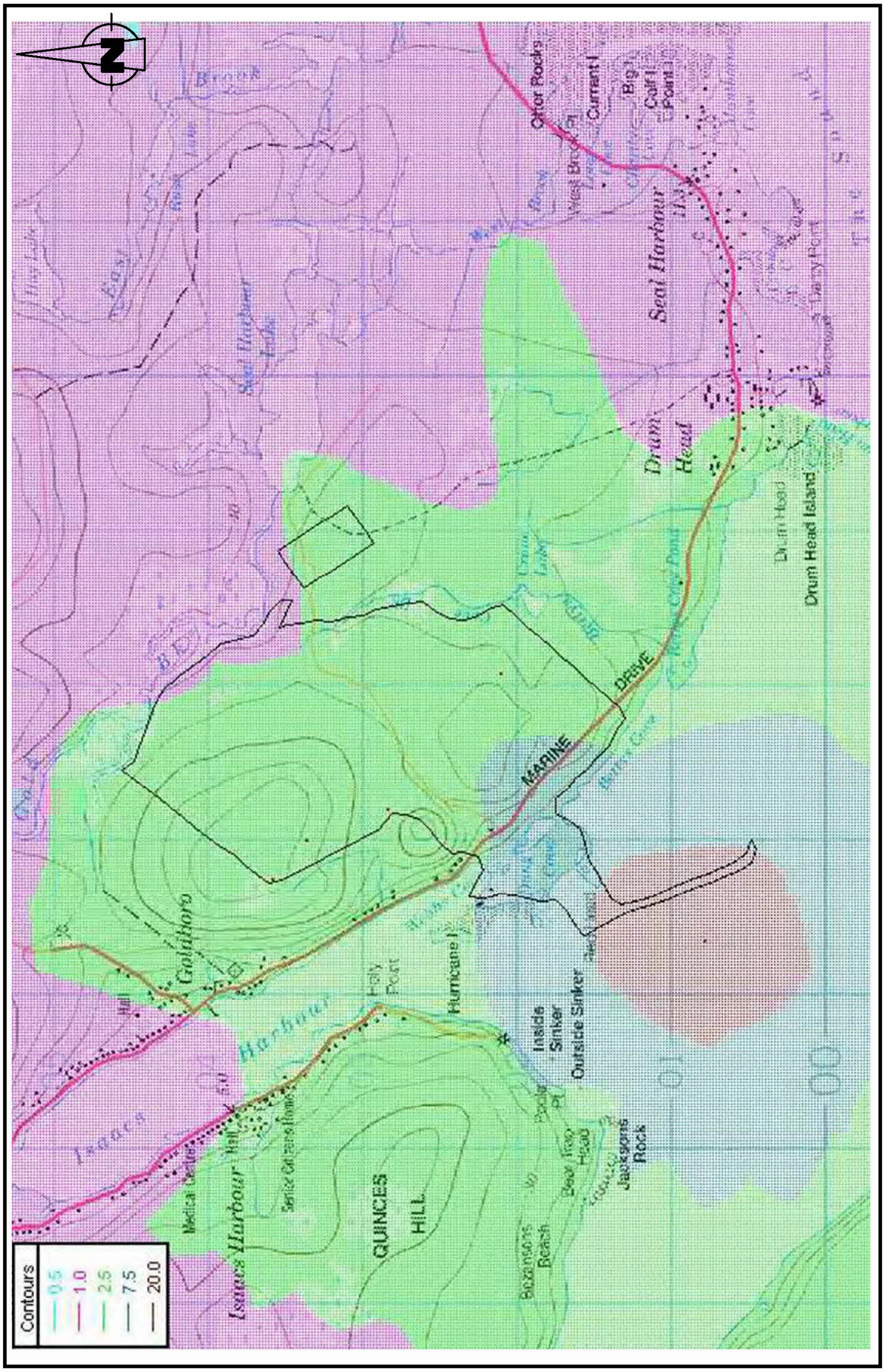

FIGURE No. 5.1-6
KELTIC PETROCHEMICALS INC.
MAXIMUM 24- HOUR SO_2 IMPACTS
JUNE 2007

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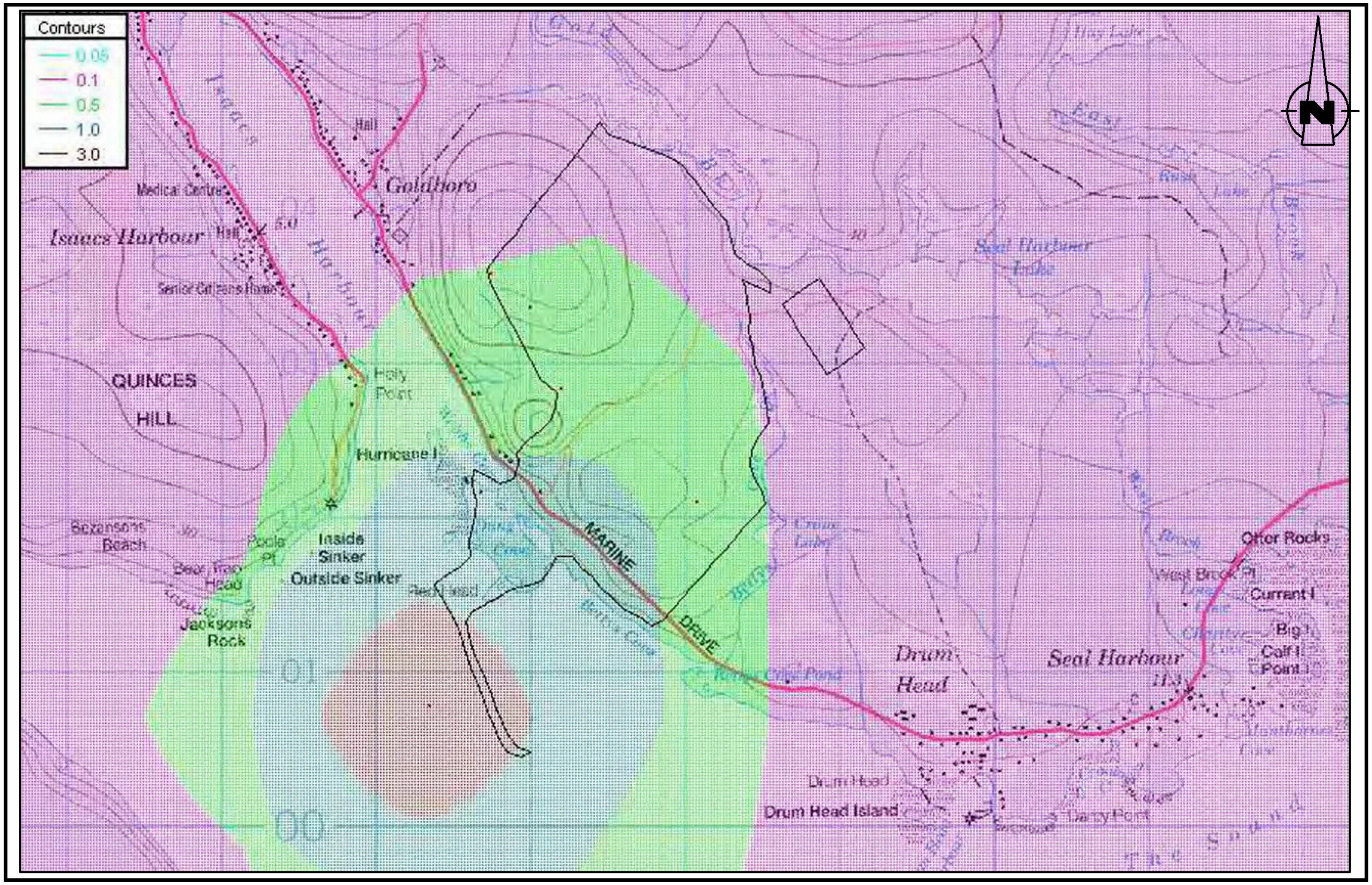

FIGURE No. 5.1-7
KELTIC PETROCHEMICALS INC.
ANNUAL AVERAGE SO_2 IMPACTS
JUNE 2007

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FIGURE No. 5.1-8
KELTIC PETROCHEMICALS INC.
MAXIMUM 24-HOUR TSP IMPACTS
JUNE 2007

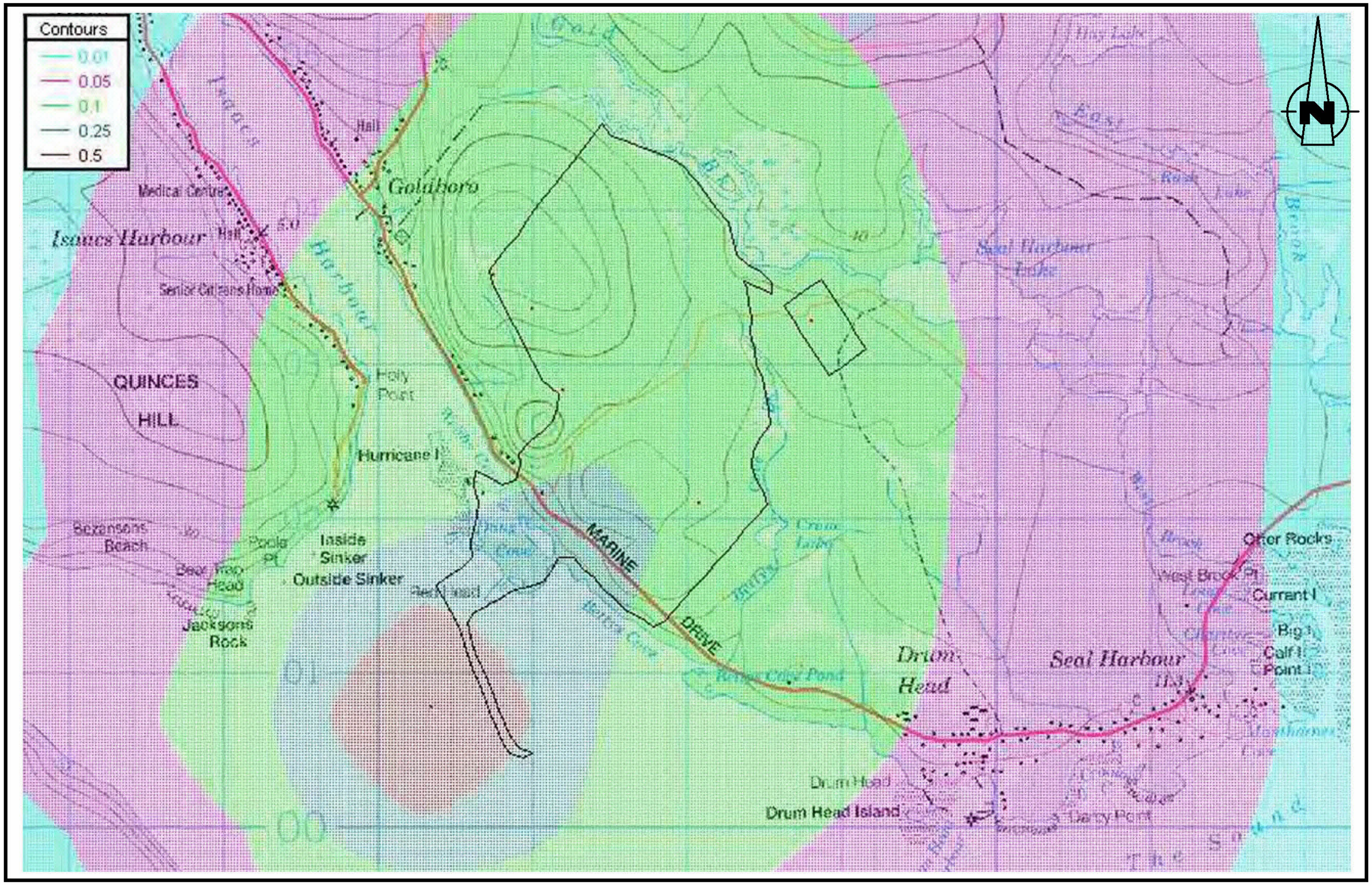

FIGURE No. 5.1-9
KELTIC PETROCHEMICALS INC.
ANNUAL AVERAGE TSP IMPACTS
JUNE 2007

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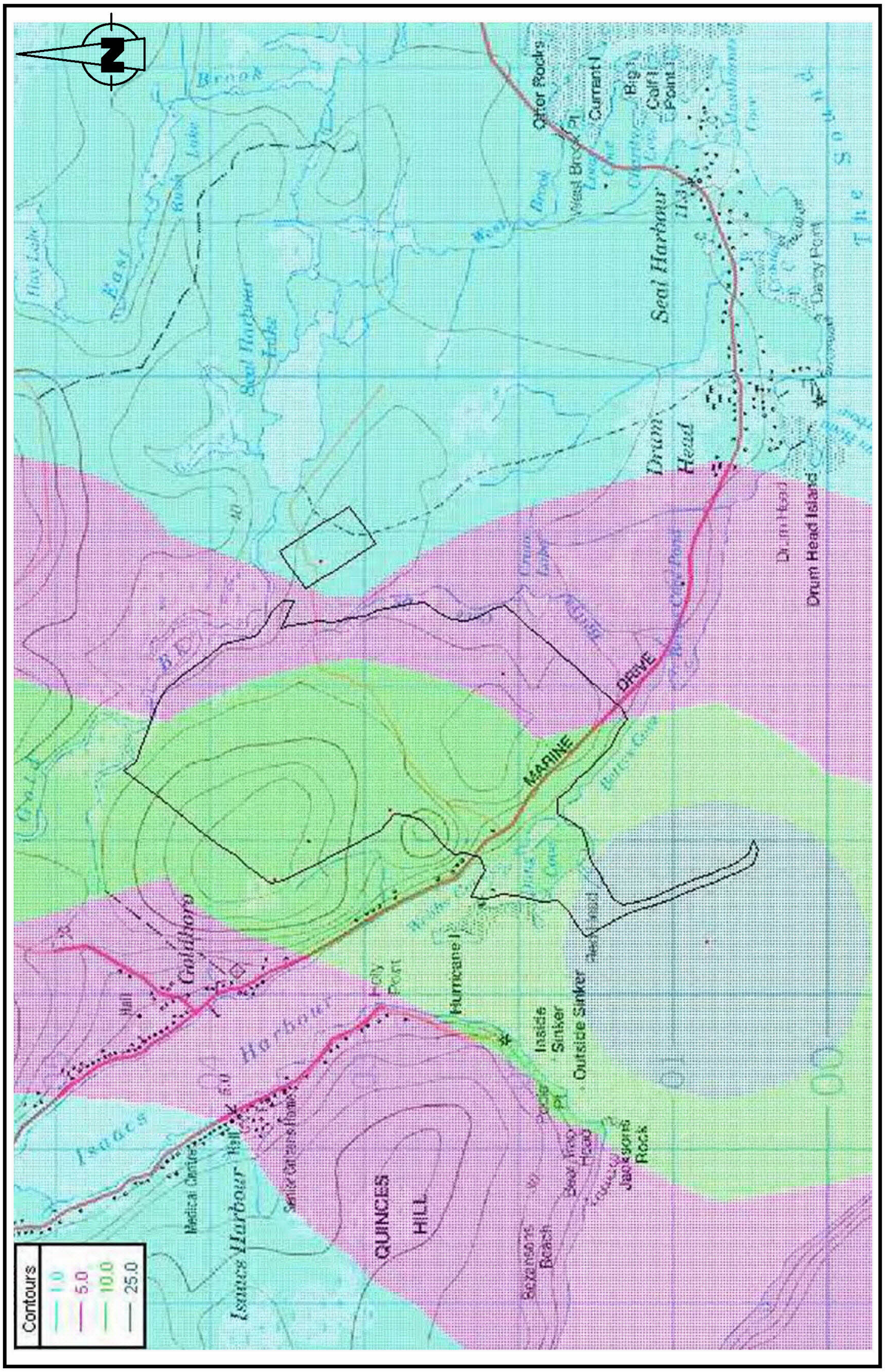

FIGURE No. 5.1-10
KELTIC PETROCHEMICALS INC.
MAXIMUM 1- HOUR CO IMPACTS
JUNE 2007

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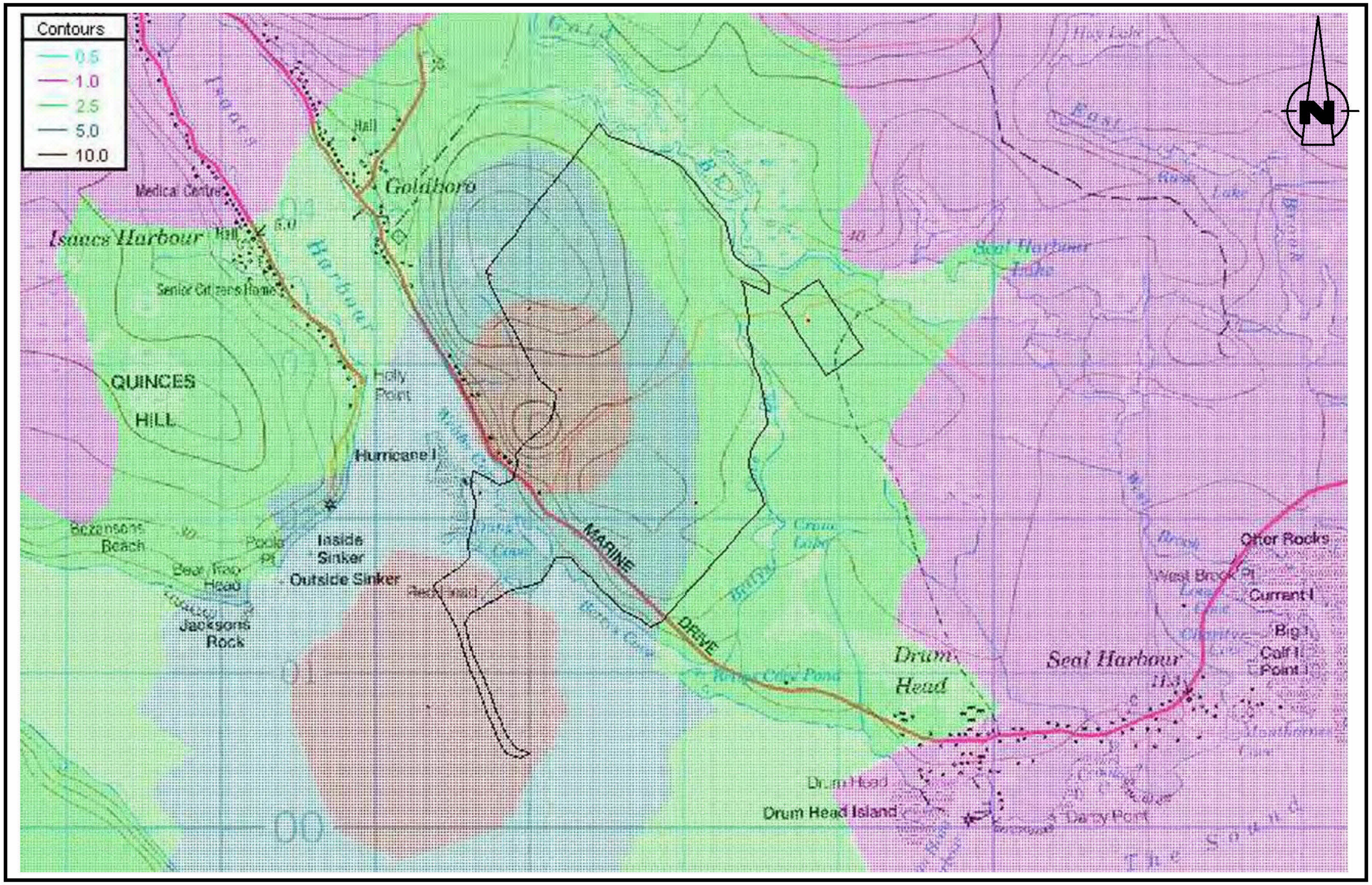

FIGURE No. 5.1-11
KELTIC PETROCHEMICALS INC.
MAXIMUM 8- HOUR CO IMPACTS
JUNE 2007

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This compares to the GHG emission estimate for NS for 2004 of 22,978,000 tonnes (Government of Canada http://pubmap.on.ec.gc.ca/cwc2_22/cesicwc2.php?LANGUAGE=en-CA&service=VCG&request=GetApplication&version=0.1.0&LANGUAGES=en-CA,fr-CA&TEMPLATES=http://pubmap.on.ec.gc.ca/cesi/templates/index.php?query=ghg-c-6-2006-en-s,http://pubmap.on.ec.gc.ca/cesi/templates/index.php?query=ghg-c-6-2006-fr-s)

Modifications and Decommissioning

Air quality related impacts associated with the decommissioning of the facility will be similar to construction.

5.1.6.2 Mitigation Measures and Monitoring

Construction

Dust control techniques will include watering and/or chemical stabilization of potential dusty sources. Other techniques that will be used to control fugitive dust emissions include covering materials being hauled from the site by truck, employing routine washing of trucks, cleaning the area around stored materials, and covering stored materials (if possible). If a concrete batch plant is located within the KDP's boundary, dust emissions from anticipated concrete batch plant operations will also be mitigated through the use of enclosures, hoods, shrouds, and water sprays. Gaseous emissions from construction equipment are mitigated by requiring regular maintenance of equipment and by maintaining speed restrictions. Background VOC monitoring will be undertaken pre-construction, and pre-operation.

Typically, in rural settings, air emissions, in particular dust, are not monitored during construction. If concerns are expressed on site related to occupational health and safety, portable PM_{10} monitors may be used for real time measurements of PM by field inspectors. If concerns are expressed regarding dust levels off-site, Keltic may elect to employ high-volume samplers to determine particulate levels at specific receptors.

Operation and Maintenance

It is anticipated that the KDP's operational air emissions will not result in exceedances of the provincial and CCME ambient air quality objectives/regulations. This will be confirmed through monitoring programs described in the following section. Air emissions from the LNG facility will mainly concern NO_x, CO, and C_xC_y (unburned hydrocarbons) caused by flue gas combustion in the submerged combustion vaporizers. To suppress the NO_x emissions, the submerged combustion vaporizers will be fitted with low NO_x burners. As process design progresses, the Proponent will take all practical measures to further reduce the air emissions discussed above, including both energy efficiency measures and improvement in emission-control technologies.

As outlined in the NSEL Terms and Conditions for Environmental Approval, under Point 2.3, a project air monitoring program will be developed. Based upon the results of the air monitoring program, necessary modifications to mitigation plans and/or operations will be implemented to prevent unacceptable environmental effects. The siting of the air monitoring stations for the air monitoring program will be based on the location of sensitive receptors, air dispersion modelling results, and meteorological data. Background VOC monitoring will be undertaken pre-construction, and pre-operation. An operational VOC monitoring program will be designed taking into account the dispersion modelling results for speciated VOCs.

Also, as outlined in the NSEL Terms and Conditions for Environmental Approval, condition 1.1 includes the requirement for a GHG Management Plan. The plan is to include an accounting of all anticipated GHG emissions, GHG monitoring and reporting protocols, GHG management and reduction targets over the life of the project, and plans for the use of best management practices.

For information on monitoring programs for the KDP outside the scope of this document, please refer to Section 13.1.2 of the Provincial EA Report (AMEC, 2006).

Modifications and Decommissioning

Mitigation recommended for construction is sufficient for decommissioning.

5.1.6.3 Residual Effects

It is anticipated that air emissions from the KDP will not exceed the ambient air quality objectives and/or regulations.

Construction

Provided the proposed mitigative measures are implemented, the environmental effects will be low in magnitude, reversible, and temporary. Therefore, no significant adverse residual environmental effects on air quality are likely to occur.

Operation and Maintenance

The effects on air quality caused by the operation of the plant are not expected to be significant with the implementation of the mitigation measures. The site is fairly isolated from the public and the effects of air emissions are expected to be not significant at off-site locations. Effective emission control measures will be employed at all identified emissions sources and will ensure that concentrations of air emissions remain within applicable government standards and guidelines. Air dispersion modelling and monitoring will be done as required by NSEL EA Terms and Conditions 1.4 and 2.3; and a GHG Management Plan will be prepared as required by condition 1.1. The modelling will include expected size, configuration, and fuel types.

Modifications and Decommissioning

Provided the proposed mitigative measures are implemented, no significant adverse residual environmental effects on air quality are expected.

5.1.6.4 Follow Up

As outlined in the NSEL Terms and Conditions for Environmental Approval, under Point 2.3, a project air monitoring program will be developed.

5.1.7 Climate Conditions

Climate change has been clearly linked to emissions of GHG. KDP-related GHG emissions, climate conditions and climate change are discussed in the context of air quality, please refer to Section 5.1.6.

5.1.8 Vegetation (terrestrial and marine)

5.1.8.1 Environmental Effects Prediction

Construction

The CSR assumes that most of the vegetation within the Project footprint will have to be removed as a result of site development work (see Figure 4.2-2 for affected vegetation types and Project footprint). The Project as defined by the scope of the CSR will affect the vegetation on Red Head only along a narrow corridor. The construction of the (above ground) marine pipeline will lead to the removal of the existing vegetation type (mapped as "Old Agricultural Fields" – see Figure 4.2-2). It is of note that the overall KDP will affect other vegetation beyond the pipeline corridor over Red Head peninsula. This is beyond the scope of the CSR and has been addressed in the provincial EA (AMEC, 2006).

Habitat disturbance from Project-related construction activities will result in the reduction of local forest habitat by approximately 149 ha. Also, clearing may expose the forest profile in adjacent areas, altering wind, temperature, and light regimes resulting in some die-off and reduced growth until edge vegetation matures.

Emissions may have an adverse effect on local vegetation nearby due to dust on leaf surfaces which may have a temporary inhibiting effect on the processes of photosynthesis and transpiration (Farmer, 1993).

A timber evaluation conducted by Scott and Stewart Forestry Consultants Ltd. (2003) indicated that the majority of the forest stand at the site is immature, and has not reached commercial size (i.e., small diametre stems and low merchantable volume). Therefore clearing at the site and inhibited growth due to emissions in nearby forest areas is expected to have minimal effects on forestry.

Construction of the Project Site will likely encourage colonization of non-native plants, as has already occurred on the site to some degree (see Section 4.2.1). These may include invasive species (such as purple loosestrife) that could spread off site into adjacent natural areas, displacing native habitat.

The LNG facility will not impinge on any marine vegetation. However, the jetty and LNG Marine Terminal will displace a minimal amount of habitat. The habitat in the vicinity of the proposed Project facilities comprises three basic types: rock and kelp; eelgrass and sand; and sand and mud. Based on video transects, the area to be occupied by the jetty associated with the LNG Marine Terminal is located in deeper water (>12 m) and characterized as having sand and mud bottom.

Operation and Maintenance

No interaction between the Project's operation and terrestrial vegetation has been identified.

There is potential for disturbance to marine vegetation as a result of propeller wash from tankers and delivery ships.

Modifications and Decommissioning

Adverse effects on terrestrial vegetation would be similar to the Construction phase however much smaller in scale as no vegetation clearing is expected. Instead, a beneficial effect is anticipated since abandoned/ decommissioned portions of the Project Site may be re-habilitated and revegetated.

No effects to marine vegetation are anticipated during the decommissioning of the facility.

5.1.8.2 Mitigation Measures and Monitoring

Construction

The mitigation measures for use during the Project operation are primarily intended to address potential effects related to the new infrastructure and to human presence and activities. To prevent the establishment of non-native vegetation the following mitigation measures will be implemented:

- do not allow disturbed soil to be exposed for longer than necessary;
- store and return top soil to sites to be landscaped, before new planting;
- use native species (i.e., species that occur naturally in the Project Area) as much as possible; and
- in some cases, pioneer species may be needed for ground cover and erosion control, but these should be short-lived successional species that eventually give way to planting and natural seeding of native species.

All temporarily used sites that have seen habitat removal should be rehabilitated.

Mitigation for emissions is discussed in Section 5.1.6. In compliance with NSEL EA approval conditions (NSEL, 14 2007) (Item 2.7), the Proponent will also implement a wildlife and vegetation monitoring plan during Project realization. This plan will provide details on effects levels and the effectiveness of vegetation rehabilitation, where applicable.

Operation and Maintenance

No mitigation is recommended for terrestrial vegetation. See comment on vegetation monitoring under "Construction." To mitigate against the effects of propeller wash on marine vegetation large vessels will be berthed with the support of tugs.

Modifications and Decommissioning

Mitigation for effects on terrestrial vegetation would be similar to the construction phase above.

5.1.8.3 Residual Effects

Construction

Given the type of vegetation involved (mostly clear-cut brush and barrens, old agricultural fields, some conifer stands), and the presence of large tracks of land adjacent to the Project Site, the residual effects on vegetation are considered not significant.

Operation and Maintenance

No effects are predicted.

Modifications and Decommissioning

The environmental effects are expected to be low in magnitude, reversible and be within the Project Site (Table 6.1-7, Section 6.0). Therefore, no significant residual effects on vegetation are likely to occur during modifications and decommissioning.

5.1.8.4 Follow Up

As mentioned under mitigation, in compliance with NSEL EA approval conditions (NSEL, 14 2007) (Item 2.7), the Proponent will implement a wildlife and vegetation monitoring plan during Project realization. This plan will provide details on effects levels and the effectiveness of vegetation rehabilitation, where applicable.

5.1.9 Species at Risk

5.1.9.1 Environmental Effects Prediction

Construction

A single rare plant species – a horsetail (*Equisetum variegatum*) was found on the plant site near the junction of Sable Road and Highway 316. This site possibly could be disrupted during construction, but proposed plans suggest this is not likely. A large population of this species is at Gold Brook Lake, and it probably is in other neighbouring areas with similar habitat places as well.

It has been suggested by the Protected Areas Branch of the Nova Scotia Government that the Endangered (COSEWIC, 2005) boreal felt lichen (*Eriodermea pedicellatum*) may be in the Study Area. The site is in the historical range of this small lichen. However, the likelihood of this lichen being in the Study Area is remote, since it is thought to be very sensitive to forestry activity; which has been extensive in the Project Site. It is known from only two small and relatively distant areas in the province; therefore, the occurrence of this species within the site would be a highly significant population.

The roseate tern colony on Country Island is listed as endangered on Schedule 1 of SARA, and as red by the NSDNR. There is potential for construction to affect the foraging of roseate tern individuals. Although no foraging sites are known to be located within or adjacent to the marginal wharf location, one individual roseate tern was observed flying near the shore of the south terminal area. The closest documented foraging site is located approximately 2 km from the Project Site, on the shore of Harbour Island. The Roseate Tern Recovery Plan (Environment Canada, 2006) identifies the need for further research on foraging habit and indicates that foraging habitat may be considered as "critical habitat" in the future.

Pipeline construction is planned to occur on the beach and dike at Dung Cove. In 2005, a greater yellowlegs was observed exhibiting breeding behaviour on the cobble beach adjacent to the eastern side of Dung Cove. The habitat at Dung Cove is not typical breeding habitat for the species. Typically the greater yellowlegs nests on the ground, in boggy coniferous areas characterized by black spruce and larch trees with abundant clearings. Erskine (1992) states that a characteristic of this species is to be noisy and appear agitated during all seasons. Therefore, during the Breeding Bird Survey reported in Erskine (1992) sightings of this species along the coast and in habitats other than forest bogs were not included as breeding bird observations. Greater yellowlegs nest in early June, and the chicks fledge by the end of July. Fall migration peaks in late August, early September. Greater Yellowlegs are known to be particularly sensitive to human disturbance and noise and are prone to abandon nests as a result.

Mainland moose (endangered) are not known to be in the direct vicinity of site, and field surveys of the area indicated no evidence of moose, so the probability of interaction with this component of the Project is low.

The LNG facility will not impinge on any marine species at risk. Adverse effects to marine species are possible due to the degradation of the marine environment through fuel spills during the construction, operation and decommissioning of the facility. These effects and the relevant mitigation have been presented in Section 10.0.

Operation and Maintenance

Disturbance of Greater Yellowlegs may occur due to maintenance activities at the pipeline.

No adverse environmental effects are anticipated as collisions of roseate terns with the marine terminal are unlikely to occur. These species are agile flyers and very rarely collide with large stationary objects such as lighthouses, bridges, light poles, communication towers or with large moving objects such as ships, even when they are brightly lit (Hatch and Kerlinger, 2004).

Adverse effects to marine species are possible due to the degradation of the marine environment through accidental fuel spills during the operation of the facility. The potential effects and mitigation for accidental events are presented in Section 10.0.

Modifications and Decommissioning

Disturbance of Greater Yellowlegs may occur due to modifications and/or decommissioning of the pipeline.

Adverse effects to marine species are possible due to the degradation of the marine environment through accidental fuel spills during the operation of the facility. The potential effects and mitigation for accidental events are presented in Section 10.0.

5.1.9.2 Mitigation Measures and Monitoring

Construction

Prior to site clearing, field surveys for species at risk (including boreal felt lichen) will be conducted in targeted habitats with high potential to support species at risk in order to identify the presence of any such species within the Project footprint. If any species at risk are identified, site specific mitigation will be developed in consultation with regulatory agencies; which could include protection/avoidance of specific areas, relocation/transplantation of species at risk, and/or Project design modifications.

To prevent the loss and/or disturbance of rare plants (i.e., *Equisetum variegatum*), a buffer zone will be flagged around these plant location(s) to keep construction activities away; otherwise plants will be transplanted to a site with similar conditions. The buffer zone size will be developed in consultation with NSDNR. The impacts on vegetative communities are expected to be minimized.

In order to prevent disturbance to the seabird colony, particularly the roseate tern on Country Island, the following will be followed:

- No ships will approach within 200 m of the island (as per the Roseate Tern Recovery Plan), unless in an emergency situation. The final location of the shipping lanes will be determined through TC's TP 1802 Routing Standards.
- No garbage is to be tossed overboard from any Project related vessel.
- All garbage is to be properly disposed (i.e., as per municipal regulations) of in closed containers in order to avoid the attraction of predators (i.e., gull species and other scavengers) to the area.

As a component of NSEL Condition 2.7, the Proponent is committed to prepare an Adaptive Management Plan (AMP), consisting of various elements acceptable to EC and NSDNR, as well as a spill response plan. Based on consultations with NSDNR and CWS, the proponent will present specific details of the plan in a draft format to NSEL for evaluation and further consultations, as necessary. The plan will include:

- A program for monitoring tern foraging activities prior to construction of the marginal wharf and LNG receiving terminal will be implemented. Such monitoring will entail land and boat-based surveys of the area throughout the upcoming breeding season (May 1 to August 31) so as to enhance current understanding of the spatial and temporal patterns of tern use of foraging habitats. The results of this upcoming season's monitoring will be used to develop mitigation measures for the construction, operation, and decommissioning phases of the project.
- Provisions for submission and review of monitoring results with Environment Canada and Nova Scotia Department of Natural Resources to allow for verification of ongoing

monitoring needs that the Proponent would be required to implement for all phases of the Project. Implementation of such monitoring will be necessary for the identification of project-related interactions and in evaluating any cumulative effects.

- A detailed description of the technically and economically feasible measures that may be necessary so as to avoid or minimize adverse effects should the potential for adverse interactions with terns be detected at any stage during the monitoring program. Such actions could include adjustments to the scheduling of certain construction and project-related activities in the vicinity of tern foraging habitats.
- A commitment to work with other stakeholders in the Country Harbour area to monitor and manage potential cumulative effects on the Roseate Tern. It is recognized that this could entail participation in an area-wide, multi-stakeholder committee that is formed to advance recovery strategy objectives. As another example, and subject to timing considerations, tern monitoring efforts will be coordinated with the Deep Panuke tern monitoring program.

In order to minimize effects on potential nesting by Greater Yellowlegs in the Dung Cove area, avoid construction, maintenance activities at the pipeline during the sensitive nesting period (June to August).

The mitigation relevant to accidents and malfunctions has been provided in Section 10.0.

<u>Operation and Maintenance</u>

The mitigation presented for the construction phase is identical for the operations and maintenance as well.

<u>Modifications and Decommissioning</u>

The mitigation presented for the construction phase is identical for modifications and decommissioning as well.

5.1.9.3 Residual Effects

Provided the proposed mitigative measures are implemented, the environmental effects will be reversible and have a low to medium magnitude. Therefore, no significant adverse residual environmental effects on species at risk are likely to occur.

5.1.9.4 Follow Up

A vegetation monitoring program will be established to check the success of replanting and habitat restoration programs, where applicable. These will be done for three consecutive years, at least twice per year in late May-early June and again in late August. Appropriate restorative plantings will be done shortly after these inspections.

As outlined in the NSEL Terms and Conditions for Environmental Approval, under Condition 2.7, a project wildlife and vegetation monitoring program will be developed in consultation with NSDNR and CWS. An AMP for the Roseate Tern will be prepared and implemented as per Section 5.1.9.2.

5.1.10 Fish and Fish Habitat (marine and freshwater)

5.1.10.1 Environmental Effects Prediction

<u>**Construction**</u>

<u>Freshwater</u>

Construction of the LNG facility will potentially interact with two watercourses, Betty's Cove Brook and the unnamed tributary to Dung Cove. The footprint of the Project does not impinge on any part of Betty's Cove Brook. There will be a minimum 15 m setback between the on-site reaches of this watercourse and any Project-related infrastructure. There will be periodic storm-water discharges to Betty's Cove Brook from one or more storm-water ponds during plant site construction and operation (see Section 5.1.2). While minor sediment and erosion events may be reversible, heavy precipitation events may lead to scouring, which has the potential to alter freshwater fish habitat. The storm-water ponds will be sized and managed to meet or exceed relevant provincial storm-water quality and quantity objectives. As such, the potential effects on fish and fish habitat in Betty's Cove Brook are expected to be minor.

A small first-order tributary is located a short distance east of the SOEI gas plant road. It appears to be spring fed, and from its origin, flows generally southward to where it crosses the existing highway and discharges to the largest pond on the Red Head peninsula. No fish were observed in this drainage feature during any Keltic survey, and no aquatic "species of concern" are associated with this tributary. The footprint of the Project does not impinge on any part of this tributary and will have no discharge of any kind to this watercourse. As such, the construction of the Project will not have any effect on the aquatic biota or habitat in this tributary.

<u>Marine</u>

The LNG facility will not impinge on any marine species. However, the LNG Marine Terminal will displace a minimal amount of habitat. The habitat in the vicinity of the proposed Project facilities comprises three basic types: rock and kelp; eelgrass and sand; and sand and mud. Based on video transects, the area to be occupied by the LNG Marine Terminal is located in deeper water (>12 m) and characterized as having sand and mud bottom. This habitat is of most value to lobster and sea urchins, two species that are fished in the area. Lobster is the principal commercial species fished in the area.

Past surveys have shown that the area of fish habitat in the eastern part of Stormont Bay is relatively consistent between the proposed Project facilities and Harbour Island – a mix of rock, boulder, kelp, and patches of sand. In deeper areas, outside Country Harbour Head and past Harbour Island, habitat is patchier, related primarily to water depth and substrate.

There is potential disturbance to kelp, eel grass, and other habitats as a result of propeller wash from tankers and delivery ships.

Adverse effects to marine species are possible due to the degradation of the marine environment through fuel spills during the construction, operation and decommissioning of the facility. These effects and the relevant mitigation have been presented in Section 10.0.

Operation and Maintenance

Freshwater

As discussed in Section 5.1.2, at the Project Site, all wastewater will be collected and treated to applicable government standards and objectives prior to discharge to the environment. The discharge quality will be monitored in order to verify the effectiveness of the treatment.

Marine

Adverse effects to marine species are possible due to the degradation of the marine environment through fuel spills during the operation of the facility. These effects and the relevant mitigation have been presented in Section 10.0.

Modifications and Decommissioning

Adverse effects to fish and fish habitat during the decommissioning phase include potential for the accidental release of contaminants to the environment.

5.1.10.2 Mitigation Measures and Monitoring

Construction

Freshwater

Please refer to the mitigation described in Sections 5.1.1 (Hydrology) and 5.1.2 (Freshwater Quality/Quantity), as they are also valid for the protection of freshwater species and their habitats. In addition, refer to Section 10.0 (Hazardous Material Spills) for impacts on freshwater species and habitat (more specifically the impacts of accidental spills on freshwater environments).

Marine

To mitigate against adverse effects to fish habitat due to propeller wash large vessels will be berthed with support of tugs. No sediment contamination has been identified in the area.

It is of note that the Proponent will also undertake further baseline work and effects predictions relevant to fish and fish habitat (both freshwater and marine). In compliance with the NSEL EA approval conditions (Item 1.10) the work will entail baseline data collection for all relevant chemical parameters which are expected to enter the environment or be remobilized as a result of Project activities in all receiving environments (including freshwater and marine environments). Baseline data and information will then be used by the Proponent to predict the assimilative capacity of all receiving environments and assessments of potential effects and/or risks on human health and organisms (including freshwater and marine biota).

In accordance with Item 1.5 in the NSEL EA approval conditions (NSEL, 2007), a plan to mitigate the human health and environmental impacts of the contaminated mine tailings and/or soils and sediments on the Project Site, via remediation or risk management will be developed and implemented. This plan will be consistent with the Nova Scotia Guidelines for the

Management of Contaminated Sites. The Remedial Action Plan and/or Risk Management Plan will be approved by NSEL prior to commencement of construction. Upon completion of the remediation or risk management work, including any required monitoring, Keltic will submit a Certificate of Compliance to NSEL to demonstrate that the remediation work has been completed and/or the Risk Management Plan is effective (NSEL, 2007).

Operation and Maintenance

Minor changes in sediment type and quality near proposed shoreline facilities are anticipated as a result of wave and current action. Changes in terminal design, however, may be required as part of the federal permitting process. Once design has been finalized, modeling will be carried out in more detail to assess potential changes in substrate and a monitoring program will be developed if required.

The mitigation presented for the construction phase is also sufficient for the operation and maintenance of the LNG facility.

Modifications and Decommissioning

Mitigation presented for the construction phase will be sufficient for the decommissioning the LNG facility.

5.1.10.3 Residual Effects

Construction

Freshwater

Provided the proposed mitigative measures are implemented, the effects on water courses due to erosion, sediment loading, and storm-water discharges will be low in magnitude and reversible. Therefore, no significant adverse residual environmental effects on fish and fish habitat are likely to occur.

Marine

The small amount of fish habitat lost as a result of the construction, operation, and decommissioning phases of the Project would not result in a significant impact on fish resources in the area. None of the habitat lost is in anyway unique to the Bay, nor does it provide a critical function to the ecosystem. The loss of production of lobster, and other fish species, would be minimal when compared to local variations in environmental factors such as water temperature and larval drift into the area. Provided the proposed mitigative measures are implemented as suggested, no significant adverse residual environmental effects on fish and fish habitat are likely to occur.

5.1.10.4 Follow Up

Construction

Freshwater

The following measures will be implemented to ensure mitigation measures are effective. Fish communities in Betty's Cove Brook and the unnamed tributary to Dung Cove will be surveyed by electro-fishing and the sediment/erosion control measures at each on-site watercourse will be inspected and/or monitored during the pre-construction period. During the construction period annual fish community surveys (electro-fishing) in all on-site watercourses will be undertaken and annual description/photographs of aquatic and riparian habitat at established representative locations will be prepared. In addition, annual reports to present results of the erosion-control monitoring and the annual fish surveys will be prepared and compared with the results (species presence, composition, etc) of previous years.

Marine

In the event that DFO requires a HADD Authorization for the LNG Marine Terminal, prior to implementation of a habitat compensation project, additional physical assessment of the area will be required. Monitoring of the habitat compensation program will be carried out to document the success of the Project. The program will be developed in consultation with DFO.

Operation and Maintenance

The following measures will be implemented to ensure mitigation measures are effective. Fish-community surveys will be undertaken in all on-site watercourses for post-construction years 1, 2, 3 and 5, and every 5 years thereafter, if required. The aquatic/riparian habitat will be described and/or photographed at established representative locations on all on-site watercourses for post-construction years 1, 2, 3 and 5, and every 5 years thereafter. Reports on results of the annual habitat and fish surveys will be prepared and compared with results (species presence, composition, etc) of previous years.

See above "Mitigation Measures" for description of follow up work in response to NSEL EA approval conditions.

Modifications and Decommissioning

No follow up monitoring has been developed at this time. Monitoring will be prepared in compliance with the regulations in place at the time of decommissioning.

See above "Mitigation Measures" for description of follow up work in response to NSEL EA approval conditions.

5.1.11 Marine Mammals

5.1.11.1 Environmental Effects Prediction

Construction

Noise that can be heard by marine mammals can be generated from construction associated with the LNG Marine Terminal, in particular, noise related to driving piles. Source levels have been shown to range from 131 - 135 decibel referenced to 1 microPascal (dB re 1 μPa) up to one kilometre from the source (Richardson et al, 1995 in Hammond et al, 2005) however there are no available data on the effects of pile driving on marine mammals (Hammond et al, 2005). At 358 m from pile driving, sound pressure levels were found to be 179 dB (decibels) at 6 m depth (Caltran, 2001). For Incidental Harassment Authorizations, the NMFS has been known to establish preliminary safety zones that have a 500 m radius around pile driving sites. These safety zones include all areas that are expected to exceed 190 dB re 1 μPa root mean square (RMS).

Construction-related adverse effects on marine mammals are possible. The NMFS has suggested that sound pressure levels that exceed 190 dB re 1 μPa may cause threshold shifts or temporary hearing impairments in marine mammals. Research on marine mammals shows that under certain circumstances underwater noise can cause a variety of effects. This includes behaviour modifications, tissue rupturing or haemorrhaging at close range to the acoustic source, and temporary or permanent hearing loss. In addition new noise sources can mask other sounds important to survival, such as those made by calves, mates, or predators (Richardson, 1995).

Stormont Bay is not particularly important in relation to marine mammals. Marine mammals appear to be transitory. Seals may haul out on the shoreline and small whales may enter the area to feed, following schools of herring and mackerel.

Adverse effects to marine mammals are also possible due to the degradation of the marine environment through fuel spills during the construction, operation and decommissioning of the facility. These effects and the relevant mitigation have been presented in Section 10.0.

Operation and Maintenance

During the operation of the Project, vessel traffic is expected to increase. 83% of the underwater acoustic field surrounding large vessels is the result of propeller cavitation (Southall, 2005). Noise from vessels may contribute to masking of sounds important to the survival of mammals. However, marine mammals have been known to adapt to masking sounds by changing the intensity and frequency of their vocalizations.

Stormont Bay is not particularly important in relation to marine mammals. Seals may haul out on the shoreline and small whales may enter the area to feed, following schools of herring and mackerel.

Modifications and Decommissioning

Adverse effects to marine mammals during the decommissioning phase include potential for the accidental release of contaminants to the environment.

5.1.11.2 Mitigation Measures and Monitoring

Construction

To minimize the effects of noise on marine mammals during construction of the jetty and the LNG Marine Terminal, the following mitigation will be applied as required:

- work at low tide;
- the use of ramped warning signals;
- the use of bubble curtains to mask the noise; and
- the use of alternative techniques to pile driving such as vibratory pile driving.

The relevant mitigative measures for accidents and malfunctions have been presented in Section 10.0.

Operation and Maintenance

No mitigation of operational activities is required given the low level of marine mammal activity in the area.

Modifications and Decommissioning

Mitigation presented for the construction phase will be sufficient for the decommissioning.

5.1.11.3 Residual Effects

Construction

Given the low importance of the marine environment at the Project Site for marine mammals, and the implementation of the proposed mitigative measures identified above, no significant adverse residual environmental effects on marine mammals are likely to occur.

Operation and Maintenance

Given the low importance of the marine environment at the Project Site for marine mammals, and the implementation of the proposed mitigative measures identified above, no significant adverse residual environmental effects on marine mammals are likely to occur.

Modifications and Decommissioning

Given the low importance of the marine environment at the Project Site for marine mammals, and the implementation of the proposed mitigative measures identified above, no significant adverse residual environmental effects on marine mammals are likely to occur.

5.1.11.4 Follow Up

No follow up monitoring is required.

5.1.12 Wildlife and Wildlife Habitat

5.1.12.1 Environmental Effects Prediction

Habitat removal may result in loss of associated wildlife. Those forms that can move easily may move to similar habitats elsewhere. Successful survival may depend on the number of individuals of the same or closely related species already in those habitats. There is potential for some loss of the wildlife currently inhabiting the site areas.

Construction

Habitat removal during the breeding season for vertebrate wildlife, roughly April through July, can have adverse effects on wildlife populations. Impact on small mammals is mainly related to loss of habitat. The main impact on raptors would be removal of prey habitat on both sides of Highway 316. The tank storage and pipe rack portion of the Project will remove approximately 20% of the existing amphibian and reptile habitat available on the LNG Project Site, and 50% of the deer wintering habitat.

Birds may be affected by noise from construction activities. Flushing of nesting birds may result in decreased productivity from such factors as increased nest predation and changes to less favourable nesting sites (Interior Waste Authority, 1994). The data regarding effective distance due to noise disturbance are relatively few and conflicting, with various field studies showing effects from edge of area of disturbance to 200 m. The distance of effect is of course related to noise volume and quality. The effects of noise on the site due to construction are expected to be short-term.

Pipeline construction is planned to occur on the beach and dike at Betty's Cove. This is important habitat for resident shorebirds. Great blue herons were noted in this area during field surveys; however no heronry was noted in the area. A heronry is reported to exist in the Gold Brook Lake wetland area, over 1 km from the Project Site.

Operation and Maintenance

Amphibians are likely to be affected, other than by habitat removal, only if drainage patterns are changed and/or if there is a significant change in water quality from operational procedures. Increased human activity will have a depressing effect on most mammal populations that remain after construction. An exception to this may be with bats, the foraging potential of which may be increased by concentrations of insects attracted to lights. Increased human activity may encourage some animals such as raccoons and skunks.

There is expected to be an increase in birds that are especially compatible with human activity; i.e. starlings, robins, grackles, cowbirds, rock doves, some of which are nest predators and may otherwise compete with woodland and edge birds. Birds are likely to undergo some mortality by collision with lighted towers and other structures. This is of particular concern with migratory birds therefore it is addressed separately in Section 5.1.13.

Modifications and Decommissioning

As mentioned in construction, noise from decommissioning activities may have an effect on birds during the breeding season. The effects of noise on the site due to decommissioning are expected to be short-term.

5.1.12.2 Mitigation Measures and Monitoring

Construction

The development of the proposed Project will involve the removal of much of the existing vegetation as well as the displacement of most of the associated wildlife. The mitigation measures proposed for this phase and location of the Project focus on minimizing the clearing area where possible, the use of effective ESCs, and the stabilization and re-vegetation of disturbed areas on the site.

Mitigation measures will include:

- clear vegetation outside the April through July time frame of vertebrate animal reproduction;
- minimize area cleared where possible;
- avoid clearing in deer wintering areas when the snow conditions are such that deer would be utilizing the area;
- progressive removal of habitat, as required, vs. clearing the entire area at once;
- use proper maintenance procedures regarding building materials, slash, litter, etc;
- try to preserve the most sensitive sites;
- ensure that all equipment has appropriate noise-muffling equipment installed and in good working order;
- conduct routine noise monitoring at the site boundaries as appropriate; and
- clear vegetation outside of bird nesting season (May 1 through August 1).

Construct the LNG pipeline along Dung Cove outside of the sensitive nesting season for the greater yellowlegs (i.e., outside of the June through July timeframe).

A monitoring program to assess wildlife populations will be established prior to commissioning and will continue 3 to 5 years following commissioning. The surveys will be carried out at appropriate times of the year as shown in Section 7.0 Table 7.2-2.

Evidence of wildlife presence and activity, and vegetation condition requiring attention, will be monitored during the surveys.

Operation and Maintenance

Proper maintenance procedures, including measures to eliminate garbage, should be followed everywhere on the Project Site to discourage the attraction of animals.

New vegetation should be established as comprehensively and as soon as possible to restore habitat for birds. New buildings should be constructed without ledges to prevent rock dove nesting.

The Proponent will initiate a monitoring program which will consist of sampling noise levels over a 24-hour period following commissioning. Noise sampling will be conducted quarterly and the results evaluated on an annual basis or following process or equipment changes. This will include monitoring of ship noise, vehicle movement, heavy equipment operations, emergency operations, and normal operating modes.

Modifications and Decommissioning

Mitigation presented for the construction phase will be sufficient for the decommissioning the LNG facility.

5.1.12.3 Residual Effects

Provided the proposed mitigative measures are implemented, the environmental effects are predicted to be low in magnitude and reversible. Therefore, no significant adverse residual environmental effects on wildlife and wildlife habitat are anticipated.

5.1.12.4 Follow Up

No follow up monitoring for has been developed.

5.1.13 Migratory Birds and Migratory Bird Habitat

5.1.13.1 Environmental Effects Prediction

Construction

As with terrestrial wildlife, the environmental effect of concern is the removal of migratory bird habitat from the LNG facility site and disturbance to migratory birds as a result of noise during construction. The effects discussed in Section 5.1.12.1 are applicable for migratory birds and habitat.

Operation and Maintenance

Migratory birds use a variety of navigational cues for finding their way between breeding and wintering sites. Some species are genetically predisposed to fly in a certain direction for a certain amount of time. Other species may use the angle of the setting sun (and the pattern of polarized light created), land features such as mountains and rivers, or wind direction.

Birds that travel by night or over vast ocean distances, such as warblers, swallows and thrushes, use a combination of star patterns, geomagnetic field, and polarized light for orientation. This makes them particularly susceptible to disorientation caused by man-made light, especially under overcast or foggy weather conditions (Evans Ogden, 1996). Birds that are not killed outright by collisions with the light sources can succumb to exhaustion brought upon by prolonged fluttering around a light source or to predation upon individuals in weakened states (Evans Ogden, 1996).

Migratory birds are likely to undergo some mortality by collision with lighted towers and other structures. These types of lights may impact upon migrating birds; however, the extent of the impact cannot be forecasted at this stage. The number of birds killed may vary from a large number per night in collision with high towers (Ornithological Council, 1999) to only a few striking household windows. Klein (1990) indicated that collision with household windows, in one instance, resulted in 26-33 birds being killed annually, and that greater than one-half of bird strikes at lighted windows were fatal. Johnston and Haines (1957) recorded thousands of bird-lighted-object deaths in Georgia; most if not all species they reported have been observed in the Project Study Area. Mortality is greatest with lighted towers (i.e., 70 m in height), and less with lights near ground level.

Previous studies have suggested that migrating birds are not equally attracted to all kinds of light (Avery et al., 1976). Strobe lights have been reported to attract fewer birds for shorter periods of time than either slow flashing lights or constant sources (Baldwin, 1965). In previous studies, migratory birds have been disoriented by red light, apparently unable to use their magnetic compass and that the ability to orient under red light depends on previous exposure to the same or similar wavelengths (Wiltschko et al., 2004).

Modifications and Decommissioning

Noise from decommissioning activities may have an effect on migratory birds during the breeding season. The effects of noise on the site due to decommissioning are expected to be short-term.

5.1.13.2 Mitigation Measures and Monitoring

Construction

The mitigation presented in Section 5.1.12.2 is sufficient for migratory birds and migratory bird habitat.

Operation and Maintenance

The lighting regime for the entire Project Area will be illuminated with downward facing white lights to minimize visual disorientation of nocturnal migrants as well as diurnal species migrating in inclement weather. It is thought that this type of lighting will not attract even night migrating songbirds (Kerlinger, 2004). It is advisable not to use illuminated structures taller than 50 feet (15 m), as these have been demonstrated to disorient birds. It is further recommended that fast-blinking strobes be used when feasible. Further details on lighting will be provided in the NSEL EA Lighting Plan.

It is of note that the Proponent will generate a lighting plan, which will incorporate a program to monitor impacts to birds. This work will be undertaken by the Proponent in compliance with Item 1.6 of the NSEL EA approval conditions (NSEL, 2007). In accordance with the NSEL conditions, the plan must be submitted to NSDNR, CWS, and TC for review and approval. Based on the results of the monitoring programs, the Proponent must make necessary modifications to the mitigation plans and/or operations to prevent any unacceptable environmental effects to the satisfaction of NSEL, based on consultation with NSDNR and CWS.

The mitigation presented in Section 5.1.12.2 and Section 5.1.15.2 is also relevant for migratory birds and habitat.

Modifications and Decommissioning

Mitigation presented for the construction phase in Section 5.1.12.2 will be sufficient for the decommissioning the LNG facility.

5.1.13.3 Residual Effects

Provided the proposed mitigative measures are implemented, the environmental effects will be reversible and will have a low magnitude (Table 6.1-12, Section 6.0). Therefore, no significant adverse residual environmental effects on migratory birds are predicted.

5.1.13.4 Follow Up

No follow up monitoring is recommended for migratory birds beyond the implementation of the approval conditions established by NSEL (see note above under “Operation and Maintenance”).

5.1.14 Wetlands

Both collectively and as individual units, wetland resources serve a variety of important ecological and socio-economic functions, including the maintenance of surface and groundwater resources and quality, as well as providing habitat for fish, wildlife, and migratory bird species. The value of wetlands to society and their ecological value are derived from their biological productivity and biodiversity. Wetland functions have been defined as the capability of wetland environments to provide goods and services including basic life-support functions (Bond et al., 1992).

As of March 1, 2006, wetlands are protected in Nova Scotia by the Wetlands Designation Policy, which replaces the Wetlands Directive from 1995. Alteration of a wetland may remove or interrupt the ability of the wetland to continue to support the same level of pre-development functions.

The Federal Government is committed to wetland conservation by adopting the “Federal Policy on Wetland Conservation” that essentially requires a no net loss in wetland function. The objective is to “promote the conservation of Canada’s wetlands to sustain their ecological and socio-economic functions.” According to the “Federal Policy on Wetland Conservation - Implementation Guide for Federal Land Managers,” in some areas (where wetland loss has been severe), the further loss of wetlands will be avoided wherever possible.

5.1.14.1 Environmental Effects Prediction

Construction

The functions and values of wetlands are generally not compatible with construction activities. Spills of fuels, lubricants, and hydraulic fluids, erosion, sedimentation, and damage caused by heavy machinery can potentially result in significant impacts.

Wetlands 1 and 12 (see Figure 4.2-1) will be affected by the construction of the marine LNG pipeline from along the Marginal Wharf to the LNG Storage Tanks. The LNG pipeline will be built on a trestle, with footings that may be placed within the wetland boundary. The exact spacing of these footings is not currently designed, but will be confirmed during the FEED process. Wetland 13 will most likely be affected by Site preparation and construction related to the LNG facility.

The construction may result in some filling, excavating, and otherwise disturbance of wetlands, which in addition to some loss of wetland habitat may alter the hydrological integrity of the site.

The kinds of potential effects on wetland function include:

- alteration/displacement of habitat;
- soil erosion;
- reduction of water quality due to suspended solids in runoff;
- noise/physical disturbance of wildlife; and
- introduction of invasive plant species.

It is of note that the other wetland located on Read Head (Wetland # 4) may also be affected by the KDP. However, any such effects would be attributed to the components that are beyond the scope of the CSR but have been addressed and assessed through the provincial EA process.

Alteration/Displacement of Wetland Habitat

Wetland vegetation is the primary biological indicator of major ecological processes, their vitality, and their ability to support wildlife. Wetland vegetation abundance and diversity depend upon a variety of factors, including soil type, topography, and the hydrologic regime (Glouschenko and Grondin, 1988). The type of wetland habitat present is a major determinant of function and values within a wetland. For instance, major changes in vegetative communities, and thus habitat types, may result in a redistribution of wildlife species within a wetland (Kobriger et al., 1983). Thus, maintenance of wetland function is dependent on maintenance of habitat types within a given wetland, as defined by vegetation, soils, and hydrologic conditions.

The movement of surface water in wetlands may contribute to the character of the existing ecosystem. Cut and fill activity can inhibit, enhance, or redirect the flow of water and, in so doing, change the nature of both the established water regime and the biological community of a site (Shuldiner et al., 1979). Engineered structures in wetlands can often affect both the timing and duration of water regime fluctuations. When the changes are pronounced, they may have significant effects (i.e., alteration of vegetation assemblages) on the wetlands involved (Shuldiner et al., 1979).

A shift in wetland habitat composition (such as distribution and abundance of wetland habitat types within a wetland) is a community level effect that may result from altered water levels, and may occur to a lesser degree from changes in periodicity, or heavy sedimentation. Wetland habitat composition is a major determinant of the wildlife values a wetland affords. Major changes in the class composition of a wetland can result in redistribution of wildlife species in relation to habitat use (Kobriger et al., 1983).

Wetlands 1 and 12 will experience some alteration and displacement of habitat with the construction of the LNG marine pipeline. The pipeline will be on a trestle with only the footings in the wetland boundary to minimize the effects. Wetland 13 may also be affected by construction through infilling that would cause displacement of habitat.

Soil Erosion

Erosion and sedimentation during and following construction may affect wetlands within the Project Site. These effects may include destabilization of slopes in wetland areas, sedimentation of wetland habitat, and sedimentation of any downstream aquatic habitat.

Changes in Water Quality

The quality of wetland waters may be subject to adverse local and/or short-term effects; widespread or long-term effects on water quality are less common (Shuldiner et al., 1979). Due to the predominance of aquatic-based food chains in wetlands, water quality changes may have significant adverse effects on wetland productivity and diversity.

The proposed Project construction activity has potential to influence water quality in wetlands 1, 12, and 13. The water quality may be affected by suspended solids in runoff and accidental leakage/spillage of hazardous materials/contaminant mobilization.

Erosion and sedimentation are known to adversely affect the ecology of most aquatic systems. The severity of problems caused by suspended solids generally decreases with distance from the area of disturbance and with time after construction is completed (Shuldiner et al., 1979). Turbidity is known to have adverse effects on aquatic primary productivity, feeding, and reproductive success of higher organisms. When prolonged turbidity is experienced, significant changes in wetland function and class structure can be expected (Shuldiner, et al., 1979).

Degradation of water quality in wetlands may occur through contamination from accidental releases of hazardous materials such as leaks from construction machinery, accidental spills of fuels and lubricants, and leaching from surfacing/construction materials. The severity of the effect of these substances on wetland habitat is variable, and may be affected by water regime, precipitation patterns, topography, and the sensitivity of particular organisms to the chemical concerned (Shuldiner, et al., 1979).

Noise/Physical Disturbance of Wildlife

Due to the limited duration of construction adjacent to wetland habitat, no significant effects to wildlife as a result of noise or physical disturbance are anticipated, assuming construction time (15 months) and habitat disruption (effected area to total approximately 0.210 km^2) are minimized.

Prevention of the Spread of Invasive Species

Invasive plants are defined as those species that have moved into a habitat and reproduced so aggressively that some of the original components of the vegetative community are displaced. An alien species is one which did not originally occur in an area where it is now established, but which arrived as a direct or indirect result of human activity. Introduction of invasive alien plant species can result in: a change to or displacement of habitat, resulting in the elimination or a decrease in the abundance of flora/fauna dependant on the original habitat; decrease in biodiversity; displacement of native genotype; hybridization with native species; and/or making an area unsuitable for human use (White, et al., 1993).

Most invasive alien plant species in Canada have first become established in the most disturbed areas (i.e., areas of high population density such as southern Ontario) and then spread to less disturbed habitats. One of the most harmful invasive alien species in eastern Canada is Purple Loosestrife (*Lythrum salicaria*), which has become well established in eastern Canada and also British Columbia. Loosestrife rapidly becomes the dominant species on wetlands, displacing valuable wildlife habitat and diversity. Loosestrife has no natural competitor, no native animals use it as forage, and it does not provide habitat for any native wildlife species.

There is potential for the use of equipment or machinery that was previously used in areas known to support invasive alien plant species, which may result in the spread of these species to and within all three wetlands in the Project Site.

Operation and Maintenance

During operation of the LNG facilities, there is potential for recreational all terrain, or off-highway vehicle users to access wetlands 1 and 12 and potentially cause environmental damage. The Nova Scotia government passed Bill 275 in 2005, amending the *Off Highway Vehicle Act*. Under the Act, off-highway vehicles cannot be operated in sensitive areas designated by the regulations, highland or coastal barrens, beaches, sand dunes, watercourses, or wetlands. Operation in a watercourse or wetland must be approved by Nova Scotia Environment and Labour through the *Environment Act*. Water quality may be adversely affected resulting from discharges and/or runoff.

Adverse effects to wetlands 1, 12, and 13 during operation are also possible through fuel spills during the operation and maintenance activities. These malfunction and accident-related effects have been described in Section 10.0.

Modifications and Decommissioning

Wetlands are at risk for disturbance from many of the same potential activities as during construction. Refer to Construction section above.

5.1.14.2 Mitigation Measures and Monitoring

Construction

A wetland functional analysis study will be conducted for wetlands 1, 12, and 13 prior to construction. A wetland mitigation plan will be drafted prior to construction for those wetlands where encroachment is unavoidable (see also note below on work to be undertaken by the Proponent in compliance with NSEL EA approval conditions). The first principal is avoidance. Where wetlands cannot be avoided, mitigative measures will protect wetlands during construction. The EPP will include the site specific protection plans for these wetlands during the construction phase. These generally include:

- minimize the length of wetland habitat disturbed;
- minimize the construction area, and construction period in wetlands;
- adhere to conditions of an applicable wetland alteration permit;
- stabilize watercourse/wetland beds and banks with clean rip rap when necessary to ensure stability; and
- minimize ground and vegetative disturbance by:
  - locating staging areas outside of the wetland, at least 30 m from the edge of wetland, where possible;
  - minimizing equipment in wetland to only that required for construction activity; and
  - using upland access roads wherever practical.
- maintain vegetative diversity by:
  - incorporating practices to prevent the spread of non-desirable invasive species throughout the construction area, including cleaning and inspection of construction equipment prior to use in wetland areas; and
  - allowing wetlands to revegetate naturally unless adjacent to areas of potentially erodible soils.
- during site restoration, mitigate effect on vegetation by:
  - not applying fertilizer, lime or mulch to wetland as part of revegetation plan;
  - in areas where there is no open water or saturated soils, separate organic top soil from underlying soils, and stock pile separately; return top soil to original horizon; and
  - restoring original contours and cross drainage patterns.
- inspect equipment daily prior to use to detect leaks of fuels;
- all on-site fuels, oils, and chemicals should be stored at least 150 m from any surface waters where possible;
- ensure all spill prevention planning and detailed cleanup procedures are in place prior to construction;

- take necessary measures to reduce or avoid disruption of surface and ground water patterns;
- drainage control features will be implemented to prevent soil erosion and impacts to water quality;
- boulders and tree trunks harvested during construction to be retained for possible use in aquatic habitat enhancements; and
- raise the pipeline in the terminal area to avoid impeding wetland flow to Betty's Cove.

Adhering to a "no net loss of function" policy is part of Project mitigation. As such, there will be a compensation plan for the impact by replacing, enhancing, or providing substitute resources or environments. This plan will be designed in conjunction with regulators and stakeholders and completed before any construction activity.

A detailed ESC plan, including a monitoring program for site runoff, to be reviewed and approved by NSEL, will be developed. Based on the results of the monitoring program, the Proponent must make necessary modifications to ESC plans and/or operations to prevent any unacceptable environmental effects, to the satisfaction of NSEL.

It is of note that the Proponent will detail the impacts to wetlands in compliance with Item 1.2 of the NSEL EA approval conditions for the KDP (NSEL, 2007). This work will address methods and plans for avoidance, mitigation, and/or compensation and will be developed in consultation with NSEL and NSDNR.

Operation and Maintenance

It is recommended that the LNG facilities are fenced to ensure no public access. Monitoring for illegal off-highway vehicle use will be conducted as part of routine operation and maintenance checks of the LNG pipeline.

See also note under "Construction" with respect to development of further mitigation measures.

Modifications and Decommissioning

As potential interactions are similar during the construction phase, similar mitigation measures apply. Requirements for mitigative measures during any future modifications and decommissioning activities will be included under the EMP.

See also note under "Construction" with respect to development of further mitigation measures.

5.1.14.3 Residual Effects

The impact of the Project on the wetlands on and near the Project Site is not expected to be significant. With the implementation of mitigation measures outlined above, the environmental effects will be low in magnitude and will only affect 3 wetlands. The site is designated for industrial use and there are numerous other wetlands in the site's vicinity. Therefore, residual effects are expected to be not significant.

5.1.14.4 Follow Up

Construction

No follow up monitoring is recommended.

For additional follow up work – see note under "5.1.14.2 Mitigation Measures".

5.1.15 Lighting Conditions

5.1.15.1 Environmental Effects Prediction

Construction

No adverse environmental effects are expected from lighting during construction, prior to commissioning of the LNG facility.

Operation and Maintenance

The area of the LNG storage tanks will be mostly in plain view of the community of Isaac's Harbour. Therefore, uncontrolled Project lighting could result in unwanted light pollution or skyglow. While the lighting levels have not been designed at this stage, they will be set to provide a low level of general lighting sufficient for security cameras. This level is not expected to provide task lighting and high masts with multi-unit high intensity fixtures will be avoided as much as possible. Where high mast lighting is required the illumination fixtures will be selected to direct light downward. Therefore, effects on local residents should be minimal.

Project lighting could also have effects on birds, as described in Section 5.1.12 and 5.1.13 above. The severity of potential effects will generally be limited to minor changes in flight path but could include uncommon instances of mortality due to collisions with taller structures or exhaustion due to disoriented flight behaviour (mainly at night).

Modifications and Decommissioning

No adverse environmental effects are expected from lighting due to the decommissioning of the LNG facility.

5.1.15.2 Mitigation Measures and Monitoring

Construction

No effects have been identified therefore mitigation is not necessary.

Operation and Maintenance

To minimize the impacts of light on the surrounding community the Proponent will apply the following measures:

- no use of unnecessary lighting;

- avoidance of use of lighted structures over 15 m in height; when necessary, use of flashing strobe lights as recommended in CWS's Best Management Practices for Tall Structures;
- shielding of lighting where possible; and
- angled lighting or lighting directed close to work area.

Mitigation to address the effects of lighting on birds has been described in Section 5.1.13.

It is of note that the Proponent will generate a lighting plan, which will incorporate a program to monitor impacts to birds. This work will be undertaken by the Proponent in compliance with Item 1.6 of the NSEL EA approval conditions (NSEL, 2007). In accordance with the NSEL conditions, the plan must be submitted to NSDNR, CWS, and TC for review and approval. Based on the results of the monitoring programs, the Proponent must make necessary modifications to the mitigation plans and/or operations to prevent any unacceptable environmental effects, to the satisfaction of NSEL, based on consultation with NSDNR and CWS.

Modifications and Decommissioning

No effects have been identified therefore mitigation is not necessary.

5.1.15.3 Residual Effects

Construction

No residual effects from this phase of the Project are anticipated.

Operation and Maintenance

Appropriate lighting is necessary to ensure safe and secure operations. While measures will be implemented to minimize disturbances to humans and wildlife as much as possible, some light sources will be unavoidable. However, the environmental effects are considered reversible and low in magnitude. Therefore, no significant residual effects are expected.

Modifications and Decommissioning

No residual effects from this phase of the Project are anticipated.

5.1.15.4 Follow Up

No follow up programs are currently considered necessary. If local residents complain about Project lighting, Keltic will make every reasonable attempt to reduce unwanted light effects based on the specific situation.

5.1.16 Atmospheric and Underwater Acoustic Environment

5.1.16.1 Environmental Effects Prediction

As a matter of good practice, Keltic will develop an atmospheric noise monitoring program that will include routine measurements during construction and operation.

In the absence of particular regulatory requirements, the Nova Scotia Government's "Guidelines for Environmental Noise Measurement and Assessments" will be used as the reference point for adhering to acceptable noise levels during construction activities at the Project Site. These Guidelines are:

- 65 dBA between the hours of 0700 to1900 (day);
- 60 dBA between the hours of 1900 to 2300 (evening); and
- 55 dBA between the hours of 2300 to 0700 (night) and on Sundays and Statutory Holidays.

The following discussion of potential effects from Project related atmospheric noise is considered in the context of these guidelines. Isaac's Harbour Villa Senior Apartment and the Isaac's Harbour Medical Centre have been identified as sensitive human receptors. However, neither of these receptors are located within 1 km of the Project Site. No hospitals, daycare centres, schools, or seniors' residences are located within a 1 km radius of the Project Site.

Construction

The construction of the KDP facility will span a period of some 33 months, and will involve site preparation (blasting, earthmoving, etc.), followed by the erection of major industrial components.

Table 5.1-7 identifies some typical noise levels for construction equipment. For comparison, a chainsaw at 1 m is approximately 110 dB, a busy highway at roadside is 80 dB, conversational speech at 1m is 60 dB, and a library is 40 dB.

TABLE 5.1-7 Typical Construction Equipment Noise Levels at 50 Feet (15 m)

Equipment	Typical Noise Range (dBA)
Loader	74-84
Bulldozer	82-95
Trucks	82-92
Pumps	68-72
Generators	72-80
Compressors	74-83

It is noted that the nearest occupied properties are some 300-500 m from the site boundary lines, and, accordingly, sound pressure levels (noise) will decrease from that point. The inverse square law states that the sound pressure level will decrease by 6 dBA for every doubling in distance from the source of noise. The following formula is used to determine the change in sound pressure levels over a distance:

$$\Delta D = 10 \log (d_1/d_2)^2$$

Where d_1 and d_2 are the two distances and ΔD is the change in sound pressure level in decibels (dBA)

Given the above formula, the approximate sound pressure levels for a bulldozer at 300m from the property boundary would be 33-49 dBA. A level of 49 dBA is below the lowest recommended noise level in the NSEL Guidelines presented above. The attenuation formula does not take into account the effect of vegetation, topography, or climatic conditions, which would further reduce the noise levels.

It is noted that when several pieces of equipment are operating in proximity to each other, sound levels (in dBA) are not additive. For example, two bulldozers, each with an operating sound level of 82 dBA would be the equivalent of a level of 85 dBA, since 3 dBA represents a doubling of the noise level, a difference that is considered to be barely perceivable to the human ear.

Blasting will be managed so as to minimize blast size and reduce maximum noise levels. It is not known precisely what sound levels blasting will cause but it will likely be noticeable and potentially disturbing to local residents.

The underwater environment may be affected by noise impacts from construction activities for the development for the LNG Marine Terminal and the LNG Tanks. Although there is not an extensive use of the nearshore waters by cetaceans and seals, these species may be susceptible to damage from the underwater noises generated using conventional pile-driving techniques. The underwater noise impacts on marine mammals are further discussed in Section 5.1.11. and the mitigation describe in this section will also mitigate any impacts of noise on fish.

Operation and Maintenance

In order to determine potential noise levels during the operational phase of the LNG Marine Terminal, similar processes from the LionGas LNG Marine Terminal in Rotterdam were reviewed. While somewhat different from the proposed process for Goldboro, the projects are comparable. The noise levels for operation at the Rotterdam project ranged from 94 dB for a BOG cooling system to 145 dB for relief/blowdown valves. Sources like relief/blowdown valves are not continuous and would only be an incidental source. The sources with the highest noise levels were flaring operations and these are periodic or incidental operation. The continuous operations ranged from 94 to 110 with mitigative measures in place such are insulation or noise hoods.

As in the construction phase, noise levels generated from a particular point source would degenerate over distance. The noise levels at 300m from the property boundary generated from the continuous sources would be in the range of 45 dB to 61 dB. The noise levels generated by periodic or incidental sources such as flaring would be between 77 and 96 dB.

Underwater noise impacts on marine mammals during operation are not expected to be significant as most noise generated (i.e., ship engines) would be of a lower frequency than pile driving and other marine construction practices. The effects of underwater noise on marine mammals due to Project operations were discussed previously in Section 5.1.11.

Modifications and Decommissioning

Potential interactions are similar as those identified for the construction phase.

5.1.16.2 Mitigation Measures and Monitoring

Construction

In conducting site construction operations, Keltic will:

- ensure that all equipment has appropriate noise-muffling equipment installed and in good working order;
- as required by the NSEL EA Approval Condition 2.2, provide for review and approval a noise monitoring program. Based on the results of the monitoring program Keltic will be required to make necessary modifications to mitigation plans and/or operations;
- conduct routine noise monitoring at both the site boundaries and nearby sensitive receptors; the measured noise levels will be compared to the Day-Night Average Sound Level (DNL) levels outlined in the Health Canada Draft Guidance on Noise Assessment for CEAA Projects;
- restrict intensive construction activities to the hours of 0700-1900 where practical;
- ensure that the public has contact numbers for appropriate construction and government personnel in the case of noise issues;
- ensure that the public is given adequate prior notice of any blasting activities scheduled to take place;
- use alternative techniques to pile driving such as vibratory pile-driving;
- confer with representatives from recreational and commercial fisheries to develop daily and seasonal activity schedules;
- work at low tide;
- use ramped warning signals;
- use bubble curtains to mask the noise if necessary; and
- maintain, where practical, treed buffers between the working site and the public.

Operation and Maintenance

In order to decrease the effects of facility operations on the acoustic environment, Keltic will:

- employ the use of a treed buffer between plant site and residences;
- use silencers and baffles on equipment;
- conduct routine noise monitoring to ensure noise levels at nearest occupied properties do not exceed Canadian Mortgage and Housing Corporation (CMHC) levels;
- supply public with contact numbers in case of noise issues;
- minimize evening and night-time operations;
- work activities will be planned as to create minimal disruption in the evening and night time hours; and
- discussions with local fishers will take place to minimize potential effects on the commercial fisheries.

As required by the NSEL EA Approval Condition 2.2, Keltic is required to provide for review and approval a noise monitoring program. Based on the results of the monitoring program Keltic will be required to make necessary modifications to mitigation plans and/or operations. The monitoring program will consist of sampling noise levels over a 24-hour period following commissioning. Noise sampling will be conducted quarterly and the results evaluated on an annual basis. The percentage of highly annoyed will be evaluated as outlined in the Health Canada Draft Guidance on Noise Assessment for CEAA Projects. Noise levels at designated sensitive receptor sites will also be determined through monitoring and compared to the sound levels outlined in the Health Canada Draft Guidance on Noise Assessment for CEAA Projects. Should noise levels be consistent over the first year, noise sampling would subsequently be conducted on a complaint basis or following process or equipment changes. This will include monitoring of ship noise, vehicle movement, heavy equipment operations, emergency operations, and normal operating modes.

Modifications and Decommissioning

As potential interactions are similar during the construction phase, similar mitigation measures apply.

5.1.16.3 Residual Effects

Provided the proposed mitigative measures are implemented as suggested, the environmental effects due to noise will have a low magnitude and will occur within 500 m of the site's boundaries. Therefore, no significant adverse residual effects on the acoustic environment are likely to occur.

5.1.16.4 Follow Up

No follow up monitoring is anticipated.

5.1.17 Current Use of Lands and Resources for Traditional Purposes by Aboriginal Persons

5.1.17.1 Environmental Effects Prediction

Construction

Mi'kmaq continue to undertake traditional activities throughout the KDP Study Area. Medicinal plant gathering sites and areas were identified by the wetlands that are within the Project Site. The construction may result in some filling, excavating, and otherwise disturbance of wetlands, in addition to some loss of wetland vegetation.

Some of the reported hunting and fishing areas overlap with the proposed LNG facility; which will result in an unavoidable loss of traditional resource area. However, the affected area (approximately 149 ha) is a very small proportion (less than 2%) of one hunting area out of approximately 10 large traditional hunting areas in Guysborough County; which encompass very large areas of land or include entire waterways. Therefore, the construction activities will result in minimal impacts to the land and resource use.

Operation and Maintenance

There are three identified sea urchin diving areas located at Betty's Cove and Red Head. It should be noted that sea urchins in this area were largely decimated by a parasite in the late 1990's and have not made a significant recovery.

Modifications and Decommissioning

No environmental are expected due to modifications or decommissioning of the LNG facility.

5.1.17.2 Mitigation Measures and Monitoring

Construction

Wetlands within the LNG facility, if affected, will be rehabilitated and/or compensated to achieve "no net loss" in wetland functions. As required by the NSEL Terms and Conditions for Environmental Assessment Approval, wetland plans for avoidance, mitigation and/or compensation will be developed in consultation with NSEL and NSDNR.

For the effects on fishing, the draft FHCP outlined in Appendix 5 includes enhancement of benthic habitat within the same urchin licence area. This is predicted to offset any loss of sea urchin production and/or access once the species returns to commercial levels.

To meet the requirements of Item 4.3 in the NSEL EA approval conditions, Keltic will develop a Mi'kmaq Communication Plan for the Project which will include but not be limited to:

1. processes for communicating Project details and seeking input from the Mi'kmaq community; and
2. plans for Mi'kmaq involvement in EEM and other Project aspects. The plan will be developed in cooperation with the Mi'kmaq Community.

Also, in accordance with Item 4.4 of the NSEL EA approval conditions, Keltic will take steps to further assess traditional Mi'kmaq use of the Project Site lands. The Proponent will develop the proposed steps in cooperation with the Mi'kmaq Community and will submit the results to NSEL.

Operation and Maintenance

For the effects on fishing, the draft FHCP outlined in Appendix 5 includes enhancement of benthic habitat within the same urchin licence area. This is predicted to offset any loss of sea urchin production and/or access once the species returns to commercial levels.

Modifications and Decommissioning

No mitigation is necessary.

5.1.17.3 Residual Effects

Provided the proposed mitigative measures are implemented, the environmental effects will have low magnitude and will be reversible. Therefore, no significant adverse residual effects on aboriginal lands or resources are expected.

5.1.17.4 Follow Up

Monitoring of the fish habitat compensation will be done to ensure successful habitat creation.

5.1.18 Physical and Cultural Heritage

5.1.18.1 Environmental Effects Prediction

Construction of the LNG Marine Terminal may have effects on physical and cultural heritage. Due to previous excavation and removal of burials at Red Head in 2000 and 2001, complemented by subsurface testing in October 2004, there is confidence that no burials remain in the cemetery and, therefore, the site is no longer believed to be of high archaeological sensitivity. However, due to its association as the final resting place of the first Black Loyalists in Goldboro and Isaac's Harbour, it remains to be of cultural significance to the nearby Black community at Lincolnville.

5.1.18.2 Mitigation Measures and Monitoring

Prior to construction, an agreement with the Department of African Nova Scotia Affairs will be entered into for the establishment of a memorial at the Red Head Cemetery site. A Cultural Heritage Plan will also be developed to ensure that Project development and operations proceed in a manner that respects the cultural heritage value of the Red Head Cemetery site to the community, and that public access to the site will be maintained. The plan will be reviewed and approved by NSEL. An archaeology and heritage resources monitoring and contingency plan will also be prepared in consultation with Mi'kmaq stakeholders, African Nova Scotia Affairs, and the Nova Scotia Museum.

5.1.18.3 Residual Effects

Provided the proposed mitigative measures are implemented as suggested, the environmental effects will have low magnitude. Therefore, no residual effects due to the Project are anticipated.

5.1.18.4 Follow Up

No follow-up programs are recommended.

5.1.19 Structures/Sites of Archaeological, Paleontological or Architectural Significance

5.1.19.1 Environmental Effects Prediction

The historical review of the Project Area demonstrated that there are key areas within the Study Area that have at one time, seen Mi'kmaq occupation. This points to the probability that Mi'kmaq artefacts could be found during construction.

Previous archaeological investigations in the vicinity of the development area, such as the archaeological intervention at Red Head Cemetery in 2001-2002 and archaeological assessments for the M&NP and SOEI project, indicated that this area was of high potential for heritage resources. The potential that it is related to late eighteenth century Black Loyalist settlement exists. Therefore, this area is believed to be of high archaeological sensitivity. Several such resources were located within the development zone during the current archaeological assessment. Under the *Special Places Protection Act*, mitigation of those resources expected to be impacted by construction or related ground-disturbance activities is required.

Construction

Each archaeological resource within the Study Area has been evaluated according to its relative significance based on the cultural and physical integrity of each resource, existing documentation, and the expected impact on those resources (Table 5.1-8).

TABLE 5.1-8 Relative Significance of Archaeological Sites within the LNG Plant Study Area

Archaeological Site or Resource	Archaeological Sensitivity	Cultural Sensitivity	Expected Impact (Yes/No)
Hattie's Belt	Medium	N/A	No
Giffin Lead	Medium	N/A	No
Skunk Den Mine Crusher	Medium	N/A	No

No archaeological sites of significance have been identified within the footprint of the proposed Project. Therefore no adverse effects are anticipated.

Operation and Maintenance

There are no anticipated effects to archaeological resources during the operation of the LNG facility.

Modifications and Decommissioning

The potential effects addressed in the construction section are relevant for the decommissioning of the facility as well.

5.1.19.2 Mitigation Measures and Monitoring

Construction

Should any artefacts or human remains be discovered, the work is to be terminated until a qualified archaeologist assesses the find. If the find is deemed significant, the work will not resume until further steps and protective measures are discussed in consultation with the archaeologist and regulatory authorities.

There is a probability that Mi'kmaq artefacts could be found during construction, and in such cases, construction workers should be made aware that this is a possibility. This may include cultural resource awareness training for construction workers. In the event that artefacts are found during construction activities, construction activities in the area of the discovery will be suspended and the discovery be reported to the Nova Scotia Museum and the Executive Director of the Union of Nova Scotia Indians immediately. In accordance with Item 4.5 in the NSEL EA approval conditions, a complete archaeological assessment of the entire KDP site will be submitted for review by NSEL. Also, as requested by Item 4.9 in the NSEL EA approval conditions, a plan will be developed to ensure the KDP construction and operations proceed in a manner that respects the cultural heritage value of the Red Head Cemetery and that public access to the site will be maintained.

Operation and Maintenance

In accordance with Item 4.9 in the NSEL EA approval conditions, a plan will be developed to ensure the KDP construction and operations proceed in a manner that respects the cultural heritage value of the Red Head Cemetery and that public access to the site will be maintained (NSEL, 2007). In accordance with Item 4.6, the Proponent, prior to construction, shall submit for review and approval of NSEL, an archaeology and heritage resources monitoring and contingency plan. The plan shall be developed in consultation with Mi'kmaq stakeholders, African Nova Scotia Affairs, and the Nova Scotia Museum.

Modifications and Decommissioning

No adverse effects are anticipated. For precautionary mitigation measures – see Construction.

5.1.19.3 Residual Effects

Construction

No residual effects on archaeological resources are expected.

Operation and Maintenance

No residual effects on archaeological resources are expected.

Modifications and Decommissioning

No residual effects on archaeological resources are expected.

5.1.19.4 Follow Up

No follow-up programs are recommended.

5.1.20 Navigation

5.1.20.1 Environmental Effects Prediction

The LNG facility is located on the mainland and therefore will have no effects on the navigation of vessels in the area.

The operation and construction of the LNG Marine Terminal may alter navigation into Isaac's Harbour from Stormont Bay. The area for the planned marine facilities is not a major fishing area and represents only a very small portion of the lobster habitat in the Stormont Bay (approximately 1.6%). Few vessels routinely use Isaac's Harbour even though the community wharf in Goldboro was substantially upgraded by SOEI for construction of the gas plant. Currently, marine traffic within the harbour is composed of the sporadic inshore fishery including a monthly passage of a shrimp trawler to the Stormont facility in Country Harbour. Proposed Project vessels are estimated to be 1 ship per day.

5.1.20.2 Mitigation Measures and Monitoring

The facilities will be well lit and marked on all navigation charts for the area. The navigation lighting and other markings will be required as per federal legislation. The very low level of boating activity in Stormont Bay and Isaac's Harbour is not expected to result in any important navigation issues with respect to marine facilities. Keltic will also provide advance notice of ship arrivals and departures to fishermen.

5.1.20.3 Residual Effects

No significant adverse residual effects on navigation are likely to occur since the effects of Project shipping will be managed through procedures that are developing during the TERMPOL process.

5.1.21 Marine Safety and Security

5.1.21.1 Environmental Effects Prediction

The LNG facility is located on the mainland and therefore will have no effects on the marine safety and security. The LNG Marine Terminal may represent an obstacle for vessels destined for or leaving Isaac's Harbour.

5.1.21.2 Mitigation Measures and Monitoring

The LNG Marine Terminal facilities will be well lit and marked on all navigation charts for the area. The navigation lighting and other markings will be required as per federal legislation. The very low level of boating activity in Stormont Bay and Isaac's Harbour is not expected to result in any important navigation issues with respect to marine facilities. Keltic will also adhere to the *Marine Transportation Security Act* and regulations.

5.1.21.3 Residual Effects

No significant adverse residual effects on marine safety and security are likely to occur as the magnitude of the effects will be minimized by the implementation of procedures developed as part of the TERMPOL process.

5.1.22 Human Health and Safety

5.1.22.1 Environmental Effects Prediction

Human health and safety includes two facets of potential adverse effects; public health and safety and worker health and safety. It is evaluated primarily to address potential health and safety risks to the public and workers associated with routine plant emissions, accidents, malfunctions, and unplanned events. Section 10.0 addresses potential effects and mitigation for accidents, malfunctions, and unplanned events.

In order to protect worker health and safety, Keltic will develop a comprehensive Health and Safety Program that will be implemented throughout the KDP, including construction, operation, and decommissioning.

Humans that may be potentially affected by construction, routine facility activities, as well as accidents, malfunctions, and unplanned events are primarily those that live in the Study Area. The nearest communities to the KDP are Goldboro and Seal Harbour. According to Industry Canada (2005), Goldboro has a population of about 80. The primary sensitive receptors in the area of the Project include the Goldboro Interpretive Centre, Isaac's Harbour Villa Senior Apartments, and Isaac's Harbour Medical Centre.

Residents in the area all use private wells, as described in Section 8.7 of the Provincial EA Report (AMEC, 2006). There are also approximately 1780 people within 30 km of Goldboro, although most of these are outside of the potential area of Project impact.

During the 33 month construction period, the facility is expected to employ up to 3000 people. Approximately 60% of the workforce could be housed in temporary construction quarters at the facility, if required. During operation, the facility is expected to employ approximately 600 workers.

The following sections describe potential impacts to health and safety during construction, operation, and decommissioning. These impacts, as well as mitigative measures, are summarized in Table 6.1-21.

Construction

During construction, there are several activities that could potentially impact human health and safety:

- dust generation during facility and roadway construction, in particular concerns with arsenic and mercury that are residuals of mining operations;
- safety concerns regarding former mine workings;
- air emissions from construction equipment and vessels transporting construction materials and equipment;
- water and waste management and control; and
- air emissions from vehicular traffic to the construction locations.

Dust generation during facility and roadway construction could occur, although potential impacts are expected to be localized. A Dust Control Plan to be implemented during construction will address this issue and provide specific monitoring requirements and controls to minimize dust. This is of particular concern in areas where mine tailings are found. As discussed in Section 5.1.5, sediment/tailing samples in Dung Cove have been shown to have elevated concentrations of arsenic ranging from 14 mg/kg to 1700 mg/kg, well above the Canadian Environmental Quality Guideline for soil of 12 mg/kg, considering either residential or industrial land use, as shown in Table 5.1-9. Concentrations of mercury in this area slightly exceed the residential guideline of 6.6 mg/kg in only one sample. Since the tailings in this area are wet, particulate generation is unlikely. However, handling of this material by workers should be conducted with adequate Health and Safety Controls, and re-use at the ground surface in other locations should be prevented. Such use could result in transport as particulates and potential exposure to the public.

Two other known tailings areas are found in locations potentially within the KDP Area (see Figure 8.13-4 from the Provincial EA Report; AMEC, 2006). In addition, others may be identified during construction activities. Health and Safety controls should be used to protect workers involved in activities in these areas, and potential airborne transport should be minimized.

Air emissions from construction equipment transporting equipment and materials should be localized with limited transport, due to their sporadic nature and emissions close to ground surface. Air emissions of vehicular traffic to the construction site will also occur, however, many of the workers may be located at the site, and much of the equipment and materials will be transported to the site by sea. Therefore, traffic to the site during construction will be minimized.

Water and waste management should not pose a hazard to public health or worker safety during construction. The primary concern is preventing run-off or other transport of soils impacted by mining. Construction practices in such areas should include provisions to control run-off and potential migration of impacted soils.

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TABLE 5.1-9 Residual Environmental Effects Criteria - Health and Safety

Chemical	Soil (mg/kg)											
	Canadian Environmental Quality Guidelines				Atlantic RCBA Version 2.0 Tier I Risk-Based Screening Level							
					Residential				Commercial			
					Potable		Non-Potable		Potable		Non-Potable	
	Agri.[1] (fine soil)	Res./Park[2] (fine soil)	Comm.[3] (fine soil)	Industrial[4] (fine soil)	Coarse-grained soil	Fine-Grained soil	Coarse-grained soil	Fine-grained soil	Coarse-grained soil	Fine-grained soil	Coarse-grained soil	Fine-grained soil
Petroleum Hydrocarbons												
Gasoline					39	140	39	330	450	520	450	10,000
Diesel/#2					140	220	140	4,400	7,400	840	7,400	7,700
#6 Oil					690	970	690	8,300	10,000	4,700	10,000	10,000
VOCs												
Benzene	0.00068	0.0068	.0.0068	0.0068	0.03	0.01	0.16	1.5	0.03	0.01	1.8	11
Toluene	0.08	0.08	0.08	0.08	0.38	0.08	14	120	0.38	0.08	160	680
Ethyl Benzene	0.018	0.018	0.018	0.018	0.08	0.02	58	430	0.08	0.02	430	430
Xylenes	2.4	2.4	2.4	2.4	11	2.3	17	160	11	2.3	200	650
Metals												
Arsenic	12	12	12	12								
Chromium (hexavalent)	0.4	0.4	1.4	1.4								
lead	70	140	260	600								
Mercury	6.6	6.6	24	50								
Criteria Air Pollutants												
CO												
Hydrogen Sulphide												
NO_2												
Ozone												
SO_2												
TSS												

1. Agricultural Land Use
2. Residential/Parkland Uses
3. Commercial Land Use
4. Industrial Land Use

Equipment and materials storage during construction is likely to consist of building materials, process components, and other items needed for construction. Spills could occur from construction equipment kept on-site during this period, or from stored fuels, or other liquid materials needed for equipment or construction. Such spills are likely to be of small volume and localized, as large quantity storage is not expected during the construction period. Nevertheless, uncontrolled spills could impact groundwater and potentially migrate to private supply wells. As discussed in Section 5.1.5, old mine workings could provide a preferential pathway for spills to impact private wells. Equipment and materials storage that could result in spills should be located away from areas with former mine workings. Spill prevention and emergency response planning will be implemented as part of the EPP during construction to provide specific requirements for storage, prevention, and response to spills to minimize any potential impact.

Old mine workings also present a safety hazard for workers during construction activities due to their potential lack of structural integrity. Steps should be taken to assure their stability, or activities or structures should be located away from such areas.

Operation and Maintenance

During facility operation, there are several activities that could potentially impact human health and safety:

- air emissions during vapourization/regasification of LNG to natural gas;
- facility wastewater discharges;
- air emissions from vehicular traffic; and
- potential spills during materials transfer and storage.

Section 5.1.6 estimated emissions from the KDP components during operation and modeled air concentrations based on these emissions and those from the SOEP gas plant. The highest predicted pollutant air concentrations are compared to Nova Scotia Maximum Permissible Concentrations. This comparison (Table 5.1-2) shows that all regulatory standards are met. In addition, the highest predicted pollutant concentration is not likely to be where there are any receptors. Table 5.1-3 shows that maximum estimated concentrations at identified sensitive receptors are much lower than the highest predicted concentrations. These comparisons indicate that air emissions during facility operation are not likely to pose a health risk.

A Spill Control Plan will be developed for facility operation. It will describe required monitoring, storage requirements, and response procedures should a spill occur. The implementation of this plan will minimize any potential impact to soils and groundwater that could result in potential impacts to human health. Many of the spill containment measures in terms of facility design and component siting are described in Section 2.0.

Expected wastewater discharges from the facility have been described in Section 5.1.2. Effluents from the facility will be treated to applicable quality standards and are not expected to present a hazard to health or safety.

Worker safety concerns are present at this facility, similar to any other industrial facility. A health and safety program will be developed and implemented for the facility that will address routine and non-routine activities and procedures to minimize potential chemical exposures and safety incidents. This program will provide the basis for compliance with all workplace standards and guidelines.

Modifications and Decommissioning

Potential adverse effects addressed for the construction phase of the Project are relevant for the decommissioning phase as well.

5.1.22.2 Mitigation Measures and Monitoring

Construction

Mitigation for human health and safety during construction involves the preparation and implementation of several plans, including:

- dust control plan;
- worker health and safety plan;
- erosion control plan; and
- EPP including spill prevention and emergency response (clean up) plan.

Further mapping will be undertaken to delineate the extent and location of old mines. For mitigation on air emissions refer to Section 5.1.6.2. Potential airborne transport of tailings should be minimized.

Mitigation for water and waste management control will include:

- Implementation of a Spill Control Plan;
- Water effluent treatment;
- Development of an Emergency Response Plan;
- Prevention of run-off and transport of mined soils; and
- Control of run-off and potential migration of impacted soils.

Operation and Maintenance

The mitigation for human health and safety during the LNG facility construction phase is relevant for the operation phase and includes the preparation and implementation of a spill prevention and emergency response (clean up) plan.

Modifications and Decommissioning

Mitigation for human health and safety during the decommissioning of the LNG facility includes the preparation and implementation of a dust control plan and spill prevention and emergency response (clean up) plan. In addition, the cover over areas containing mine tailings should be retained to prevent re-suspension if affected by the modification/decommissioning work.

5.1.22.3 Residual Effects

Table 5.1-9 summarizes the relevant criteria for chemicals that might be spilled or released during construction, operation, or decommissioning. Anticipated concentrations exceeding criteria shown in this Table have been considered a significant adverse effect.

Criteria are not shown in Table 5.1-9 to address worker health and safety. A preventative health and safety program will be implemented for construction, operation, and decommissioning that ensures that the public and workers are not adversely affected during routine operations, and that contingency plans are in place to prevent impacts during accidents, malfunctions, and unplanned events.

Provided the proposed mitigative measures are implemented, the environmental effects will:

- be low in magnitude;
- occur within the KDP area, Betty's Cove, or Dung Cove;
- be reversible; and
- will be intermittent and short term.

Therefore, the significance of the environmental effects is expected to be not significant (see Table 6.1-21).

5.1.22.4 Follow Up

No follow up monitoring is anticipated.

5.1.23 Fisheries

5.1.23.1 Environmental Effects Prediction

Commercial fishing is an important economic activity that occurs within the marine environment of Stormont Bay. Commercial fishing occurs almost entirely outside of the estuaries of Country Harbour and Isaac's Harbour. Recreational fisheries in the area are small but diverse, and include both freshwater and estuarine components. Brook trout are the primary recreational species. They are fished both in many of the lakes, rivers and streams that flow into Stormont Bay and in the inner parts of the estuary. Smelt are often fished recreationally under the ice in the upper estuaries. Commercial lobster fishing is the only harvesting that occurs in close proximity to the Project.

Information on harvesting was obtained primarily through discussion with local residents. Background information was also provided by the Guysborough County Coastal Resources Mapping Project. Numerous consultation meetings with the commercial fishers who fish within Stormont Bay were held by Keltic and Project consultants. A traditional Aboriginal fishery for urchin was also identified in Section 5.1.17.

Construction

Freshwater

Betty's Cove Brook and the unnamed tributary to Dung Cove could support local recreational fisheries, which may be effected by water quality/quantity effects described in Section 5.1.2 due to storm water runoff during construction. Accidental spills of contaminants could also harm local fisheries. Potential effects and mitigation for accidental events are presented in Section 10.0.

Marine

Local fishers have expressed concern about disruption to their traditional fishing activities from construction and operation of the Project. Marine impacts of construction will be concentrated in the wharf and terminal areas, either as a result of construction or facilities equipment being transported to the site, or actual construction of the wharf and terminal.

The magnitude of construction impacts will be related to the seasonal timing of activities. Impacts will be greater if activities occur during the relevant fishing seasons, particularly the lobster fishing season, which runs from April 19 to June 20. Little fishing activity takes place in the central deep water part of the bay where the larger LNG and cargo vessels will be transitting.

For a significant impact on fishing activity to occur, the earnings from the fishery would need to be affected as a result of decreased catch quantity and/or quality, or increased costs of fishing from longer travel times or similar issues. The overall productivity of the bay and the associated amount of lobster habitat are important factors determining the potential quantity and quality of the catch and thus monetary return to local fishers.

The fishery may be affected because of the attraction of fish to lighting from construction activities.

In the event that the construction of the LNG Marine Terminal will result in the loss of fish habitat, DFO will require replacement of the area of fish habitat lost with habitat of similar or higher type and quality. Potential compensation areas in Fisherman's Harbour has been identified (see Appendix 5) where a habitat augmentation project could provide several times more lobster habitat of similar in quality to that lost to construction. Keltic will continue consultations with local recreational fisheries groups and municipalities to refine compensation plans. Additional details for proposed Habitat-Compensation Plans are being prepared separately from this CSR process and as part of Keltic's Application to DFO for Authorization.

Adverse effects to fisheries are also possible due to the degradation of the marine environment through freshwater quality effects described in Section 5.1.2. Accidental spills of contaminants could also harm local fisheries. Potential effects and mitigation for accidental events are presented in Section 10.0.

Operation and Maintenance

Potential interaction will be similar to construction.

Modifications and Decommissioning

Potential interaction will be similar to construction. No significant effects are expected.

5.1.23.2 Mitigation Measures and Monitoring

The effects of the LNG Marine Terminal construction and operation will be mitigated by the development of a compensation plan for local fishers who hold licences for that area.

A compensation policy for fishing equipment damaged by the KDP's construction phase will also be developed and implemented. This compensation policy will follow the Canada – Nova Scotia and Canada – Newfoundland Offshore Petroleum Board document: Compensation Guidelines Respecting Damages Relating to Offshore Petroleum Activity. As requested in the NSEL Terms and Conditions, a monitoring program for site runoff will also be developed.

Provided the following mitigative measures are implemented the potential lighting effects on fish should be insignificant:

- no unnecessary lighting will be used, especially on structures taller than 15 m, and use fast-blinking strobes if possible;
- area lighting will be angled directly at work areas and shielded where possible; and
- implementation of a Lighting Plan.

A Potential Effects Analysis should be developed, including consultation with marine fisheries authorities and the local fishing community and advance notice of ship arrivals will be provided to fishers.

No potential adverse effects have been identified for decommissioning of the LNG facility, therefore mitigation is not necessary.

5.1.23.3 Residual Effects

Provided mitigation is implemented as described above, no potential adverse effects are expected. The effects will be low in magnitude. Therefore, residual effects of the Project during all Project phases have been determined not significant.

5.1.23.4 Follow Up

Follow up monitoring presented in Section 5.1.2.4 will detect any unpredicted adverse effects.

5.1.24 Aquaculture

5.1.24.1 Environmental Effects Prediction

There is no direct interaction between the LNG facilities and local aquaculture. The only effects to aquaculture would be the accidental release of contaminants to the marine environment. Potential effects and mitigation for accidental events and malfunctions is described in Section 10.0.

5.1.24.2 Mitigation Measures and Monitoring

In accordance with Item 3.4 of the NSEL EA approval conditions, a proposed aquaculture compensation plan will be developed to be implemented in the event that any KDP related adverse effects on aquaculture are detected.

5.1.24.3 Residual Effects

No residual effects are expected.

5.1.24.4 Follow Up

No follow up monitoring is required.

5.1.25 Tourism

5.1.25.1 Environmental Effects Prediction

The Guysborough County Heritage Association works to promote tourism, heritage, and culture in the region. One of the prime assets of the Eastern Shore tourism sector is its natural beauty. However, the sector also suffers from lack of accessibility which leads to reduced tourism flows and limited services for tourists.

The Project may have adverse effects on tourism near the Project Site due to the inevitable change of the visual landscape character.

<u>Construction</u>

Tourism may be impacted during construction in the short term due to potential highway detours and truck access to the site as well as possible lane closures during construction near Highway 316.

<u>Operation and Maintenance</u>

Although, some components of the proposed development will be hidden from views along the highway, the new facility will be clearly visible and change the local visual character of the landscape from a rural, mostly natural setting to a landscape with industrial development. This is likely to affect outdoor-oriented tourism in the immediate vicinity of the Project Site.

The increased economic activity in the area caused by the new facility will bring about improvements in accommodations and food services, other personal services, and retail trade. The Eastern Shore has a limited supply of these services. Their expansion will make the general area more attractive to tourists and provide the potential for tourism related economic growth.

The Guysborough County Heritage Association is currently developing a marketing strategy that includes a website, brochures, and signage, to increase the profile of the region and highlight its heritage resources. Currently, most visitors are likely to just pass through the area due to a lack of infrastructure.

There are potential adverse effects to the visual character of the landscape due to the construction of the facilities.

Modifications and Decommissioning

No environmental effects on tourism are expected during the decommissioning of the LNG facility.

5.1.25.2 Mitigation Measures and Monitoring

Construction

Dust suppressants and regular road cleaning protocols will be applied as required to reduce the loss of the natural landscape character. Also, during initial site clearing, the tree and shrub buffer along the site perimeter will be maintained as a visual screen. Road access will also be designed to minimize views into the construction site.

Operation and Maintenance

Tree and shrub planting as visual screens along the site perimeter and Marine Drive will be implemented near the Project. Colour schemes that support background blending will also be utilized for stacks and higher buildings. Road access will be jogged to prevent clear views of the facility and roadways will be cleaned regularly. A Dust Management Plan, ESC Plan, and Surface Water Monitoring Program will be implemented.

Modifications and Decommissioning

During decommissioning and modifications, the interpretive centre will be used to keep the public informed of current activities.

5.1.25.3 Residual Effects

The Project is not expected to have significant adverse effects on tourism near the Project Site. It is unlikely that the Project will have a significant effect on tourism over the long term and on a regional scale. It has been seen with other large scale developments in rural areas with little tourism-related infrastructure, the effects may be beneficial to the tourism.

Construction

During construction, the Project is expected to have no significant adverse effects on tourism near the Project Site.

Operation and Maintenance

During operation and maintenance, no significant adverse residual effects on tourism are likely to occur.

Modifications and Decommissioning

During modifications and decommissioning, no significant adverse residual effects on tourism are likely to occur.

5.1.25.4 Follow Up

No follow up monitoring is anticipated.

5.2 ENVIRONMENTAL EFFECTS OF THE MARGINAL WHARF

5.2.1 Hydrology

There are no environmental effects on hydrology for this Project component as it is marine and intertidal in nature.

5.2.2 Freshwater Quality/Quantity

5.2.2.1 Environmental Effects Prediction

Construction

The construction of the marginal wharf on the Red Head peninsula will result in the filling in of two brackish ponds. The potential effects and mitigation are discussed in Section 5.2.14. The portion of the unnamed tributary to Dung Cove will be avoided. The potential effects to it are discussed in Section 5.1.2.1.

Operation and Maintenance

There are no environmental effects on freshwater quality/quantity for this Project component as it is marine and intertidal in nature.

Modifications and Decommissioning

The potential effects to freshwater quality/quantity during the decommissioning of the LNG facility are applicable for decommissioning of the marginal wharf.

5.2.2.2 Mitigation Measures and Monitoring

The mitigation presented in Section 5.1.2.2 is considered to be sufficient for construction, operation, and decommissioning of the marginal wharf.

5.2.2.3 Residual Effects

With the implementation of the mitigation measures provided in Section 5.1.2.2, the magnitude of the environmental effects from potential sedimentation will be low and the geographic extent will be a small local water course adjacent to the Marginal Wharf. The duration of the effect will be short term and restricted to only storm events. Also, the effect from sedimentation is expected to be reversible. Therefore, no significant adverse residual effects are likely to occur during any of the Marginal Wharf Project phases.

5.2.2.4 Follow Up

The follow up presented in Section 5.1.2.4 is considered to be sufficient for construction, operation, and decommissioning of the marginal wharf. Other monitoring for mitigation measures are presented in Section 5.1.2.2.

5.2.3 Groundwater Quality/Quantity

5.2.3.1 Environmental Effects Prediction

There are no environmental effects on groundwater quality/quantity for this Project component as it is marine and intertidal in nature.

5.2.4 Marine Water Quality

5.2.4.1 Environmental Effects Prediction

The construction, operation and decommissioning of the marginal wharf may cause impacts to marine water quality.

The water quality may be impacted by the re-suspension of contaminated sediments through construction activities and propeller wash from large vessels. Additional potential impacts would be the result of fuel spills from construction vehicles or marine vessels or the release of contaminants from the operation of the facility. The effects and mitigation for accidents and malfunctions is discussed more thoroughly in Section 10.0.

The effects of suspended sediments during construction, operation, and decommissioning are addressed in Section 5.2.5.

5.2.4.2 Mitigation Measures and Monitoring

As per the Provincial EA Report commitments, silt screens, curtains, and containment booms surrounding the construction area will be utilized to reduce the potential siltation/sediment loading impacting fish populations (especially sensitive species that may frequent the area) and benthic communities. Construction techniques will be designed to minimize the disturbance of sediment and the use of appropriate erosion and sediment control measures will be implemented to also minimize the disturbance of sediment. See Section 10.0 for mitigation measures for accidents and malfunctions, and Section 5.2.5 for more mitigation measures for suspended sediments. In accordance with Item 1.5 in the NSEL EA approval conditions (NSEL, 2007), a plan to mitigate the human health and environmental impacts of the contaminated mine tailings and/or soils and sediments on the Project Site, via remediation or risk management will be developed and implemented. This plan will be consistent with the Nova Scotia Guidelines for the Management of Contaminated Sites. The Remedial Action Plan and/or Risk Management Plan will be approved by NSEL prior to commencement of construction. Upon completion of the remediation or risk management work, including any required monitoring, Keltic will submit a

Certificate of Compliance to NSEL to demonstrate that the remediation work has been completed and/or the Risk Management Plan is effective (NSEL, 2007).

Large vessels will be berthed with the support of tugs to prevent the re-suspension of contaminated sediments. Vessels will operate with adherence to International Convention for the Prevention of Pollution from Ships (MARPOL) as outlined in Section 10.0.

Mitigation for marine water quality will include visual monitoring for turbidity which will then require the collection of water sampling for the measurement of sediment levels. If sediment levels exceed CCME limits as a result of construction or infill activities, the work will be stopped and DFO / NSEL will be contacted. Materials used for infill will be free of excessive fines, clean, non-toxic and from a non-ore bearing source. If any construction debris/material enters the marine environment it will be removed immediately and disposed of in a provincially approved manner. Any equipment that has been in the marine environment will be cleaned of any sediments, plants, or animals and washed with freshwater and/or sprayed with undiluted vinegar prior to being mobilized to the Project Site. All construction waste material (including excavated soil and creosote timber waste) will be disposed of in a provincially approved manner. Careful maintenance and monitoring of all equipment will be carried out to minimize the risk of spills or leaks of petroleum based products.

Equipment refuelling operations will take place at least 30 m from any watercourse and as well as Stormont Bay harbour and the refuelling will take place on a prepared impermeable surface with a collection system with the exception of marine equipment. All equipment to be used in or over the marine environment is to be free from leaks or coating of hydrocarbon-based fluids and/or lubricants that are harmful to the environment. Hoses and tanks will also be inspected on a regular basis to prevent fractures and breaks.

Contaminated material will not be placed in a non-contained area. All debris and leachates (films on water surface) will be contained within the area of the work by using containment devices such as floating booms or screens.

The following protection procedures are intended to minimize the potential effect of accidental releases and the cleaning of concrete pouring equipment in the terrestrial and/or marine environment:

- any accidental release of concrete will be removed prior to solidification;
- concrete trucks will be clean and will not release any material during transport to the site;
- wash water from the cleaning of concrete trucks will be discharged either at the concrete manufacturer's place of business or to a designated area off-site;
- all such discharges will be of minimal volume and will not occur within the buffer zone of a watercourse/wetland or other environmentally sensitive area;
- miscellaneous concrete equipment will be washed and cleaned at an approved location off-site.
- residual concrete, including concrete resulting from cleaning of concrete pumping systems/equipment and rejected concrete batches, will be disposed of at concrete collection facilities;

- concrete handling will be conducted under the WHMIS program, whereby only trained personnel handle the concrete and only in accordance with manufacturer's instructions and government regulations; and
- all employees responsible for the handling of concrete will be appropriately trained.

5.2.4.3 Residual Effects

Provided the proposed mitigation measures are implemented as suggested in Sections 10.0 and 5.2.5, all environmental effects on marine water quality are expected to be reversible and of low magnitude. Therefore, any residual environmental effects on marine water quality are likely not significant.

5.2.4.4 Follow Up

As per the Provincial EA Report commitments, turbidity will be monitored during construction of the marginal wharf and will continue 2 to 3 days after construction is complete.

5.2.5 Soil/Sediment Quality (terrestrial and marine)

5.2.5.1 Environmental Effects Prediction

Construction of the marginal wharf may impact both terrestrial and marine soil quality. The potential adverse effects, mitigation, residual effects, and follow up for terrestrial soil quality have been presented in Section 5.1.5 and are relevant here. The potential impacts for marine sediments will be covered in this section.

Construction

The marginal wharf will be constructed from pre-cast concrete caissons, placed on a granular stone mattress then positioned on the seabed. Construction of the marginal wharf will involve enclosing the future wharf area with concrete caissons or sheet piling, followed by filling the interior with aggregate to provide a structure capable of holding heavy large storage silos and other equipment. The construction procedure will prevent sediment escape from the interior of the wharf infill area. Propeller wash from vessels could potentially disturb sediments in and around the wharf and terminal. As per Condition 1.10 of the NSEL EA sediment modelling to predict the assimilative capacity of all receiving environments will be conducted.

Marine sediment may be impacted by the introduction of contaminants in runoff as a result of accidental spills and malfunctions. This has been addressed in Section 10.0.

Operation and Maintenance

Propeller wash from vessels could potentially disturb sediments in and around the wharf and terminal.

Marine sediment may be impacted by the introduction of contaminants in runoff as a result of accidental spills and malfunctions. This has been addressed in Section 10.0.

Modifications and Decommissioning

Potential effects to soil and/or sediment quality due to the decommissioning of the marginal wharf include the re-suspension of contaminants from marine sediment and the introduction of contaminants in runoff as a result of accidental spills and malfunctions.

5.2.5.2 Mitigation Measures and Monitoring

Construction

To mitigate possible re-suspension of sediment during construction of the marginal wharf concrete caissons or sheet piling will be put in place followed by filling the interior with aggregate to provide a structure capable of holding heavy large storage silos and other equipment. The construction procedure will prevent sediment escape from the interior of the wharf infill area. Silt curtains and booms will also be used during construction to minimize siltation in the marine environment.

Tugs will be used to manoeuvre and dock large vessels, minimizing the potential impact of propeller wash. As a result, no impact from sediment contamination is anticipated.

Also, in accordance with Item 1.10 in the NSEL EA approval conditions, baseline data collection for all relevant chemical parameters which are expected to enter the environment or be remobilized as a result of Project activities in all receiving environments will be collected. Assimilative capacity of all receiving environments for all relevant chemical parameters will then be predicted (NSEL, 2007).

Mitigation for spills from potential accidents and malfunctions is covered in Section 10.0.

Operation and Maintenance

Tugs will be used to manoeuvre and dock large vessels, minimizing the potential impact of propeller wash. As a result, no impact from sediment contamination is anticipated.

Modifications and Decommissioning

Mitigation measures presented for the construction phase are sufficient for modifications and the decommissioning phase as well.

5.2.5.3 Residual Effects

Construction

The low probability of contaminants occurring in the marine construction area, coupled with the proposed construction methods, will ensure no heavy metal contamination results from the construction of the marginal wharf. Therefore, no significant adverse residual environmental effects on soil and sediment quality are likely to occur.

Operation and Maintenance

Provided the proposed mitigative measures are implemented as suggested, the environmental effects due to re-suspension of contaminated sediments from propeller wash and accidental spills from vessels will be low in magnitude and reversible. Therefore, no significant adverse residual environmental effects on soil and sediment quality are expected.

Modifications and Decommissioning

See “Construction” above.

5.2.5.4 Follow Up

No follow up monitoring is anticipated.

5.2.6 Air Quality

Air quality was originally conducted for the purpose of the provincial EA Report (AMEC, 2006) and included all KDP components as well as the petrochemical and co-generation facilities. Therefore, the case presented for air quality is for the worst case scenario as additional facilities outside of the scope of this document are included in the modelled numbers. Please refer to Section 5.1.6 for details on the effects of air quality for the KDP.

As mentioned in Section 5.1.6.1, potential emissions from cargo vessels which will be tied up at the Marginal wharf were not included in the modeling assessment as the size, configuration and fuel types were not known. However, an additional air dispersion modelling analysis will be done in accordance with the NSEL Terms and Conditions for Environmental Assessment Approval. This analysis will include potential emissions from cargo vessels at the Marginal Wharf.

5.2.7 Climate Conditions

Climate conditions and climate change are discussed in the context of air quality, please refer to Section 5.1.6.

5.2.8 Vegetation (terrestrial and marine)

5.2.8.1 Environmental Effects Prediction

Construction

The marine habitat in the vicinity of the proposed marginal wharf facilities is predominantly rock and kelp with patches of eelgrass and sand. This habitat is of most value to lobster, the principal commercial species fished in the area, however the area that will be lost has not been identified as limiting or critical habitat. In addition, contaminated sediments could be re-suspended and re-distributed during construction of the marginal wharf.

Terrestrial vegetation on the Red Head Peninsula will be lost as a result of the marginal wharf construction. A more complete discussion of the effects, mitigation and residual effects to terrestrial vegetation can be found in Section 5.1.8.

Several wetlands may receive impacts from construction of the marginal wharf. Site construction may result in filling, excavating, and otherwise disturbing wetlands, which in addition to unique habitat loss may alter the hydrological integrity of the site. A more complete discussion of the effects, mitigation and residual effects to wetlands can be found in Section 5.2.14.

Operation and Maintenance

Contaminated sediments could be re-suspended and re-distributed by propeller wash from LNG tankers or supply ships docking at the marginal wharf. There is also an opportunity for invasive aquatic species to be introduced via ballast water from these vessels.

Modifications and Decommissioning

Adverse effects to vegetation during the decommissioning phase include potential for the accidental release of contaminants to the environment.

5.2.8.2 Mitigation Measures and Monitoring

Construction

Construction of the marginal wharf will not include dredging and will begin by enclosing the future wharf area with concrete caissons or sheet piling, followed by filling the interior with aggregate. This procedure will prevent sediment escape from the interior of the wharf infill area. In addition, silt curtains and booms will be used during construction to minimize siltation in the marine environment.

No sediment contamination was identified in the area of the marginal wharf. Large vessels, however, will be berthed with support of tugs in order to minimize the effect of propeller wash.

Marine vegetation can be expected to establish itself on the marginal wharf following construction and FHCP will provide some habitat for the establishment of marine plants (Appendix 5).

Operation and Maintenance

Mitigation measures will be used to prevent the spread of invasive and non-native species within the marine environment. LNG vessels will be brought in fully loaded and re-ballasted offshore. Keltic will adhere to the Ballast Water Control and Management Regulations.

No sediment contamination was identified in the area of the marginal wharf. Large vessels, however, will be berthed with support of tugs in order to minimize the effect of propeller wash.

Modifications and Decommissioning

Mitigation presented for the construction phase is sufficient for the decommissioning phase as well.

5.2.8.3 Residual Effects

Provided the proposed mitigative measures are implemented, the magnitude of the Marginal Wharf Project effects on vegetation will be low (See Table 6.2-5, Section 6.0). Therefore, no significant adverse residual environmental effects on vegetation are likely to occur.

5.2.8.4 Follow Up

Construction

Monitoring of the Fish Habitat Compensation will be done to determine the success of the new habitat

Operation and Maintenance

A vegetation monitoring program will be established to check the success of replanting and habitat restoration programs, where applicable. These will be done at least twice per year in late May-early June and again in late August, as required. Appropriate restorative plantings will be done shortly after these inspections.

Modifications and Decommissioning

No vegetation monitoring programs have been developed at this time.

5.2.9 Species at Risk

5.2.9.1 Environmental Effects Prediction

Construction

There is potential for the construction of the marginal wharf to effect the foraging of roseate tern individuals. Although no foraging sites are known to be located within or adjacent to the marginal wharf location, one individual roseate tern was observed flying near the shore of the south terminal area. The closest documented foraging site is located approximately 2 km from the Marginal Wharf Project Site, on the shore of Harbour Island. The Roseate Tern Recovery Plan (Environment Canada, 2006) identifies the need for further research on foraging habit and indicates that foraging habitat may be considered as “critical habitat” in the future.

Construction of the marginal wharf will be short term (approximately 15 months).

Adverse effects to species at risk during the construction phase include potential for the accidental release of contaminants to the environment. Mitigation for accidental events is presented in Section 10.0.

Operation and Maintenance

There are potential adverse effects to the roseate tern nesting habitat on Country Island, including foraging. The colony could be affected by ship deliveries, ship lights, and from bilge water or accidental spill of fuel or other contaminants from vessels. Booms and other spill prevention and clean-up equipment will be maintained at the wharf facilities to ensure minor spills do not impact the local environment. Mitigation for accidental events is presented in Section 10.0.

Modifications and Decommissioning

Adverse effects to species at risk during the decommissioning phase include potential for the accidental release of contaminants to the environment. Mitigation for accidental events is presented in Section 10.0.

5.2.9.2 Mitigation Measures and Monitoring

Construction

Keltic personnel will be trained in identifying the roseate tern and will report any occurrences of the species in the marginal wharf area during construction to the CWS. Information on the bird's activities such as flying, diving, swimming, etc will be documented and provided.

As a component of NSEL Condition 2.7, the Proponent is committed to prepare an Adaptive Management Plan (AMP), consisting of various elements acceptable to EC and NSDNR, as well as a spill response plan. To address concerns with potential impacts to foraging Roseate Terns in Stormont Bay, it is expected that the AMP will include coordination with multiple stakeholders to monitor and manage potential cumulative effects on the Roseate Tern.

Mitigation relevant to accidents and malfunctions has been provided in Section 10.0.

Operation and Maintenance

To mitigate potential effects shipping lanes will be established so no ships will approach within 200 m of Country Island (as per the Roseate Tern Recovery Strategy) as well as establishment and adherence to MARPOL.

Mitigation relevant to accidents and malfunctions has been provided in Section 10.0.

Modifications and Decommissioning

Mitigation relevant to accidents and malfunctions has been provided in Section 10.0.

5.2.9.3 Residual Effects

Construction

No significant adverse residual environmental effects on roseate tern are likely to occur. The environmental effects will be low in magnitude, temporary, and reversible (See Table 6.2-6, Section 6.0).

Operation and Maintenance

No residual effects are anticipated since the environmental effects are low in magnitude and are reversible.

Modifications and Decommissioning

No residual effects are anticipated.

5.2.9.4 Follow Up

As outlined in the NSEL Terms and Conditions for Environmental Approval, under Condition 2.7, a project wildlife monitoring program will be developed in consultation with NSDNR and CWS. An AMP for the Roseate Tern will be prepared and implemented as per Section 5.2.9.2.

5.2.10 Fish and Fish Habitat (marine and freshwater)

5.2.10.1 Environmental Effects Prediction

The potential adverse effects, mitigation, and residual effects to fish habitat as a result of contaminated sediment are discussed in Section 5.2.5. The FHCP (Appendix 5) details the potential effects on the fish habitat to be altered or destroyed.

Construction

Freshwater

No freshwater areas are anticipated to be impacted as a result of the proposed Project; however, the construction of the marginal wharf on the Red Head peninsula will result in the filling in of Ponds 4 and 5 at that site (Figure 4.1-5). These ponds both have brackish water and are less than 1 ha in total area. Given the size of the ponds and that they are isolated and only provide habitat for forage fish, destruction of the ponds does not represent a significant impact to fish habitat. Fish habitat compensation will be determined through a *Fisheries Act* authorization.

Marine

The marine habitat of Stormont Bay supports a typical range of marine and estuarine species (i.e. fish, shellfish, marine mammals, and coastal and seabirds), and provides a migratory path for some fish, such as Atlantic salmon and sea-run trout. Lobster is by far the most important species in terms of economic value within the Bay, and thus the emphasis in assessing impacts has been placed on this species.

The marginal wharf will result in loss of fish habitat measuring approximately 210,000 m^2. A permitting process (HADD) through DFO is required to authorize this loss.

The marginal wharf has the potential to affect wave action and currents around the facilities which influence sediment distribution, particularly the marginal wharf. The information contained in the Country Harbour Report was used to design the jetty and the trestle and will be used to finalize wharf design as FEED progresses.

A general assessment of these potential impacts was carried out. In summary, currents in the vicinity of the marginal wharf will be affected by the presence of the wharf. The increased strength of currents adjacent to the face of the wharf is anticipated to increase by between 10 and 20 per cent. Increased current strength near the face of the wharf will tend to create more scour and may result in the movement of material, with more movement of finer-grained sediments. The effect of the local wave climate will be to lessen the potential for sediment transport north in the lee of the wharf but increase it to the west and south due to reflected wave energy. The existing shoreline is composed primarily of coarse cobble-sized rock pushed shoreward during storms. Sand and finer materials are only available in relatively small depressions near the wharf. Overall, relatively minor changes in sediment texture and thus fish habitat are anticipated following wharf construction.

Detailed oceanographic modelling and the impact on shorelines in the area will be conducted as part of the FEED to confirm the configuration of the wharf and jetty. Any sediment movement identified during this modelling stage will be addressed through Project design and/or mitigation.

The habitat in the vicinity of the proposed Keltic facilities comprises three basic types: rock and kelp; eelgrass and sand; and sand and mud. Based on video transects, the area to be occupied by the wharf is predominantly rock and kelp with patches of eelgrass and sand. Sand and mud bottom are primarily associated with deeper water (>12 m) where the proposed LNG Marine Terminal is to be located. This habitat is of most value to lobster and sea urchins, two species that are fished in the area. Lobster is the principal commercial species fished in the area.

Environmental effects of the marginal wharf on macrobenthos habitat and communities will occur during the construction phase. Physical destruction and alteration, of the seabed will occur as a result of the marginal wharf concrete caissons placed on the substrate. These activities will displace a limited number of benthic organisms that are considered typical in the area. These species are listed in Section 4.2.2.1.

Past surveys have shown that the area of fish habitat in the eastern part of Stormont Bay is relatively consistent between the proposed Keltic facilities and Harbour Island – a mix of rock, boulder, kelp, and patches of sand. In deeper areas, outside Country Harbour Head and past Harbour Island, habitat is patchier, related primarily to water depth and substrate.

Approximately 60% of the wharf area is typical of lobster habitat, representing approximately 1.6% of the lobster habitat within Stormont Bay. If lobster habitat within the approaches to Stormont Bay is also considered, the percent lost to construction of the wharf drops to 0.45%.

Factors that most influence lobster productivity is habitat and food supply (Cobb et al., 1999). The type of fish habitat preferred by lobster, however, changes with the age of the animal.

Post-larval lobsters live in burrows until they reach about 25 mm carapace length (CL). For lobsters between 25-50 mm CL a coarse substrate and a suitable amount of cover is necessary. Lobsters with a CL of >50 mm prefer areas with algae, stones, and large crevices. Some larger lobsters have been observed on compact sand or mud bottoms consolidated by eelgrass. All sizes of lobster have been observed co-existing in areas with large stone size and heavy algal cover. Sand covered in eelgrass had a low abundance of juveniles and adults, while on bare sand bottoms no resident lobsters were observed (National Oceanographic and Atmospheric Association, 1994).

Post-larval lobsters spend a few years "in self-dug tunnels or in the natural crevices under cobble" (Harding, 1992). Post-larvae, in their burrows, feed on plankton and may also prey on small benthic organisms. This habitat provides shelter from potential predators when the post-larval lobsters are still small and quite vulnerable. This part of the life cycle is critical to recruitment to the fishery, and the amount of post-larvae that settle in an area is directly proportional to the number of fishery recruits to that area (Miller, 1997). At the same time, the numbers of post-larvae that settle in an area is an overriding factor in determining an area's productivity.

The nearshore migration of a small number of searun trout and Atlantic salmon may be affected by the construction of the wharf.

Operation and Maintenance

Freshwater

As discussed in Section 5.1.2, at the Project Site, all wastewater will be collected and treated to applicable government standards and objectives prior to discharge to the environment. The discharge quality will be monitored in order to verify the effectiveness of the treatment. Adverse effects on aquatic species and habitat during the operation phase are not expected to be significant.

Marine

The operation of the Marginal Wharf Project facilities will involve arrival, loading or unloading of cargo, and departure of cargo vessels. Anticipated traffic is perhaps as many as three traditional cargo vessels. Booms and other spill prevention and clean-up equipment will be maintained at the wharf facilities to ensure minor spills do not impact the local environment, including fish habitat. Thus, no ongoing impacts on fish habitat are anticipated.

Modifications and Decommissioning

Decommissioning activities may increase the turbidity in both the freshwater and marine environments. The potential also exists for the accidental release of contaminants into these environments.

5.2.10.2 Mitigation Measures and Monitoring

Construction

Freshwater

No impacts are anticipated to freshwater areas as part of the proposed Project, however, construction of the marginal wharf and LNG Marine Terminal on Red Head Peninsula will result in the loss of two brackish ponds and their associated habitat and fish community. These losses will be separately addressed in the FHCP which will be submitted to DFO as part of Keltic's Application for Authorization, a draft of which is presented in Appendix 5 of this CSR. The FHCP will be completed in accordance with DFOs hierarchy of compensation options and the "no net loss" of habitat objective. In addition, the following mitigative measures should be followed:

- conduct in-water works during non-critical periods;
- restore substrates;
- use suitable backfill materials; and
- implement effective erosion control measures.

Marine

The construction of the Marginal Wharf Project will result in some losses and alterations of fish and aquatic habitat that cannot be avoided. In accordance with the requirements of the *Fisheries Act* and relevant policies of the DFO, Keltic will be required to compensate for these losses/alterations to the satisfaction of DFO so as to achieve "no net loss" of fish habitat. Information on fish habitat was collected by ROV survey and submitted to DFO as part of this permitting process, along with an assessment of the role of this habitat to fish production, primarily lobster. Under the HADD process, compensation for loss of productive habitat is required, and information on a potential compensation projects were also submitted to DFO. The proposed mitigation and compensation plans are addressed in the FHCP. These assessments indicated that it should be possible to augment fish habitat in the vicinity of Stormont Bay to more than replace any loss of habitat due to the facilities. Keltic will continue consultations with local recreational fisheries groups and municipalities to refine marine compensation plans. Options for proposed FHCPs are presented in Appendix 5.

Essentially all of the mitigative actions described in Section 5.1.2 and 5.1.4 are also valid for the protection of marine species and their habitats, so the reader is referred to this section. In addition, readers should refer to the following two sections relating to impacts on marine species and habitat (more specifically the impacts of accidental spills on marine environments):

- Section 5.1.5 Mine Workings; and
- Section 10.0 Hazardous Material Spills.

Existing habitat could be adversely affected by sediment from construction, disturbance of heavy metals in sediment, or accidental spills. Mitigation of these effects includes the use of construction techniques designed to minimize the disturbance of sediment in the marine environment. Sediments in the vicinity of the proposed wharf do not have concentrations of contaminants to be of concern. Mitigation related to sediment and spill control will include standard measures such as the use of a boom and silt curtain around the construction area to contain any accidental spills or minor sediment plumes.

Once the wharf and terminal design has been finalized, modeling will be carried out in more detail to assess potential changes in substrate and a monitoring program will be developed if required. For mitigation measures for the possible effects from the Marginal Wharf infill, readers should also refer to Section 5.1.4.2 and Table 10.9-1 from the Provincial EA Report (AMEC, 2006).

Operation and Maintenance

Freshwater

Contingency and remediation measures will be in place in case accidental spill events occur that have the potential to damage freshwater aquatic habitat. This includes measures applicable to the operational phase of the LNG Unloading Facilities. Spill prevention and clean-up equipment will be maintained at the wharf facilities to ensure minor spills do not impact the local environment, including fish habitat. Additional mitigation for freshwater quality is presented in Section 5.2.2.

Marine

The operation of the Marginal Wharf Project will not result in routine emissions which will impact fish habitat. Equipment will be maintained on-site to handle small accidental spills, and a boom will be deployed around vessels actively loading or unloading hydrocarbons or other noxious material. Arrangements will be made with appropriate responder organizations to assist in the event of a large spill (see also discussions in Section 10.0).

Modifications and Decommissioning

Mitigative measures presented for the construction phase are sufficient for the decommissioning phase as well.

5.2.10.3 Residual Effects

Construction

It is unlikely that the nearshore migration effects on searun trout and Atlantic salmon will be significant for either of these species since the remaining channel area will be very large and these fish tend to move relatively slowly upstream during the period of adjustment from saltwater to freshwater, generally moving towards a river mouth with tidal flows.

The amount of fish habitat lost as a result of construction of marine facilities, between 0.45 and 1.6%, will be replaced through the fish habitat compensation project required by DFO.

Provided the proposed mitigative measures are implemented, no significant adverse residual environmental effects on fish and fish habitat in both freshwater and marine environments are likely to occur.

<u>Operation and Maintenance</u>

Provided the proposed mitigative measures are implemented, the environmental effects are expected to be low in magnitude and reversible. The geographic extent of the effect is the entrance to Isaac's Harbour and Stormont Bay. Therefore, no significant adverse residual environmental effects on fish and fish habitat in both freshwater and marine environments are likely to occur (See Table 6.2-7, Section 6.0).

<u>Modifications and Decommissioning</u>

Provided the proposed mitigative measures are implemented, no significant adverse residual environmental effects on fish and fish habitat in both freshwater and marine environments are likely to occur since the environmental effects are expected to be temporary, reversible, and low in magnitude.

5.2.10.4 Follow Up

<u>Construction</u>

<u>Freshwater</u>

The monitoring programs planned for the construction period for freshwater fish and fish habitats are:

- survey fish communities in the unnamed tributary to Dung Cove by electrofishing and by trap netting in Dung Cove Pond;
- inspect/monitor sediment/erosion control measures at each on-site watercourse;
- annual fish community surveys (electro-fishing) in the unnamed tributary to Dung Cove Pond and annual trap-net surveys in Dung Cove Pond throughout construction period;
- annual description/photographs of aquatic and riparian habitat at established representative locations on all on-site watercourses and in Dung Cove Pond; and
- prepare annual reports to present results of the erosion-control monitoring and the annual fish surveys, and compare results (species presence, composition, etc) with previous years.

<u>Marine</u>

Monitoring of the habitat compensation project will be conducted in order to determine the success of the compensation project in relation to habitat production. Monitoring details will be developed in consultation with DFO and finalized once a Project has been accepted.

<u>Operation and Maintenance</u>

<u>Freshwater</u>

The monitoring programs to ensure the mitigation measures are effective for the construction period for freshwater fish and fish habitat are:

- Fish-community surveys in all on-site watercourses and the large Red Head pond for post-construction years 1, 2, 3 and 5, and every 5 years thereafter, if required.
- Describe/photograph aquatic/riparian habitat at established representative locations on all on-site watercourses and in Dung Cove Pond for post-construction years 1, 2, 3 and 5, and every 5 years thereafter.
- Prepare reports on results of the annual habitat and fish surveys and compare results (species presence, composition, etc) to previous years.

Marine

The monitoring program described for the construction phase will apply to the operational phase as well.

Modifications and Decommissioning

No follow up monitoring plans have been developed at this time.

5.2.11 Marine Mammals

5.2.11.1 Environmental Effects Prediction

Construction

Noise that can be heard by marine mammals can be generated from construction associated with the marginal wharf and the jetty, in particular, noise related to driving piles. Source levels have been shown to range from 131 - 135 decibels referenced to 1 microPascal (131 – 135 dB re 1 µPa) up to one kilometre from the source (Richardson et al, 1995 in Hammond et al, 2005) however there are no available data on the effects of pile driving on marine mammals (Hammond et al, 2005). At 358 m from pile driving, sound pressure levels were found to be 179 dB at 6 m depth (Caltran, 2001).

Construction-related adverse effects on marine mammals are possible. The NMFS has suggested that sound pressure levels that exceed 190 dB re 1 µPa may cause threshold shifts or temporary hearing impairments in marine mammals. Research on marine mammals shows that under certain circumstances underwater noise can cause a variety effects. This includes behaviour modifications, tissue rupturing or haemorrhaging at close range to the acoustic source, and temporary or permanent hearing loss. In addition new noise sources can mask other sounds important to survival, such as those made by calves, mates, or predators (Richardson et al., 1995).

Operation and Maintenance

During the operation of the Marginal Wharf, vessel traffic is expected to increase. 83% of the underwater acoustic field surrounding large vessels is the result of propeller cavitation (Southall, 2005). Little underwater acoustic energy is transmitted into the water from on-board machinery or movement of the vessel through the water. Noise from vessels may contribute to masking of sounds important to the survival of mammals. However, marine mammals have been known to adapt to masking sounds by changing the intensity and frequency of their vocalizations.

Stormont Bay is not particularly important in relation to marine mammals. Seals may haul out on the shoreline and small whales may enter the area to feed, following schools of herring and mackerel, but it is not considered critical or limiting habitat. Therefore, no significant impacts from the operation of the Marginal Wharf Project are expected.

Modifications and Decommissioning

An increase in noise may occur due to decommissioning efforts. Adverse effects during the decommissioning phase may also include potential for the accidental release of contaminants to the environment.

5.2.11.2 Mitigation Measures and Monitoring

Construction

The mitigation measures for underwater noise due to construction activities are outlined in Section 5.2.16.2 and Section 5.1.11.2. Mitigation for spills from potential accidents and malfunctions is covered in Section 10.0.

Operation and Maintenance

No mitigation of operational activities is required given the low level of marine mammal activity in the area.

Modifications and Decommissioning

Mitigation presented for the construction phase will be sufficient for the decommissioning.

5.2.11.3 Residual Effects

Construction

Given the low importance of the marine environment at the Marginal Wharf Project Site for marine mammals, and the implementation of the proposed mitigative measures identified above, no significant adverse residual environmental effects on marine mammals are likely to occur.

Operation and Maintenance

No significant adverse residual environmental effects on marine mammals are likely to occur (see Table 6.2-8 and text above in “Construction”).

Modifications and Decommissioning

No significant adverse residual environmental effects on marine mammals are likely to occur (see Table 6.2-8 and text above in “Construction”).

5.2.11.4 Follow Up

No follow up monitoring is planned.

5.2.12 Wildlife and Wildlife Habitat

5.2.12.1 Environmental Effects Prediction

Construction

A number of furbearers are on-site. The aquatic furbearers, mink, muskrat, beaver, and otter are on the terminal area around Dung Cove Pond and associated wetland. Habitat removal and disturbance may result in some or all of these being extirpated from the area.

The most concentrated winter deer activity observed was on Red Head Peninsula (See Figure 4.1-5). Clearing and construction activities are expected to have an impact, in all likelihood reducing or eliminating winter use by deer. Some loss of habitat is expected especially in the wetter areas such as Map Sites 4 and 5 (Figure 4.2-1) and Dung Cove Pond in the terminal area. Loss of habitat will affect snakes throughout, and possibly turtle habitat in Dung Cove Pond in the terminal area. Impact on small mammals is mainly related to loss of habitat. There are no rare or otherwise unique species expected in the area. There may be some minor noise effects on waterfowl that spend time along the marine shore in the terminal area due to blasting (if required).

Operation and Maintenance

The furbearers and wintering deer populations on the terminal area may be displaced; deer may winter elsewhere along the coast toward Drum Head and Seal Harbour.

There is expected to be an increase in birds that are especially compatible with human activity; i.e. starlings, robins, grackles, cowbirds, rock doves, some of which are nest predators and may otherwise compete with woodland and edge birds. Noise affects could cause changes in wildlife behaviour in nearby areas.

Birds are likely to undergo some mortality by collision with lighted towers and other structures. A more thorough discussion of the effects on birds can be found in Section 5.2.13 (Migratory Birds).

Modifications and Decommissioning

No adverse effects have been identified for the decommissioning of the marginal wharf. Potential impacts to water quality and soil and/or sediment quality are discussed in Sections 5.2.4 and 5.2.5 respectively.

5.2.12.2 Mitigation Measures and Monitoring

Construction

In addition to the mitigation provided in Section 5.1.12.2, disturbance to Dung Cove Pond will be minimized in order to avoid the potential loss of furbearer habitat in the Dung Cove Pond area. The area that is disturbed/ lost will also be minimized as much as possible in order to avoid the potential loss of white-tailed deer habitat (i.e., winter-concentration area in and near terminal area). Blasting activities will be conducted outside of bird nesting season (May 1 through August 1). Equipment must have appropriate noise-muffling equipment installed and in good working order. Noise monitoring at the site boundaries will be conducted as appropriate.

An EPP will be developed to mitigate the disturbance of the Dung Cove Pond area. The EPP will include site specific protection plans that will include:

- minimize the length of Dung Cove Pond area habitat disturbed;
- minimize the construction area, and construction period;
- stabilize watercourse/wetland beds and banks with clean rip rap when necessary to ensure stability;
- minimize ground and vegetative disturbance by:
    - locating staging areas outside of the Dung Cove Pond area, at least 30 m from the edge of wetland, where possible;
    - minimizing equipment in the Dung Cove Pond area to only that required for construction activity; and
    - using upland access roads wherever practical.
- maintain vegetative diversity by:
    - incorporating practices to prevent the spread of non-desirable invasive species throughout the construction area, including cleaning and inspection of construction equipment prior to use in Dung Cove Pond areas; and
    - allowing the Dung Cove Pond area to revegetate naturally unless adjacent to areas of potentially erodible soils.
- during site restoration, mitigate effect on vegetation by:
    - not applying fertilizer, lime, or mulch to the Dung Cove Pond area as part of the revegetation plan;
    - separating organic top soil from underlying soils, stock piling separately; and returning top soil to original horizon in areas where there is no open water or saturated soils; and
    - restoring original contours and cross drainage patterns.
- inspect equipment daily prior to use to detect leaks of fuels;
- all on-site fuels, oils, and chemicals will be stored at least 50 m from any surface waters where possible;

- ensure all spill prevention planning and detailed cleanup procedures are in place prior to construction;
- take necessary measures to reduce or avoid disruption of surface and ground water patterns;
- drainage control features will be implemented to prevent soil erosion and impacts to water quality; and
- boulders and tree trunks harvested during construction to be retained for possible use in aquatic habitat enhancements.

In compliance with NSEL condition for approval (Item 3.1), the EPP will be submitted to NSEL for review and approval. Also, the effects on Dung Cove Pond due to any drainage will be minimized due to the piping being on tresses.

Operation and Maintenance

The mitigation presented in Operation and Maintenance for the LNG facility is sufficient for the marginal wharf (Section 5.1.12.2).

Modifications and Decommissioning

The mitigation presented in construction for the LNG facility is sufficient for the marginal wharf (Section 5.1.12.2).

5.2.12.3 Residual Effects

Construction

The displacement and/or loss of wildlife are both permanent and non-reversible. The species that are being affected are not protected and there are no designated or protected lands involved in the clearing. Provided the proposed mitigative measures, such as the EPP (see Section 5.2.12.2 for details), are implemented, no significant adverse residual environmental effects to wildlife and wildlife habitat are likely to occur. Refer to Table 6.2-9 for more details on the criteria to determine the significance of residual environmental effects.

Operation and Maintenance

Provided the proposed mitigative measures are implemented as suggested, the magnitude of the environmental effect from the increased risk of bird collisions to the marginal wharf lighting is low in magnitude and temporary. Therefore, no significant adverse residual environmental effects on wildlife and wildlife habitat are likely to occur.

Modifications and Decommissioning

As outlined in Table 6.2-9, the criteria for residual environmental effects for the modifications and decommissioning phase is the same as the construction phase. Provided the proposed mitigative measures are implemented, no significant adverse residual environmental effects on wildlife and wildlife habitat are likely to occur.

5.2.12.4 Follow Up

The monitoring program described in Section 5.1.12 is applicable to the construction and operation of the marginal wharf.

5.2.13 Migratory Birds and Migratory Birds Habitat

5.2.13.1 Environmental Effects Prediction

Construction

As with terrestrial wildlife, the environmental effect of concern is the removal of migratory bird habitat from the LNG facility site and disturbance to migratory birds as a result of noise during construction. The effects discussed in Section 5.1.12.1 are applicable for migratory birds and habitat.

Operation and Maintenance

The effects discussed in Section 5.1.12.1 are sufficient to cover the possible effects for the operation of the marginal wharf.

Modifications and Decommissioning

No adverse effects have been identified for the decommissioning of the marginal wharf.

5.2.13.2 Mitigation Measures and Monitoring

Construction

The mitigation presented in construction for the LNG facility is sufficient for the marginal wharf.

Operation and Maintenance

The mitigation presented in operation and maintenance for the LNG facility is sufficient for the marginal wharf.

Modifications and Decommissioning

No mitigation is required.

5.2.13.3 Residual Effects

Provided the proposed mitigation measures are implemented, the magnitude of the environmental effects is low. Therefore, no significant adverse residual environmental effects on migratory birds are likely. See Table 6.2-10 in Section 6.0 for more details on the significance criteria.

5.2.13.4 Follow Up

No follow up monitoring is recommended for migratory birds.

5.2.14 Wetlands

5.2.14.1 Environmental Effects Prediction

Construction

The construction of the marginal wharf requires the infilling of two wetland ponds on the red head peninsula. This wetland habitat will be permanently lost. The loss of these wetlands accounts for less than 0.8 ha of the 5.2 ha of wetland habitat present on the LNG Project Site. Details of the impacts to wetlands will be submitted in accordance with Item 1.2 in the NSEL EA approval conditions (NSEL, 2007).

Operation and Maintenance

The two wetlands located within the marginal wharf footprint will be infilled during construction; therefore no environmental effects will occur as a result of operation and maintenance of the wharf.

Modifications and Decommissioning

The two wetlands located within the marginal wharf footprint will be infilled during construction; therefore no environmental effects will occur as a result of modifications and decommissioning of the wharf.

5.2.14.2 Mitigation Measures and Monitoring

Construction

A wetland functional analysis will be conducted prior to construction of the marginal wharf to document the habitat and functions that will be lost from the wetlands. This information will be used in completing a wetland compensation plan for the loss of this habitat. The Proponent will provide details for the plans for avoidance, mitigation, and or compensation for review and approval by the NSEL. This work will be undertaken by the Proponent in compliance with Item 1.2 of the NSEL EA approval conditions (NSEL, 2007). In accordance with the NSEL conditions, an EPP will also be implemented that will include the site specific protection plans for wetlands during the construction phase. See Section 5.1.14.2 for more details on the measures that will be implemented through the EPP.

Operation and Maintenance

No mitigation is required.

Modifications and Decommissioning

No mitigation is required.

5.2.14.3 Residual Effects

The geographic extent of the effects is the Red Head Peninsula, and the magnitude of the environmental effects is determined to be medium. Therefore, significance of the residual environmental effects is medium (not significant). Provided the wetland compensation plan is carried out, no significant adverse residual effects are expected during any of the Marginal Wharf Project phases.

5.2.14.4 Follow Up

A wetland compensation plan will be submitted to regulators for approval prior to construction. The compensation plan will include a monitoring program to verify that the work has been successful.

5.2.15 Lighting Conditions

5.2.15.1 Environmental Effects Prediction

Construction

No adverse environmental effects are expected from lighting during construction, prior to commissioning of the LNG facility.

Operation and Maintenance

Light will be emitted from all components of the KDP; however, the most noticeable will be from the Marine terminals, especially when vessels are at berth. This area is in the direct view plane of the communities of Goldboro, Isaac's Harbour, and Drum Head.

As discussed in Section 5.1.13, some migratory bird species can be particularly susceptible to disorientation caused by man-made light, especially under overcast or foggy weather conditions (Evans Ogden, 1996). Birds that are not killed outright by collisions with the light sources can succumb to exhaustion brought upon by prolonged fluttering around a light source or to predation upon individuals in weakened states (Evans Ogden, 1996).

Modifications and Decommissioning

No adverse environmental effects are expected from lighting due to the decommissioning of the marginal wharf.

5.2.15.2 Mitigation Measures and Monitoring

Construction

The mitigative measures presented for the facility operation are sufficient for the construction phase of the Marginal Wharf Project.

Operation and Maintenance

To minimize the impacts of light on the surrounding community the following measures should be applied:

- no unnecessary lighting should be used;
- lighting is to be shielded where possible; and
- lighting is to be angled or directed to work area.

The mitigation measures presented in Section 5.1.13 for migratory birds are sufficient for the operation and maintenance phase of the Marginal Wharf Project. In particular, the Proponent will comply with Item 1.6 of the NSEL EA approval conditions (NSEL, 2007).

Modifications and Decommissioning

No effects have been identified therefore mitigation is not necessary.

5.2.15.3 Residual Effects

Provided the proposed mitigative measures are implemented for construction and operations, the environmental effects are expected to be reversible and low in magnitude. Therefore, no significant adverse residual effects from lighting are predicted.

Modifications and Decommissioning

No residual effects from this phase of the Marginal Wharf Project are anticipated.

5.2.15.4 Follow Up

No follow up monitoring is anticipated.

5.2.16 Atmospheric and Underwater Acoustic Environment

5.2.16.1 Environmental Effects Prediction

There are concerns as to the impacts from construction activities that generate noise emissions transmitted through the underwater environment.

Construction

Although there is not an extensive use of the nearshore waters by cetaceans and seals (Section 5.2.11.1), these species may be susceptible to damage from the underwater noises generated using conventional pile-driving techniques.

A recent study on bottlenose dolphins showed that pile driving has the potential to negatively affect dolphin populations at a distance of up to 40 km. The potential impacts include interfering with communications, foraging, echolocation, and breeding.

Source levels have been shown to range from 131 - 135 dB re 1 μPa up to one kilometre from the source (Richardson et al, 1995 in Hammond et al, 2005) however there are no available data on the effects of pile driving on marine mammals (Hammond et al, 2005). At 358 m from pile driving, sound pressure levels were found to be 179 dB at 6 m depth (Caltran, 2001). For Incidental Harassment Authorizations, the NMFS has been known to establish preliminary safety zones that have a 500 m radius around pile driving sites. The safety zone is to include all areas that are expected to exceed 190 dB re 1 μPa RMS.

Construction-related adverse effects on marine mammals are possible. The NMFS has suggested that sound pressure levels that exceed 190 dB re 1 μPa may cause threshold shifts or temporary hearing impairments in marine mammals. Research on marine mammals shows that under certain circumstances underwater noise can cause a variety effects. This includes behaviour modifications, tissue rupturing or haemorrhaging at close range to the acoustic source, and temporary or permanent hearing loss. In addition new noise sources can mask other sounds important to survival, such as those made by calves, mates, or predators (Richardson et al., 1995).

Operation and Maintenance

Noise impacts on marine mammals during operation is not expected to be significant as most noise generated (i.e. ship engines) would be of a lower frequency than pile driving and other marine construction practices. The effects of underwater noise on marine mammals due to Project operations were discussed previously in Section 5.1.11.

Modifications and Decommissioning

The potential effects present for the construction phase are applicable for the decommissioning phase as well.

5.2.16.2 Mitigation Measures and Monitoring

Construction

The disturbance of marine life through noise emissions transmitted through the underwater environment (from activities such as conventional pile driving) (David, 2006) will be mitigated by the implementation of alternative techniques for pile driving such as vibratory pile-driving, adjusting the timing around sensitive periods and conducting driving during low tide. In addition recreational and commercial fishery representatives will be conferred with to develop seasonal and daily schedules to minimize disruption of fisheries.

Operation and Maintenance

No mitigation of operational activities is required given the low level of marine mammal activity in the area.

Modifications and Decommissioning

The potential effects addressed in the construction section are relevant for the decommissioning of the facility as well.

5.2.16.3 Residual Effects

Provided the proposed mitigative measures are implemented, the environmental effects will be reversible, temporary, and medium in magnitude (see Table 6.2-13, Section 6.0). Therefore, no significant adverse residual environmental effects are likely to occur.

5.2.16.4 Follow Up

No follow up programs are anticipated to be necessary.

5.2.17 Current Use of Lands and Resources for Traditional Purposes by Aboriginal Persons

5.2.17.1 Environmental Effects Prediction

Construction

There are three sea urchin diving areas located at Betty's Cove and Red Head. The construction of the marginal wharf will likely limit Mi'kmaq harvesting in this area. It should be noted that sea urchins in this area were largely decimated by a parasite in the late 1990's and have not made a significant recovery.

Medicinal plant gathering sites and areas were identified by the wetlands that are within the Project Site. The construction may result in some filling, excavating, and otherwise disturbance of wetlands, in addition to some loss of wetland vegetation.

Operation and Maintenance

The environmental effects for operation are the same as construction.

Modifications and Decommissioning

There are no environmental effects expected due to the decommissioning of the marginal wharf.

5.2.17.2 Mitigation Measures and Monitoring

Construction

For the effects on fishing, the draft FHCP outlined in Appendix 5 includes enhancement of benthic habitat within the same urchin licence area. This is predicted to offset any loss of sea urchin production and/or access once the species returns to commercial levels.

Wetlands within the LNG facility, if affected, will be rehabilitated and/or compensated to achieve "no net loss" in wetland functions. As required by the NSEL Terms and Conditions for Environmental Assessment Approval, wetland plans for avoidance, mitigation and/or compensation will be developed in consultation with NSEL and NSDNR.

To meet the requirements of Item 4.3 in the NSEL EA approval conditions, Keltic will develop a Mi'kmaq Communication Plan for the Project which will include but not be limited to:

1. processes for communicating Project details and seeking input from the Mi'kmaq community; and
2. plans for Mi'kmaq involvement in EEM and other Project aspects. The plan will be developed in cooperation with the Mi'kmaq Community.

Also, in accordance with Item 4.4 of the NSEL EA approval conditions, Keltic will take steps to further assess traditional Mi'kmaq use of the Project Site lands. The Proponent will develop the proposed steps in cooperation with the Mi'kmaq Community and will submit the results to NSEL.

Operation and Maintenance

For the effects on fishing, the draft FHCP outlined in Appendix 5 includes enhancement of benthic habitat within the same urchin licence area. This is predicted to offset any loss of sea urchin production and/or access once the species returns to commercial levels.

Modifications and Decommissioning

No mitigation is required.

5.2.17.3 Residual Effects

Construction

There will be no significant adverse residual effects due to the construction of the marginal wharf as the FHCP will offset any loss of sea urchin production and/or access once the species returns to commercial levels.

Operation and Maintenance

There will be no significant adverse residual effects due to the operation and maintenance of the marginal wharf as the FHCP will offset any loss of sea urchin production and/or access once the species returns to commercial levels.

Modifications and Decommissioning

No significant adverse residual effects due to the decommissioning of the marginal wharf are anticipated.

5.2.17.4 Follow Up

Monitoring of the Fish Habitat Compensation projects will be done to determine the success of the new habitat structures.

5.2.18 Physical and Cultural Heritage

5.2.18.1 Environmental Effects Prediction

Construction and operation of the Marginal Wharf may have effects on physical and cultural heritage. Due to previous excavation and removal of burials at Red Head in 2000 and 2001, complemented by subsurface testing in October 2004, there is confidence that no burials remain in the cemetery and, therefore, the site is no longer believed to be of high archaeological sensitivity. However, due to its association as the final resting place of the first Black Loyalists in Goldboro and Isaac's Harbour, it remains as a site of cultural significance to the nearby Black community at Lincolnville.

5.2.18.2 Mitigation Measures and Monitoring

In compliance with NSEL conditions of approval, prior to construction, an agreement with the African Nova Scotia Affairs will be entered into for the establishment of a memorial at the Red Head Cemetery site (Item 4.8) and a Cultural Heritage Plan will also be developed to ensure that the KDP construction and operations proceed in a manner that respects the cultural heritage value of the Red Head Cemetery site to the community, and that public access to the site will be maintained (Item 4.9). The plan will be reviewed and approved by NSEL. Additionally, an archaeology and heritage resources monitoring and contingency plan will also be prepared by engagement with Mi'kmaq stakeholders, African Nova Scotia Affairs, and the Nova Scotia Museum (Item 4.6).

5.2.18.3 Residual Effects

Table 6.2-15 outlines the significance of the criteria such as magnitude and geographic extent that is used to determine if there will be residual environmental effects. No significant adverse residual effects due to the construction, operation and decommissioning of the marginal wharf are anticipated.

5.2.18.4 Follow Up

No follow-up programs are required.

5.2.19 Structures/Sites of Archaeological, Paleontological or Architectural Significance

5.2.19.1 Environmental Effects Prediction

A complete discussion on the significance of archaeological resources is presented in Section 5.1.19.1

Construction

Each archaeological resource within the Study Area has been evaluated according to its relative significance based on the cultural and physical integrity of each resource, existing documentation, and the expected impact on those resources (Table 5.2-1).

TABLE 5.2-1 Relative Significance of Archaeological Sites within the Marginal Wharf Study Area

Archaeological Site or Resource	Archaeological Sensitivity	Cultural Sensitivity	Expected Impact (Yes/No)
Red Head Cemetery	Medium	High	Yes
Sculpin Cove 1	High	High	Unknown
Sculpin Cove 2	High	High	Unknown
Sculpin Cove 3	High	High	Unknown
Sculpin Cove 4	High	High	Unknown
Sculpin Cove 5	High	High	Unknown
Hurricane Island Mine	High	N/A	Unknown
McMillan Mine	Low	N/A	Yes
Dung Cove	High	High	Unknown
Giffin's Mill	High	N/A	No

Construction of the Marginal Wharf may have effects on several archaeological features. However, due to previous excavation and removal of burials at Red Head in 2000 and 2001, complemented by subsurface testing in October 2004, there is confidence that no burials remain in the cemetery and, therefore, the site is no longer believed to be of high archaeological sensitivity. However, due to its association as the final resting place of the first Black Loyalists in Goldboro and Isaac's Harbour, Red Head remains a site of cultural significance to the nearby Black community at Lincolnville. This site lies within the impact zone and is expected to be heavily disturbed.

The Sculpin Cove 1 to 5 sites produced no surface artefacts and shoreline erosion has not exposed any material culture. Although they are obviously of human construction, there is no evidence to indicate that they were occupied for extensive periods of time and their cultural, functional, and historical period affiliations are unknown. However, the possibility that they are related to late eighteenth century Black Loyalist settlement is present. Research into Black Loyalist settlement is just beginning in Nova Scotia and it is a current focal point of several projects in the province (Cottreau-Robins, MacLeod-Leslie, Niven, Whitehead). For these reasons, these features are believed be of high archaeological and cultural sensitivity. Although none of these five features are expected to be directly impacted by construction, the effect of ship wakes on these features as a result of product storage construction and ship berthing is of concern.

Hurricane Island Mine is a pristine example of late nineteenth-century mining in Nova Scotia. To the best of the archaeologists' knowledge, no research has been conducted to date on historic mining in the province during any period of the past. This site, then, is deemed of high archaeological sensitivity and community members have expressed concern regarding the fate of historic resources on the island. Hurricane Island is not expected to be impacted by construction.

The McMillan Mine is of early to mid twentieth-century origin and, therefore, is believed to be of low archaeological sensitivity. This site is located directly in the impact zone and is expected to be heavily disturbed by construction of the product storage area and access road.

The Dung Cove site is located within close proximity to the impact zone and the possible level of impact needs to be further understood. Due to the obscurity of features by low tree cover, no structural remains were visible at the Dung Cove site. However, the site does exhibit landscape modification congruent with agricultural activity. Although no surface artefacts were present to indicate the age of the site or its cultural affiliation, the potential that it is related to late eighteenth century Black Loyalist settlement exists. Therefore, this area is believed to be of high archaeological sensitivity.

The physical integrity of features at Giffin's Mill and the possibility of recoverable material culture make this site one of high archaeological sensitivity. There has been little or no research conducted on early twentieth century mills in the province and this site and its contents would likely be of interest to the Museum of Industry. The mill site is not expected to be impacted by construction.

Operation and Maintenance

The only expected impacts to archaeological resources during the operation phase are associated with the continued rise in water levels at Sculpin Cove and Hurricane Island. A rise in sea level and wakes created by ship berthing as a result of the operation of the marginal wharf may cause erosion to known archaeological sites at Sculpin Cove and on Hurricane Island.

Modifications and Decommissioning

The potential effects addressed in the construction section are relevant for the decommissioning of the facility as well.

5.2.19.2 Mitigation Measures and Monitoring

Construction

As a general rule, should any artefacts or human remains be discovered at any time during the construction work, the work is to be terminated until a qualified archaeologist assesses the find. To meet the requirements of the NSEL EA approval conditions (Item 4.7) (NSEL, 2007), if an archaeological site or artefact is discovered, the work will be halted and the Curator of Archaeology at the Nova Scotia Museum, and the Executive Director of the Union of Nova Scotia Indians will be contacted immediately. Should the find be deemed significant, the work is not to resume until further steps and protective measures are discussed in consultation with the archaeologist and regulatory authorities.

Red Head Cemetery

There is a high level of confidence that additional burials at the Red Head cemetery site are unlikely and that no further manual excavation is necessary. Due to the remaining cultural sensitivity of the site, however, a plan to ensure that Marginal Wharf Project development proceeds in a manner that respects the cultural heritage value of the Red Head Cemetery site to the community, and that public access to the site will be maintained. Also, an agreement will be entered into with the Office of African Nova Scotia affairs for the establishment of a memorial at the site. The agreement and the Cultural Heritage Plan will be implemented in accordance of Items 4.8 and 4.9 in the NSEL EA approval conditions (NSEL, 2007).

Sculpin Cove

The Sculpin Cove sites 1 through 5 are not expected to be directly impacted by construction and, therefore, no recommendations for mitigation are considered necessary. A complete archaeological assessment of the entire KDP site will be completed prior to construction as requested in the NSEL EA approval conditions (NSEL, 2007). Also, in accordance with Item 4.6 of the NSEAL EA approval conditions, an archaeology and heritage resources monitoring and contingency plan will be developed prior to construction. The plan will be developed in consultation with Mi'kmaq stakeholders, African Nova Scotia Affairs, and the Nova Scotia Museum.

McMillan Mine

The McMillan Mine is expected to be affected by construction of the product-storage area and wharf at Sand Cove as well as by the associated access road. It is considered to be of low archaeological sensitivity given its recent age, however, and no pre-construction investigation of the features is required. It should be noted that Sand Cove is situated north of Dung Cove, between Sculpin Cove and Red Head Cemetery. The Marginal Wharf will be constructed where Sand Cove is.

A complete archaeological assessment of the entire KDP site will be completed prior to construction as requested in the NSEL EA approval conditions (NSEL, 2007). Also, in accordance with Item 4.6 of the NSEAL EA approval conditions, an archaeology and heritage resources monitoring and contingency plan will be developed prior to construction. The plan will be developed in consultation with Mi'kmaq stakeholders, African Nova Scotia Affairs, and the Nova Scotia Museum.

Dung Cove

The Dung Cove location is believed to be of high archaeological and cultural sensitivity. The level of confidence concerning an understanding of the full extent of the site is low due to the obscurity of features by low tree cover. At this time, the site is not located within a direct impact zone (i.e., within the footprint of necessary infrastructure). A complete archaeological assessment of the entire KDP site will be completed prior to construction as requested in the NSEL EA approval conditions (NSEL, 2007). Also, in accordance with Item 4.6 of the NSEAL EA approval conditions, an archaeology and heritage resources monitoring and contingency plan will be developed prior to construction. The plan will be developed in consultation with Mi'kmaq stakeholders, African Nova Scotia Affairs, and the Nova Scotia Museum.

Giffin's Mill

Giffin's Mill is not expected to be affected by construction. Due to elevated levels of archaeological sensitivity, however, a complete archaeological assessment of the entire KDP site will be completed prior to construction as requested in the NSEL EA approval conditions (NSEL, 2007). Also, in accordance with Item 4.6 of the NSEAL EA approval conditions, an archaeology and heritage resources monitoring and contingency plan will be developed prior to construction. The plan will be developed in consultation with Mi'kmaq stakeholders, African Nova Scotia Affairs, and the Nova Scotia Museum.

Operation and Maintenance

In accordance with Item 4.9 in the NSEL EA approval conditions, a plan will be developed to ensure the KDP construction and operations proceed in a manner that respects the cultural heritage value of the Red Head Cemetery and that public access to the site will be maintained (NSEL, 2007). In accordance with Item 4.6, the Proponent, prior to construction, shall submit for review and approval of NSEL, an archaeology and heritage resources monitoring and contingency plan. The plan shall be developed in consultation with Mi'kmaq stakeholders, African Nova Scotia Affairs, and the Nova Scotia Museum.

Modifications and Decommissioning

Mitigative measures for the construction phase of the Marginal Wharf Project will be sufficient for the decommissioning phase as well.

5.2.19.3 Residual Effects

Construction

Table 6.2-16 outlines the significance of the criteria such as magnitude and geographic extent that is used to determine if there will be residual environmental effects. Provided the proposed mitigative measures are implemented, no significant adverse residual effects on archaeological resources or resources are likely to occur.

Operation and Maintenance

Table 6.2-16 outlines the significance of the criteria such as magnitude and geographic extent that is used to determine if there will be residual environmental effects. Provided the proposed mitigative measures are implemented, no significant adverse residual effects on archaeological resources or resources are likely to occur.

Modifications and Decommissioning

Table 6.2-16 outlines the significance of the criteria such as magnitude and geographic extent that is used to determine if there will be residual environmental effects. Provided the proposed mitigative measures are implemented, no significant adverse residual effects on archaeological resources or resources are likely to occur.

5.2.19.4 Follow Up

Archaeological compliance and monitoring programs are regulated by the NSMNHs manager of Special Places and subject to approval. The monitoring plans for these sites are summarized in Section 7.0 Table 7.2-4.

5.2.20 Navigation

5.2.20.1 Environmental Effects Prediction

Construction

Vessel traffic required during construction will have similar effects to vessels required during operation and maintenance of the marginal wharf.

Operation and Maintenance

Potential operational impacts are associated with Marginal Wharf Project-related vessels entering and leaving the bay, but may also be related to other marine traffic traveling around the proposed marginal wharf into and out of Isaac's Harbour from Stormont Bay.

The wharf extends into the entrance of Isaac's Harbour, occupying about 45% of the width of the entrance between Red Head and Bear Trap Head. However, the entrance to Isaac's Harbour naturally reduces to a similar width another 500 m further into the Harbour. Furthermore, the marginal wharf is located in an area of comparatively shallow water, leaving the deeper water portion of the entrance unaffected.

The wharf itself will be equipped with navigation aids, such as lights and fog horns, as required by TC, mitigating navigation concerns. Few vessels routinely use Isaac's Harbour even though the community wharf in Goldboro was substantially upgraded by SOEI for construction of the gas plant.

The current marine traffic within the harbour is composed of one or two inshore fishery vessels and the occasional recreational vessel. In addition, there is a monthly passage of a shrimp trawler to the Stormont facility in Country Harbour. These vessel dimensions and displacements range respectively from: 5.5 m length overall x 1.8 m beam and 1 m draft, to 19 m length overall x 6 m beam and 3.3 m draft, to 52 m length overall x 11 m beam and 5.5 m draft. An exact count and analysis of marine shipping activity within the harbour will be accomplished during the engineering FEED study.

Overall, the reduction in channel width at the entrance should not have a significant impact on navigation.

Modifications and Decommissioning

Vessel traffic required during decommissioning will have similar effects to vessels required during operation and maintenance of the marginal wharf.

5.2.20.2 Mitigation Measures and Monitoring

Construction

The marginal wharf may alter navigation into Isaac's Harbour from Stormont Bay; however, the wharf will be well lit and marked on all navigation charts for the area in accordance with federal legislation. The very low level of boating activity in from Stormont Bay into Isaac's Harbour is not expected to result in any important navigation issues with respect to marine facilities. Fishermen will be notified in advance on the arrival and departure of vessels.

Operation and Maintenance

Potential operational impacts are associated with shipping entering and leaving the bay, but may also be related to other marine traffic traveling around the proposed marginal wharf into and out of Isaac's Harbour. The wharf protrudes into the entrance of Isaac's Harbour, occupying about 45% of the width of the entrance between Red Head and Bear Trap Head. However, the entrance to Isaac's Harbour reduces to a similar width another 500 m further into Isaac's Harbour. Furthermore, the marginal wharf is located in an area of comparatively shallow water, leaving the deeper water portion of the entrance unaffected. The wharf itself will be equipped with navigation aids, such as lights and fog horns, as required by TC, mitigating other navigation concerns. Fishermen will be notified in advance on the arrival and departure of vessels.

Modifications and Decommissioning

Mitigative measures for the operations phase of the Marginal Wharf Project will be sufficient for the decommissioning phase as well.

5.2.20.3 Residual Effects

Provided the proposed mitigative measures are implemented, the environmental effects will be reversible and will have low magnitude (see Table 6.2-17, Section 6.0). Therefore, no significant adverse residual effects to navigation are predicted to occur during any phases of the Marginal Wharf Project.

5.2.20.4 Follow Up

No follow up monitoring is anticipated.

5.2.21 Marine Safety and Security

5.2.21.1 Environmental Effects Prediction

Environmental effects of construction, operations and maintenance as well as modifications and decommissioning on marine safety include mainly navigational issues. These have been addressed in the previously in Section 5.2.20.

Marine security issues are addressed in the through the requirements of the *Marine Transportation Security Act* and in the QRA conducted for the KDP.

5.2.21.2 Mitigation Measures and Monitoring

Mitigation for construction, operations and maintenance as well as modifications and decommissioning are the same as for navigation and has been addressed in Section 5.2.20.

Marine security issues are addressed through the requirements of the *Marine Transportation Security Act* and in the QRA conducted for the KDP.

5.2.21.3 Residual Effects

With the implementation of the recommended mitigation measures in Section 5.2.20 and the outcomes of the QRA minimal significant adverse residual effects are likely. The effects will be of low magnitude and reversible. Therefore, the residual environmental effects are not significant.

5.2.21.4 Follow Up

No follow up monitoring is anticipated.

5.2.22 Human Health and Safety

5.2.22.1 Environmental Effects Prediction

A thorough discussion of the potential environmental effects is presented in Section 5.1.22. This section will focus on additional effects and mitigation for the construction, operation and decommissioning of the marginal wharf. The spatial boundaries for Marginal Wharf Project-related marine accidents are the shipping lanes and Stormont Bay from the end of the shipping lanes to the pier. Temporal boundaries include the time traveling to the pier and docked at the facility. It is estimated that vessels will arrive approximately every 3-4 days during the initial Marginal Wharf Project phase and then every 3.5 to 1.8 days.

Construction

The potential effects presented in 5.1.22.1 for construction of the LNG facility are relevant for the construction of the marginal wharf. In addition, there will be potential effects due to air emissions from vessels and vehicular traffic delivering equipment to the job site.

Operation and Maintenance

As with construction, the potential effects presented in 5.1.22.1 for operation of the LNG facility are relevant for the marginal wharf. In addition, air emissions from marine vessel and vehicular traffic are unlikely to impact humans, since the shipping lane is quite distant from human receptors. However, during hoteling and unloading of LNG ships (approximately 24 hours), engines will be idling. Emissions are expected to occur over this period. These impacts have been considered in the modeling of air emissions, which is discussed in Section 5.2.6.

Modifications and Decommissioning

The potential effects addressed for decommissioning of the LNG facility (Section 5.1.22.1) are relevant for the marginal wharf.

5.2.22.2 Mitigation Measures and Monitoring

Construction

The mitigation presented in Section 5.1.22.2 (Human Health and Safety) and 5.1.6.2 (Air Quality) is sufficient for construction of the marginal wharf.

Operation and Maintenance

The mitigation presented in Section 5.1.22.2 (Human Health and Safety) and 5.1.6.2 (Air Quality) is sufficient for operation of the marginal wharf.

Modifications and Decommissioning

The mitigation presented in Section 5.1.22.2 (Human Health and Safety) is sufficient for decommissioning of the marginal wharf.

5.2.22.3 Residual Effects

Provided the proposed mitigative measures are implemented, the environmental effects due to increased risk of air emissions, dust generation, and water/waste management control will be reversible. Therefore, no significant adverse residual effects on human health and safety are likely to occur.

5.2.22.4 Follow Up

No follow up monitoring is anticipated.

5.2.23 Fisheries

5.2.23.1 Environmental Effects Prediction

Construction

Freshwater

The construction of the marginal wharf on the Red Head peninsula will result in the filling in of Ponds 4 and 5 at the Marginal Wharf Project Site (Figure 4.1-5). There is no recreational, Aboriginal, or commercial fishery associated with these ponds. No Marginal Wharf Project-related interactions with fishery resource uses are expected. Mitigation for fish and fish habitat is discussed in Section 5.2.10 and mitigation for freshwater quality/quantity is discussed in Section 5.2.2.

Marine

Local fishers have expressed concern about disruption to their traditional fishing activities from construction and operation of the Marginal Wharf Project. Marine impacts of construction will be concentrated in the wharf and terminal areas, either as a result of construction or facilities equipment being transported to the site, or actual construction of the wharf and terminal.

The magnitude of construction impacts will be related to the seasonal timing of activities. Impacts will be greater if activities occur during the relevant fishing seasons, particularly the lobster fishing season, which runs from April 19 to June 20. The level of fishing effort in the area of the marginal wharf is variable, depending on the catch in other parts of the bay, lateness in the fishing season, water temperatures, and closeness to a particular fisher's home. In consultations with the eight local registered fishers it was identified that while at times a number of fishers do set traps in the area the marginal wharf is not a major fishing area, and most fishing tends to occur further out into the harbour, limiting the potential for disruption to traditional fishing patterns. In addition, little fishing activity takes place in the central deep water part of the bay where the larger LNG and cargo vessels will be transitting.

For a significant impact on fishing activity to occur, the earnings from the fishery would need to be affected as a result of decreased catch quantity and/or quality, or increased costs of fishing from longer travel times or similar issues. The overall productivity of the bay and the associated amount of lobster habitat are important factors determining the potential quantity and quality of the catch and thus monetary return to local fishers.

During construction of these facilities, the potential for unavoidable light (direct or reflected) hitting the water exists, and may have some effect on fish activity in the immediate area, although the long-term effects should not be significant. These construction activities will be the focus of some consultation with both recreational and commercial fishery representatives in the area.

Mitigation for fish and fish habitat is discussed in Section 5.2.10 and mitigation for marine water quality/quantity is discussed in Section 5.2.4.

<u>Operation and Maintenance</u>

There will be no additional effects on Aboriginal, or commercial fisheries than those described in construction.

Potential operational impacts are associated with Marginal Wharf Project-related vessels entering and leaving the bay, but may also be related to other marine traffic traveling around the proposed marginal wharf into and out of Isaac's Harbour.

The marginal wharf will occupy approximately 45% of the width of the entrance to Isaac's Harbour between Red Head and Bear Trap Head. The current marine traffic within the harbour is sporadic, composed of one or two inshore fishery vessels and the occasional recreational vessel. In addition, there is a monthly passage of a shrimp trawler to the Stormont facility in Country Harbour and the occasional offshore supply vessel interfacing with the ExxonMobil SOEI facility. The dimensions and displacements of the vessels in the area vary. The potential impact of safety or exclusion zones around LNG vessels is considered to be negligible.

Impacts associated with commercial fisheries other than lobster are expected to be minor. For example, fishers may have to shift gillnets set for herring or mackerel in the central part of the bay. The potential effect on overall catch or the cost of fishing is anticipated to be insignificant. The marginal wharf area will, by necessity, be well-lit with high intensity lighting at night, and will be directed as narrowly as possible on the work areas (wharf and vessel). The lighting may have some effect on fish activity in the immediate area, although the long-term effects are not expected to be significant.

Modifications and Decommissioning

Adverse effects to fisheries during the decommissioning phase include potential for the accidental release of contaminants to the environment.

5.2.23.2 Mitigation Measures and Monitoring

Construction

DFO will require replacement of the area of fish habitat lost with habitat of similar or higher quality. Several potential compensation areas have been identified (see Appendix 5). Keltic has consulted with local recreational fisheries groups and municipalities to identify marine and freshwater compensation options.

A compensation policy for fishing equipment damaged by the Marginal Wharf Project construction will be developed and implemented. This compensation policy will follow the Canada – Nova Scotia and Canada – Newfoundland Offshore Petroleum Board document: Compensation Guidelines Respecting Damages Relating to Offshore Petroleum Activity.

Provided the following mitigative measures are implemented the potential lighting effects on fish should be insignificant:

- no unnecessary lighting will be used, especially on structures taller than 15 m, and use fast-blinking strobes if possible;
- area lighting will be angled directly at work areas and shielded where possible; and
- implementation of a Lighting Plan.

A Potential Effects Analysis should be developed, including consultation with marine fisheries authorities and the local fishing community and advance notice of ship arrivals will be provided to fishers.

To mitigate potential effects of fish habitat, in accordance with the NSEL EA approval conditions, the following will be implemented:

- Condition 1.10 - modelling to predict the assimilative capacity of all receiving environments for all relevant chemical parameters which are expected to enter the environment as a result of Project activities;
- Condition 1.12 - Project EMP;
- Condition 2.4 - a detailed ESC plan, including a monitoring program for site runoff; and
- Condition 2.8 - a monitoring program to determine the potential for and extent of sulphide bearing material and a plan to manage any exposed acid generating material and associated drainage.

Additional mitigative measures are discussed in Section 5.2.4.

Operation and Maintenance

In addition to the mitigation measures outlined above, the effects of the marginal wharf on local fisheries are due to the reduction in size of the mouth of Isaac's Harbour and the additional shipping traffic generated by the Marginal Wharf Project. The mitigation measures for these effects include:

- Keltic will provide advance notice of ship arrivals and departures to ensure fishers can manage their gear without damage.
- Local vessel operators will be notified of the LNG tanker schedules and the extent and duration of the exclusion zone.
- A Potential Effects Analysis and consultation with marine fisheries authorities and the local fishing community will be completed to address the potential effect on overall catch or the cost of fishing.

The mitigation measures for the effects of lighting during the marginal wharf operation are discussed in Section 5.2.15.

Modifications and Decommissioning

Mitigative measures for accidents and malfunctions are presented in Section 10.0.

5.2.23.3 Residual Effects

Provided mitigation is implemented as described above, no potential adverse effects are expected. The effects will be low in magnitude. Therefore, residual effects of the Project during all Project phases have been determined not significant.

5.2.23.4 Follow Up

There is no freshwater fishery associated with this area, therefore no follow up monitoring is recommended.

Monitoring of inshore fishing activity is difficult because reporting of specific fishing locations is not required for most fisheries and individual catches are considered confidential by DFO. However, since lobster is the primary species caught in Stormont Bay, a monitoring catch-rate program will be implemented in conjunction with local fishers. Such a program will be important as part of a compensation program to provide independent and objective assessment of potential impacts on the fishery. A monitoring program will document catch in different parts of Stormont Bay during the commercial fishing season. It will involve placing an observer on local fishing vessels at three different times during the fishing season, with specific criteria for consistent setting of traps. Details of such a program will need to be developed in consultation with and approved by local fishers and DFO.

Monitoring of the Fish Habitat Compensation projects will be done to determine the success of the new habitat structures.

5.2.24 Aquaculture

5.2.24.1 Environmental Effects Prediction

Aquaculture is an important economic activity within the marine environment of Country Harbour.

Construction

Aquaculture operations are located entirely within Country Harbour and no construction activities or transport of equipment will occur near these operations. Release of sediments or contaminants to the water column from construction is also anticipated to be minimal, and thus no impacts on aquaculture operations are expected.

Blasting is not expected in the marine environment. If required, blasting in or near watercourses will require approval from DFO and shall be conducted in accordance with the "Guidelines for Use of Explosives in or Near Canadian Fisheries Waters." Blasting shall also be conducted in accordance with the General Blasting Regulations made pursuant to the *Nova Scotia Occupational Health and Safety Act*.

Operation and Maintenance

Routine operations are not anticipated to have any impacts on aquaculture within Country Harbour, but hydrocarbons or other contaminants could be released in a major accident at the KDP Site or during shipping operations. The potential for such an accident is judged to be extremely low.

Modifications and Decommissioning

Adverse effects to aquaculture during the decommissioning phase include potential for the accidental release of contaminants to the environment.

5.2.24.2 Mitigation Measures and Monitoring

Construction

Standard mitigating measures to control sediment and small spills will be implemented to ensure the aquaculture operations in Country Harbour are not adversely affected by construction activities.

Operation and Maintenance

Aquaculture operations could be affected by a large spill. In accordance with Item 3.4 in NSEL EA approval conditions, a proposed aquaculture compensation plan will be implemented in the event that any Project related adverse effects on aquaculture are detected. The compensation plan will ensure adequate compensation is provided in the event a large spill affects operations.

Modifications and Decommissioning

Mitigative measures for accidents and malfunctions are the same as the construction phase.

5.2.24.3 Residual Effects

Provided the mitigation measures are implemented, the environmental effects from the release of sediments into the water column from construction or a large spill have a low magnitude, are localized, and are reversible. Therefore, no significant residual environmental effects are expected.

5.2.24.4 Follow Up

No follow up monitoring is anticipated.

5.2.25 Tourism

The discussion regarding effects on tourism for the construction and operation of the LNG facility is presented in detail in Section 5.1.25 and is consistent with effects for the construction of the marginal wharf.

5.2.25.1 Mitigation Measures and Monitoring

Refer to the mitigation described for tourism for the construction and operation of the LNG facility in Section 5.1.25.

5.2.25.2 Residual Effects

With the implementation of the mitigation measures described in Section 5.1.25, no significant residual effects are likely. Table 6.2-22 in Section 6.0 summarizes the criteria used to determine the likelihood of significant residual effects.

5.2.25.3 Follow Up

No follow up monitoring is anticipated.

5.3 ENVIRONMENTAL EFFECTS OF THE PROJECT RELATED SHIPPING WITHIN 25 KM OF COUNTRY ISLAND

In support of the product output, marine traffic for the proposed Keltic facility will include the transshipment of feedstocks, product components, and byproducts. These shipments will increase traffic levels somewhere in the neighbourhood of 200 additional vessels entering the port per year. This means a yearly traffic flow into the harbour of 300 to 400 LNG and product carriers. The total number of ships accessing the zone equals approximately half the number of moves presently managed through the pilot authority. This number does not include the movement of harbour tug, offshore and inshore fisheries vessels or vessels of less than 100 m length overall.

At the two-vessel proposed output scenario assuming a lower end of tanker capacity of 160,000 m^3, one LNG tanker will arrive at the LNG Marine Terminal every 3.5 to 1.8 days. This will result in a total of 105 to 210 LNG tankers per year. This number can be marginally reduced if larger capacity LNG tankers (250,000 m^3) are made available (5.4 to 2.7 days).

5.3.1 Hydrology

There are no environmental effects on hydrology for this Project component as it is solely marine in nature.

5.3.2 Freshwater Quality/Quantity

There are no environmental effects on freshwater for this Project component as it is solely marine in nature.

5.3.3 Groundwater Quality/Quantity

There are no environmental effects on groundwater for this Project component as it is solely marine in nature.

5.3.4 Marine Water Quality

5.3.4.1 Environmental Effects Prediction and Mitigation

The potential effects on marine water quality related to shipping are limited to routine releases such as bilge water or accidental spill of fuel or other contaminants from vessels and potential re-suspension of contaminated sediments from propeller wash during the construction, operation and decommissioning of the LNG Marine Terminal or marginal wharf.

The MARPOL is the main international convention addressing pollution in the marine environment by oil, chemicals, harmful substances in packaged form, sewage, and garbage discharges from shipping (http://www.imo.org/Conventions/contents.asp?doc_id=678&topic_id=258#1). Project shipping will conduct all activities in strict adherence to both the *Canada Shipping Act* and related regulations and MARPOL as a result, routine releases will be minimized and effects on marine water quality are not considered significant. To mitigate the re-suspension of contaminated sediments large vessels will be berthed with the support of tugs.

Potential effects and mitigation measures for accidents and malfunctions are addressed in Section 10.0.

5.3.4.2 Residual Effects

As identified in Section 10.0, no residual effects are expected. The effects due to bilge water or accidental spills from vessels will have a low magnitude and will be reversible.

5.3.4.3 Follow Up

As identified in Section 10.0, no follow up monitoring is required.

5.3.5 Soil/Sediment Quality (terrestrial and marine)

Two sampling programs found no areas with contaminated sediments near the Project shipping site. However, higher levels of arsenic and mercury exist within Isaac's Harbour and Stormont Bay; however sediments in these areas are not expected to be affected by shipping activities. .

There are no environmental effects on terrestrial soil/sediment for this Project component as it is solely marine in nature.

Similar to marine water quality above, the potential effects on marine sediment quality related to shipping are limited to accidental spill of fuel or other contaminants from vessels and potential re-suspension of contaminated sediments from propeller wash during the construction, operation and decommissioning of the LNG Marine Terminal or marginal wharf.

5.3.5.1 Mitigation Measures and Monitoring

To reduce the sediment disturbance from the vessels, large vessels will be berthed with the support of tugs. A plan to mitigate the human health and environmental impacts of contaminated mine tailings and/or soils and sediments due to the KDP will be developed. The plan will be consistent with the Nova Scotia Guidelines for the Management of Contaminated Sites. As outlined in the NSEL EA approval conditions (NSEL, 2007), when any remediation or risk management work is completed, which includes any required monitoring, a Certificate of Compliance to demonstrate the remediation or risk management work is completed and effective. A detailed ESC plan will also be developed in accordance with Item 2.4 in the NSEL EA approval conditions (NSEL, 2007).

Potential effects and mitigation measures for accidents and malfunctions are addressed in Section 10.0.

5.3.5.2 Residual Effects

As identified in Section 10.0, no residual effects are expected. The effects on soil/sediment quality due to bilge water or accidental spills from vessels will be low in magnitude and reversible (see Table 6.3-2, Section 6.0).

5.3.5.3 Follow Up

As identified in Section 10.0, no follow up monitoring is required.

5.3.6 Air Quality

Effects on air quality from shipping will be limited to emissions related to fuel combustion.

The specific air pollutants emitted consist of the following:

- SO_2, formed when fuel containing sulphur, such as coal and oil, is burned;
- NO_x, generated when fuel is burned at high temperatures as in a combustion process;
- CO, formed from the incomplete combustion of carbon-containing fuel;

- TSP, PM with PM_{10} and $PM_{2.5}$, terms for particles found in the air, including dust, dirt, soot, smoke, and liquid droplets; and
- VOCs.

5.3.6.1 Environmental Effects Prediction

Air dispersion modelling of predicted concentrations of air pollutants from all KDP sources has been presented in Section 5.1.6.1. Given the emission rates, the ground level concentrations would be below any health criteria, either federal or provincial, and it is expected that the distance to receptors will mitigate potential odours. The highest NO_2 and CO offsite concentrations tend are predicted occur to the southwest of the co-generation plant near the property boundary due to the combined cycle gas turbine emissions. The highest SO_2, and TSP concentrations are predicted to occur near the LNG tanks and in the area northwest of the ethylene unit near the property boundary.

Vessel traffic (particularly LNG tankers) is expected to contribute a significant proportion of all KDP related air emissions as follows:

- SO_2 – 142.1 t/year (60% of KDP total);
- NO_x – 142.1 t/year (7% of KDP total);
- CO – 63.7 t/year (24% of KDP total);
- TSP – 20.8 t/year (16% of KDP total); and
- VOCs – 23.5 t/year (9% of KDP total).

5.3.6.2 Mitigation Measures and Monitoring

Project shipping will be in good working order and will take every reasonable measure to reduce unnecessary fuel consumption. As outlined in the *Canada Shipping Act*, no soot will be blown while a ship is within 915 m of land if:

1. it would have been practicable to carry out that operation before approaching land;
2. it would be practicable to delay that operation until after leaving land; or
3. an alternative method of removing soot could be employed.

5.3.6.3 Residual Effects

The results of air quality monitoring are presented in Section 9.6 of the provincial EA Report (AMEC, 2006). These results indicate that emissions related to Project shipping during all Project phases will be far below the Nova Scotia Maximum Permissible Concentrations and Canada National Ambient Air Quality Objectives & Guidelines for all parameters. Consequently, the effects of the shipping on air quality have been determined not significant.

5.3.6.4 Follow Up

Construction

No monitoring during construction is recommended.

Operation and Maintenance

Real-time ambient air quality analysis will serve as both a check on the ground-level concentrations of pollutants which have been modeled, as well as an assurance that other activities are not unduly impacting upon local conditions. It is anticipated that any requirements for such monitoring (both in terms of parameters; number of monitoring sites; and duration) will form part of the Industrial Approval, and would likely focus on NO_x and SO_2, and PM and be conducted periodically during the year. An Industrial Approval is a site specific NSEL Regulatory Document that is enforceable under the *Nova Scotia Environment Act*. The approval contains terms and conditions that the Project Proponent must follow to prevent adverse effects to the environment.

Normally, monitoring sites are located (where practical) at locations indicated by modeling as the point of greatest impact, and/or sites involving sensitive receptors. Reporting of results of the ambient monitoring are made available to both the regulatory authorities and the public. Although real-time monitoring of VOCs is not contemplated, Keltic intends to commission VOC monitoring (essentially 24 hour 'grab' sampling) both prior to and during operations, in order to assess the quantity and makeup of any VOCs at a number of points which will be determined as the specific design phase is completed. In addition, should odours be detected off-site, VOC monitoring will be undertaken to determine the source(s), and allow for appropriated mitigation measures.

Efforts will be made to coordinate with SOEI regarding existing monitoring equipment utilization and data resources.

Modifications and Decommissioning

No monitoring during construction is recommended.

5.3.7 Climate Conditions

Climate change has been clearly linked to emissions of GHG. Project related shipping will contribute minor amounts of GHG to the atmosphere during all phases of the KDP; therefore the potential for adverse effects should be considered.

5.3.7.1 Environmental Effects Prediction

Construction

GHG emissions during construction are expected to be short term and limited in volume.

Operation and Maintenance

Tankers are expected to contribute up to 63.7 t/year of CO_2 (based on modelling presented in the provincial environmental report (AMEC, 2006)). This volume is not expected to have any measurable effect on global climate change. Larger potential sources for GHG occur in other KDP components (described above); and the incremental contribution of GHG from shipping is duly considered in Section 8.0 (cumulative effects).

Modifications and Decommissioning

GHG emissions during any modifications or decommissioning are expected to be short term and limited in volume.

5.3.7.2 Mitigation Measures and Monitoring

During all phases of the KDP, Keltic will implement energy-efficiency measures throughout its facilities including the use of low pressure fuel or waste heat. Further planning and implementation of measures related to climate change issues will take place as the Federal and Provincial Governments move forward with policy/legislative guidance.

5.3.7.3 Residual Effects

The additional shipping that will occur within 25 km of Country Island is not expected to significantly contribute to global GHG concentrations.

5.3.7.4 Follow Up

Follow up monitoring of GHG emissions for the KDP will likely be included in the operating permit. Specific monitoring related to shipping would only be conducted if such a requirement were included in the permit.

5.3.8 Vegetation (terrestrial and marine)

5.3.8.1 Environmental Effects Prediction

There are no environmental effects on terrestrial vegetation for this Project component as it is solely marine in nature.

The potential effects on marine vegetation related to shipping are limited to accidental spill of fuel or other contaminants from vessels and disturbance from propeller wash during the construction, operation and decommissioning of the LNG Marine Terminal or marginal wharf. To mitigate the effects of propeller wash large vessels will be berthed with the support of tugs. Potential effects and mitigation measures for accidents and malfunctions are addressed in Section 10.0.

5.3.8.2 Residual Effects

The effects of these spills are low in frequency and are reversible. Therefore, as identified in Section 10.0, no residual effects are expected.

5.3.8.3 Follow Up

As identified in Section 10.0, no follow up monitoring is required.

5.3.9 Species at Risk

The potential for increased shipping within the Study Area to cause adverse effects to the colony of roseate terns that nest on Country Island and/or protected marine mammals in the shipping lanes should be considered. While there is a remote possibility that other marine species at risk (particularly certain marine mammal species at risk) could occur (as described in Section 4.2.5 above) within the 25 km zone around Country Island, such occurrences would be extremely infrequent and the likelihood of potential interaction is negligible.

5.3.9.1 Environmental Effects Prediction

Project related shipping may take place during all phases (construction, operation, and decommissioning). Vessel traffic may be more frequent during construction and decommissioning but will be of very short duration. In support of the product output, marine traffic for the proposed Keltic facility will include the transshipment of feedstocks, product components, and byproducts. These shipments will increase traffic levels somewhere in the neighbourhood of 200 additional vessels entering the port per year. This means a yearly traffic flow into the harbour of 300 to 400 LNG and product carriers. The total number of ships accessing the zone equals approximately half the number of moves presently managed through the pilot authority. This number does not include the movement of harbour tug, offshore and inshore fisheries vessels or vessels of less than 100 m length overall.

Country Island hosts one of the few breeding populations of roseate terns in Canada and ships are not permitted within 200 m of the island, according to the Recovery Plan. The proposed shipping lane for Keltic traffic will be established in accordance with TC's TP 1802 Routing Standards. Even so, due to the large foraging area of the roseate tern, there is still potential for interaction between the shipping and the species. In the event that a foraging roseate tern encounters an LNG ship, the tern could change course leaving the chicks vulnerable for longer periods or even abandon the effort entirely, returning back to the nest without food.

There are shoals around Country Island that would be avoided by LNG tankers; recently, a shrimp boat was grounded near Country Island with no adverse effect on the roseate tern colony (A. Boyne, pers. comm.). No impacts are expected during typical operations.

While effects of extreme weather may cause minor changes in shipping schedule or routing, and could increase difficulty of safe and accurate navigation, mitigation measures related to extreme weather are discussed in Section 9.0 that will reduce potential impacts to insignificance.

5.3.9.2 Mitigation Measures and Monitoring

Adherence to the designated shipping lane will prevent disturbance of nesting roseate terns. In addition, prescribed navigational routes are not to pass within the exclusion zone established for Country Island.

As a component of NSEL Condition 2.7, the Proponent is committed to prepare an Adaptive Management Plan (AMP), consisting of various elements acceptable to EC and NSDNR, as well as a spill response plan. To address concerns with potential impacts to foraging Roseate Terns in Stormont Bay, it is expected that the AMP will include coordination with multiple stakeholders to monitor and manage potential cumulative effects on the Roseate Tern.

Mitigation relevant to accidents and malfunctions has been provided in Section 10.0.

5.3.9.3 Residual Effects

The magnitude of the environmental effects is determined to be low and reversible (see Table 6.3-5, Section 6.0). Therefore, it is predicted that no significant residual effects on species at risk are likely to occur.

5.3.9.4 Follow Up

As outlined in the NSEL Terms and Conditions for Environmental Approval, under Condition 2.7, a project wildlife monitoring program will be developed in consultation with NSDNR and CWS. An AMP for the Roseate Tern will be prepared and implemented as per Section 5.3.9.2.
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5.3.10 Fish and Fish Habitat (marine and freshwater)

5.3.10.1 Environmental Effects Prediction

There are no environmental effects on freshwater fish and fish habitat for this Project component as it is solely marine in nature.

The potential effects on marine water quality related to shipping are limited to potential releases such oil, chemicals, harmful substances in packaged form, sewage and garbage or accidental spill of fuel or other contaminants from vessels during the construction, operation and decommissioning of the LNG Marine Terminal or marginal wharf.

As stated in Section 5.3.4.1 above, the *Canada Shipping Act* and regulations and MARPOL will be followed by all Project shipping.

Potential effects and mitigation measures for accidents and malfunctions are addressed in Section 10.0.

5.3.10.2 Residual Effects

Provided the proposed mitigative measures are implemented, no significant adverse residual environmental effects on fish and fish habitat are likely to occur since the environmental effects are expected to be temporary, reversible, and low in magnitude.

5.3.10.3 Follow Up

As identified in Section 10.0, no follow up monitoring is required.

5.3.11 Marine Mammals

Stormont Bay/Country Harbour is not an important area for cetaceans. Whales or seals may enter the area following schools of herring or mackerel from spring to fall and seals frequently haul out on the shoreline.

5.3.11.1 Environmental Effects Prediction

The potential effects on marine mammals related to shipping are limited to underwater noise and potential releases such oil, chemicals, harmful substances in packaged form, sewage and garbage or accidental spill of fuel or other contaminants from vessels during the construction, operation and decommissioning of the LNG Marine Terminal or marginal wharf. 83% of the underwater acoustic field surrounding large vessels is the result of propeller cavitation (Southall, 2005). Noise from vessels may contribute to masking of sounds important to the survival of mammals. The noise disturbance may also add to the risk of injury or death due to collisions with vessels. However, marine mammals have been known to adapt to masking sounds by changing the intensity and frequency of their vocalizations. Little underwater acoustic energy is transmitted into the water from on-board machinery or movement of the vessel through the water.

See Section 5.3.16.2 for mitigation measures for vessels to minimize the likelihood of mammal collisions. As stated in Section 5.3.4.1 above, the *Canada Shipping Act* and regulations and MARPOL will be followed by all Project shipping; therefore, no significant effects are anticipated from routine releases (if any).

There is potential for impairment to the marine habitat as a result of re-suspension of contaminated sediments from propeller wash. Although no sediment contamination has been identified large vessels will be berthed with support of tugs. In addition a mitigation plan for contaminated tailings and/or soils and sediments will be developed.

Potential effects and mitigation measures for accidents and malfunctions are addressed in Section 10.0.

5.3.11.2 Residual Effects

As outlined in Section 6.3.7, the effects on marine mammals will be of low magnitude and reversible. Therefore, no significant adverse residual effects are expected.

5.3.11.3 Follow Up

As identified in Section 10.0, no follow up monitoring is required.

5.3.12 Wildlife and Wildlife Habitat

There are no environmental effects on (terrestrial) wildlife and wildlife habitat for this Project component as it is solely marine in nature.

5.3.13 Migratory Birds and Migratory Birds Habitat

5.3.13.1 Environmental Effects Prediction

The potential effects on migratory birds and their habitat related to shipping are limited to potential releases such oil, chemicals, harmful substances in packaged form, sewage and garbage or accidental spill of fuel or other contaminants from vessels during the construction, operation, and decommissioning of the LNG Marine Terminal or marginal wharf.

As stated in Section 5.3.4.1 above, the *Canada Shipping Act* and MARPOL will be followed by all Project shipping; therefore, no significant effects are anticipated from routine releases (if any).

There is potential for seabird mortality due to attraction to ship related lighting. One of the seabird species found in Stormont Bay is Leach's storm-petrel, which is known to be attracted to lights on ships, barges, dredges, and offshore platforms. They commonly feed offshore on bioluminescent plankton, so are particularly drawn to light. The petrels may be attracted to lighthouses, offshore drilling platforms, and the high-intensity lamps used by fishers (Guynup, 2003).

5.3.13.2 Mitigation Measures and Monitoring

With respect to LNG shipping/delivery, seabird mortality due to artificial lights Keltic will employ the following mitigation measures:

- alerting vessels to the risk associated with the use of ice-lights and other deck lighting, particularly on nights when visibility is poor and in the vicinity of seabird islands;
- encourage the use of black-out blinds on all portholes and windows with external lighting kept to the minimum required for safe navigation and operation of vessels;
- keeping deck lights to a minimum when at anchor or close to inshore overnight;
- providing information on how to treat and release birds found on deck; and
- maintaining records of birds found on deck (species, position, and weather conditions).

5.3.13.3 Residual Effects

Provided the mitigation measures provided above are implemented, no significant adverse residual effects are expected since the magnitude of the environmental effects are expected to be low and reversible. See Table 6.3-8 in Section 6.0 for more details.

5.3.13.4 Follow Up

As identified in Section 10.0, no follow up monitoring is required.

5.3.14 Wetlands

There are no environmental effects on wetlands for this Project component as it is solely marine in nature.

5.3.15 Lighting Conditions

5.3.15.1 Environmental Effects Prediction and Mitigation

It has been demonstrated that ships lights can cause some behavioural changes or disorientation for foraging and migratory birds at sea. These effects are generally considered to be insignificant for most species but could be significant for the roseate tern colony on Country Island. Adherence to the Roseate Tern Recovery Plan will mitigate against potential effects to the colony on Country Island. Potential effects and mitigation have been discussed in detail for this species at risk in Section 5.3.9 above.

5.3.15.2 Residual Effects

The effect of seabirds being attracted to ship lights is low in magnitude and is reversible. Therefore, as identified in Section 5.3.9, no significant adverse residual effects are expected.

5.3.15.3 Follow Up

As identified in Section 5.3, Keltic will explore follow up measures in consultation with EC which could include such things as contribution to monitoring programs to help identify roseate tern foraging areas.

5.3.16 Atmospheric and Underwater Acoustic Environment

5.3.16.1 Environmental Effects Prediction

Noise impacts may be associated with shipping and may result in disturbance in the marine environment. 83% of the underwater acoustic field surrounding large vessels is the result of propeller cavitation (Southall, 2005). Noise from vessels may contribute to masking of sounds important to the survival of mammals, which may result in collisions. However, marine mammals have been known to adapt to masking sounds by changing the intensity and frequency of their vocalizations.

The noise impact on marine mammals during operation is not expected to be as significant as noise impacts generated by pile driving. The ship engines would be of a lower frequency than pile driving and other marine construction practices. Most acoustic energy radiating from large commercial vessels is below 1 kilohertz (kHz) (Southall, 2005).

5.3.16.2 Mitigation Measures and Monitoring

Standard vessel operating procedures will be followed to further avoid the minimal risk of marine mammal collisions and disturbance. The procedures will include measures such as:

- reviewing current versions of the Canadian Annual Notice to Mariners for marine mammal guidelines and marine mammal protected areas before entry into Canadian waters;
- reducing vessel speeds when passing through areas where they have been recent whale sighting reports;

- when in an area frequented by whales, posting a look-out to increase the likelihood of sighting and avoiding marine mammals;
- when manoeuvring around marine mammal activity, travelling parallel to marine mammals, avoiding sudden changes in speed or direction, avoiding heading directly toward marine mammals; and
- reducing speed and waiting until animals are more then 400 m away when it is not possible to manoeuvre around marine mammals.

5.3.17 Current Use of Lands and Resources for Traditional Purposes by Aboriginal Persons

The operational phase will likely limit Mi'kmaq sea urchin fishing in this area. It should be noted that sea urchins in this area were largely decimated by a parasite in the late 1990's and have not made a significant recovery.

For the effects on sea urchin fishing, the draft FHCP outlined in Appendix 5 includes enhancement of benthic habitat within the same urchin licence area. This is predicted to offset any loss of sea urchin production and/or access once the species returns to commercial levels.

Therefore, no significant adverse residual effects are expected due to marine operations.

5.3.18 Physical and Cultural Heritage

No effects on physical and cultural heritage from Project related shipping are likely since this Project component is entirely marine in nature.

5.3.19 Structures/Sites of Archaeological, Paleontological or Architectural Significance

No effects on structures/sites of archaeological, paleontological, or architectural significance from Project related shipping are likely since this Project component is entirely marine in nature. No potential for interaction with marine sites of potential archaeological significance has been identified.

5.3.20 Navigation

Project related shipping during operation will increase the current volume of large vessel traffic (mainly LNG tankers) in the Study Area. The current marine traffic within the harbour is composed of one or two inshore fishery vessels and the occasional recreational vessel. In addition, there is a monthly passage of a shrimp trawler to the Stormont facility in Country Harbour. These vessel dimensions and displacements range respectively from: 5.5 m length overall x 1.8 m beam and 1 m draft, to 19 m length overall x 6 m beam and 3.3 m draft, to 52 m length overall x 11 m beam and 5.5 m draft. An analysis of marine shipping activity within the harbour is being completed as a component study under the TERMPOL process.

In general navigation within 25 km of Country Harbour is well established and shoals such as Black Ledge and Tom Cod Rock are marked with navigation aids. The shipping lane will be established under TP 1802 Routing Standards. Communications and port operations plans will be developed by Keltic for approval by TC Marine Safety. In addition, the Atlantic Pilotage

Authority has indicated that the approach to the KDP will be a Mandatory Pilotage Area. Therefore, no significant effects on local navigation are expected.

5.3.21 Marine Safety and Security

Environmental effects on marine safety include mainly navigational issues. The KDP has initiated the TERMPOL process. Keltic is currently preparing a scoping document on the proposed simulations to be conducted for the Project. This, as well as a number of related studies, will be reviewed with the TERMPOL Technical Review Committee and the recommendations that arise will be incorporated by Keltic to protect marine safety and security. As well, Keltic and the ships it charters will follow the *Marine Transportation Act* and regulations.

A Marine Terminal Manual shall be developed in consultation with the Canadian Coast Guard, the Atlantic Pilotage Authority, and TC Marine Safety and be submitted to TC Marine Safety for written approval in advance of any vessels carrying LNG or for delivery to the facility. A draft of this plan shall be submitted to the Canadian Coast Guard, the Atlantic Pilotage Authority, and TC Marine Safety six months in advance of the first shipment to the facility. Further, the Proponent shall require adherence to the approved Marine Terminal Manual as a condition to the acceptance of all vessels at the facility.

The Proponent must comply with TC's new marine security requirements under the IMO International Ship and Port Facility Security (ISPS) Code. The requirements under the ISPS Code are being implemented through Canada's Marine Transportation Security Regulations, as well as through amendments to the International Convention for the Safety of Life at Sea, 1974. In accordance with the Marine Transportation Security Regulations, the Proponent is required to prepare a Port Facility Security Assessment and develop and implement a Facility Site Security Plan. This must be completed prior to the operation of the marine terminal.

Therefore, no significant impacts on marine safety and security in the Study Area are expected.

5.3.22 Human Health and Safety

Effects on human health and safety from the KDP related shipping would only stem from navigational marine safety and accidental events. These have been previously addressed in Sections 5.3.20 and 5.3.21 above and no significant effects on human health and safety are expected.

5.3.23 Fisheries

5.3.23.1 Environmental Effects Prediction

Marine activities associated with construction and operation of the KDP is related to vessels entering and leaving the bay. The impacts will be greater when activities occur during the relevant fishing seasons, particularly the lobster fishing season, which runs from April 19 to June 20. Little fishing activity takes place in the central deep water part of the bay where the larger LNG and cargo vessels will be transiting. The potential effects on marine water quality related to shipping are limited to potential releases such as oil, chemicals, harmful substances in packaged form, sewage and garbage or accidental spill of fuel or other contaminants from vessels during the construction, operation, or decommissioning of the LNG Marine Terminal or marginal wharf. The *Canada Shipping Act* and regulations and MARPOL will be followed by all Project shipping.

Impacts associated with commercial fisheries other than lobster are expected to be minor. For example, fishers may have to shift gillnets set for herring or mackerel in the central part of the bay.

5.3.23.2 Mitigation Measures and Monitoring

The mitigation measures for these effects include:

- Keltic providing advance notice of ship arrivals and departures to ensure fishers can manage their gear without damage;
- local vessel operators being notified of the LNG tanker schedules and the extent and duration of the exclusion zone;
- analyzing potential effects and consulting with marine fisheries authorities and the local fishing community to address the potential effect on overall catch or the cost of fishing; and
- a Potential Effects Analysis will be developed in consultation with marine fisheries authorities and the local fishing community.

DFO will also require replacement of three to five times the area of fish habitat lost with habitat of similar or higher type and quality. Potential compensation areas have been identified (see Appendix 5) where habitat augmentation projects would provide more lobster habitat, similar in quality to that lost to construction. Keltic will continue consultations with local recreational fisheries groups and municipalities on the compensation plans. Options for proposed FHCPs are being prepared in Appendix 5 of this CSR and as part of Keltic's Application to DFO for Authorization.

A compensation policy for fishing equipment damaged by the Project's shipping will be developed and implemented. This compensation policy will follow the Canada – Nova Scotia and Canada – Newfoundland Offshore Petroleum Board document: Compensation Guidelines Respecting Damages Relating to Offshore Petroleum Activity.

5.3.24 Aquaculture

Shipping routes stay clear of aquaculture sites. Appropriate ballast water and discharge water control and antifouling protocols will be undertaken with establishment and adherence to MARPOL (see Section 5.3.4.1)). Only accidental spillage of fuel or other contaminants could result in significant impacts on local aquaculture.

Potential effects and mitigation measures for accidents and malfunctions are addressed in Section 10.0.

5.3.24.1 Residual Effects

The environmental effects from potential releases of contaminants from vessels have a low magnitude and are reversible (see Table 6.3-15, Section 6.0). Therefore, as also identified in Section 10.0, no significant adverse residual effects are expected.

5.3.24.2 Follow Up

As identified in Section 10.0, no follow up monitoring is required.

5.3.25 Tourism

There are no known tourism ventures that will be affected by shipping around Country Island or any neighbouring islands. Effects on tourism due to shipping are deemed to be not significant.

6.0 RESIDUAL EFFECTS ASSESSMENT SUMMARY

Residual impacts refer to those environmental effects predicted to remain after the application of mitigation outlined in this EA. The predicted residual effects are considered for each Project phase (Construction, Operation, Decommissioning/post-decommissioning, and Unplanned Events). As per the criteria established in Section 2.5, the Significance has been determined for each residual adverse effect (no significance rating was established for positive effects). For ease of reference, these criteria are repeated here:

Significant

- Major: Potential impact could jeopardize the long term sustainability of the resource. Criteria used to evaluate the long term sustainability of the resource include consideration of the following: magnitude, geographic extent, duration/frequency, reversibility, and ecological and socio/cultural context. Professional judgement and expertise is used to determine significance as a function of these criteria. Section 2.5 gives further detail on how each of the criteria is evaluated. Additional research, monitoring, and/or recovery initiatives should be considered.

Not Significant

- Medium: Potential impact could result in a decline of a resource in terms of quality/quantity, such that the impact is considered moderate in its combination of magnitude, aerial extent, duration, and frequency, but does not affect the long term sustainability (that is, it is considered reversible). Additional research, monitoring, and/or recovery initiatives may be considered.
- Minor: Potential impact may result in a localized or short-term decline in a resource during the life of the Project. Typically, no additional research, monitoring, and/or recovery initiatives are considered.
- Minimal: Potential impact may result in a small, localized decline in a resource during the construction phase of the Project, and should be negligible to the overall baseline status of the resource.

Only effects considered significant underwent an additional consideration of the likelihood of their occurrence and the level of confidence underlying the effects prediction.

The results of the assessment have been developed and presented in Sections 6.1 through 6.3. The tables describe the predicted effect on several indicator criteria representing each VEC and the identified avoidance or mitigation measures which could eliminate or reduce the predicted effect. It is of note that, for the purposes of this CSR, a FHCP is considered to be a mitigation measure. The same is assumed with respect to Wetland Compensation Plans and the Terms and Conditions specified by the NSEL Environmental Assessment Approval. The Project phase or phases to which the identified effect applies have been listed, followed by the type of impact (adverse or positive) and the significance of residual effects.

Accidental events can occur, potentially causing damage to the biophysical environment, as well as to effects on human health and safety. The severity of effects from accidental events is dependent upon the magnitude of the event, location of the event, and the time of year. For the prediction of residual adverse environmental effects, it is acknowledged that, while the likelihood

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is low, the result can be significant. Unplanned events are, by their nature difficult to predict, the approach has been to apply environmental management practice to prevention and preparedness training so as to reduce the likelihood of such events, but to be well prepared to implement an effective emergency response should an event occur. Emergency Preparedness Planning will include the development and maintenance of a high degree of readiness through equipment purchase and maintenance, training exercises, and simulations. As has been previously noted, Emergency Preparedness Planning has been integrated into all phases of Project design, planning, and execution. The objective is to perform well above the industry average, and to improve on the record continuously. Accidental events are by their nature unpredictable and are not described further in this section. However, a detailed assessment of potential effects and mitigation for accidental events is provided in Section 10.0.

Through careful design and planning, combined with prudent application of proven mitigation measures, Keltic has identified and addressed all potential adverse environmental effects, and reduced the predicted adverse impacts to a low level of significance. The Project will also have important economic benefits both locally and regionally.

For several VECs no adverse environmental effects were identified that could result from normal/routine works and activities during any of the Project phases. Therefore, residual effects tables have not been included for these VECs in this section. A summary of these VECs is provided below by component. It is of note, that potential adverse effects resulting from malfunctions and accidents may involve these VECs. This is discussed in the Section 10.0.

Marginal Wharf

- Hydrology; and
- Groundwater Quality/Quantity.

Shipping within 25 km of Country Island

- Hydrology;
- Freshwater Quality/Quantity;
- Groundwater Quality/Quantity;
- Wildlife and Wildlife Habitat;
- Wetlands;
- Physical and Cultural Heritage;
- Structures/Sites of Archaeological, Paleontological or Architectural Significance;
- Human Health & Safety; and
- Tourism.

6.1 LNG TERMINAL, MARINE TRANSFER PIPELINES, LNG STORAGE TANKS AND THE REGASIFICATION FACILITIES

6.1.1 Hydrology

TABLE 6.1-1 Residual Environmental Effects Summary for Hydrology

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence **	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R= reversible NR = Not reversible)	Ecological/ Social-cultural and Economic Context			
Construction										
High runoff flows to watercourses	A	• Site-specific SWMP. • The storm-water ponds will be sized to accommodate flows from the exposed areas upstream of the ponds during the construction phase. • Peak flows discharged will not exceed existing peak flows. • Implementation of an ESC Plan.	Low	Betty's Cove Brook and unnamed tributary to Dung Cove	Intermittent and short term over 2.5 years	R	Betty's Cove Brook used for recreational fishing	Minor (Not significant)		
Operation and Maintenance										
High runoff flows to watercourses	A	• Implementation of Storm Water Management Plan with: o Hydrologic modelling to design peak flows attenuation and groundwater recharge. o Maintaining/ creating pervious surfaces for recharge where possible. o Use of retention ponds/fire ponds to collect and control runoff from paved areas.	Low	Betty's Cove Brook drainage below Crane Lake	Intermittent and short term over 20+ year lifetime	R	Betty's Cove Brook used for recreational fishing	Minor (Not significant)		

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Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects: Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R= reversible NR = Not reversible)	Ecological/ Social-cultural and Economic Context	Significance	Likelihood of Occurrence **	Level of Confidence**
		• Implementation of an ESC Plan.								
Reduced base flow to watercourses	A	• Implementation of SWMP to direct appropriate flow to Betty's Cove Brook. • Controlled discharges to the environment. • Discharge of collected storm-water within respective watershed.	Low	Betty's Cove Brook drainage below Crane Lake	Intermittent and short term over 20+ year lifetime	R	Betty's Cove Brook used for recreational fishing	Minor (Not significant)		
Modifications and Decommissioning										
High runoff flows to watercourses	A	Same as construction	Low	Same as construction	Intermittent and short term over weeks or months	R	Betty's Cove Brook used for recreational fishing	Minor (Not significant)		

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

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6.1.2 Freshwater Quality/Quantity

TABLE 6.1-2 Residual Environmental Effects Summary for Freshwater Quality/Quantity

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence **	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R= reversible NR = Not reversible)	Ecological/ Social-cultural and Economic Context			
Construction										
Effects on watercourses (erosion, sediment loading, storm-water discharges, spills) watercourses	A	• Erosion and sediment control plan. • Sediment ponds sized to accommodate flows; flocculent, if required. • Buffer zone. • Sanitary wastewater will be stored and hauled off site during early construction and treated using approved sanitary wastewater methods on site for remainder of construction. • SWMP. • Spill prevention and response plan. • Designated fuelling and material storage site. • Sulphide monitoring program and management plan for exposed acid generating material and drainage.	Low	Betty's Cove Brook and Unnamed tributary to Dung Cove	Intermittent and short term over 2.5 years	R	Betty's Cove Brook used for recreational fishing	Minimal (Not significant)		
Disturbance of tailings during construction	A	• Once final site layout is determined, if tailings disturbance is required, a tailings management strategy, likely including encapsulation, will be developed in concert with regulatory authorities. • Mitigation plan for contaminated tailings and/or soils and sediments.	Low	Betty's Cove Brook and Unnamed tributary to Dung Cove	Intermittent and short term over 2.5 years	R	Soil/ sediment quality locally affected by historic mining activities	Minor (Not significant)		

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Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects: Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R= reversible NR = Not reversible)	Ecological/ Social-cultural and Economic Context	Significance	Likelihood of Occurrence **	Level of Confidence**
		• Data collection and assimilative capacity assessment for all relevant chemical parameters expected to enter the environment or be remobilized due to construction activities.								
Effect of flows to watercourses	A	• Implementation of Storm Water Management Plan. • Hydrologic modelling to design peak flows attenuation and groundwater recharge. • Flow measurement analysis.	Low	Betty's Cove Brook drainage below Crane Lake	Intermittent and short term over 20+ year lifetime	R	Betty's Cove Brook used for recreational fishing	Minor (Not significant)		
Operation & Maintenance										
Effects on surface water quality as a result of discharges of: Storm-water, Process water, and Sanitary waste water	A	• Implementation of SWMP. • Use of a CPI Separator and an IAFU for removal of oils. • First flush approach directs initial 25 mm rain to storm-water ponds. • On-site waste water treatment plant to collect and treat all waste water streams. • Controlled discharge point(s). • Monitoring of discharge quality. • Mitigation plan for contaminated tailings and/or soils and sediments. • Qualitative and quantitative sampling of the benthic-invertebrate community.	Low	Betty's Cove Brook and Unnamed tributary to Dung Cove	Intermittent and short term over 20+ year lifetime	R	Betty's Cove Brook used for recreational fishing	Minor (Not significant)		
		• Sulphide monitoring program and management plan for exposed acid generating material and drainage.								

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence **	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R= reversible NR = Not reversible)	Ecological/ Social-cultural and Economic Context			
Effects of flows to watercourses	A	• Implementation of Storm Water Management Plan with: • Hydrologic modelling to design peak flows attenuation and groundwater recharge. • Peak flows will be attenuated where possible. • Flow measurement analysis.	Low	Betty's Cove Brook drainage below Crane Lake	Intermittent and short term over 20+ year lifetime	R	Betty's Cove Brook used for recreational fishing	Minor (Not significant)		
Modifications And Decommissioning										
Same as construction	A	See construction.	Low	See above	Intermittent and short term over weeks or months	R	See above	Minimal (Not significant)		

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

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6.1.3 Groundwater Quality/Quantity

TABLE 6.1-3 Residual Environmental Effects Summary for Groundwater

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Construction										
Siltation of dug and drilled wells and possible permanent decrease in well yield of drilled wells from blasting and vibrations and heavy equipment use	A	• Avoid blasting to the extent possible within 800 m of residential wells. • Pre-blast well survey. • Remedial action as necessary to restore damaged wells and/or provide temporary potable water as needed.	Low	40 wells within 1 km of site	Temporary (dug and drilled wells) possibly permanent (drilled)	R/NR	Vacant Project Site; sparsely populated area	Minimal (Not significant)		
Water level reductions in dug wells as a result of trenching, site drainage, and large cuts or changes in surface topography.	A	• Monitoring and remedial action as necessary to restore damaged wells and/or provide temporary potable water as needed. • Arbitration and resolution documents will be prepared for owners of water supply wells.	Low	40 wells within 1 km of site	Permanent	NR	Vacant Project Site; sparsely populated area	Minimal (Not significant)		
Water quality degradation from uncontrolled site and road runoff	A	• Proper fuel management. • Application of EPP. • Monitoring and local remedial action as necessary. • ESC Plan.	Low	Two On-site water courses	Intermittent and short term over 2.5 years	R	Betty's Cove Brook used for recreational fishing	Minimal (Not significant)		
Contamination of wells and/or onsite streams from acidic	A	• Test bedrock in high potential areas where grading is required and areas of borrow	Nil	40 wells within 1 km of site; three	Intermittent and short term over 2.5 years	R	Betty's Cove Brook used for recreational	Minimal (Not significant)		

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
drainage in areas of known sulphide mineralization on site		sources; implement acid rock management program, if necessary. • Sulphide monitoring program and management plan for exposed acid generating material and drainage. • Arbitration and resolution documents will be prepared for owners of water supply wells.		on-site water course			fishing; sparsely populated area			
Degradation of groundwater quality due to accidental release of fuel chemicals and hazardous materials	A	• Proper fuel management. • Application of EPP. • Monitoring and local remedial action as necessary.	Low	Two on-site water courses; 40 wells within 1 km of site;	Intermittent and short term over 2.5+ years	R	Watercourses with no importance for local fisheries and water supply; Project Area sparsely populated	Minimal (Not significant)		

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Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Operation and Maintenance										
Degradation of surface and groundwater and well water quality due uncontrolled site and road runoff	A	• Incorporation of design features such as: o Application of EMP. o Monitoring and local remedial action as necessary. o Sulphide monitoring program and management plan for exposed acid generating material and drainage. o Arbitration and resolution documents will be prepared for owners of water supply wells. o ESC Plan. o Sulphide monitoring program and management plan for exposed acid generating material and drainage.	Low	Two on-site water courses; 40 wells within 1 km of site;	Intermittent and short term over 20+ year lifetime	R	Watercourses with no importance for local fisheries and water supply; Project Area sparsely populated	Minimal (Not significant)		

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Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects: Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context	Significance	Likelihood of Occurrence**	Level of Confidence**
Degradation of groundwater quality due to accidental and chronic spills and release of chemical and hazardous materials	A	• EMP. • Monitoring and local remedial action as necessary. • Secondary containment; leak detection; monitoring. • Proper management of fuel, product and material storage, and handling.	Low	Two on-site water courses; 40 wells within 1 km of site;	Intermittent and short term over 20+ year lifetime	R	Watercourses with no importance for local fisheries and water supply; Project Area sparsely populated	Minimal (Not significant)		
Modifications And Decommissioning										
Siltation of dug and drilled wells and possible permanent decrease in well yield of drilled wells from blasting and vibrations and heavy equipment use	A	• Avoid blasting to the extent possible within 500 m of residential wells. • Pre-blast well survey. • Remedial action as necessary to restore damaged wells and/or provide temporary potable water as needed.	Low	40 wells within 1 km of site	Temporary (dug and drilled wells) possibly permanent (drilled)	R/NR	Vacant Project Site; sparsely populated area	Minimal (Not significant)		
Contamination of wells and/or onsite streams from acidic drainage in areas of known sulphide mineralization on site	A	• Test bedrock in high potential areas where grading is required and areas of borrow sources; implement acid rock management program, if necessary.	Nil	40 wells within 1 km of site; three on-site water course	Intermittent and short term over weeks or months	R	Betty's Cove Brook used for recreational fishing; sparsely populated area	Minimal (Not significant)		

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

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6.1.4 Marine Water Quality

TABLE 6.1-4 Residual Environmental Effects Summary for Marine Water Quality

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance**	Likelihood of Occurrence***	Level of Confidence***
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Nor reversible	Ecological/Social-cultural and Economic Context			
Construction										
Effects on marine water, (sediment loading, storm-water discharges, spills)	A	• Erosion and sediment control plan. • SWMP. • Spill prevention and response plan. • Designated fuelling and material storage site. • Visual monitoring for turbidity. • Use of clean and non-toxic materials. • Environment Management Plan for disposal, containment, and protection procedures. • Mitigation plans for environmental impacts from contaminated sediments.	Low	LNG Terminal area in Stormont Bay	Intermittent and short term over 2.5 years	R	Potential fish habitat	Minimal (Not significant)		
Re-suspension of contaminated sediments from propeller wash	A	• Large vessels to be berthed with support of tugs. • Mitigation plans for environmental impacts from contaminated sediments.	Low	LNG Terminal area in Stormont Bay	Temporary / Average one ship per day	R	See above	Minimal (Not significant)		

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Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance**	Likelihood of Occurrence***	Level of Confidence***
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Nor reversible	Ecological/Social-cultural and Economic Context			
Operation										
Effects on marine water quality as a result of discharges of: Storm-water, Process water, and Sanitary waste water	A	• Implementation of SWMP. • On-site waste water treatment plant to collect and treat all waste water streams. • Thermal pollution modelling. • Controlled discharge point(s). • Monitoring of discharge quality.	Low	Stormont Bay	Intermittent and short term over 20+ year lifetime	R	See above	Minor (Not significant)		
Re-suspension of contaminated sediments from propeller wash	A	• Large vessels to be berthed with support of tugs. • Mitigation plans for environmental impacts from contaminated sediments.	Low	LNG Terminal area in Stormont Bay	Permanent / Average one ship per day	R	See above	Minimal (Not significant)		
Modifications And Decommissioning										
Same as construction	A	See construction.	Low	See above	Intermittent and short term over weeks or months	R	See above	Minimal (Not significant)		

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6.1.5 Soil/Sediment Quality (terrestrial & marine)

TABLE 6.1-5 Residual Environmental Effects Summary for Soil/Sediment Quality (terrestrial & marine)

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects: Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context	Significance	Likelihood of Occurrence**	Level of Confidence**
Construction										
Disturbance of mine tailings could remobilization arsenic- and mercury-bearing sediment	A	• Test overburden where grading is required and areas of borrow sources. • Implementation of EPP policies. • Tailings areas will be fenced and avoided where feasible, otherwise tailings will be encapsulated. • Mitigation plan for contaminated tailings and/or soils and sediments. • Monitoring plan for all relevant chemical parameters expected to enter the environment or be remobilized. • Baseline data collection and assimilative capacity assessment for all relevant chemical parameters expected to enter the environment or be remobilized due to construction activities.	Low	Project Site and vicinity	Intermittent and short term over 2.5 years	NR	Known historic mining activities and tailings	Minor (Not significant)		

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Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Old mine sites could pose a health and safety concern during construction	A	• Additional surveys of the Project Site to identify former mine sites in areas of concern. • Additional surface mapping with GPS. • Shallow mine workings will be pumped out for further analysis.	Low	Project Site	Intermittent and short term over 2.5 years	R	Known historic mining activities and tailings	Minor (Not significant)		
Re-suspension of contaminated sediments from propeller wash	A	• Large vessels to be berthed with support of tugs.	Low	LNG Terminal area in Stormont Bay	Temporary / Average one ship per day	R	See above	Minimal (Not significant)		
Potential for acid drainage	A	• Detailed analysis to define sites. • Testing of bedrock in potential acid drainage areas. • Where acid drainage potential is confirmed, grading design will be changed. • Mitigation plan for contaminated tailings and/or soils and sediments. • Monitoring program for sulphide bearing material. • Management Plan for exposed acid generating material and associated drainage.	Nil	Project Site	Intermittent and short term over 2.5 years	R	Known historic mining activities and tailings	Minor (Not significant)		

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Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects: Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context	Significance	Likelihood of Occurrence**	Level of Confidence**
Operation & Maintenance										
Accidental spills flowing through old mine workings into wells and oceans	A	• Mitigation plan for contaminated tailings and/or soils and sediments. • Store materials that may cause potential spills away from old mine workings (See Section 2.0). • Fill or avoid all old mine working that may pose a risk.	Low	Project and vicinity	Intermittent and short term over 20+ years	R	Known historic mining activities and tailings	Minor (Not significant)		
Disturbance of mine tailings could remobilization arsenic- and mercury-bearing sediment	A	• Implementation of EPP policies. • Tailings areas will be fenced and avoided where feasible, otherwise tailings will be encapsulated. • Mitigation plan for contaminated tailings and/or soils and sediments. • Monitoring plan for all relevant chemical parameters expected to enter the environment or be remobilized.	Low	Project Site and vicinity	Intermittent and short term over 2.5 years	NR	Known historic mining activities and tailings	Minor (Not significant)		
Re-suspension of contaminated sediments from propeller wash	A	• Large vessels to be berthed with support of tugs.	Low	LNG Terminal area in Stormont Bay	Permanent / Average one ship per day	R	See above	Minimal (Not significant)		

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Potential for acid drainage	A	• Mitigation plan for contaminated tailings and/or soils and sediments. • Monitoring program for sulphide bearing material. • Management Plan for exposed acid generating material and associated drainage.	Nil	Project Site	Intermittent and short term over 2.5 years	R	Known historic mining activities and tailings	Minor (Not significant)		
Modifications and Decommissioning										
Disturbance of mine tailings could remobilization arsenic- and mercury-bearing sediment	A	• Test overburden where grading is required and areas of borrow sources. • Implementation of EPP policies. • Tailings areas will be fenced and avoided where feasible, otherwise tailings will be encapsulated.	Low	Project Site and vicinity	Intermittent and short term over weeks or months	NR	Known historic mining activities and tailings	Minor (Not significant)		
Old mine sites could pose a health and safety concern during construction	A	• Additional surveys of the Project Site to identify former mine sites in areas of concern. • Additional surface mapping with GPS. • Shallow mine workings will be pumped out for further analysis.	Low	Project Site	Intermittent and short term over 2.5 years	R	Known historic mining activities and tailings	Minor (Not significant)		

021099

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Potential for acid drainage	A	• Detailed analysis to define sites. • Testing of bedrock in potential acid drainage areas. • Where acid drainage potential is confirmed, grading design will be changed. • Mitigation plan for contaminated tailings and/or soils and sediments. • Monitoring program for sulphide bearing material. • Management Plan for exposed acid generating material and associated drainage.	Nil	Project Site	Intermittent and short term over 2.5 years	R	Known historic mining activities and tailings	Minor (Not significant)		

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021100

C0115-433

021101

6.1.6 Air Quality

TABLE 6.1-6 Residual Environmental Effects Summary for Air Quality*

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence***	Level of Confidence***
			Magnitude**	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Construction										
Emissions of gaseous pollutants from diesel powered construction equipment and marine vessels delivering equipment as well as from private vehicles of workers	A	• Maintaining vehicles and equipment in good working condition. • Minimizing distance between transfer points. • Promote car pooling. • Maintaining speed restrictions on roads. • Baseline data collection for relevant parameters expected to enter the environment and modelling to predict assimilative capacity.	Low	Construction envelope plus adjacent lands and transport routes	Intermittent and short term over 2.5 years	R	Rural setting; sparsely populated; nearest residential receptors 300 to 500 m off site	Minimal (Not significant)		
Fugitive dust emissions from excavating and moving earth, construction equipment , and the concrete batch plant	A	• Cleaning the area around stored materials. • Covering stored materials, if necessary. • Vacuum sweeping or flushing roads. • Applying dust suppressant. • Reducing the working faces of material piles. • Cover materials hauled from the site by truck. • Routine washing of trucks.	Low	Construction envelope plus adjacent lands	Intermittent and short term over 2.5 years	R	Rural setting; sparsely populated; nearest residential receptors 300 to 500 m off site	Minimal (Not significant)		

021102

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects: Magnitude**	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context	Significance	Likelihood of Occurrence***	Level of Confidence***
		• Use of enclosures, hoods, shrouds, and sprays for possible concrete batch plant. • Monitor PM_{10} if concerns occur. • Employment of high-volume samplers if concerns occur regarding dust. • Baseline data collection for relevant parameters expected to enter the environment and modelling to predict assimilative capacity.								
Operation & Maintenance										
Emissions from LNG tankers, gas vent stacks, submerged combustion vapourizers, and LNG extraction plant	A	• Monitoring and maintenance of emission control system. • Monitoring of VOCs prior to and during operation. • Maximize efficiency of operations. • Use of ultra low NO_x burners. • Air Monitoring Program. • Air Emissions Management Plan.	Low (levels all within applicable regulatory standards)	> 3.5km^2	Construction phase	R	Rural setting; sparsely populated; nearest residential receptors 300 to 500 m off site	Minor (Not significant)		
Project contribution to GHG emissions (CO_2)	A	• Reduce emissions by implementing measures to improve efficiency and through selection of latest emissions control technologies.	Low (in context of provincial emissions)	Global	Constant over 20+ year lifetime	NR	GHGs already represent a significant impact due to large contributions by industrialized	Minor (Not significant)		

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence***	Level of Confidence***
			Magnitude**	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
		• Greenhouse Emissions Management Plan.					countries, and particularly the United States			
Modifications and Decommissioning										
See Construction above										

* Air quality was originally conducted for the purpose of the provincial environmental report (AMEC, 2006) and included all Project components as well as the petrochemical and co-generation facilities. Therefore the case presented above is for the worst case scenario as additional facilities outside of the scope of this document are included in the modeled numbers.

** For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5

*** Only addressed for significant effects

021103

021104

6.1.7 Vegetation

TABLE 6.1-7 Residual Environmental Effects Summary for Vegetation

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Construction										
Reduction in local forest area could limit local forestry activities	A	None	Low	Project Site (149 ha)	Intermittent and short term over 2.5 years	R	Forest on site mostly without merchantable timber	Minimal (Not significant)		
Introduction of invasive plants resulting from imported soil on construction equipment and land clearance	A	• Ensure that construction equipment is thoroughly cleaned prior to transport to the Keltic Project Area. • Quickly stabilize exposed soil. • Store and return topsoil to sites to be landscaped and revegetate using native species. • If required, use short lived successional pioneer species for ground cover and erosion control. • Vegetation Monitoring Plan.	Low	Project Site (149 ha)	Intermittent and short term over 2.5 years	R	Rural setting previously disturbed from forestry and gold mining activities	Minor (Not significant)		
Dust impacts on vegetation	A	See mitigation for Air Quality.	Low	Project Site (149 ha) and adjacent lands	Intermittent and short term over 2.5 years	R	Rural setting previously disturbed from forestry and gold mining activities	Minimal (Not significant)		

021105

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Habitat Removal	A	• Rehabilitate all temporarily used sites.	Medium	Project Site (149 ha)	Permanent	R	No designated / protected lands involved	Medium (Not significant)		
Potential disturbance to kelp, eel grass, etc as a result of propeller wash from tankers and delivery ships	A	• Large vessels to be berthed with support of tugs.	Low	LNG Terminal area in Stormont Bay	Temporary / Construction Phase	R	Affected habitat type widely represented within Stormont Bay	Minimal (Not significant)		
Operation & Maintenance										
Potential disturbance to kelp, eel grass, etc as a result of propeller wash from tankers and delivery ships	A	• Large vessels to be berthed with support of tugs. • No sediment contamination identified.	Low	LNG Terminal area in Stormont Bay	Permanent / Average one ship per day	R	Affected habitat type widely represented within Stormont Bay	Minimal (Not significant)		
Modifications and Decommissioning										
See Construction above										

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

6.1.8 Species at Risk

TABLE 6.1-8 Residual Environmental Effects Summary for Species at Risk

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects: Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Socio-cultural and Economic Context	Significance	Likelihood of Occurrence**	Level of Confidence**
Construction										
Disturbance of Roseate tern nesting habitat on Country Island from ship deliveries	A	• No ships will approach within 200m of Country Island (as per the roseate tern recovery plan).	Low	200 m radius from Country Island	Temporary / Construction Phase	R	Species protected under SARA Schedule 1	Minimal (Not significant)		
Potential effects of foraging of roseate tern	A	• Keltic personnel will be trained in identifying the roseate tern and will report any occurrences of the species in the Project Area during construction to the CWS. Information on the bird's activities such as flying, diving, swimming, etc will be documented and provided. • As a component of NSEL Condition 2.7, the Proponent is committed to prepare an Adaptive Management Plan (AMP) acceptable to EC and NSDNR.	Low	25 km radius from Country Island	Temporary / Construction Phase	R	Species protected under SARA Schedule 1	Low to Medium (Not significant)		
Potential effects of ship lights on roseate terns	A	• No ships will approach within 200m of Country Island (as per the roseate tern recovery plan).	Low	200 m radius from Country Island	Temporary / Average one ship per day	R	Species protected under SARA Schedule 1	Minimal (Not significant)		
Potential for disturbance or destruction of a rare	A	• A buffer zone will be flagged around these plant location(s)	Medium	Near the junction of	Intermittent and short	R	A large population of	Medium (Not		

021106

C0115-439

021107

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects: Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context	Significance	Likelihood of Occurrence**	Level of Confidence**
plant species found on site: horsetail (*Equisetum variegatum*)		to keep construction activities away; otherwise plants will be transplanted to a site with similar conditions. The buffer zone size will be developed in consultation with NSDNR.		Sable road and Highway 316	term over 2.5 years		this species is at Gold Brook Lake, and it probably is in other neighbouring places as well	significant)		
Disturbance/displacement of the Boreal felt lichen (*Eriodermea pedicellatum*)	A	• Conduct a field survey for the boreal lichen during the proper season prior to clearing/construction and develop site specific mitigation in consultation with regulators.	Low	Project Site (149 ha)	Intermittent and short term over 2.5 years	R	The site is in the historical range of this species. Species is listed as endangered by COSEWIC.	Minor (Not significant)		
Disturbance to potential Greater Yellowlegs habitat	A	• Conduct pipeline construction outside of the sensitive nesting season (i.e., June to August).	Low	Barrier beach adjacent to Dung Cove Pond	Intermittent and short term over 2.5 years	R	Greater yellowlegs is a species at risk that is sensitive to human disturbance while nesting	Minor (Not significant)		
Operation & Maintenance										
Disturbance to potential sensitive greater yellowlegs habitat	A	• Conduct pipeline maintenance outside of the sensitive nesting season (i.e., June to August).	Low	Barrier beach adjacent to Dung Cove Pond	Intermittent and short term over days or weeks	R	see above	Minor (Not significant)		

C0115-440

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Disturbance of Roseate tern nesting habitat on Country Island from ship deliveries	A	• Establishment of approved shipping lanes at least 200 m from Country Island.	Low	200 m radius from Country Island	Permanent / Average one ship per day	R	Species protected under SARA Schedule 1	Minimal (Not significant)		
Potential effects of foraging of roseate tern	A	• No ships will approach within 200m of Country Island (as per the roseate tern recovery plan). • As a component of NSEL Condition 2.7, the Proponent is committed to prepare an Adaptive Management Plan (AMP) acceptable to EC and NSDNR.	Low	200 m radius from Country Island	Permanent / Average one ship per day	R	Species protected under SARA Schedule 1	Minimal (Not significant)		
Potential effects of ship lights on roseate terns	A	• No ships will approach within 200m of Country Island (as per the roseate tern recovery plan).	Low	200 m radius from Country Island	Permanent / Average one ship per day	R	Species protected under SARA Schedule 1	Minimal (Not significant)		
Modifications and Decommissioning										
Same as Construction above										

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021108

021109

6.1.9 Fish and Fish Habitat (freshwater and marine)

TABLE 6.1-9 Residual Environmental Effects Summary for Fish and Fish Habitat

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Construction										
Effects on fish and fish habitat due to watercourses (erosion, sediment loading, storm-water discharges)	A	• Erosion/sediment control plan. • Buffer zone. • SWMP. • Designated fuelling and material storage site. • Data collection and assimilative capacity assessment for all relevant chemical parameters expected to enter the environment or be remobilized due to construction activities.	Low	Betty's Cove Brook and unnamed tributary to Dung Cove	Intermittent and short term over 2.5 years	R	Small, local drainage systems	Minimal (Not significant)		
Potential loss of habitat and disruption of marine fishery	A	• Compensation (if required) will be offered for HADD of fish habitat for the construction. • DFO will require replacement of the area lost with habitat of similar or higher type and quality.	Low	Stormont Bay	Permanent	R	The area of the wharf/marine terminal is not a major fishing area	Minimal (Not significant)		
Potential disturbance to kelp, eel grass, etc as a result of propeller wash from tankers and delivery ships	A	• Large vessels to be berthed with support of tugs. • No sediment contamination identified. • Mitigation plans for environmental impacts from contaminated sediments.	Low	LNG Terminal area in Stormont Bay	Temporary / Average one ship per day	R	Affected habitat type widely represented within Stormont Bay	Minimal (Not significant)		

021110

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Operation & Maintenance										
Effects on watercourses (erosion, sediment loading, storm-water discharges) watercourses	A	• Erosion/sediment control plan. • Buffer zone. • SWMP. • Designated fuelling and material storage site. • Modelling for potential changes in substrate. • Mitigation plans for environmental impacts from contaminated sediments.	Low	Betty's Cove Brook	Intermittent and short term over 20+ years	R	Small, local drainage systems	Minimal (Not significant)		
Potential loss of lobster habitat and disruption of marine fishery	A	• Mitigation provided for construction phase is sufficient for the operation and maintenance phases.	Low	Stormont Bay	Permanent	R	See above	Minimal (Not significant)		
Modifications & Decommissioning										
Effects on watercourses (erosion, sediment loading, storm-water discharges) watercourses	A	• Erosion/sediment control plan. • Buffer zone. • SWMP. • Designated fuelling and material storage site.	Low	Betty's Cove Brook and unnamed tributary to Dung Cove	Intermittent and short term over weeks or months	R	Small, local drainage systems	Minimal (Not significant)		
Potential loss of lobster habitat and disruption of marine fishery	A	• Mitigation presented for the construction phase will be sufficient for the decommissioning the LNG facility.	Low	Stormont Bay	Permanent	R	See above	Minimal (Not significant)		

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

6.1.10 Marine Mammals

TABLE 6.1-10 Residual Environmental Effects Summary for Marine Mammals

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Construction										
Potential hearing impairment toward marine mammals from noise related to driving piles	A	To minimize the effects of noise on marine mammals during construction of the jetty and the LNG Terminal, the following mitigation will be applied as required: o work at low tide; o the use of ramped warning signals; o the use of bubble curtains to mask the noise; and o the use of alternative techniques to pile driving such as vibratory pile driving.	Low	Stormont Bay	Temporary-Infrequent during construction	R	Stormont Bay is not particularly important in relation to marine mammals as they appear to be transitory	Minimal (Not significant)		
Operation										
Potential noise masking from noise related to vessels	A	• None since there is a low level of marine mammal activity in the area.	Low	Stormont Bay	Intermittent and short	R	Stormont Bay is not particularly important in relation to marine mammals as they appear to be transitory	Minimal (Not significant)		

021111

C0115-444

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Modification & Decommissioning										
Same as Construction above										

021112

6.1.11 Wildlife and Wildlife Habitat

TABLE 6.1-11 Residual Environmental Effects Summary for Wildlife and Wildlife Habitat

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects: Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context	Significance	Likelihood of Occurrence**	Level of Confidence**
Construction										
Habitat removal during the sensitive seasons could temporarily reduce local populations	A	• Clear vegetation outside the April through July time frame of vertebrate animal reproduction. • Minimize area cleared where possible. • Avoid clearing in deer wintering areas when the snow conditions are such that deer would be utilizing the area. • Progressive removal of habitat, as required, vs. clearing the entire area at once. • Use proper maintenance procedures regarding building materials, slash, litter, etc. • Try to preserve the most sensitive sites. • Ensure that all equipment has appropriate noise-muffling equipment installed and in good working order. • Conduct routine noise monitoring at the site boundaries as appropriate.	Low	Project Site (149 ha)	Staged activities over 2.5 years	R	Rural setting, previously disturbed by gold mining activities and forestry.	Minor (Not significant)		

021113

C0115-446

021114

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
		• Clear vegetation outside of bird nesting season (May 1 through August 1). • Monitoring program to assess wildlife populations.								
Pipeline construction on beach near sensitive bird habitat	A	• Conduct pipeline construction outside of the peak shorebird migration season.	Low	Barrier beach adjacent to Dung Cove Pond	Intermittent and short term over 2.5 years	R	Important shorebird migratory habitat	Minor (Not significant)		
Noise effects on birds from construction equipment during breeding season	A	See above	Low	Project Site (149 ha)	Intermittent and short term over 2.5 years	R	Rural setting, previously disturbed by gold mining activities and forestry.	Minor (Not significant)		
Operation & Maintenance										
Potential for increased human activity to attract pest mammal populations that remain after construction (Skunks, raccoons)	A	• Follow proper maintenance procedures, including measures to eliminate and contain garbage, debris, etc . • New buildings should be constructed without ledges to prevent rock dove nesting.	Low	Project Site (149 ha)	Intermittent and short term over 20+ years	R	Rural setting; sparsely populated	Minimal		

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Noise affects cause changes in wildlife behavior in nearby areas	A	See above	Low (noise levels within regulatory standards for human receptors)	Up to 300 m from LNG facility for intermittent sound, approximately 200 m for constant sound	Intermittent or Constant over 20+ years	R	Rural setting, previously disturbed by gold mining activities and forestry.	Minor (Not significant)		
Modifications and Decommissioning										
Habitat removal during the vertebrate breeding season could temporarily reduce local populations	A	• Clear vegetation outside the April through July time frame of vertebrate animal reproduction. • Minimize area cleared where possible. • Use proper maintenance procedures regarding building materials, slash, litter, etc.	Low	Project Site (149 ha)	Staged activities over weeks or months	R	Rural setting, previously disturbed by gold mining activities and forestry.	Minor (Not significant)		

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021115

6.1.12 Migratory Birds and Migratory Birds Habitat

TABLE 6.1-12 Residual Environmental Effects Summary for Migratory Birds and Migratory Bird Habitat

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Construction										
Reduction in various habitat (mainly forest) may result in short term adverse effects on local populations of migratory birds	A	• Clear vegetation outside the April through July time frame of vertebrate animal reproduction. • Minimize area cleared where possible. • Progressive removal of habitat, as required, vs. clearing the entire area at once. • Use proper maintenance procedures regarding building materials, slash, litter, etc. • Try to preserve the most sensitive sites.	Low	Project Site (149 ha)	Staged clearing over 2.5 years plus 1 year for displaced birds to establish nesting in other local areas	R	Rural setting, previously disturbed by gold mining activities and forestry.	Minor (Not significant)		
Noise effects cause changes in migratory bird behavior in nearby areas	A	• Clear vegetation outside of bird nesting season (May 1 through August 1). • Ensure that all equipment has appropriate noise-muffling installed and in good working order. • Conduct routine noise monitoring at the site	Low	Project Site (149 ha)	Intermittent and short term over 2.5 years	R	Rural setting, previously disturbed by gold mining activities and forestry.	Minor (Not significant)		

021116

021117

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects: Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context	Significance	Likelihood of Occurrence**	Level of Confidence**
		boundaries as appropriate.								
Operation & Maintenance										
Bird mortality or exhaustion from collisions or disorientation from high mast lighting	A	• No unnecessary lighting will be used, especially on structures taller than 15 m, and use fast-blinking strobes if possible. • Area lighting is to be angled directly at work areas and shielded where possible. • Implementation of a Lighting Plan.	Low	Up to 2 km from LNG facility	Constant over 20+ years	R	Rural setting; sparsely populated; Certain migratory species are attracted to light sources causing mortality	Minor (Not significant)		
Noise effects cause changes in bird behavior in nearby areas	A	• Ensure that all equipment has appropriate noise-muffling installed and in good working order. • Conduct routine noise monitoring at the site boundaries as appropriate.	Low	Up to 300 m from LNG facility for intermittent sound Approximately 200 m for constant sound	Intermittent or Constant over 20+ years	R	Rural setting, previously disturbed by gold mining activities and forestry.	Minor (Not significant)		
Modifications & Decommissioning										
Noise from decommissioning may affect migratory birds during breeding season	A	See construction	Low	Project Site (149 ha)	Intermittent and short term over weeks or months	R	Rural setting, previously disturbed by gold mining activities and forestry.	Minimal (Not significant)		

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021118

6.1.13 Wetlands

TABLE 6.1-13 Residual Environmental Effects Summary for Wetlands

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence **	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R= reversible NR = Not reversible)	Ecological/ Social-cultural and Economic Context			
Construction										
Erosion, sedimentation, and damage caused by heavy machinery	A	• Conduct a wetland functional analysis on wetlands prior to construction. • Implementation of EMP with erosion and sediment control plan.	Low	3 wetlands	Intermittent and short term over 2.5 years	R	Site designated for industrial use; numerous wetlands in site vicinity	Minor (Not significant)		
Alteration/displacement of habitat (filling, excavation, and other disturbance) that may alter hydrological integrity of the site	A	• Wetland functional analysis conducted prior to construction. • Documentation of habitat and functions lost. • Submission of a detailed Impact Analysis. • Application of a "**no net loss**" policy through the implementation of a wetland compensation plan. • Methods and plans for avoidance/mitigation/compensation will be developed and implemented. • Implementation of an EPP.	Nil	3 wetlands	Permanent	NR	Site designated for industrial uses; numerous wetlands in site vicinity	Minimal (Not significant)		

021119

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence **	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R= reversible NR = Not reversible)	Ecological/ Social-cultural and Economic Context			
Reduction of wetland water quality due to suspended solids in runoff		• Develop and implement EPP. • Methods and plans for avoidance/mitigation/compensation will be developed and implemented. • ESC Plan.	Low	3 wetlands	Intermittent and short term over 2.5 years	R	Site designated for industrial use; numerous wetlands in site vicinity	Minor (Not significant)		
Spread of invasive species due to the use of equipment/machinery previously used in other areas that supported invasive species		• Develop and implement EPP. • Methods and plans for avoidance/mitigation/compensation will be developed and implemented.	Low	3 wetlands	Intermittent and short term over 2.5 years	R	Site designated for industrial use; numerous wetlands in site vicinity	Minor (Not significant)		
Operation and Maintenance										
Reduction of wetland water quality resulting from discharges/runoff from Project	A	• Implementation of on-site SWMP. • Controlled discharges to the environment and effluent monitoring. • Implementation of EMP with spill prevention and cleanup procedures. • Methods and plans for avoidance/mitigation/compensation will be developed and implemented. • ESC Plan.	Low	3 wetlands	Intermittent and short term over 20+ years	R	Site designated for industrial uses; numerous wetlands in site vicinity	Minor (Not significant)		

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Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence **	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R= reversible NR = Not reversible)	Ecological/ Social-cultural and Economic Context			
Potential of recreational all terrain or off-highway vehicle users to access wetlands and cause environmental damage	A	• Monitoring of illegal off-highway vehicle use.	Low	2 wetlands	Intermittent and short term over 20+ years	R	Site designated for industrial uses; numerous wetlands in site vicinity	Minor (Not significant)		
Modifications and Decommissioning										
See construction										

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021121

6.1.14 Lighting Conditions

TABLE 6.1-14 Residual Environmental Effects Summary for Lighting Conditions

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Construction										
No effect predicted										
Operation & Maintenance										
Bird mortality or exhaustion from collisions or disorientation from high mast lighting	A	• No unnecessary lighting will be used, especially on structures taller than 15 m, and use fast-blinking strobes if possible. • Area lighting is to be angled directly at work areas and shielded where possible. • Implementation of a Lighting Plan.	Low	Up to 2 km from LNG facility	Constant over 20+ years	R	Rural setting; sparsely populated; Certain migratory species are attracted to light sources causing mortality	Minor (Not significant)		
Impacts of light on surrounding community due to unwanted light pollution and skyglow	A	• Unnecessary lighting will not be used. • Avoid use of light structures over 15 m in height and use of flashing strobe lights. • Shield lighting where possible. • Use of angled lighting or lighting directed close to work area.	Low	Up to 2 km for LNG Facility	Constant over 20+ years	R	Rural setting; sparsely populated; Certain migratory species are attracted to light sources causing mortality	Minor (Not significant)		
Modifications and Decommissioning										
No effect predicted										

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

6.1.15 Atmospheric and Underwater Acoustics

TABLE 6.1-15 Atmospheric and Underwater Acoustics

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Construction										
Periodic sound levels related to blasting and construction equipment could exceed NSEL guidelines at nearest receptors	A	• Install standard noise-muffling on all equipment. • Conduct noise monitoring at nearby residences as per Health Canada's Draft Guidance on Noise Assessment for CEAA Projects. • Based on the results of noise monitoring, make necessary modifications to mitigation plans and/or operations. • Restrict hours of intensive construction activities. • Provide contact numbers for reporting noise issues to Keltic and government agencies. • Give adequate prior notice of any blasting activities. • Maintain forested noise buffers between construction and residents. • Consult with local commercial fishermen.	Low	Up to 500 m from site boundaries	Intermittent and short term over 2.5 years	R	Rural setting; sparsely populated	Minor (Not significant)		

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Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Minimize the effects of noise on marine mammals during construction of the Jetty and the LNG Terminal	A	• Work at low tide. • Use ramped warning signs. • Use bubble curtains to mask the noise. • Use alternative techniques to pile driving such as vibratory pile driving.	Low	Stormont Bay	Temporary/ Infrequent during construction	R	Stormont Bay is not particularly important in relation to marine mammals as they appear to be transitory	Minimal		
Operation & Maintenance										
Periodic sound levels related to LNG facilities operation (i.e., blowdown) could exceed Health Canada guidelines at nearest receptors	A	• Maintain a treed buffer between plant site and residences. • Use silencers and baffles on equipment. • Conduct routine noise monitoring to ensure noise levels at nearest occupied properties do not exceed Health Canada guidelines. • Based on the results of noise monitoring, make necessary modifications to mitigation plans and/or operations. • Supply public with contact numbers in case of noise issues. • Minimize evening and night-time operations. • Consult with local commercial fisheries.	Low (Noise levels to remain within provincial standards)	Up to 500 m from facility	Intermittent and short term over 20+ years	R	Rural setting; sparsely populated	Minor (Not significant)		

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Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Effect of underwater noise on marine mammal masking	A	• None since there is a low level of marine mammal activity in the area.	Low	Stormont Bay	Intermittent and short	R	Stormont Bay is not particularly important in relation to marine mammals as they appear to be transitory	Minimal (Not significant)		
Modifications and Decommissioning										
See Construction above										

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021125

6.1.16 Current Use of Lands and Resources for Traditional Purposes by Aboriginal Persons

TABLE 6.1-16 Residual Environmental Effects Summary for Current Use of Lands and Resources for Traditional Purposes by Aboriginal Persons

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R= reversible NR = Not reversible)	Ecological/ Social-cultural and Economic Context			
Construction										
Reduction in traditional Mi'kmaq hunting area and potential impacts on traditionally fished waterways and medicinal plant gathering sites	A	• Conduct Project activities that affect waterways in an environmentally acceptable manner so that traditional fisheries are not compromised. • Wetlands will be rehabilitated or compensated for “no net loss”. • Wetland plans for avoidance/mitigation/compensation will be implemented. • Mi’kmaq Communication Plan. • Further assessments of Mi’kmaq traditional use of lands. • An archaeology and heritage resources monitoring and contingency plan will be developed and implemented.	Low	149 ha (<2%) of one large traditional hunting area	At least 25 years (i.e., during the lifetime of the Project)	R	Affected hunting area represents one of approximately 10 large hunting areas in Guysborough County	Minor (Not significant)		

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Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R= reversible NR = Not reversible)	Ecological/ Social-cultural and Economic Context			
Operation & Maintenance										
Limit possibility of harvesting sea urchin	A	• FHCP includes enhancement of benthic habitat within the same urchin licence area. This is predicted to offset any loss of sea urchin production and/or access once the species returns to commercial levels. • An archaeology and heritage resources monitoring and contingency plan will be developed and implemented.	Low	Marine Terminal	Constant 20+ years	NR	• Sea urchin in area were largely decimated in the past and have not recovered	Minimal (Not significant)		
Modifications & Decommissioning										
None										

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021127

6.1.17 Physical and Cultural Heritage

TABLE 6.1-17 Residual Environmental Effects Summary for Physical and Cultural Heritage

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R= reversible NR = Not reversible)	Ecological/ Social-cultural and Economic Context			
Construction										
Community concerns on cultural significance of Red Head Cemetery.	A	• Agreement for the establishment of a memorial at the Red Head Cemetery Site. • Cultural Heritage Plan. • Archaeology and heritage resources monitoring and contingency Plan.	Low	Red Head Cemetery	Permanent	NR	Area of known historical burial site High public sensitivity	Minimal (Not significa nt)		
Operation & Maintenance										
Same as above										
Modifications & Decommissioning										
Same as above										

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021128

6.1.18 Structures/Sites of Archaeological, Paleontological or Architectural Significance

TABLE 6.1-18 Residual Environmental Effects Summary for Structures/ Sites of Archaeological, Paleontological, or Architectural Significance

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude	Geographic Extent	Duration/ Frequency	Reversibility (R= reversible NR = Not reversible)	Ecological/ Social-cultural and Economic Context			
Construction										
Heavy disturbance of land will occur near the former Red Head Cemetery by the marine facility	A	• Cultural Heritage Plan. • Complete archaeological assessment for entire Project. • Conduct monitoring by a qualified archaeologist during ground disturbance and in the event that artefacts are encountered regulatory agencies will be notified and appropriate additional mitigation would be developed.	Unknown	Unknown	Permanent	NR	Area close to known historical burial site High public sensitivity	Unknown but expected to be minor (not significant) following mitigation		
Operation										
Access to former Red Head Cemetery by public for cultural purposes could be interrupted by Project infrastructure	A	• Escorted access to the former Red Head Cemetery site will be provided. • Cultural Heritage Plan. • Archaeology and heritage resources monitoring and contingency Plan.	Low	Former Red Head Cemetery	Permanent	R	Area of known historical burial site High public sensitivity	Minor (Not significant)		
Modification & Decommissioning										
None										

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021129

6.1.19 Navigation

TABLE 6.1-19 Residual Environmental Effects Summary for Navigation

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Construction										
Increased risks from vessel traffic surrounding marine terminal	A	• Navigation and other markings will follow the recommendations of TC. • Low level of boat activity is not expected to result in any important navigation issues with respect to marine facilities. • Fishermen will be notified in advance of ship arrivals and departures.	Low	Stormont Bay	Permanent-Average one ship per day	R	Harbour currently has minimal commercial traffic	Minor (Not significant)		
Operation										
Same as above										
Modification & Decommissioning										
None										

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021130

6.1.20 Marine Safety and Security

See Table 6.1-19
Marine security issues will be addressed in the TERMPOL process and in the QRA.

6.1.21 Human Health and Safety

TABLE 6.1-21 Residual Environmental Effects Evaluation Assessment Matrix - Health and Safety

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Construction										
Potential effects from dust generation (arsenic/mercury Mining residuals)	A	• Dust Control Plan, Worker Health and Safety Plan, Erosion Control Plan, and Spill Prevention and Emergency Response Plan will be implemented during construction.	Low	Entire Keltic Project Area (350 ha)	Intermittent and short term over 2.5 years	R	Pre-existing mine tailings cause localized dust problems	Minimal (Not significant)		
Safety concerns regarding former mine workings	A	• Health and Safety controls should protect workers in tailings/mining areas. • Potential airborne transport should be minimized. • Further mapping will be done to delineate the extent and location of old mines.	Low	LNG Site (149 ha)	Intermittent and short term over 2.5 years	R	Dung Harbour has been shown to have elevated concentrations of arsenic	Minimal (Not significant)		
Increased potential effects from air emissions; caused by construction equipment, increased	A	• See above; also air emissions should be localized with limited transport, due to their sporadic nature and emissions close to ground surface.	Low	Entire Keltic Project Area (350 ha)	Intermittent and short term over 2.5 years	R	Rural setting, sparsely populated	Minimal (Not significant)		

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Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Vehicular traffic and vessels transporting Construction materials and equipment		• Maintaining vehicles and equipment in good working condition.								
		• Minimizing distance between transfer points. • Promote car pooling. • Maintaining speed restrictions on roads.								
Potential effects of water and waste management and control	A	• Spill Control Plan. • Water effluent treatment. • Emergency Response Plan. • Prevent run-off and transport of mined soils. • Control run-off and potential migration of impacted Soils.	Low	Betty's Cove Brook and unnamed tributary to Dung Cove	Intermittent and short term over 2.5 years	R	Minor local fisheries in Isaac's Harbor and small tributaries.	Minimal (Not significant)		
Operation & Maintenance										
Increased potential effects from air emissions; caused by Project operations, vehicular traffic and vessels	A	• See above	Low	Keltic Project Area (350 ha)	Intermittent and short term over 30 years	R	Rural setting, sparsely populated	Minimal (Not significant)		
Potential effects of water and waste management and control	A	• See above	Low	Betty's Cove Brook and unnamed tributary to Dung Cove	Intermittent and short term over 30 years	R	Minor local fisheries in Isaac's Harbor and small tributaries.	Minimal (Not significant)		

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Modifications & Decommissioning										
Potential effects from dust generation (arsenic/mercury Mining residuals)	A	• Dust Control Plan, Worker Health and Safety Plan, Erosion Control Plan and Spill, Control Plan will be implemented during construction.	Low	Keltic Project Area (350 ha)	Intermittent and short term over 12 months	R	Pre-existing mine tailings cause localized dust problems	Minimal (Not significant)		

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021132

6.1.22 Fisheries

TABLE 6.1-22 Residual Environmental Effects Evaluation Assessment Matrix - Fisheries

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects: Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context	Significance	Likelihood of Occurrence**	Level of Confidence**
Construction										
Potential disruption of fishing activities	A	• Fishing Equipment Compensation Policy. • Provide advance notice of ship arrivals. • Potential Effects Analysis and consultation with marine fisheries authorities and local fishing community.	Low	Marine Terminal	Permanent	NR	The area of the marine terminal is not a major fishing area	Minimal (Not significant)		
Water quality effects on fish habitat	A	• Erosion/sediment control plan. • Buffer zone. • SWMP. • Designated fuelling and material storage site. • Data collection and assimilative capacity assessment for all relevant chemical parameters expected to enter the environment or be remobilized due to Project activities. • Sediment ponds sized to accommodate flows; flocculent, if required. • Sanitary wastewater will be stored and hauled off site during early construction and treated using approved sanitary wastewater	Low	Betty's Cove Brook and unnamed tributary to Dung Cove	Intermittent and short term over 2.5 years	R	Small, local drainage systems	Minimal (Not significant)		

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Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects: Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context	Significance	Likelihood of Occurrence**	Level of Confidence**
		methods on site for remainder of construction.								
		• Sulphide monitoring program and management plan for exposed acid generating material and drainage. • Visual monitoring for turbidity. • Use of clean and non-toxic materials. • Environment Management Plan for disposal, containment, and protection procedures.								
Fish will be attracted to lighting from Construction Activities	A	• No unnecessary lighting will be used, especially on structures taller than 15 m, and use fast-blinking strobes if possible. • Area lighting will be angled directly at work areas and shielded where possible. • Implementation of a Lighting Plan.	Low	Marine Terminal	Short term over 2.5 years	R	The area of the marine terminal is not a major fishing area	Minimal (Not significant)		
Operation & Maintenance										
Potential disruption of fishing activities	A	• Fishing Equipment Compensation Policy. • Provide advance notice of ship arrivals. • Notify local vessels of LNG tanker schedules, and duration of the exclusion zone. • Potential Effects Analysis and consultation with marine fisheries authorities and local fishing	Low	Stormont Bay	Intermittent and short term over 20+ year lifetime	R	The proposed shipping channel in Stormont Bay and approaches is not a major marine fishing area	Minimal (not significant)		

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Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
		community. • Monitoring program for site runoff.								
Fish will be attracted to lighting from LNG Terminal	A	• No unnecessary lighting will be used, especially on structures taller than 15 m, and use fast-blinking strobes if possible. • Area lighting will be angled directly at work areas and shielded where possible • Implementation of a Lighting Plan	Low	Marine Terminal	Short term over 2.5 years	R	The area of the marine terminal is not a major fishing area	Minimal (Not significant)		
Water quality effects on fish habitat	A	• Erosion/sediment control plan. • Buffer zone. • SWMP. • Designated fuelling and material storage site. • Sulphide monitoring program and management plan for exposed acid generating material and drainage. • Visual monitoring for turbidity. • Environment Management Plan for disposal, containment, and protection procedures.	Low	Betty's Cove Brook	Intermittent and short term over 20+ years	R	Small, local drainage systems	Minimal (Not significant)	A	
Modifications & Decommissioning										
None										

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021136

6.1.23 Aquaculture

TABLE 6.1-23 Residual Environmental Effects Summary for Aquaculture

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Construction										
Release of sediments or contaminants into the water column from construction	A	• Employ standard mitigation measures to control sediment and small spills. • Implementation of an Aquaculture Compensation Plan.	Low	LNG Terminal	Construction Phase	R	Aquaculture facilities are located in Country Harbour, not in the vicinity of the LNG Terminal location	Minimal (Not significant)		
Large spill or accident from construction vessels	A	• Implementation of an Aquaculture Compensation Plan.	Low	Country Harbour	Localized; short term	R	Country Harbour is not a major shipping destination/route	Minimal (Not significant)		
Operation										
Large spill or accident from Project vessels	A	• Implementation of an Aquaculture Compensation Plan.	Low	Country Harbour	Localized; short term	R	Country Harbour is not a major shipping destination/route	Minimal (Not significant)		
Modification & Decommissioning										
See construction										

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021137

6.1.24 Tourism

TABLE 6.1-24 Residual Environmental Effects Summary for Tourism

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects: Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context	Significance	Likelihood of Occurrence**	Level of Confidence**
Construction										
Effects on regional visual landscape character may affect outdoor oriented tourism	A	• Implementation of Dust management plan. • Regular road cleaning. • Maintaining tree and shrub buffer along the site perimeter. • Design of jogged road access. • Implementation of ESC plan and Surface Water Monitoring Program.	low	149 ha in area; locally visible	Constant over construction phase	NR	• Eastern Shore tourism sector known for its natural beauty, coastal views, rural landscape. • Little tourism infrastructure in area. • Project Area is zoned for industrial use.	Minimal (not significant)		
Operation & Maintenance										
Effects on regional visual landscape character	A	• Implementation of Dust management plan. • Colour schemes that support background blending to be used for stacks and higher buildings. • Locate flare stack at the back of the site. • Regular road cleaning. • Maintaining tree and shrub buffer along the site perimeter. • Design of jogged road access.	low	149 ha in area; locally visible	Constant over operational phase	NR	• Eastern Shore tourism sector known for its natural beauty, coastal views, rural landscape. • Little tourism infrastructure in area. • Project Area is zoned for	Minimal (not significant)		

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
		• Implementation of ESC plan and Surface Water Monitoring Program.					industrial use.			
Modifications & Decommissioning										
None										

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

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6.2 MARGINAL WHARF

6.2.1 Freshwater Quality/Quantity

TABLE 6.2-1 Residual Environmental Effects Summary for Freshwater Quality/Quantity

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Construction										
Potential for sedimentation through site development and grading in unnamed tributary to Dung Cove	A	• Erosion and sediment control plan. • Maintain 15 m buffer zone. • SWMP. • Spill prevention and response plan. • Designated fuelling and material storage site. • Sediment ponds sized to accommodate flows; flocculent, if required. • Sanitary wastewater will be stored and hauled off site during early construction and treated using approved sanitary wastewater methods on site for remainder of construction. • Sulphide monitoring program and management plan for exposed acid generating material and drainage.	Low	Small local water course adjacent to the Project Site.	Short term and mainly restricted to storm events.	R	Some sediment and water quality impacts from historic mining have occurred in local watercourses.	Minimal (not significant)		

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Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Infilling two wetland ponds on the red head peninsula	A	• Wetland functional analysis conducted prior to construction. • Documentation of habitat and functions lost. • Information used in a wetland compensation plan for habitat loss. • Submission of a detailed Impact Analysis. • Methods and plans for avoidance/mitigation/compensation will be developed and implemented. • Implementation of an EPP.	Medium	Red head peninsula	Permanently lost	NR	Site designated for industrial Uses; numerous wetlands in site vicinity.	Medium/ Major (Not significant/ significant)	High	High
Operation										
None										
Modification & Decommissioning										
Same as for construction above										

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021141

6.2.2 Marine Water Quality

TABLE 6.2-2 Residual Environmental Effects Summary for Marine Water Quality

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects: Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context	Significance	Likelihood of Occurrence**	Level of Confidence**
Construction										
Possible re-suspension of sediment during construction of the marginal wharf	A	• Concrete caissons or sheet piling will be put in place and filled with aggregate to provide a structure capable of holding heavy large storage silos. • Use of silt curtains and booms.	Low	Size of Rock Mattress for Wharf: 0.210 km^2	Temporary / Construction of the marginal wharf	R	Affected habitat type widely represented within Stormont Bay.	Minimal (Not significant)		
Re-suspension of contaminated sediments from propeller wash	A	• Large vessels to be berthed with support of tugs. • Mitigation plans for environmental impacts from contaminated sediments.	Low	Wharf/ terminal: 0.203 km^2	Temporary / Average one ship per day	R	Affected habitat type widely represented within Stormont Bay.	Minimal (Not significant)		
Bilge water or accidental spill of fuel or other contaminants from vessels	A	• Establishment and adherence to MARPOL and *Canada Shipping Act*. • Oil Pollution Prevention regulations. • Ballast Water Control Regulations. • Response Organizations and Oil Handling Facilities Regulations. • TP 12402 Oil Handling Facilities Standards.	Low	Stormont Bay	Temporary / Construction Phase	R	Marine water quality.	Minimal (Not significant)		

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Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Operation										
Re-suspension of contaminated sediments from propeller wash	A	• Large vessels to be berthed with support of tugs. • Mitigation plans for environmental impacts from contaminated sediments.	Low	Wharf/ terminal: 0.203 km^2	Permanent / Average one ship per day	R	Affected habitat type widely represented within Stormont Bay.	Minimal (Not significant)		
Bilge water or accidental spill of fuel or other contaminants from vessels	A	• Establishment and adherence to MARPOL.	Low	Stormont Bay	Permanent / Average one ship per day	R	Marine water quality.	Minimal (Not significant)		
Modification & Decommissioning										
Same as construction										

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021143

6.2.3 Soil/Sediment Quality (terrestrial and marine)

TABLE 6.2-3 Residual Environmental Effects Summary for Soil/Sediment Quality (terrestrial and marine)

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Construction										
Possible re-suspension of sediment during construction of the marginal wharf	A	• Concrete caissons or sheet piling will be put in place and filled with aggregate to provide a structure capable of holding heavy large storage silos. • Use of silt curtains and booms. • Baseline data collection and assimilative capacity assessment for all relevant chemical parameters expected to enter the environment or be remobilized due to construction activities.	Low	Size of Rock Mattress for Wharf: 0.210 km^2	Temporary / Construction of the marginal wharf	R	Affected habitat type widely represented within Stormont Bay.	Minimal (Not significant)		
Re-suspension of contaminated sediments from propeller wash	A	• Large vessels to be berthed with support of tugs. • No sediment contamination identified.	Low	Size of Rock Mattress for Wharf: 0.210 km^2	Temporary / Construction Phase	R	Affected habitat type widely represented within Stormont Bay.	Minimal (Not significant)		
Bilge water or accidental spill of fuel or other contaminants from vessels	A	• Establishment and adherence to MARPOL and *Canada Shipping Act*. • Oil Pollution Prevention regulations.	Low	Stormont Bay	Temporary / Construction Phase	R	Marine water quality	Minimal (Not significant)		

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Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects: Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context	Significance	Likelihood of Occurrence**	Level of Confidence**
		• Ballast Water Control Regulations. • Response Organizations and Oil Handling Facilities Regulations. • TP 12402 Oil Handling Facilities.								
Operation										
Re-suspension of contaminated sediments from propeller wash	A	• Large vessels to be berthed with support of tugs.	Low	Size of Rock Mattress for Wharf: 0.210 km^2	Permanent / Average one ship per day	R	Affected habitat type widely represented within Stormont Bay	Minimal (Not significant)		
Bilge water or accidental spill of fuel or other contaminants from vessels	A	• Establishment and adherence to MARPOL and *Canada Shipping Act.* • Oil Pollution Prevention regulations. • Ballast Water Control Regulations. • Response Organizations and Oil Handling Facilities Regulations. • TP 12402 Oil Handling Facilities.	Low	Stormont Bay	Permanent / Average one ship per day	R	Marine water quality	Minimal (Not significant)		

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Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Modification & Decommissioning										
Re-suspension of contaminated sediments from propeller wash	A	• Large vessels to be berthed with support of tugs. • No sediment contamination identified.	Low	Size of Rock Mattress for Wharf: 0.210 km^2	Temporary / Construction Phase	R	Affected habitat type widely represented within Stormont Bay	Minimal (Not significant)		
Bilge water or accidental spill of fuel or other contaminants from vessels	A	• Establishment and adherence to MARPOL and *Canada Shipping Act.* • Oil Pollution Prevention regulations. • Ballast Water Control Regulations. • Response Organizations and Oil Handling Facilities Regulations. • TP 12402 Oil Handling Facilities.	Low	Stormont Bay	Temporary / Construction Phase	R	Marine water quality	Minimal (Not significant)		

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021146

6.2.4 Air Quality

TABLE 6.2-4 Residual Environmental Effects Summary for Air Quality

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects: Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context	Significance	Likelihood of Occurrence**	Level of Confidence**
Construction										
Emissions of gaseous pollutants from diesel powered construction equipment and marine vessels delivering equipment as well as from private vehicles of workers	A	• Maintaining vehicles and equipment in good working condition. • Minimizing distance between transfer points • Promote car pooling. • Maintaining speed restrictions on roads.	Low	Construction envelope plus adjacent land and transport routes	Temporary / Construction Phase	R	Rural setting; sparsely populated; nearest residential receptors 300 to 500 m off site.	Minimal (Not significant)		
Fugitive dust emissions from, construction equipment	A	• Cleaning the area around stored materials. • Covering stored materials, if necessary. • Applying dust suppressant. • Reducing the working faces of material piles. • Cover materials hauled from the site by truck. • Routine washing of trucks. • Use of enclosures, hoods, shrouds, and sprays for possible concrete batch plant. • Monitor PM_{10} if concerns occur. • Employment of high-volume samplers if concerns occur regarding dust.	Low	Construction envelope plus adjacent land and transport routes	Temporary / Construction Phase	R	Rural setting; sparsely populated; nearest residential receptors 300 to 500 m off site.	Minimal (Not significant)		

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Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
		• Baseline data collection for relevant parameters expected to enter the environment and modelling to predict assimilative capacity.								
Operation										
Emissions from ship deliveries of equipment and supplies	A	• Monitoring and maintenance of emission control system. • Monitoring of VOCs prior to and during operation. • Maximize efficiency of operations. • Air dispersion modelling assessment for effects from vessels tied up at Marginal Wharf. • Air Monitoring Program.	Low	> 3.5 km^2	Intermittent / As needed	R	Rural setting; sparsely populated; nearest residential receptors 300 to 500 m off site	Minor (Not significant)		
Modification & Decommissioning										
Same as construction										

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021148

6.2.5 Vegetation (terrestrial and marine)

TABLE 6.2-5 Residual Environmental Effects Summary for Vegetation (terrestrial and marine)

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects: Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context	Significance	Likelihood of Occurrence**	Level of Confidence**
Construction										
Habitat Removal	A	• Minimize construction envelope. • Rehabilitate all temporarily used sites.	Medium	Rock Mattress for wharf (0.210 km^2)	Permanent	NR	No designated / protected lands involved	Medium (Not significant)		
Dust impacts on vegetation	A	• Vegetation Monitoring Plan. • Cleaning the area around stored materials. • Covering stored materials, if necessary. • Vacuum sweeping or flushing roads. • Applying dust suppressant. • Reducing the working faces of material piles. • Cover materials hauled from the site by truck. • Routine washing of trucks. • Use of enclosures, hoods, shrouds, and sprays for possible concrete batch plant.	Low	Project Site and adjacent lands	Temporary / Construction phase	R	Vegetation affected without protective status	Minimal (Not significant)		
Potential infilling, excavating, and otherwise disturbing wetlands	A	• Dredging will not be performed. • Concrete caissons or sheet piling will minimize sedimentation.	Low	> 3.5 km^2	Temporary / Construction phase	R	Vegetation affected without protective status	Minimal (Not significant)		

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Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects: Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context	Significance	Likelihood of Occurrence**	Level of Confidence**
Potential introduction of exotic invasive plant species	A	• Ballast water exchange in compliance with guidelines and the Canadian Ballast Water Control and Management Regulations under the *Canada Shipping Act.* • Vegetation Monitoring Plan. • Ensure that construction equipment is thoroughly cleaned prior to transport to the Keltic Project Area. • Quickly stabilize exposed soil. • Store and return topsoil to sites to be landscaped and revegetate using native species. • If required, use short lived successional pioneer species for ground cover and erosion control.	Low	North Atlantic	Construction period	R	Displacement of native species	Minimal (Not significant)		
Potential disturbance to kelp, eel grass, etc as a result of propeller wash from tankers and delivery ships	A	• Large vessels to be berthed with support of tugs.	Low	Rock Mattress for Wharf: 0.210 km^2	Temporary / Construction Phase	R	Affected habitat type widely represented within Stormont Bay	Minimal (Not significant)		

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects: Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context	Significance	Likelihood of Occurrence**	Level of Confidence**
Operation										
Potential introduction of exotic vegetation from ballast water discharges	A	• Ballast water exchange in compliance with guidelines and the Canadian Ballast Water Control and Management Regulations under the *Canada Shipping Act.* • Vegetation Monitoring Plan.	Low	North Atlantic	Permanent / Average one ship per day	R	Displacement of native species	Minimal (Not significant)		
Potential disturbance to kelp, eel grass, etc as a result of propeller wash from tankers and delivery ships	A	• Large vessels to be berthed with support of tugs. • No sediment contamination identified.	Low	Wharf/ terminal: 0.135 km^2	Permanent / Average one ship per day	R	Affected habitat type widely represented within Stormont Bay	Minimal (Not significant)		
Modification & Decommissioning										
Same as construction										

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

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6.2.6 Species at Risk

TABLE 6.2-6 Residual Environmental Effects Summary for Species at Risk

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Construction										
Disturbance of Roseate tern nesting habitat on Country Island from ship deliveries	A	• No ships will approach within 200 m of Country Island (as per the roseate tern recovery plan).	Low	200 m radius from Country Island	Temporary / Construction Phase	R	Species protected under SARA Schedule 1	Minimal (Not significant)		
Potential effects of foraging of roseate tern	A	• Keltic personnel will be trained in identifying the roseate tern and will report any occurrences of the species in the marginal wharf area during construction to the CWS. Information on the bird's activities such as flying, diving, swimming, etc will be documented and provided. • As a component of NSEL Condition 2.7, the Proponent is committed to prepare an Adaptive Management Plan (AMP) acceptable to EC and NSDNR.	Low	25 km radius from Country Island	Temporary / Construction Phase	R	Species protected under SARA Schedule 1	Low to medium (Not significant)		
Potential effects of ship lights on roseate terns	A	• No ships will approach within 200 m of Country Island (as per the roseate tern recovery plan).	Low	200 m radius from Country Island	Temporary / Average one ship per day	R	Species protected under SARA Schedule 1	Minimal (Not significant)		

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Bilge water or accidental spill of fuel or other contaminants from vessels	A	• Establishment and adherence to MARPOL and *Canada Shipping Act*. • Oil Pollution Prevention regulations. • Ballast Water Control Regulations. • Response Organizations and Oil Handling Facilities Regulations. • TP 12402 Oil Handling Facilities Standards.	Low	Stormont Bay	Temporary / Construction Phase	R	Marine water quality	Minimal (Not significant)		
Operation										
Disturbance of Roseate tern nesting habitat on Country Island from ship deliveries	A	• Establishment of approved shipping lanes at least 200 m from Country Island.	Low	200 m radius from Country Island	Permanent / Average one ship per day	R	Species protected under SARA Schedule 1	Minimal (Not significant)		
Potential effects of foraging of roseate tern	A	• No ships will approach within 200m of Country Island (as per the roseate tern recovery plan). • As a component of NSEL Condition 2.7, the Proponent is committed to prepare an Adaptive Management Plan (AMP) acceptable to EC and NSDNR.	Low	25 km radius from Country Island	Permanent / Average one ship per day	R	Species protected under SARA Schedule 1	Minimal (Not significant)		
Potential effects of ship lights on roseate terns	A	• No ships will approach within 200m of Country Island (as per the roseate tern recovery plan).	Low	200 m radius from Country Island	Permanent / Average one ship per day	R	Species protected under SARA Schedule 1	Minimal (Not significant)		
Bilge water or accidental spill of fuel or other contaminants from vessels	A	• Establishment and adherence to MARPOL and *Canada Shipping Act.* • Oil Pollution Prevention regulations. • Ballast Water Control Regulations.	Low	Stormont Bay	Permanent / Average one ship per day	R	Marine water quality	Minimal (Not significant)		

		• Response Organizations and Oil Handling Facilities Regulations. • TP 12402 Oil Handling Facilities Standards.								
Modification & Decommissioning										
See construction										

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021153

6.2.7 Fish and Fish Habitat (marine and freshwater)

TABLE 6.2-7 Residual Environmental Effects Summary for Fish and Fish Habitat (marine and freshwater)

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Construction										
Loss of fish / lobster habitat	A	• Implementation of habitat compensation in accordance with DFO requirements. • Conduct in-water works during non-critical periods. • Restore substrates. • Use suitable backfill materials. • Implement effective erosion control measures. • Wetland functional analysis conducted prior to construction. • Documentation of habitat and functions lost.	Low	Size of Rock Mattress for Wharf: 0.210 km^2	Construction Phase; effect will terminate with successful completion of compensation plan	R	The area of the wharf/marine terminal is not a substantial amount of habitat	Minimal (Not significant)		
Potential introduction of exotic vegetation from ballast water	A	• LNG vessels will be brought in fully loaded and re-ballasted offshore.	Low	North Atlantic	Temporary / Construction period	R	Displacement of native species	Minimal (Not significant)		
Potential disturbance to kelp, eel grass, etc as a result of propeller wash from tankers and delivery ships	A	• Large vessels to be berthed with support of tugs. • No sediment contamination identified. • Mitigation plans for environmental impacts from contaminated sediments.	Low	Size of Rock Mattress for Wharf: 0.210 km^2	Temporary / Average one ship per day	R	Affected habitat type widely represented within Stormont Bay	Minimal (Not significant)		

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Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Bilge water or accidental spill of fuel or other contaminants from vessels	A	• Establishment and adherence to MARPOL and *Canada Shipping Act.* • Oil Pollution Prevention regulations. • Ballast Water Control Regulations. • Response Organizations and Oil Handling Facilities Regulations. • TP 12402 Oil Handling Facilities Standards. • Booms and other spill prevention and clean up equipment will be maintained on site.	Low	Stormont Bay	Temporary / Construction Phase	R	Marine water quality	Minimal (Not significant)		
Effects on fish and fish habitat due to affected watercourses (erosion, sediment loading, storm-water discharges)	A	• Erosion/sediment control plan. • Buffer zone. • SWMP. • Designated fuelling and material storage site. • Data collection and assimilative capacity assessment for all relevant chemical parameters expected to enter the environment or be remobilized due to construction activities.	Low	Stormont Bay	Intermittent and short term over 2.5 years	R	The area of the wharf/marine terminal is not a major fishing area	Minimal (Not significant)		

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Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
		• Concrete caissons or sheet piling will be put in place and filled with aggregate to provide a structure capable of holding heavy large storage silos. • Use of silt curtains and booms. • Large vessels to be berthed with support of tugs. • Mitigation plans for environmental impacts from contaminated sediments.								
Operation										
Marine fish may be attracted by facility lights at night and may perceive noises at a distance from the operation	A	• Monitoring programs to be followed.	Low	Stormont Bay	Operation Phase	R	The area of the wharf/marine terminal is not a major fishing area	Minimal (Not significant)		
Effects on watercourses (erosion, sediment loading, storm-water discharges) watercourses	A	• See construction above.	Low	Stormont Bay	Intermittent and short term for 20+years	R	The area of the wharf/marine terminal is not a major fishing area	Minimal (Not significant)		

021157

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Modification & Decommissioning										
Turbidity Effects on watercourses (erosion, sediment loading, storm-water discharges) watercourses	A	• Erosion/sediment control plan. • Buffer zone. • SWMP. • Designated fuelling and material storage site.	Low	Stormont Bay	Intermittent and short term over weeks or months	R	The area of the wharf/marine terminal is not a major fishing area	Minimal (Not significant)		
Potential loss of fish habitat	A	• Mitigation presented for the construction phase will be sufficient for the decommissioning the Marginal Wharf.	Low	Size of Rock Mattress for Wharf: 0.210 km^2	Permanent	R	See above	Minimal (Not significant)		

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021158

6.2.8 Marine Mammals

TABLE 6.2-8 Residual Environmental Effects Summary for Marine Mammals

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Construction										
Potential hearing impairment toward marine mammals from noise related to driving piles	A	• To minimize the effects of noise on marine mammals during construction of the jetty and the LNG Terminal, the following mitigation will be applied as required. • Work at low tide. • The use of ramped warning signals. • The use of bubble curtains to mask the noise. • The use of alternative techniques to pile driving such as vibratory pile driving.	Low	Stormont Bay	Temporary-Infrequent during construction	R	Stormont Bay is not particularly important in relation to marine mammals as they appear to be transitory	Minimal		
Disturbance of marine mammals from Project-related marine traffic	A	• NA, Stormont Bay is not an important marine mammal location.	Low	Stormont Bay	Construction Phase - Infrequent	R	Stormont Bay is not an important marine mammal location	Minimal		
Operation										
Disturbance of marine mammals through noise from Project-related marine traffic	A	• NA (Stormont Bay is not an important marine mammal location).	Low	Stormont Bay	Operation Phase	R	Stormont Bay is not an important marine mammal location	Minimal (Not significant)		
Modification & Decommissioning										
Same as construction above										

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021159

6.2.9 Wildlife and Wildlife Habitat

TABLE 6.2-9 Residual Environmental Effects Summary for Wildlife and Wildlife Habitat

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects: Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context	Significance	Likelihood of Occurrence**	Level of Confidence**
Construction										
Loss of animal habitat as a result of disturbance and habitat alteration	A	• Minimize disturbance to avoid the potential loss of furbearer habitat in Dung Cove Pond area and implement EPP. • Minimize area cleared where possible. • Use proper maintenance procedures regarding building materials, slash, litter, etc. • Try to preserve the most sensitive sites. • Avoid clearing in deer wintering areas when the snow conditions are such that deer would be utilizing the area. • Clear vegetation outside the April through July time frame of vertebrate animal reproduction. • Ensure that all equipment has appropriate noise-muffling equipment installed and in good working order. • Conduct routine noise monitoring at the site boundaries as appropriate. • Clear vegetation outside of bird nesting season (May 1 through August 1).	High	Wharf size: 0.203 km^2	Permanent	NR	There are no rare or otherwise unique species expected in the area.	Medium (Not significant)		

021160

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects: Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context	Significance	Likelihood of Occurrence**	Level of Confidence**
		• Monitoring Program to assess wildlife populations.								
Noise effects on waterfowls during blasting	A	• Conduct blasting outside of bird nesting season (May 1 through August 1).	Low	Wharf size: 0.203 km^2	Temporary / Construction phase	NR	Waterfowl will return when blasting is finished	Minimal (Not significant)		
Operation										
Increased risk of bird collisions with marginal wharf lighting	A	• Use downward facing lights. • Use strobes when possible. • Do not use red lights. • Do not light structures taller than 50 feet.	Low	Wharf Size: 0.203 km^2	Temporary / Operation phase	NR	Sea birds known to forage in the local shoreline area	Minimal (Not significant)		
Noise affects cause changes in wildlife behavior in nearby areas	A	• See above.	Low (noise levels within regulatory standards for human receptors)	Up to 300 m from marginal wharf for intermittent sound, approximately 200 m for constant sound	Intermittent or Constant over 20+ years	R	Rural setting, previously disturbed by gold mining activities and forestry.	Minor (Not significant)		
Modification & Decommissioning										
Same as construction										

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021161

6.2.10 Migratory Birds and Migratory Birds Habitat

TABLE 6.2-10 Residual Environmental Effects Summary for Migratory Birds and Migratory Birds Habitat

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Construction										
Reduction in various habitat (mainly forest) may result in short term adverse effects on local populations of migratory birds	A	• Clear vegetation outside the April through July time frame of vertebrate animal reproduction. • Minimize area cleared where possible. • Progressive removal of habitat, as required, vs. clearing the entire area at once. • Use proper maintenance procedures regarding building materials, slash, litter, etc. • Try to preserve the most sensitive sites.	Low	Project Site (149 ha)	Staged clearing over 2.5 years plus 1 year for displaced birds to establish nesting in other local areas	R	Rural setting, previously disturbed by gold mining activities and forestry.	Minor (Not significant)		
Noise effects cause changes in migratory bird behavior in nearby areas	A	• Clear vegetation outside of bird nesting season (May 1 through August 1). • Ensure that all equipment has appropriate noise-muffling installed and in good working order. • Conduct routine noise monitoring at the site boundaries as appropriate.	Low	Wharf Size: 0.203 km^2	Intermittent and short term over 2.5 years	R	Rural setting, previously disturbed by gold mining activities and forestry.	Minor (Not significant)		

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021162

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Operation										
Bird mortality or exhaustion from collisions or disorientation from high mast lighting	A	• No unnecessary lighting will be used, especially on structures taller than 15 m, and use fast-blinking strobes if possible. • Area lighting is to be angled directly at work areas and shielded where possible. • Implementation of a Lighting Plan.	Low	Up to 2 km from Marginal Wharf	Constant over 20+ years	R	Rural setting; sparsely populated; Certain migratory species are attracted to light sources causing mortality	Minor (Not significant)		
Noise effects cause changes in bird behavior in nearby areas	A	• Ensure that all equipment has appropriate noise-muffling installed and in good working order. • Conduct routine noise monitoring at the site boundaries as appropriate.	Low	Up to 300 m from Marginal Wharf for intermittent sound Approximately 200 m for constant sound	Intermittent or Constant over 20+ years	R	Rural setting, previously disturbed by gold mining activities and forestry.	Minor (Not significant)		
Modification & Decommissioning										
None										

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

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021163

6.2.11 Wetlands

TABLE 6.2-11 Residual Environmental Effects Summary for Wetlands

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Construction										
Infilling two wetland ponds on the red head peninsula	A	• Wetland functional analysis conducted prior to construction. • Documentation of habitat and functions lost. • Submission of a detailed Impact Analysis. • Methods and plans for avoidance/mitigation/compensation will be developed and implemented. • Implementation of an EPP.	Medium	Red head peninsula	Permanently lost	NR	Site designated for industrial Uses; numerous wetlands in site vicinity	Medium/Major (Not significant/ significant)	High	High
Operation										
None										
Modification & Decommissioning										
None										

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021164

6.2.12 Lighting Conditions

TABLE 6.2-12 Residual Environmental Effects Summary for Lighting Conditions

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Construction										
None										
Operation										
Bird mortality or exhaustion from collisions or disorientation from high mast lighting	A	• No unnecessary lighting will be used, especially on structures taller than 15 m, and use fast-blinking strobes if possible. • Area lighting is to be angled directly at work areas and shielded where possible. • Implementation of a Lighting Plan.	Low	Up to 2 km from LNG facility	Constant over 20+ years	R	Rural setting; sparsely populated; Certain migratory species are attracted to light sources causing mortality	Minor (Not significant)		
Impacts of light on surrounding community due to unwanted light pollution and skyglow	A	• Unnecessary lighting will not be used. • Avoid use of light structures over 15 m in height and use of flashing strobe lights. • Shield lighting where possible. • Use of angled lighting or lighting directed close to work area.	Low	Up to 2 km for LNG Facility	Constant over 20+ years	R	Rural setting; sparsely populated; Certain migratory species are attracted to light sources causing mortality	Minor (Not significant)		
Modification & Decommissioning										
None										

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021165

6.2.13 Atmospheric and Underwater Acoustic Environment

TABLE 6.2-13 Residual Environmental Effects Summary for Atmospheric and Underwater Acoustic Environment

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Construction										
Effects on cetacean and seal behavior from underwater noise generated by pile-driving	A	• Work at low tide. • Use ramped warning signs. • Use bubble curtains to mask the noise. • Use alternative techniques to pile driving such as vibratory pile driving.	Medium	Isaac's Harbour, Stormont Bay	Temporary-Infrequent During Construction phase	R	Isaac's Harbour and Stormont Bay not know to be frequented by cetaceans Seals commonly use local shoreline area	Minor (Not significant)		
Disturbance to fisheries operations by underwater noise from pile driving	A	• Commercial fishery Reps will be consulted and will develop schedules to minimize disruption of fisheries.	Medium	Isaac's Harbour, Stormont Bay	Temporary-Infrequent During Construction phase	R	Local fisheries are relatively small	Minimal (Not significant)		
Operation										
Effect of underwater noise on marine mammal masking	A	• None since there is a low level of marine mammal activity in the area.	Low	Isaac's Harbour Stormont Bay	Intermittent and short	R	Stormont Bay/Isaac's Harbour is not particularly important in relation to marine mammals as they appear to be transitory	Minimal (Not significant)		
Modification & Decommissioning										
Same as Construction										

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

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6.2.14 Current Use of Lands and Resources for Traditional Purposes by Aboriginal Persons

TABLE 6.2-14 Residual Environmental Effects Summary for Current Use of Lands and Resources for Traditional Purposes by Aboriginal Persons

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects: Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R= reversible NR = Not reversible)	Ecological/ Social-cultural and Economic Context	Significance	Likelihood of Occurrence**	Level of Confidence**
Construction										
Minor reduction in traditional Mi'kmaq hunting area and potential impacts on traditionally fished waterways and medicinal plant gathering sites	A	• Conduct Project activities that affect waterways in an environmentally acceptable manner so that traditional fisheries are not compromised. • Wetlands will be rehabilitated or compensated for "no net loss". • Wetland plans for avoidance/mitigation/ compensation will be implemented. • Mi'kmaq Communication Plan. • Further assessments of Mi'kmaq traditional use of lands. • An archaeology and heritage resources monitoring and contingency plan will be developed and implemented.	Low	Wharf Size: 0.203 km^2	At least 25 years (i.e., during the lifetime of the Project)	R		Minor (Not significant)		
Operation										
Limit possibility of harvesting sea urchin	A	• FHCP includes enhancement of benthic habitat within the same urchin licence area. This is predicted to offset any loss of sea urchin production and/or access once the species returns to commercial levels.	Low	Wharf Size: 0.203 km^2	Constant 20+ years	NR	Sea urchin in area were largely decimated in the past and have not recovered	Minimal (Not significant)		

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R= reversible NR = Not reversible)	Ecological/ Social-cultural and Economic Context			
Modification & Decommissioning										
None										

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

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6.2.15 Physical and Cultural Heritage

TABLE 6.2-15 Residual Environmental Effects Summary for Physical and Cultural Heritage

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R= reversible NR = Not reversible)	Ecological/ Social-cultural and Economic Context			
Construction										
Community concerns on cultural significance of Red Head Cemetery.	A	• Agreement for the establishment of a memorial at the Red Head Cemetery Site. • Cultural Heritage Plan. • Archaeology and heritage resources monitoring and contingency Plan.	Low	Red Head Cemetery	Permanent	NR	Area of known historical burial site High public sensitivity	Minimal (Not significant)		
Operation & Maintenance										
Same as above										
Modifications & Decommissioning										
Same as above										

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021169

6.2.16 Structures/Sites of Archaeological, Paleontological or Architectural Significance

TABLE 6.2-16 Residual Environmental Effects Summary for Structures/ Sites of Archaeological, Paleontological, or Architectural Significance

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude	Geographic Extent	Duration/ Frequency	Reversibility (R= reversible NR = Not reversible)	Ecological/ Social-cultural and Economic Context			
Construction										
Heavy disturbance of land will occur at the former Red Head Cemetery by marginal wharf and marine facility	A	• Public consultation with Lincolnville Black community. • Conduct monitoring by a qualified archaeologist during ground disturbance and in the event that artifacts are encountered regulatory agencies will be notified and appropriate additional mitigation would be developed. • Cultural Heritage Plan. • Complete archaeological assessment for entire Project.	Unknown	Unknown	Permanent	NR	Area close to known historical burial site High public sensitivity	Unknown but expected to be minor (not significant) following mitigation		
Direct physical disturbance of McMillan Mine site by construction	A	• Monitoring during ground disturbance and in the event that artifacts are encountered regulatory agencies will be notified and appropriate additional mitigation would be developed. • Complete archaeological assessment for the entire Project. • Archaeology and Heritage Resources Monitoring and Contingency Plan.	Unknown	Unknown	Permanent	NR	Low value resource due to recent age but may overlie more important earlier artifacts	Unknown but expected to be minor (not significant) following mitigation		
Operation										

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Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude	Geographic Extent	Duration/ Frequency	Reversibility (R= reversible NR = Not reversible)	Ecological/ Social-cultural and Economic Context			
Access to former Red Head Cemetery by public for cultural purposes could be interrupted by Project infrastructure	A	• Design Project infrastructure so that public access to the former Red Head cemetery is not interrupted. • Archaeology and Heritage Resources Monitoring and Contingency Plan.	Low	Former Red Head Cemetery	Permanent	R	Area of known historical burial site High public sensitivity	Minor (Not significant)		
Erosion may be caused at Sculpin Cove (1-5) and Hurricane Island sites by shipping wakes (possibly in combination with rising sea levels).	A	• Monitor for potential effects of Project related vessel wakes causing erosion at these sites. • If Project effects become evident then implement archaeological assessment in consultation with regulatory agencies. • Complete archaeological assessment for the entire Project.	Unknown	Shoreline	Unknown	NR	Areas of known historical resources	Unknown but expected to be minor (not significant) following mitigation		
Modification & Decommissioning										
Same as construction phase										

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

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6.2.17 Navigation

TABLE 6.2-17 Residual Environmental Effects Summary for Navigation

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Construction										
Increased risks from vessel traffic surrounding marginal wharf	A	• Navigation and other markings will follow the recommendations of TC. • Low level of boat activity is not expected to result in any important navigation issues with respect to marine facilities. • Fishermen will be notified in advance on the arrival and departure of vessels.	Low	Stormont Bay	Temporary / Construction Phase	R	Harbour currently has minimal commercial traffic	Minor (Not significant)		
Operation										
Potential effects could arise from vessels entering and departing Stormont Bay	A	• Implementation of navigation aid equipment, (lights and fog horns) will be positioned on wharf. • Fishermen will be notified in advance on the arrival and departure of vessels.	Low	Stormont Bay, Isaac's Harbour, Marginal wharf vicinity	Permanent-Infrequent during Operational phase	R	Harbour currently has minimal commercial traffic	Minor (Not significant)		
Increased risks from marine traffic surrounding marginal wharf	A	• Establishment of proper lighting/markers will be positioned on wharf. • Low level of boat activity is not expected to result in any important navigation issues with respect to marine facilities. • Fishermen will be notified in advance on the arrival and departure of vessels.	Low	Stormont Bay	Permanent-Infrequent; Average one ship per day	R	Harbour currently has minimal commercial traffic	Minor (Not significant)		

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Modification & Decommissioning										
Same as Operation										

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021172

6.2.18 Marine Safety and Security

Environmental effects on marine safety include mainly navigational issues. Please see Table 6.2-17.

Marine security issues are addressed in the TERMPOL process.

6.2.19 Human Health and Safety

TABLE 6.2-19 Residual Environmental Effects Summary for Human Health and Safety

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social -cultural and Economic Context			
Construction										
Increased risk of dust generation (arsenic and mercury residuals from mining operations)	A	• Dust Control Plan, Worker health and safety plan, erosion control plan and spill control plan.	Medium-to High	Dung Harbour area	Permanent-Infrequent to windy conditions	R	Health and safety of Keltic employees and surrounding communities	Medium (Not significant)		
Increased risk of air emissions from construction equipment and vessels transporting construction materials and equipment and vehicular traffic	A	• See above; also air emissions should be localized with limited transport, due to their sporadic nature and emissions close to ground surface. • Maintaining vehicles and equipment in good working condition. • Minimizing distance between transfer points. • Promote car pooling. • Maintaining speed restrictions on roads.	Low	Regional	Permanent-Construction and Operational phase	R	Health and safety of Keltic employees and surrounding communities	Medium (Not significant)		
Safety concerns regarding former mine workings	A	• Health and Safety controls should protect workers in tailings/mining areas.	Low	Marginal Wharf	Intermittent and short term over 2.5 years	R	Former mine sites are present in the area of the KDP	Minimal (Not significant)		

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Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects: Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context	Significance	Likelihood of Occurrence**	Level of Confidence**
		• Potential airborne transport should be minimized. • Further mapping will be done to delineate the extent and location of old mines.								
Increased risk of water and waste management and control		• Spill Control Plan. • Water effluent treatment. • Emergency Response Plan. • Prevent run-off and transport of mined soils. • Control run-off and potential migration of impacted Soils.	Low	Short term	Unknown	R		Minor (Not significant)		
Operation										
Increased risk from air emissions; caused by Project operations, vehicular traffic and vessels	A	• See above.	Low	Marginal Wharf	Intermittent and short term over 30 years	R	Rural setting, sparsely populated	Minimal (Not significant)		
Potential effects of water and waste management and control	A	• See above.	Low	Stormont Bay	Intermittent and short term over 30 years	R	Minor local fisheries in Isaac's Harbor and small tributaries.	Minimal (Not significant)		
Modification and Decommissioning										
Potential effects from dust generation (arsenic/mercury Mining residuals)	A	• Dust Control Plan, Worker Health and Safety Plan, Erosion Control Plan and Spill, Control Plan will be implemented during construction.	Low	Marginal Wharf area	Intermittent and short term over 12 months	R	Pre-existing mine tailings cause localized dust problems	Minimal (Not significant)		

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021175

6.2.20 Fisheries

TABLE 6.2-20 Residual Environmental Effects Summary for Fisheries

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects: Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context	Significance	Likelihood of Occurrence**	Level of Confidence**
Construction										
Disruption of marine fishing activities from equipment transported to site and actual construction of wharf	A	• Fishing Equipment Compensation Policy. • Provide advance notice of ship arrivals. • Potential Effects Analysis and consultation with marine fisheries authorities and local fishing community. • FHCP.	Low	Size of Rock Mattress for Wharf: 0.210 km^2	Permanent	NR	The area of the wharf/marine terminal is not a major fishing area	Minimal (Not significant)		
Decrease in marine fishery-related earnings as a result of loss of fish habitat with construction of wharf and terminal	A	• Implementation of habitat compensation in accordance with DFO requirements.	Low	Size of Rock Mattress for Wharf: 0.210 km^2	Construction Phase; effect will terminate with successful completion of compensation plan	R	The area of the wharf/marine terminal is not a major fishing area	Minimal (Not significant)		
Fish will be attracted to Lighting from construction activities	A	• No unnecessary lighting will be used, especially on structures taller than 15 m, and use fast-blinking strobes if possible. • Area lighting will be angled directly at work areas and shielded where possible. • Implementation of a Lighting Plan.	Low	Wharf size: 0.203 km^2	Short term over 2.5 years	R	The area of the marginal wharf is not a major fishing area	Minimal (Not significant)		

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Water quality effects on fish habitat	A	• Erosion/sediment control plan. • Buffer zone. • SWMP. • Designated fuelling and material storage site. • Sulphide monitoring program and management plan for exposed acid generating material and drainage. • Visual monitoring for turbidity. • Use of clean and non-toxic materials • EMP for disposal, containment, and protection procedures. • Data collection and assimilative capacity assessment for all relevant chemical parameters expected to enter the environment or be remobilized due to Project activities.	Low	Stormont Bay	Intermittent and short term for 2.5 years	R	The area of the wharf/marine terminal is not a major fishing area	Minimal (Not significant)		

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Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Operation										
Disruption of marine fishing activities from vessels in the bay.	A	• Fishing Equipment Compensation Policy. • Provide advance notice of ship arrivals. • Potential Effects Analysis and consultation with marine fisheries authorities and local fishing community. • FHCP.	Low	Stormont Bay	Average 1 vessel per day over 20+ years	R	The proposed shipping channel in Stormont Bay and approaches is not a major marine fishing area	Minor (Not significant)		
Impacts on navigation from the narrower entrance to Isaac's harbour created by the marginal wharf	A	• NA (The harbour narrows to a similar width 500 m further into the harbour).	Low	Entrance to Isaac's Harbour	Permanent	R	Isaac's harbour is not a major shipping destination/route	Minimal (Not significant)		
Marine fish may be attracted by facility lights at night and may perceive noises at a distance from the operation	A	• No unnecessary lighting will be used, especially on structures taller than 15 m, and use fast-blinking strobes if possible. • Area lighting will be angled directly at work areas and shielded where possible. • Implementation of a Lighting Plan.	Low	Isaac's Harbour	Operation Phase	R	The area of the wharf/marine terminal is not a major fishing area	Minimal (Not significant)		

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Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects: Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context	Significance	Likelihood of Occurrence**	Level of Confidence**
Water quality effects on fish habitat	A	• Erosion/sediment control plan. • Buffer zone. • SWMP. • Designated fuelling and material storage site. • Sulphide monitoring program and management plan for exposed acid generating material and drainage. • Visual monitoring for turbidity. • EMP for disposal, containment, and protection procedures.	Low	Stormont Bay	Intermittent and short term for 20+years	R	The area of the wharf/marine terminal is not a major fishing area	Minimal (Not significant)		
Modification & Decommissioning										
None										

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021179

6.2.21 Aquaculture

TABLE 6.2-21 Residual Environmental Effects Summary for Aquaculture

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context			
Construction										
Release of sediments or contaminants into the water column from construction	A	• Employ standard mitigation measures to control sediment and small spills. • Implementation of an Aquaculture Compensation Plan.	Low	Wharf size: 0.203 km^2	Construction Phase	R	Aquaculture facilities are located in Country Harbour, not in the vicinity of the marginal wharf location	Minimal (Not significant)		
Large spill or accident from construction vessels	A	• Implementation of an Aquaculture Compensation Plan.	Low	Country Harbour	Localized; short term	R	Country Harbour is not a major shipping destination/route	Minimal (Not significant)		
Operation										
Large spill or accident from Project vessels	A	• Implementation of an Aquaculture Compensation Plan.	Low	Country Harbour	Localized; short term	R	Country Harbour is not a major shipping destination/route	Minimal (Not significant)		
Modification & Decommissioning										
See construction										

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021180

6.2.22 Tourism

TABLE 6.2-22 Residual Environmental Effects Summary for Tourism

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects: Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context	Significance	Likelihood of Occurrence**	Level of Confidence**
Construction										
Effects on regional visual landscape character	A	• Implementation of Dust management plan. • Regular road cleaning. • Maintaining tree and shrub buffer along the site perimeter. • Design of jogged road access. • Implementation of ESC plan and Surface Water Monitoring Program.	Low	At end of construction phase approx 3 to 5 km	Construction Phase	IR	• Eastern Shore tourism sector known for its natural beauty, coastal views, rural landscape. • Little tourism infrastructure in area.	Minimal (Not Significant)		
Operation										
Effects on regional visual landscape character	A	• Implementation of Dust management plan. • Regular road cleaning. • Maintaining tree and shrub buffer along the site perimeter. • Design of jogged road access. • Implementation of ESC plan and Surface Water Monitoring Program.	Low	Marginal Wharf area	Constant over operational phase	IR	• Eastern Shore tourism sector known for its natural beauty, coastal views, rural landscape • Little tourism infrastructure in area. • Project Area is zoned for industrial use	Minimal (Not significant)		
Modification & Decommissioning										
None										

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021181

6.3 PROJECT RELATED SHIPPING WITHIN 25 KM OF COUNTRY ISLAND

6.3.1 Marine Water Quality

TABLE 6.3-1 Residual Environmental Effects Summary for Marine Water Quality

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Nor reversible	Ecological/Social-cultural and Economic Context			
Construction										
Shipping within 25 km of Country Island										
Bilge water or accidental spill of fuel or other contaminants from vessels	A	• Establishment and adherence to MARPOL and *Canada Shipping Act:* ○ Oil Pollution Prevention regulations. ○ Ballast Water Control Regulations. ○ Response Organizations and Oil Handling Facilities Regulations. • TP 12402 Oil Handling Facilities Standards.	Low	Stormont Bay	Temporary / Construction Phase	R	Large wide open bay; Country Island has Roseate tern nesting colony (SARA Schedule 1 species)	Minimal (Not significant)		
Re-suspension of contaminated sediments from propeller wash	A	• Large vessels to be berthed with support of tugs.	Low	Stormont Bay	Temporary / Construction Phase	R	Affected habitat type widely represented within Stormont Bay	Minimal (Not significant)		

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Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects: Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Nor reversible	Ecological/Social-cultural and Economic Context	Significance	Likelihood of Occurrence**	Level of Confidence**
Operation										
Shipping within 25 km of Country Island										
Bilge water or accidental spill of fuel or other contaminants from vessels	A	• Establishment and adherence to MARPOL and *Canada Shipping Act:* ○ Oil Pollution Prevention regulations. ○ Ballast Water Control Regulations. ○ Response Organizations and Oil Handling Facilities Regulations. • TP 12402 Oil Handling Facilities Standards.	Low	Stormont Bay	Permanent / Average one ship per day	R	see above	Minimal (Not significant)		
Re-suspension of contaminated sediments from propeller wash	A	• Large vessels to be berthed with support of tugs.	Low	Stormont Bay	Permanent / Average one ship per day	R	Affected habitat type widely represented within Stormont Bay	Minimal (Not significant)		

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021183

6.3.2 Soil/Sediment Quality (terrestrial and marine)

TABLE 6.3-2 Residual Environmental Effects Summary for Soil/Sediment Quality (terrestrial and marine)

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Nor reversible	Ecological/Social-cultural and Economic Context			
Construction										
Shipping within 25 km of Country Island										
Bilge water or accidental spill of fuel or other contaminants from vessels	A	• Establishment and adherence to MARPOL and *Canada Shipping Act:* ○ Oil Pollution Prevention regulations. ○ Ballast Water Control Regulations. ○ Response Organizations and Oil Handling Facilities Regulations. • TP 12402 Oil Handling Facilities Standards.	Low	Stormont Bay	Temporary / Construction Phase	R	Marine water quality	Minimal (Not significant)		
Re-suspension of contaminated sediments from propeller wash	A	• Large vessels to be berthed with support of tugs. • No sediment contamination identified • Mitigation plan for contaminated tailings and/or soils and sediments.	Low	Stormont Bay	Temporary / Construction Phase	R	Affected habitat type widely represented within Stormont Bay	Minimal (Not significant)		
Operation										
Shipping within 25 km of Country Island										
Bilge water or accidental spill of fuel or other contaminants from vessels	A	• Establishment and adherence to MARPOL and *Canada Shipping Act:* ○ Oil Pollution Prevention regulations.	Low	Stormont Bay	Permanent / Average one ship per day	R	Marine water quality	Minimal (Not significant)		

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Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Nor reversible	Ecological/Social-cultural and Economic Context			
		○ Ballast Water Control Regulations. ○ Response Organizations and Oil Handling Facilities Regulations. • TP 12402 Oil Handling Facilities Standards.								

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021184

6.3.3 Air Quality

TABLE 6.3-3 Residual Environmental Effects Summary for Air Quality

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects: Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Nor reversible	Ecological/Social-cultural and Economic Context	Significance	Likelihood of Occurrence**	Level of Confidence**
Construction										
Shipping within 25 km Country Island										
Emissions of gaseous pollutants from marine vessels delivering equipment	A	• Project shipping will be in good working order and will take every reasonable measure to reduce unnecessary fuel consumption. • According to *Canada Shipping Act* – no soot will be blown within 1000 yards of land.	Low	Construction envelope plus adjacent transport routes	Temporary / Construction Phase	R	Rural setting; sparsely populated; nearest residential receptors 300 to 500 m off site	Minimal (Not significant)		
Operation										
Shipping within 25 km of Country Island										
Emissions from LNG tankers and other marine vessels	A	• According to *Canada Shipping Act* – no soot will be blown within 1000 yards of land.	Low	Adjacent transport routes	Permanent / Average one ship per day	R	Rural setting; sparsely populated; nearest residential receptors 300 to 500 m off site	Minimal (Not significant)		

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

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6.3.4 Vegetation

TABLE 6.3-4 Residual Environmental Effects Summary for Vegetation (terrestrial and marine)

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects: Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Not reversible	Ecological/Social-cultural and Economic Context	Significance	Likelihood of Occurrence**	Level of Confidence**
Construction										
Potential disturbance to kelp, eel grass, etc as a result of propeller wash from tankers and delivery ships	A	• Large vessels to be berthed with support of tugs.	Low	Stormont Bay	Temporary / Construction Phase	R	Affected habitat type widely represented within Stormont Bay	Minimal (Not significant)		
Operation										
Potential disturbance to kelp, eel grass, etc as a result of propeller wash from tankers and delivery ships	A	• Large vessels to be berthed with support of tugs. • No sediment contamination identified.	Low	Stormont Bay	Permanent / Average one ship per day	R	Affected habitat type widely represented within Stormont Bay	Minimal (Not significant)		
Modification & Decommissioning										
Same as construction										

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021186

6.3.5 Species at Risk

TABLE 6.3-5 Residual Environmental Effects Summary for Species at Risk

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects: Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Nor reversible	Ecological/Social-cultural and Economic Context	Significance	Likelihood of Occurrence**	Level of Confidence**
Construction										
Shipping within 25 km of Country Island										
Disturbance of seabird (Roseate tern) nesting habitat on Country Island from vessel movement	A	• No ships will approach within 200 m of the island (as per the roseate tern recovery plan). • The final location of the shipping lanes will be determined through the TERMPOL process and TP 1802 Routing Standards. • As a component of NSEL Condition 2.7, the Proponent is committed to prepare an Adaptive Management Plan (AMP) acceptable to EC and NSDNR. • *Canada Shipping Act* and regulations	Low	200 m radius exclusion zone; Stormont Bay	Temporary / Construction Phase	R	Species protected under SARA Schedule 1; nesting habitat on Country Island	Minimal (Not significant)		

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Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Nor reversible	Ecological/Social-cultural and Economic Context			
Potential effects of ship lights on roseate terns	A	• Establishment and adherence to 200 m exclusion zone. • No ships will approach within 200m of the island (as per the roseate tern recovery plan). • As a component of NSEL Condition 2.7, the Proponent is committed to prepare an Adaptive Management Plan (AMP) acceptable to EC and NSDNR.	Low	Stormont Bay	Temporary / Construction Phase	R	Species protected under SARA Schedule 1; nesting habitat on Country Island	Minimal (Not significant)		
Disturbance of seabird (Roseate tern) foraging / feeding activities	A	• Establishment and adherence to 200 m exclusion zone. • No ships will approach within 200m of the island (as per the roseate tern recovery plan). • Potential contribution to monitoring programs to identify roseate tern foraging areas. • As a component of NSEL Condition 2.7, the Proponent is committed to prepare an Adaptive Management Plan (AMP) acceptable to EC and NSDNR.	Low	Stormont Bay	Temporary / Construction Phase	R	Species protected under SARA Schedule 1; nesting habitat on Country Island	Minimal (Not significant)		

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Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Nor reversible	Ecological/Social-cultural and Economic Context			
Operation										
Shipping within 25 km of Country Island										
Disturbance of seabird (Roseate tern) nesting habitat on Country Island from vessel movement	A	• Establishment and adherence to 200 m exclusion zone. • No ships will approach within 200m of Country Island (as per the roseate tern recovery plan). • As a component of NSEL Condition 2.7, the Proponent is committed to prepare an Adaptive Management Plan (AMP) acceptable to EC and NSDNR.	Low	200 m radius exclusion zone; Stormont Bay	Permanent / Average one ship per day	R	Species protected under SARA Schedule 1; nesting habitat on Country Island	Minimal		
Potential effects of ship lights on roseate terns	A	• Establishment and adherence to 200 m exclusion zone. • No ships will approach within 200m of Country Island (as per the roseate tern recovery plan). • As a component of NSEL Condition 2.7, the Proponent is committed to prepare an Adaptive Management Plan (AMP) acceptable to EC and NSDNR.	Low	Stormont Bay	Permanent / Average one ship per day	R	Species protected under SARA Schedule 1; nesting habitat on Country Island	Minimal (Not significant)		
Disturbance of seabird (Roseate tern) foraging / feeding activities	A	• Establishment and adherence to 200 m exclusion zone. • No ships will approach within 200m of the island (as per the roseate tern recovery plan).	Low	Stormont Bay	Permanent / Average one ship per day	R	Species protected under SARA Schedule 1; nesting habitat on Country Island	Minimal (Not significant)		

C0115-522

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Nor reversible	Ecological/Social-cultural and Economic Context			
		• As a component of NSEL Condition 2.7, the Proponent is committed to prepare an Adaptive Management Plan (AMP) acceptable to EC and NSDNR.								

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021190

021191

6.3.6 Fish and Fish Habitat (marine and freshwater)

TABLE 6.3-6 Residual Environmental Effects Summary for Fish and Fish Habitat (marine and freshwater)

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Nor reversible	Ecological/Social-cultural and Economic Context			
Construction										
Shipping within 25 km of Country Island										
Potential releases such as oil, chemicals, sewage and garbage or accidental spill of fuel or other contaminants from vessels	A	• Establishment and adherence to MARPOL and *Canada Shipping Act:* ○ Oil Pollution Prevention regulations. ○ Ballast Water Control Regulations. ○ Response Organizations and Oil Handling Facilities Regulations. • TP 12402 Oil Handling Facilities Standards. • Applicable provincial Acts and Regulations.	Low	Stormont Bay	Temporary / Average one ship per day	R	Marine water quality	Minimal (Not significant)		
Operation										
Shipping within 25 km of Country Island										
Potential releases such as oil, chemicals, sewage and garbage or accidental spill of fuel or other contaminants from vessels	A	• Establishment and adherence to MARPOL and *Canada Shipping Act:* ○ Oil Pollution Prevention regulations.	Low	Stormont Bay	Permanent / Average one ship per day	R	Marine water quality	Minimal (Not significant)		

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Nor reversible	Ecological/Social-cultural and Economic Context			
		○ Ballast Water Control Regulations. ○ Response Organizations and Oil Handling Facilities Regulations. • TP 12402 Oil Handling Facilities Standards. • Applicable provincial acts and Regulations.								

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021192

021193

6.3.7 Marine Mammals

TABLE 6.3-7 Residual Environmental Effects Summary for Marine Mammals

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Nor reversible	Ecological/Social-cultural and Economic Context			
Construction										
Shipping within 25 km of Country Island										
Potential releases such as oil, chemicals, sewage and garbage or accidental spill of fuel or other contaminants from vessels	A	• Establishment and adherence to MARPOL and *Canada Shipping Act:* ○ Oil Pollution Prevention regulations. ○ Ballast Water Control Regulations. ○ Response Organizations and Oil Handling Facilities Regulations. • TP 12402 Oil Handling Facilities Standards.	Low	Stormont Bay	Temporary / Construction Phase	R	Stormont Bay is not an important marine mammal location	Minimal (Not significant)		
Disturbance of marine mammals from Project-related marine traffic	A	• The International Convention MARPOL will be followed by all Project shipping and *Canada Shipping Act:* ○ Oil Pollution Prevention regulations. ○ Ballast Water Control Regulations. ○ Response Organizations and Oil Handling Facilities Regulations. • TP 12402 Oil Handling Facilities Standards.	Low	Stormont Bay	Temporary / Construction Phase	R	Stormont Bay is not an important marine mammal location	Minimal (Not significant)		

C0115-526

021194

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects: Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Nor reversible	Ecological/Social-cultural and Economic Context	Significance	Likelihood of Occurrence**	Level of Confidence**
		• Standard Vessel Operating Procedures. • Review of current versions of the Canadian Annual Notice to Mariners for marine mammal guidelines. • Reducing vessel speed in areas of whale sightings. • Posting a look-out in areas frequented by whales. • Travel parallel to marine mammals and avoiding sudden changes when manoeuvring around whales. • If it is not possible to manoeuvre around marine mammals, reduce speed and wait until marine mammals are more than 400 m away.								
Marine habitat impairment as a result of re-suspension of contaminated sediments from propeller wash	A	• Large vessels to be berthed with support of tugs. • No sediment contamination identified. • Mitigation plan for contaminated tailings and/or soils and sediments.	Nil	Size of Rock Mattress for Wharf: 0.210 km^2	Temporary / Construction Phase	R	Affected habitat type widely represented within Stormont Bay	Minimal (Not significant)		

021195

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Nor reversible	Ecological/Social-cultural and Economic Context			
Operation										
Shipping within 25 km of Country Island										
Potential releases such as oil, chemicals, sewage and garbage or accidental spill of fuel or other contaminants from vessels	A	• Establishment and adherence to MARPOL shipping and *Canada Shipping Act:* o Oil Pollution Prevention Regulations. o Ballast Water Control Regulations. o Response Organizations and Oil Handling Facilities Regulations. • TP 12402 Oil Handling Facilities Standards.	Low	Stormont Bay	Permanent / Average one ship per day	R	Stormont Bay is not an important marine mammal location	Minimal (Not significant)		
Disturbance of marine mammals from Project-related marine traffic	A	• See Construction Mitigation above.	Low	Stormont Bay	Permanent / Average one ship per day	R	Stormont Bay is not an important marine mammal location	Minimal (Not significant)		
Marine habitat impairment as a result of re-suspension of contaminated sediments from propeller wash	A	• See Construction Mitigation above.	Nil	Size of Rock Mattress for Wharf: 0.210 km^2	Permanent / Average one ship per day	R	Affected habitat type widely represented within Stormont Bay	Minimal (Not significant)		

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

C0115-528

021196

6.3.8 Migratory Birds and Migratory Birds Habitat

TABLE 6.3-8 Residual Environmental Effects Summary for Migratory Birds and Migratory Birds Habitat

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Nor reversible	Ecological/Social-cultural and Economic Context			
Construction										
Shipping within 25 km of Country Island										
Seabirds that nest on Country island could be attracted to ship lights	A	• Alerting vessels to risks with the use of ice-lights and deck lighting. • Use black-out blinds on all portholes. • Keep deck lights to a minimum. • Maintain records of birds found on deck.	Low	200 m radius exclusion zone	Temporary / Construction Phase	R	No protective status under SARA Schedule 1	Minimal (Not significant)		
Operation										
Shipping within 25 km of Country Island										
Seabirds that nest on Country island could be attracted to ship lights	A	• Use black-out blinds on all portholes. • Keep deck lights to a minimum. • Do not use ice lights during periods of low visibility.	Low	200 m radius exclusion zone	Permanent / Average one ship per day	R	No protective status under SARA Schedule 1	Minimal (Not significant)		

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021197

6.3.9 Lighting Conditions

TABLE 6.3-9 Residual Environmental Effects Summary for Lighting Conditions

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Nor reversible	Ecological/Social-cultural and Economic Context			
Construction										
Shipping within 25 km of Country Island										
Seabirds (petrels) that nest on Country island could be attracted to ship lights	A	• Use black-out blinds on all portholes. • Keep deck lights to a minimum. • Do not use ice lights during periods of low visibility. • Adherence to Roseate Tern Recovery Plan.	Low	200 m radius exclusion zone	Temporary / Construction Phase	R	No protective status under SARA Schedule 1	Minimal (Not significant)		
Operation										
Shipping within 25 km of Country Island										
Seabirds (petrels) that nest on Country island could be attracted to ship lights	A	• Use black-out blinds on all portholes. • Keep deck lights to a minimum. • Do not use ice lights during periods of low visibility. • Adherence to Roseate Tern Recovery Plan.	Low	200 m radius exclusion zone	Permanent / Average one ship per day	R	No protective status under SARA Schedule 1	Minimal (Not significant)		

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021198

6.3.10 Atmospheric and Underwater Acoustic Environment

TABLE 6.3-10 Residual Environmental Effects Summary for Atmospheric and Underwater Acoustic Environment

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Nor reversible	Ecological/Social-cultural and Economic Context			
Construction										
Shipping within 25 km of Country Island										
Disturbance of marine mammals from underwater noise due to Project-related marine traffic	A	• The International Convention MARPOL will be followed by all Project shipping. • Standard Vessel Operating Procedures - • Review of current versions of the Canadian Annual Notice to Mariners for marine mammal guidelines. • Reducing vessel speed in areas of whale sightings. • Posting a look-out in areas frequented by whales. • Travel parallel to marine mammals and avoiding sudden changes when manoeuvring around whales. • If it is not possible to manoeuvre around marine mammals, reduce speed and wait until marine mammals are more than 400 m away.	Low	Stormont Bay	Temporary / Construction Phase	R	Stormont Bay is not an important marine mammal location	Minimal (Not significant)		

C0115-531

021199

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects: Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Nor reversible	Ecological/Social-cultural and Economic Context	Significance	Likelihood of Occurrence**	Level of Confidence**
Operation										
Shipping within 25 km of Country Island										
Disturbance of marine mammals from underwater noise due to Project-related marine traffic	A	• The International Convention MARPOL will be followed by all Project shipping Standard Vessel Operating Procedures – • Review of current versions of the Canadian Annual Notice to Mariners for marine mammal guidelines. • Reducing vessel speed in areas of whale sightings. • Posting a look-out in areas frequented by whales. • Travel parallel to marine mammals and avoiding sudden changes when manoeuvring around whales. • If it is not possible to manoeuvre around marine mammals, reduce speed and wait until marine mammals are more than 400 m away.	Low	Stormont Bay	Permanent / Average one ship per day	R	Stormont Bay is not an important marine mammal location	Minimal (Not significant)		

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

C0115-532

6.3.11 Current Use of Lands and Resources for Traditional Purposes by Aboriginal Persons

TABLE 6.3-11 Residual Environmental Effects Summary for Current Use of Lands and Resources for Traditional Purposes by Aboriginal Persons

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R= reversible NR = Not reversible)	Ecological/ Social-cultural and Economic Context			
Construction										
Reduced opportunity of harvesting sea urchin	A	• FHCP includes enhancement of benthic habitat within the same urchin licence area. This is predicted to offset any loss of sea urchin production and/or access once the species returns to commercial levels.	Low	Stormont Bay	At least 25 years (i.e., during the lifetime of the Project)	R	• Sea urchin in area were largely decimated in the past and have not recovered	Minor (Not significant)		
Operation & Maintenance										
Reduced opportunity of harvesting sea urchin	A	• FHCP includes enhancement of benthic habitat within the same urchin licence area. This is predicted to offset any loss of sea urchin production and/or access once the species returns to commercial levels.	Low	Stormont Bay	Constant 20+ years	R	• Sea urchin in area were largely decimated in the past and have not recovered	Minimal (Not significant)		
Modifications & Decommissioning										
None										

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021200

021201

6.3.12 Navigation

TABLE 6.3-12 Residual Environmental Effects Summary for Navigation

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects: Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Nor reversible	Ecological/Social-cultural and Economic Context	Significance	Likelihood of Occurrence**	Level of Confidence**
Construction										
Shipping within 25 km of Country Island										
Increase in collision rates due to construction-related marine traffic	A	• Shipping lane to be established following recommendations of TC. • Modern navigation aids. • Pilotage. • Appropriate communication systems. • Adherence to *Canada Shipping Act*-Oil pollution prevention regulations, Garbage pollution Prevention regulations, Response Organizations and oil handling facilities regulations, TP 12402 Oil Handling Facilities Standards, and applicable provincial Acts and Regulations.	Medium	Stormont Bay	Temporary / Construction Phase	R	Shipping lanes in Stormont Bay	Medium (Not significant)		
Operation										
Shipping within 25 km of Country Island										
Increase in collision rates due to Project-related marine traffic	A	• Shipping lane to be established following recommendations of TC. • Modern navigation aids. • Pilotage.	Medium	Stormont Bay	Permanent / Average one ship per day	R	Shipping lanes in Stormont Bay	Medium (Not significant)		

021202

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Nor reversible	Ecological/Social-cultural and Economic Context			
		• Appropriate communication systems. • Adherence to *Canada Shipping Act*-Oil pollution prevention regulations, Garbage pollution Prevention regulations, Response Organizations and oil handling facilities regulations, TP 12402 Oil Handling Facilities Standards, and applicable provincial Acts and Regulations.								

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

C0115-535

6.3.13 Marine Safety and Security

TABLE 6.3-13 Residual Environmental Effects Summary for Marine Safety and Security

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Nor reversible	Ecological/Social-cultural and Economic Context			
Construction										
Shipping within 25 km of Country Island										
Increase in collision rates due to construction-related marine traffic	A	• Adherence to the TERMPOL process. • Shipping lane to be established following recommendations of TC. • Modern navigation aids. • Pilotage. • Appropriate communication systems.	Medium	Stormont Bay	Temporary / Construction Phase	R	Shipping lanes in Stormont Bay	Medium (Not significant)		
Operation										
Shipping within 25 km of Country Island										
Increase in collision rates due to Project-related marine traffic	A	• Adherence to the TERMPOL process. • Shipping lane to be established following recommendations of TC. • Modern navigation aids. • Pilotage. • Appropriate communication systems.	Medium	Stormont Bay	Permanent / Average one ship per day	R	Shipping lanes in Stormont Bay	Medium (Not significant)		

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021203

6.3.14 Fisheries

TABLE 6.3-14 Residual Environmental Effects Summary for Fisheries

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Nor reversible	Ecological/Social-cultural and Economic Context			
Construction										
Shipping within 25 km of Country Island										
Disruption of marine fishing activities from construction-related vessels in the bay.	A	• Fishing Equipment Compensation Policy. • Provide advance notice of ship arrivals. • Potential Effects Analysis and consultation with marine fisheries authorities and local fishing community. • Local vessel operators will be notified in advance of LNG tanker schedules and duration of the exclusion.	Low	Stormont Bay	Temporary / Construction Phase	R	The proposed shipping channel in Stormont Bay and approaches is not a major marine fishing area	Minor (Not significant)		
Potential releases such as oil, chemicals, sewage and garbage or accidental spill of fuel or other contaminants from vessels	A	• Establishment and adherence to MARPOL.	Low	Stormont Bay	Temporary / Construction Phase	R	The proposed shipping channel in Stormont Bay and approaches is not a major marine fishing area	Minimal (Not significant)		
Operation										
Shipping within 25 km of Country Island										
Disruption of marine fishing activities from LNG and cargo vessels in the bay.	A	• Fishing Equipment Compensation Policy. • Provide advance notice of ship arrivals. • Notify local vessels of LNG tanker schedules, and duration of the exclusion zone.	Low	Stormont Bay	permanent / average one ship per day	R	The proposed shipping channel in Stormont Bay and approaches is not a major marine fishing area	Minor (Not significant)		

021205

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Nor reversible	Ecological/Social-cultural and Economic Context			
		• Potential Effects Analysis and consultation with marine fisheries authorities and local fishing community.								
Potential releases such as oil, chemicals, sewage and garbage or accidental spill of fuel or other contaminants from vessels	A	• Establishment and adherence to MARPOL.	Low	Stormont Bay	Permanent / Average one ship per day	R	The proposed shipping channel in Stormont Bay and approaches is not a major marine fishing area	Minimal (Not significant)		

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

021206

6.3.15 Aquaculture

TABLE 6.3-15 Residual Environmental Effects Summary for Aquaculture

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation and Monitoring	Significance Criteria for Environmental Effects					Significance	Likelihood of Occurrence**	Level of Confidence**
			Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility (R=reversible NR=Nor reversible	Ecological/Social-cultural and Economic Context			
Construction										
Shipping within 25 km of Country Island										
Potential releases such as oil, chemicals, sewage and garbage or accidental spill of fuel or other contaminants from vessels	A	• Establishment and adherence to MARPOL. • Implementation of aquaculture compensation plan.	Low	Stormont Bay	Temporary / Construction Phase	R	Aquaculture facilities are located in Country Harbour, not in the vicinity of shipping channel, wharf or LNG Terminal	Minimal (Not significant)		
Operation										
Shipping within 25 km Country Island										
Potential releases such as oil, chemicals, sewage and garbage or accidental spill of fuel or other contaminants from vessels	A	• Establishment and adherence to MARPOL. • Implementation of aquaculture compensation plan.	Low	Stormont Bay	Permanent / Average one ship per day	R	see above	Minimal (Not significant)		

* For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** Only addressed for significant effects

6.4 EFFECTS OF THE PROJECT ON RENEWABLE RESOURCES

It is a requirement of CEAA to consider the capacity of renewable resources to meet present and future needs. This section presents the results of the assessment of the Project's effects on the capacity of renewable resources.

In the first step, it was determined if any of the VECs representing the renewable resources of the Project Area are significantly affected by the Project. If a potential for significant adverse effects was identified, the second step was to investigate whether the resource would be affected to the point that it would no longer be sustainable, i.e., if the effects would extend beyond the capacity of the resource. For this purpose, "capacity" was interpreted as a resource's sustainability. The principle of sustainability considered is consistent with the United Nations' definition of sustainable development, i.e., "economic development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Several of the VECs identified, may be considered to be renewable resources (i.e., resource will return to a natural state over time) as follows:

- Freshwater Quality/Quantity;
- Groundwater Quality/Quantity;
- Vegetation;
- Wildlife and Wildlife Habitat;
- Wetlands;
- Fish; and
- Atmospheric and Underwater Conditions

Presently, all of the VECs identified above are managed by the Provincial and Federal agencies, which allow sustainable harvesting/usage of VECs such as hunting, fishing, and forestry. Based on the assessment of Project and cumulative effects (Sections 5.0, 8.0, and 10.0), no significant adverse residual effects are likely to occur on any of the VECs, with application of the identified mitigation. Within the local and regional context, a significant effect was considered to diminish the quality of the renewable resource, critically reduce the availability of the renewable resource, or compromise the ability of other species or future generations to meet their needs. Since no significant adverse effects are anticipated, the capacity of the renewable resources identified above to meet present and future needs is considered to be unaffected by the Project. Therefore, no additional mitigation is necessary to protect renewable resources.

7.0 PROPOSED ENVIRONMENTAL MONITORING AND FOLLOW-UP PROGRAMS

7.1 INTRODUCTION

Follow-up programs as defined in the Act, means a program for verifying the accuracy of the EA of a project, and determining the effectiveness of any measures taken to mitigate the adverse environmental effects of the project.

An Environmental Compliance Monitoring (ECM) program is undertaken for a project to ensure that all applicable regulations, conditions of approval, and company specifications are met during Project implementation. EEM is used to assess the accuracy of any predictions made in the CSR concerning potential effects.

Most of the monitoring activities and mitigative measures to be employed for both the construction and operation of the various Project components will be guided by the regulatory/policy regimes of the Nova Scotia and Federal government requirements and the CSR Conditions of Approval. The NSEL EA approval conditions that are relevant to the CSR will also guide the monitoring activities and mitigative measures. The relevant NSEL EA approval conditions are included in the following sections and the Proponent's adherence to these conditions will ensure compliance with federal and provincial Acts and Regulations. The Proponent's monitoring programs will address concerns identified by the residents of the Goldboro area. A number of follow-up programs are proposed for defining objectives and content of specific monitoring work-plans.

Anticipated compliance and monitoring follow-up requirements were evaluated for potential environmental effects related to each of the proposed Project facilities. These include the: 1) LNG Terminal, marine transfer pipelines, LNG storage tanks, and the regasification facilities, 2) marginal wharf and, 3) structures and equipment connected with the marine shipment of goods associated with the LNG Terminal and marginal wharf.

7.2 LNG TERMINAL, MARINE TRANSFER PIPELINES, LNG STORAGE TANKS AND THE REGASIFICATION FACILITIES

7.2.1 Air Quality Monitoring

It is anticipated that air emissions from the Project (including site preparation and construction) will not exceed the ambient air quality objectives and/or regulations. To confirm this, the Proponent will undertake the following monitoring programs.

7.2.1.1 Construction

As outlined in Item 1.10 in the NSEL EA approval conditions, baseline data will be collected for all relevant chemical parameters that are expected to enter the environment or be remobilized as a result of Project Activities. As outlined in Item 1.4 in the NSEL EA approval conditions, air dispersion modelling will be completed with onsite meteorological data and more detailed design data to further assess potential Project impacts.

Typically, in rural settings, air emissions, in particular dust, are not monitored during construction. If concerns are expressed on site related to occupational health and safety, portable PM_{10} monitors may be used for real time measurements of PM by field inspectors. If concerns are expressed regarding dust levels off-site, the Project may elect to employ high-volume samplers to determine particulate levels at specific receptors.

7.2.1.2 Operations

The LNG facility is expected to operate with minimal emissions to the atmosphere and thus continuous monitoring for this facility is not deemed to be necessary.

Although real-time monitoring of VOCs is not contemplated, Keltic intends to commission VOC monitoring (essentially 24 hour 'grab' sampling), both prior to and during operations, in order to assess the quantity and makeup of any VOCs at a number of points which will be determined as the specific design phase is completed. In addition, should odours be detected off-site, VOC monitoring will be undertaken to determine the source(s), and allow for appropriate mitigation measures.

Efforts will be made to coordinate with SOEI regarding existing monitoring equipment utilization and data resources. In accordance with Item 2.3 of the NSEL EA approval conditions, an air monitoring program will be developed and implemented. In accordance with Item 1.1, an Air Emissions Management Plan and a Greenhouse Gas Management Plan will also be implemented for the Project.

7.2.2 Noise and Light Monitoring

7.2.2.1 Construction

Monitoring will be conducted if complaints arise as a result of construction activities or truck traffic through Goldboro and/or other communities during construction.

A traffic/vehicle management system will be implemented if traffic-related noise threshold levels are exceeded.

In accordance with the NSEL EA approval conditions, a Lighting Plan will be implemented. The Lighting Plan will be reviewed and approved by NSDNR, CWS, and TC. The Lighting Plan will incorporate a program to monitor birds.

Routine noise monitoring will be conducted at both the site boundaries and nearby sensitive receptors; the measured noise levels will be compared to the DNL levels outlined in the Health Canada Draft Guidance on Noise Assessment for CEAA Projects

7.2.2.2 Operations

The Proponent will initiate a noise monitoring program in accordance with Item 2.2 in the NSEL EA approval conditions. The monitoring program will consist of sampling noise levels over a 24-hour period following commissioning. Noise sampling will be conducted quarterly and the results evaluated on an annual basis. The percentage of highly annoyed will be evaluated as outlined in the Health Canada Draft Guidance on Noise Assessment for CEAA Projects. Noise levels at designated sensitive receptor sites will also be determined through monitoring and compared to the sound levels outlined in the Health Canada Draft Guidance on Noise

Assessment for CEAA Projects. Should noise levels be consistent over the first year, noise sampling would subsequently be conducted on a complaint basis or following process or equipment changes. This will include monitoring of vehicle movement, heavy equipment operations, emergency operations, and normal operating modes.

The Proponent will notify the public in advance of any potentially unusual noise-related events. The Proponent will provide a direct contact number for a responsible company official to residents and other interested stakeholders.

7.2.3 Surface Water Monitoring

In accordance with Item 1.5 in the NSEL EA approval conditions, mitigation plans for environmental impacts due to contaminated mine tailings and/or soils and sediments from the Project Site will be implemented using risk and remediation management. The Remedial Action Plan and/or Risk Management Plan, which will include monitoring as required, will be approved prior to construction. The mitigation plans will also address degradation, reduction, or loss of water quality or quantity.

7.2.3.1 Construction

To meet the requirements of Item 2.4, in the NSEL EA approval conditions, an ESC Plan will also be developed and implemented. The Erosion and Sediment Control (ESC) Plan will include a monitoring program for site runoff and will be reviewed and approved by NSEL.

Baseline information will be collected for all relevant chemical and biological parameters expected to enter the environment due to Project activities. This information will be used to predict assimilative capacity of all receiving environments and assess potential effects and/or risks on marine biota. This will be done in accordance with Item 1.10, of the NSEL EA approval conditions (NSEL, 2007).

Surface water quality monitoring programs for the construction phase will be established in consultation with regulatory agencies and as part of the permitting process through the Conditions of Approval. Notwithstanding this, a proposed water quality monitoring plan (Table 7.2.1) is presented that describes the objectives and substance of monitoring.

With the exception of Betty's Cove Brook, it is anticipated that there will be no discharges into on-site or off-site watercourses. As a result, monitoring is not proposed for the unnamed tributary to Dung Cove. As Betty's Cove Brook may receive periodic discharges from the site during construction, it will be sampled at key stream locations for TSS during storm events and during sediment pond discharge or dewatering. It will also be monitored as part of the groundwater monitoring program on the plant site (see Section 7.2.5) because of the identified dynamic relationship between groundwater and surface water in the area.

As an additional tool for assessing the water quality impacts resulting from possible spills or other unforeseen effects of the Project operations, a benthic-invertebrate survey will be conducted at relevant locations in the Keltic Study Area. A monitoring program to determine the potential for and extent of sulphide bearing material will also be implemented with a plan to manage any exposed acid generating material and associated drainage. The sulphide monitoring program and management plan will be developed in accordance with Item 2.8 of the NSEL EA approval conditions.

7.2.3.2 Operations

Surface water quality monitoring programs for the operation phase will be established in consultation with regulatory agencies and as part of the permitting process through the Conditions of Approval. Notwithstanding this, a proposed water quality monitoring plan (Table 7.2.1) is presented that describes the objectives and substance of the monitoring.

TABLE 7.2-1 Proposed Surface Water Monitoring Program Elements

Project		Proposed Monitoring Program Elements
Phase	**Component**	
Pre-Construction	Project Site	• Qualitative/quantitative sampling of the benthic-invertebrate community at one station on Betty's Cove Brook (upstream and downstream of site). • One measurement of turbidity, and TSS within on-site watercourses under typical flow conditions. • Water samples for mercury levels annually from watercourses that flow through or near former tailings disposal areas. • Prepare a report on results and analyses of benthic invertebrate surveys (ephemeroptera/plecoptera/trichoptera index, taxon dominance, density, species diversity, Hilsenhoff biotic index, etc.).
Construction	Project Site	• Inspect, monitor erosion/sediment control measures at on-site watercourses throughout construction. • Periodically measure turbidity and TSS in on-site watercourses. • Water samples for mercury levels annually from watercourses that flow through or near former tailings disposal areas. • Annual qualitative/quantitative sampling of the benthic-invertebrate community at one station on Betty's Cove Brook (upstream and downstream of site). • Prepare annual reports on results of erosion-control and benthic-invertebrate surveys (ephemeroptera/plecoptera/trichoptera index, taxon dominance, density, species diversity, Hilsenhoff biotic index, etc.), compare with previous years.
Operation and Maintenance	Project Site	• Annual qualitative/quantitative sampling of the benthic-invertebrate community at one station on Betty's Brook, during post construction years 1, 2, 3, and 5, and every 5 years thereafter. • Water samples for mercury levels annually from watercourses that flow through or near former tailings disposal areas. • Prepare annual reports on survey results (ephemeroptera/ plecoptera/trichoptera index, taxon dominance, density, species diversity, hilsenhoff biotic index, etc.), compare results with previous years.

A monitoring program to determine the potential for and extent of sulphide bearing material will also be implemented with a plan to manage any exposed acid generating material and associated drainage. The sulphide monitoring program and management plan will be developed in accordance with Item 2.8 of the NSEL EA approval conditions.

In accordance with Item 1.5 in the NSEL EA approval conditions (NSEL, 2007), a plan to mitigate the human health and environmental impacts of the contaminated mine tailings and/or soils and sediments on the Project Site, via remediation or risk management will be developed and implemented. This plan will be consistent with the Nova Scotia Guidelines for the Management of Contaminated Sites. The Remedial Action Plan and/or Risk Management Plan will be approved by NSEL prior to commencement of construction. Upon completion of the remediation or risk management work, including any required monitoring, Keltic will submit a Certificate of Compliance to NSEL to demonstrate that the remediation work has been completed and/or the Risk Management Plan is effective (NSEL, 2007).

7.2.4 Water Supply Wells

7.2.4.1 Plant Site Pre-construction, Construction, and Operation

An inventory and water sampling of many wells within 1 km of the Project Site have already been completed. Prior to construction, the Proponent will expand on this earlier work by attempting to:

- interview all well owners not yet interviewed;
- review and document (including photos) well construction not yet inspected;
- collect water samples for general chemistry, metals and coliform analysis where sampling has not yet been done; and
- collect additional samples at wells previously sampled so as to identify possible seasonal or other temporal changes in water quality.

As construction work progresses on the plant site, follow-up well sampling will be done, as required, to adequately assess general groundwater and specific well water supply quality.

To meet the requirements of Item 2.4, in the NSEL EA approval conditions, an ESC plan will also be developed and implemented. The ESC Plan will include a monitoring program for site runoff and will be reviewed and approved by NSEL. A monitoring program to determine the potential for and extent of sulphide bearing material will also be implemented with a plan to manage any exposed acid generating material and associated drainage. The sulphide monitoring program and management plan will be developed in accordance with Item 2.8 of the NSEL EA approval conditions.

During plant operation, there will be regular monitoring of well water quality at key wells located near the plant site. The post construction report will identify these wells (selected on the basis of possible exposure to detrimental effects, if any, from plant operations, and on the basis of providing optimum scientific information), other possible future monitoring needs, and protocol for modifying the proposed monitoring program so as to continually optimize scientific data quality and resource utilization. Sampling at these wells will include analysis for general chemistry, metals, coliform, petroleum hydrocarbons, VOCs, and others as deemed necessary based on plant site operations and monitoring results.

7.2.4.2 Contingency Monitoring and Resolution

The above will form part of an overall water supply well contingency monitoring and resolution program. In accordance with Item 3.3 in the NSEL EA approval conditions, the contingency plan will address any well interference effects and/or well complaints. The Proponent will deliver an arbitration and resolution document to all owners of water supply wells located within 800 m of the proposed plant site boundaries. The Proponent is prepared to provide temporary water supply during construction should existing supplies be disrupted. Additionally, in the event that wells are adversely or permanently affected by plant-site preparation, construction, or plant operation the Proponent will repair or replace any affected wells.

7.2.5 Groundwater at the Plant Site

Since petroleum hydrocarbons other than LNG (i.e. diesel fuel for back up generators) and other chemicals are to be stored on the site, a groundwater monitoring program for the particular chemical(s) of concern will be implemented. The groundwater monitoring program will be in accordance with Item 2.6, of the NSEL EA approval conditions.

To meet the requirements of Item 2.4, in the NSEL EA approval conditions, an ESC Plan will also be developed and implemented. The ESC Plan will include a monitoring program for site runoff and will be reviewed and approved by NSEL. A monitoring program to determine the potential for and extent of sulphide bearing material will also be implemented with a plan to manage any exposed acid generating material and associated drainage. The sulphide monitoring program and management plan will be developed in accordance with Item 2.8 of the NSEL EA approval conditions.

The exact nature and location of on-site storage has not yet been determined, and thus detailed groundwater monitoring requirements have not been finalized, however samples for mercury will be taken initially for all groundwater samples for which Keltic can maintain proper security and control. Once the design of the plant site, facilities locations, and storage criteria have been completed, a groundwater monitoring well system will be designed and installed to expand upon the existing seven monitoring well stations installed on-site during spring 2005. Some of the wells will be installed before any site preparation or construction activities begin while others will be completed once the storage systems are in place.

The plant site groundwater monitoring system will be designed, constructed, and maintained in accordance with Conditions of Approvals, where applicable. The system will also be used to augment current baseline data, to monitor early site preparation and construction effects, and assist the Proponent and the neighbouring community for the duration of plant operation. The intent is to incorporate data collected from groundwater monitoring stations, in conjunction with other data which may become available on the abandoned mine workings, into groundwater models so as to allow for a more a comprehensive groundwater flow migration forecasting. This information would form part of the spill response and contingency plan.

The plant site monitoring system sampling schedule will include:

- a sufficient number of monitoring stations to provide full (both background or up-gradient and down gradient) on-site and nearby off-site coverage;
- multi-level and multi-well stations at key locations;

- proximal and distal monitoring capability for all fuel/chemical storage;
- timely response to any spill event; and
- four-season and longer temporal coverage.

This will include installations inside and at plant-site boundaries, outside plant-site boundaries (particularly in the east and south between the plant and Betty's Cove Brook, west between the plant site and the ocean, and north and northwest between the plant site and the community of Goldboro). Infill monitoring stations will be installed as suggested by early monitoring results and data collected.

In addition to the on-site and site-perimeter monitoring stations, groundwater monitoring stations will be installed at select locations within the community of Goldboro so as to allow uninhibited and unbiased collection of groundwater quantity and quality data (i.e. to simulate water supply wells).

It is expected that key monitoring stations will be assessed regularly for vapours that are relevant to storage and plant operations, and for water levels (data loggers). At others, groundwater levels will be measured and water samples collected regularly for general chemistry, metals, total petroleum hydrocarbons, and VOC analysis. A protocol will be established to enable the program to be modified to optimize the use of monitoring resources, scientific data quality, and knowledge of on site hydrogeological characteristics.

Where data suggests that there may be surface-water/groundwater interaction, select streams will be sampled for such parameters as general chemistry, metals, total petroleum hydrocarbons, VOC analysis, and mercury. This will serve to give a better insight on groundwater conditions and augment the surface water monitoring program described in Section 7.2.3.

7.2.6 Flora, Fauna and Terrestrial Habitat Monitoring

Keltic proposes to conduct terrestrial habitat monitoring upon completion of commissioning and during the first 3 to 5 years operation of the Project. The proposed Study Areas and detailed scope for each of the components will be developed prior to commissioning. Monitoring of illegal off-highway vehicle use will be conducted as part of routine operation and maintenance checks of the LNG pipeline. Prior to construction, a wetland functional analysis study will be conducted. Details of the Project impacts to wetlands will be evaluated further and plans for the avoidance, mitigation, and/or compensation will be developed in accordance with Item 1.2, NSEL EA approval conditions.

A terrestrial biological monitoring program will be established that includes the principal components described below. The findings will be documented on an annual basis and the scope of the program will be evaluated annually.

7.2.6.1 Bird Census

As required by Item 1.6 in the NSEL EA approval conditions, a Lighting Plan will be implemented. The Lighting Plan will be submitted to NSDNR, CWS, and TC for review and approval. The Lighting Plan will include a program to monitor birds. A breeding bird census will be carried out that monitors birds along the shoreline and Stormont Bay, and in the on-site terrestrial habitats. Counts will be taken at least twice per year for all birds (late May-early June and late August-early September), and at least once more (first two weeks of November) for sea birds and waterfowl.

In addition, routine site monitoring (i.e. daily during peak migration in the first year of operation) will be done to maintain records of bird mortality noted on site to enable identification of potential issues related to lighting. Should it be determined that significant lighting related mortalities are occurring, then appropriate mitigative strategies will need to be identified.

7.2.6.2 Vegetation

In accordance with the NSEL EA approval condition 2.7, a vegetation monitoring plan will be implemented. The plan will provide details on effects levels and the effectiveness of vegetation rehabilitation, where applicable. The vegetation monitoring plan will be conducted over a three-year period, at least twice per year in late May-early June and again in late August. Appropriate restorative plantings, if required, will be done shortly after these inspections.

As mentioned in Section 5.1.9.2, a baseline boreal felt lichen survey will be conducted prior to construction. The results of this survey will be used to provide additional information for finalizing site layout, design, and perhaps operation. Where applicable, post monitoring programs for this species will be developed in consultation with regulators and incorporated into the vegetation monitoring program described above.

7.2.6.3 Wildlife

In accordance with the NSEL EA approval condition 2.7, a wildlife monitoring plan will be implemented. The plan will provide details on effects levels and the effectiveness of mitigation, where applicable. The monitoring plan to assess wildlife populations will be established, with surveys carried out at appropriate times of the year as shown in Table 7.2-2.

TABLE 7.2-2 Proposed Survey Times for Wildlife Monitoring Program

Wildlife Species	Survey Times, Notes
Amphibians	Early May
Reptiles	June-August
Small mammals	June-July (check especially meadow vole activity)
Fur bearers	Fall and Winter (check tracks and other signs, especially in Dung Cove Pond area)
Deer	Winter (check tracks in areas of previously known concentration)

Evidence of wildlife presence and activity, and vegetation condition requiring attention, will be monitored during the surveys. Routine noise monitoring will also be conducted at site boundaries as appropriate.

As a component of NSEL Condition 2.7, the Proponent is committed to prepare an Adaptive Management Plan (AMP), consisting of various elements acceptable to EC and NSDNR, as well as a spill response plan. To address concerns with potential impacts to foraging Roseate Terns in Stormont Bay, it is expected that the AMP will include coordination with multiple stakeholders to monitor and manage potential cumulative effects on the Roseate Tern.

7.2.7 Freshwater Species and Habitat Monitoring

Prior to construction, a wetland functional analysis study will be conducted. Details of the Project impacts to wetlands will be evaluated further and plans for the avoidance, mitigation, and/or compensation will be developed in accordance with Item 1.2, NSEL EA approval conditions.

Although there are no freshwater bodies associated with the Project, there are brackish water bodies and programs for monitoring fish and fish habitat in these areas will be established as required. A number of programs are proposed in Table 7.2-3 for delineating the anticipated objectives and substance of the monitoring work plan. Monitoring required for water quality is covered in Section 7.2.3.

TABLE 7.2-3 Proposed Fish and Fish Habitat Monitoring

Project		Monitoring Program Elements
Phase	**Component**	
Pre-Construction	Project Site[1]	• Survey fish communities in all on-site watercourses (Betty's Cove Brook and unnamed tributary to Dung Cove) by electrofishing and by trap netting in Dung Cove. • Collect and determine assimilative capacity assessment for all relevant chemical and biological parameters expected to enter the environment or be remobilized due to construction activities.
Construction	Project Site	• Inspect/monitor sediment/erosion control measures at each on-site watercourse. • Annual fish community surveys (electrofishing) in all on-site watercourses (Betty's Cove Brook and unnamed tributary to Dung Cove) and annual trap-net surveys in Dung Cove throughout construction period. • Annual description/photographs of aquatic and riparian habitat at established representative locations on all on-site watercourses and in Dung Cove. • Prepare annual reports to present results of the erosion-control monitoring and the annual fish surveys and compare results (species presence, composition, etc.) with previous years.

Project		Monitoring Program Elements
Phase	**Component**	
Operation and Maintenance	Project Site	• Fish-community surveys in all on-site watercourses and Dung Cove Pond for post-construction years 1, 2, 3 and 5, and every 5 years thereafter, if required. • Describe/photograph aquatic/riparian habitat at established representative locations on all on-site watercourses and in Dung Cove Pond for post-construction years 1, 2, 3 and 5, and every 5 years thereafter. • Prepare reports on results of the annual habitat and fish surveys, compare results (species presence, composition, etc.) to previous years.

Notes: 1 – Completed as part of the baseline studies for this report.

7.2.8 Inshore Fisheries Monitoring

Monitoring of inshore fishing activity is difficult because reporting of specific fishing locations is not required for most fisheries and individual catches are considered confidential by DFO. However, since lobster is the primary species caught in Stormont Bay, a monitoring catch-rate program will be implemented in conjunction with local fishers. Such a program will be important as part of a compensation program to provide independent and objective assessment of potential impacts on the fishery. A monitoring program will document catch in different parts of Stormont Bay during the commercial fishing season. It will involve placing an observer on local fishing vessels at three different times during the fishing season, with specific criteria for consistent setting of traps.

There are different approaches that can be used to design the monitoring program. A Potential Effects Analysis will be done to determine the potential factors that could influence fishing success. The difference in catch rates will be monitored when these factors are present or absent. However, in order for the proposed “monitoring catch rate program” to be effective for comparison purposes, the program will be implemented pre-construction to establish baseline information. Details of such a program will need to be developed in consultation with local fishers and DFO. For monitoring and follow-up for fish and fish habitat, see Section 7.2.7 and Section 7.2.9.

7.2.9 Marine Species and Habitat Monitoring

Minor changes in sediment type and quality near proposed shoreline facilities are anticipated as a result of wave and current action. Changes in jetty and trestle design, however, may be required as part of the federal permitting process. Once design has been finalized, modeling will be carried out in more detail to assess potential changes in substrate and a monitoring program will be developed if required. To meet the requirements of Item 2.4, in the NSEL EA approval conditions, an ESC Plan will also be developed and implemented. The ESC Plan will include a monitoring program for site runoff and will be reviewed and approved by NSEL. Mitigation plans for environmental impacts due to contaminated mine tailings and/or soils and sediments from the Project Site will be implemented using risk and remediation management as outlined in Item 1.5 in the NSEL EA approval conditions. The Remedial Action Plan and/or Risk Management Plan will be approved prior to construction.

Baseline information will be collected for all relevant chemical and biological parameters expected to enter the environment due to Project activities. This information will be used to predict assimilative capacity of all receiving environments and assess potential effects and/or risks on marine biota. This will be done in accordance with Item 1.10, of the NSEL EA approval conditions (NSEL, 2007).

7.2.10 Archaeological Resource Monitoring

An archaeology and heritage resources monitoring and contingency plan will be developed prior to construction in accordance with Item 4.6 in the NSEL EA approval conditions. The plan will be developed in consultation with Mi'kmaq stakeholders, African Nova Scotia Affairs, and the Nova Scotia Museum. Archaeological compliance and monitoring programs are regulated by the Nova Scotia Museum's manager of Special Places and subject to approval. In accordance to Item 4.5 in the NSEL EA approval conditions, a complete archaeological assessment of the entire KDP site will be submitted for review by NSEL. A number of recommendations have been made to minimize impact on significant archaeological resources and are summarized in Table 7.2-4.

TABLE 7.2-4 Proposed Archaeological Compliance and Monitoring Programs

Archaeological Site or Resource		Proposed Compliance and/or Monitoring
LNG and Plant Site	Red Head Cemetery	Community consultation and monitoring of ground disturbance.
	Sculpin Cove 1	Monitoring of shoreline erosion. Archaeological testing as follow-up if sites are threatened.
	Sculpin Cove 2	
	Sculpin Cove 3	
	Sculpin Cove 4	
	Sculpin Cove 5	
	Hurricane Island Mine	
	McMillan Mine	Monitoring of ground disturbance.
	Dung Cove	None currently.
	Giffin's Mill	
	Hattie's Belt	
	Giffin Lead	
	Skunk Den Mine Crusher	
	South Mulgrave Lead	Monitoring of ground disturbance.
	Buckley Farm	Follow-up investigation once brush is cleared.
	Random Mining Activity	None.

7.2.11 Pre Blast Survey

The locations of buildings and wells situated within 800 m of the Project Site have been identified. The design and grading details of the Project Site are not yet available. However, upon defining these criteria, and thus blasting requirements, a pre-blast survey of all homes and all wells present within 800 m of the blast zone boundaries will be carried out following the NSEL guidelines for blasting at quarries. This type of survey will include:

- an inspection of all buildings located within the pre-blast survey areas by qualified persons; and

- a complete inventory and testing, as appropriate, of all wells to determine individual pre-blast well condition and nearby aquifer capacity.

Before any blasting begins, a copy of all pre-blast survey results, along with complete description of the arbitration and resolution methods to be used will be delivered to both building and well owners and NSEL.

Blasting programs will be reviewed by qualified engineers and/or geoscientists. Trained and qualified personnel using appropriate equipment will be deployed to the field to monitor air and ground vibrations during all blasting. Blasting programs will be modified according to monitoring results so as to avoid any impacts to nearby buildings and water supply wells. Copies of all monitoring results will be available for review by NSEL.

Should any nearby building or water supply well owner claim deleterious effects from blasting activities, then qualified individual follow-up assessments of buildings (cosmetic and structural inspections and comparison to pre-blast documentation) and wells (water quality testing and other hydrogeologic evaluations as needed) will be done. These assessments will evaluate damage and recommend mitigative and/or corrective measures.

7.2.12 Community Involvement

The Proponent has already established a liaison committee to help consult and inform communities in the area. The committee was elected at a public meeting on August 2, 2004, and is represented by individuals who have expressed an interest in the Project. There are 12 individuals on the committee who represent the seven communities of Goldboro, Isaac's Harbour, Drum Head, Coddles Harbour, Stormont, Country Harbour, and Seal Harbour. The Antigonish-Guysborough Black Development Association, the Municipality of the District of Guysborough, and the District of Saint Mary's are also represented.

The liaison committee meets regularly with the Proponent and will continue to be used as a sounding board for any issues (such as safety, environmental concerns, employment, etc.) that arise. The most recent meetings were held November 8, 2005, February 13, 2006, and March 27, 2006. In addition to the liaison committee, the Proponent will continue to liaise with the GCRDA and the Guysborough Journal as a means of communicating any information. The Proponent will also liaise actively with local emergency service providers, such as the RCMP, fire, and emergency health response.

In accordance with the NSEL EA approval and conditions, the following plans will be developed for community involvement: Local Economic Community Benefits Plan, Community Liaison Committee Plan, and Mi'kmaq Communication Plan. As outlined in the NSEL EA approval conditions, Keltic will take steps to further assess traditional Mi'kmaq use of the Project Site lands. These steps will be developed in cooperation with the Mi'kmaq Community and will be submitted to NSEL for review. A Public Reporting and Communication Protocol will also be developed and provided to NSEL for review. The Public Reporting and Communication Protocol will be developed as requested by Item 2.9 in the NSEL EA approval conditions.

Prior to construction, as outlined in the NSEL EA approval conditions, a Cultural Heritage Plan will also be developed to ensure the Project development and operations proceed in a manner that respects the cultural heritage value of the Red Head Cemetery site to the community, and that public access to the site is maintained (NSEL, 2007).

7.2.13 Other Monitoring Plans

Other monitoring requirements may be identified as part of the terms of the CSR approval and permitting processes.

7.2.14 Environmental Protection Plans (EPPs)

EPPs and emergency response plans for the construction and operation phases of the Project will be completed after CSR approval and prior to construction and will form part of the overall EMP for the Project. These plans will be submitted to NSEL for approval, which will involve circulation also to EC, DFO and other regulatory agencies as required. A draft scoping document for the EMP is provided in Appendix 1.

The EPP for the construction phase will require all contractors to work in compliance with the EPP. Key provisions of the EPP will include but will not necessarily be limited to such topics as:

- roles, responsibilities and accountabilities for EPP implementation;
- temporary storm-water management and dewatering;
- Erosion Control Plan;
- fuels and lubricant storage;
- material storage;
- spill prevention;
- emergency response (spill containment and clean up protocols and equipment);
- maintenance of machinery;
- housekeeping protocols;
- construction waste management;
- dust management;
- encounter of finds of potential archaeological interest;
- encounter of contaminated soils;
- site access and construction traffic routing;
- construction site security;
- tree protection;
- environmental supervision and inspection;
- health and Safety standards and protocols;
- community Action Plan; and
- reporting.

A response and follow up procedure will be developed should there be complaints.

The EPP is expected to contain general and specific mitigation measures for Project construction and operation, including measures specified in this document and applicable approval conditions. For example, the EPP will combine generic protection measures applicable to general industrial site preparation and construction projects, with environmental protection measures specific to this Project (i.e., use and maintenance of silt curtains, fuel handling protocol, etc.). In particular, areas of special environmental consideration (i.e., surveys and testing where there may be acid drainage potential, other areas requiring additional information) will be identified with specific protection measures included as appropriate.

The EPP will also contain requirements for the contractor to complete a work progression schedule for approval by the Project Engineer. Monitoring requirements, including, but not limited to, those noted above, will also be included. As part of the EPP, the design of the road and structures which make up the site preparation and structures at the plant site will be carried out such that contractors have clear direction for environmental controls made available to them both on the contract drawings and in Project specifications. These measures may include those described in the CSR; conditions of release from the assessment process; and other regulatory requirements and best management practices.

Similar to the EPP for the construction phase, an EPP will be developed for plant operation. The overall objective of the EPP is to ensure the plant operates in compliance with regulatory standards and permits issued by the Ministry of the Environment. Its content is briefly described here as it applies to most of the discussions of effects and mitigation measures.

The EPP will become an integral part of the plant operation manuals and protocols and will be subject to periodic reviews and updating. Plant personnel will be trained on the provisions of the EPP and will be responsible for its implementation. Key provisions will include but will not necessarily be limited to such topics as:

- responsibilities;
- environmental procedures;
- emission control systems;
- water discharges;
- waste management;
- chemical management;
- shut down policies;
- inspections;
- spill prevention;
- monitoring and reporting;
- icing and fogging;
- equipment;
- preventative maintenance;

- corrective maintenance;
- health and safety;
- policies;
- standards and protocols;
- requirements for contractors and suppliers;
- incident reporting;
- Emergency Preparedness and Response Plan;
- responsibilities;
- spill containment and clean up procedures and equipment;
- notification, training, drills;
- management of Environmental Program;
- training;
- documentation and record keeping;
- reporting;
- continuous improvement;
- management review; and
- community liaison and complaint procedure.

7.2.15 Waste Management Plan

A Waste Management Plan will be designed to meet the objectives of the Proponent's purpose, vision, and values. It will provide the basis for sound waste management practices that will focus on reduction, reuse, and recycling. The plan will cover all aspects of waste generation, storage, handling, shipping, and reporting. The plan will apply to the construction and operation phases of the Project and to all subcontractors.

7.2.16 Contingency Plan

In accordance with Item 3.2 in the NSEL EA approval conditions, a Contingency Plan will be developed in accordance with NSEL's Contingency Planning Guidelines that addresses;

- fires or other emergencies; and
- discharge, emissions, escapes, leaks or spills of dangerous goods or waste dangerous goods.

The plan will be developed in consultation with local fire and emergency service providers and will demonstrate compliance with Federal and Provincial regulatory requirements (NSEL, 2007).

7.3 MARGINAL WHARF

7.3.1 Air Quality Monitoring

It is anticipated that air emissions from the Project (including site preparation, construction, and shipping/receiving) will not exceed the ambient air quality objectives and/or regulations. To confirm this, the Proponent will undertake the following monitoring programs.

7.3.1.1 Construction

As outlined in Item 1.10 in the NSEL EA approval conditions, baseline data will be collected for all relevant chemical parameters that are expected to enter the environment or be remobilized as a result of Project Activities. As outlined in Item 1.4 in the NSEL EA approval conditions, air dispersion modelling will be completed with onsite meteorological data and more detailed design data to further assess potential Project impacts.

Typically, in rural settings, air emissions, in particular dust, are not monitored during construction. If concerns are expressed on site related to occupational health and safety, portable PM_{10} monitors may be used for real time measurements of PM by field inspectors. If concerns are expressed regarding dust levels off-site, the Project may elect to employ high-volume samplers to determine particulate levels at specific receptors.

7.3.1.2 Operations

Although real-time monitoring of VOCs is not contemplated, Keltic will commission VOC monitoring (essentially 24 hour 'grab' sampling), both prior to and during operations, in order to assess the quantity and makeup of any VOCs at a number of points which will be determined as the specific design phase is completed. In addition, should odours be detected off-site, VOC monitoring will be undertaken to determine the source(s), and allow for appropriate mitigation measures. In accordance with Item 2.3 of the NSEL EA approval conditions, an air monitoring program will be developed and implemented.

Efforts will be made to coordinate with SOEI regarding existing monitoring equipment utilization and data resources.

7.3.2 Noise and Light Monitoring

Monitoring will be conducted if complaints arise as a result of construction or operation activities associated with the marginal wharf.

7.3.2.1 Construction

Monitoring will be conducted if complaints arise as a result of construction activities or truck traffic through Goldboro and/or other communities during construction.

A traffic/vehicle management system will be implemented if traffic-related noise threshold levels are exceeded.

The Proponent will notify the public in advance of any potentially unusual noise-related events. The Proponent will provide a direct contact number for a responsible company official to residents and other interested stakeholders.

In accordance with the NSEL EA approval condition 1.6, a Lighting Plan will be implemented. The Lighting Plan will be reviewed and approved by NSDNR, CWS, and TC. A program to monitor birds will be included in the Lighting Plan.

7.3.2.2 Operations

The Proponent will initiate a noise monitoring program in accordance with Item 2.2 in the NSEL EA approval conditions. The monitoring program will consist of sampling noise levels over a 24-hour period following commissioning. Noise sampling will be conducted quarterly and the results evaluated on an annual basis. Should noise levels be consistent over the first year, noise sampling would subsequently be conducted on a complaint basis or following process or equipment changes. This will include monitoring of vehicle movement, heavy equipment operations, emergency operations, and normal operating modes.

The Proponent will notify the public in advance of any potentially unusual noise-related events. The Proponent will provide a direct contact number for a responsible company official to residents and other interested stakeholders.

In accordance with the NSEL EA approval condition 1.6, a Lighting Plan will be implemented. The Lighting Plan will be reviewed and approved by NSDNR, CWS, and TC. The Lighting Plan will incorporate a program to monitor birds.

7.3.3 Surface Water Monitoring

In accordance with Item 1.5 in the NSEL EA approval conditions, mitigation plans for environmental impacts due to contaminated mine tailings and/or soils and sediments from the Project Site will be implemented using risk and remediation management. The Remedial Action Plan and/or Risk Management Plan, which will include monitoring as required, will be approved prior to construction. The mitigation plans will also address degradation, reduction, or loss of water quality or quantity.

To meet the requirements of Item 2.4, in the NSEL EA approval conditions, an ESC Plan will also be developed and implemented. The ESC Plan will include a monitoring program for site runoff and will be reviewed and approved by NSEL.

Baseline information will be collected for all relevant chemical, and biological parameters as well as any potential thermal plume expected to enter the environment due to Project activities. This information will be used to predict assimilative capacity of all receiving environments and assess potential effects and/or risks on marine biota. This will be done in accordance with Item 1.10, of the NSEL EA approval conditions (NSEL, 2007).

Surface water quality monitoring programs will be established in consultation with regulatory agencies in accordance with Item 2.5 in the NSEL EA approval conditions (NSEL, 2007) and as part of the permitting process through the Conditions of Approval. Notwithstanding this, a proposed water quality monitoring plan is presented for the purpose of describing the objectives and substance of monitoring.

With the exception of Betty's Cove Brook, it is anticipated that there will be no discharges into on-site or off-site watercourses. As a result, monitoring is not proposed for the unnamed tributary to Dung Cove. As Betty's Cove Brook may receive periodic discharges from the site during construction, it will be sampled at key stream locations for TSS during storm events and during sediment pond discharge or dewatering. It will also be monitored as part of the groundwater monitoring program on the plant site (see Section 7.2.5) because of the identified dynamic relationship between groundwater and surface water in the area.

As an additional tool for assessing the water quality impacts resulting from possible spills or other unforeseen effects of the Project operations, a benthic-invertebrate survey will be conducted at relevant locations in the Keltic Study Area. A monitoring program to determine the potential for and extent of sulphide bearing material will also be implemented with a plan to manage any exposed acid generating material and associated drainage. The sulphide monitoring program and management plan will be developed in accordance with Item 2.8 of the NSEL EA approval conditions.

These and other proposed water quality monitoring programs are presented in Table 7.3-1.

7.3.4 Groundwater Monitoring

A groundwater monitoring program will not be implemented at the marginal wharf. However, groundwater monitoring will be conducted at the Plant site. For details, please see Section 7.2.5.

7.3.5 Flora, Fauna and Terrestrial Habitat Monitoring

Keltic proposes to conduct terrestrial habitat monitoring upon completion of commissioning and during the first 3 to 5 years operation of the Project. The proposed Study Areas and detailed scope for each of the components will be developed prior to commissioning. Prior to construction, a wetland functional analysis study will be conducted. Details of the Project impacts to wetlands will be evaluated further and plans for the avoidance, mitigation, and/or compensation will be developed in accordance with Item 1.2, NSEL EA approval conditions. An ESC plan will also be developed and implemented in accordance with Item 2.4 in the NSEL EA approval conditions. The ESC Plan will include a monitoring program for site runoff and will be reviewed and approved by NSEL.

A modified terrestrial biological monitoring program will include birds, inshore fisheries, marine species, and habitat monitoring. The findings will be documented on an annual basis and the scope of the program will be evaluated annually.

7.3.5.1 Bird Census

As required by Item 1.6 in the NSEL EA approval conditions, a Lighting Plan will be implemented. The Lighting Plan will be submitted to NSDNR, CWS, and TC for review and approval. The Lighting Plan will include a program to monitor birds. A bird census will be

TABLE 7.3-1 Proposed Surface Water Monitoring Program Elements

Project Phase	Project Component	Proposed Monitoring Program Elements
Pre-Construction	Project Site	• Qualitative/quantitative sampling of the benthic-invertebrate community at one station on Betty's Cove Brook (upstream and downstream of site). • One measurement of turbidity and TSS within on-site watercourses under typical flow conditions. • Prepare a report on results and analyses of benthic invertebrate surveys (ephemeroptera/plecoptera/trichoptera index, taxon dominance, density, species diversity, Hilsenhoff biotic index, etc.). • Implement an ESC plan.
Construction	Project Site	• Inspect, monitor erosion/sediment control measures at on-site watercourses throughout construction. • Periodically measure turbidity and TSS in on-site watercourses. • Annual qualitative/quantitative sampling of the benthic-invertebrate community at one station on Betty's Cove Brook (upstream and downstream of site). • Prepare annual reports on results of erosion-control and benthic-invertebrate surveys (ephemeroptera/plecoptera/trichoptera index, taxon dominance, density, species diversity, Hilsenhoff biotic index, etc.), compare with previous years. • Implement an ESC plan.
Operation and Maintenance	Project Site	• Annual qualitative/quantitative sampling of the benthic-invertebrate community at one station on Betty's Brook, during post construction years 1, 2, 3, and 5, and every 5 years thereafter. • Prepare annual reports on survey results (ephemeroptera/ plecoptera/trichoptera index, taxon dominance, density, species diversity, hilsenhoff biotic index, etc.), compare results with previous years. • Implement an ESC plan.

carried out that monitors birds along the shoreline and Stormont Bay, and in the on-site terrestrial habitats. In accordance with Item 2.7 in the NSEL EA approval conditions, a bird monitoring program will be developed. Counts will be taken at least twice per year for all birds (late May-early June and late August-early September), and at least once more (first two weeks of November) for sea birds and waterfowl.

In addition, routine site monitoring will be done to maintain records of bird mortality noted on site to enable identification of potential issues related to lighting. Should it be determined that significant lighting related mortalities are occurring, then appropriate mitigative strategies will need to be identified.

7.3.5.2 Vegetation

There will be no vegetative monitoring program associated with the marginal wharf. However, monitoring will be conducted for the Plant site as outlined in Section 7.2.6.2.

7.3.5.3 Wildlife

In accordance with the NSEL EA approval condition 2.7 , a wildlife monitoring plan will be implemented. The plan will provide details on effects levels and the effectiveness of mitigation, where applicable. The monitoring plan to assess wildlife populations will be established, with surveys carried out at appropriate times of the year as shown in Table 7.3-2. Routine noise monitoring will also be conducted at site boundaries as appropriate.

TABLE 7.3-2 Proposed Survey Times for Wildlife Monitoring Program

Wildlife Species	Survey Times, Notes
Amphibians	Early May
Reptiles	June-August
Small mammals	June-July (check especially meadow vole activity)
Fur bearers	Fall and Winter (check tracks and other signs, especially in Dung Cove Pond area)
Deer	Winter (check tracks in areas of previously known concentration)

Evidence of wildlife presence and activity, and vegetation condition requiring attention, will be monitored during the surveys.

As a component of NSEL Condition 2.7, the Proponent is committed to prepare an Adaptive Management Plan (AMP), consisting of various elements acceptable to EC and NSDNR, as well as a spill response plan. To address concerns with potential impacts to foraging Roseate Terns in Stormont Bay, it is expected that the AMP will include coordination with multiple stakeholders to monitor and manage potential cumulative effects on the Roseate Tern.

7.3.6 Freshwater Species and Habitat Monitoring

There will be no freshwater species and habitat monitoring directly associated with the marginal wharf. However, monitoring will be conducted for the Plant site as outlined in Section 7.2.7.

7.3.7 Inshore Fisheries Monitoring

Monitoring of inshore fishing activity is difficult because reporting of specific fishing locations is not required for most fisheries and individual catches are considered confidential by DFO. However, since lobster is the primary species caught in Stormont Bay, a Potential Effects Analysis and a Catch-Rate monitoring program will be completed will be implemented in conjunction with local fishers. A monitoring program will document catch in different parts of Stormont Bay during the commercial fishing season. It will involve placing an observer on local fishing vessels at three different times during the fishing season, with specific criteria for consistent setting of traps. A catch rate monitoring program will help track Project impacts on inshore fisheries. Details of such a program will need to be developed in consultation with local fishers and DFO.

7.3.8 Marine Species and Habitat Monitoring

Modeling will be carried out to assess potential changes in substrate and a monitoring program will be developed if required.

Minor changes in sediment type and quality near proposed shoreline facilities are anticipated as a result of wave and current action. Changes in wharf design, however, may be required as part of the federal permitting process. Once design has been finalized, modeling will be carried out in more detail to assess potential changes in substrate and a monitoring program will be developed if required. To meet the requirements of Item 2.4, in the NSEL EA approval conditions, an ESC Plan will also be developed and implemented. The ESC Plan will include a monitoring program for site runoff and will be reviewed and approved by NSEL. Mitigation plans for environmental impacts due to contaminated mine tailings and/or soils and sediments from the Project Site will be implemented using risk and remediation management as outlined in Item 1.5 in the NSEL EA approval conditions. The Remedial Action Plan and/or Risk Management Plan will be approved prior to construction.

Prior to implementation of a habitat compensation project, additional physical assessment of the area will be required to ensure that bottom conditions are appropriate.

Monitoring of the habitat compensation program will be carried out to document its success. The program will be developed in consultation with DFO.

Baseline information will be collected for all relevant chemical and biological parameters expected to enter the environment due to Project activities. This information will be used to predict assimilative capacity of all receiving environments and assess potential effects and/or risks on marine biota. This will be done in accordance with Item 1.10, of the NSEL EA approval conditions (NSEL, 2007).

7.3.9 Archaeological Resource Monitoring

An archaeology and heritage resources monitoring and contingency plan will be developed prior to construction. The plan will be developed in consultation with Mi'kmaq stakeholders, African Nova Scotia Affairs, and the Nova Scotia Museum. Archaeological compliance and monitoring programs are regulated by the Nova Scotia Museum's manager of Special Places and subject to approval. In accordance to Item 4.5 in the NSEL EA approval conditions, a complete archaeological assessment of the entire KDP site will be submitted for review by NSEL. A number of recommendations have been made to minimize impact on significant archaeological resources and are summarized in Table 7.3-3.

7.3.10 Pre Blast Survey

No blasting will be required in association with the marginal wharf. Therefore, no pre-blast survey will be conducted.

TABLE 7.3-3 Proposed Archaeological Compliance and Monitoring Programs

Archaeological Site or Resource		Proposed Compliance and/or Monitoring
LNG and Marginal Wharf	Red Head Cemetery	Community consultation and monitoring of ground disturbance.
	Sculpin Cove 1	Monitoring of shoreline erosion. Archaeological testing as follow-up if sites are threatened.
	Sculpin Cove 2	
	Sculpin Cove 3	
	Sculpin Cove 4	
	Sculpin Cove 5	
	Hurricane Island Mine	
	McMillan Mine	Monitoring of ground disturbance.
	Dung Cove	None currently.
	Giffin's Mill	
	Hattie's Belt	
	Giffin Lead	
	Skunk Den Mine Crusher	
	South Mulgrave Lead	Monitoring of ground disturbance.
	Random Mining Activity	None.

7.3.11 Community Involvement

The Proponent has already established a liaison committee to help consult and inform communities in the area. The committee was elected at a public meeting on August 2, 2004, and is represented by individuals who have expressed an interest in the Project. There are 12 individuals on the committee who represent the seven communities of Goldboro, Isaac's Harbour, Drum Head, Coddles Harbour, Stormont, Country Harbour, and Seal Harbour. The Antigonish-Guysborough Black Development Association, the Municipality of the District of Guysborough, and the District of Saint Mary's are also represented.

The liaison committee meets regularly with the Proponent and will continue to be used as a sounding board for any issues (such as safety, environmental concerns, employment, etc.) that arise. The most recent meetings were held November 8, 2005; February 13, 2006, and March 27, 2006. In addition to the liaison committee, the Proponent will continue to liaise with the GCRDA and the Guysborough Journal as a means of communicating any information. The Proponent will also liaise actively with local emergency service providers, such as the RCMP, fire, and emergency health response.

In accordance with the NSEL EA approval and conditions, the following plans will be developed for community involvement: Local Economic Community Benefits Plan, Community Liaison Committee Plan, and Mi'kmaq Communication Plan. As outlined in the NSEL EA approval conditions, Keltic will take steps to further assess traditional Mi'kmaq use of the Project Site lands. These steps will be developed in cooperation with the Mi'kmaq Community and will be submitted to NSEL for review. A Public Reporting and Communication Protocol will also be developed and provided to NSEL for review. The Public Reporting and Communication Protocol will be developed as requested by Item 2.9 in the NSEL EA approval conditions.

Prior to construction, a Cultural Heritage Plan will also be developed to ensure the Project development and operations proceed in a manner that respects the cultural heritage value of the Red Head Cemetery site to the community, and that public access to the site is maintained (NSEL, 2007).

7.3.12 Other Monitoring Plans

Other monitoring requirements may be identified as part of the terms of the CSR approval and permitting processes.

7.3.13 Environmental Protection Plan (EPP)

EPPs and emergency response plans for the construction and operation phases of the Project will be completed after CSR approval and prior to construction and will form part of the overall EMP for the Project. These plans will be submitted to NSEL for approval, which will involve circulation also to EC, DFO and other regulatory agencies as required. Key provisions of the EPP are available in Section 7.2.14. A draft scoping document for the EMP is provided in Appendix 1.

7.3.14 Waste Management Plan

A Waste Management Plan will be designed to meet the objectives of the Proponent's purpose, vision, and values. This plan will provide the basis for sound waste management practices that will focus on reduction, reuse, and recycling. The plan will cover all aspects of waste generation, storage, handling, shipping, and reporting. The plan will apply to the construction and operation phases of the Project and to all subcontractors.

7.3.15 Contingency Plan

In accordance with Item 3.2 in the NSEL EA approval conditions, a Contingency Plan will be developed in accordance with NSEL's Contingency Planning Guidelines that addresses;

- fires or other emergencies; and
- discharge, emissions, escapes, leaks or spills of dangerous goods or waste dangerous goods.

The plan will be developed in consultation with local fire and emergency service providers and will demonstrate compliance with Federal and Provincial regulatory requirements (NSEL, 2007).

7.4 PROJECT RELATED SHIPPING WITHIN 25 KM OF COUNTRY ISLAND

7.4.1 Air Quality Monitoring

There will be no air quality monitoring program related to shipping activities. However, an air quality monitoring program will be implemented for the Project Site.

7.4.2 Noise and Light Monitoring

There will be no noise and light monitoring program related to shipping activities. However, a noise and light monitoring program will be implemented for the Project Site.

7.4.3 Surface Water Monitoring

This does not apply to shipping activities.

7.4.4 Water Supply Wells

This will not apply to shipping activities.

7.4.5 Groundwater at the Plant Site

This does not apply to shipping activities.

7.4.6 Flora, Fauna and Terrestrial Habitat Monitoring

7.4.6.1 Bird Census

A bird census will be carried out that monitors birds along the shoreline and Stormont Bay, and in the on-site terrestrial habitats. Counts will be taken at least twice per year for all birds (late May-early June and late August-early September), and at least once more (first two weeks of November) for sea birds and waterfowl.

In addition, routine site monitoring will be done to maintain records of bird mortality noted on site to enable identification of potential issues related to lighting. Should it be determined that significant lighting related mortalities are occurring, then appropriate mitigative strategies will need to be identified.

7.4.6.2 Vegetation

This does not apply to shipping activities.

7.4.6.3 Wildlife

As a component of NSEL Condition 2.7, the Proponent is committed to prepare an Adaptive Management Plan (AMP), consisting of various elements acceptable to EC and NSDNR, as well as a spill response plan. To address concerns with potential impacts to foraging Roseate Terns in Stormont Bay, it is expected that the AMP will include coordination with multiple stakeholders to monitor and manage potential cumulative effects on the Roseate Tern.

7.4.7 Freshwater Species and Habitat Monitoring

This does not apply to shipping activities.

7.4.8 Inshore Fisheries Monitoring

Monitoring of inshore fishing activity is difficult because reporting of specific fishing locations is not required for most fisheries and individual catches are considered confidential by DFO. However, since lobster is the primary species caught in Stormont Bay, a monitoring catch-rate program will be implemented in conjunction with local fishers. Such a program will be important as part of a compensation program to provide independent and objective assessment of potential impacts on the fishery. A monitoring program will document catch in different parts of Stormont Bay during the commercial fishing season. It will involve placing an observer on local fishing vessels at three different times during the fishing season, with specific criteria for consistent setting of traps. Details of such a program will need to be developed in consultation with local fishers and DFO.

7.4.9 Archaeological Resource Monitoring

This does not apply to shipping activities.

7.4.10 Pre Blast Survey

This does not apply to shipping activities.

7.4.11 Community Involvement

The Proponent has already established a liaison committee to help consult and inform communities in the area. The committee was elected at a public meeting on August 2, 2004, and is represented by individuals who have expressed an interest in the Project. There are 12 individuals on the committee who represent the seven communities of Goldboro, Isaac's Harbour, Drum Head, Coddles Harbour, Stormont, Country Harbour, and Seal Harbour. The Antigonish-Guysborough Black Development Association, the Municipality of the District of Guysborough, and the District of Saint Mary's are also represented.

The liaison committee meets regularly with the Proponent and will continue to be used as a sounding board for any issues (such as safety, environmental concerns, employment, etc.) that arise. The most recent meetings were held November 8, 2005, February 13, 2006, and March 27, 2006. In addition to the liaison committee, the Proponent will continue to liaise with the GCRDA and the Guysborough Journal as a means of communicating any information. The Proponent will also liaise actively with local emergency service providers, such as the RCMP, fire, and emergency health response.

In accordance with the NSEL EA approval and conditions, the following plans will be developed for community involvement: Local Economic Community Benefits Plan, Community Liaison Committee Plan, and Mi'kmaq Communication Plan. A Public Reporting and Communication Protocol will also be developed and provided to NSEL for review. The Public Reporting and Communication Protocol will be developed as requested by Item 2.9 in the NSEL EA approval conditions.

7.4.12 Other Monitoring Plans

Other monitoring requirements may be identified as part of the terms of the CSR approval and permitting processes.

7.4.13 Environmental Protection Plan (EPP)

EPPs and emergency response plans for the construction and operation phases of the Project will be completed after CSR approval and prior to construction and will form part of the overall EMP for the Project. These plans will be submitted to NSEL for approval, which will involve circulation also to EC, DFO and other regulatory agencies as required. Key provisions of the EPP are available in Section 7.2.14. A draft scoping document for the EMP is provided in Appendix 1.

7.4.14 Waste Management Plan

A Waste Management Plan will be designed to meet the objectives of the Proponent's purpose, vision, and values. This plan will provide the basis for sound waste management practices that will focus on reduction, reuse, and recycling. The plan will cover all aspects of waste generation, storage, handling, shipping, and reporting. The plan will apply to the construction and operation phases of the Project and to all subcontractors.

7.4.15 Contingency Plan

In accordance with Item 3.2 in the NSEL EA approval conditions, a Contingency Plan will be developed in accordance with NSEL's Contingency Planning Guidelines that addresses:

- fires or other emergencies; and
- discharge, emissions, escapes, leaks or spills of dangerous goods or waste dangerous goods.

The plan will be developed in consultation with local fire and emergency service providers and will demonstrate compliance with Federal and Provincial regulatory requirements (NSEL, 2007).

8.0 CUMULATIVE ENVIRONMENTAL EFFECTS ASSESSMENT

The effect of a project on the environment may not be fully represented by the individual interactions of project components or activities with VECs. In many cases, individual projects and/or project components produce environmental effects that are not significant. However, when combined with the effects of other project components or other projects and activities, these small effects may become a concern, as they may cause a cumulative effect. The basis for the consideration of the cumulative environmental effects are provided in the Responsible Authority's Guide (the Agency, 1994), and supplemented by the Cumulative Effects Practitioners Guide (the Agency, 1999).

The Cumulative Effects Assessment Practitioners Guide (the Agency, 1999) defines cumulative effects as:

"changes to the environment that are caused by an action in combination with other past, present and future human actions."

The formally remote area where the Keltic Project is proposed has been subjected to past and ongoing human activities such as industrial development, mining, and forestry. A description of the baseline conditions of the site are presented in Section 4.0 of the CSR. This Cumulative Effects Assessment (CEA) has considered potential cumulative effects that may result from Project construction or operation in concert with any other past, present, or foreseeable future projects.

8.1 METHODOLOGY

This CEA incorporates the five key steps outlined in the Cumulative Effects Practitioners Guide:

- *Scoping*: identification of regional issues of concern, VEC's, spatial and temporal boundaries, other unrelated projects, and potential effects of unrelated projects;
- *Analysis of Effects*: analysis of effects of VEC's identified during scoping;
- *Mitigation:* recommend mitigation for effects identified;
- *Evaluation of significance:* determine residual effects and their significance with consideration of land use thresholds and land use objectives and trends; and
- *Follow*-up: identify appropriate monitoring.

8.1.1 Scoping

The objective of scoping is to identify the key environmental areas of concern that should be considered in the analysis of effects for the CEA.

As part of this CSR, direct Project potential effects on VECs identified as within the scope of the CSR are presented, prior to mitigation, and then residual effects determined after mitigation measures were considered (Section 5.0). Provides a summary of the significance of these effects along with other cumulative projects.

8.1.1.1 Regional Issue Identification

The next step for a CEA is to identify regional issues that may also result in environmental effects and to then determine where they overlap with potential residual Project effects identified in this CSR. These include:

- industrial development's contribution to GHG emissions;
- increased industrial development of the area and associated effects;
- changes in marine fish species assemblages (commercial and non-commercial); and
- loss of tourism resulting from development.

The regional concerns listed have a distinct overlap with the direct effects of the proposed Project, outlined in Section 5.0. These overlapping issues will be assessed in this CEA.

8.1.1.2 Regional VEC Identification

The regional VEC's assessed in this CEA have been selected based on a thorough understanding of the region that was acquired in the preparation of this CSR. This understanding is based on professional judgement, consultation with regulatory agencies, and stakeholder input. Table 8.1-1 summarizes regional issues, associated regional VEC's, and example indicators.

TABLE 8.1-1 Regional VEC Summary

Environmental feature	Regional Issue/Concern	Regional VEC	Example Indicator
Hydrology/Freshwater Quality/Quantity	Loss/alteration of fish and fish habitat	Aquatic flora and fauna	Fish species composition and population size, benthic community
Groundwater Quality/Quantity	Ability to use potable water wells	Potable water wells Aquatic flora and fauna	Depth to groundwater in wells, groundwater quality in wells, and surface water quality in Betty's Cove Brook and the unnamed tributary in Dung's Cove
Marine Water Quality	Loss of aquatic habitat/direct mortality	Fish	Fish habitat
Soil/Sediment Quality	Soil contamination, topsoil mixing, loss of productivity	Terrestrial flora	Potential receptors for contaminants in aquatic environments
Air Quality	Human health, terrestrial vegetation, wildlife	Residential receptors Terrestrial flora and fauna	NO_x, SO_x, PM
Climate Condition	Global Warming/GHG emissions	GHG regional targets	Stack emissions of CO, CO_2, and other GHGs and other Project reported emissions
Vegetation	Loss/fragmentation of habitat	Wildlife, avian resources	Local fauna, resident and migratory birds
Species at Risk	Loss/fragmentation of habitat	Roseate tern habitat	Roseate tern
Fish and Marine Habitat	Loss/alteration of aquatic habitat	Fish, aquatic fauna	Fish species composition and population size
Marine Mammals	Loss/alteration of aquatic habitat	Whales	Whales

Environmental feature	Regional Issue/Concern	Regional VEC	Example Indicator
Wildlife	Loss/fragmentation of habitat	Local fauna	Local fauna
Migratory Birds	Loss/fragmentation of habitat	Migratory birds, seabirds	Avian populations, at risk birds such as Roseate Tern
Wetlands	Loss of wetlands function	Wetlands	Depth to groundwater, vegetation composition
Lighting Conditions	Attracting or repelling wildlife	Avian and terrestrial wildlife	Roseate tern, and local avian and terrestrial populations
Atmospheric and Acoustic Environment	Noise within limits for residents or not affecting wildlife	People, whales	Noise measurement
Traditional Use	Loss of ability to use traditional land	Fisheries, hunting	Community relations
Heritage and Archaeological Sites	Loss of resources	Cemeteries, artefacts	Mitigative resource recovery
Navigation	Increased traffic	Regional shipping	TERMPOL process
Marine and Human Health and Safety	Potential for collisions; Worker and resident Health and Safety	People and vessels	TERMPOL process Incident reporting
Fisheries	Loss of income for fishermen from reduction in fish stocks.	Fisheries - lobster	Compensation agreement
Aquaculture	Impacts to water quality	Aquaculture production	See water quality
Tourism	Loss of tourism resulting from development.	Tourism	Local tourism business receipts

8.1.1.3 Temporal and Spatial Boundaries

Spatial boundaries reflect potential Project impacts and potential interactions with other projects. The local Study Area is the respective watershed as identified previously for aquatic VECs. For atmospheric VECs the Study Area is the regional air shed. For terrestrial VECs, spatial boundaries reflect potential for direct or indirect disturbances (such as noise). For VECs where potential significant effects are more widely distributed, such as impact to a rare species with a regional or national distribution, a larger Study Area (based on the VEC population) is considered. With respect to the assessment of effects related to Country Island, a 25 km boundary was established in accordance with the scoping of the CSR.

Temporal boundaries encompass past projects and activities resulting in the conditions of the existing environment and certain and reasonably foreseeable future projects and activities that could influence the environmental conditions for the life of the Project.

Because of the temporal boundaries set for this CEA, based on the ability to determine certain or likely projects, given the estimated 50 year life, decommissioning is not considered in this CEA.

The CEA addresses cumulative effects between both the Project and other projects and activities, and between Project components. Often the intra-Project assessment is included with the direct effects assessment (Section 6.0) but where some of the Project works and activities are distinctly separated in time, as is the case with the proposed Project, it makes sense to consider potential effects for Project components as being cumulative.

The Project components within the scope of the CSR to be addressed in the CEA are:

- LNG Terminal, marine transfer pipelines, LNG storage tanks and the regasification facilities;
- marginal wharf; and
- Project related shipping within 25 km of Country Island.

Other Keltic Project components, that are not part of the CSR scope but that are included as "other projects and activities" in the CEA include:

- petrochemical facilities;
- co-generation power plant; and
- Meadow Lake impoundment (including and water supply infrastructure).

Regulatory requirements and objectives and Project mitigation are provided in Sections 1.0 and 5.0, respectively. Existing management plans for the VECs, such as EC's Recovery Strategy for the Roseate Tern in Canada, are incorporated in the consideration of impacts (individual and cumulative) and in development of mitigation.

The rationale and methods for determining significance (magnitude, geographic extent, duration/frequency, and reversibility) are as identified for the direct effects assessment (Section 5.0).

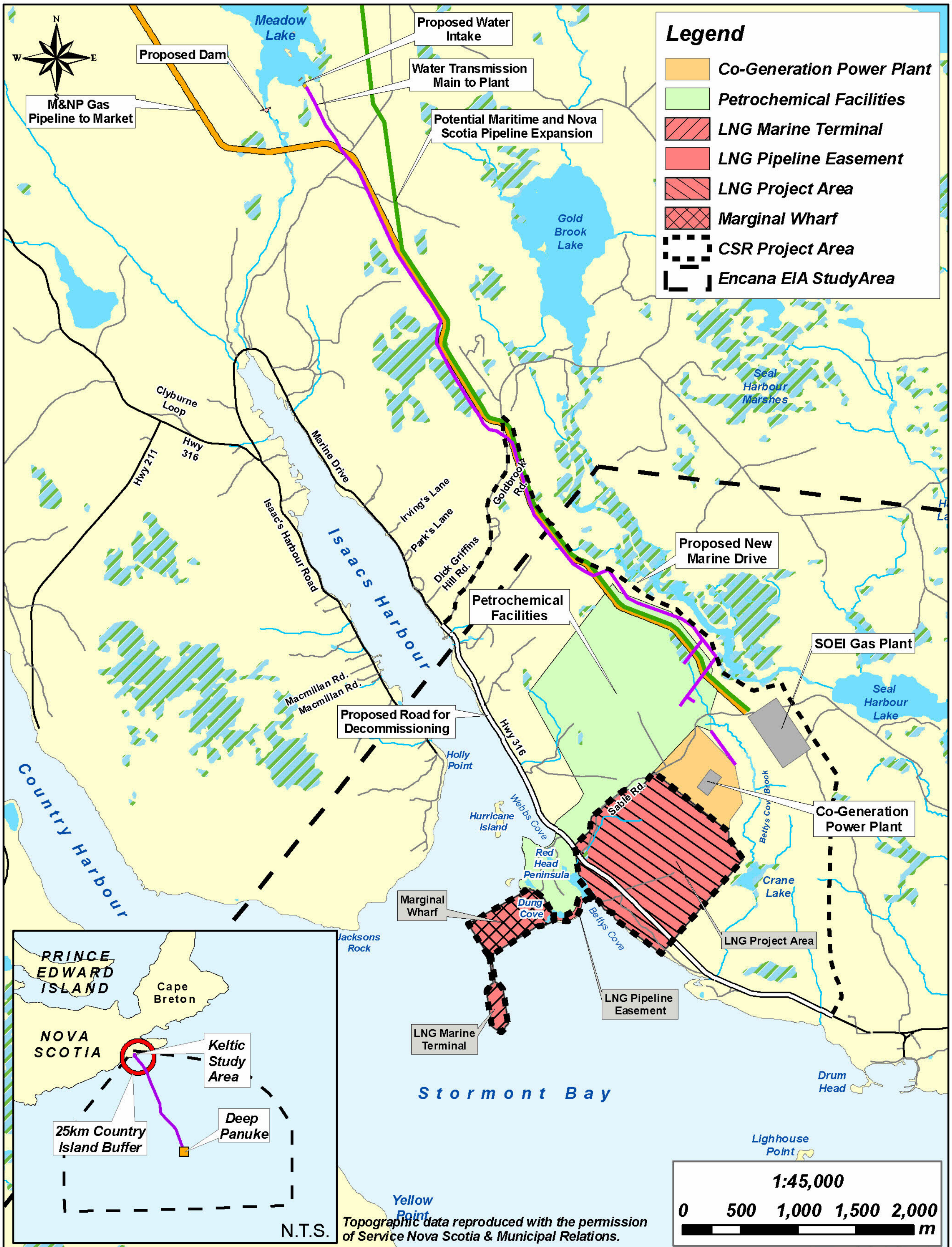
8.1.1.4 Selection of Other Projects and Activities

For the purposes of the assessment, it is assumed that the existing status or condition of each VEC reflects the influence of other past and current projects and activities occurring within or outside of the Project Area. It also assumes (unless there is evidence to the contrary, such as predictable down or upward trends in a population) that these existing activities will continue to be carried out in the future and will have similar effects as are currently observed. The assessment has, therefore, integrated the cumulative effects of these ongoing projects and activities. The CEA thus focuses on the effects of other future projects and activities, as considered and assessed for each VEC.

The future projects considered include planned or reasonably foreseeable projects/development activities in Nova Scotia both onshore and offshore that might interact in a cumulative fashion with activities of the Project. Projects were considered if planned and/or likely to proceed (have initial level of regulatory approval/engagement) and include:

- regional oil and gas developments;
- upgrades or realignments of existing roads and other linear corridors; and
- other Keltic Project components (not included within scope of CSR):
    - petrochemical facility;
    - co-generation plant; and
    - Meadow Lake impoundment.

See Figure 8.1-1 for locations of other projects in relation to Keltic Projects and watersheds.



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June 2007
Drawn by S. Turner
Projection: NAD83 CSRS UTM Zone 20N
Job No.: TV61029

Figure 8.1-1
KELTIC PETROCHEMICALS INC.
Location of Other Projects in Relation to the Keltic Development Project and the CSR Project
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Regional Oil and Gas and Related Developments

Other planned or reasonably foreseeable future projects related to oil and gas development that, together with the proposed Project, may cause cumulative effects include:

- EnCana Corporation's Deep Panuke project; and
- M&NP pipeline expansion.

Oil and gas exploration and development in Nova Scotia, in particular the offshore, has slowed in recent years with significantly less exploration related activities occurring or anticipated to occur in the near future as indicated by the decrease in EAs under consideration by the Canada Nova Scotia Offshore Petroleum Board (Table 8.1-2).

TABLE 8.1-2 Number of Environmental Assessments (EAs) Considered by the Canada Nova Scotia Offshore Petroleum Board, 2001-2005

Activity	Seismic Surveys	Other Geophysical Surveys	Drilling Programs	Totals[1]
2004-2005	2	3	1	7
2003-2004	13	4	10	29
2002-2003	7	4	8	21
2001-2002	8	7	2	18

Totals include a small number of Strategic EAs and other studies

The one exception to this trend is EnCana Corporation's Deep Panuke project which has entered the Development Plan approval stage. This Project is addressed in the CEA. Key concerns for potential cumulative effects relate to effects on the marine environment, navigation, and air quality.

In addition to the Keltic proposal, one other LNG project is currently under consideration outside the CEA boundary at Bear Head, Nova Scotia. This Project has received an initial Permit to Construct from the NSUARB but is currently on hold.

Potential for additional gas delivery via offshore Nova Scotia or LNG sources may require the expansion of the M&NP pipeline capacity through additional compression or looping of the current pipeline. The expansion is contingent on the amount of gas that will be delivered by Deep Panuke and the KDP as well as the gas generated from ExxonMobil's Sable project. Expansion by compression will occur outside the CEA boundary.

In addition to the further development of offshore natural gas resources and the importation of LNG, Nova Scotia has experienced an increase in exploration for onshore natural gas; however, none of these activities are within the spatial boundaries of this assessment.

Road Upgrades and Realignments

The only road project that may cause cumulative effects together with the proposed Project is the realignment of Route 316. Key issues for consideration include habitat fragmentation and potential adverse effects on fish and habitat as a result of stream crossings and potential discharges to surface water environments.

Other Keltic Project Components

Other Keltic Project components relevant for the CEA are:

- petrochemical plant;
- co-generation plant; and
- impoundment of Meadow Lake.

The three components are described in detail in the provincial EA Report (AMEC, 2006). Key issues relevant for the CEA are related to climate conditions (contributions to GHG emissions) water quality (fresh and salt water), air emissions, loss, and impairment of terrestrial habitat and wetlands and changes in lighting conditions.

8.1.1.5 Potential Effects of Other Projects and Activities

The key potential effects associated with other projects and activities, having the potential to affect VECs, include:

- loss/alteration of fish and fish habitat;
- loss of habitat and behavioural changes for the roseate tern;
- loss/alteration of aquatic habitat;
- loss/fragmentation of habitat;
- loss of tourism resulting from development; and
- loss of income for fishermen from reduction in fish stocks.

8.1.1.6 Summary of VECs Interacting with Other Projects

Subsequent sections discuss potential cumulative effects on each VEC. Potentially affected VECs include: aquatic, atmospheric, terrestrial, and various socio-economic environment components. Aquatic interactions occur primarily through water quality effects of storm or process discharges within the local watershed. Air quality interactions occur through contribution of emissions to local or regional air quality issues including GHGs. Socio-economic interactions typically occur through resource interactions or disturbance. In the initial scoping of the potential for cumulative interaction with a given VEC, the following criteria were applied:

- a measurable environmental effect within the Study Area related to the Keltic Project component and reasonably foreseeable Project components was identified as acting on the VEC; and
- the environmental effect in question is demonstrated to act cumulatively.

Potential cumulative interactions between Projects and VECs and relative timing of Projects are identified in Table 8.1-3 and Table 8.1-4 respectively.

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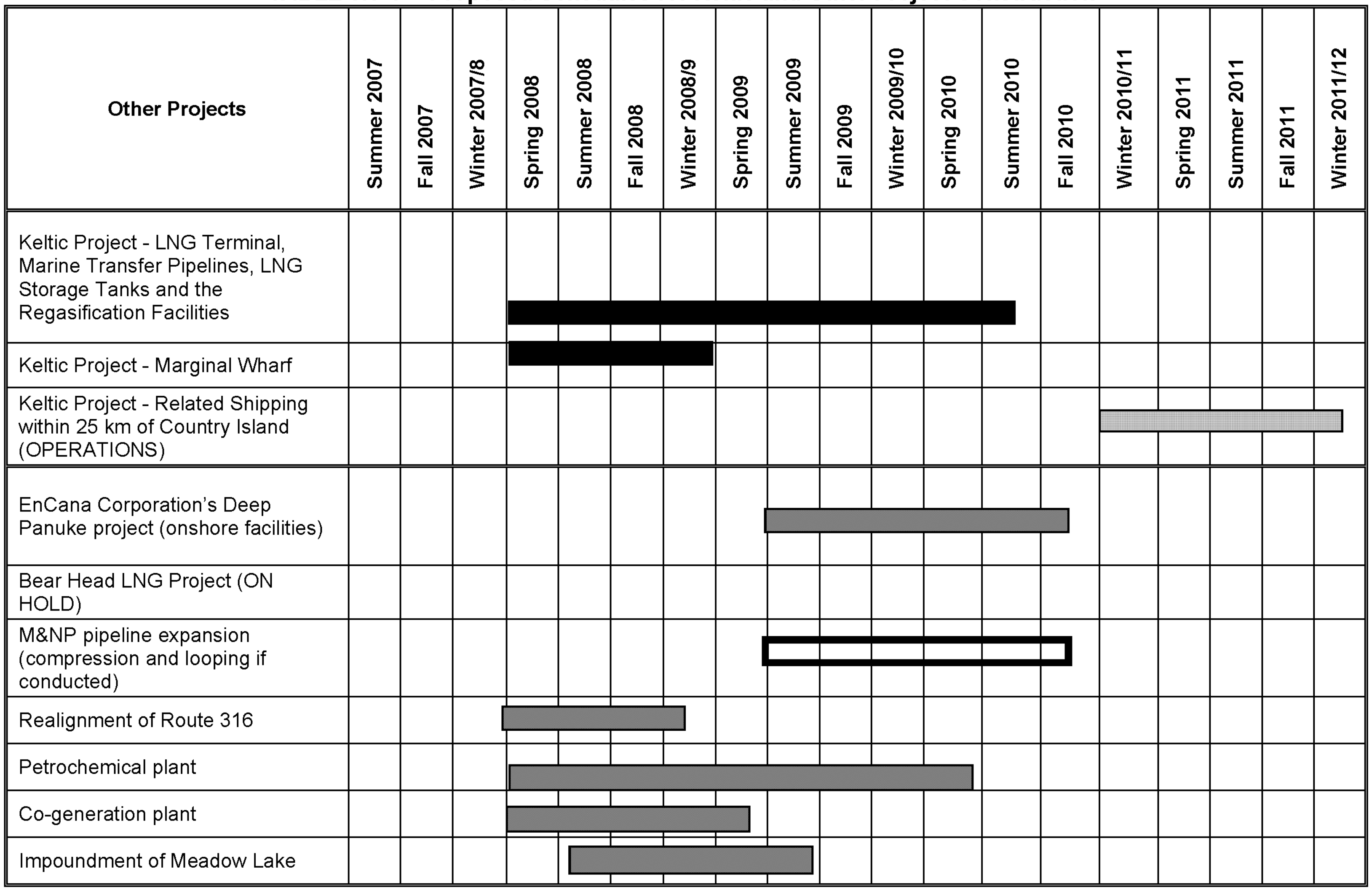
TABLE 8.1-3 VEC Pathway Interaction Matrix

Other Projects/ activities Considered	VECs																					
	Hydrology/ Freshwater Quality/Quantity	Groundwater Quality/Quantity	Marine Water Quality	Soil/Sediment Quality	Air Quality	Climate Condition	Vegetation	Species at Risk	Fish & Marine Habitat	Marine Mammals	Wildlife	Migratory Birds	Wetlands	Lighting Conditions	Atmospheric and Acoustic Environment	Traditional Use	Heritage and Archaeological Sites	Navigation	Marine and Human H&S	Fisheries	Aquaculture	Tourism
Keltic Petrochemical Plant, Co-generation Facility, Meadow Lake Impoundment, Road	F	F	FW	FWS	F	F	X	FWS	FWS	FWS	F	FWS	F	FW	X	X	FW	FW	F	FWS	FWS	FW
Other Regional Oil and Gas development	F	X	FW	FWS	F	F	X	FWS	FWS	FWS	F	FWS	F	FW	FWS	X	FW	FWS	FS	FWS	FWS	FW

Notes: F = LNG Facilities, W - Marginal Wharf, S - Shipping = Potentially significant cumulative effects likely.
X = Potentially significant cumulative effects not likely (i.e., interaction screened from further investigation) LNG Terminal, Marine Transfer Pipelines, LNG Storage Tanks and the Regasification Facilities

TABLE 8.1-4 Proposed Schedules for Keltic and Other Project Construction*



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8.2 LNG MARINE TERRMINAL, MARINE TRANSFER PIPELINES, LNG STORAGE TANKS, AND THE REGASIFICATION FACILITY

8.2.1 Assessment

8.2.1.1 Hydrology

Potential cumulative effects to surface, freshwater, groundwater, and marine water quality are addressed in Sections below.

8.2.1.2 Freshwater Quality/Quantity

The principal interaction between the Project activities and surface waters (of Betty's Cove Brook and Unnamed Tributary to Dung Cove) is associated with land disturbance during construction and commissioning of the Project. The three principal types of water discharge expected at the site during construction are:

- clean and possibly sediment-laden storm-water;
- construction wastewater (hydrostatic test waters, concrete wash water, storm-water that has been in contact with uncured concrete); and
- sanitary waste water (worker sites and field offices).

During construction, TSS concentrations in storm-water, residual hydrocarbons, and/or metals in hydrostatic test waters, or the concentration of lime in concrete production wastewaters, could exceed the water quality guidelines for the protection of aquatic life published by the CCME (1999).

The principal interactions between the Project activities and surface waters during the operation phase of the Project are associated with wastewater and storm-water discharges. The largest discharge component by volume is expected to be storm-water.

The principal types of water discharge expected during operations for the component of the Project include:

- potentially oily storm-water from some process complexes (paved or hard surfaces), process water, cooling water blow down;
- clean storm-water from some process complexes and general areas, either paved (hard surface) and unpaved (soft surface); and
- domestic-type or sanitary waste water (some from process complexes and some from common-user utilities).

With the mitigation measures outlined in Section 5.1.2, effects on water quality during construction are anticipated to be minor (not significant) based on the small magnitude and infrequency of large runoff flows. Any effect will be temporary and reversible. During operation, mitigation measures will be used to attenuate peak flows to watercourses and maintain base flows in watercourses. Proper modeling and design of the storm-water management system will ensure maintenance of flows in watercourses. Any residual effect is minor (not significant), temporary and reversible.

The Project construction overlaps with the foreseen construction schedules with the Deep Panuke on-shore facilities, possibly the M&NP pipeline expansion, and the Keltic Petrochemical plant and co-generation plant (Table 8.1-2), all which will have similar construction issues that could potentially affect water quality in Betty's Cove or the Unnamed Tributary to Dung Cove. The realignment of Route 316 and the Meadow Lake Impoundment are not located within the same sub-watershed as the facility and thus do not act cumulatively on freshwater VECs.

With respect to water quality, the Keltic facilities not covered in this CSR will implement similar mitigation measures during construction. It is also expected that other projects implement similar mitigation measures during construction, including adherence to the "Erosion and Sedimentation Control Handbook for Construction Sites" (Nova Scotia Department of the Environment, 1988). The offset staging of construction periods for identified projects will also reduce construction period effects. As such, the cumulative effect on water quality in Betty's Cove and the Unnamed Tributary to Dung Cove is anticipated to be minor, short-term, and reversible.

Although the footprint of the Project is relatively small, it will result in an increase in impervious cover, which will reduce the amount of recharge area, which can cause drier conditions and longer dry periods between flow events in streams. The net effect is a possible increase in stream erosion and channel straightening over time, accompanied by reduced water and aquatic habitat quality. The Project will mitigate this effect by maintaining as much vegetation as possible in the stream-bed and through the design of the storm-water facility.

Construction of other Keltic facilities and the Deep Panuke on-shore facilities, which is expected to modify drainage within over 50% of the watershed, will also alter the flow regime, in particular within Betty's Cove Brook. However, with a similar commitement to proper storm-water design and maintaining riparian vegetation, the cummulative effect on water quantity is anticiapted to be minimal, long-term, and reversible, and to comply with regulatory requirements.

Monitoring for the operation phase of the Project will consist of annual qualitative/quantitative sampling of the benthic-invertebrate community at one station on both Betty's Brook and the unnamed tributary to Dung Cove during post construction years 1, 2, 3, and 5, and every 5 years thereafter. Annual reports based on survey results (ephemeroptera/ plecoptera/ trichoptera index, taxon dominance, density, species diversity, hilsenhoff biotic index, etc.) will be prepared and the results compared with previous years. This monitoring will ensure that significant cumulative effects on water quality and quantity are not of a magnitude to effect aquatic habitat.

Table 8.2-1 summarizes the cumulative effects discussed for freshwater quality/quantity.

TABLE 8.2-1 Cumulative Summary – Freshwater

Cumulative Project – Environment Interaction	Residual Project Impact with Mitigation (Section 5.0)	Mitigating Factor	Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility	Significance**	Likelihood of Significant Cumulative Occurrence***	Level of Confirdence***
Operational storm-water discharges in combination with other discharges from other project s in fresh-watershed	Minor	Storm-water discharges within the watershed from other Keltic Project components and other oil and gas projects are designed to meet regulatory limits.	Low	Betty's Cove Brook watershed	Storm events	R	Not significant		

*For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** For definition of levels of significance (major, medium, minor, minimal) refer to Section 2.5
*** Only addressed for significant effects

8.2.1.3 Groundwater Quality/Quantity

The issues regarding the quality and quantity of groundwater are the effects that the plant construction and operation may have on water supply wells, and the effects that changes to the groundwater regime may have on surface water bodies, streams, and wetlands adjacent to the Project.

The field reconnaissance indicates that there are approximately 40 wells located within 1 km of the site boundaries of the Keltic Development Proposal. There are also two streams within the site boundaries (Betty's Cove Brook and the unnamed tributary to Dung Cove) which may have groundwater supplies interrupted by excavation associated with site preparation and construction.

Based on the projected gravitational groundwater flow lines shown in Figure 4.1-6, possible surface water receptors include Betty's Cove Brook, and associated wetlands, the unnamed tributary to Dung Cove, Dung Cove, and Stormont Bay. Possible receptor wells, depending upon the final site configuration, are likely to include wells west of the site within a zone that extends along Highway 316 between Webbs Cove and Dung Cove, the degree and significance of which would depend on the exact locations and nature of the source, well type, nature of the surficial and bedrock geology present between the source and the well, and distance to the well. Depending upon facilities locations, other wells north of this zone could, to a lesser degree, also become receptors.

The severity of the water supply well impacts are expected to be a function of well type (spring, dug well, drilled well), age of the well, well construction method, distance from the site boundaries, overburden thickness, and the hydraulic properties of the soil and bedrock.

With respect to groundwater quantity, the main concerns related to plant site construction are:

- potential loss of well yield or lowered water level in dug wells (this is not expected to be significant due to the relative distance and small number of wells involved);

- possible damage to, or loss of drilled wells during blasting operations; and
- possible reduction in base flow at on-site streams and reduced (or increased) discharge at wetlands.

With respect to groundwater quality, the main concerns related to plant site construction are:

- chemistry changes in down-gradient wells due to uncontrolled runoff;
- temporary siltation of dug wells during heavy equipment operations; and
- accidental release of hazardous materials up-gradient of wells or streams.

Although similar concerns exist for any construction activity, including other Keltic facilities, the Deep Panuke Project, and the M&NP pipeline expansion, with proper site grading, improvements as required to affected wells, as outlined in Section 5.1.3.2., and the implementation of the Emergency Management Plan, cumulative effects on groundwater and secondary effects such as effects on wells, are anticipated to be minimal.

As construction work progresses, follow-up well sampling will be done, as required, to adequately assess general groundwater and specific well water supply quality. No follow-up is required for the operations phase.

Table 8.2-2 summarizes the cumulative effects discussed for Groundwater.

TABLE 8.2-2 Cumulative Summary – Groundwater

Cumulative Project – Environment Interaction	Residual Project Impact with Mitigation (Section 5.0)	Mitigating Factor	Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility	Significance**	Likelihood of Significant Cumulative Occurrence***	Level of Confirdence***
Project affects on local wells or surface water/wetlands	Minor	Wells are typically downgradient and will be monitored during construction	Low	Local ground watershed	project	R	Not significant		

*For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** For definition of levels of significance (major, medium, minor, minimal) refer to Section 2.5
*** Only addressed for significant effects

8.2.1.4 Marine Water Quality

Storm and process water discharges from the regasification plant, terminal, and LNG Storage tanks (including hydrostatic test water) as well as portions of the co-generation facility, Petrochemical plant, and proposed Deep Panuke Facilities may contribute contaminants to the nearshore marine environment either directly or indirectly. Storm-water is dealt with separately in Section 8.2.1.2 and is anticipated to have a minimal significant effect.

At maximum capacity (18 billion m^3/year) the LNG facility will discharge approximately 490,000 m^3/year consisting of purge water from SCVs and cooling water from the BOG compressor. Discharges of purge and cooling water to the marine environment may introduce contaminants to the marine environment and cause thermal pollution in the vicinity of the discharge point. Only other potential sources for effects on the marine water from the LNG facility may result from accidental spills of contaminated material. Potential effects from accidental events and malfunctions are described in Section 10.0.

Significant cumulative impacts from construction activities are not expected to occur due to effective mitigation measures, and effects that are short term in nature, reversible and involving relatively small volumes from the various projects at one time within the watershed.

Coastal and marine development such as the Deep Panuke pipeline may also affect marine water quality in the same general area through addition of contaminants on a chronic or acute basis. Construction of other projects in the immediate vicinity is not expected to occur concurrently and is not considered cumulative. In addition, ongoing contributions of contaminants are anticipated in the general marine area due to runoff from historical mining areas. While not quantified, mining contributions are expected to be minor due to the limited area of impact. Contaminants may also be released into the marine environment on an ongoing basis from the historical deposition of mine tailings or other contaminants in sediment. Cumulative sources of marine water contaminants to the general marine area are limited in extent, have low concentrations, are not known to include substances that bioaccumulate, and are not expected to result in significant cumulative effects. Table 8.2-3 summarizes the cumulative effects discussed for marine water quality.

To ensure the adequacy of the mitigation measures and the proper functioning of the process water treatment, monitoring of effluent quality (including temperature) and quantity at the point of discharge will be conducted. Details of the program will be established in consultation with the provincial regulator during the permitting stage and detailed design.

8.2.1.5 Soil/Sediment Quality (terrestrial and marine)

Sediment quality in the adjacent watercourses (fresh and marine) can be affected by addition of storm-water/process water from the Project facilities and other Keltic components, and the proposed Deep Panuke facilities as noted above for water quality. As no significant water quality cumulative effects are anticipated, sediment effects are unlikely. Marine sediment sampling in the wharf and terminal area found no indications of existing contaminants. Other potential sources of contaminants in the general area are small as development is limited. Although existing contaminants were found (arsenic, mercury) in Isaac's Harbour, neither of these metal are components of the Project and cumulative impacts are not anticipated.

It is of note that in compliance with EA approval conditions (Item 1.5) established by NSEL (NSEL, Environmental Assessment Approval. March 14, 2007 - http://www.gov.ns.ca/enla/ea/kelticpetro/KelticPetro_Conditions.pdf), Keltic will generate a plan to mitigate human health and environmental impacts of contaminated mine tailings and/or soils

TABLE 8.2-3 Cumulative Summary – Marine Water Quality

Cumulative Project – Environment Interaction	Residual Project Impact with Mitigation (Section 5.0)	Mitigating Factor	Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility	Significance**	Likelihood of Significant Cumulative Occurrence***	Level of Confirdence***
Operational storm and process water discharges in combination with similar discharges from other projects to same general marine area	Minimal	• All process and storm-water discharges from other Keltic Project components and oil and gas projects to the immediate marine watershed are designed to meet regulatory limits. • Low concentrations of contaminants in existing environment; not bioaccumulating substances in either.	Low	Local to the mixing zone adjecent the Study Area	Storm or mixing events	R	Not significant		

*For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** For definition of levels of significance (major, medium, minor, minimal) refer to Section 2.5
*** Only addressed for significant effects

and sediments on the Project Site, via remediation or risk management. This will be consistent with the Nova Scotia Guidelines for the Management of Contaminated Sites. The Remediation Action Plan and /or Risk Management Plan will be approved by NSEL prior to commencement of construction. Upon completion of the remediation or risk management work, Keltic will submit a certificate of Compliance to NSEL to demonstrate that the work has been completed and/or the Risk Management is effective.

In accordance with Item 2.10 in the NSEL EA approval conditions, a plan will be developed and implemented to monitor environmental effects for all relevant chemical and biological parameters that are expected to enter the environment or be remobilized as a result of Project activities in all receiving environments, including those which may impact human health and/or organisms (NSEL, 2007).

Mitigation for accidental spills and malfunctions is presented in Section 10.0. Table 8.2-4 provides a summary.

8.2.1.6 Air Quality

Construction types of air emissions of the Keltic Project and any of the identified other planned and future projects will occur over a relatively brief period of time, will have only very localized and reversible impacts, and are not expected to act cumulatively. Typically, in rural settings, air emissions, in particular dust, are not monitored during construction. If concerns are expressed on site related to occupational health and safety, portable PM_{10} monitors may be used for real time measurements of PM by field inspectors. If concerns are expressed regarding dust levels off-site, Keltic may elect to employ high-volume samplers to determine particulate levels at specific receptors.

TABLE 8.2-4 Cumulative Summary – Soil/Sediment Quality

Cumulative Project – Environment Interaction	Residual Project Impact with Mitigation (Section 5.0)	Mitigating Factor	Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility	Significance**	Likelihood of Significant Cumulative Occurrence***	Level of Confirdence***
Operational storm and process water discharges in combination with similar discharges from other projects to the landscape or downstream receiving waters	Minimal	• All process and storm-water discharges from other Keltic Project components and oil and gas projects to the immediate marine watershed are designed to meet regulatory limits. • Low concentrations of contaminants in existing environment; not bioaccumulating substances in either.	Low	Local to the mixing zone adjecent the Study Area	Storm or mixing events	R	Not significant		

*For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** For definition of levels of significance (major, medium, minor, minimal) refer to Section 2.5
*** Only addressed for significant effects

During facility operation, effective emission control measures will be employed at all identified Keltic emissions sources and will ensure that concentrations of air emissions remain within applicable government standards and guidelines. Cumulative effects may occur with emissions from the SOEI gas plant and metering station, other Keltic components, local traffic, regional transport of air pollutants, and the proposed Deep Panuke Facilities. However, the site is rural, traffic in the area is low, and cumulative effects of air emissions are expected to be not significant at off-site locations. Air quality modelling conducted for this Project included SOEI emissions to verify Nova Scotia Air Quality Regulations and CEPA Ambient Air Quality Objectives would be met. Modelling confirmed a negligible contribution to regional emissions of ozone, with the precursors to ozone, NO_x and VOCs, representing 2.8% and 0.5% of the provincial totals.

It is anticipated that Project's air emissions from its operations, including all components (LNG delivery and natural gas send-out, co-generation, petrochemical operations and feed/product shipping), will not result in exceedances of the provincial and CCME ambient air quality objectives/regulations. This will be confirmed through monitoring programs described in the following section. Air emissions from the LNG facility will mainly concern NO_x, CO, and C_xC_y (unburned hydrocarbons) caused by flue gas combustion in the submerged combustion vaporizers. To suppress the NO_x emissions, the submerged combustion vaporizers will be fitted with low NO_x burners. As process design progresses, the Proponent will take all practical measures to further reduce the air emissions discussed above, including both energy efficiency measures and improvement in emission-control technologies.

As outlined in the NSEL Terms and Conditions for Environmental Approval, under Condition 2.3, a project air monitoring program will be developed. Based upon the results of the air monitoring program, necessary modifications to mitigation plans and/or operations will be implemented to prevent unacceptable environmental effects. The locations of the air monitoring stations for the air monitoring program will be based on the location of sensitive receptors, air dispersion modelling results, and meteorological data.

The other main contributor to potential air quality effects is the SOEI gas plant. Total contributions to air quality indicators including NO_2, SO_2, TSP, $PM_{2.5}$, CO and Ozone were modelled and results presented in Section 5.1.6. The results indicate that total emissions for the two projects collectively comply with provincial air quality guidelines.

In summary, the increase in localized industrial development will result in a cumulative increase in air emissions. However, it is anticipated that these cumulative air quality emissions will comply with provincial and CCME ambient air quality objectives/regulations. In the event of exceedances, additional mitigation measures will be implemented as required, possibly including energy saving measures and improvement in emission control technologies. This will ensure that the cumulative effect on air quality is minor.

Table 8.2-5 summarizes the cumulative effects discussed for air quality.

TABLE 8.2-5 Cumulative Summary – Air Quality

Cumulative Project – Environment Interaction	Residual Project Impact with Mitigation (Section 5.0)	Mitigating Factor	Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility	Significance**	Likelihood of Significant Cumulative Occurrence***	Level of Confirdence***
Operational air emissions in combination with other projects with similar emissions to same airshed	Minor	• All oil and gas project emissions within the immediate airshed are designed to meet regulatory limits. • Contribution to regional emissions of ozone neglible.	Low	Very Local	Frequent	R	Not significant		

*For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** For definition of levels of significance (major, medium, minor, minimal) refer to Section 2.5
*** Only addressed for significant effects

8.2.1.7 Climate Conditions

Greenhouses gases are an increasingly important issue and an important consideration for how power is to be generated in Nova Scotia. The Keltic facilities main contributor to GHG will be the 200 MW co-generation plant however, regasification of LNG is also a source. The release of CO_2 will be greatly minimized when compared to the alternative of taking power off the NSPI grid. Typically, one would expect CO_{2eq} to be approximately 1,000,000 t/year from the 200 MW co-generation facility, whereas the equivalent from a utility coal-fired plant would be in the order of 1,700,000 t/year (not including allowances for transmission losses). This is due to both the inherent advantages of using natural gas as compared to coal and Bunker C, the avoidance of transmission losses, as well as the energy efficiencies gained from a combined cycle facility. The annual release of some 270 t of VOCs will also contribute to GHGs; however, until specific compound speciation is known, i.e. between methane and non-methane VOCs, the actual CO_{2eq} cannot be appropriately estimated. These figures can be set in the context of Nova Scotia's total annual emissions of approximately 23,000,000 t of CO_{2eq} per year (EC, 2004).

Keltic will implement energy-efficiency measures throughout its facilities including the use of low pressure fuel or waste heat. The Proponent will also take steps to promote energy savings by its employees on both an individual and collective basis, including the potential of car pooling for those commuting to the workplace. Further planning and implementation of measures related to climate change issues will be described in Keltic's Sustainable Development Plan required under Condition 1.1 of the NSEL Conditions of Approval and as the Federal and Provincial Governments move forward with policy/legislative guidance.

Larger potential sources for GHG occur in other future projects, such as the proposed Deep Panuke Facilities (primarily offshore) and include activities such as flaring, venting, shipping and construction/ maintenance, which would result in a cumulative increase in GHG. The Environmental Assessment Report for the Deep Panuke Project concluded that its GHG emissions represent only 0.7% of Nova Scotia's total GHG emissions (EnCana Corporation, 2006).

As such, due to mitigation efforts of all projects considered in this CEA to reduce GHG emissions and their contribution to Nova Scotia's total contribution, the cumulative effect on global warming is anticipated to be minor.

Table 8.2-6 summarizes the cumulative effects discussed in the above section.

TABLE 8.2-6 Cumulative Summary – GHG

Cumulative Project – Environment Interaction	Residual Project Impact with Mitigation (Section 5.0)	Mitigating Factor	Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility	Significance**	Likelihood of Significant Cumulative Occurrence***	Level of Confirdence***
Operational air emissions of GHG in combination with other Keltic Project components and other future projects with similar emissions regionally / nationally	Minor	• Energy-efficient measure minimizing GHG. • Contribution to total of regional GHG neglible.	Low	National	Frequent	No	Not significant		

*For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** For definition of levels of significance (major, medium, minor, minimal) refer to Section 2.5
*** Only addressed for significant effects

8.2.1.8 Vegetation (terrestrial and marine)

Potential impacts to terrestrial vegetation will result from the loss of land required to construct the Keltic facilities, Deep Panuke (on shore), and the M&NP expansion. Construction of the components of the Keltic Project covered in this CSR will result in the removal of 149 ha of local forest. Given the type of vegetation involved (mostly clear-cut brush and barrens, old agricultural fields, and some conifer stands), and the presence of large tracts of land adjacent to the Project Site, no significant residual effects on vegetation are likely to occur during construction. There are no terrestrial plant species of special status within the LNG Facility Area.

Construction of other Keltic facilities, Deep Panuke on-shore facilities, the SOEI gas plant, and possibly the M&NP pipeline expansion, will result in a local cumulative effect on vegetation, however, given the remote nature of the site and the amount of undisturbed surrounding vegetation of greater ecological value (i.e. not clear-cut brush and old agricultural fields), the regional cumulative effect on terrestrial vegetation is anticipated to be minor to minimal.

In compliance with NSEL EA approval conditions (Item 2.7) (NSEL, 2007), the Proponent will also implement a wildlife and vegetation monitoring plan during Project realization. This plan will provide details on effects levels and the effectiveness of vegetation rehabilitation, where applicable.

Potential impacts to marine vegetation could occur through surface water or sediment contaminants, although this is unlikely to be a significant pathway. Cumulative effects were not noted for these pathways and thus are not anticipated for marine vegetation.

8.2.1.9 Species at Risk

Potential species at risk identified for the general Facility site include Boreal Felt Lichen (not confirmed or likely at the property given lack of mature forest habitat), Wood turtle (not confirmed for area but if present could use terrestrial habitat in general area), Short-eared Owl (observed for wetlands along Betty's Cove Brook), Terns (foraging in general area) and moose (known for general area but no evidence observed on site). As well, habitat for Gaspé shrew and long-tailed shrew was identified although these species are not known in area. Bats are expected to feed in the general area of the Project. Semi-palmated plover migrate along shore. Four-toed salamander may occur in wetlands and Atlantic salmon historically occurred in the general area.

Given available habitat/populations are limited, there is potential for significant cumulative effects if losses/impact occurred with the Project. However, the facility site has not been identified as important habitat for species at risk based on field investigations undertaken to date and therefore, the impact assessment does not identify impacts to species at risk or their habitats in the construction / operation of the LNG Facility.

There is potential for combined impacts from the M&NP and Encana Deep Panuke projects which, as currently proposed, could impact foraging terns through disturbance, spills, and habitat loss. The Proponent has committed to the development and implementation of an Adaptive Management Plan (AMP), consisting of various elements. To address concerns with potential cumulative impacts to foraging Roseate Terns in Country Harbour, it is expected that the AMP will include coordination with EnCana and other stakeholders to monitor and manage potential cumulative effects on the Roseate Tern.

Additional field surveys for species at risk are planned for all Project components prior to Project implementation. It is anticipated, that, if any such species is identified at or near the site, appropriate mitigation measures will be developed and implemented in consultation with the relevant provincial and federal agencies. The Project therefore, is not expected to cause significant adverse effects on species at risk.

The future road alignment is not expected to cause adverse effects on Species at Risk due to the limited geographic extent of the undertaking, existing disturbances related to forestry and the SOEI gas plant. The on-shore portion of the proposed Deep Panuke project is not expected to interact with Species at Risk as it will be largely associated with existing facilities. Table 8.2-7 provides a summary for at risk species (excluding migratory birds).

Potential interactions with species at risk migratory birds are discussed separately below.

TABLE 8.2-7 Cumulative Summary – Species at Risk

Cumulative Project – Environment Interaction	Residual Project Impact with Mitigation (Section 5.0)	Mitigating Factor	Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility	Significance**	Likelihood of Significant Cumulative Occurrence***	Level of Confirdence***
Loss of habitat or species	Minimal	• Additional field surveys. • Potential for at risk species low. • Development of mitigation and compliance with recovery plans.	Low	Depending on species regional to national	Variable	R or Not depending on species	Not significant		

*For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** For definition of levels of significance (major, medium, minor, minimal) refer to Section 2.5
*** Only addressed for significant effects

8.2.1.10 Fish and Fish Habitat (Marine and Freshwater)

Potential for cumulative effects to fish and fish habitat related to the proposed Keltic facilities and other future projects could occur through surface water quality pathways (cumulative storm/process water discharges) within the Betty's Cove Brook watershed and directly or indirectly to the adjacent marine environment. Another potential for cumulative effects relates to the potential physical interference of fish migration routes by one or more of the proposed developments. Impacts to water quality are not expected to be significant (see Sections 8.2.1.2 and 8.2.1.4).

Fish migration to Isaac's Harbour is not expected to be restricted by the presence of the proposed Keltic LNG Terminal, Marginal Wharf or any of the Deep Panuke project components. The Meadow Lake impoundment will be designed to maintain fish passage. Consequently, cumulative effects to fish and fish habitat are not expected to be significant.

Habitat loss associated with pond infilling will be addressed through habitat compensation and cumulative effects are not anticipated. Fish habitat lost as a result of the construction, operation, and decommissioning phases of the Project construction of marine facilities will not result in a significant impact on fish resources in the area. None of the habitat lost is in anyway unique to the Bay, nor does it provide a critical function to the ecosystem. The loss of production of lobster, and other fish species, would be dwarfed by local variations in environmental factors such as water temperature and larval drift into the area. Provided the proposed mitigative measures are implemented as suggested, no significant adverse residual environmental effects on fish and fish habitat are likely to occur. The potential exists for the Deep Panuke project to also affect marine water quality in the Bay by temporarily increased localized SPM during pipe laying, and through the release of hydrostatic testing water.

However, given the localized nature of the increase in SPM, and EnCana Corporation's commitment to Screen chemicals through Offshore Chemical Selection Guidelines (OCSG) and to conduct bioassay tests and plume dispersion modelling in consultation with EC to minimize potential environmental effects, cumulative marine water quality effects are anticipated to be minimal. Table 8.2-8 below summarizes the cumulative effects discussed for fish and fish habitat.

TABLE 8.2-8 Cumulative Summary – Fish/Habitat

Cumulative Project – Environment Interaction	Residual Project Impact with Mitigation (Section 5.0)	Mitigating Factor	Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility	Significance**	Likelihood of Significant Cumulative Occurrence***	Level of Confirdence***
Operational storm and process water discharges in combination with other Keltic Project components and other future project s with similar discharges to same general marine area affecting habitat quality	Minimal	• Water quality impacts are minimal.	Low	Betty's Cove Brook watershed and local marine environment	Frequent	R	Not significant		
Fish access to Isaac's Harbour and other migratory patterns could be disrupted by terminal and other existing/ proposed marine facilities in the area	Minimal	• The majority of the access to the harbour is still available.	Low	Local terminal area	Constant	Yes	Not significant		

*For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** For definition of levels of significance (major, medium, minor, minimal) refer to Section 2.5
*** Only addressed for significant effects

Construction of other facilities such as the other Keltic facilities could impact marine water through sediment loading and storm-water discharge effects, with the pathway being Betty's Cove Brook and the unnamed tributary to Dung Cove. However, provided the proposed mitigative measures are implemented as suggested, the effects on water courses due to erosion, sediment loading, and storm-water discharges will be low in magnitude and reversible. Therefore, no significant adverse residual environmental effects on fish and fish habitat are likely to occur.

Compensation (if required) will be offered for HADD of fish habitat for the construction of the LNG Terminal and jetty to compensate for loss of habitat and for potential disruption of fishery. DFO will require replacement of the area of fish habitat lost with habitat of similar or higher type and quality.

It is of note that the Proponent will also undertake further baseline work and effects predictions relevant to fish and fish habitat (both freshwater and marine). In compliance with the NSEL EA approval conditions (Item 1.10) the work will entail baseline data collection for all relevant chemical parameters which are expected to enter the environment or be remobilized as a result of Project activities in all receiving environments (including freshwater and marine environments). Baseline data and information will then be used by the Proponent to predict the assimilative capacity of all receiving environments and assessments of potential effects and/or risks on human health and organisms (including freshwater and marine biota).

8.2.1.11 Marine Mammals

Marine mammal (whales and seals, excluding at risk species - see at risk section) use of the general area is occasional (feeding or haul out). Potential for cumulative effects to marine mammals through cumulative effects from the future projects could occur through surface water quality pathways (cumulative storm/process water discharges) within the adjacent marine environment or physical interference. Potential cumulative impacts to water quality/habitat or physical interference of marine mammals are not expected to be significant (see Sections 8.2.1.2 and 8.2.1.4). Given the large size of Stormont Bay, the proposed Keltic LNG Terminal, marginal wharf and Deep Panuke near-shore pipeline and landfall structures are not expected to limit the movement of marine mammals.

Construction-related adverse effects on marine mammals are also possible. The National Marine Fisheries Service (NMFS) has suggested that sound pressure levels that exceed 190 dB re 1 µPa may cause threshold shifts or temporary hearing impairments in marine mammals. Research on marine mammals shows that under certain circumstances underwater noise can cause a variety of effects. This includes behaviour modifications, tissue rupturing or haemorrhaging at close range to the acoustic source, and temporary or permanent hearing loss. In addition new noise sources can mask other sounds important to survival, such as those made by calves, mates, or predators (Richardson et. al., 1995).

During the operation of the Project, vessel traffic is expected to increase. 83% of the underwater acoustic field surrounding large vessels is the result of propeller cavitation (Southall, 2005). Noise from vessels may contribute to masking of sounds important to the survival of mammals. However, marine mammals have been known to adapt to masking sounds by changing the intensity and frequency of their vocalizations. Little underwater acoustic energy is transmitted into the water from on-board machinery or movement of the vessel through the water.

Construction of the Deep Panuke Project, in particular laying of pipelines and pile driving, will also contribute to underwater noise. However, this effect will be temporary and noise during operation will be significantly reduced.

Given the low importance of the marine environment at the Project Site for marine mammals, and with the implementation of the proposed mitigative measures identified in Section 5.1.11, cumulative effects on marine mammals are anticipated to be temporary, reversible, and of minimal significance.

Table 8.2-9 below summarizes the cumulative effects discussed for marine mammals.

TABLE 8.2-9 Cumulative Summary – Marine Mammals

Cumulative Project – Environment Interaction	Residual Project Impact with Mitigation (Section 5.0)	Mitigating Factor	Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility	Significance**	Likelihood of Significant Cumulative Occurrence***	Level of Confirdence***
Operational storm and process water discharges in combination with other projects with similar discharges to same general marine area affecting habitat quality	Minimal	• Water quality impacts are minimal.	Low	Local marine environment	Frequent	R	Not significant		
Marine mammal movement in the area could be disrupted by terminal and other existing/ proposed marine facilities in the area	Minimal	• The majority of the access to the harbour is still available. • Not likely to affect populations.	Low	Local terminal area	Constant	Yes	Not significant		

*For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** For definition of levels of significance (major, medium, minor, minimal) refer to Section 2.5
*** Only addressed for significant effects

8.2.1.12 Wildlife and Wildlife Habitat

Potential impacts of the Project to wildlife and wildlife habitat are not significant. Deer wintering areas (which will be lost) were only noted in the vicinity of the LNG storage tanks. Although other wildlife habitat loss will also occur with other regional development, known projects are not expected to significantly reduce available habitat in the region and cumulative effects are not anticipated.

8.2.1.13 Migratory Birds and Migratory Birds Habitat

Birds and their habitat may be affected during construction through loss of nesting habitat either directly or through disturbance including noise or habitat fragmentation, by mortality associated with strikes related to lighting of structures, interference with feeding areas along the coast and inland, food chain contaminants or oiling impacts from accidental releases. As with general wildlife habitat, the foreseeable future developments in the region will not significantly reduce available bird nesting and foraging habitat. The majority of the development is within an area surrounding the Keltic and SOEI complex and the proposed Deep Panuke facilities including associated easements /transmission lines, flares and the Meadow Lake impoundment. This concentrates the disturbance to one location and combines easements where possible. This limits the extent of the potential effect, but may increase the duration and intensity, particularly for potential light attraction and collision risk.

It is of note that the Proponent will generate a lighting plan, which will incorporate a program to monitor impacts to birds. This work will be undertaken by the Proponent in compliance with Item 1.6 of the NSEL EA approval conditions (NSEL, 2007). In accordance with the NSEL conditions, the plan must be submitted to NSDNR, CWS, and TC for review and approval. Based on the results of the monitoring programs, the Proponent must make necessary modifications to the mitigation plans and/or operations to prevent any unacceptable environmental effects, to the satisfaction of NSEL, based on consultation with NSDNR and CWS.

Keltic will work with CWS to implement mitigation (as outlined in Section 5.0, such as EC's recommendations for Interactions with Lights and Flares and Storm-Petrel stranding protocol as well as monitoring for seabirds from ships), review of monitoring programs, and identify the potential for large scale events such as weather conditions or migratory conditions that may concentrate birds or include species at risk species use in the area and increase the risk of bird collisions/mortality. Mitigation measures such as reducing lighting during vulnerable periods may be required to minimize potential cumulative effects.

With the implementation of mitigation measures for terrestrial wildlife (Section 5.1.12) and the mitigation implemented for lighting, the potential for the Keltic Project to contribute to cumulative effects on migratory birds will be significantly reduced. It is nonetheless possible that collisions of birds with project structures could occur, although unlikely in numbers sufficient to affect bird populations. With the implementation of monitoring, and as necessary, working with CWS to mitigate further identified effects on migratory birds, cumulative effects are anticipated to be of minor significance.

Table 8.2-10 summarizes the cumulative effects discussed for migratory birds.

8.2.1.14 Wetlands

Wetlands were identified for the Dung Cove Pond area and adjacent to the Facilities along Betty's Cove Brook. Loss of regional wetlands may also occur from Meadow Lake impoundment and the proposed re-alignment for Route 316. Potential impacts to wetlands will be addressed through habitat compensation and no cumulative effects are anticipated.

It is of note that the Proponent will detail the impacts to wetlands in compliance with Item 1.2 of the NSEL EA approval conditions for the Keltic Development Proposal (NSEL, 2007). This work will address methods and plans for avoidance, mitigation, and/or compensation and will be developed in consultation with NSEL and NSDNR.

8.2.1.15 Lighting Conditions

Other local sources of light include the SOEI plant, existing roadways, other Keltic facilities, and proposed Deep Panuke facilities. The LNG storage tanks and flare stacks from the petrochemical plant may be visible from Stormont Bay and the general site may have 'skyglow' which may contribute to overall appearance of industrialization of the area. Given the limited number of receptors and the designation of the site for industrial use, this is not anticipated to be a significant impact. Table 8.2-11 below summarizes the cumulative effects discussed for lighting.

TABLE 8.2-10 Cumulative Summary – Migratory Birds

Cumulative Project – Environment Interaction	Residual Project Impact with Mitigation (Section 5.0)	Mitigating Factor	Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility	Significance**	Likelihood of Significant Cumulative Occurrence***	Level of Confirdence***
Construction habitat loss / disturbance within the local area from oil and gas development and easements	Minor	• Habitat loss small portion of overall available area and not identified as critical for species present.	Low	Terrestrial Study Area	One time	No	Not significant		
Interference with feeding areas of future marine infrastructure in the general area	Minor	• Habitat disturbance small portion of overall available area and not identified as critical for species present.	Low	Terrestrial Study Area and local marine environment	Constant	No	Not significant		
Collision mortality from future infrastructure in the general area	Minor	• Mitigation/ Monitoring to be undertaking in cooperation with CWS.	Low	Local terminal area	Constant	No	Not significant		
Food chain contaminants or oiling impacts from acute or chronic water quality contaminants in general area	Minor	• No signifcant levels of non-bioaccumulating contaminants. • Oil spill response planning.	Low	Regional area	Infrequent	R	Not significant		

*For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** For definition of levels of significance (major, medium, minor, minimal) refer to Section 2.5
*** Only addressed for significant effects

TABLE 8.2-11 Cumulative Summary – Lighting

Cumulative Project – Environment Interaction	Residual Project Impact with Mitigation (Section 5.0)	Mitigating Factor	Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility	Significance**	Likelihood of Significant Cumulative Occurrence***	Level of Confirdence***
Local increase in light in the general area from all development	Minor	• Consistant with industrial development for the area as identified in the regional plan.	Low	Local	Frequent	R	Not significant		

*For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** For definition of levels of significance (major, medium, minor, minimal) refer to Section 2.5
*** Only addressed for significant effects

8.2.1.16 Atmospheric and Underwater Acoustic Environment

Atmospheric effects are addressed under air quality and climate change.

Noise impacts may be associated with construction (pile driving) of the terminal which may result in disturbance in the marine environment. This is a short term effect and no other marine disturbances are known to combine with this activity to result in cumulative effects over the construction period.

The underwater environment may be affected by noise impacts from construction activities for the development for the LNG Terminal and the LNG Tanks. Although there is not an extensive use of the nearshore waters by cetaceans and seals, these species may be susceptible to damage from the underwater noises generated using conventional pile-driving techniques. The underwater noise impacts on marine mammals are further discussed in Section 8.2.1.11.

There will be some overlapping construction activities with the other Keltic components. The detailed design for all of the Keltic components has not been completed and therefore noise modelling has not yet been conducted. Noise modeling will be completed for the Project as a whole (LNG, petrochemical facility and co-generation plant) once the details are complete. If it is determined from the modeling that the Canadian Mortgage and Housing Corporation (CMHC) levels will be exceeded, then measures will be taken to acoustically shield components to ensure the noise does not exceed CMHC levels. Therefore cumulative noise effects are anticipated to be short-term (construction), reversible, and local in nature (within 500 m of source), and of minor significance.

The Proponent will initiate a monitoring program that will consist of sampling noise levels over a 24-hour period following commissioning. Noise sampling will be conducted quarterly and the results evaluated on an annual basis. Should noise levels be consistent over the first year, noise sampling would subsequently be conducted on a complaint basis or following process or equipment changes. This will include monitoring of ship noise, vehicle movement, heavy equipment operations, emergency operations, and normal operating modes.

8.2.1.17 Current Use of Lands and Resources for Traditional Purposes by Aboriginal Persons

Mi'kmaq continue to undertake traditional activities throughout the Keltic Development Proposal Study Area. Medicinal plant gathering sites and areas were identified adjacent to wetlands within the Project Site. The construction may result in some filling, excavating, and otherwise disturbance of wetlands, in addition to some loss of wetland vegetation.

Some of the reported hunting and fishing areas overlap with the proposed LNG facility; which will result in an unavoidable loss of traditional resource area. However, the affected area (approximately 149 ha) is a very small proportion (less than 2%) of one hunting area out of approximately 10 large traditional hunting areas in Guysborough County; which encompass very large areas of land and includes entire waterways. Therefore, the construction activities will result in minimal impacts to the land and resource use. As well the marine environment was a potential urchin harvest area. Alternative resources are available outside this and other project study areas. Use of the urchin harvest area is presently limited by a decline the population.

Wetlands within the LNG facility, if affected, will be rehabilitated and/or compensated to achieve "no net loss" in wetland functions. As required by the NSEL Terms and Conditions for Environmental Assessment Approval, wetland plans for avoidance, mitigation and/or compensation will be developed in consultation with NSEL and NSDNR.

For the effects on fishing, the draft FHCP outlined in Appendix 5 includes enhancement of benthic habitat within the same urchin licence area. This is predicted to offset any loss of sea urchin production and/or access once the species returns to commercial levels.

To meet the requirements of Item 4.3 in the NSEL EA approval conditions, Keltic will develop a Mi'kmaq Communication Plan for the Project which will include but not be limited to:

- Processes for communicating Project details and seeking input from the Mi'kmaq community.
- Plans for Mi'kmaq involvement in EEM and other Project aspects. The plan will be developed in cooperation with the Mi'kmaq Community. Also, in accordance with Item 4.4 of the NSEL EA approval conditions, Keltic will take steps to further assess traditional Mi'kmaq use of the Project Site lands. The Proponent will develop the proposed steps in cooperation with the Mi'kmaq Community and will submit the results to NSEL.

Similar potential effects exist for the development of other Keltic facilities, the SOEI gas plant, and the Deep Panuke project. However, Keltic anticipates being able to mitigate any negative effects through its consultation with the Mi'kmaq and therefore expects a minimal cumulative effect on traditional land use.

8.2.1.18 Physical and Cultural Heritage

Construction of the LNG Terminal may have effects on physical and cultural heritage. Due to previous excavation and removal of burials at Red Head in 2000 and 2001, complemented by subsurface testing in October 2004, there is confidence that no burials remain in the cemetery and, therefore, the site is no longer believed to be of high archaeological sensitivity. However, due to its association as the final resting place of the first Black Loyalists in Goldboro and Isaac's Harbour, it remains to be of cultural significance to the nearby Black community at Lincolnville.

Prior to construction, an agreement with the Department of African Nova Scotia Affairs will be entered into for the establishment of a memorial at the Red Head Cemetery site. A Cultural Heritage Plan will also be developed to ensure that Project development and operations proceed in a manner that respects the cultural heritage value of the Red Head Cemetery site to the community, and that public access to the site will be maintained. The plan will be reviewed and approved by NSEL. An archaeology and heritage resources monitoring and contingency plan will also be prepared in consultation with Mi'kmaq stakeholders, African Nova Scotia Affairs, and the Nova Scotia Museum.

A potential positive cumulative effect for cultural heritage relates to an overall increase of the understanding of the heritage of the area with the research undertaken for this Project and other projects in the general area.

8.2.1.19 Structures/Sites of Archaeological, Paleontological or Architectural Significance

There is a probability that Mi'kmaq artefacts could be found during construction, and in such cases, construction workers should be made aware that this is a possibility. This may include cultural resource awareness training for construction workers. In the event that artefacts are found during construction activities, construction activities in the area of the discovery will be suspended and the discovery be reported to the Nova Scotia Museum and the Executive Director of the Union of Nova Scotia Indians immediately. In accordance with Item 4.5 and 4.6 in the NSEL EA approval conditions, a complete archaeological assessment of the entire Keltic Development Proposal site will be submitted for review by NSEL. This submission will also include an archaeological monitoring plan. A contingency plan for the discovery of archaeological or cultural resources will be included in the EPP. Also, as requested by Item 4.9 in the NSEL EA approval conditions, a plan will be developed to ensure the Keltic Development Proposal construction and operations proceed in a manner that respects the cultural heritage value of the Red Head Cemetery and that public access to the site will be maintained.

In accordance with Item 4.9 in the NSEL EA approval conditions, a plan will be developed to ensure the Keltic Development Proposal construction and operations proceed in a manner that respects the cultural heritage value of the Red Head Cemetery and that public access to the site will be maintained (NSEL, 2007).

Construction activities any of the Projects identified in this CEA have the same potential for affecting structures/sites of archaeological, paleontological or architectural significance; however, with similar mitigation measures as proposed for the Keltic Project, cumulative effects are anticipated to minor.

A potential positive cumulative effect for sites of significance relates to an overall increase of the understanding of the heritage of the area with the research undertaken for this Project and other projects in the general area.

8.2.1.20 Navigation

Three fishing vessels are reported for Isaac's Harbour (1999 data). The wharf/marine terminal and associated facilities were not identified as significantly affecting access to and from the harbour. The Proponent has initiated the TERMPOL process, which, in part, will be used to resolve navigation conflicts as they relate to the Project. Cumulative interference is not anticipated with underwater facilities such as the SOEI pipeline and proposed Deep Panuke pipeline, and effects are anticipated to be minimal.

8.2.1.21 Marine Safety and Security

The TERMPOL process is intended to result in the operation of the facilities to protect public and environmental safety and security. Through this process the potential risks associated with accidents will be identified and plans developed to mitigate these risks. Keltic will also adhere to the *Marine Transportation Security Act* and regulations. As a result, the Project is not expected to cumulatively affect marine safety or security.

8.2.1.22 Human Health and Safety

Potential risks associated with accidents and in particular with increased vehicular traffic for the area may be cumulative in relation to several projects in the area with respect to human health and safety. The Proponent is completing a QRA for the Project, which will identify overall risk associated with the LNG Terminal, and provide mitigating measures.

With respect to traffic, a significant cumulative increase in terms of demands on infrastructure and the additional traffic may result in more vehicle collisions on an annual basis. A traffic impact study and a traffic infrastructure study will be undertaken as part of the Project design process. These studies will identify the measures that will need to be taken to maintain safety and to minimize the potential cumulative traffic related health effects.

As discussed in Section 8.2.1.6, all cumulative air quality parameters will meet regulatory requirements, and as such, health effects from dust emissions and stack emissions are not expected to result in a cumulative health effect.

Table 8.2-12 below summarizes the cumulative effects discussed for health and safety.

TABLE 8.2-12 Cumulative Summary – Health and Safety

Cumulative Project – Environment Interaction	Residual Project Impact with Mitigation (Section 5.0)	Mitigating Factor	Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility	Significance**	Likelihood of Significant Cumulative Occurrence***	Level of Confirdence***
Traffic and infrastructure requirements in the general area	Minimal	• Traffic impact study as part of Project design phase.	Low	Local	Frequent	R	Not significant		
Operational air emissions in combination with other projects with similar emissions to same airshed	Minor	• All oil and gas project emissions within the immediate airshed are designed to meet regulatory limits. • Contribution to regional emissions of ozone neglible.	Low	Very Local	Frequent	R	Not significant		

*For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** For definition of levels of significance (major, medium, minor, minimal) refer to Section 2.5
*** Only addressed for significant effects

8.2.1.23 Fisheries

The construction of marine facilities will affect fishing at or near the construction sites. The construction of the marginal wharf/marine terminal will affect one local fisher. The effects of the LNG Terminal construction and operation will be mitigated by the development of a compensation plan for local fishers who hold licences for that area. A FHCP (Appendix 5) has been developed and will be implemented in consultation with the DFO. The proposed Deep Panuke facilities are expected to have comparable minimal effect on near-shore fisheries and to implement similar compensation schemes for affected parties, if applicable. Both projects are expected to have very localized effects on fish habitat and effects on fish or lobster stocks in the Bay as a whole are not anticipated. As a result, cumulative effects on fisheries are anticipated to be minimal.

8.2.1.24 Aquaculture

Potential for cumulative effects to aquaculture related to the Facilities could occur through surface water quality pathways (cumulative storm/process water discharges, mine legacy effects) within adjacent marine environment. Impacts to water quality are not expected to be significant, existing aquaculture sites are located at a distance and no leases are proposed for the area. Cumulative effects to identified aquaculture sites are not anticipated.

8.2.1.25 Tourism

Impacts of the Facilities on tourism are expected to be minimal over the short term and potentially beneficial over the long-term. Other likely regional projects/developments are expected to have similar effects and are focused within areas designated for industrial development. Although the Project will be visible from Route 316 to tourist traffic, it only makes up a small proportion of the broader visual landscape when viewed from Route 316, and is not likely to affect tourist's decision to visit the area. The cumulative impact of increasing industrialization of the area will be mitigated by appropriate regional planning and is expected to be balanced by economic benefits to the private and public sector, which will facilitate tourism infrastructure improvements. Table 8.2-13 summarizes the cumulative effects discussed for tourism.

TABLE 8.2-13 Cumulative Summary – Tourism

Cumulative Project – Environment Interaction	Residual Project Impact with Mitigation (Section 5.0)	Mitigating Factor	Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility	Significance**	Likelihood of Significant Cumulative Occurrence***	Level of Confirdence***
Industrial development in the Project Area	Minimal	• Regional planning. • Inceased investments in toursim infrastructure.	Low	Regional	Constant	No	Not significant		

*For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** For definition of levels of significance (major, medium, minor, minimal) refer to Section 2.5
*** Only addressed for significant effects

8.2.2 Conclusion

Based on the review of potential effects and identification of available mitigation measures, it is unlikely that the construction and operation of the Keltic LNG Terminal and associated infrastructure will result in significant adverse environmental or socio-economic impacts, including cumulative effects.

Some cumulative effects have been identified in Section 8.2 and mitigation for the Project effects on the affected VECs will also mitigate cumulative effects to some degree (such as reductions in emissions of GHGs); however, no significant cumulative effects have been identified for which special mitigation is necessary.

8.3 MARGINAL WHARF

8.3.1 Assessment

8.3.1.1 Hydrology

The wharf does not interact with regional hydrology.

8.3.1.2 Freshwater Quality/Quantity

The wharf does not interact with the freshwater watershed.

8.3.1.3 Groundwater Quality/Quantity

The wharf area is expected to be a groundwater discharge zone and cumulative effects are not anticipated.

8.3.1.4 Marine Water Quality

Storm and process water discharges in the wharf area may contribute contaminants to the marine environment, primarily during construction. Marine water quality is primarily a concern in relation to marine biological organisms. Other projects may also contribute to the near-shore marine environment contaminants in the vicinity of the wharf. Sediment may be contributed by development (whether oil and gas or road realignments) within onshore contributing watersheds. Significant cumulative impacts from construction activities are not expected to occur due to the short term nature, reversibility, and relative volumes expected to be produced.

As per the Provincial EIA commitments, visual monitoring, silt screens, curtains and containment booms surrounding the construction area will be utilized to reduce the potential siltation/sediment loading impacting fish populations (especially sensitive species that may frequent the area) and benthic communities. These measures will also help mitigate any negative effects from other projects being constructed at the same time. These commitments will also assess if loads are deemed to be out of the ordinary for Isaac's Harbour. Construction techniques will be designed to minimize the disturbance of sediment and the use of appropriate erosion and sediment control measures will be implemented to also minimize the disturbance of sediment. Turbidity will be monitored during construction of the marginal wharf and will continue 2 to 3 days after. Construction of other facilities such as the Deep Panuke onshore facilities and the SOEI gas plant will implement similar erosion control measures and as such, sedimentation effects are likely to be infrequent, reversible, and of minor significance.

Coastal and marine development such as the proposed Deep Panuke pipeline may also affect marine water quality through addition of contaminants on a chronic or acute basis in the event of a leak, or through the discharge of hydrostatic testing water. Contaminants may also be released into the marine environment on an ongoing basis from historical mine tailings deposition in sediment. Cumulative sources of marine water contaminants to the general marine area are limited in extent, have low concentrations, are not known to include substances that bioaccumulate and are not expected to result in significant cumulative effects. Table 8.3-1 summarizes the cumulative effects discussed for marine water quality.

TABLE 8.3-1 Cumulative Summary – Marine Water Quality

Cumulative Project – Environment Interaction	Residual Project Impact with Mitigation (Section 5.0)	Mitigating Factor	Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility	Significance**	Likelihood of Significant Cumulative Occurrence***	Level of Confirdence***
Operational storm and process water discharges in the wharf area in combination with other projects with similar discharges to same general marine area	Minimal	• All oil and gas project process and storm-water discharges within the immediate marine watershed are designed to meet regulatory limits. • Low concentrations of contaminants, not bioaccumulating substances.	Low	Local to the mixing zone adjecent the Study Area	Storm or mixing events	R	Not significant		

*For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** For definition of levels of significance (major, medium, minor, minimal) refer to Section 2.5
*** Only addressed for significant effects

8.3.1.5 Soil/Sediment Quality (Terrestrial and Marine)

Sediment quality in the adjacent watercourses (fresh and marine) can be affected by addition of storm-water/process water in the wharf area, other Keltic components, and the proposed Deep Panuke facilities. As no significant water quality cumulative effects are anticipated (see above 8.3.1.4), sediment effects are unlikely. Marine sediment sampling in the wharf and terminal area found no indications of existing contaminants. Other potential sources of contaminants in the general area are small as development is limited. Although existing contaminants were found (arsenic, mercury) in Isaac's Harbour, neither of these metal are components of the Project and cumulative impacts are not anticipated.

8.3.1.6 Air Quality

Air quality related impacts associated with the wharf are very localized and not expected to interact with other projects or result in cumulative effects.

8.3.1.7 Climate Conditions

Wharf operation is not expected to contribute to cumulative GHG impacts.

8.3.1.8 Vegetation (Terrestrial and Marine)

Terrestrial vegetation is not present in the wharf area. Potential, although unlikely, impacts to marine vegetation could occur though surface water or sediment contaminants. Cumulative effects were not noted for these pathways and thus are not anticipated for marine vegetation.

8.3.1.9 Species at Risk

There is potential for the construction of the marginal wharf to effect the foraging of roseate tern individuals. Although no foraging sites are known to be located within or adjacent to the marginal wharf location, one individual roseate tern was observed flying near the shore of the south terminal area. The closest documented foraging site is located approximately 3 km from the Marginal Wharf Project Site, on the shore of Harbour Island. Construction of the marginal wharf will be short term.

No adverse environmental effects are anticipated, as collisions of roseate terns with the marginal wharf and marine terminal are unlikely to occur. These species are agile flyers and very rarely collide with large stationary objects such as lighthouses, bridges, light poles, communication towers or with large moving objects such as ships, even when they are brightly lit (Kerlinger and Hatch, 2004).

None of the construction for other projects considered in this CEA are documented foraging sites for the roseate tern and with additional mitigation measures being implemented for migratory birds (Section 5.1.13.2) and those being implemented for the other respective projects, cumulative effects on the roseate tern are anticipated to be minimal. Interactions with migratory birds are discussed further in a separate section, below

There is however, potential for combined impacts from the M&NP and Encana Deep Panuke projects which, as currently proposed, could impact foraging terns through disturbance, spills, and habitat loss. The Proponent has committed to the development and implementation of an Adaptive Management Plan (AMP), consisting of various elements. To address concerns with potential cumulative impacts to foraging Roseate Terns in Country Harbour, it is expected that the AMP will include coordination with EnCana and other stakeholders to monitor and manage potential cumulative effects on the Roseate Tern.

As outlined in the NSEL Terms and Conditions for Environmental Approval, under Point 2.7, a project wildlife and vegetation monitoring program will be developed in consultation with NSDNR and CWS.

8.3.1.10 Fish and Fish Habitat (Marine and Freshwater)

An impact on marine environments from the wharf facility and other marine infrastructure in the area includes loss of direct and indirect benthic habitat, through disturbance.

Fish access to Isaac's Harbour is not expected to be restricted by the terminal and other nearby marine infrastructure. The Deep Panuke Project will not adversely affect fish passage and the inclusion of fish passage structure for the Meadow Lake impoundment will ensure that it does not restrict fish passage. As a result, cumulative effects to fish and fish habitat are not expected to be significant. Existing mine legacy issues and other development storm and process water may contribute to negative effects on surface water quality and heavy metal contamination in the marine environment. However, sampling indicated no concern for existing contaminants in the area of the wharf. Measures have been taken to minimize Project effects on surface water quality and fish and marine habitat. Cumulative effects on fish habitat are not expected to be significant.

As outlined in the NSEL Terms and Conditions for Environmental Approval, under Point 2.7, a project wildlife and vegetation monitoring program will be developed in consultation with NSDNR and CWS. Table 8.3-2 below summarizes the cumulative effects discussed for fish and fish habitat.

TABLE 8.3-2 Cumulative Summary – Fish/Habitat

Cumulative Project – Environment Interaction	Residual Project Impact with Mitigation (Section 5.0)	Mitigating Factor	Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility	Significance**	Likelihood of Significant Cumulative Occurrence***	Level of Confirdence***
Operational storm and process water discharges in combination with other projects with similar discharges to same general marine area affecting habitat quality	Minimal	• Water quality impacts are minimal.	Low	Local marine environment	Frequent	R	Not significant		
Fish access to Isaac's Harbour and other migratory patterns could be disrupted by wharf and proposed marine facilities in the area	Minimal	• The majority of the access to the harbour is still available.	Low	Local terminal area	Constant	Yes	Not significant		

*For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** For definition of levels of significance (major, medium, minor, minimal) refer to Section 2.5
*** Only addressed for significant effects

8.3.1.11 Marine Mammals

Marine mammal (whales and seals, excluding at risk species - see at risk section) use of the general area is occasional (feeding or haul out). Potential for cumulative effects to marine mammals related to the wharf and other projects could occur through surface water quality pathways (cumulative storm/process water discharges) within adjacent marine environment or physical interference (cumulative disturbance of Keltic marine infrastructure and proposed Deep Panuke facilities). Potential cumulative impacts to water quality/habitat or physical interference of marine mammals are not expected to be significant. Table 8.3-3 summarizes the cumulative effects discussed for marine mammals.

8.3.1.12 Wildlife and Wildlife Habitat

Potential impacts of the Project to terrestrial wildlife and wildlife habitat are not significant (bird and marine habitat is discussed in separate sections). Deer wintering areas were noted in the vicinity of the wharf area. Although other wildlife habitat loss will also occur with other regional development, known projects are not expected to significantly reduce available habitat in the region and cumulative effects are not anticipated.

TABLE 8.3-3 Cumulative Summary – Marine Mammals

Cumulative Project – Environment Interaction	Residual Project Impact with Mitigation (Section 5)	Mitigating Factor	Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility	Significance**	Likelihood of Significant Cumulative Occurrence***	Level of Confirdence***
Operational storm and process water discharges in combination with other projects with similar discharges to same general marine area affecting habitat quality	Minimal	• Water quality impacts are minimal.	Low	Local marine environment	Frequent	R	Not significant		
Marine mammal movement in the area could be disrupted by wharf and other existing/ proposed marine facilities in the area	Minimal	• The majority of the access to the harbour is still available. • Not likely to affect populations.	Low	Local terminal area	Constant	Yes	Not significant		

*For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** For definition of levels of significance (major, medium, minor, minimal) refer to Section 2.5
*** Only addressed for significant effects

A monitoring program to assess wildlife populations will be established prior to commissioning and will continue 3 to 5 years following commissioning. The surveys will be carried out at appropriate times of the year as shown in Section 7.0 Table 7.2-2.

Evidence of wildlife presence and activity, and vegetation condition requiring attention, will be monitored during the surveys.

8.3.1.13 Migratory Birds and Migratory Birds Habitat

As discussed in the context of the LNG facility (Section 8.2.1.13) there is a potential for cumulative effects of the identified future projects on migratory birds. Keltic will work with CWS to implement mitigation (as outlined in Section 5.0, such as: EC's recommendations for Interactions with Lights and Flares, and Storm-Petrel stranding protocol as well as monitoring for seabirds from ships), review of monitoring programs, and identification of potential for large scale events such as weather conditions or migratory conditions that may concentrate birds or result in species at risk species use of the area thus increasing the risk of bird collisions/mortality. Mitigation such as specialized lighting during vulnerable periods may be required to minimize potential cumulative effects.
As was the case with the LNG facilities, the lighting regime for the entire Project Area will be illuminated with downward facing white lights to minimize visual disorientation of nocturnal migrants as well as diurnal species migrating in inclement weather. It is thought that this type of lighting will not attract even night migrating songbirds (Kerlinger, 2004). It is advisable not to

use illuminated structures taller than 50 feet (15 m), as these have been demonstrated to disorient birds. It is further recommended that fast-blinking strobes be used when feasible.

It is of note that the Proponent will generate a lighting plan, which will incorporate a program to monitor impacts to birds. This work will be undertaken by the Proponent in compliance with Item 1.6 of the NSEL EA approval conditions (NSEL, 2007). In accordance with the NSEL conditions, the plan must be submitted to NSDNR, CWS, and TC for review and approval. Based on the results of the monitoring programs, the Proponent must make necessary modifications to the mitigation plans and/or operations to prevent any unacceptable environmental effects to the satisfaction of NSEL, based on consultation with NSDNR and CWS.

Table 8.3-4 below summarizes the cumulative effects discussed for migratory birds.

TABLE 8.3-4 Cumulative Summary – Migratory Birds

Cumulative Project – Environment Interaction	Residual Project Impact with Mitigation (Section 5.0)	Mitigating Factor	Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility	Significance**	Likelihood of Significant Cumulative Occurrence***	Level of Confirdence***
Construction disturbance within the local area from oil and gas development	Minimal	• Habitat loss small portion of overall available area and not identified as critical for species present.	Low	Terrestrial Study Area	One time	No	Not significant		
Interference with feeding areas of proposed marine infrastructure in the general area	Minimal	• Habitat disturbance small portion of overall available area and not identified as critical for species present.	Low	Terrestrial Study Area and local marine environment	Constant	No	Not significant		
Collision mortality from proposed infrastructure in the general area	Minimal	• Mitigation/ Monitoring to be undertaking in cooperation with CWS.	Low	Local terminal area	Constant	No	Not significant		
Food chain contaminants or oiling impacts from acute or chronic water quality contaminants in general area	Minimal	• No signifcant levels of non-bioaccumulating contaminants • Oil spill response planning.	Low	Regional area	Infrequent	R	Not significant		

*For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** For definition of levels of significance (major, medium, minor, minimal) refer to Section 2.5
*** Only addressed for significant effects

8.3.1.14 Wetlands

Wetlands are not affected by the proposed wharf and cumulative effects are not applicable.

8.3.1.15 Lighting Conditions

As discussed in the context of the LNG facility (Section 8.2.1.15) there is a potential for cumulative effects of the identified future projects on lighting conditions. However, given the limited number of receptors and the designation of the site for industrial use, this is not anticipated to be a significant impact. Impacts related to birds are discussed in the migratory bird section above. Table 8.3-5 below summarizes the cumulative effects discussed for lighting.

TABLE 8.3-5 Cumulative Summary – Lighting

Cumulative Project – Environment Interaction	Residual Project Impact with Mitigation (Section 5.0)	Mitigating Factor	Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility	Significance**	Likelihood of Significant Cumulative Occurrence***	Level of Confirdence***
Local increase in light in the general area from all development	Minor	• Consistant with industrial development for the area as identified in the regional plan.	Low	Local	Frequent	R	Not significant		

*For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** For definition of levels of significance (major, medium, minor, minimal) refer to Section 2.5
*** Only addressed for significant effects

8.3.1.16 Atmospheric and Underwater Acoustic Environment

Atmospheric effects are addressed under air quality and climate change.

Noise impacts may be associated with construction of the wharf which may result in disturbance in the marine environment. Research on marine mammals shows that under certain circumstances underwater noise can cause a variety effects. This includes behaviour modifications, tissue rupturing or haemorrhaging at close range to the acoustic source, and temporary or permanent hearing loss. In addition new noise sources can mask other sounds important to survival, such as those made by calves, mates, or predators (Richardson et. al., 1995).

The disturbance of marine life through noise emissions transmitted through the underwater environment (from activities such as conventional pile driving) (David, 2006) will be mitigated by the implementation of alternative techniques for pile driving such as vibratory pile-driving, adjusting the timing around sensitive periods and conducting driving during low tide. In addition recreational and commercial fishery representatives will be conferred with to develop seasonal and daily schedules to minimize disruption of fisheries.

Any residual effects will be short-term and no other marine disturbances, with the exception of the LNG Marine Terminal, are expected to combine with this activity to result in cumulative effects over the construction period. The Deep Panuke project construction is not anticipated to begin until after completion of the Keltic marginal wharf construction. Although the Deep Panuke construction will extend the period that the underwater acoustic environment will experience elevated noise, cumulative effects on the acoustic environment are anticipated to be of minor significance.

There will be some overlapping construction activities with the other Keltic components. The detailed design for all of the Keltic components has not been completed and therefore noise modelling has not yet been conducted. Noise modeling will be completed for the project as a whole (LNG, petrochemical facility and co-generation plant) once the details are complete. If it is determined from the modeling that the CMHC levels will be exceeded, then measures will be taken to acoustically shield components to ensure the noise does not exceed CMHC levels.

8.3.1.17 Current Use of Lands and Resources for Traditional Purposes by Aboriginal Persons

The general area of the wharf site was identified as a potential urchin harvest area. The draft FHCP outlined in Appendix 5 includes enhancement of benthic habitat within the same urchin licence area. This is predicted to offset any loss of sea urchin production and/or access once the species returns to commercial levels.

8.3.1.18 Physical and Cultural Heritage

Physical and cultural heritage resources are not expected to be affected by the Project. Access to the former Red Head cemetery location may be affected by project infrastructure or site security requirements. The Proponent has committed to working with the Black Loyalist community to provide access to Red Head. Cumulative effects associated with cultural heritage relate to an overall increase of the understanding of the heritage of the area with the research undertaken for this Project and other projects in the general area. Construction of other projects such as other Keltic facilities, the SOEI gas plant, the M&NP pipeline expansion, and the Deep Panuke Project (on-shore facilities) also have the potential to adversely affect this resource.

In compliance with NSEL conditions of approval, prior to construction, an agreement with the African Nova Scotia Affairs will be entered into for the establishment of a memorial at the Red Head Cemetery site (Item 4.8) and a Cultural Heritage Plan will also be developed to ensure that the Keltic Development Proposal construction and operations proceed in a manner that respects the cultural heritage value of the Red Head Cemetery site to the community, and that public access to the site will be maintained (Item 4.9). The plan will be reviewed and approved by NSEL. Additionally, an archaeology and heritage resources monitoring and contingency plan will also be prepared by engagement with Mi'kmaq stakeholders, African Nova Scotia Affairs, and the Nova Scotia Museum (Item 4.6).

With the implementations of these measures for each of the projects, cumulative effects are anticipated to be of minor significance.

8.3.1.19 Structures/Sites of Archaeological, Paleontological or Architectural Significance

Construction of the Marginal Wharf may have effects on several archaeological features. However, due to previous excavation and removal of burials at Red Head in 2000 and 2001, complemented by subsurface testing in October 2004, there is confidence that no burials remain in the cemetery and, therefore, the site is no longer believed to be of high archaeological sensitivity. However, due to its association as the final resting place of the first Black Loyalists in Goldboro and Isaac's Harbour, it remains to be of cultural significance to the nearby Black community at Lincolnville. This site lies within the impact zone and is expected to be heavily disturbed.

To meet the requirements of the NSEL EA approval conditions (Item 4.7) (NSEL, 2007), if an archaeological site or artefact is discovered, the work will be halted and the Curator of Archaeology at the Nova Scotia Museum, and the Executive Director of the Union of Nova Scotia Indians will be contacted immediately. Should the find be deemed significant, the work is not to resume until further steps and protective measures are discussed in consultation with the archaeologist and regulatory authorities.

A complete archaeological assessment of the entire Keltic Development Proposal site will be completed prior to construction as requested in the NSEL EA approval conditions (NSEL, 2007). Also, in accordance with Item 4.6 of the NSEL EA approval conditions, an archaeology and heritage resources monitoring and contingency plan will be developed prior to construction. The plan will be developed in consultation with Mi'kmaq stakeholders, African Nova Scotia Affairs, and the Nova Scotia Museum.

Also, an agreement will be entered into with the Office of African Nova Scotia affairs for the establishment of a memorial at the site. The agreement and the Cultural Heritage Plan will be implemented in accordance of Items 4.8 and 4.9 in the NSEL EA approval conditions (NSEL, 2007).

With these mitigation measures in place, construction and operation of the marginal wharf is not anticipated to have a significant cumulative effect on Structures/Sites of Archaeological, Paleontological or Architectural Significance.

Cumulative effects associated with sites of significance relate to an overall increase of the understanding of the heritage of the area with the research undertaken for this Project and other projects in the general area.

8.3.1.20 Navigation

Three fishing vessels are reported for Isaac's Harbour (1999 data). The wharf/marine terminal and associated facilities were not identified as significantly affecting access to and from the harbour. The Proponent has initiated the TERMPOL process, which, in part, will be used to resolve navigation conflicts as they relate to the Project. Cumulative interference is not anticipated with underwater facilities such as the proposed Deep Panuke pipeline.

8.3.1.21 Marine Safety and Security

The Project will be operated under safety policies and procedures that meet or exceed industry standards. Keltic will also adhere to the *Marine Transportation Security Act* and regulations. Potential risks associated with accidents for the area may be cumulative in relation to several projects in the area. The TERMPOL process is intended to result in the operation of the facilities in a manner that will protect the public and ensure environmental safety and security. Through this process the potential risks associated with accidents will be identified and plans developed to mitigate these risks. As a result, the Project is not expected to cumulatively affect marine safety or security.

8.3.1.22 Human Health and Safety

Safety during construction and operation of the marginal wharf is governed by the NSEL. In addition, the Project will be operated under safety policies and procedures that meet or exceed industry standards. The same measures implemented for the LNG facilities will be implemented to ensure cumulative effects on human health and safety is not significant.

8.3.1.23 Fisheries

The construction of the marginal wharf will affect fishing at or near the construction sites. This construction will affect one local fisher. Keltic will negotiate compensation for the economic loss. The proposed Deep Panuke facilities are expected to have comparable minimal effect on near-shore fisheries and to implement similar compensation schemes for affected parties, if applicable. Cumulative effects are not anticipated.

8.3.1.24 Aquaculture

Potential for cumulative effects to aquaculture related to the wharf could occur through surface water quality pathways (cumulative storm/process water discharges, mine legacy effects) within adjacent marine environment. This potential effect is assessed in the freshwater quality section and the cumulative effect was not deemed to be significant. As a result, impacts to water quality are not expected to be significant and cumulative effects to aquaculture are not anticipated.

8.3.1.25 Tourism

Construction of the marginal wharf will contribute to a visual change in the shoreline, which will also be affected by construction of other Keltic facilities. However, as discussed with respect to discussion of the LNG facilities, no cumulative effects are anticipated related to tourism (Section 8.2.1.25). Impacts of the marginal wharf on tourism are expected to be minimal over the short term and potentially beneficial over the long-term. Other likely regional projects/developments are expected to have similar effects and are focused within areas designated for industrial development. The cumulative impact of increasing industrialization of the area will be mitigated by appropriate regional planning and is expected to be balanced by economic benefits to the private and public sector, which will facilitate tourism infrastructure improvements.

8.3.2 Conclusion

Based on the review of potential effects and identification of available mitigation measures, it is unlikely that the construction and operation of the wharf and associated infrastructure will result in significant adverse environmental or socio-economic impacts, including cumulative effects.

Some cumulative effects have been identified in Section 8.3 and mitigation for the Project effects on the affected VECs will also mitigate cumulative effects to some degree (such as mitigation for bird strikes); however, no significant cumulative effects for which special mitigation is necessary have been identified.

8.4 PROJECT RELATED SHIPPING WITHIN 25 KM OF COUNTRY ISLAND

8.4.1 Assessment

8.4.1.1 Hydrology

Shipping does not interact with regional hydrology.

8.4.1.2 Freshwater Quality/Quantity

Shipping does not interact with freshwater quality/quantity.

8.4.1.3 Groundwater Quality/Quantity

Shipping does not interact with groundwater quality/quantity.

8.4.1.4 Marine Water Quality

Shipping both related to the Keltic Project and to other projects in the area may affect marine water quality through discharges of wastewater, chronic releases, or accidents. This may also be cumulative with limited surface water discharges of contaminants from land based sources in the general area. Approximately 300 – 400 ships per year (half of which are tankers at one every two to four days, half are support vessels) are expected to use the facility. This is reported to be half the existing volume of ships over 100 m length (not including harbour tug, fisheries vessels, and other small vessels) presently managed in the region. On average this would be about two ships a day in the area. There is potential for a cumulative effect on marine water quality however, this is expected to be limited in duration, intensity, and extent by mitigative measures by all parties to protect fish and fish habitat, and is not expected to result in a significant cumulative impact.

The MARPOL addresses and protects the marine environment from pollution by oil, chemicals, harmful substances in packaged form, sewage, and garbage. Since Project shipping will conduct all activities in strict adherence to MARPOL, no potentially significant effects are anticipated from routine releases (if any).Table 8.4-1 summarizes the cumulative effects discussed for marine water quality.

TABLE 8.4-1 Cumulative Summary – Marine Water Quality

Cumulative Project – Environment Interaction	Residual Project Impact with Mitigation (Section 5.0)	Mitigating Factor	Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility	Significance**	Likelihood of Significant Cumulative Occurrence***	Level of Confirdence***
Operational waste water discharges in combination with other projects with similar discharges to same general marine area	Minimal	• All oil and gas project process and storm-water discharges within the immediate marine watershed are designed to meet regulatory limits. • Low concentrations of contaminants, not bioaccumulating substances.	Low	The 25 km Study Area	Moderate	R	Not significant		

*For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** For definition of levels of significance (major, medium, minor, minimal) refer to Section 2.5
*** Only addressed for significant effects

8.4.1.5 Soil/Sediment Quality (Terrestrial and Marine)

Similar to marine water quality above, the potential effects on marine sediment quality related to shipping are limited to accidental spill of fuel or other contaminants from vessels during the construction, operation and decommissioning of the LNG Terminal or marginal wharf. Shipping discharges, both related to the Project and to other ventures in the area as noted above, as well as limited surface water discharges of contaminants from land based sources in the general area may affect marine sediment quality.

To reduce the sediment disturbance from the vessels, large vessels will be berthed with the support of tugs. A plan to mitigate the human health and environmental impacts of contaminated mine tailings and/or soils and sediments due to the Keltic Development Proposal will be developed. The plan will be consistent with the Nova Scotia Guidelines for the Management of Contaminated Sites. As outlined in the NSEL EA approval conditions (NSEL, 2007), when any remediation or risk management work is completed, which includes any required monitoring, a Certificate of Compliance to demonstrate the remediation or risk management work is completed and effective. A detailed erosion and sedimentation control plan will also be developed in accordance with Item 2.4 in the NSEL EA approval conditions (NSEL, 2007).

With these measures in place, shipping is not expected to add significantly to existing marine sedimentation and associated quality and cumulative effects are not anticipated. Bottom disturbances were not identified as having potential for remobilization of contaminants. Shipping does not interact with terrestrial soil quality.

8.4.1.6 Air Quality

Air quality related impacts associated with shipping are very localized and not expected to interact with other projects. The use of natural gas/electric engines for tankers reduces this contribution further. The incremental contribution is not expected to result in a cumulative effect.

8.4.1.7 Climate Conditions

The additional shipping that will occur within 25 km of Country Island is not expected to appreciatively contribute to cumulative GHG impacts within the airshed. Tankers are expected to contribute approximately 63.7 t/year of CO_2 (based on similar projects). Larger potential sources for GHG occur in other Keltic components such as the Co-generation Facility and the SOEI gas plant and proposed Deep Panuke facilities offshore. Shipping emissions are insignificant in relation to other sources. As assessed in Section 8.2.1.7, cumulative effects are anticipated to be of minor significance.

8.4.1.8 Vegetation (Terrestrial and Marine)

Terrestrial vegetation will not be affected by shipping. Potential impacts to marine vegetation could occur though surface water or sediment contaminants. Cumulative effects were not noted for these pathways and thus are not anticipated for marine vegetation.

8.4.1.9 Species at Risk

Species at Risk that may potentially interact with Project shipping and other shipping activities include a variety of marine mammals (whales, dolphins) as well at the Roseate Tern colony at Country Island.

The roseate tern, designated as “Threatened” under the SARA; is located within 25 km of the proposed Project. The proposed Recovery Strategy for the roseate tern identifies “critical habitat” as defined in SARA and recommends that critical habitat be identified as:

- Sites that currently support more than 15 pairs of roseate terns (The Brothers and Country Islands, Nova Scotia).
- Tern colonies in areas that have supported small but persistent numbers of nesting roseate terns for over 30 years (Sable Island, Magdalen islands, Chenal Island).

This designation includes the entire terrestrial habitat of all islands as well as aquatic habitat 200 m seaward from the mean high tide line of each island.

A colony of roseate tern has been identified on Country Island, about 9 km from the proposed LNG site. Additionally, one roseate tern was observed flying near the shore south of the proposed site. Foraging occurs along the mainland and island shores, predominantly on sand lance (A. Boyne, CWS, pers. comm.; Rock, 2005). No foraging site has been identified for the areas associated with the Project.

Shipping will not occur within 200 m of Country Island. Due to the large foraging area of the roseate tern, there is still potential for interaction between the shipping and the species. In the event that a foraging roseate tern encounters an LNG ship, the tern could change course leaving the chicks vulnerable for longer periods or even abandon the effort entirely, returning back to the nest without food.

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No adverse environmental effects are anticipated, as collisions of roseate terns with shipping are unlikely to occur. These species are agile flyers and very rarely collide with large stationary objects such as lighthouses, bridges, light poles, communication towers or with large moving objects such as ships, even when they are brightly lit (Kerlinger and Hatch, 2004).

There is potential for combined impacts from the Encana Deep Panuke project which, as currently proposed, could impact foraging terns through disturbance, spills, and habitat loss. Development of the Deep Panuke project and other Keltic Project components will result in increased boat traffic, both during construction and operation, as there are numerous fishing boats travelling in this area, the increase in boat traffic from these projects will not significantly increase the number of boats in this area. The Keltic Project will result in an additional 5-7 boats per week. Furthermore, although it is possible that the roseate tern alters its behaviour to avoid boats, this has not been scientifically demonstrated. Nonetheless, Keltic understands the importance of protecting endangered species and is committed to their protection. In addition to the mitigation measures discussed in Section 8.4.1.13 Migratory Birds, Keltic will explore follow up measures in consultation with CWS and EC, which could include such measures as contributions to monitoring programs to help identify roseate tern foraging areas.

The Proponent has committed to the development and implementation of an Adaptive Management Plan (AMP), consisting of various elements. To address concerns with potential cumulative impacts to foraging Roseate Terns in Country Harbour, it is expected that the AMP will include coordination with EnCana and other stakeholders to monitor and manage potential cumulative effects on the Roseate Tern.

With the implementation of mitigation measures, the uncertainty that the roseate tern is influenced by encounters with boats, and the scale of increase of navigational traffic, cumulative effects are anticipated to be minimal.

8.4.1.10 Fish and Fish Habitat (Marine and Freshwater)

Potential cumulative interactions for marine ecosystems from the shipping components occur in combination with concurrent commercial fishing activities and oil and gas exploration and production activities. The cumulative impact of these effects is most likely additive but likely insignificant in relation to the continued impact of the fishing mortality from commercial fisheries. No freshwater habitat impacts are associated with shipping.

The potential effects on marine water quality related to shipping are limited to potential releases such oil, chemicals, harmful substances in packaged form, sewage and garbage or accidental spill of fuel or other contaminants from vessels during the construction, operation and decommissioning of the LNG Terminal or marginal wharf.

As stated in Section 5.3.4.1 above, the International Convention MARPOL will be followed by all Project shipping; therefore, no potentially significant effects are anticipated from routine releases (if any).

8.4.1.11 Marine Mammals

Marine mammals (excluding at risk species identified in previous sections) may be cumulatively affected by Project and other shipping activities through increased potential for noise disturbance and collisions. Stormont Bay is not an important area for cetaceans. Whales or seals may enter the area following schools of herring or mackerel from spring to fall and seals frequently haul out on the shoreline. Shipping effects on cetaceans are not expected to be significant as their use of the area is limited and cumulative effects are limited to short-term construction noise from the Deep Panuke Project, and releases sedimentation and accidental release from other chemical facilities and the SOEI gas plant, which can be readily mitigated through the proposed measures.

8.4.1.12 Wildlife and Wildlife Habitat

Shipping activities are not expected to interact with wildlife habitat (other then marine habitat addressed in other sections) and cumulative effects are not anticipated.

8.4.1.13 Migratory Birds and Migratory Birds Habitat

Noise impacts (including interference with feeding areas along the coast and inland), physical disturbance, lighting related collisions, food chain contaminants, and oiling impacts from chronic or acute accidental releases may be associated with shipping impacts to migratory birds.

Keltic will work with CWS to implement mitigation (as outlined in Section 5.0, such as: EC's recommendations for Interactions with Lights and Flares and Storm-Petrel stranding protocol as well as monitoring for seabirds from ships), review of monitoring programs, identify the potential for large scale events such as weather conditions or migratory conditions that may concentrate birds or result in species at risk species use of the area and increase the risk of bird collisions/mortality. Mitigation measures such as specialized lighting may be required to minimize potential cumulative effects. Oil Spill contingency plans are discussed in Section 10.0. Table 8.4-2 summarizes the cumulative effects discussed for migratory birds.

8.4.1.14 Wetlands

Shipping activities are not expected to interact with terrestrial wetlands and cumulative effects are not anticipated.

8.4.1.15 Lighting Conditions

Lighting associated with ships is not expected to have cumulative effects (potential effects on birds are addressed in Migratory Bird section).

8.4.1.16 Atmospheric and Underwater Acoustic Environment

Atmospheric effects are addressed under air quality and climate change.

Noise impacts may be associated with shipping or marine facilities and may result in disturbance in the marine environment (affects on birds including species at risk terns are discussed in the Migratory Bird section). The total number of ships known for the area is limited. Cumulative interactions may occur with the short term construction (pipe-laying) for the Deep Panuke Project. Table 8.4-3 below summarizes the cumulative effects discussed for underwater acoustic.

TABLE 8.4-2 Cumulative Summary – Migratory Birds

Cumulative Project – Environment Interaction	Residual Project Impact with Mitigation (Section 5.0)	Mitigating Factor	Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility	Significance**	Likelihood of Significant Cumulative Occurrence***	Level of Confirdence***
Noise interference with feeding areas of marine infrastructure (existing and proposed) in the general area	Minimal	• Shipping lanes distant from feeding areas or other critical habitat.	Low	Terrestrial Study Area and local marine environment	Constant	No	Not significant		
Collision mortality (existing and proposed) in the general area	Minimal	• Mitigation/ Monitoring to be undertaking in cooperation with CWS.	Low	Local terminal area	Constant	No	Not significant		
Food chain contaminants or oiling impacts from acute or chronic water quality contaminants in general area	Minimal	• No signifcant levels of non-bioaccumulating contaminants. • Oil spill response planning	Low	Regional area	Infrequent	R	Minimal		

*For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** For definition of levels of significance (major, medium, minor, minimal) refer to Section 2.5
*** Only addressed for significant effects

TABLE 8.4-3 Cumulative Summary – Underwater Acoustic

Cumulative Project – Environment Interaction	Residual Project Impact with Mitigation (Section 5.0)	Mitigating Factor	Magnitude*	Geographic Extent	Duration/ Frequency	Reversibility	Significance**	Likelihood of Significant Cumulative Occurrence***	Level of Confirdence***
Noise of shipping in addition to Deep Panuke construction	Minimal	• Short term (bird impacts to be addressed with CWS as in Migratory Bird section).	Low	Local to the Deep Panuke Project work	Short term	R	Not significant		

*For definition of levels of magnitude (high, medium, low, nil, unknown) refer to Section 2.5
** For definition of levels of significance (major, medium, minor, minimal) refer to Section 2.5
*** Only addressed for significant effects

8.4.1.17 Current Use of Lands and Resources for Traditional Purposes by Aboriginal Persons

No impacts were identified for this VEC in relation to shipping in combination with other projects.

8.4.1.18 Physical and Cultural Heritage

Marine heritage components were not specifically identified and cumulative effects are not anticipated. Any wrecks in the area are not expected to be affected by ships with a draft of approximately 14 m and the focus of shipping will be in the shipping lanes/designated areas.

8.4.1.19 Structures/Sites of Archaeological, Paleontological or Architectural Significance

Marine structures/sites of archaeological, paleontological, or architectural significance were not specifically identified and cumulative effects are not applicable.

8.4.1.20 Navigation

The total number of ships known for the area is limited; navigation routes are well established and controlled. Controls will be developed in consultation with Atlantic Pilots Association, TC, and the Canadian Coast Guard using the TERMPOL process and a simulation study as guidance. Navigation routing considers other ship movements and minimizes potential for cumulative effects.

8.4.1.21 Marine Safety and Security

Potential risks associated with accidents including potential for ship collisions in the area may be cumulative in relation to several projects in the area. Keltic will also adhere to the *Marine Transportation Security Act* and regulations. The TERMPOL process is intended to result in the operation of the facilities in a manner that will protect the public and ensure environmental safety and security. Through this process the potential risks associated with accidents will be identified and plans developed to mitigate these risks. As a result, the Project is not expected to cumulatively affect marine safety or security.

8.4.1.22 Human Health and Safety

Potential risks associated with accidents and in particular with increased ship traffic for the area may be cumulative in relation to several projects in the area, including Deep Panuke construction (pipe-laying) activity. A risk assessment is currently being undertaken for the Project. Risk will be managed based on the study to minimize potential for cumulative effects.

8.4.1.23 Fisheries

Potential cumulative effects related to shipping within 25 km of the Project Site are expected to be not significant. There were 49 fishing boats identified within the general area (1999 data). Keltic will provide advance notice of ship arrivals and departures and Keltic will consult with fisheries groups. Interaction with the level of shipping associated with the Project and other known oil and gas development shipping should not interfere with fishing operations. In addition, Keltic has committed to developing a compensation plan for gear damage and related loss of income due to Project activities.

8.4.1.24 Aquaculture

Several aquaculture operations occur along the shoreline within the 25 km Study Area. These sites are primarily located within Country Harbour. Shipping routes stay clear of aquaculture sites, appropriate ballast water and discharge water control and antifouling protocols will be undertaken, and the cumulative effects are not anticipated.

8.4.1.25 Tourism

The low level of shipping associated with the Project is unlikely to interact with tourism either by itself or with other low level shipping activity.

8.4.2 Conclusion

Based on the review of potential effects and identification of available mitigation measures, it is unlikely that the shipping (within 25 km) associated with the Project will result in significant adverse environmental or socio-economic impacts, including cumulative effects.

Some cumulative effects have been identified in Section 8.4 and mitigation for the Project effects on the affected VECs will also mitigate cumulative effects to some degree (such as mitigation for Migratory Birds in consultation with CWS); however, no significant cumulative effects have been identified for which special mitigation is necessary.

8.5 OVERALL CUMULATIVE SUMMARY

Table 8.5-1 provides the summary of previous assessments of impacts on Project VECs (or approximate Project VECs) and of the cumulative impact assessment.

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TABLE 8.5-1 Summary of Impact Assessment Significance for Cumulative Projects

	Ecological / Social Cultural Context [1]	Keltic LNG (Construction)[1]	Keltic Marginal Wharf (Construction)[1]	Keltic Shipping 25 km from Country Island (Construction)[1]	Keltic LNG (Operation)[1]	Keltic Marginal Wharf (Operation)[1]	Keltic Shipping 25 km from Country Island (Operation)[1]	Deep Panuke[2]	Other Keltic Projects[3]	M&NP Expansion[4]	Factor in Cumulative Assessment Significance	Overall Cumulative Significance
Hydrology	Included in water quality/ quantity VECs below	Minor	NAEE[5]	NAEE	Minor	NAEE	NAEE	Not Significant (On Shore VEC)	Minimal to Minor	Minimal to Minor	• Included in water quality/ quantity VECs below	
Freshwater Quality/ Quantity	Watersheds shared by projects -Betty's Cove Brook; Dung Cove/Crusher Brook and direct to marine environment	Minor	Minimal	Minimal	Minor	None	Minimal	Not Significant (On Shore VEC)	Minimal to Minor	Minimal to Minor	• Betty's Cove Brook only local watershed for cumulative projects with water user (limited valued recreational fishery) • Cumulative clearing of significant portion of local watershed occupied by cumulative projects may potential affect surface water runoff at a low level • Construction from several projects potentially occurring concurrently. Storm-water to meet regulatory requirements and effects reversible and generally minimal to minor • Operations discharges from all facilities to meet regulatory quality requirements and effects minimal to minor • Storm water design incorporates watershed development character • Cumulative mitigation to moderate changes to water quality / quantity to meet regulatory standards • Monitoring of water quality and aquatic habitat	Not Significant
Groundwater Quality/ Quantity	Down-gradient groundwater users and contribution to down-gradient surface water/ wetland discharge	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Not Significant (On Shore VEC)	Minimal	Minimal to Minor	• No down-gradient groundwater users identified for Keltic Project limits cumulative interactions • Potential effects for all projects minimal to minor • Projects include local well pre/post construction monitoring	Not Significant
Marine Water Quality	Marine environment	Minimal	Minimal	Minimal	Minor	Minimal	Minimal	Not Assessed	Not Assessed	Minimal to Minor	• Construction and operations discharges for cumulative projects minimal to minor impacts • Construction of marine facility separated from onshore works • Historical contribution of historical mining expected to be low level and not bioaccumulative • Contributions from project small in volume and concentrations compared to assimilative capacity • Monitoring of discharge from Keltic Project to be undertaken and expected similar requirements for other projects	Not Significant

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	Ecological / Social Cultural Context [1]	Keltic LNG (Construction)[1]	Keltic Marginal Wharf (Construction)[1]	Keltic Shipping 25 km from Country Island (Construction)[1]	Keltic LNG (Operation)[1]	Keltic Marginal Wharf (Operation)[1]	Keltic Shipping 25 km from Country Island (Operation)[1]	Deep Panuke[2]	Other Keltic Projects[3]	M&NP Expansion[4]	Factor in Cumulative Assessment Significance	Overall Cumulative Significance
Soil/ Sediment Quality	Existing site not productive agricultural soils; known historical mining impacts	Minor	Minimal	Minimal	None	Minimal	Minimal	Not Significant (On Shore VEC)	Not Assessed	Minimal to Minor	• No direct soil users (i.e. agriculture) • Potential effects for cumulative projects minimal to minor • Remediation Action Plan / Risk Management Plan to address existing contaminants for Keltic Projects	Not Significant
Air Quality	Rural area limited local air pollutants Nearest residence 300-500 m.	Minimal	Minimal	Minimal	Minor	Minor	Minimal	Not Significant (On Shore VEC)	Minimal to Minor	Minimal to Minor	• Monitoring if concerns during construction (air quality is by nature cumulative and monitoring will reflect other activities within the local air shed at the time) • Air quality monitoring included SOEI emissions and identified as having negligible contributions	Not Significant
Climate Condition	Regional targets for GHGs	As above	As above	As above	As above	As above	As above	Not Significant (On Shore VEC)	As above	Minimal to Minor	• Cumulative GHG emissions including Deep Panuke predicted to be minor contribution to Nova Scotia's total GHG	Not Significant
Vegetation	Extensive areas of similar baseline vegetation present; large portions previously disturbed (forestry, mining)	Minimal to Minor	Minimal to Medium (loss of Project footprint)	NAEE	None	Minimal	NAEE	Not Significant (On Shore VEC)	Medium	Minimal to Minor	• Area within Project footprint not identified as having species of special status • Wildlife and vegetation monitoring plan and rehabilitation as required for Keltic Project	None
Species at Risk	Species specific context for respective critical habitat types	Medium (un-common horsetail) to Minor	Minimal	Minimal	Minor	Minimal	Minimal	Not Significant (On Shore VEC)	Minor	Minimal to Minor	• At risk species not confirmed at site • Uncommon / rare horsetail in LNG area not designated as Species at Risk • Migratory birds considered separately • Monitoring programs to be undertaken and if identified development of management plans/mitigation in consultation with regulatory authorities • Coordination of monitoring program with other stakeholders	Not Significant
Fish and Marine Habitat	Fresh water – small drainage; Marine – not major fishery	Minimal	Minimal	Minimal to Minor	Minimal	Minimal to Minor	Minimal to Minor	Not Assessed	Minor to Medium (fresh water) Minimal	Minimal to Minor	• Cumulative impacts not expected for water quality / habitat • Compensation required to meet No Net Loss of fish habitat for any project with potential habitat losses • • Further monitoring proposed to address assimilative capacity	Not Significant
Marine Mammals	Important marine mammals not known for area	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Not Significant	Minimal	Minimal to Minor	• Low importance of Project Area for marine mammals • Onshore construction generally separated in time from marine Deep Panuke construction • Construction related effects expected to be reversible • Operation related vessel noise not expected to cause significant effect	Not Significant

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	Ecological / Social Cultural Context [1]	Keltic LNG (Construction)[1]	Keltic Marginal Wharf (Construction)[1]	Keltic Shipping 25 km from Country Island (Construction)[1]	Keltic LNG (Operation)[1]	Keltic Marginal Wharf (Operation)[1]	Keltic Shipping 25 km from Country Island (Operation)[1]	Deep Panuke[2]	Other Keltic Projects[3]	M&NP Expansion[4]	Factor in Cumulative Assessment Significance	Overall Cumulative Significance
Wildlife and Habitat	Large available habitat area	Minor	Minor to Medium (cleared area)	NAEE	Minor	Minimal	NAEE	Not Significant (On Shore VEC)	Medium (clear-ing)	Minimal to Minor	• Available wildlife habitat in far exceeds cumulative habitat loss associated with the projects	None
Migratory Birds	Alternate nesting habitat generally available	Minor	Minimal	Minimal	Minor	Minimal	Minimal	Not Significant	Included in Wildlife	Minimal to Minor	• Mitigation measures for cumulative projects include avoiding nesting periods • Adoption of EC recommendations for Interactions with Lights and Flares and Storm-petrel Stranding Protocol • Roseate tern monitoring and integration with Recovery Plan and other project monitoring if available	Not Significant
Wetlands	Requirement for No Loss of Wetland Function	Minor	Medium to Major (wetland loss but compensated to replace function)	NAEE	Minor	None	NAEE	Not Significant (On Shore VEC)	Minor	Minimal to Minor	• Compensation required to meet No Loss of Wetland Function for any project with potential habitat losses	None
Lighting Conditions	Existing environment typically rural with low levels of lighting	None	Minor	Minimal	Minor	Minor	Minimal	Not Significant (On Shore VEC)	Minor	Minimal to Minor	• Projects in the area contributing low levels of localized 'skyglow' • Adoptions of measures to protect birds as in Migratory Bird section	Not Significant
Atmospheric and Acoustic Environment	Rural, sparsely populated	Minor	Minimal to Minor	NAEE	Minor	None	NAEE	Not Significant (On Shore VEC)	Minimal	Minimal to Minor	• Noise impacts short term • Deep Panuke construction expected to occur later than onshore works • Predicted effects for all projects none to minor • Noise modeling to be undertaken to confirm predictions	None
Traditional Use	One of 10 larger hunting areas	Minor	Minor	NAEE	None	None	NAEE	Positive / No Significant Effect (On Shore VEC)	Not identified	Minimal to Minor	• Alternate hunting/ fisheries areas available • Predicted effects for all projects none to minor	None
Heritage Sites	Heritage sites known for area	NAEE	NAEE	NAEE	NAEE	NAEE	NAEE	Positive / No Significant Effect (On Shore VEC)	Minimal to Minor	Minimal to Minor	• Increased understanding of heritage in area due to research for this and other projects in area	None
Archaeological Sites	High public sensitivity, burial sites and artefacts known for area	NAEE	Minor (un known)	NAEE	NAEE	Minor	NAEE	Positive / No Significant Effect (On Shore VEC)	Minimal to Minor	Minimal to Minor	• Increased understanding of resources in area due to research for this and other projects in area	None
Navigation	Harbour has minimal commercial traffic	NAEE	Minor	Medium (potential for collision)	NAEE	Minor	Medium (potential for collision)	Not Significant (Other Ocean VEC)	Not Assessed (see Health and Safety)	Minimal to Minor	• TERMPOL process to resolve issues arising	None
Marine Health and Safety	Limited fisheries/shipping	NAEE	Minor to Medium (increased traffic)	Medium (potential for collision)	NAEE	None	Medium (potential for collision)	Not Significant (Other Ocean VEC)	Minimal to Minor; Medium (potential for collision)	Minimal to Minor	• TERMPOL process to facilitate decreased risk of potential accidents	None

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	Ecological / Social Cultural Context [1]	Keltic LNG (Construction)[1]	Keltic Marginal Wharf (Construction)[1]	Keltic Shipping 25 km from Country Island (Construction)[1]	Keltic LNG (Operation)[1]	Keltic Marginal Wharf (Operation)[1]	Keltic Shipping 25 km from Country Island (Operation)[1]	Deep Panuke[2]	Other Keltic Projects[3]	M&NP Expansion[4]	Factor in Cumulative Assessment Significance	Overall Cumulative Significance
Human Health and Safety	Health and safety of employees and surrounding communities Existing dust and air, limited fisheries/shipping	Minimal	Minor to Medium (increased traffic)	Medium (potential for collision)	Minimal	None	Medium (potential for collision)	Not Significant (Other Ocean VEC)	Minimal to Minor; Medium (potential for collision)	Minimal to Minor	• TERMPOL process to facilitate decreased risk of potential accidents	Not Significant
Fisheries	Wharf and shipping channel in Stormont Bay not a major fishing area	NAEE	Minimal	Minimal to Minor	Not Assessed	Minimal to Minor	Minimal to Minor	Not Significant	Minor	Minimal to Minor	• Compensation for loss of fishing near construction sites	None
Aquaculture	Aquaculture facilities in Country Harbour, not in vicinity of site	NAEE	Minimal	Minimal	Not Assessed	Minimal	Minimal	Not Significant	Minimal	Minimal to Minor	• Water quality impacts not expected to be significant • Aquaculture sites beyond Study Area	None
Tourism	Eastern shore tourism sector renowned for natural beauty, coastal views, rural landscape Project Site is zoned for industrial use	Major (visual effects only), NA[6] for other tourism	Major (visual), other positive	NAEE	NA	Major (visual), other positive	NAEE	Positive (Economy)	Minor (negative) Minor to Medium (positive)	Minimal to Minor	• Visual impact of cumulative projects major but local and not expected to affect regional tourism • Tourism in general expected to benefit by improved infrastructure to the region	Not Significant

1) Section 5.0 of this document
2) Jacques Whitford Environmental Limited, 2006
3) AMEC, 2006
4) Preliminary assessment based on available information
5) NAEE – No Adverse Environmental Effect from routine works/activities
6) NA - Not Applicable

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9.0 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

9.1 INTRODUCTION

By the definition of "environmental effect" under CEAA, any change to the project that may be caused by the environment must be considered in the determination of environmental effects. As such, a federal EA is required to consider effects of the environment on the Project in addition to evaluating effects of the Project on the environment.

A significant effect of the environment on the Project would be one that results in:

- substantial delay in Project schedule during construction;
- long-term interruption in service, such as ship-to-shore product transfer at the LNG Terminal or marginal wharf;
- damage to plant and site infrastructure such that public health and safety or the environment is at risk; and
- damage to plant and site infrastructure that would not be technically or economically feasible to repair.

Minor effects of the environment on the Project would be ones that result in short-term delays in construction schedules, frequent short-term disruptions in service, and increased operating or maintenance costs.

The types of natural environmental issues or events that could have an effect on the Project during construction or operation of the plant-site components include the following:

- construction-site or shore-line erosion, seismic activity including tsunamis;
- precipitation, wind and waves;
- sea ice;
- climate change with associated sea level rise; and
- forest fires.

In anticipation of climate change including the effects of extreme weather conditions, the Project will require design parameters that reflect the increased severity and variability currently predicted. Expert advice, including that of EC, will be solicited during the FEED stage to develop appropriate design parameters.

In order to minimize these effects on the Project, mitigative measures will be employed during the design, construction, and operation of Project facilities based on appropriate environmental design criteria to ensure the safety and integrity of all facilities during severe environmental conditions, including high winds, extreme rainfall, and major marine storm surges. The EMP will incorporate these mitigative measures under its umbrella. Specific EPPs will be created addressing key mitigative measures needed during construction, operation and maintenance, and modifications and decommissioning.

Designs will incorporate an adequate factor of safety to deal with possible changes in weather severity during the lifetime of the Project, including storms and sea level rise associated with climate change. Monitoring and/or contingency planning will also serve to minimize potential adverse effects. These mitigative measures are noted in the appropriate section below.

With the implementation of mitigation measures, the environment is not expected to significantly affect the Project. The Project is not expected to experience effects to the extent that there is a long-term interruption in service, a substantial loss of Project schedule, damage to infrastructure which puts public health and safety or the environment at risk, or that there is damage to infrastructure that would not be technically or economically feasible to repair.

9.2 LNG TERMINAL, MARINE TRANSFER PIPELINES, LNG STORAGE TANKS AND THE REGASIFICATION FACILITIES

9.2.1 Erosion

Erosion of the construction site or shoreline may be caused by heavy rainfall events or significant wave action. The potential exists for failure of erosion and sediment control structures due to such precipitation events. Such a failure could result in the release of a large quantity of sediment-laden runoff to receiving watercourses with potential adverse environmental effects on fish and fish habitat. Under the EMP, the erosion and sediment control structures will be regularly monitored, particularly after a heavy precipitation event or snow melt, and remedial action will be taken as necessary.

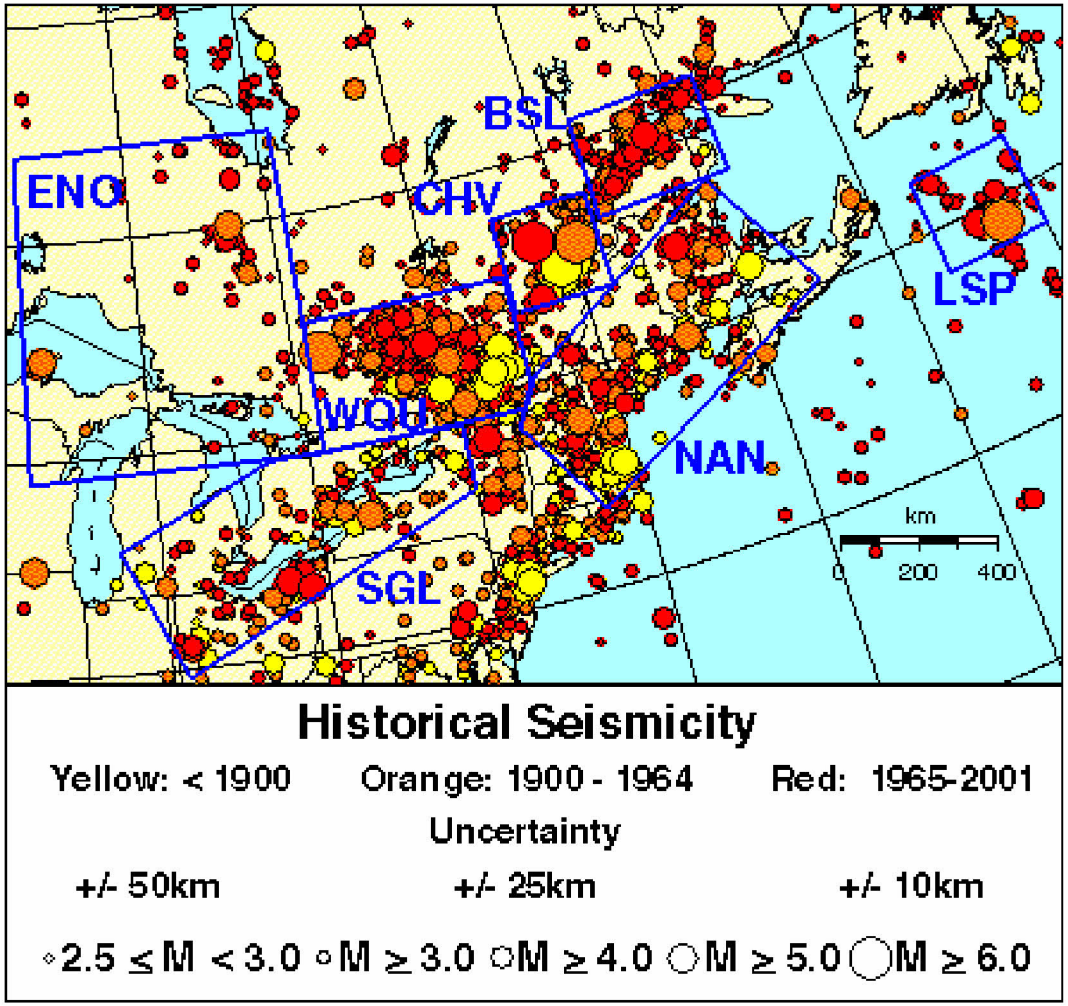
Erosion and shoreline breaches may also wash out soil beneath the pipeline trestle. This will be mitigated by supporting the pipeline on a series of independent foundations. The spacing and dimensions of the foundations will be such that, in the event of a washout along one pipeline segment, sufficient support is provided by the other foundations. In addition, operational plans will specify that no unloading activities will take place during severe weather conditions. Ongoing monitoring of the pipeline pressure will ensure that in case of a rupture, a shut down of the system is triggered.

Considering mitigative measures and the definition of significant effect on the Project as outlined in Section 9.1, the effect of erosion on this Project component is not considered to be significant.

9.2.2 Seismic Events

9.2.2.1 Background

Eastern Canada is located within a stable continental part of the North American Tectonic Plate, and as such has a relatively low rate of earthquake activity. Nevertheless, within Canada's eastern seismic region, large earthquakes have occurred in the past and will inevitably occur in the future. Figure 9.2-1 shows the size and frequency of events and boundaries of the subregions within which earthquakes occur most frequently in Canada's eastern seismic region.



Geological Survey of Canada

FIGURE 9.2-1
KELTIC PETROCHEMICALS INC.
SEISMIC SUB REGIONS
JUNE 2007

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The causes of earthquakes in eastern Canada are not well understood: unlike at plate boundary regions where the rate and size of seismic activity is directly correlated with plate interaction, seismic activity seems to be related to the regional stress fields (Ruffman, 1994), with the earthquakes concentrated in regions of crustal weakness (Bent, 1995) at depths varying from surface to 30 km (Geological Survey of Canada, 2003).

Seismic activity under the ocean could cause a tsunami, which would generate an ocean surge ("tidal wave") that may damage coastal structures or cause flooding. There are historical accounts of tsunamis occurring in Atlantic Canada. Much background information is provided in Section 8.13.5.2 of the provincial EA Report (AMEC, 2006). The tsunami that is most relevant to the proposed Project site occurred on November 18, 1929, in which a magnitude 7.2 earthquake occurred along the southern edge of the Grand Banks (epicentre of 44.5°N, 56.3°W) that was felt as far away as New York and Montreal (Geological Survey of Canada, 2005). On land, damage due to earthquake vibrations was limited to Cape Breton Island, where chimneys were overthrown or cracked, and where some highways were blocked by minor landslides. The earthquake triggered a large submarine slump that generated a tsunami that was seen in Cape Breton Island, where it did minor damage; it was physically seen as far southwest as Lunenburg, Nova Scotia, and in Bermuda. It was recorded on tide gauges as far south as Charleston in the US, in the Azores, and across the Atlantic Ocean in Portugal (Ruffman, 2001).

9.2.2.2 Seismic Hazard

The 2005 edition of the NBCC contains significant changes in the provisions for seismic loading and design (Heidebrecht, 2003). The 2005 edition of the NBCC uses a probability of exceedance of 2% in 50 years, and calculates hazard in the form of uniform hazard spectra, which provides a much better period dependent representation of earthquake effects on structures. Keltic has committed to applying a 0.0002 p.a. probabilistic ground motion design criteria.

Table 9.2-1 presents the seismic hazard for various spectral acceleration time periods as given by Adams and Halchuk (2003) for site category C (very dense soil and soft rock, $360 < V30 \leq 760$ m per second (m/s)), and seismic hazard with appropriate ground motion amplification factors as defined by Liam Finn and Wightman (2003) applied for site categories B (rock, $760 < V30 \leq 1{,}500$ m/s) and A (hard rock, $V30 > 1{,}500$ m/s) for three localities along Nova Scotia's Eastern Shore, compared to three urban areas with low to high levels of seismic hazard, i.e. Toronto, Montreal, and Vancouver (Heidebrecht, 2003).

The seismic hazard at the proposed Project Site would fall somewhere between that for Halifax and Canso, and since all important structures will have foundations built directly onto bedrock, it could be defined as a class A to B site. Even when taking into account the nearby magnitude 7.2 Grand Banks event of 1929, Figure 9.2-1 shows the seismic hazard for the Project Site to be generally low; similar to or less than site class A to B criteria for Toronto for time periods of 0.2 and 0.5 seconds, and only slightly above that for Toronto and significantly less than for Montreal for 1.0 second period events.

TABLE 9.2-1 Seismic Hazard

Site Class	Locality	Spectral Acceleration (0.2)	Spectral Acceleration (0.5)	Spectral Acceleration (1.0)	Spectral Acceleration (2.0)	Peak Ground Acceleration
C	Halifax	0.23	0.13	0.069	0.019	0.12
	Canso	0.24	0.14	0.071	0.020	0.13
	Louisburg	0.22	0.12	0.066	0.018	0.12
	Toronto	0.26	0.13	0.055	0.015	0.17
	Montreal	0.69	0.34	0.140	0.048	0.43
	Vancouver	0.94	0.64	0.330	0.170	0.46
A	Halifax	0.16	0.08	0.035	--	--
	Canso	0.17	0.08	0.036	--	--
	Louisburg	0.15	0.07	0.033	--	--
	Toronto	0.18	0.08	0.028	--	--
	Montreal	0.55	0.22	0.070	--	--
	Vancouver	0.75	0.42	0.165	--	--
B	Halifax	0.18	0.09	0.041	--	--
	Canso	0.19	0.1	0.043	--	--
	Louisburg	0.18	0.08	0.040	--	--
	Toronto	0.21	0.09	0.033	--	--
	Montreal	0.62	0.26	0.084	--	--
	Vancouver	0.94	0.54	0.231	--	--

Note: Spectral Acceleration (g) with Time Periods 0.2, 0.5, 1.0 and 2.0 sec., and Peak Ground Acceleration (g) for Normalized Site Class C and for Site Classes A, B (after Adams and Halchuk, 2003 and Heidebrecht, 2003)

9.2.2.3 Tsunami Hazard

The frequency and severity of tsunamis at the site is uncertain.

Typically, tsunamis are triggered by deep-seated earthquakes. The frequency of tsunamis in Atlantic Canada is uncertain. Ruffman (Heritage Newfoundland, 2003) suggested that earthquakes of the magnitude that triggered the 1929 tsunami are 1 per 1000 years, but could be as low as 1 per 100 years for magnitude 6.0 earthquakes. A magnitude 6.0 earthquake off the east coast would likely not be strong enough to cause a tsunami by itself, but it could cause an underwater landslide that could cause a tsunami.

Campbell et al. (2003) note that large failures occurred during the late glacial period between 20 and 10 kiloannum (ka) and appear to have a recurrence interval on the order of 2000 years. They also suggest that at present the risk of a local large tsunami appears to be low based on the occurrence of only two large failure events during the last 7000 years.

Researchers have only begun to model submarine slump-generated tsunami (Bornhold et al., 2004; Finea et al., 2005) and their possible effect on Atlantic Canada coastlines. Regarding the tsunami that was triggered by the 1929 Grand Banks earthquake, models by Murty et al. (2005a, 2005b) have shown that quarter wave resonance amplification played a major role in amplifying the tsunami in some of the bays and gulfs on the south coast of Newfoundland. Their model suggested that tsunami energy could not propagate towards Nova Scotia, mainly because of extensive sand banks east of Nova Scotia. As FEED progresses, Keltic will review available research on tsunamis and identify additional information that can be incorporated in the design of the facilities and emergency response plans.

At sea, tsunamis travel as a shallow water wave with a small height (generally less than 1 m) and usually go unnoticed. On reaching shallow water, speed diminishes but the energy in the wave remains constant, and so wave height must increase.

The foundations for the LNG tanks have been sited +15 m above sea level which gives a large margin of confidence against any tsunami wave. Historical data dating back to 1774 shows tsunamis affecting Canada's Atlantic coast have been limited to no more than three occurrences which only impacted Newfoundland's coast with a maximum 15 m water height (National Geophysical Data Centre). The sheltered on-shore facilities of the Project complex are not expected to be vulnerable to a major LNG release caused by a tsunami.

Presently, there are tsunami warning systems in the Pacific Ocean and in the Gulf Coast. To date, none are located in the Atlantic Ocean; however, one is planned near Canadian shores that will reportedly involve all Atlantic Provinces (Murty et al, 2005a). With the USA government's commitment to enhance the tsunami early warning and detection system by 2007, it is expected that sufficient advance warning will be communicated to marine vessels servicing the Keltic complex to provide them adequate disengagement time to return to the safety of the open sea before a tsunami makes landfall.

9.2.2.4 Mitigation Measures and Residual Effects

In order to minimize these effects on the Project, mitigative measures will be employed during the design and construction of Project facilities. Primarily these mitigative measures are:

- Tanks and other structures on site will be designed for the seismic rating in the region, as required under CSA Z276-01.
- All structures at the site will be built to meet or exceed relevant building codes, including the new design criteria as set out in the 2005 edition of the NBCC.
- Appropriate contingency planning will also address the possibility of structural failure which may result from ground vibration caused by a severe seismic event.
- Foundations for the LNG tanks have been sited +15 m above sea level, which is the maximum historical height for tsunamis in the region.
- During the FEED stage, the best available information will be used to estimate possible wave size and run-up in Stormont Bay and at the proposed Project Site. The results of this modeling will be used, as appropriate, in the design of the wharf and plant facilities and in developing emergency response procedures.
- A tsunami warning system is planned for the Atlantic Ocean near Canadian shores, which will provide adequate warning to Project related shipping of approaching tsunamis. Contingency plans developed for the site will include actions to be taken in the event of a tsunami warning.
- In the event of a tsunami/tsunami warning, ship-to-shore transfers would be postponed and ships would be dispatched to harbour anchorage or the open sea.

Considering the mitigative measures and the definition of significant effect on the Project as outlined in Section 9.1, the effect of potential seismic events on this Project component is expected to be significant; however, the likelihood is considered to be extremely low.

9.2.3 Precipitation and Fog

The 1982 to 2002 mean annual total precipitation for the Keltic Study Area was 1438 mm. Although rain may occur in any month of the year, rainfall in the Keltic Study Area is generally the highest during fall. Snow and freezing precipitation can occur between October and May, with the largest amounts falling between December and March. Storm precipitation events in the Keltic Study Area can be severe – the 100, 200 and 500 year 24 hour-duration events estimated to be 152 mm, 162 mm and 175 mm, respectively.

Extreme rain can result in stoppages of outdoor work, particularly during construction phases of the plant site. If unusual wet periods or excessive rain do occur, this can result in Project delays and an associated delay in completion and could result in additional capital cost. Erosion and sedimentation are addressed in Section 9.2.1.

Extreme snowfall can affect winter construction or contribute to unusual flooding during snow-melt. It has the potential to increase structural loadings on facility and temporary buildings. Exceptional early snowfall could delay construction and result in additional work for snow clearing and removal. This could increase construction costs. Early snow cover can minimize or prevent ground freezing and this may also affect winter construction intended at improving work progress and accessibility.

Dense inland fog is more prevalent in late spring and early summer. Chilled air above southerly-flowing ocean currents mixing with warm, moisture-laden air moving from the Gulf Stream can generate bands of thick, cool fog off the coast. Dense fog originating inland may reduce visibility and can interfere with the operation of vehicles on the highway. With onshore winds, fog banks can move far inland. Fog can interfere with the docking of vessels at the LNG Terminal.

The EMP will include mitigative measures for minimizing these effects of high precipitation during Project construction and operation. Project components will be designed to withstand the forces of storms, with associated precipitation, storm surge, waves and associated sea spray, as well as snowfall loading on structures. The design parameters with respect to extreme weather, including precipitation, will be determined in consultation with specialists, including EC, during the FEED stage; also the terminal's operating manual will be accessible for all operators. Measures associated with erosion are addressed in Section 9.2.1. Modern navigation aids and piloting service will minimize the effects of fog on docking and berthing at the LNG Terminal.

Considering mitigative measures and the definition of significant effect on the Project as outlined in Section 9.1, the effect of precipitation on this Project component is not considered to be significant.

9.2.4 Wind

Winds blow predominantly from the south or southwest during summer and from the northwest during winter, although severe storms, including summer hurricanes and winter "nor'easters" may generate strong winds from the northeast. High winds can also increase structural loading on large or tall structures. High winds for the Project are defined as steady wind speeds of 65 km/h, or gusts of 90 km/h (EC, 2007) with extreme winds as one-hour wind speeds of 122 km/h or 3 second gust speeds over 196 km/h for a 100-year return period (Seaconsult Marine Research Ltd., 1985). Wind borne sea spray can lead to long-term corrosion on exposed oxidizing metal surfaces and structures.

High winds could have an effect on the transfer of product to/from ships. High winds and heavy seas at reduced temperatures can cause freezing spray conditions. Freezing spray can occur between November and April; however the potential for moderate or greater vessel icing from freezing spray is greatest in February. Safe work aboard a vessel can be impeded by freezing spray, as could some work tasks at the LNG Terminal.

Due consideration to wind will be given to components design. All facilities will be fully weather proofed and designed for a full range of climatic conditions including severe wind. The design parameters with respect to wind will be determined in consultation with specialists, including EC, during the FEED stage. Regular inspection for damage due to wind will occur during construction and operation of the facility.

Also in the event of an extreme weather event, ships will not be allowed to dock or remain at the facility if sea conditions do not allow safe operation.

LNG vessels have the potential to experience severe weather conditions. High winds, dense fog, rain, or snow could potentially affect the transfer operations at the LNG Marine Terminal. If sea conditions did not allow safe operation, LNG vessels would not be allowed to dock or remain but would be dispatched to harbour anchorage.

LNG vessels will enter Stormont Bay under pilotage. The LNG vessel will be directed and moored to the LNG Marine Terminal aided by tugs. Supply ships will enter Stormont Bay and will dock against the Marginal Wharf.

The marginal wharf and LNG Marine Terminal will be designed to withstand extreme storm/wave/wind events. The design parameters with respect to waves will be determined based on the Seaconsult Marine Research Limited report in consultation with specialists, including EC, during the FEED stage. There is anchorage available in Stormont Bay if conditions are not appropriate for docking. The captain or the pilot of the ship will make decisions with respect to safe navigation at sea and when transfer activities must be postponed due to rough seas. Port communication systems will be in place to ensure procedure coordination between the captain of the vessel and LNG Terminal and marginal wharf operators.

The KDP has initiated the TERMPOL process; which is intended to result in the operation of the facilities in a manner that will protect the public and ensure environmental safety and security. Through this process the potential risks associated with accidents will be identified and plans developed to mitigate these risks. A marine risk assessment is currently underway and is incorporating the wind, wave, and storm surge events from existing information available for Stormont Bay. As part of the assessment, Keltic will also seek the advice of EC and NRCan with respect to anticipated sea-level rise and the impact on storm surge heights. Therefore, no significant impacts on marine safety and security in the Study Area are expected.

If extreme weather is anticipated or occurs during a transfer the activities will be postponed, and ships will be dispatched to harbour anchorage.

Considering mitigative measures and the definition of significant effect on the Project as outlined in Section 9.1, the effect of wind on this Project component is not considered to be significant.

9.2.5 Waves

Extreme wind can produce high waves, dense blowing sea foam, heavy tumbling of the sea, and poor visibility. Run-up waves can be produced from wind blowing over the surface of water. Maximum wave height is primarily a function of wind strength, wind duration, and length of exposed water (fetch). Substantial run-up waves can occur during extreme storm events, such as during tropical storms, hurricanes, and "nor'easters."

Stormont Bay is open to the ocean and to easterly gales that can bring large waves ashore. The predominant winds are from the Northwest and Southwest, and easterly winds at sea generally shift to northeast, thus reducing wave force within Stormont Bay. Storm surges for this Project are defined as an increase of at least 0.6 m above the normal astronomical high tide (EC, 2007). Seaconsult Marine Research Ltd. (1985) reports that a 1 in 100 year event would equate to a surge of 0.6 metres in Country Harbour. Extreme weather events can lead to storm surges of 1.5 m as was shown in the Halifax Harbour after the passing of Hurricane Juan in 2003 (Bowyer, 2003).

The LNG storage facility will be located and designed in consideration of potential wave run-up conditions. The LNG Terminal will be designed to withstand extreme storm/wave/wind events. The design parameters and detailed information with respect to waves will be determined in consultation with specialists, including EC, during the FEED and subsequent modeling stage. This modeling will include an assessment of the potential coastal impacts to Stormont Bay as a result of the Marginal wharf and LNG Marine Terminal structures. This study will specifically assess how ocean waves, river, and tidal currents may be altered by the proposed Marginal wharf and LNG Marine Terminal structures and how in turn those impacts may alter the coastal processes and physical environment of Stormont Bay (Vancouver Port Authority, 2006). The height of storm surge that can be expected in Stormont Bay ranges from .44 m to .65 m (Seaconsult Marine Research Limited, 1985), however, recent events such as Hurricane Juan indicate that the storm surges can exceed 1 m.

There is anchorage available in Stormont Bay if conditions are not appropriate for docking. The captain of the ship or when in the pilotage area, pilots will decide if navigation to / docking at the terminal is safe navigation and when transfer activities must be postponed due to rough seas. Appropriate communication systems will be in place to ensure procedure coordination between the captain of the vessel and shore-based personnel.

Considering mitigative measures and the definition of significant effect on the Project as outlined in Section 9.1, the effect of precipitation on this Project component is not considered to be significant.

9.2.6 Ice

Sea ice forms along Nova Scotia's Atlantic coast during January, February, and March, peaking in late February and March. Sea ice formed in the Gulf of St. Lawrence can also drift through the Cabot Strait onto the Scotian Shelf and pile up along the coast when winds are from the north and east. Ice accumulations occur mainly between the second week of February and the second week of May.

In the coastal area around Country Harbour, the frequency of occurrence of ice could be up to 33% during the first week of March and between 1% and 15% in February and the rest of March. In addition, ice is expected to form locally in January and February. The 30-year median of the predominant ice type is new or grey-white ice (less than 0.3 m thick) in February, grey ice (less than 0.15 m thick) during the 1st week of March, and first year ice (up to 0.7 m thick) for the rest of March (ExxonMobil, 2006).

When carried away to sea by winds and currents, the coastal ice cover melts and does not hinder navigation. The likelihood of Gulf of St. Lawrence ice occurring at the development sites is relatively low; however it is believed that a much larger proportion than 1% comes from the Gulf, especially in February and March. Sea ice, both local and from the Gulf of St. Lawrence, are considered to be potentially significant environmental factors affecting navigation and design of coastal structures. The Canadian Coast Guard Icebreaking Program would be able to support LNG marine vessels and facilities by assisting commercial vessels to voyage efficiently and safely through or around ice covered waters. With the support of the Canadian Coast Guard Icebreaking Program, most Canadian ports are open for business year-round (DFO, 2004).

Icebergs originate from glaciers in Greenland and drift with the Labrador Current and typically decay on the Grand Banks of Newfoundland. According to a few local residents, icebergs have never been seen in the Keltic Study Area. Only one iceberg has been reported in the Keltic Study Area in the last 60 years (ExxonMobil, 2006), and the probability of future iceberg occurrences is low.

The formation of ice in the shallow coastal waters must be taken into account when designing the LNG Terminal facility. Operational procedures will include a monitoring program for the presence of area ice, both local and from the Gulf of St. Lawrence, as well as the rare possibility of ice bergs in the Keltic Study Area.

Considering mitigative measures and the definition of significant effect on the Project as outlined in Section 9.1, the effect of icing on this Project component is not considered to be significant.

9.2.7 Climate Change

Global climate change has emerged as a long-term environmental challenge of global significance. Emissions of GHGs are ascribed to contribute to global warming in addition to the natural warming the earth has been subject to since its advance out of the pleistocene ice age starting about 10,000 years ago. In addition to general global temperature increases, climate change projections for the Project Area include increased precipitation, sea level rise due to thermal expansion and melting of glacial ice and overall changes in the frequency and severity of storms. Many of the aspects of climate change are covered individually in this section with the exception of sea level rise and crustal subsidence.

The extremes and variability of all of these factors, especially with the influence of climate change, require consideration in the FEED stage and subsequent construction and operation of the facility.

9.2.7.1 Background

Table 9.2-2 summarizes the climate criteria changes provided by the Canadian Institute for Climate Studies (CICS) (2006) scenario projection model as a result of global warming through to the 2080s due to natural and anthropogenic causes.

TABLE 9.2-2 CICS Scenario Projection Model Results for Nova Scotia through to the 2080s

Climate Parameter	Units of Change	Mean Annual	Winter	Spring	Summer	Fall
temperature	ºC	+4	+5	+3.5	+4.3	+3
precipitation	%	+3	+5	-4	+7	+5
Max. temperature	ºC	+4	+3.5	+4	+4	+3.5
Min. temperature	ºC	+4.2	+6.2	+4	+3.2	+3
Solar radiation	Watts per m^2 (W/m^2)	0	+1	+1	-6	0
Wind speed	%	+5	0	+14	0	+3
evaporation	mm per day (mm/d)	+0.2	-0.2	+0.7	+0.25	+0.2
Soil moisture capacity fraction	%	0	0	0	0	-0.05
Mean sea level pressure	Hectopascal (hPa)	+0.4	0	+1.3	-1	-0.2
Snow water content	Kg/m^2	0	0	0	0	0
Sea ice	Kg/m^2	0	0	0	0	0
Derived vapour pressure	hPa	+3.4	+2.2	+2.2	+4	+3.5
Derived relative humidity	%	0	0	-1	+1.5	+0.5
Derived diurnal temp. change	ºC	-0.5	-2.5	0	-0.5	0
Surface temperature	ºC	+4	+5.2	+3.8	+4	+3.5

Note: This data was based upon default model CGCM2 A21 SRES.

Global warming within this time period is expected to result in:

- a reduction in northern hemisphere snow cover and extent of sea-ice;
- global sea level rise of up to 59 cm as a result of the above;
- global changes in the frequency and intensity of extreme climate events in the north Atlantic;

- more frequent heat waves and fewer cold waves and frost days; and
- increased incidents of coastal flooding, accelerated coastal erosion and possible increased saltwater intrusion into groundwater resources.

This is just one of many climate change models. As an input to the FEED, Keltic will seek out other climate change models for consideration. CICS has expertise on techniques for evaluating other model results and considering their applicability to the future case. EC will also be contacted for advice at this stage.

9.2.7.2 Effects of Climate Change

The effects of climate change on the Project are not considered to be particularly relevant during the construction phase due to the time frame associated with climate change relative to the proposed time frame for Project construction. During Project operation, the changes noted above are expected to have an effect over time on various (sensitive) components of the natural ecosystem. An increase in extreme marine related events (including increased storm intensity, winds, ocean waves, and storm surges) could result in an increased number of operation disruptions at the LNG Terminal facilities.

It is possible that extreme events could increase the likelihood of accidents or malfunctions if structures were not designed to withstand frequent storms, which could lead to environmental impacts on marine fish, marine mammals, birds, surface water, etc. Structures will be properly designed, and appropriate mitigation measures in place to deal with the increased likelihood of such malfunctions or accidents.

Sea level rise is an important consideration for coastal projects. For example, tidal records for the Halifax region show that the mean tide level has risen approximately 0.36 m per century, or at least 40 m in the past 10,000 years (Shaw et al., 1993; Stea et al., 1994).

In 2007, IPCC's The Fourth Assessment Report IPCC projected that by 2100, global warming will lead to a sea level rise of approximately 0.2 to 0.6 m. This rise will mostly be due to warming of the oceans and glacial cap melting. This would be in addition to the 0.36 m per century already being experienced, thus a potential rise in sea level between 0.45 m and 1.25 m may occur at the site during the next century. In addition to sea-level rise caused by climate change, land is subsiding in the Maritimes by about 0.2 m per century (EC, 2004a). The LNG Terminal will not be affected by sea-level rise and crustal subsidence as allowances for sea-level rise and crustal subsidence will be incorporated in the design.

9.2.7.3 Mitigative Measures and Residual Effects

The LNG Terminal will be sited and designed to be able to withstand possible rises in sea elevations and crustal subsidence which may result from climate change. At the FEED stage, the Proponent will review various climate change models (including those of CICS) and solicit EC for advice on their applicability in order to select appropriate design parameters.

Considering mitigative measures and the definition of significant effect on the Project as outlined in Section 9.1, the effect of climate change on this Project component as currently understood is not considered to be significant.

9.2.8 Forest Fires

Two thirds of all forest fires in Canada are caused by people, the third is caused by lightning (Canadian Forest Service, 2006). However, a fire could be caused by a liquid hydrocarbon spill, another accident involving fire, carelessness, or by natural causes. The immediate concern would be for human health and safety.

The Keltic Project is registered under a number of NFPA codes, standards, and regulations associated with the prevention and protection against fire. Mitigative measures include:

- NFPA codes will be in place on Project Site: Portable fire extinguishers, Standard for installation of centrifugal fire pumps, Installation of private fire service mains, Flammable and combustible liquids code, Standard for the Installation and use of Stationary Combustion Engines and Gas Turbines, National Fuel Gas code, National Fire Alarm code, Lightning Protection code, Standard for the Installation, Maintenance and use of Public Fire service communication systems.
- Area will be clear of slash, litter, building materials, and gear for access and safety purposes.
- Mobile fire-fighting equipment will be provided by a central fire station as part of common user facilities.
- Latest technology in fire sensing will be incorporated in the facility design and will respond to appropriate fire-control centres as needed:
  - all process and storage areas will be serviced by underground pipelines and hydrants as well as strategically placed special fire-fighting equipment; and
  - operators at all process units will be located in individual control centres and will be trained as first responders for fire-fighting.

In the event a forest fire occurs, all valves will be shut off to isolate sections of the LNG facilities. Project personnel will follow proper mitigation procedures and use NFPA equipment to contain and extinguish local fires as quickly as possible until fire fighting response crews arrive. The LNG facilities will maintain safe working areas free of access debris, litter, and extraneous building materials which may catch fire.

The central administration complex will have a fully equipped fire station. The operation of the fire station will be coordinated with the local community volunteer fire departments. Local fire fighting response will be available at each of the main process areas. The existing heli-pad in the Industrial Park will be re-established at the central administration complex.

Considering mitigative measures and the definition of significant effect on the Project as outlined in Section 9.1, the effect of forest fires on this Project component is not considered to be significant.

9.3 MARGINAL WHARF

9.3.1 Erosion

The location of the marginal wharf rests on the northeast side of Stormont Bay, where wave erosion is likely to occur. Due to the coastal location of the marginal wharf, waves are one of the most widely recognized indicators of storm events and a natural hazard for shoreline erosion (Shaw, 2001). The marginal wharf will be constructed from pre-cast concrete caissons, placed on a granular stone mattress then positioned on the seabed. The marginal wharf is located in a sheltered location where rigorous waves traveling at high speeds would be less predominant; therefore, the magnitude of shoreline erosion would most likely be minimal. Erosion could potentially be caused by heavy rainfall events, large storms, significant wave action, and sea level rise. Wind and ice erosion is more severe during winter months and could potentially cause damage to the marginal wharf over the long-term.

An assessment of the stability of the slope/shoreline will be undertaken, to facilitate proper design of sediment control structures, such as erosion control blankets and armour stone. Silt curtains and booms will be used during construction to minimize siltation in the marine environment caused by shoreline erosion. Armour stone will be placed along the shoreline to ensure long term protection from wave erosion. Erosion control structures will be monitored regularly, especially after storm events, heavy precipitation, or snow melt, and corrective action will be taken as necessary. Details, including blanket thickness and the size of armour will be determined during the FEED stage.

Considering mitigative measures and the definition of significant effect on the Project as outlined in Section 9.1, the effect of erosion on this Project component is not considered to be significant.

9.3.2 Seismic Events

As described in Section 9.2.2 above, the Project location lies within a stable continental region of the North American Tectonic Plate, within Canada's eastern seismic region, large earthquakes have occurred in the past and will inevitably occur in the future. The frequency and magnitude of seismic effects (including tsunamis) at the Project location are expected to be low. However, the marginal wharf will serve as the port facility for loading and unloading large quantities of petrochemical by-products, process feed stocks and as a transport and containment vessel dockage facility; therefore, the wharf will be designed for the seismic rating in the region, as required under CSA Z276-01. In addition, all structures at the site will be built to meet or exceed the new design criteria as set out in the 2005 edition of the NBCC. Appropriate contingency planning will also address the possibility of structural failure which may result from an extreme seismic event.

In order to minimize these effects on the Project, mitigative measures will be employed during the design and construction phase. Primarily these mitigative measures are:

- The marginal wharf will be designed for the seismic rating in the region, as required under CSA Z276-01.
- All structures at the site will be built to meet or exceed relevant building codes, including the new design criteria as set out in the 2005 edition of the NBCC.

- Appropriate contingency planning will also address the possibility of structural failure which may result from a severe seismic event.
- During the FEED stage, the best available information will be used to estimate possible wave size and run-up in Stormont Bay and at the proposed Project Site. The results of this modeling will be used, as appropriate, in the design of the wharf and plant facilities and in developing emergency response procedures.
- A tsunami warning system is planned for the Atlantic Ocean near Canadian shores, which will provide adequate warning to Project related shipping of approaching tsunamis.
- In the event of a tsunami / tsunami warning, ship-to-shore transfers would be postponed and ships would be dispatched to harbour anchorage or the open sea.
- Prepare and regularly update disaster plans. Address both response and recovery issues.

Considering the mitigative measures and the definition of significant effect on the Project as outlined in Section 9.1, the effect of potential seismic events on this Project component is expected to be significant; however, the likelihood is considered to be extremely low.

9.3.3 Precipitation and Fog

The Atlantic Ocean influences climate surrounding the Keltic Study Area, causing consistent precipitation, thick fog, and sea ice annually. The marginal wharf extends into Stormont Bay and further the Atlantic Ocean to the southeast, where effects from extreme rainfall could result in stoppages of outdoor work on the marginal wharf facility. The marginal wharf is required for receipt and shipment of products and by-products and will also receive supplies and equipment during construction of the entire complex. The wharf is a highly important element of the Project; however heavy rain, fog, freezing rain, hail, ice, and snow can interfere with the operation of the marginal wharf and LNG marine terminal. Slippery conditions and limited visibility may cause concern when service crafts (tugs, pilot, vessel, etc) require docking on the north and western side of the marine facility, along with the roll-off dock for unloading of equipment and materials from ships during construction

Precipitation is common year-round in Nova Scotia, however rainfall is slightly greater in late fall and early winter because of the more frequent and intense storm activity. Storm precipitation events in the Keltic Study Area can be severe, quite possibly causing the marginal wharf to be slippery, icy, and unsafe during construction phases and operation. Snow and freezing precipitation can occur between October and May, with the largest amounts falling between December and March. If unusual wet periods, fog, or excessive rain occur during construction, this could result in Project delays and an associated delay in completion and could result in additional capital cost.

Periods from mid-spring to early summer are typically the foggiest. Bands of thick, cool fog lie off the coast created when chilled air above southerly-flowing ocean currents mixing with warm, moisture-laden air moving from the Gulf Stream. Dense fog originating inland may reduce visibility and can interfere with the operation and navigation of vessels approaching the marine facilities. With onshore winds, fog banks can move far inland. Fog can interfere with the docking of vessels at the marginal wharf.

The EMP will include mitigative measures for minimizing the effects of high precipitation during Project construction and operation. Project components will be designed to withstand the forces of storms, with associated precipitation, storm surge, waves and associated sea spray, as well as snowfall loading on structures. The design parameters with respect to extreme weather, including precipitation, will be determined in consultation with specialists, including NRCan and EC, during the FEED stage. Measures associated with erosion are addressed in Section 9.3.1 above. Modern navigation aids and piloting service will minimize the effects of fog on docking and berthing at the marginal wharf.

Considering mitigative measures and the definition of significant effect on the Project as outlined in Section 9.1, the effect of precipitation on this Project component is not considered to be significant.

9.3.4 Wind

A variety of weather conditions from hurricane–force winds to heavy precipitation can pass rapidly through areas of Nova Scotia or suspend over a region for days. Nova Scotia frequently experiences storms which pass close to the Atlantic coast, producing highly changeable and often stormy weather. According to Atlantic Climate Centre, “the wind at any given location is often quite different from the wind conditions which prevail even a short distance away. The variation between wind direction and speed results from the characteristics of natural and manmade obstructions, topography, and surface cover.” Winds blow predominantly from the south or southwest during summer with an average speed of about 10 to 15 km/h. In the coldest months the predominant direction is from the west and northwest with an average speed of 22 km/h (EC, 2005a). Severe storms, including summer hurricanes and winter “nor’easters”, may generate strong winds from the northeast.

Extreme weather events have the potential to delay construction and create damage to the marginal wharf and the following marine structures: supports along the southeast side of the LNG pipeline and vapour return pipeline, along with the containment structure, warehouse facility, and roll-off dock for unloading. The purpose and design of the marginal wharf structure extends off the shoreline into Stormont Bay to receive and ship products therefore it has greater exposure to wind and extreme weather events than in-shore facilities. Marginal wharf construction materials, such as concrete caissons and a granular mattress have been chosen appropriately to suit and withstand a variety of weather conditions.

Extreme weather events may include high wind speeds, heavy rainfall or snowfall, hail, lightning, and fog. High wind speeds are an important element and indicator of storms and cause rough waters, waves, and surges. High winds and heavy seas at reduced temperatures can cause freezing spray condition between November and April. In winter months, sea spray will freeze, creating unsafe conditions on the marginal wharf which could lead to work stoppage.

To minimize effects on the marginal wharf, extra precaution will be taken during high wind storms to reduce damage during transfer of product to/from ships. The EMP will specify regular inspection for damage or unsafe working conditions due to wind during construction and operation. Due consideration to wind will be given to component design; ensuring all structures on the marginal wharf facility are extremely secure, and provide the greatest possible protection to operators from dangerous high wind/freezing spray conditions.

Considering mitigative measures and the definition of significant effect on the Project as outlined in Section 9.1 the effect of wind on this Project component is not considered to be significant.

9.3.5 Waves

The coastal location of Stormont Bay is open to the ocean and to easterly gales that can bring large waves ashore. However, winds travel mainly from the Northwest and Southwest, and easterly winds at sea generally shift to northeast, thus reducing wave force within Stormont Bay. Ocean waves are one of the most widely recognized indicators of storm activity and constitute a significant natural hazard for shoreline erosion and infrastructure damage in coastal settings (Shaw, 2001). The marginal wharf, situated at the mouth of Isaac's Harbour will be exposed to waves impinging on shore and crashing upon the wharf structure. Large buoys or tires will be placed along sides of the marginal wharf to protect all service craft from damage caused by wave motion. LNG vessel navigation and docking procedures for the Keltic facility as well as other necessary marine operational manuals will be developed through the TERMPOL process, through consultation with Canadian Coast Guard, TC, and the Atlantic Pilotage Authority.

In the event of a winter storm; a variety of weather conditions from freezing spray, high gusting winds, heavy storm surges, choppy waves, sea foam, rain, fog, and poor visibility could cause docking and navigation problems for vessels. Winds associated with nor'easter winter storms can create peak wave heights as high as 14 m. If extreme wave conditions are anticipated or occur, ships will not be allowed to dock or remain at the facility if sea conditions do not allow safe operation. If extreme weather occurs during a transfer the activities will be postponed, and ships will be dispatched to harbour anchorage.

The marginal wharf will be designed to withstand extreme storm/wave/wind events. The design parameters with respect to waves will be determined in consultation with specialists, including EC, during the FEED stage. There is anchorage available in Stormont Bay if conditions are not appropriate for docking. The captain of the ship will make decisions with respect to safe navigation at sea and when transfer activities must be postponed due to rough seas. Appropriate communication systems will be in place to ensure procedure coordination between the captain of the vessel and marginal wharf operators.

Considering mitigative measures and the definition of significant effect on the Project as outlined in Section 9.1, the effect of waves on this Project component is not considered to be significant.

9.3.6 Ice

As described in Section 9.2.6 above, ice accumulations occur mainly between the second week of February and the second week of May. Sea ice, both local and from the Gulf of St. Lawrence, is considered to be potentially significant environmental factors affecting navigation and design of coastal structures. The formation of ice in the shallow coastal waters must be taken into account when designing the marginal wharf. Operational procedures will include a monitoring program for the presence of area ice, both local and from the Gulf of St. Lawrence, as well as the rare possibility of ice bergs in the Keltic Study Area.

Impacts of sea ice are important to note, in the event that thick sea ice formation is prevalent surrounding the marginal wharf. Ice ride-up could occur, causing corrosion and weathering on the marginal wharf structure. De-icing the marginal wharf could require a fairly large amount of time during winter conditions, to ensure safe surfaces for operators. However, a large amount of sea ice forming in Stormont Bay is improbable as it rests in a protected location.

The bitter Atlantic winter weather can bring harsh challenges for ships navigating on the east coast of Canada. The Icebreaking Program would be able to support LNG marine vessels and facilities by assisting commercial vessels to voyage efficiently and safely through or around ice covered waters. With the support of the Canadian Coast Guard Icebreaking Program, most Canadian ports are open for business year-round (DFO, 2004).

Considering mitigative measures and the definition of significant effect on the Project as outlined in Section 9.1, the effect of icing on this Project component is not considered to be significant.

9.3.7 Climate Change

The United Nations Framework Convention on Climate Change 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." Cumulative effects of climate change have implications toward the world's oceans, changes in sea level, threatening the loss of fish habitat and species, flooding of property, shoreline erosion, contamination of coastal water supplies, and a reduced visibility of ports. Higher sea levels could increase coastal erosion and damage from storm surges, and present problems for coastal infrastructure. The extremes and variability of factors listed above require consideration in the FEED stage and subsequent construction and operation of the Keltic Project.

9.3.7.1 Effects of Climate Change

The effects of climate change on the Project are not considered to be particularly relevant during the construction phase due to the time frame associated with climate change relative to the proposed time frame for Project construction. An increase in extreme storm intensity, winds, ocean waves, and storm surges could result in an increased number of operation disruptions at the marginal wharf.

Sea level rise is an important consideration for coastal Projects. As described in Section 9.2.7.2 above, a potential rise in sea level between 0.45 m and 1.25 m may occur at the site during the next century; which could impact operations and design requirements.

The marginal wharf will be sited and designed to be able to withstand possible rises in sea elevations which may result from climate change. At the FEED stage, the Proponent will review various climate change models (including those of CICS) and solicit EC for advice on their applicability in order to select appropriate design parameters.

Considering mitigative measures and the definition of significant effect on the Project as outlined in Section 9.1, the effect of climate change on this Project component as currently understood is not considered to be significant.

9.3.8 Forest Fires

A forest fire could be caused by a liquid hydrocarbon spill, another accident involving fire, carelessness, or by natural causes. The marginal wharf is not directly surrounded by forested areas; however fire can easily spread from on-shore toward marine facilities. The immediate concern for a fire would be for human health and safety.

The Keltic Project is registered under a number of NFPA codes, standards, and regulations associated with the prevention and protection against fire. Mitigative measures include:

- NFPA codes will be in place on Project Site: Portable fire extinguishers, Standard for installation of centrifugal fire pumps. Installation of private fire service mains, Flammable and combustible liquids code, Standard for the Installation and use of Stationary Combustion Engines and Gas Turbines, National Fuel Gas code, National Fire Alarm code, Lightning Protection code, Standard for the Installation, Maintenance and use of Public Fire service communication systems.
- Area will be clear of slash, litter, building materials, and gear for access and safety purposes.
- Mobile fire-fighting equipment will be provided by a central fire station as part of common user facilities.
- Latest technology in fire sensing will be incorporated in the facility designs and will respond to appropriate fire-control centres as needed:
    - all process and storage areas will be serviced by underground pipelines and hydrants as well as strategically placed special fire-fighting equipment; and
    - operators at all process units will be located in individual control centres and will be trained as first responders for fire-fighting.

In the event a forest fire occurs, all valves will be shut off to isolate sections of the LNG transfer pipeline heading toward the LNG storage tanks. Marginal wharf operators will follow proper mitigation procedure and use NFPA equipment to contain and extinguish the fire as quickly as possible until local fire station response arrives. The marginal wharf will maintain a safe working facility with no access debris, litter, and extraneous building materials lying on deck to catch fire.

The central administration complex will have a fully equipped fire station. The operation of the fire station will be coordinated with the local community volunteer fire departments. Local fire fighting response will be available at each of the main process areas. The existing heli-pad in the Industrial Park will be re-established at the central administration complex.

Considering mitigative measures and the definition of significant effect on the Project as outlined in Section 9.1, the effect of forest fires on this Project component is not considered to be significant.

9.4 PROJECT RELATED SHIPPING WITHIN 25 KM OF COUNTRY ISLAND

Effects of the environment on Project related shipping has included the area within 25 km of Country Island in order to ensure consideration of any potential effects in the context of the presence of a roseate tern colony on the Island. This population was listed by COSEWIC as threatened in Canada in 1986 and as endangered in the USA in 1987 (United States Fish and Wildlife Service, 1987).

During operations of the Keltic facility, the movement of large ships close to Country Island is restricted because of the presence of seabirds. No ships will approach within 200 m of the island (as per the Roseate Tern Recovery Plan), unless in an emergency situation. The final location of the shipping lanes will be determined through consultation with TC and follow TC Marine Safety's Development of Routing Standards (TP 1802 E) http://www.tc.gc.ca/marinesafety/tp/TP1802/menu.htm. Under normal circumstances, Project related shipping can avoid significant impacts on seabirds given the relatively infrequent passage of ships through the area. The following sections will consider if effects of the environment on the Project could alter this condition.

9.4.1 Seismic Events

The potential for seismic events in the Keltic Project Area has been described in Section 9.2.2 above. It is possible that ships could experience the effects of tsunamis while at sea, however, tsunamis travel in open water as a shallow water wave with a small height (generally less than 1 m) and usually go unnoticed.

On reaching shallow water, tsunami wave height increases. Therefore, it is possible that tsunamis could affect shipping operations at the LNG Terminal or marginal wharf. A tsunami warning system is planned near Canadian shores that will reportedly involve all Atlantic Provinces (Murty et al, 2005a). It is expected that sufficient advance warning will be communicated to marine vessels servicing the Keltic complex to allow adequate disengagement time to return to the safety of the open sea before a tsunami makes landfall. It is possible that tsunami events could cause short-term delays and minor route alterations in shipping activities but not in any way that would affect the roseate tern colony or other environmental components.

9.4.2 Precipitation and Fog

Local precipitation and fog conditions have been described in Section 9.2.3 above. Extreme weather including heavy precipitation or dense fog banks can interfere with vessel navigation or increase the likelihood of accidental events.

The EMP will include mitigative measures for minimizing the effects of high precipitation during Project construction and operation. Navigation aids and piloting service will minimize the effects of fog on navigation and safety in the shipping lanes. Appropriate communication systems will be in place to ensure procedure coordination between the captain of the vessel and shore-based personnel.

9.4.3 Wind

Stormont Bay receives strong winds, especially in the colder months, blowing most frequently from the west or northwest as the cold arctic air approaches (NSMNH, 1996a and b). This could have great impacts on shipping as a vessel might stray off-course. Country Island hosts one of the few breeding populations of roseate terns. Ships are not permitted within 200 m of the island (as per the Roseate Tern Recovery Plan), unless in an emergency situation. Tern colonies are particularly vulnerable to disturbance. The birds startle easily, flying up from their nests, and leaving their chicks and eggs vulnerable to gulls, crows, and other predators, or to hypothermia.

Many times high wind events are compounded by low visibility. This could make navigation at sea and the avoidance of sensitive areas difficult. During high winds, a ship could be blown off-course bringing it close enough to Country Island to disturb the sensitive population of roseate terns. In addition, terns may become disoriented themselves and risk flying into the lights of ships passing nearby.

Shipping lanes will be established in consultation with TC in accordance with TP 1802 Routing Standards and the CWS to keep ships away from the island and its population of endangered roseate terns. Modern navigation aids and piloting service will minimize the effects of extreme weather on navigation in the shipping lanes. Therefore, the effects of wind on vessel navigation are not expected to be significant, i.e., are not expected to have significant consequential effects on the Country Island roseate tern colony.

9.4.4 Waves

The Atlantic Ocean has some of the world's busiest shipping lanes; however LNG shipping transport is extremely regulated through strict international standards set out by the IMO. In the event extreme winds create high waves, surrounding Country Island, LNG shipping tankers would take precautions.

The size and capacity of LNG shipping vessels will be able to withstand stormy conditions, with high winds and run-up waves; however proper anchoring systems and mitigation procedures must be in place. TC, working through the TERMPOL process and with appropriate agencies, advocates increased international measures aimed at providing navigational aids, and pilots in emergency situations. When combined with mitigation for effects from other types of extreme weather, waves are not expected to cause significant effects on navigation that could have significant consequential effects on the Country Island roseate tern colony.

9.4.5 Ice

The Nova Scotia current is a smaller coastal movement of cool water from the Gulf of St. Lawrence along the Scotian Shelf to the Gulf of Maine (Draper, 2002). Sea ice forms along Nova Scotia's coast during January, February, and March. More specifically, the frequency of ice Stormont Bay receives could be up to 33% during the first week of March and between 1% and 15% in February and the rest of March. It is important to consider that a large proportion of sea ice comes from the Gulf of St. Lawrence, especially in February and March, along with local ice forming in January and February. The 30-year median of the predominant ice type is new or grey-white ice (less than 0.3 m thick) in February, grey ice (less than 0.15 m thick) during the 1st week of March, and first year ice (up to 0.7 m thick) for the rest of March (ExxonMobil, 2006) .

Sea ice has not been predicted to obstruct navigation of shipping vessels near Country Island. The coastal ice cover melts when it's carried away to sea by winds and currents. The likelihood of Gulf of St. Lawrence ice occurring at development sites is very low. However, formation of ice in shallow coastal waters, surrounding Country Island must be taken into account. The LNG shipping tankers 700 m available turning radius increases the potential for collisions between fixed objects, such as Country Island. Risk reduction and mitigation include control of ships by tug escort into Stormont Bay and where there is an increased mobility in sea ice conditions by contacting Canadian Coast Guard Officials.

While it is possible that icing could cause short-term delays and minor route alterations in shipping activities, no additional significant impacts on navigation are anticipated that could cause significant consequential effects on the Country Island roseate tern colony or other environmental components.

9.4.6 Climate Change

The potential effects of climate change in the Keltic Project Area have been described in Section 9.2.7 above. The only potential effect of climate change on Project related shipping would be an increase in the frequency or severity of extreme weather events or changes in sea ice conditions. As described in the preceding sections, these factors could cause short-term delays or minor alterations in shipping activities but would not cause significant consequential affects on the Country Island roseate tern colony or other environmental components.

10.0 ENVIRONMENTAL EFFECTS OF ACCIDENTS & MALFUNCTIONS

This section provides a summary of the potential malfunctions and accidents that could occur at the Project facilities, the potential effect of these incidents on the environment, and mitigation measures that will be implemented as part of the Project design. The following potential scenarios were assessed:

- hydrocarbon and hazardous material spills;
- LNG releases;
- forest fires;
- discharge of sediment to environment;
- discharges from ships;
- grounding of ships; and
- risk of accidents during decommissioning.

These scenarios have been identified by CEAA as the most relevant potential malfunctions and accidents that may occur for Project components presented in this CSR. As a first step in their assessment, the VECs identified in Section 2.5.2.3 were reviewed for each of the above scenarios to identify those VECs that may be affected by one or more malfunction or accident scenarios. Those VECs for which such an interaction was considered plausible (Table10.0-1) were carried forward for a detailed assessment (Sections 10.1 to 10.3). The assessment of malfunctions and accidents addresses all three phases of the Project, i.e., the construction phase, operation phase and decommissioning phase.

During the construction phase, the potential for malfunctions and accidents related to the proposed Project components are similar to any other large construction site. They can occur as a result of the use of machinery and equipment, and in particular, the storage of fuels and lubricants and refuelling procedures.

During the operations phase, malfunctions specifically related to the transport, handling and storage of LNG and the transport of natural gas by pipeline may occur. This is in addition to conventional accidents related to operating and maintaining process equipment (i.e., working on energized systems, welding, and cutting, working at height or in confined spaces). Accidents may also occur as a result of increased marine vessel and vehicular traffic required to transport LNG to the jetty or petrochemical plant supplies to and products from the marginal wharf.

10.1 LNG TERMINAL, MARINE TRANSFER PIPELINES, LNG STORAGE TANKS AND THE REGASIFICATION FACILITIES

Accidents and malfunctions that could occur at the LNG Terminal, marine transfer pipelines, LNG storage tanks, and Regasification facilities include all of the identified scenarios:

- hydrocarbon and hazardous material spills;
- LNG releases;
- forest fires;

TABLE 10.0-1 Interactions Between Accidents & Malfunctions and ECCs

ECC	LNG Terminal, Marine Transfer Pipelines, LNG Storage Tanks & Regasification Facilities						Marginal Wharf						Project Related Shipping Within 25 km of Country Island		
	Hydrocarbon & Hazardous Material Spills	Accidental Forest Fires	Discharge of Sediment to Marine Environment	Discharges From Ships	Grounding of Ships	Risk of Accidents & Malfunctions During Decommissioning	Hydrocarbon & Hazardous Material Spills	Accidental Forest Fires	Discharge of Sediment to Marine Environment	Discharges From Ships	Grounding of Ships	Risk of Accidents & Malfunctions During Decommissioning	Hydrocarbon & Hazardous Material Spills	Discharges From Ships	Grounding of Ships
Hydrology															
Freshwater Quality/Quantity	√	√				√									
Groundwater Quality/Quantity	√					√									
Marine Water Quality	√		√	√	√	√	√		√	√	√	√	√	√	√
Soil/Sediment Quality	√					√	√					√	√		
Air Quality	√	√				√	√					√	√		
Climate Conditions															
Vegetation (terrestrial & marine)	√	√		√		√	√				√	√	√		√
Species At Risk	√	√		√	√	√	√				√	√	√		√
Fish & Fish Habitat (marine & fresh)	√	√	√	√		√	√		√	√	√	√	√	√	√
Marine Mammals	√		√	√		√	√		√	√	√	√	√	√	
Wildlife & Habitat	√	√				√									
Migratory Birds & Habitat	√	√		√	√	√	√			√	√		√		√
Wetlands															
Lighting Conditions															
Atmospheric & Underwater Acoustic Environment															
Physical & Cultural Heritage[1]															
Current Use of Lands & Resources for Traditional Purposes – Aboriginal Persons	√	√				√	√					√			

ECC	LNG Terminal, Marine Transfer Pipelines, LNG Storage Tanks & Regasification Facilities						Marginal Wharf						Project Related Shipping Within 25 km of Country Island		
	Hydrocarbon & Hazardous Material Spills	Accidental Forest Fires	Discharge of Sediment to Marine Environment	Discharges From Ships	Grounding of Ships	Risk of Accidents & Malfunctions During Decommissioning	Hydrocarbon & Hazardous Material Spills	Accidental Forest Fires	Discharge of Sediment to Marine Environment	Discharges From Ships	Grounding of Ships	Risk of Accidents & Malfunctions During Decommissioning	Hydrocarbon & Hazardous Material Spills	Discharges From Ships	Grounding of Ships
Archaeological, Paleontological or Architectural Significance[1]	√	√	√												
Navigation	√				√	√	√				√	√	√		√
Marine Safety & Security	√				√	√	√				√	√	√		√
Human Health & Safety	√	√		√		√	√					√	√		
Fisheries	√		√	√	√	√	√		√	√	√	√	√	√	√
Aquaculture	√		√	√	√	√	√		√	√	√	√	√	√	√
Tourism	√					√	√					√	√		

Notes:
1 Sites will be identified and protected from Project impacts.

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- discharge of sediment to environment;
- discharges from ships;
- grounding of ships; and
- risk of accidents during decommissioning.

The following text briefly discusses the circumstances of each scenario and evaluates the likely environmental effects on potentially affected VECs. Mitigation and management measures are identified and taken into consideration in the final determination of the significance of the effect.

10.1.1 Hydrocarbon and Hazardous Material Spills

10.1.1.1 Spills of Hydrocarbons (excluding LNG) and Hazardous Materials

The potential for spills of hydrocarbons and hazardous materials exists for all phases of the Project. During the construction and commissioning phases, the potential for spills is limited to materials used in site preparation, and fabrication and installation of the facilities and equipment. For example, gasoline, diesel fuel, propane, grease, motor oil, and hydraulic fluids are all needed for heavy equipment required for site preparation. Construction of the facilities will also require hazardous materials such as acetylene, oxygen and other compressed gases, form oil, paints, epoxies, concrete additives, glycol/methanol, cleaners, and solvents.

The probability of spills and the effects of spills, in the event that they occur, will be reduced by a number of design, mitigation, and contingency planning measures (see Sections 10.1.1.4 and 10.1.1.5). These include for example:

- The implementation of hazardous materials management processes and procedures. The handling of fuel and other hazardous materials will comply with the *Transportation of Dangerous Goods Act.*
- Bulk storage of all fuel products, concrete additives and other hazardous materials in aboveground, self-dyked tanks or drums with secondary containment.
- Maintenance of a complete inventory of all fuels and hazardous materials.
- Handling of fuels and other hazardous materials only by persons who will be trained and qualified in handling these materials.
- Implementation of WHMIS to ensure proper handling and storage is achieved.

During the operations phase, the potential for spills relates to most of the materials identified for the construction phase and will be managed similarly. The hazardous material unique to the operations phase is LNG, which is discussed separately in the following section.

10.1.1.2 LNG Releases

The potential for LNG releases is only applicable during the operation phase of the Project. LNG is comprised of methane, with fractional amounts of ethane and propane. It is odourless, colourless, non-corrosive, and non-toxic. Release of cryogenic LNG due to spills, leaks, or

intentional draining can expose facility personnel to several hazards. These hazards include oxygen deficiency, freezing injuries, fire hazards, and air-gas mixtures.
LNG releases can occur:

- from various components of the process;
- during unloading of LNG from vessels;
- from the site pipelines;
- from marine vessel accidents;
- from accumulation of gas in a confined space; and
- as a result of sabotage or terrorist attacks.

LNG Properties and Behaviour

LNG spills do not pose an explosion risk unless the spill occurs in an uncontrolled confined space. Natural gas has a relatively low reactivity and low burning speed. Because of its narrow flammability range (i.e. 5 – 15 volume % in air), unconfined clouds of natural gas generated by an outdoor leak of LNG spill present little danger of explosion. Natural gas is lighter than air and quickly mixes into the surrounding air, forming an air-gas mixture that is below its Lower Flammable Limit. If ignition from an external ignition source should occur, burning will take place only along the air/gas interface where the mixture is above the Lower Flammable Limit. Flame speeds in unconfined natural gas clouds (about 4 to 10 m/s) are far below those that would produce dangerous overpressure or an explosive event. A flash or detonation is considered very unlikely.

Natural gas presents the greatest safety risk when gas leaks or LNG spills occur in confined areas. Confinement, such as an enclosed compressor building, can allow flammable vapour to accumulate and increases the possibility of ignition and the risk of localized damage. Once ignited, pressure will build in the enclosed area; however, flame speeds decelerate rapidly beyond the boundaries of the confinement and limit the extent of potential damage and injuries. The risk of explosion in a confined space is minimized by providing good ventilation in structures that contain or possibly contain natural gas. Ventilation allows the naturally rising natural gas to escape and dilute below its flammability range. Gas-detection equipment will enable operator control to prevent fires and explosions. (For other design, mitigation and contingency planning measures refer to Sections 10.1.1.4 and 10.1.1.5).

LNG boils when the released liquids contact warmer surfaces such as concrete or soil. The rate of boiling is rapid initially but decreases as the surfaces in contact with the liquid cools. The gas evolved mixes with the surrounding air to form three types of mixtures:

1. Near the surface of the liquid, the mixture of gas and air will be too rich in hydrocarbons to burn.
2. A distance away from the liquid surface, the mixture of gas and air will be too dilute in hydrocarbons to burn.

3. Between these two non-flammable mixtures, there is a flammable air-gas mixture. The flammable range of natural gas in air is approximately 5 to 15% by volume. Ignition of this mixture will result in a flame, which travels to the source of the gas.

LNG vapours will be heavier than air at temperatures of -107°C or below and will tend to spread out laterally along the ground rather than rise vertically. As the cloud warms above -107°C, its density becomes less than air and the cloud will rise. Atmospheric water vapour will condense to form a localized white cloud or fog as the air and cold gas mix. The flammable air-gas mixture can exist inside or outside of the visible cloud. The dispersion of the cloud depends on atmospheric and wind conditions as well as the rate at which the vapour is released or generated. Gas, at concentrations above its Lower Flammable Limit, can exist for a considerable distance from its source.

Natural gas produced from LNG is odourless. Odourizer is typically only added just inside battery limits of the regasification process on the natural gas send-out pipeline. For this reason, fixed and portable combustible gas detection equipment is provided within the natural gas and LNG process and handling areas.

10.1.1.3 Potential Environmental Concerns of Spills of Hydrocarbons, LNG, and hazardous Materials

Accidental Spills of Hydrocarbons, LNG, and hazardous Materials could result in potential adverse environmental effects on numerous VECs (see Interaction Matrix Table 10.0-1). These interactions are briefly discussed below.

Effects on Freshwater Quality/Quantity

Spills of hydrocarbons, LNG, and hazardous materials to the freshwater environment have the potential to result in freshwater habitat loss, avoidance of habitat, and direct mortality of freshwater species. Spills of other hazardous materials, including fuels, lubricants, solvents and concrete, may temporarily degrade water quality and subsequently affect fish, through mortality, avoidance of habitat, and disruption of feeding and migration patterns.

The likelihood of impacts will be reduced through the designation of fuel storage and refuelling areas at locations at least 30 m from watercourses and fish habitat and through the development of emergency spill response measures. Given the potential environmental effects from release of LNG, hydrocarbons, or other hazardous material into fresh or marine waters, combined with proposed mitigation and contingency plans (Sections 10.1.1.4 and 10.1.1.5), the potential for environmental effects from a spill is considered unlikely.

Effects on Groundwater Quality/Quantity

The accidental spill of a hazardous liquid during construction or operation could render the groundwater resource unusable for a long period if the spill was sufficiently large. A release of hazardous materials may result from leaks from construction equipment, accidents involving fuel or other hazardous material storage or transport, or from leaks from facilities and pipelines. The likelihood of a large hazardous material spill, however, is considered low due to environmental protection procedures to be applied in the EPP, and the implementation of the design and operational safeguards discussed in Section 10.1.1.4 and the contingency and emergency response procedures described in Section 10.1.1.5. In addition, there are no wells downgradient of the LNG facilities. Given the proposed mitigation and the low risk for impact, the environmental effect of a hazardous material spill on groundwater is considered not significant.

Effects on Marine Water Quality/Quantity

The accidental release of a hazardous liquid into the marine environment could result from an accident involving tankers and other marine vessels at the terminal, or an event involving offloading at the terminal. Hazardous materials may include oil, fuels, lubricants, and LNG. Although there is no industry history of a substantial release of LNG into the marine environment (Section 10.1.1.4), the expected behaviour of an LNG spill on water is described in Section 10.1.1.2. An LNG spill would not affect marine water quality, as the material is not persistent or toxic. Boiling and cryogenic effects are physical effects and are short-term in duration. Spills of other petroleum products would degrade marine water quality. Effects on marine water quality have the potential to result in impacts to fish, marine mammals, fisheries and aquaculture, which are addressed separately subsequent sections.

Effects on Soil/Sediment Quality

Spilled contaminants can accumulate in soils and sediments and be mobilized into groundwater and surface waters slowly over time affecting water quality and fish and fish habitat. The likelihood of a large hazardous material spill, however, is low due to environmental protection procedures established in the EPP, and the implementation of numerous design and operational safeguards (Section 10.1.1.4) and the contingency and emergency response procedures (Section 10.1.1.5). The potential for adverse effects is considered not significant.

Effects on Air Quality

Spills of hydrocarbons, LNG, and hazardous materials have the potential to result in temporary effects on air quality, manifesting as odours, cloud of vapourized LNG, or fire if an ignition source is present. The effect of such events on human health and safety is addressed separately, below.

The effects of process upset events may include minor emissions of PM and combustion gases from equipment and small fugitive releases of natural gas from valves and flanges. Given the mitigation and effect management measures that will be incorporated with the design, operation and management of the Project (Section 10.1.1.4; see also Sections 2.2.4.1 and 2.2.4.2) these types of emissions are expected to be nominal and the environmental effects minimal, i.e., not significant.

Effects on Vegetation

Hazardous material spills may, depending on the toxicity of the substance, cause direct or indirect mortality of vegetation, by oiling plant surfaces or contaminating plant surfaces, water, or soil or in the case of LNG, possible freezing effects. Impacts to vegetation would be limited to areas in direct contact with spilled material and direct impacts on vegetation are unlikely as the spills would most likely occur and be contained in developed areas of the site. Given the proposed mitigation and the risk for impact, the environmental effect of a hazardous material spill on vegetation is considered not significant.

Effects on Species at Risk

Hazardous material spills may, depending on the toxicity of the substance, cause direct or indirect mortality of species at risk, by contaminating water, soil, or food sources. Chemicals may be directly absorbed through dermal contact or ingested. The only species at risk known to occur in the area is the roseate tern, which nest on Country Island, approximately 10 km from the facility. Given the distance from the facility, the risk for effect on the terns from a hazardous material spill or release of LNG at the terminal is considered unlikely. However, although unlikely, the loss of a single species at risk would be considered significant. Nonetheless, with spill prevention measures to be implemented (Section 10.2.1.2) the potential for large scale and frequent accidents is expected to be low. Furthermore, in the unlikely event of a spill, emergency response planning (Section 10.2.1.3) will considerably reduce the potential effect on avian species at risk, including the roseate tern. Given the proposed mitigation measures and the low risk for impact, the environmental effect of a hazardous material spill on species at risk is considered not significant.

Effects on Fish and Fish Habitat

A spill of LNG has the potential to effect biota present at the air/water interface and in intertidal habitat (if a spill reaches shore) during the cryogenic stage (as described under 10.1.1.2 LNG Properties and Behaviour, above). As effects decrease with water depth, and LNG is not persistent and is not toxic to marine biota, an LNG spill is not predicted to have a significant effect on marine fish or fish habitat. An LNG spill is considered to have significantly less severe environmental effects to fish and fish habitat than a spill of hazardous materials such as fuel, oil, and lubricants.

A spill of hazardous materials such as fuels and lubricants into or near a watercourse or the marine environment could temporarily degrade water quality and have subsequent effects on freshwater and marine fish and habitat. Contaminants can also accumulate in sediments and subsequently be mobilized over time, also affecting fish. The effects of a major spill at or near a watercourse could extend downstream, depending on material quantity and toxicity. Fish mortality could occur at all life stages in the affected area. Other effects could include avoidance of the habitat, and disruption of feeding and migration patterns. The magnitude of an effect of a spill is dependant on a number of variables; however, considering mitigation including spill prevention (Section 10.2.1.2) and emergency response planning (Section 10.2.1.3) to be in place, the potential for large scale and frequent accidents is expected to be low. The potential effects to fish and fish habitat from a hazardous material spill are therefore determined to be not significant.

Effects on Marine Mammals

A spill of LNG has the potential to affect marine biota present at the air/water interface and in intertidal habitat (if a spill reaches shore) during the cryogenic stage (as described under LNG Behaviour, above). As effects decrease with water depth, and LNG is not persistent and is not toxic to marine biota, an LNG spill is not predicted to have a significant effect on marine mammals present at depth. An LNG spill could result in asphyxiation (oxygen deficiency) of marine mammals present at the air/water interface in the area of the spill. An LNG spill is considered to have significantly less severe environmental effects on marine mammals than a spill of hazardous materials such as fuel, oil, and lubricants.

A spill of hazardous materials such as fuels and lubricants into the marine environment could temporarily degrade water quality and have subsequent effects on marine mammals. Animal oiling and mortality could occur at all life stages in the affected area. Other effects could include avoidance of the habitat, and disruption of feeding and migration patterns. Marine waters around the facility are not considered to support significant habitat for, or numbers of, marine mammals. The magnitude of an effect of a spill is highly variable depending on its nature; however, considering mitigation measures that will be in place, the low probability of an accident, and the nature of the potential environmental effects, the potential effects to marine mammals from a hazardous material spill are predicted to be not significant.

Effects on Wildlife and Habitat

Hazardous material spills may, depending on the toxicity of the substance, cause direct or indirect mortality of wildlife, by contaminating water, soil, or food sources. Wildlife that may come into direct contact with LNG may be affected by freezing effects. Chemicals may be directly absorbed through dermal contact or ingested. The highest potential of hazardous material or LNG spill potentially affecting wildlife and habitat is associated with developed areas of the Project. Given the proposed mitigation and the low risk for impact, the environmental effect of a hazardous material spill on wildlife and habitat is considered not significant.

Effects on Migratory Birds and Habitat

An LNG release to the marine environment could result in direct bird mortality. As LNG is a cryogenic liquid at -161°C, the extreme low temperature could result in severe freezing on contact if birds remained on the water within the affected zone. This effect would last until the LNG evaporated, generally less than 10 minutes.

The water is unlikely to freeze. Rather, as LNG floats on the water surface (with a density of 45% of the density of freshwater), the water would warm the LNG, causing it to vapourize, forming a spreading cloud. Cryogenic effects are limited to direct contact with the LNG and not the cold LNG vapour. This would create elevated methane levels at the air/water interface that could lead to asphyxiation of birds in the immediate vicinity of the pooled LNG. If an ignition source is present and the LNG vapour burns, bird mortality will result from thermal radiation. There is no explosion risk in open air.

The persistence of environmental effects to marine birds would be less (shorter duration) from an LNG spill than spills of other hydrocarbons or hazardous materials. Hydrocarbon spills could result in oiling of birds and habitat. Depending on the toxicity of the substance, hazardous material spills may result in bird mortality through contamination of water, soil, and/or food sources. Chemicals may be absorbed by birds through dermal contact with contaminated soils or water, or through ingestion of contaminated food sources. The effect on birds from an LNG spill are considered not significant if the spill is contained, and significant (but unlikely) if the spill is not contained.

Effects on Current Use of Lands and Resources for Traditional Purposes by Aboriginal Persons

An accidental LNG or other hazardous material spill has the potential to affect use of lands and resources in and around the facility by Aboriginals. For a description of the type of impacts, refer to the effects discussions for wildlife and fish. Some of the areas traditionally used by Aboriginals for hunting and fishing occur within the LNG site; however, with the development of the lands for the Project the lands will not be accessible for use. For the most part, the land areas with potential to be effected by a spill are of limited significance. A spill into Stormont Bay and surrounding areas, however, could impact traditional Aboriginals fisheries. Given the proposed mitigation including design and operational safeguards and contingency planning (Sections 10.1.1.4 and 10.1.1.5) and the risk for impact (as addressed above under wildlife and fisheries), the environmental effect of a hazardous material spill on the use of lands and resources by Aboriginal persons is considered not significant.

Effects on Archaeological, Paleontological or Architectural Resources

A spill of hydrocarbon or hazardous material that requires clean-up may involve ground disturbance, with potential to affect unidentified archaeological, paleontological, or architectural resources. Areas known to have such resources will be avoided as much as possible. Spills will be infrequent and minor due to the environmental protection precautions required to be undertaken by Contractors and operations staff. Further, it is anticipated that spills requiring clean-up would likely occur and be contained within areas where equipment and vehicles are parked and used where ground disturbance has already occurred. These areas will be assessed for archaeological and paleontological resources prior to construction. The overall effect on unidentified archaeological, paleontological, or architectural resources therefore, has been determined not significant.

Effects on Navigation

Marine vessel accidents could result in temporary loss of access to or alteration of navigation routes as a result of the establishment of exclusion zones around spills. As discussed in Section 10.1.1.4 below, the LNG shipping industry has an excellent safety record. The probability of accidental interactions between LNG facility vessels and public vessels is considered low due to the public vessel advisories or exclusion zones to be established around moving tankers, the terminal's operating procedures and worker training, which will serve to ensure that public watercraft are not in the vicinity of facility tankers when they are manoeuvring in the area. Further, a catastrophic failure of an LNG tanker is considered highly unlikely given tanker design and the marine safety record to date. Therefore, potential accidents of a magnitude to potentially affect marine vessel navigation in Stormont Bay are considered highly unlikely to occur and have been determined not significant.

Effects on Human Health and Safety

At the two-vessel proposed output scenario (2 bcf/d vs 1 bcf/d) assuming a lower end of tanker capacity of 160,000 m^3, one LNG tanker will arrive at the LNG Terminal every 3.5 to 1.8 days. This will result in a total of 105 to 210 LNG tankers per year. This number can be marginally reduced if larger capacity LNG tankers (250,000 m^3) are made available. (5.4 to 2.7 days).

A spill of hazardous materials or LNG could affect both the general public and workers at the LNG facility. An LNG release to the marine environment has the potential to result in direct impacts on humans. As LNG is a cryogenic liquid at -161°C, the extreme low temperature could result in severe freezing on contact if a person remained on the water within the affected zone. This effect would last until the LNG evaporated, generally less than 10 minutes. The extent of the affected zone and timeframe for evaporation will be quantified as part a QRA currently being undertaken for the Project.

When LNG comes into contact with water, the water is unlikely to freeze. Rather, as LNG floats on the water surface (with a density of 45% of the density of freshwater), the water would warm the LNG, causing it to vapourize, forming a spreading cloud. Cryogenic effects are limited to direct contact with the LNG and not the cold LNG vapour. This would create elevated methane levels at the air/water interface that could lead to asphyxiation of persons in the immediate vicinity of the pooled LNG. If an ignition source is present and the LNG vapour burns, mortality will result from thermal radiation. As noted above, the extent of the affected zone will be quantified as part of the QRA. There is no explosion risk in open air.

LNG releases in confined spaces may create oxygen deficient or explosive atmospheres, posing a safety risk to workers.

Accidents related to LNG handling and processing and the transport of natural gas will, for the most part, be addressed by safe operating practices and other measures identified below to reduce the probability and severity of LNG releases (Sections 10.1.1.4 and 10.1.1.5). Additionally, recognizing the proximity of workers to any accidents and the role workers may play in response to accidents and malfunctions, worker safety will also be addressed by the implementation of the Worker Health and Safety Plan, Worker Health and Safety Procedures, and proper training in plant operations and the proper handling and processing of LNG (see Sections 10.1.1.5, 2.2.4.1, and 2.2.4.2).

The use of pipelines to transport natural gas is considered safe. Injuries reported for National Energy Board-regulated pipelines for employees and contractors totalled less than 1 injury in the year 2000 and less than 2 in the year 2001 for every 200 000 hours worked (the equivalent of 100 full time workers) (Jacques Whitford, 2004). Assuming a worst case accident frequency of 2 injuries for every 100 full time workers, and 5 full time workers assigned to operate and maintain the facility's natural gas pipeline, an accident frequency of 0.1 injury per year, or 1 injury every 10 years, is predicted (Jacques Whitford, 2004). Although this is a low rate of injury, further measures, such as the Worker Health and Safety Plan and Safe Operating Procedures, will be employed to reduce it further.

While the likelihood of an LNG release of substantial size is extremely low, given facility design and operational requirements (Sections 10.1.1.4 and 10.1.1.5), as well as the safety record of the LNG industry, the potential effects to human health and safety from a catastrophic spill of LNG are considered significant, although not likely to occur.

Effects on Fisheries

A spill of hydrocarbons or hazardous materials may result in temporary closure of herring, mackerel, lobster, and rock crab fishing grounds in Isaac's Harbour, Country Harbour, and/or Stormont Bay; closure of specific fisheries due to species contamination; or damage to/destruction of fishing gear from oiling or other contamination. Planned mitigation will reduce the potential for accidental events, and spill response and contingency plans (Section 10.1.1.4) will mitigate effects.

An LNG spill will not contaminate fishery resources as LNG is not toxic to aquatic organisms below the water surface. Consequently, an LNG spill is not likely to affect bottom fisheries such as lobster, scallop, and groundfish. There is, however, potential for very short-term effects to commercial fishing activity and fishing gear on the water surface due to both cryogenic and thermal radiation effects.

The persistence of environmental effects to commercial fisheries would be less severe (shorter duration) from an LNG spill than spills of other hydrocarbons or hazardous materials. Establishment of a dynamic exclusion zone for tankers traveling in shipping lanes and from the end of the shipping lane to the jetty would restrict any authorized vessel from coming into proximity with a moving tanker, reducing the potential for collision and spills. The extent and conditions of this tanker exclusion zone will be determined by the Proponent with the Atlantic Pilotage Authority, Canadian Coast Guard, TC, DFO and local fishers.

Overall, the effects of a spill of hydrocarbons or hazardous materials are considered to not be significant.

Effects on Aquaculture

A spill of hydrocarbons or hazardous materials may result in temporary closure of aquaculture sites in operation in Country Harbour, due to species contamination, or damage to/destruction of aquaculture gear and infrastructure from oiling or other contamination. Planned mitigation will reduce the potential for accidental events, and spill response and contingency plans will mitigate effects.

An LNG spill will not contaminate aquaculture resources as LNG is not toxic to aquatic organisms below the water surface. There is, however, potential for short-term effects to aquaculture activity and gear on the water surface due to both cryogenic and thermal radiation effects. Given the distance between the LNG Terminal and the aquaculture sites cryogenic and thermal radiation effects are not considered likely.

Effects on Tourism

Accidents and malfunctions at the LNG Terminal are not expected to result in effects on tourism as these events will have only short-term impacts on local tourist traffic.
Marine vessel accidents could result in temporary impacts on access to or from Stormont Bay as a result of the establishment of short term exclusion zones around spills. As discussed in Section 10.1.1.4, the LNG shipping industry has an excellent safety record. The probability of accidental interactions between LNG facility vessels and public vessels is considered low due to the public vessel advisories or exclusion zones to be established around moving tankers, the terminal's operating procedures and worker training, which will serve to ensure that public watercraft are not in the vicinity of facility tankers when they are manoeuvring in the area. Further, a catastrophic failure of an LNG tanker is considered highly unlikely given tanker design and marine safety record to date. Therefore, potential accidents of a magnitude to potentially affect marine vessel navigation in Stormont Bay are considered highly unlikely to occur.

10.1.1.4 Design and Operational Safeguards

The LNG industry has a long and excellent safety record, due to strict industrial safety standards applied worldwide. Busy ports around the world have LNG facilities that have operated for up to 40 years without an incident impacting the public.

LNG Industry Safety Record

Since commercial LNG transport began in 1959, LNG has been safely transported, stored, and delivered to densely populated cities in the US, Europe, and Japan. LNG has an excellent safety record with more than 33,000 carrier voyages covering 60 million miles around the globe without a major accident over a 45-year history.

Ocean-going tanker transportation of LNG has a long record of safe operation. Few accidents have occurred since the first converted freighter delivered a Lake Charles, Louisiana cargo of LNG to the UK in January 1959, none involving a fatality or major release of LNG. The outstanding LNG shipping safety record is attributable to continuously improving tanker technology, tanker safety equipment, comprehensive safety procedures, training, equipment maintenance, and effective government regulation and oversight.

LNG ships are well-built, robust vessels with a double-hull designed and built to withstand the low-energy impacts common during harbour and docking operations. They are a common sight throughout much of the world.

LNG carrier safety equipment includes sophisticated radar and positioning systems that alert the crew to other traffic and hazards around the ship. A number of distress systems and beacons will automatically send out signals if the ship is in difficulty. The cargo system safety features include an extensive instrumentation package that safely shuts down the system if it starts to operate out of predetermined parameters. Ships are also equipped with gas and fire detection systems.

LNG Terminals have been operating for over 40 years without a serious public safety incident. An incident resulting in loss of life occurred in Cleveland, Ohio in 1944. At this time, knowledge of storage of LNG, or of the low temperature performance of materials, was not as advanced as today. Improper materials used in a single unprotected containment system failed and resulted in spilled LNG. Current design of containment systems utilizes low temperature nickel steel and a secondary containment vessel.

Other incidents attributed to LNG are:

- A construction accident on Staten Island in 1973 where the construction crew was working inside an (empty, warm) LNG tank. Although often referred to as an LNG accident this was, strictly speaking, a construction accident.
- Failure of an electrical seal on an LNG pump in 1979 permitted gas (not LNG) to enter an enclosed electrical switchgear building. A spark caused the building to explode. As a result of this incident, the electrical code has been revised for the design of electrical seals used with all flammable fluids under pressure.

- The recent incident at Skikda in Algeria in 2004 is naturally causing some concern due to the loss of life. The cause of this incident was likely due to a steam boiler explosion. It should be noted that even the resulting fire did not damage storage tanks that are somewhat similar to those that would be utilized at the LNG facility. Furthermore, it should be noted that the Skikda facility is a liquefaction plant, which is completely different compared to the LNG import terminal.

The design of the LNG facility takes into account mitigative measures that would protect humans and the environment in the event of an accident or malfunction. Details about the mitigative features of the facility are outlined in the following and Sections 2.0 and 5.0. A brief overview of the mitigative measures is presented in this section. However it is noted that during the design of the facility, extensive safety studies, for instance Hazard and Operability Analysis (HAZOP), and a QRA, will be performed to achieve a high site and public safety level.

Detection and Response Equipment

Flame Detectors

Infrared and combined infrared/ultraviolet flame detectors will be located at the LNG storage tank roof area, regasification area, and jetty head. An alarm signal from any detector within a fire zone will initiate visual and audible alarms. Signals from detectors in a fire zone will initiate shutdown actions and the firewater and dry chemical systems.

Flammable Gas Detection System

Flammable gas detectors will be employed in the tank zone, regasification area, jetty head, and ventilation air intakes. An alarm signal from the detector within a fire zone will initiate visual and audible alarms. Similar to the flame detectors, the detectors in a fire zone will trigger shutdown actions as well as shutting down the building ventilation system.

Cold Detectors

Temperature probe type cold detectors will be installed in LNG collection trays, drainage channels, or basins to detect an LNG spill.

Heat Detectors

Heat detectors consisting of pneumatically pressurized fusible plastic tubing will be used to provide linear heat detection on and around LNG tank roof areas. Signals from one tube rupturing will initiate visual and audible alarms and start the fire pumps.

Terminal Alarm System

The terminal alarms will be generated by the Emergency Shut Down (ESD) system and consist of warning sirens located in the LNG tanks area, process area, jetty head, and buildings. The alarm system alerts personnel either at the jetty, in the process/tankage area and the buildings in these areas. Once activated, the alarm tone will be supplemented by a speech broadcast over the handheld radio system, giving type and location of incident.

Fire Protection

Fire protection will consist of fixed protection systems which comprise high expansion foam systems, gaseous extinguishing systems, dry chemical systems, hydrants, and monitors, in areas where it is most likely for a fire to occur. These systems will be supplemented by fire extinguishers.

Water deluge systems are not appropriate for extinguishing LNG fires. The application of water on an LNG liquid surface will increase the vapour formation rate thus increasing the burning rate. However, firewater monitors shall be used for exposure protection.

Extinguishment of an LNG fire shall be by dry chemical. High expansion foam will be used for controlling sump fires. Dry chemical shall be used for snuffing LNG tank relief valve tail pipes.

Water curtains will be provided between the jetty head and the tanker to protect the hull of the tanker from fire, cold liquid, or gas. The water curtains will be initiated automatically on confirmed fire detection.

The LNG tank area, the regasification area, and the jetty head will have remote/manually operated oscillating monitors, with design flow rate of 2850 L/min, connected to the fire ring main.

Two remote controlled tower water monitors of each 4000 L/min will be strategically placed to protect the most vulnerable areas of the Jetty Head. They will be able to reach the ship's manifold and offer protection to the Unloading Arm area.

LNG retention sumps or basins will have high expansion foam generators to enable remote manually operated blanketing of any LNG spillage collected in the sump/basin. In the event of ignition, the high expansion foam will reduce the flame size and hence the radiation rate. The LNG retention sumps/basins collect spillage from the curbed areas and spillage trays located around and under significant LNG leakage sources. If necessary, foam retention fences or screens shall be erected around LNG retention sumps/basins to prevent wind destroying the foam blanket.

Both the jetty head impoundment sump and the regasification impoundment sump will have a high expansion foam system (200 L/min).

Firewater hydrants will be provided throughout the regasification area and jetty and will be located not less than 15m from the protected risk. Hoses and hose cabinets shall be provided adjacent to the hydrants.

The jetty head will be protected by 6 double outlet fire hydrants. One hydrant at the jetty head will be equipped with an International Shore to Ship Connection.

The regasification area will be protected by 8 double outlet fire hydrants. Hydrants will be spaced not more than 30m apart in the regasification area.

Fixed dry chemical extinguishing systems will be provided for extinguishing the tail pipe vents from the relief valves on the LNG storage tanks should they ignite. The system operates automatically on confirmed fire detection and includes a main and reserve supply.

Two dry chemical hose reel systems will be provided at the jetty head. These will enable a pool fire in the spill containment areas or other fires to be approached from two directions for fire fighting purposes.

At the Terminal

Prevention and mitigation of hydrocarbon (LNG) and hazardous material spills at the LNG Terminal will be accomplished by the following means:

- inherent safe vessel design;
- the use of competent crews;
- operational procedures and training;
- security plans and procedures; and
- effective emergency planning and preparedness.

Vessel Design and Selection

LNG tankers are ocean-going vessels, double-hulled and specifically designed and insulated to prevent leakage or rupture. Tankers equipped with double hulls have reduced oil spills from groundings by 90 percent and from collisions by 29 percent (DNV (Det Norske Veritas), 1990). Double-hulled tankers have also been shown to reduce the size of spills when they occur. The vessel's LNG containment system is located within the inner hull and maintained at atmospheric pressure and -161°C. LNG tankers are relatively new vessels worldwide with approximately 20 percent of the world tanker fleet less than 5 years old (Jacques Whitford, 2004).

LNG tankers are certified by the International Association of Classification Societies, which provides compliance certification as well as technical support, research and development. Tankers selected to transport LNG and unload to the facility will meet or exceed international standards. The Proponent will require that vessels meet stated standards by using an auditing system such as the Ship Inspection Report Programme (SIRE), a safety initiative introduced by the OCIMF. The SIRE Programme is a tanker risk assessment tool, a large database of up-to-date information about tankers. SIRE serves a dual purpose - it has focused tanker industry awareness on the importance of meeting satisfactory tanker quality and ship safety standards, and it provides documentation of vessel condition. Since its introduction, the SIRE Programme has received industry-wide acceptance and participation by both OCIMF Members, Programme recipients and by ship Operators. The program is a vetting system, allowing prospective charterers to better ascertain whether chartered vessels are well managed and maintained. Additionally, inspection reports, which are maintained on the database for 2 years will be provided to regulators to demonstrate that tankers used to transport LNG to the terminal meet standards.

Mitigation of accidents and malfunctions is taken into consideration in the design of the components of transfer piping from LNG carriers to storage tank headers. Section 2.2 provides details on the proposed design of the following components of this system:

- LNG marine carrier unloading and transfer system design; and
- transfer piping system.

Mitigative features of the LNG Marine Carrier Unloading and Transfer System Design include the following:

- installation of Powered Emergency Release Couplers at the loading arms; and
- during unloading of the LNG carrier the ESD system of the LNG carrier and the LNG import terminal will be coupled.

Crew Training and Communication

Tanker crews will be required to undergo a high standard of training. Training contributes significantly to minimizing spills; 75 to 90% of significant incidents are attributed to human error. Additionally, communication with and between the crew during an emergency can reduce risk. Consequently, tanker officers will be orally proficient in both English and the predominant language of the crew.

The Proponent will require that vessel crews meet stated standards by using an auditing system such as OCIMF's SIRE. Notably, SIRE's Vessel Particulars Questionnaire for Bulk Oil/Chemical Carriers and Gas Carriers (1997) includes information on vessel crews, including minimum and actual manning, nationality, crew employer, manning agent name and contact information, crew continuity, and crew training information. The questionnaire is intended to be completed by the ship's operator and then be made available to inspecting parties, including prospective charterers, terminal operators, and regulators. The reports, which are maintained on the OCIMF database for 2 years will be provided to regulators to demonstrate that the crews of tankers used to transport LNG to the terminal meet standards.

Vessel Movement and Operations

Vessel movement and communications among vessels is coordinated by the Canadian Coast Guard. A number of measures will be applied towards accidents involving marine vessels. Adherence to proper procedures, as defined in the Marine Terminal Manual, and the use of exclusion zones or public vessel advisories will serve to keep public vessels and marine craft at a proper distance from LNG tankers as they are manoeuvring in the harbour.

Marine/navigational safety issues will be addressed via the TERMPOL Review Process under direction of TC Marine Safety. TC is mandated to be part of the technical review committee for the EA to serve this purpose. TC will use the tools in the TERMPOL Review Process to objectively appraise operational ship safety, route safety, and management and environmental concerns associated with the location, construction, and subsequent operation of a marine terminal system for the bulk handling of LNG and other deleterious cargoes identified by TC.

As part of the risk management process identified in the TERMPOL Review Process, establishing safe conditions for the port transit of LNG will be of major importance and will be a direct responsibility of the port authority along with input from Keltic and the various ship operators. A Vessel Traffic System, as specified by the IMO (Resolution A.578-14) for marine traffic management will be implemented in order to prevent close encounters between LNG carriers and other marine traffic. Necessary subordinate specifications concerning traffic management will be developed according to the risk identified in each particular situation.

Other conditions for establishing safe operations in port will include adequate navigation marks and lights in accordance with NWPA, limited ship movement in conditions of poor visibility, and a high standard of pilotage service all of which will contribute to minimizing the risk of marine transport anomalies. The quality of pilotage service is of particular importance. As part of terminal planning Keltic with the facilitation of American Petroleum Association will establish a fixed pilot boarding area at a safe distance offshore beyond which specific sized vessels will not be allowed to continue without a pilot in place.

As part of the operations study within the port design process, navigational risks management will be reviewed and developed based upon the following factors:

- number and types of ships and other craft using the port;
- projected accident scenarios;
- navigational distances and difficulty through the port and jetty approach;
- the maximum draft of the ships;
- tidal conditions (tidal ranges and tidal currents);
- the nature of the sea-bed;
- meteorological conditions (wind, waves, sea-ice and visibility); and
- proximity of the terminal to populated areas and industrial sites.

Marine Security

Maritime security plans and established operational procedures will be in place that complies with new IMO security requirements, the Government of Canada's National Security Policy and the requirements of the *Marine Transportation Security Act* as it relates to ports and port facilities.

Under the approved security plan the Project's security program will include:

- surveillance equipment, including cameras and closed-circuit TV systems;
- improvements to dockside and perimeter security and access control, such as fencing, gates, signage, and lighting;
- command, control, and communications equipment, such as portable and vessel-to-shore radios; and
- infrastructure security protective measures, such as security guards and arrangements with local police departments.

Following the planned port facility security assessment/risk analysis, a security plan will be developed in agreement with the current IMOs Security Code requirement. As required under the *Marine Transportation Security Act* (Section 303 (c)), Keltic will designate in writing the name of the Marine Facility Security Officer to prepare the Port Facility Security Plan. This plan will outline the operational and physical security measures the port facility should take to meet the various required security levels. This plan will also include the appropriate control inspections and additional control measures for evaluating incoming vessel security information.

Introduction to Quantitative Risk Assessment (QRA)

In addition to the facilities being engineered and constructed in strict accordance with regulatory requirements, a QRA is a valuable tool for determining the risk of the use, handling, transport, and storage of dangerous substances. A QRA is used to demonstrate the risk caused by the activity and to provide regulators with relevant information to enable decisions on the acceptability of risk related to the Project.

Predictive modelling and analysis was conducted as part of the Project planning and conceptual design. This analysis provided necessary details associated with siting the facilities relative to surrounding land uses and the spacing of infrastructure within the facility. In addition to this preliminary analysis, a more detailed QRA is required as part of the review process associated with the Nova Scotia Utility and Public Review Board Permit to Construct process and as part of the federal TERMPOL process under the direction of TC. The QRA is being conducted for these parallel processes as part of the permitting process associated with the operations of the facilities. The QRA is currently in parallel with the conceptual design of the facility and will be reviewed with provincial and federal agencies.

QRA has evolved into a state-of-the-art process for evaluating the safety of facilities having the potential for major hazards. A QRA must first establish what the risk is (Risk Analysis), and then evaluate this risk by comparison to risk acceptability criteria. In risk management, the QRA forms a basis for decision-making principally related to:

- acceptability of a proposed new facility;
- land-use planning for the region surrounding a facility; and
- requirements for additional mitigation within a facility.

QRAs can consider risks to (i) the public near a facility, (ii) workers at a facility, and (iii) the operator of a facility – in terms of financial risk. These are the so-called risk receptors. The scope of a QRA must identify which risk receptors are to be considered. This is of particular importance for the proposed facility since it is located in a remote location. Risk assessments for public risk can consider risk to an individual and to society as a whole within the region near the proposed facility and near the transport routes. The Major Industrial Accident Council of Canada (MIACC) process, described below, although focusing on individual risk, considers both. This approach has been recommended to local regulatory agencies for this Project.

However, in other jurisdictions, principally Europe, a more rigorous quantification of societal risk via so-called F-N curves is required. The QRA will identify how risk is to be measured.

The Major Industrial Accident Council of Canada (MIACC) Process for Canada

The MIACC risk-based approach was initially developed for land use planning in the vicinity of hazardous installations. It is equally applicable to the siting of proposed new hazardous installations. Although it is based on an individual risk calculation that produces a risk-separation distance curve, the interpretation for land-use planning has elements of societal risk. A risk analysis combines these consequences with their likelihood, or frequency, of occurrence.

Quite simply: Risk = Frequency × Consequences.

In a risk analysis, a number of accident scenarios are identified (i.e. release of a gas under stable atmospheric conditions and low wind speed). The frequency and consequences are quantified separately and multiplied to determine the risk. This process is undertaken for all accident scenarios that are identified, and the risks summed to obtain the total risk. The total risk is typically shown as iso-risk lines around the hazard source, with risk decreasing with increasing separation distance.

Figure 10.1-1 shows a generic risk curve and MIACCs risk acceptability criteria. These guidelines for acceptable levels of risk are as follows:

- From the risk source to the 1 in 10,000 (10^{-4}) annual chance of fatality risk contour the risk to the public is deemed unacceptable and no other land uses except the source facility.
- In the area between the 1 in 10,000 to 1 in 100,000 (10^{-4} to 10^{-5}) annual chance of fatality risk contours, land uses involving continuous access and the presence of limited numbers of people that can be readily evacuated, can be allowed. For example: open spaces (golf courses, parks), warehouses, and manufacturing plants.
- In the area between the 1 in 100,000 to 1 in 1,000,000 (10^{-5} to 10^{-6}) annual chance of fatality risk contours, uses involving a slightly higher population density, but still having continuous access and easy evacuation, i.e. commercial uses, low-density residential areas, offices.
- Beyond the 1 in 1,000,000 (10_{-6}) annual chance of fatality risk contour the risk is deemed acceptable and there are no land use restrictions.

These criteria are similar to those used in other jurisdictions (i.e. Europe) for major hazard installations and in other industries (North American nuclear industry). MIACC never defined “low density residential” or “high density residential.” For the purposes of this risk assessment, these are assumed to be as follows:

- Low Density Residential: < 5 dwellings per hectare (rural region); and
- High Density Residential: > 5 dwellings per hectare (small town; urban region).

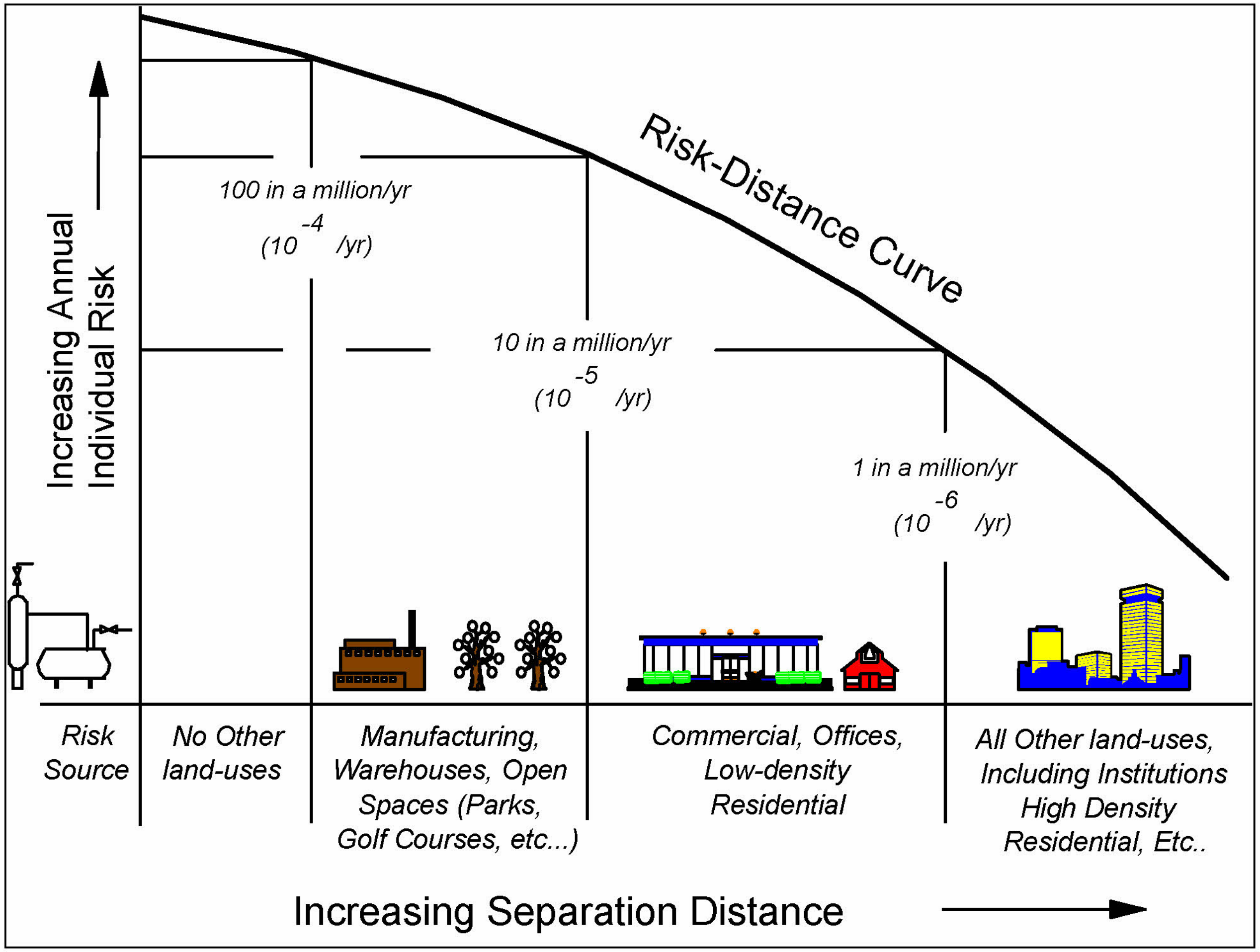

Figure 10.1-1
KELTIC PETROCHEMICALS INC.
Major Accidents in Europe and North America
Major Industrial Accident Council of Canada Land-Use Risk Acceptability Criteria
JUNE 2007

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In addition to the approaches and methodologies provided by the Major Industrial Accident Council of Canada Process for Canada (MIACC), the Council for Reducing Major Industrial Accidents/Conseil pour la reduction des accidents industriels majeurs ("CRAIM"), the internationally accepted Dutch Purple Book (CPR 18; Guidelines for Quantitative Risk Assessments) will be utilized accordingly in the identification and modeling of potential accident scenarios.

Liquefied Natural Gas ("LNG") is listed in Schedule 1 of the Environmental Emergency Regulations under the CEPA. The Environmental Emergency Regulations set out specific requirements for the preparation of environmental emergency plans and reporting of accidental releases of listed substances. The CRAIM document and the CSA Emergency Planning for Industry (third edition of CAN/CSA–Z731-03) are both identified as pertinent references in the Implementation Guidelines for Part 8 of the Canadian Environmental Protection Act, 1999 – Environmental Emergency Plans. The CRAIM document also provides recognized guidance in conducting consequence analyses and in considering worst-probable-case-scenarios and alternative-case-scenarios that are required in the Environmental Emergency Plans.

Emergency Planning and Preparedness

In the unlikely event of a spill occurring at the terminal or from a vessel, emergency response plans will be in place to ensure that the size of the spill and potential for effects of the spill are minimized. Details are provided in the following section.

At the LNG Facilities

Prevention and mitigation of hydrocarbon (LNG) and hazardous material spills at the LNG facilities will be accomplished by the following means:

- inherent safe design;
- the use of competent staff;
- operational procedures and training;
- security plans and procedures; and
- effective emergency planning and preparedness (addressed in the following section).

Facility Design

On-site safety measures include leak alarms, emergency shutdown systems, and spill containment. The LNG tanks are of the "full containment" type and designed to fully contain any spills or leaks occurring at the inner tank. The LNG Storage Tanks will be designed to take into consideration mitigative measures related to accidents and malfunctions. In the unlikely event that a failure occurs in the 9% nickel steel inner tank, the outer concrete tank will be capable of containing the full tank contents. Facility design will include adequate ventilation systems to prevent the build up of natural gas in confined spaces. Additionally, gas and temperature monitors will allow early detection of LNG releases, reducing the likelihood of natural gas accumulation in the facility.

Staff Training

All employees and contractors will be trained in operational procedures and environmental emergency response procedures to ensure safe operation of tanker unloading and facility operation. Operating procedures, including confined space entry protocols, and operator training will be implemented to ensure that works are able to identify and take appropriate safe actions in response to LNG releases in confined areas.

Facility Operation

Further hazard analysis of the design will provide for additional level of assurance that the potential for spills or unintentional releases of natural gas is minimized. Operational procedures will be prepared to ensure the transport, handling and process systems are operated within the design parameters. Chemical storage and handling will be done in accordance with the manufacturers' recommendations and federal and provincial regulations, where applicable. Accidental spills will be prevented and mitigated through the implementation of the EPP, the EMP, the Worker Health and Safety Plan, and the Terminal Operations Manual. Procedures and restrictions, including for example, restrictions on smoking and burning, will minimize the possibility and magnitude of adverse effects of a natural gas-related accident, malfunction, or upset condition. Prevention and mitigation of all hydrocarbon spills will be accomplished through adherence to the EPP and Spill Contingency Plan.

Emergency Planning and Preparedness

Contingency planning, personnel training, procedures, restrictions on smoking and burning, emergency response planning and other initiatives will minimize the possibility and magnitude of adverse effects of a natural gas-related accident, malfunction, or upset condition. In the unlikely event of a spill occurring at any of the LNG facilities, emergency response plans will be in place to ensure that the size of the spill and potential for effects of the spill are minimized. Emergency medical facilities will be provided at the central administration complex with first aid stations at each of the main facilities and within the process areas and marine facilities as required. Details are provided in the following section.

10.1.1.5 Contingency and Emergency Response Procedures

Emergency response and contingency planning will take precedence in the development of facility process control measures. Emergency planning will consider dealing with the largest incident that can reasonably be foreseen, but detailed plans will concentrate on events that are most probable as identified through the QRA program.

These activities will be developed with close consultation with port users, ship's agencies, municipal authorities, police, fire, and medical service providers. As a means to minimize, contain, and control potential releases of environmental contaminants, a site specific Emergency Response and Contingency Plan will be developed based on the CAN/CSA Z731-03 standard. The plan will be communicated to all relevant parties that may be involved in responding to each specific emergency to ensure they all understand their appropriate response. All personnel will be appropriately trained in the applications of first response measures and emergency communication requirements.

The plan will include a description of biological and human-use resources that could be impacted in the case of an accident. It will also include an inventory of oil and chemical products and associated storage locations for both Project construction and operational phases. In the event of a spill, or other type of emergency, the incident reporting system outlined in the plan, including notification and alerting procedures, will be adhered to.

Included in the plan will be a list of response organizations and clarification of the roles of each organization. Critical procedures for mobilizing emergency services, triggering mutual aid arrangements, personnel evacuation, casualty handling, and external announcements will be set out in the plan. The plan will also specify the critical actions to be taken to minimize the impact of an accident (marine or land based) in its immediate aftermath, to secure the affected area, and to protect the individuals involved and the surrounding area of the accident. The severity of an emergency may range from an incident, which can be dealt with by local personnel, to one for which effective response and containment requires assistance from the community's emergency services. The plan will identify which is the responsible party in order that immediate decision making processes can be effective and appropriate to the emergency being managed. The plan will also give clear directions for the mobilization of emergency services support, with clear guidance as to how, when, and what to communicate.

A traffic management plan will be established under the umbrella of the EPC Contractor's Health & Safety and Security Program. This program will be developed to ensure personnel and asset safeguard against deliberate or unintentional anomalies.

To minimize, contain, and control any potential releases of hazardous materials, a site-specific Spill Management Plan will be developed. This plan will outline procedures for responding to spills and releases, including a list of spill response equipment that will be stored on-site at all times in the case of emergency events. All staff will be appropriately trained in the handling, storage, and disposal of hazardous materials (i.e. WHMIS, Transportation of Dangerous Goods (TDG)).

In addition, the ESD procedures, fire fighting equipment, leak/fire detection systems and other preventive and repressive measures, which could prevent any loss of containment, will be evaluated during the design of the terminal and safety studies. All preventive and repressive measures will be designed according to the appropriate codes and standards.

During the engineering and construction phases of the LNG facility, failure scenarios will be defined for each component. Technical and organizational measures will be identified to minimize the effects in case of failure. Examples of some of the preventative and repressive measures that will likely be employed at the facility are listed below:

- Malfunctions during LNG unloading:
    - In the event of slipping off of the unloading arms, the carrier's unloading pumps will immediately be shut down automatically.
    - In the event of slipping off of the vapour return line, the carrier's unloading pumps will immediately be shut down automatically.

- Malfunctions of LNG storage:
    - In the event the pressure is too high in the LNG storage tanks, initially vapours will be directed to the flare. In the event the pressure further increases, vapour will be released via a pressure relief valve.
    - In the event of failure of the boil off gas compressors, boil off gas will be flared.
- Malfunctions of the booster pumps and SCVs:
    - In the event of failure of the booster pumps or SCVs, available spare capacity will be put in operation. If this is insufficient, the in tank pumps will be turned down, resulting in a decrease of the send-out capacity. Increased emissions are avoided.
- Malfunctions of nitrogen production:
    - In the event of failure of the air compressors, the ASU will operate at part load or will be completely shut down. This will not result in increased emissions.
    - In the event of failure of other compressors, expansion cooling can only take place partly or not at all. As a result, the ASU will operate at part load, or will be completely shut down. This will not result in increased emissions.
- Pipe Fracture
    - Pipe fracture may occur throughout the LNG facility. Periodical pipe inspections will be undertaken to identify and register possible pipe fractures.
    - Leak detection systems will be installed at strategic locations.
    - In the event of a pipe fracture, the fracture location will be isolated according to the ESD procedure.

10.1.1.6 Conclusion

Environmental effects from hydrocarbon and hazardous materials spills are not likely to be significant considering the measures to be taken in the design, construction, and operation of the facility described above.

10.1.2 Accidental Forest Fires

Project-related forest fires could be caused by a liquid hydrocarbon spill fire, or any other Project-related accident involving fire.

10.1.2.1 Potential Environmental Concerns

Accidental forest fires could result in potential adverse environmental effects on numerous VECs (see Interaction Matrix Table 10.0-1). These interactions are briefly discussed below.

Effects on Freshwater Quality/Quantity

Forest fire can degrade water quality in watercourses, resulting in effects to fish and fish habitat, including fish mortality. The extent of fire damage, type of fire, and time of year will affect the severity and duration of environmental effects from fire. The physical environmental effects are reversible, but it would take a number of years for the environment to recover. Fire damage could result in increased erosion in the watershed, leading to increased sediment loads in watercourses for a number of years, which would affect fish and fish habitat. Changes in freshwater flow could also result in changes to groundwater patterns and groundwater contribution to baseflow, as a result of changes to evaporation and infiltration rates. Re-establishment of riparian and other vegetative communities in the watershed over time would reverse the impacts.

A fire break of cleared land will be developed and maintained between the facility and surrounding forest to minimize the potential for forest fires caused by on-site accidents. This, together with all other design and operational safeguards and contingency planning measures designed to minimize the forest fire risks, is expected to make Project-related forest fires an extremely unlikely event. The environmental effects have been determined not significant.

Effects on Soil/Sediment Quality

As mentioned above, forest fires could result in increased erosion in the watershed, leading to increased sediment loads in watercourses for a number of years, which would affect fish and fish habitat.

Rehabilitation of the disturbed area may include:

- replacement of subsoil and topsoil with soil recovered at the site or with suitable fill from another area; and
- addition of soil amendments as required to optimize and restore soil nutrient levels, organic matter and soil acidity, and to optimize physical properties of the topsoil; and re-grading and reseeding the disturbed area to minimize soil erosion.

Overall the effects of forest fires on soils and sediment quality are considered temporary and reversible and have been determined not significant.

Effects on Air Quality

Fires have the potential to result in temporary effects on air quality, from odours and PM. The effect of thermal radiation on human health and safety is addressed separately, below. While the likelihood of a fire is extremely low, given facility design and operational requirements and the safety record of the LNG industry, the potential effects to air quality from a fire are predicted to be significant in the short-term, but reversible.

Effects on Vegetation

Forest fires can have long lasting effects on the vegetation. Depending on the severity of the fire, it can destroy the entire forest community and convert the area for years to come into open herbaceous shrub vegetation. This would affect the wildlife and bird populations in the area. The potential destruction of riparian woodland vegetation along watercourses may affect fish and fish habitat. The extent of fire damage, type of fire, and time of year will affect the severity and duration of environmental effects from fire. Fire damage could also result in increased erosion in the watershed, leading to increased sediment loads in watercourses for a number of years, which would also affect fish and fish habitat. Re-establishment of riparian and other vegetative communities in the watershed over time would reverse the impacts. Mitigation measures to prevent, contain, and reverse the effects of forest fires are available and effective. Overall, the effects of Project-related forest fires on vegetation are considered not significant.

Effects on Species at Risk

Forest fires have the potential to affect one species at risk, horsetail (*Equisetum variegatum*), which was identified on the site near the junction of Sable Road and Highway 316, over 300 m from the facility. Given the distance from the facility, and the observation that horsetail is also widely distributed around Gold Brook Lake, the risk for an irreversible effect on this rare plant from a forest fire is considered low. The effect is considered not significant.

Effects on Fish and Fish Habitat

Forest fire can destroy riparian vegetation along watercourses, resulting in effects to fish and fish habitat, including fish mortality. The extent of fire damage, type of fire, and time of year will affect the severity and duration of environmental effects from fire. The physical environmental effects are reversible, but would take a number of years for the environment to recover. Fire damage could also result in increased erosion in the watershed, leading to increased sediment loads in watercourses for a number of years, which would also affect fish and fish habitat. Changes in freshwater flow could also result in changes to groundwater patterns and groundwater contribution to baseflow, as a result of changes to evaporation and infiltration rates. This could also result in an effect on fish and fish habitat.

Emergency response measures developed for the Project also serve to minimize the extent of accidental fires. Mitigation measures to minimize erosion and to re-establish riparian and other vegetative communities are available and effective. Consequently, the effect of Project-related forest fires on vegetation is considered not significant.

Effects on Wildlife and Habitat

Forest fires could result in direct wildlife mortalities and indirect effects by changing wildlife habitat. The likelihood of forest fires during construction and operation is low considering the design features and safe operating procedures. Emergency response measures also serve to minimize the extent of accidental fires. Consequently, the potential adverse effects associated with forest fires at the facility are considered not significant.

Effects on Migratory Birds and Habitat

Forest fires could result in direct bird mortality and could have indirect impact through a change in available breeding, nesting and foraging habitat. However, as mentioned above under effects on vegetation, mitigation measures to prevent, contain, and reverse the effects of forest fires are available and effective. Consequently, the effects of Project-related forest fires on migratory birds and habitat are considered not significant

Effects on Current Use of Lands and Resources for Traditional Purposes by Aboriginal Persons

An accidental fire has the potential to affect use of lands and resources in and around the facility by Aboriginal persons. For a description of the type of impacts, refer to the effects discussions for wildlife and fish. Some of the areas traditionally used by Aboriginals for hunting and fishing occur within the LNG site but these areas will not be available once construction commences. For the most part, the land areas with potential to be affected by a forest fire are of limited significance. Given the proposed mitigation and the risk for impact (as addressed under wildlife and fisheries), the environmental effect of a fire on the use of lands and resources by Aboriginal persons is considered not significant.

Effects on Archaeological, Paleontological or Architectural Resources

Forest fires have the potential to directly damage heritage resources or indirectly damage inground archaeological, paleontological, or architectural resources as a result of increased erosion from the removal of vegetation and application of water during fire fighting. The potential for a forest fire resulting from an accident at the LNG facility is considered low, due to facility safety mechanisms and features. Following a fire, any areas with known or potential archaeological, paleontological, or architectural resources will be stabilized to prevent erosion. The overall effect on unidentified archaeological, paleontological, or architectural resources therefore, has been determined not significant.

Effects on Human Health and Safety

The immediate concern for a forest fire would be for human health and safety. Local air quality conditions associated with the fire and the flames have the potential to kill humans and wildlife in the area. The major emissions would be smoke (PM) and CO_2 but would also include CO, NO_x, SO_2, VOCs, and PAHs (polycyclic aromatic hydrocarbons). A large fire could create PM levels greater than the ambient air quality standard over distances greater than 10 km but such situations would be of short duration.

While the likelihood of a fire is extremely low, given facility design and operational requirements, as well as the safety record of the LNG industry, the potential effects to human health and safety from a fire are considered significant, although not likely to occur.

10.1.2.2 Design and Operational Safeguards

The potential for fire during construction and operation will be mitigated through controlling or prohibiting burning, equipment maintenance (i.e., power saw mufflers and vehicle exhaust systems), vegetation management (i.e., vegetation clearing along the pipeline), and facility design and operational protocols intended to reduce the potential for releases of hazardous materials (Sections 10.1.1.4 and 10.1.1.5). The probability of facility operation causing a forest fire is low. A fire break of cleared land will be developed and maintained between the facility and surrounding forest.

10.1.2.3 Contingency and Emergency Response Procedures

Fire fighting capability includes fire detection and emergency response plans. The central administration complex will have a fully equipped fire station. The operation of the fire station will be coordinated with the local community volunteer fire departments. Local fire fighting response will be available at each of the main process areas. For unanticipated large fires and/or fires in isolated areas, assistance will be requested from appropriate government departments.

10.1.2.4 Conclusion

Environmental effects from forest fires are not likely to be significant considering the measures described in the preceding sections to be taken in the design, construction, and operation of the facility.

10.1.3 Discharge of Sediment to Marine Environment

This malfunction and accident scenario involves the failure of erosion and sediment control structures due to precipitation events and the subsequent discharge of sediments to the marine environment.

10.1.3.1 Potential Environmental Concerns

Failure of erosion and sediment control structures could result in the release of a large quantity of sediment-laden runoff to marine waters with potential adverse environmental effects (see Interaction Matrix Table 10.0-1):

- marine water quality;
- fish and fish habitat;
- marine mammals;
- fisheries; and
- aquaculture.

The interactions between the malfunction/accident scenario and these VECs are briefly discussed below.

Effects on Marine Water Quality/Quantity

The potential effects on marine water quality as a result of discharge of sediment to the marine environment have been described in Section 5.1.4. Environmental effects were considered not significant based on the availability of effective mitigation and monitoring measures.

Effects on Fish and Fish Habitat

The potential effects on fish and fish habitat as a result of discharge of sediment have been described in Section 5.1.10 Environmental effects were considered not significant based on the availability of effective mitigation and monitoring measures.

Effects on Marine Mammals

The potential effects on marine mammals would be similar in nature to the effects described for fish and fish habitat above, i.e. not significant.

Effects on Fisheries

The potential effects on fisheries as a result of discharge of sediment have been described in Section 5.1.23 and have been determined not significant.

Effects on Aquaculture

The potential effects on aquaculture as a result of discharge of sediment have been described in Section 5.1.24 and have been determined not significant.

10.1.3.2 Design and Operational Safeguards

The design of the LNG Terminal will include measures to control and treat storm-water run-off to minimize the discharge of sediments during the construction and operation of the facility as described in previously. Erosion and sediment control measures will be implemented and maintained according to the EPP and will be monitored by an environmental inspector, particularly after a heavy precipitation event or snow melt.

10.1.3.3 Contingency and Emergency Response Procedures

Contingency measures to respond to a malfunction of erosion and sediment controls will be provided as part of the Project's Contingency Response Plan (Sections 10.2.1.3 and 10.2.3.3).

10.1.3.4 Conclusion

Environmental effects from discharges of sediment to the marine environment are expected to be small scale, short term, and reversible. Effects will be minimized by the implementation of mitigation measures as described previously and through Contingency Response Planning. Overall, the effects have been determined not significant

10.1.4 Discharges from Ships

Accidental discharges from ships, including bilge water, have the potential for environmental impacts. Bilge water is the water that is collected inside the bottom of a ship's hull (the bilge). Bilge water can be found aboard every vessel, but its composition is unique because the bilge wells receive fluids from many parts of the ship, such as leaks from the engine components and in the cooling system or washdown operations. Bilge water can contain water, oil, dispersants, detergents, solvents, chemicals, and particles. It may also contain exotic, invasive species, depending on previous ports of call. If this water is released at the terminal or to the marine environment, it can impact water quality.

10.1.4.1 Potential Environmental Concerns

Discharges from ships are considered to potentially affect the following VECs (see Interaction Matrix Table10.0-1):

- marine water quality;
- vegetation (marine);
- species at risk (marine);
- fish and fish habitat;
- marine mammals;
- migratory birds and habitat;
- human health and safety;
- fisheries; and
- aquaculture.

The potential effects as a result of discharge of hazardous materials and hydrocarbons have been addressed in Section 10.1 and have been determined not significant for all of the above VECs. The effects of invasive species are addressed here. While ballast water from large vessels is considered a significant source of introductions of harmful invasive aquatic species, bilge water (especially as larvae, eggs or cysts in the case of algae) is also a source of alien species. Invasive species introduced in this manner can include a diversity of living, non-native aquatic organisms. For the LNG Terminal, ballast water will be taken on in Stormont Bay following off-loading. Discharge of ballast on incoming vessels is not anticipated and if required will be done outside the limits of Stormont Bay in accordance with TC protocols.

Not all introduced organisms will survive in their new surroundings, but some are extremely hardy, have no natural predators in their new environment, and can multiply profusely. The infamous European zebra mussel's introduction into the North American Great Lakes, and its subsequent spread to rivers, has jeopardized commercial and recreational fisheries, and caused expensive infrastructure problems. The introduction of invasive or exotic species can result in habitat modification, which then can potentially affect numerous species associated with particular habitats. Other impacts include competition, predation, disease, and hybridization.

Five species of seaweeds and approximately 12 species of invertebrates have invaded the marine vegetation of Atlantic Canada's rocky shorelines, salt marshes and seagrass meadows since the early 19th century (NRCan, 2007). Many originated primarily from Europe. Invasive species that arrived in the 20th century originated from the Indo-Pacific region. Some of the invasive or exotic species have had major, sometimes devastating, effects on native communities and on the harvest of commercial species. Large tracts of the sublittoral zone of the lower Gulf of St. Lawrence are now occupied by the European seaweeds *Fucus serratus* and *Furcellaria lumbricalis*. *Furcellaria lumbricalis* have become so abundant that they are now harvested in Canada. The Common periwinkle from Europe (*Littorina littorea*) invaded both soft sediment and rocky shores of Atlantic Canada and now plays a major role in structuring both salt marsh and rocky intertidal communities in eastern North America. A more recent invader, which has become abundant, is green crab, (*Carcinus maenas*). High green crab densities in other parts of the world have had major effects on marine communities. In the last decade of the 20th century, a European bryozoan, *Membranipora membranacea*, reached Nova Scotia and caused mass die-offs of native kelps. This process facilitated establishment and spread of the alien green seaweed *Codium fragile sp. tomentosoides*.

Marine Water Quality

The discharges from ships can affect the quality of the marine water in the vicinity of the vessel. The primary concern is with respect to the release of hazardous materials and hydrocarbons. As mentioned above, this has been addressed in Section 10.1 and has been determined not significant. The introduction of alien species does not affect the water quality but is of concern for marine organisms and is addressed below.

Effects on Vegetation (Marine), Species at Risk (Marine), Fish and Fish Habitat, Marine Mammals, Migratory Birds and Habitat

Effects on marine vegetation, fish, vertebrate and benthic species from introduced invasive species, can alter the entire ecosystem, indirectly affecting fish including species at risk, marine mammals, and migratory water birds that rely on those environmental components as a food source, or habitat.

The likelihood of any such effects to occur because of the LNG tankers is considered low. The LNG tankers will carry minimal ballast arriving in Stormont Bay and will take on ballast following unloading; therefore no discharge of ballast water in Stormont Bay is anticipated. Bilge water discharges will be avoided based on specific environmental management and operational procedures for vessels docking at the LNG Terminal. Accidental releases are considered limited to small volumes and rare occurrences.

Human Health and Safety

The concerns with respect to effects of ship discharges on Human Health and Safety relate primarily to the potential impacts on water quality as a result of accidental releases of hazardous materials and hydrocarbons to the marine environment. These have been addressed in Section 10.1 and have been determined not significant.

Effects on Fisheries and Aquaculture

Effects of invasive organisms on commercially harvested fish and habitat, as discussed above, have the potential to affect fisheries.

Some invasive organisms can become toxic, posing threats to other species and aquaculture stocks. On Prince Edward Island, clubbed tunicates have caused substantial problems at commercial shellfish sites. Since 1998, the dense masses of tunicates have proliferated, growing on lines and other aquaculture gear, smothering and killing the molluscs. More than one million pounds of tunicates are removed from the island each year, yet they continue to come back. Similarly, the multinucleate sphere X (MSX) virus has impacted commercial and Aboriginal oyster fisheries in the Bras D'Or Lakes.

The likelihood of any such effects to occur because of the LNG tankers is considered low. The LNG tankers will not carry and therefore will not discharge any ballast water. Bilge water discharges will be avoided based on specific environmental management and operational procedures for vessels docking at the LNG Terminal (Section 10.1.4.2 and 10.1.4.3). Accidental releases are considered limited to small volumes and rare occurrences. The effects are expected to be not significant.

10.1.4.2 Design and Operational Safeguards

To prevent the accidental discharge of oil or oily water, crews will be required to seal the engine room bilge overside discharge valve(s). Bilge water will be routinely monitored for oil and treated in the ships oil/water separator prior to discharge if found to be contaminated. Regular visual monitoring will be conducted around all vessels while in port to identify accidental discharges. Keltic will adhere to the *Canada Shipping Act* and regulations.

10.1.4.3 Contingency and Emergency Response Procedures

All accidental overside discharges are to be reported immediately to the Terminal operator. If the discharges contain oil or other deleterious substances, the vessel must immediately notify the Terminal operator and the vessel must immediately activate its Oil Pollution Emergency Plan. This plan is a requirement of the *Canada Shipping Act*. The Oil Pollution Emergency Plan must identify the person authorized to implement the plan and also confirm the vessel has an arrangement with a Canadian Coast Guard certified response organization. In the event of a spill, the vessel must immediately notify the Terminal operator which in turn notifies the Canadian Coast Guard.

10.1.4.4 Conclusion

Environmental effects from accidental discharges of hazardous materials and hydrocarbons through accidental release of ship bilge water to the marine environment are expected to be short term and reversible. Effects from the introduction of invasive species through bilge water discharges are more difficult to predict and potentially have significant long-term impacts. The likelihood of such effects to occur because of the LNG tankers is considered low. The LNG tankers will not carry and therefore will not discharge any ballast water. Bilge water discharges will be avoided based on specific environmental management and operational procedures for vessels docking at the LNG Terminal (Section 10.1.4.2 and 10.1.4.3). Accidental releases are considered limited to small volumes and rare occurrences. The effects, although difficult to predict, are expected to be not significant.

10.1.5 Grounding of Ships

The grounding of ships may result from a ship crossing an area of insufficient water depth (i.e., less than 15 m) due to a navigational error, malfunctioning of navigation equipment, or drifting into shallow water following engine malfunction. As there is sufficient depth available for LNG tankers in the vicinity of the facility and the concern with grounding is more closely related to areas on the approach to Stormont Bay, the assessment of the environmental effects of grounding addressed in Section 10.3 are also applicable to the LNG facility.

10.1.6 Risk of Accidents and Malfunctions during Decommissioning

Accidents and malfunctions during decommissioning are considered all included in the malfunction and accident scenarios assessed in the preceding sections. No other scenarios specific to the decommissioning phase have been identified. The environmental effects, mitigation measures, contingency and emergency response procedures described above equally apply to accidents and malfunctions that may occur during decommissioning.

10.2 MARGINAL WHARF

Accidents and malfunctions with potential to occur at the marginal wharf include the following:

- hydrocarbon and hazardous material spills;
- discharge of sediment to environment;
- discharges from ships;
- grounding of ships; and
- risk of accidents and malfunctions during decommissioning.

Forest fires are not a considered a possibility at the marginal wharf, as the area surrounding marginal wharf will be cleared and developed.

10.2.1 Hydrocarbon and Hazardous Material Spills

In support of the product output from the petrochemical facility, marine traffic for this facility will include the transshipment of feedstocks, product components, and byproducts. These shipments will increase traffic levels by an estimated 200 additional vessels entering the port per year. This means a yearly traffic flow into Stormont Bay of 300 to 400 LNG and product carriers. This number does not include the movement of harbour tug, offshore and inshore fisheries vessels or vessels of less than 100 m length.

The potential for spills of hydrocarbons and hazardous materials exists for all phases of the Project. During the construction and commissioning phases, the potential for spills is limited to materials used in site preparation, and fabrication and installation of the facilities and equipment. For example, gasoline, diesel fuel, propane, grease, motor oil, and hydraulic fluids are all needed for heavy equipment required for site preparation. Construction of the facilities will also require hazardous materials such as acetylene, oxygen and other compressed gases, form oil, paints, epoxies, concrete additives, glycol/methanol, cleaners, and solvents.

The probability of spills and the effects of spills, in the event that they occur, will be reduced by the implementation of hazardous materials management processes and procedures. The handling of fuel and other hazardous materials will comply with the *Transportation of Dangerous Goods Act*. All bulk storage of fuel products, concrete additives and other hazardous materials will be stored in aboveground, self-dyked tanks or drums with secondary containment. A complete inventory of all fuels and hazardous materials will be maintained and fuels and other hazardous materials will only be handled by persons who will be trained and qualified in handling these materials. The Project will also implement WHMIS to ensure proper handling and storage is achieved.

10.2.1.1 Potential Environmental Concerns

Potential environmental concerns associated with malfunctions and accidents related to the marine components of the LNG facility (Section 10.1) are also applicable to the marginal wharf with the exception of environmental effects related to LNG releases.

10.2.1.2 Design and Operational Safeguards

Design and operational safeguards associated with malfunctions and accidents related to the marine components of the LNG facility (Section 10.1.1.4) are also applicable to the marginal wharf.

10.2.1.3 Contingency and Emergency Response Procedures

Contingency and emergency response procedures associated with malfunctions and accidents related to the marine components of the LNG facility (Section 10.1.1.5) are also applicable to the marginal wharf.

10.2.1.4 Conclusion

Based on the foregoing, environmental effects from hydrocarbon and hazardous materials spills are not likely to be significant considering the measures described in the preceding sections to be taken in the design, construction, and operation of the facility.

10.2.2 Discharge of Sediment to Marine Environment

The potential exists for failure of erosion and sediment control structures due to precipitation events.

Potential environmental concerns, mitigative measures, and conclusions associated with discharges to the marine environment described for the LNG facility are also applicable to the marginal wharf with the exception of environmental effects related to LNG releases.

10.2.3 Discharges from Ships

As mentioned above, these shipments to and from the marginal wharf will increase traffic levels by an estimated 200 additional vessels entering the port per year. This means a yearly traffic flow into Stormont Bay of 300 to 400 LNG and product carriers. This number does not include the movement of harbour tug, offshore and inshore fisheries vessels or vessels of less than 100 m length.

The general environmental concern is identical with that discussed for the LNG Terminal and relates to the potential for environmental impacts from discharges to the marine environment of bilge water, which has the potential to release hydrocarbon contaminants and/or invasive/exotic species (see Section 10.1.4). The concern with respect to the potential introduction of release of invasive/exotic species is somewhat elevated at the marginal wharf. Most of the vessels docking at the marginal wharf will arrive with ballast water, which will be discharged in accordance with the *Ballast Water Control and Management Regulations* prior to arriving in Stormont Bay.

10.2.3.1 Potential Environmental Concerns

Potential environmental concerns associated with the introduction of alien invasive species and marine water quality, fish and fish habitat, marine mammals, migratory birds and habitat, fisheries and aquaculture as a result of accidental discharges from ships, presented in Section 10.1.4 (as related to the marine components of the LNG facility) are also applicable to the marginal wharf.

10.2.3.2 Design and Operational Safeguards

Design and operational safeguards associated with accidental discharges of hydrocarbon contaminants from ships related to the marine components of the LNG facility (Section 10.1.4.2) are also applicable to the marginal wharf.

The introduction of invasive species to the marine environment through release of ballast water at or near the marginal wharf is a potential scenario but is considered unlikely. Ballast exchanges are mandated by the IMO ballast water guidelines and the Canadian Ballast Water Control and Management Regulations under the *Canada Shipping Act*.

The Canadian Ballast Water Control and Management Regulations require the vessel operator to exchange ballast water at sea:

- In accordance with the regulations, vessel operators must carry a ballast water management plan on board. The plan must specify such aspects as:
  - ballast water management processes to be used and procedures to be followed;
  - procedures to be followed for co-ordinating ballast water management with Canadian authorities;
  - detailed description of the on-board ballast water system and the system's design specifications;
  - on-board responsible officer; and
  - ballast water reporting form and reporting requirements.
- The implementation of the ballast water management plan is the responsibility of the vessel operator.
- In accordance with the Canadian Ballast Water Control and Management Regulations, if exceptional circumstances (equipment failure, weather/ safety considerations) prevent a proper ballast water exchange, TC is to be notified as soon as possible by the vessel. The Minister of Transport determines, in consultation with the master of the ship, mitigation measures prior to the discharge / exchange of ballast water in Canadian waters. This will involve considerations of the nature of the ballast water, the likelihood of introduction of harmful aquatic organisms, safety and environmental conditions, and may result in decisions such as ballast water retention, discharge at sea in an alternate exchange zone, treatment prior to discharge etc.

Compliance with the regulations is monitored as part of TCs routine ship inspections. Keltic will monitor the proper implementation of ballast water exchange practices by requesting, that the vessel operator provides Keltic with a copy of the completed ballast water reporting form for each voyage to the marginal wharf.

10.2.3.3 Contingency and Emergency Response Procedures

Contingency and emergency response procedures associated with accidental discharges from ships related to the marine components of the LNG facility (Section 10.1.4.3) are also applicable to the marginal wharf.

10.2.3.4 Conclusion

Environmental effects from accidental discharges of hazardous materials and hydrocarbons through accidental release of ship bilge water to the marine environment are expected to be short term and reversible. Bilge water discharges will be avoided and effects of accidental releases minimized based on specific environmental management and operational procedures for vessels docking at the LNG Terminal (Sections 10.1.4.2 and 10.1.4.3).

The likelihood of effects from the introduction of invasive species through ballast water discharges is considered low. The ballast water exchange is regulated by the Canadian Ballast Water Control and Management Regulations under the *Canada Shipping Act*. These regulations ensure that ballast water is exchanged in the open sea in order to minimize the risk of introducing alien species.

Overall, the effects of accidental discharges from ships are considered not significant.

10.2.4 Grounding of Ships

The grounding of ships may result from a ship crossing an area of insufficient water depth (i.e., less than 15 m) due to a navigational error, malfunctioning of navigation equipment, or drifting into shallow water following engine malfunction. As there is sufficient depth available for cargo vessels in the vicinity of the facility and the concern with grounding is more closely related to areas on the approach to Stormont Bay, the assessment of the environmental effects of grounding addressed in Section 10.3.3 are also applicable to the marginal wharf.

10.2.5 Risk of Accidents and Malfunctions During Decommissioning

Accidents and malfunctions during decommissioning are considered all included in the malfunction and accident scenarios assessed in the preceding sections. No other scenarios specific to the decommissioning of the marginal wharf have been identified. The environmental effects, mitigation measures, contingency and emergency response procedures described above equally apply to accidents and malfunctions that may occur during decommissioning.

10.3 PROJECT RELATED SHIPPING WITHIN 25 KM OF COUNTRY ISLAND

Accidental events and malfunctions may occur in shipping within 25 km of Country Island including the potential for grounding on shoals; and collisions involving tankers, cargo vessels and other marine vessels. These specific scenarios assessed include:

- hydrocarbon and hazardous material spills;
- discharges from ships; and
- grounding of ships.

The interactions between these scenarios and potentially affected VECs (Interaction Matrix, Table 10.0-1) are briefly discussed below.

10.3.1 Hydrocarbon and Hazardous Material Spills

The potential for spills of hydrocarbons and hazardous materials identified for both the construction and operational phases of the LNG Terminal and the marginal wharf equally apply to the spills resulting from shipping accidents (grounding or collision). They may involve release of bilge water, LNG tank ruptures, or spills of Marine Diesel Oil (MDO) (MDO- Petroleum Distillate Fuel).

10.3.1.1 Potential Environmental Concerns

Potential environmental concerns for the marine environment associated with malfunctions and accidents related to the marine components of the LNG facility (see relevant subsections in Sections 10.1 and 10.2) are also applicable to Project related shipping, with the exception of potential effects to migratory birds, which are located in closer proximity to shipping lanes than to the terminal.

Effects on Species at Risk

Hazardous material spills may, depending on the toxicity of the substance, cause direct or indirect mortality of species at risk by contaminating water, soil, or food sources. Chemicals may be directly absorbed through dermal contact or ingested. The only species at risk known to occur in the area is the roseate tern, which nest on Country Island, approximately 5 km from the proposed shipping lane. Given this distance, the risk for effect on the terns from a hazardous material spill is considered low. Given the proposed mitigation (Sections 10.3.1.2 and 10.3.1.3) and the low probability for impact, the environmental effect of a hazardous material spill on species at risk is considered not significant.

10.3.1.2 Design and Operational Safeguards

Design and operational safeguards associated with malfunctions and accidents related to the marine components of the LNG facility (Section 10.2.1.2) are also applicable to shipping. Additionally, the following measures will be employed for shipping operations:

Project related shipping will comply with the outcomes of the TERMPOL review process which will detail anticipated Project shipping, shipping protocols and communications for the Project, pilotage requirements, and emergency response requirements.

Some examples of the operational safeguards include:

- the marginal wharf and LNG Terminal will be a compulsory pilotage area; and
- ships will not be allowed to approach, dock, or remain at the facility if sea conditions do not allow safe operation.

Navigation aids and piloting service will assist with shipping operations in foggy conditions.

In severe wave conditions environmental effects will be mitigated by:

- the LNG storage facility will be located and designed to appropriate wave run-up conditions;
- the LNG Terminal and marginal wharf will be designed to with stand storm/wave/wind events and LNG ships are designed to be seaworthy in all types of weather; and
- ships will not dock and, if docked, will depart if waves exceed design criteria.

Operational procedures will include a monitoring program for the rare possibility of icebergs.

10.3.1.3 Contingency and Emergency Response Procedures

Contingency and emergency response procedures associated with malfunctions and accidents related to the marine components of the LNG facility (Section 10.1.1.5) are also applicable to Project shipping.

10.3.1.4 Conclusion

Based on the foregoing, environmental effects from hydrocarbon and hazardous materials spills are not likely to be significant considering the measures described in the preceding sections to be taken in the design and operation of Project shipping.

10.3.2 Discharges from Ships

Accidental discharges from ships with the potential for environmental impacts include bilge water, which has the potential to release hydrocarbon contaminants and/or invasive/exotic species to the marine environment. Potential exists for environmental effects from the discharge of bilge water from vessels. Bilge water can contain water, oil, dispersants, detergents, solvents, chemicals, particles and exotic, invasive species, depending on previous ports of call. If this water is released to the marine environment, it can impact water quality.

10.3.2.1 Potential Environmental Concerns

Potential environmental concerns associated with marine water quality, fish and fish habitat, marine mammals, fisheries, and aquaculture as a result of accidental discharges from ships, presented in Sections 10.1.1.3, 10.1.2.1, 10.1.3.1, and 10.1.4.1 (as related to the marine components of the LNG facility) are also applicable to Project shipping.

10.3.2.2 Design and Operational Safeguards

Design and operational safeguards associated with accidental discharges of hydrocarbon contaminants from ships related to the marine components of the LNG facility (Section 10.1.4.2) are also applicable to the shipping within 25 km of Country Island.

The introduction of invasive species to the marine environment through release of ballast water at or near the island is a potential scenario but is considered unlikely. Ballast exchanges are mandated by the IMO ballast water guidelines and the Canadian Ballast Water Control and Management Regulations under the *Canada Shipping Act*.

The Canadian Ballast Water Control and Management Regulations require the vessel operator to exchange ballast water at sea. Specific stipulations have been described in 10.2.3.2 and equally apply for the shipping within 25 km of Country Island.

10.3.2.3 Contingency and Emergency Response Procedures

Contingency and emergency response procedures associated with accidental discharges from ships related to the marine components of the LNG facility are also applicable to Project shipping.

10.3.2.4 Conclusion

Environmental effects from accidental discharges of hazardous materials and hydrocarbons through accidental release of ship bilge water to the marine environment are expected to be short term and reversible. Bilge water discharges will be avoided and effects of accidental releases minimized based on specific environmental management and operational procedures for vessels docking at the LNG Terminal and marginal wharf (Sections 10.1.4.2 and 10.1.4.3).

The likelihood of effects from the introduction of invasive species through ballast water discharges is considered low. The ballast water exchange is regulated by the Canadian Ballast Water Control and Management Regulations under the *Canada Shipping Act*. These regulations ensure that ballast water is exchanged in the open sea in order to minimize the risk of introducing alien species.

Overall, the effects of accidental discharges from ships are considered not significant.

10.3.3 Grounding of Ships

The grounding of ships may result from a ship crossing an area of insufficient water depth (i.e., less than 15 m) due to a navigational error, malfunctioning of navigation equipment, or drifting into shallow water following engine malfunction. This possibility has been raised as a concern by both regulatory agencies and the public as there are a number of shoals to the south of Country Island and along the western side of the approach to Stormont Bay. Partly as a result of these characteristics, the Project will be under compulsory pilotage from a point outside Stormont Bay. This location will be decided by TC and the Atlantic Pilotage Authority, as recommended by the TERMPOL process.

10.3.3.1 Potential Environmental Concerns

Hazardous material spills resulting from grounding of ships may, depending on the toxicity of the substance, cause direct or indirect mortality of species at risk by contaminating water or food sources. Chemicals may be directly absorbed through dermal contact or ingested. The only species at risk known to occur in the area is the roseate tern, which nest on Country Island.

10.3.3.2 Design and Operational Safeguards

Design and operational safeguards associated with malfunctions and accidents presented for hydrocarbon and hazardous material spills in Section 10.1.1.4 are also applicable to grounding of ships.

10.3.3.3 Contingency and Emergency Response Procedures

Contingency and emergency response procedures associated with malfunctions and accidents presented for hydrocarbon and hazardous material spills in Section 10.1.1.5 are also applicable to grounding of ships.

10.3.3.4 Conclusion

Based on the foregoing, environmental effects from ship groundings are not likely to be significant considering the measures described in the preceding sections to be taken in the design and operation of Project shipping.

11.0 CONCLUSION

In accordance with the requirements of Section 16 (1) and (2) of CEAA and the Terms of Reference, this EA includes:

- A discussion of the alternatives to the Project and the alternative means of carrying out the Project that are technically and economically feasible and the environmental effects of any such alternative means.
- A description of the proposed Project including the purpose, and need, the proposed facilities and activities, and the potential malfunctions or accidental events that may occur in connection with the Project.
- A summary of consultation mechanisms and issues raised during consultation (i.e., issues scoping) as well as a description of the methodological approach to the environmental impact assessment.
- An assessment of the environmental effects of the proposed Project for each of the VECs, including cumulative environmental effects and the significance of the effects;
- An assessment of the effects of the environment on the Project.
- Identification of measures to mitigate any significant adverse environmental effects.
- Recommendations for monitoring and follow-up.

The results of the assessment have been developed and summarized in Section 6.0 of the CSR. This section describes the predicted effect and the identified mitigation or avoidance measures which could reduce or eliminate the predicted effects.

Environmental management practice involving prevention and preparedness training is proposed to reduce the likelihood of unplanned (accidental) events. As well, effective emergency response programs will be developed should an event occur. The Emergency Preparedness planning will include the purchase of required equipment, the careful maintenance of equipment and infrastructure, and the frequent scheduling of training exercises and emergency response simulations. Emergency Preparedness Planning will be integrated into all phases of the Project design, planning, and execution. The objective is to achieve a safety and emergency preparedness level higher than the industry average, and continuously to improve upon this standard.

Through careful design and planning, combined with prudent application of proven mitigation measures, Keltic has identified and addressed all potential adverse environmental effects, and reduced the predicted impacts to their lowest level of significance.

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PERSONNEL COMMUNICATIONS

Contact Name	Organization	Date Contacted
Avery, Kim	Guysborough County Heritage Association.	2006
Boyne, Andrew	Canadian Wildlife Service	
Cleary, Gary	Municipality of the County of Guysborough	2006
Eagles, Michael	Fisheries and Oceans Canada:	2001
Forbes, Dr. Graham	University of New Brunswick	
Gagne, Rick	earth-water Concepts inc.	2007
Hayne, Derek	Municipality of the District of Guysborough.	2006
Hayne, Lynn, 2006..	Guysborough County Heritage Association.	2006
Manthorne, F,		
Mitchell, Bruce	Mercator Geological Services Ltd.	2006
O'Neil,		2005
Parsons		2005
Ross, Theodore	NSDEL, Public Safety. Program Administration Officer	2006
Seymour, N.	St. Francis Xavier University	
Smith, Paul		2001
Torrey, D	Municipality of the County of Guysborough	2006
	CWS	
	NSDNR	

APPENDIX 1

CEAA Scoping Document for the Petrochemical And Liquefied Natural Gas Facilities at Goldboro, NS and Addendum to Scoping Document

021373

Canadian Environmental Assessment Act

Scoping Document

for the

Petrochemical and

Liquefied Natural Gas Facilities

at

Goldboro, N.S.

Prepared by:
Transport Canada
Fisheries and Oceans Canada

May 24, 2005

021374

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Appendix 1 Glossary of Terms

021375

Please note that underlined words are defined in Appendix 1, Glossary of Terms.

1.0 Introduction

Keltic Petrochemicals Inc. (Proponent) proposes to construct and operate a Petrochemical Complex and Liquefied Natural Gas (LNG) Importation and Vapourization Facility, in Goldboro, Nova Scotia. The proposal includes petrochemical plants, a marginal wharf, a LNG Terminal, LNG storage and regassification facilities, and an electrical co-generation facility. A pipeline will be constructed from the Vaporization Plant to the property boundary. The proposal also includes construction of a highway between the development site and Antigonish. These facilities, and any associated auxiliary facilities, are referred to collectively in this document as the development proposal. Refer to Figures 1 and 2.

Transport Canada (TC) and Fisheries and Oceans Canada (DFO) are each required to exercise regulatory decision-making authorities in regard to some components of the development proposal in order for it to proceed. For this reason, both departments are required to ensure that a federal environmental assessment is conducted, pursuant to the *Canadian Environmental Assessment Act* (the Act), prior to taking their respective decisions.

The development proposal is subject to a provincial environmental assessment in accordance with the Nova Scotia *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 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 Act, 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 Act.

Information on the deadline for comment, and how to submit comments, are found in Section 7.0.

Following the public comment period, in accordance with Section 21(2) of the Act, DFO and TC will provide a report to the federal Minister of the Environment. DFO and TC will also make a recommendation to the Minister on whether to continue with the environmental assessment by means of a comprehensive study or to refer the project to a mediator, for mediation, or a review panel.

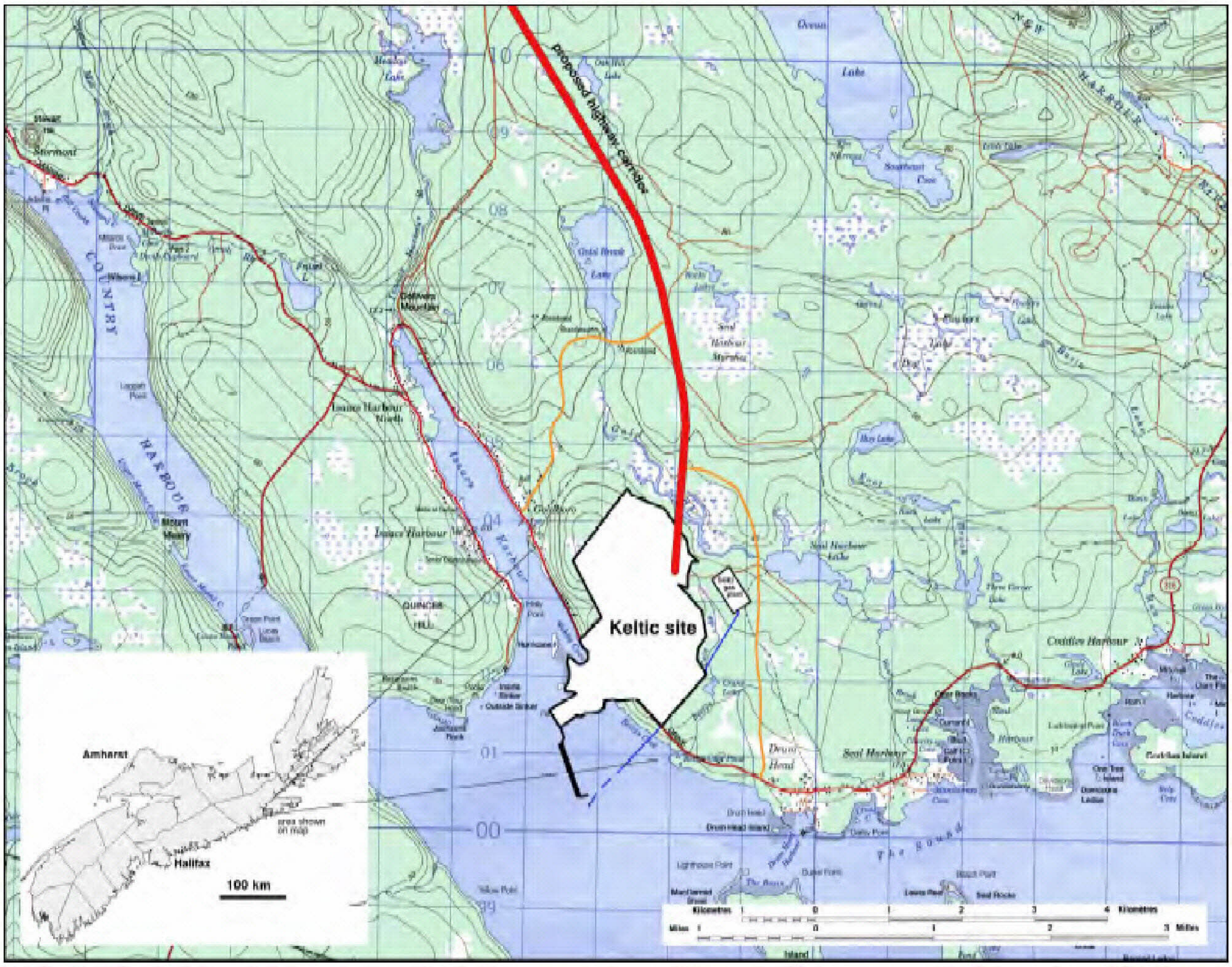

Figure 1 – Development Proposal Site

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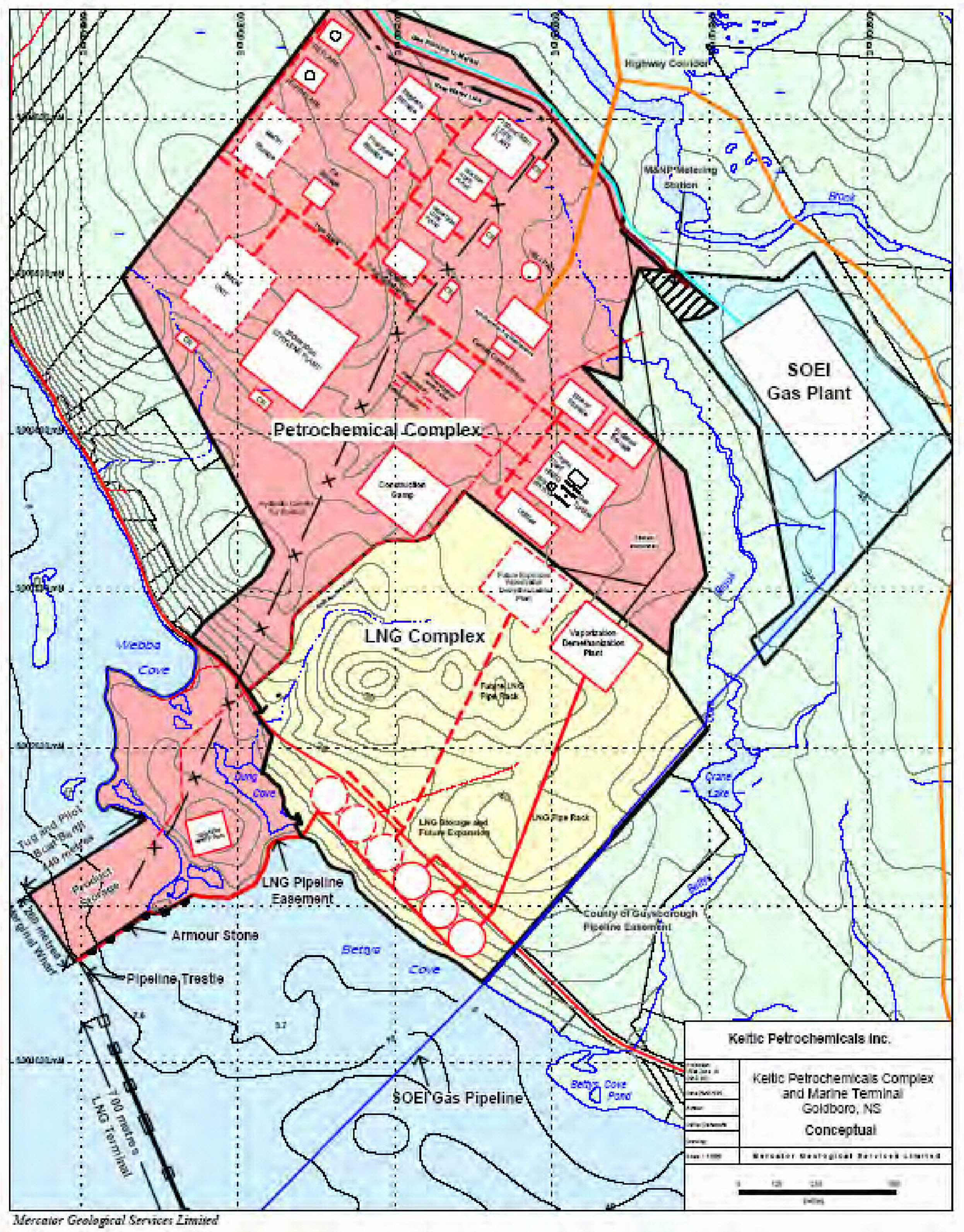

Mercator Geological Services Limited

Figure 2 – Detailed Development Proposal Site Plan

2.0 Federal Environmental Assessment

2.1 Regulatory Context

DFO and TC are both required to ensure that a federal environmental assessment is conducted in accordance with the Act. Therefore, both departments are responsible authorities (RAs) under the Act. Each RA's responsibility to ensure an assessment is conducted relates to the issuance of a permit, license or other approval that is included in the *Law List Regulations* of the Act.

2.1.1 Transport Canada

TC's responsibilities under the Act arise from the anticipated requirement for a *Navigable Waters Protection Act* (NWPA), section 5(1)(a), approval to allow for an interference to navigation, associated with the LNG Terminal and marginal wharf (refer to Figure 2).

2.1.2 Fisheries and Oceans Canada

DFO's responsibilities under the Act arise from the anticipated requirement for a *Fisheries Act* section 35(2) authorization, for the harmful alteration, disruption, or destruction of fish habitat associated with the marginal wharf (refer to Figure 2).

2.2 Level of the Environmental Assessment

A comprehensive study is required under the Act, pursuant to paragraph 28(c) of the *Comprehensive Study List Regulations,* because both the LNG Terminal and marginal wharf will be designed to handle vessels larger than 25 000 dead weight tonnes.

2.3 Overview of the Environmental Assessment Process

Following this initial public consultation, pursuant to subsection 21(2) of the Act, the RAs must report to the Minister of the Environment on the following:

- the scope of the project, the factors to be considered in the environmental assessment and the scope of those factors;
- public concerns in relation to the project;
- the project's potential to cause adverse environmental effects; and
- the ability of the comprehensive study to address issues relating to the project.

The RA's must also recommend to the Minister of the Environment whether the environmental assessment should be continued by means of a comprehensive study, or whether the project should be referred to a mediator or 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). During the comprehensive study process, public participation is required.

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 determination. 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 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 Act. 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.

2.4 Provision of Expert Advice from other Departments

Environment Canada (EC), Natural Resources Canada (NRCan), and Health Canada (HC) will provide specialist or expert information and knowledge in support of the environmental assessment process.

3.0 Canada-Nova Scotia Harmonization

The development proposal is subject to a provincial environmental assessment in accordance with the Nova Scotia *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.

A document outlining the information that the Proponent must provide, as part of the provincial environmental assessment, was finalized on April 8, 2005. It is entitled "Terms of Reference, As Required by the *Environment Act* for Preparation of an Environmental Assessment Report, Proponent: Keltic Petrochemical Inc., Project: Petrochemical Plant and LNG Facilities, Goldboro, NS". The document can be viewed at http://www.gov.ns.ca/enla/ess/ea/kelticpetro.asp. Information provided by the Proponent will be used as part of both the provincial environmental assessment process, and the federal environmental assessment process.

4.0 TERMPOL

TERMPOL Review Process refers to the Technical Review Process of Marine Terminal Systems and Transshipment sites. The purpose of the TERMPOL review is to objectively appraise operational ship safety, route safety, management and environmental concerns associated with the location, construction and operation of a Marine Terminal.

It is the policy of Transport Canada to initiate TERMPOL upon the request of the Proponent and upon the initiation of the federal environmental assessment process for the project. If the Proponent does not elect to follow the TERMPOL process, the Navigable Waters Protection Division of Transport Canada may require that the Proponent carry out the relevant studies identified in TERMPOL as part of the navigational review process for the NWPA permit. The TERMPOL review is not limited to the scope of the environmental assessment review, nor is the NWPA review process exclusive of the components of the TERMPOL review process. In addition, the LNG tankers will be required to meet all national and international standards for the operation of such tankers.

5.0 Overview of the Development Proposal

5.1 Proposal Location

The Petrochemical Complex, supported by a LNG Importation and Vapourization Facility and an Electric Co-generation Plant, would be located in Goldboro, Guysborough County, Nova Scotia. A portion of the proposal (landbased facilities) would be located within the Goldboro Industrial Park. The associated marine facilities would be located on the northeast side of Isaacs Harbour. The highway would connect the Goldboro site and Antigonish. Refer to Figure 1.

5.2 Components of the Development Proposal

5.2.1 LNG Importation (includes the LNG Terminal) and Vapourization Facility

The LNG Facility will offload, store and revapourize LNG for the supply of feed stock and energy requirements for the Petrochemical Complex and the Electric Co-generation Plant. The capacity will be 1 billion cubic feet (BCF) per day of LNG, expandable to 2 BCF per day. Sufficient natural gas pipeline take-away capacity exists in close proximity to the LNG facility, if there is residual gas for market.

The LNG will be offloaded at the LNG Terminal located in Isaacs Harbour. The LNG Terminal will accommodate special ships designed for the transportation of LNG in the range of 70 000 dead weight tonne (DWT), with a draft up to fourteen meters and capable of holding up to 250,000 m^3 of LNG. The LNG Terminal will be constructed of pipe pile mooring piers and berthing dolphins. The piers will be capped and connected with a concrete bridge and deck. The LNG transfer line will be routed to the LNG storage tanks via a pipeline and maintenance trestle.

LNG vessels will arrive approximately every eight days at the facility's initial capacity. Hotelling and unloading of LNG ships will typically require 24 hours. This will include activities such as customs and immigration, servicing, provisioning and unloading. LNG vessels will be brought in fully loaded and reballasted offshore.

Onboard ship pumps will deliver LNG to low pressure onshore LNG storage tanks via stainless steel loading arms and cryogenic piping. A total of four marine unloading arms will be installed, three for liquid delivery and one for vapour return to the ship.

There will be three full containment, top entry storage tanks. Three additional tanks are planned, for future expansion. The LNG will be contained in an inner tank. An outer tank will surround the inner tank. The bottom of the tank will be insulated with foamglass. The LNG tank foundation will be elevated several feet above the ground to prevent frost heave. All connections to the LNG tanks will be from the top.

5.2.2 Petrochemical Complex (includes the Marginal Wharf)

The Petrochemical Complex will consist of process units for ethylene, propylene, polypropylene, high density polyethylene, low density polyethylene, and linear low density polyethylene. The plants will obtain their feedstock (ethane, propane and butane) and process gas from both the LNG system and SOEI. Gas obtained from SOEI will be returned to the SOEI plant after extraction of the feedstock liquids described above. Power will be supplied by the Electric Co-generation Facility. The Petrochemical Complex will require an industrial water supply. A marginal wharf will be constructed in Issacs Harbour.

Other feedstocks (eg. refinery propylene, methanol) will be imported to the Goldboro site by ship and offloaded at the marginal wharf. The products and byproducts of the Petrochemical Complex will be transported to the marginal wharf for storage in silos (as required), and will be shipped out from there. One side of the marginal wharf will be used for berthing tugs and pilot boats.

The marginal wharf will be approximately 670 m in average length and 330 m in width. Construction will be done using pre-cast concrete caissons. The caissons will be floated into position, and placed on a granular mattress on the seabed. This will eliminate the need to dredge and dispose of seabed materials. Fill will be placed in the area behind the caissons.

5.2.3 Electric Co-generation Plant

The Electric Co-generation Plant will have a gas turbine and heat recovery steam generator with a capacity of 200 megawatts, to meet the development requirements. The electricity will be generated at 35 kilowatts per annum, three phase and 60 Hertz. This will enable connection to the Nova Scotia Power Inc. grid for purchase of incremental power required by the site, and to provide some backup.

5.2.4 Highway

The existing highways, although not at capacity, are not well suited for industrial traffic. The proposed 100 series highway would begin at the Goldboro site, and run north-northeast through Guysborough County to the Trans Canada Highway 104/Beech Hill Road intersection at Antigonish, a distance of approximately 60 kilometers.

5.2.5 Pipeline

A pipeline will be constructed from the LNG Vaporization Plant to the property boundary, to allow for future connection, by other parties, with the existing Maritimes and Northeast Pipeline system.

6.0 Scope and Level of the Federal Environmental Assessment

6.1 Scope of the Project

DFO and TC, each have a responsibility to ensure that an environmental assessment is conducted in accordance with the Act. As outlined in the Act, section 15(1), the scope of the project to be assessed is determined by the RA.

TC has determined, based on the anticipated NWPA section 5(1)(a) trigger under the Law List Regulations of the Act, that the scope of the project for the purposes of TC's environmental assessment will be the construction, operation, maintenance, modification and decommissioning of the following components: LNG Terminal, marine transfer pipelines, the LNG storage tanks, the marginal wharf, any temporary marine facilities and structures and equipment that are connected with the movement of goods between ships and shore, the regassification plant.

DFO has determined, based on the anticipated *Fisheries Act*, section 35(2) trigger under the Law List Regulations of the Act, that the scope of the project for the purposes of DFO's environmental assessment will be the construction and operation of the marginal wharf. Operation of the marginal wharf does not include shipping, but does include docking and deberthing of vessels.

DFO and TC will work together to conduct a single federal assessment process that will allow both RAs to fulfill their respective responsibilities under the Act**,** in a unified non-duplicative manner.

6.2 Factors to be Considered in the Environmental Assessment

The comprehensive study will consider those factors required pursuant to section 16 of the Act:

- 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 Act and the regulations;
- measures that are technically and economically feasible and that would <u>mitigate</u> any significant adverse environmental effects of the project;
- the purpose of the project;
- <u>alternative means of carrying out the project</u> that are technically and economically feasible and the environmental effects of any such alternative means;
- the need for, and the requirements of, any <u>follow-up program</u> 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 Act, the comprehensive study will also include a consideration of the "need for" the project and "<u>alternatives to" the project</u>.

As stated in the Act, "environmental effect" means, in respect of a project:

a) *any change that the project may cause in the <u>environment</u>, 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 such things as:

- geological events (e.g., seismic activity);
- icing and winter conditions;
- erosion, fire, flooding; and
- climate change.

The cumulative effects assessment will take into consideration, effects related to components of the development proposal that are not included in the scope of project (e.g., electrical co-generation plant, petrochemical plants).

It is important to note that 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. For example, a decision to place a toll on a highway would not be considered under the Act because the toll is not related to a change in the environment.

6.3 Scope of the Factors to be Considered

6.3.1 Environmental Components

In order to obtain a good prediction of the effects of a project on the environment, it is important to focus the assessment. “Environmental components” is a term used to describe various aspects of the biological, physical and social environment. Environmental components can be something physical such as vegetation, a process such as biodegradation, or a condition such as biodiversity.

One of the purposes of this public comment period is to identify “environmental components of concern” (ECC). These are the environmental components that exist in the area, and therefore could possibly be impacted by the project. As the assessment proceeds, a determination will be made on which of these environmental components of

concern would be impacted by the project, and are of legal, scientific, ecological, cultural, economic, etc. value. These will be referred to as the "valued environmental components" and will be the focus of the environmental assessment.
Please note that the scope of project, as described in Section 5.1 above, does not mean that the area to be studied will be confined to the project site. Rather, the study area, for the purposes of the environmental assessment, must include the area within which the environmental components that could potentially be affected by the scoped project (i.e., undertakings associated with the LNG Terminal and marginal wharf) are located.

The environmental assessment methodology to be used by the Proponent will include the following:

- an overview or study, as appropriate, for each of the ECC, in order to describe the actual conditions in the study area (i.e., baseline conditions);
- prediction of environmental effects,
- identification of mitigation that can be used to avoid or minimize adverse effects on the environment;
- identification and assessment of residual (i.e., still remaining) effects;
- prediction of cumulative environmental effects
- discussion of significance; and
- preparation and implementation of a follow-up program.

The following provides a preliminary list of ECC that will be considered in the environmental assessment. This list is not intended to be exhaustive.

- freshwater quality/quantity;
- marine water quality/quantity;
- groundwater quality/quantity;
- soil/sediment quality;
- hydrology;
- air quality;
- climatic conditions;
- vegetation;
- species at risk;
- fish and fish habitat;
- wildlife and wildlife habitat;
- migratory birds and their habitat;
- physical and cultural heritage;
- current use of lands and resources for traditional purposes by Aboriginal persons;
- navigation;
- marine safety and security;
- wetlands;
- fisheries;
- human health and safety;
- structures/sites of archaeological, paleontological or architectural significance;
- marine mammals;
- lighting conditions;

- acoustic environment.

Temporal and spatial boundaries will be determined for each ECC, early in the assessment. Temporal bounding refers to the determination of the time period during which an ECC 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 ECC 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 all of the ECC could be impacted.

6.4 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 Agency. Comments must be received no later than July 4, 2005. Comments may be sent to:

Transport Canada
Environmental Affairs, MKE
P.O. Box 42
Moncton, NB E1C 8K6
Fax: (506) 851-7542 or E-mail : atlwebcomments@tc.gc.ca

Clearly reference the Keltic LNG Facility and Marginal Wharf on your submission.

The Agency will receive all public comments on the scoping document and distribute them to TC, DFO, EC, HC, and NRCan.

7.2 Participant Funding

The Agency will provide participant funding to assist groups and individuals to take part in the environmental assessment, whether it proceeds by means of a comprehensive study or is referred to a mediator or review panel. 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.

7.3 Canadian Environmental Assessment Registry (CEAR)

Pursuant to the Act, 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 TC at 506-851-6962.

If you have general questions in relation to the Act, 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 Act, 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 Act, 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 Act 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 Act, 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 Act, 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 Act, 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 33of the Act and that includes a consideration of the factors required to be considered under subsections 16(1) and (2) of the Act.

ADDENDUM TO THE SCOPING DOCUMENT FOR THE PETROCHEMICAL AND LIQUIFIED NATURAL GAS FACILITIES AT GOLDBORO, NS, PREPARED BY TRANSPORT CANADA and FISHERIES and OCEANS CANADA, DATED MAY 24, 2005.

Pursuant to subsection 21(1) of CEAA, on June 1, 2005 and June 3, 2005, TC and DFO, invited the public to comment on the Scoping Document. The following actions were taken:

- A notice was posted in the Chronicle-Herald and the Guysborough Journal on June 1st
- A notice was posted in Le Courrier de la Nouvelle -Ecosse on June 3rd

The document was available for public review at the following locations:

- The Ecology Action Centre, Halifax
- Municipality of the District of Guysborough, Guysborough
- Sherbrooke Branch Library, Sherbrooke
- Isaacs Harbour Medical Centre, Isaacs Harbour.

Comments were requested to be provided by July 3, 2005.

In accordance with section 21(1) of the CEAA, TC and DFO consulted with the public, with respect to the proposed scopes of the projects for the purposes of the environmental assessment, the factors proposed to be considered in its assessment, the proposed scope of those factors, and the ability of the comprehensive study to address issues relating to the projects. Natural Resources Canada, Environment Canada, and Health Canada, as expert federal authorities under the CEAA, were also consulted.

TC originally scoped the project to include the construction, operation, maintenance, modification and decommissioning of the following components: LNG terminal, marine transfer pipelines, the LNG storage tanks, the marginal wharf, any temporary marine facilities and structures and equipment that are connected with the movement of goods between ship and shore, and the regassification plant. Based on comments received during consultation on the Scoping Document, TC will amend its scope of project to include shipping within 25 km of Country Island.

DFO originally scoped the project to include the construction and operation of the marginal wharf, stating that operation of the marginal wharf does not include shipping but does include docking and deberthing of vessels. After considering public comments, DFO has decided that their scope of project will remain the same.

Based on the comments that were received from the public and expert departments, two additional "Possible Environmental Components of Concern" will have to be considered in the EA - aquaculture and tourism. The RAs will require that the species at risk environmental component refer specifically to the roseate tern. Contaminants in the environment will have to be quantified by the project proponent during the collection of baseline information.

It should be reiterated that the list included in the Scoping Document is not exhaustive. During collection of baseline information, the project proponent is expected to expand on this list if it is determined that there are additional environmental components of concern.

APPENDIX 2

Nova Scotia Department of Environment and Labour
Environmental Assessment
Terms and Conditions for Environmental Assessment Approval

021392

Environmental Assessment Approval

Approval Date: March 14, 2007

Keltic Petrochemicals Inc. LNG and Petrochemical Plant Facilities

Keltic Petrochemicals Inc., Proponent

Goldboro, Nova Scotia

The Keltic Petrochemicals Inc. LNG and Petrochemical Plant Facilities Project (the "Undertaking"), proposed by Keltic Petrochemicals Inc. (the "Proponent"), in Goldboro, Nova Scotia is approved pursuant to Section 26. This Approval is subject to the following conditions and obtaining all other necessary approvals, permits or authorizations required by municipal, provincial and federal acts, regulations, by-laws, guidelines, policies or standards before commencing work on the Undertaking. It is the responsibility of the Proponent to ensure that all such approvals, permits or authorizations are obtained before commencing work on the Undertaking.

This Environmental Assessment Approval is based upon the review of the conceptual design, environmental baseline information, impact predictions, and mitigation presented in the Environmental Impact Assessment, as well as the findings and recommendations of the Environmental Assessment Board.

Terms and Conditions for Environmental Assessment Approval

1.0 Phase I - Studies, Inventory & Analysis

Prior to application for Part V approval under the *Environment Act* the Proponent must provide for review and approval:

1.1 a Sustainable Development Plan for the project. The plan shall include but not be limited to the following components:
- A study to re-assess possible water supplies for the project (including Meadow lake) from an environmental effects and sustainability perspective.
- An Air Emissions Management Plan for the project. The plan will include an accounting of all anticipated air emissions, monitoring and reporting protocols, emissions management and reduction targets over the life of the project, and plans for the use of best management practices.
- A Pollution Prevention Plan which includes measures including, but not limited to chemical recycling, reduced chemical use over time, and waste management.

- A *Greenhouse Gas (GHG) Management Plan* for the project. The plan will include an accounting of all anticipated GHG emissions, GHG monitoring and reporting protocols, GHG management and reduction targets over the life of the project, and plans for the use of best management practices.

1.2 details of the impacts to wetlands, methods and plans for avoidance, mitigation and/or compensation, developed in consultation with NSEL and NSDNR. The Proponent must not construct or operate within 30 metres of any wetland or watercourse unless otherwise approved in writing by NSEL.

1.3 results of a project Traffic Impact Study developed in consultation with NSTPW and the Municipality of the District of Guysborough. The results of the study shall be considered in the development of a transportation management plan for the project.

1.4 the following air emissions data for NSEL review prior to submission of the project air monitoring program:

- chemical characterization of Sable Offshore Energy Inc. (SOEI) gas plant particulates and SO_x emission
- anticipated emissions data from the proposed petrochemical plant for SO_x, O_3, known specific VOCs, and other air emissions as appropriate, based on relevant Alberta and Ontario data
- anticipated emissions data for the proposed incinerator, including emission compounds, concentrations and incinerator hours of operation
- two seasons of meteorological data on the site, to identify variances with data used in the existing air quality dispersion model.
- results of an air quality dispersion modelling exercise using site specific meteorlogical data. The model will be used to produce maximum and annual concentration contour maps for air quality components to be determined by NSEL. The contour maps will cover a radius of 25 km from the Goldboro project site.

1.5 a plan to mitigate the human health and environmental impacts of contaminated mine tailings and/or soils and sediments on the Project site, via remediation or risk management. This plan shall be consistent with the Nova Scotia Guidelines for the Management of Contaminated Sites. The Remedial Action Plan and/or Risk Management Plan shall be approved prior to commencement of construction. Upon completion of the remediation or risk management work, including any required monitoring, the Proponent shall submit a Certificate of Compliance to

NSEL to demonstrate that the remediation work has been completed and/ or the Risk Management Plan is effective. The CoC shall be submitted no later than 3 years after completion of construction of the land-based components of the Project.

1.6 a proposed lighting plan which incorporates a program to monitor impacts to birds. The plan must be submitted to NSDNR, Canadian Wildlife Service (CWS), and Transport Canada (TC) for review and approval. Based on the results of the monitoring programs, the Proponent must make necessary modifications to mitigation plans and/or operations to prevent any unacceptable environmental effects, to the satisfaction of NSEL, based on consultation with NSDNR and CWS.

1.7 results of a study to determine potential impacts of the Meadow Lake alterations on the salmon migration corridor. The scope of the study shall be developed in consultation with DFO, NSEL, and NSF&A. Results of the study shall also be submitted to these agencies for review, and the proponent shall develop mitigation measures as required to prevent any identified salmon migration impacts.

1.8 results of a phosphorus modelling exercise for Meadow Lake, using NSEL's standard lake phosphorus model, detailing the assessment of present and predicted trophic states of the lake; and results of a receiving water assimilative capacity study for Betty's Cove Brook and any other freshwaters receiving runoff or effluent from the project site.

1.9 an assessment of impacts associated with dam location at Meadow Lake, including but not limited to consideration of alternatives, and dam failure with associated impacts including but not limited to flooding, the movement of contaminants, and loss or damage to property.

1.10 to NSEL and Environment Canada for review and approval:

- modelling to predict the assimilative capacity of all receiving environments for all relevant chemical parameters which are expected to enter the environment as a result of Project activities. Such modelling shall include prediction of the potential for bioaccumulation in organisms of any persistent compounds either emitted by the Project or re-mobilized by Project activities; and provide an evaluation of the potential effects, including both acute and chronic (long term) impacts. Effects evaluation shall focus in particular on any potential impacts on human health and/or on organisms.

- baseline data collection for all relevant chemical parameters which are expected to enter the environment or be remobilized as a result of Project activities in all receiving environments, including those which may impact on human health and/or on organisms;

1.11 to NSEL and NSTPW, a Transportation Management Plan which shall include, but not be limited to :

- the identification of primary and secondary transportation routes;
- details of all required road realignments and upgrades
- transportation schedules;
- dust management measures;
- safety management measures;
- methods to ensure contractor compliance;
- monitoring measures;
- and, communication policies.

1.12 a project Environmental Management Plan (EMP) to be submitted to NSEL for review and approval. Any proposed modifications to the EMP and associated component plans throughout the duration of the project must be submitted to NSEL for review and approval.

2.0 Phase II - Monitoring Plans

The Proponent, as part of the application for Part V Approval under the Environment Act, must provide for review and approval a project Environmental Effects Monitoring Plan that will include, but not be limited to:

2.1 a detailed sampling, analysis and quality assurance plan.

2.2 a noise monitoring program, including the anticipated noise levels associated with the project, to be reviewed and approved by NSEL. Based on the results of the monitoring program, the Proponent must make necessary modifications to mitigation plans and/or operations to prevent any unacceptable environmental effects, to the satisfaction of NSEL.

2.3 a project air monitoring program. The Air Monitoring Program shall be developed in consultation with NSEL, Environment Canada, and other agencies as determined by NSEL. Based on the results of the monitoring program, the Proponent must make necessary modifications to mitigation plans and/or operations to prevent any unacceptable environmental effects, to the satisfaction of NSEL. The program, shall include an incinerator monitoring plan.

The Air Monitoring Program shall be based upon consideration of one complete year of baseline data for ambient and peak concentrations of gases and aerosols that may be released from the proposed project, including nitrogen oxides (NO_x), sulfur oxides (SO_x), carbon monoxide (CO), ozone (O_3), volatile organic compounds (VOCs), total suspended particulate (TSP), particulate matter less than 2.5 micrometres in diameter ($PM_{2.5}$), and particulate matter less than 10 micrometres in diameter (PM_{10})].

2.4 a detailed erosion and sedimentation control (ESC) plan, including a monitoring program for site runoff, to be reviewed and approved by NSEL. Based on the results of the monitoring program, the Proponent must make necessary modifications to ESC plans and/or operations to prevent any unacceptable environmental effects, to the satisfaction of NSEL.

2.5 a program to monitor surface waters, including monitoring location and parameters. Based on the results of the monitoring program, the Proponent must make necessary modifications to mitigation plans and/or operations to prevent any unacceptable environmental effects, to the satisfaction of NSEL.

2.6 a groundwater monitoring program including location of monitoring wells and parameters. The program must be designed to evaluate potential impacts to both groundwater levels and groundwater quality. Based on the results of the monitoring program, the Proponent must make necessary modifications to mitigation plans and/or operations to prevent any unacceptable environmental effects, to the satisfaction of NSEL.

2.7 a wildlife and vegetation monitoring plan, developed in consultation with NSDNR and CWS. As part of the wildlife and vegetation monitoring plan, the Proponent must provide details of a bird monitoring program, to the standards as defined by NSDNR and CWS. Based on the results of the monitoring program, the Proponent must make necessary modifications to mitigation plans and/or operations to prevent any unacceptable environmental effects, to the satisfaction of NSEL.

2.8 details of a monitoring program to determine the potential for and extent of sulphide bearing material and a plan to manage any exposed acid generating material and associated drainage, in consultation with NSEL.

2.9 a Public Reporting and Communication Protocol which shall include, but not be limited to:

- report on project activities/status
  - how results get reported
  - which results get reported

- ‣ when results get reported;
- and, details of the communication methods for reporting to the public and other stakeholders.

2.10 a plan for monitoring for environmental effects for all relevant chemical and biological parameters which are expected to enter the environment or be remobilized as a result of Project activities in all receiving environments, including those which may impact human health and/or organisms.

3.0 Phase III - Mitigation/ Contingency Plans

The Proponent, as part of the application for Part V Approval under the Environment Act, must provide for review and approval:

3.1 a project Environmental Protection Plan which shall include, but not be limited to an overall:

- mitigative measures plan;
- mitigation monitoring plan that will describe how planned mitigation measures will be evaluated during all phases of the project;
- quality assurance / quality control measures plan for all construction and site management activities at the site(s);
- project sedimentation control plan;
- dust control plan
- wastewater management plan;

3.2 a Contingency Plan developed in accordance with NSEL's Contingency Planning Guidelines that addresses:

- fires or other emergencies;
- and discharge, emissions, escapes, leaks or spills of dangerous goods or waste dangerous goods.

The plan shall be developed in consultation with local fire and emergency service providers, and demonstrate compliance with Federal and Provincial regulatory requirements.

3.3 a mitigation plan to address degradation, reduction, or loss of water quality or quantity of residential water supplies and a contingency plan to address any well interference effects and/or well complaints. If the mining operation causes water quality or quantity problems at existing water wells, the Proponent must rectify the problem to the satisfaction of NSEL.

3.4 a proposed aquaculture compensation plan to be implemented in the event that any project related adverse effects on aquaculture are detected.

4.0 Community Involvement & Archaeological/Heritage Resources

4.1 Prior to construction, the Proponent shall prepare a Local Economic and Community Benefits Plan that includes:

- a Local Employment Strategy
- a Local Supply and Procurement Strategy
- an Equal Opportunities Employment Strategy
- an Education and Training Strategy to support local employment
- an Employee/Community Recreation Strategy

The Plan shall be developed in consultation with the Municipality of the District of Guysborough, Nova Scotia Economic Development, and other stakeholders as required by NSEL.

4.2 Prior to construction, the Proponent must submit to NSEL for review and approval, a plan for the formation and operation of a representative community liaison committee (CLC) for the project, including a terms of reference (refer to the NSEL Guidelines for the Formation of a Community Liaison Committee).

4.3 Prior to construction, the Proponent shall develop a Mi’kmaq Communication Plan for the project which will include but not be limited to:

- Processes for communicating project details and seeking input from the Mi’kmaq community
- Plans for Mi’kmaq involvement in environmental effects monitoring and other project aspects. The plan shall be developed in cooperation with the Mi’kmaq Community.

4.4 Prior to application(s) for Part V Approval under the Environment Act, the Proponent shall take steps to further assess traditional Mi’Kmaq use of the project site lands. The Proponent shall develop the proposed steps in cooperation with the Mi'kmaq Community and shall submit the results to NSEL.

4.5 Prior to construction, the Proponent shall submit a complete archaeological assessment of the entire project site for review and approval of the Nova Scotia Museum and NSEL.

4.6 Prior to construction, the Proponent shall submit for review and approval of NSEL, an archaeology and heritage resources monitoring and contingency plan. The plan shall be developed in consultation with Mi’kmaq stakeholders, African Nova Scotia Affairs, and the Nova Scotia Museum.

4.7 The Proponent shall halt work and contact the Curator of Archaeology at the Nova Scotia Museum, and the Executive Director of the Union of Nova Scotia Indians immediately upon discovery of an archaeological site or artifact.

4.8 Prior to construction, the Proponent shall enter into an agreement with the Office of African Nova Scotia Affairs for the establishment of a memorial at the Red Head Cemetary site.

4.9 Prior to construction, the Proponent shall submit to NSEL for review and approval, a plan to ensure that project development and operations proceed in a manner which respects the cultural heritage value of the Red Head Cemetary site to the community, and that public access to the site will be maintained.

5.0 General Approval

5.1 This Environmental Assessment Approval is limited to the scope of the Undertaking as described in the *Environmental Impact Assessment,* dated July 2006, and subject to the following conditions. Any proposal by the Proponent for expansion, modification or relocation of any aspect of the project from that proposed in the Environmental Impact Assessment must be submitted to the Environmental Assessment Branch for review and may require an environmental assessment.

5.2 The Proponent must, within two years of the date of issuance of this approval, commence work on the Undertaking unless granted a written extension by the Minister.

5.3 The Proponent must implement all mitigation and commitments in the Environmental Impact Assessment, unless approved otherwise by Nova Scotia Environment & Labour (NSEL).

5.4 The Proponent shall apply the Canadian Chemical Producers' Association (CCPA) Responsible Care® principles to the design, maintenance, and operation of the petrochemical plant.

Original signed by

Mark Parent
Minister of Environment and Labour

APPENDIX 3

Proposed Table of Contents for Environmental Management Plan

021401

ENVIRONMENTAL MANAGEMENT PLAN
DRAFT
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APPENDIX 4

Issues and Concerns Raised During Public Consultation Program

021405

TABLE 4-1 Summary of the Major Concerns Raised at the Erinville Open House and the Responses to these Concerns from Keltic

Category	Concern	Response
Employment	What employment opportunities will be offered to local workers?	Local workers will be eligible to fill all positions for which they are qualified.
	Will locals be given notice as to what jobs will be available in order to train for them?	A full list of which has already been supplied to the community.
General	Will there be noise-pollution restrictions, such as prohibiting air braking in residential areas?	All provincial regulations will be followed.
	When will it be known if the Project is going to go ahead or not?	An LNG supplier is still being negotiated, and the EA process is still ongoing, but Keltic is committed to the completion of the Project.

TABLE 4-2 Summary of the Major Concerns Raised at the Antigonish Open House and the Responses to these Concerns from Keltic

Category	Concern	Response
Employment	How many post-construction jobs will there be?	There will be approximately 600 direct post-construction jobs.
	How can locals get these jobs? Will local workers be hired preferentially?	Qualified locals may apply for all jobs. Keltic is partnering with other companies for the operations of the plants, and will urge that qualified locals be given preferential treatment.
Safety	Will Goldboro be in danger in the event of an explosion?	Although a large amount of energy is stored in LNG, it cannot be released rapidly enough to cause the overpressures associated with an explosion.
General	Will the Bear Head LNG affect the chances of this Project being completed?	The Bear Head project does not affect the Keltic Project, as the US energy marketplace can accommodate large volumes of gas.
	What are the main reasons for the delays on the Project?	The EA must be approved, and a supply for the LNG must be secured.

021406

TABLE 4-3 Summary of Questions and Responses from Port Bickerton Open House on Proposed Keltic Habitat Compensation Project

Category	Concern	Response
Habitat Compensation	What do you do to improve habitat?	Rock is placed on the seafloor, creating crevices and encouraging algal growth. These conditions approximate natural lobster habitat.
	Have similar habitat compensation projects been done before?	Similar projects have been completed elsewhere in the Maritimes, but no studies have yet been completed to evaluate their effectiveness
	Have there been studies to support these types of compensation projects?	Studies are ongoing in several locations to evaluate similar projects, but none have as yet been completed.
	Why go ahead with this type of compensation when there are no study results supporting their effectiveness?	DFO requires habitat compensation, generally in the vicinity of the project. This project is seen as a viable opportunity to enhance lobster habitat in the area.
	Is the proposed Project area important for lobster at different times of the year?	The chosen site is not considered to be important for lobster productivity in its current state, but is seen as an ideal candidate site for enhancement.
	Should studies be undertaken to investigate year-round habitat use of proposed Project site?	Surveys of the site have occurred inside and outside of the lobster fishing season.
	Is the proposed compensation site the only location that was considered for this Project?	The proposed site is considered the most ideal location for habitat enhancement. Other sites, determined by input from fishers, may be considered.

021407

APPENDIX 5

Draft Fish Habitat Compensation Plan (HADD)

021408

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1.0 INTRODUCTION

Keltic Petrochemicals Inc. (Keltic) is proposing to construct and operate a Petrochemical and Liquefied Natural Gas (LNG) Facility in Goldboro, Nova Scotia. The primary facilities proposed include an LNG regasification facility, a petrochemical complex, a marginal wharf, a marine LNG Terminal, LNG storage, and an electric co-generation facility. Of particular interest in terms of this compensation plan is the construction of the marginal wharf and LNG marine terminal.

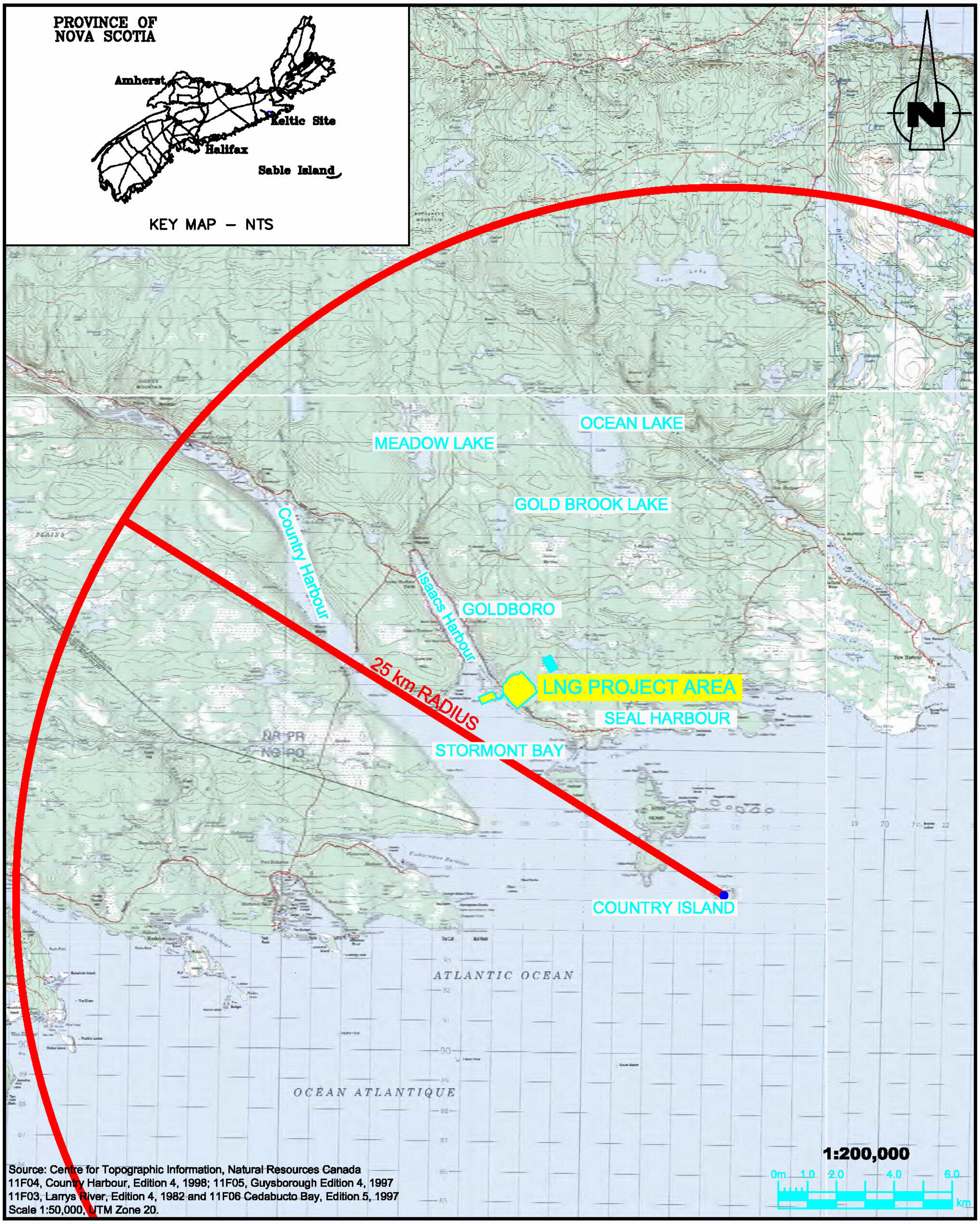
The marginal wharf area is required for receipt and shipment of products and by-products in support of the petrochemical plant and for receiving supplies and equipment during construction of the entire complex.

The wharf will extend off Red Head into Stormont Bay (Figure 1). Although adverse environmental effects have been addressed in the Comprehensive Study Report (CSR), the destruction of fish habitat is inevitable during the construction of the marginal wharf.

A two berth piled marine terminal will be connected to the marginal wharf facility by a piled jetty. This marine terminal will be used to receive and transfer product via LNG transfer lines along the jetty and marginal wharf facility to the LNG tanks where it is stored.

The Canadian Fisheries Act (Sections 35(1) and 35(2)) prohibits any work or undertaking that causes harmful alteration, disruption or destruction (HADD) of fish habitat unless authorized. Canada's "no net loss" policy requires, when authorization has been given, that the lost habitat is compensated for by creating new or increasing the productive capacity of existing habitat.

Keltic is proposing a habitat compensation plan (HCP) that both creates new habitat and enhances the productivity of existing locations. The plan also incorporates compensation in three different environments; marine, estuarine and freshwater.



Source: Centre for Topographic Information, Natural Resources Canada
11F04, Country Harbour, Edition 4, 1998; 11F05, Guysborough Edition 4, 1997
11F03, Larrys River, Edition 4, 1982 and 11F06 Cedabucto Bay, Edition 5, 1997
Scale 1:50,000, UTM Zone 20.

LEGEND

LNG Project Area

FIGURE No. 1
KELTIC PETROCHEMICALS INC.
PROJECT LOCATION AND REGIONAL SETTING
JUNE 2007

021411

2.0 EXISTING ENVIRONMENT

2.1 PHYSICAL ENVIRONMENT

Stormont Bay and the surrounding areas offer a diversity of marine habitats that include freshwater, estuarial, nearshore, and deepwater environments.

Habitat types in the area have been mapped by several groups in the last 12 years, including:

- The Guysborough County Coastal Resources Mapping Project;
- Sable Offshore Energy Project;
- Encana's Deep Panuke Project;
- Canadian Seabed Research;
- Keltic; and
- Nova Scotia Department of Natural Resources and the Geological Survey of Canada.

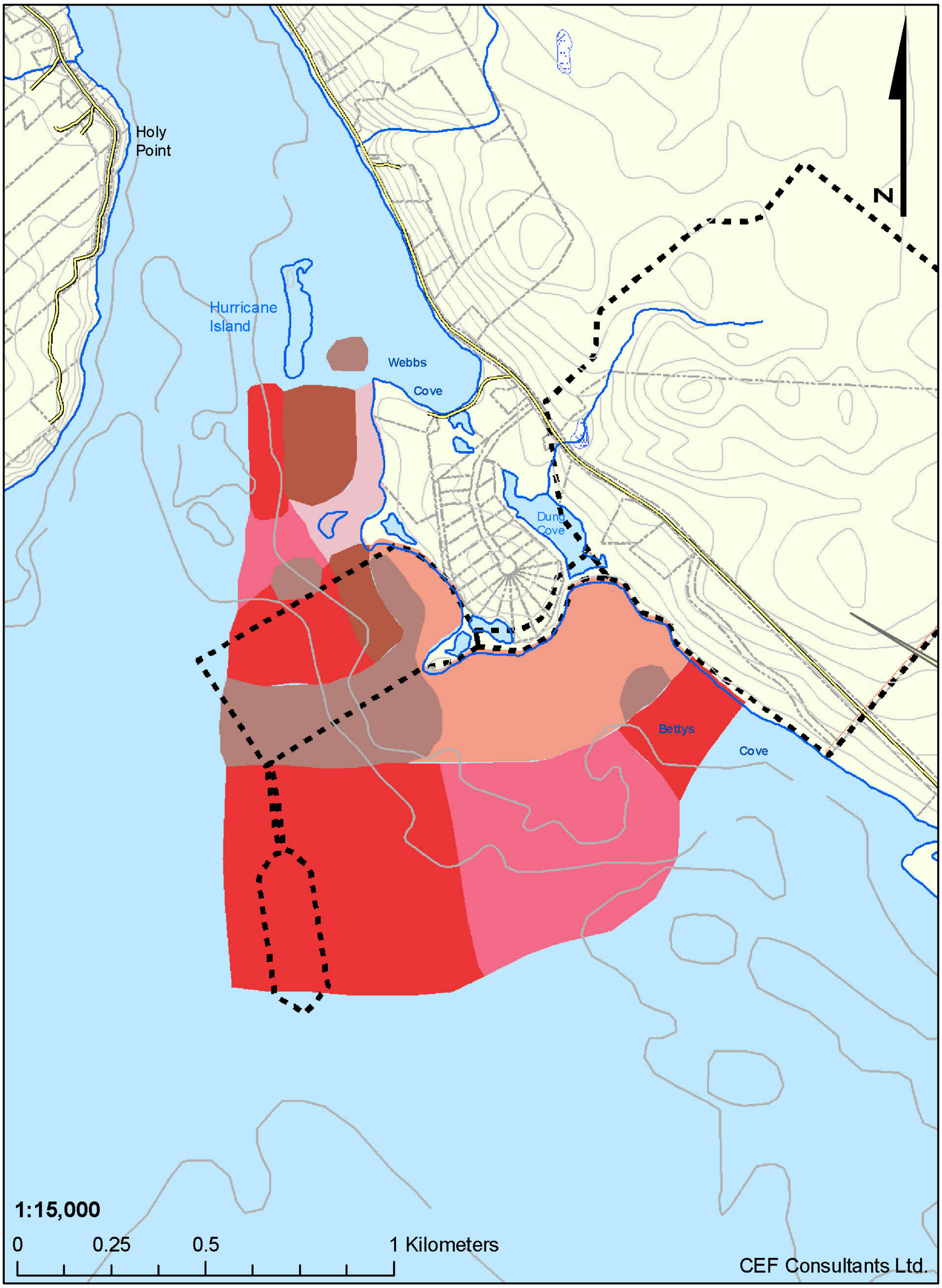
These exercises have found that the near-shore marine habitat at Red Head, the site of the proposed marginal wharf, has a substrate of boulders, cobbles, and pebbles, with finer materials such as sand and gravel prevalent in more protected bays. A narrow band of coarser sediment with relatively sparse macro algae cover stretches from the shoreline seaward for approximately 50 m. Marine plants such as kelp are associated with rockier areas, while eelgrass beds occur on sandy substrates (Figure 2). These habitat variations are similar to what predominates in nearshore coastal areas elsewhere in Stormont Bay.

The total area of the marginal wharf is approximately 20.3 hectares (ha), calculated from the high water mark. The rock mattress that will support the concrete caissons will extend beyond the area of the wharf encompassing an additional .7 ha for a total habitat loss of 21.0 ha. The type of habitat that will be lost can be divided into three distinct types; rock and kelp, sand and silt, and eelgrass and sand. The most predominant habitat type in the footprint of the marginal wharf is rock and kelp, comprising approximately 55% (11.6 ha) of the total area. The remainder of the footprint is comprised of sand and silt and eelgrass and sand at 33% (7.0 ha) and 12% (2.5 ha) respectively (Figure 2).

2.2 BIOLOGICAL ENVIRONMENT

The marine vegetation of Stormont Bay and the Red Head area specifically is typical of the rocky intertidal zone of Nova Scotia's Atlantic shore. The intertidal zone is dominated by fucoids, namely rockweed (*Ascophyllum nodosum*) and bladder wrack (*Fucus* sp.). Seaweed growth is sparse in the area of the marginal wharf, mainly growing in the lower intertidal and subtidal areas. As discussed above, rock and kelp comprise the majority of the habitat in the footprint of the marginal wharf. Kelp and other subtidal seaweeds are generally abundant in all nearshore areas of Stormont Bay.

Several species of fish have been identified as occurring in the vicinity of the marginal wharf footprint in the CSR. The habitat being lost does not represent any limited or critical habitat for marine fish species in the area. This plan proposes the creation or enhancement of a variety of habitats, all which will benefit several fish species.



Legend

- CSR Project Area
- Approximate Rock and Kelp Area
- Approximate Sand and Silt Area
- Inferred Sand and Silt Area
- Approximate Eelgrass and Sand Area
- Inferred Eelgrass and Sand Area
- Inferred Rock and Kelp Area

FIGURE No. 2

KELTIC PETROCHEMICALS INC.

FISH HABITAT IN THE VICINITY OF KELTIC FACILITIES

June 2007

021413

C0115-746

The footprint of the marginal wharf encompasses habitat that is desired by invertebrates, namely lobster, rock crabs, and sea urchins. Lobster and rock crab adults often seek out areas with cover, either rocky habitats with algal growth or eelgrass beds. Post larval and juvenile lobsters prefer rocky habitats with tunnels and crevices for protection from predation. Sea urchins feed on algae so they seek out areas with rocky bottoms that can sustain the growth of marine vegetation.

3.0 PROPOSED HABITAT COMPENSATION PLAN (HCP)

The proposed HCP addresses both the creation of and enhancements to habitat in different ecosystems that will address a variety of habitats and species.

3.1 MARINE

DFO has a preference for habitat compensation to be of a similar type and in the same general area as that lost. Construction of additional habitat within the bay is not practical because of the large area required and the presence of already suitable habitat in all nearshore areas. A search was undertaken to find a suitable area consisting of predominantly sand near the outer entrance to the bay.

The largest habitat creation area is located in Fisherman's Harbour between two shoal areas which protrude at low tide. Depths range from 10 to 14 metres (m) within the area, and substrate is consistently silty-sand. The only fauna present currently are sand dollars.

The area does not serve as a navigation channel for the ports of Port Bickerton, Country Harbour, or Isaac's Harbour. Following habitat creation, water depths would be reduced by less than one metre.

Additional sandy bottom sites have been identified seaward of Dung Cove and in a sheltered area behind Harbour Island. Habitat structures may also be placed along the periphery of existing habitat in Stormont Bay (Figure 3).

The habitat creation methodology proposed is the construction of an artificial reef within the described area in Fisherman's Harbour. The design, described below, is based on successful laboratory (Miller et al, 2006) and field (G. Sharp, pers. comm.) trials that have been undertaken in Nova Scotia.

Miller et al (2006) conducted experiments that showed juvenile lobster preferred artificial habitats built on sandy bottoms with gravel sizes less than 3 cm. The type of rock that showed the most success was large flat rocks that allowed larger crevices under the rock. The experimental work has been scaled up to field trials in the Sambro, NS area (G. Sharp, pers. comm.). The reefs that have been constructed are now inhabited by juvenile crabs, juvenile urchins, and juvenile fish. Marine vegetation has started to establish on the rocks, creating additional habitat for juvenile and adult fish. To date, lobsters have not established themselves at the location but the researchers are confident they will (G. Sharp, pers. comm.).

To create a series of artificial reefs for juvenile lobsters (carapace length (CL) 50-79 millimetres), rock will be dumped in small piles by a crane fixed with a grab. Flat quarry rock measuring approximately 25 to 50 centimetres (cm) (with the greatest length more than four times the depth) will be dumped by a grab in a random pattern on the sea bottom.

FIGURE 3 Proposed Habitat Creation Area – Fisherman's Harbour

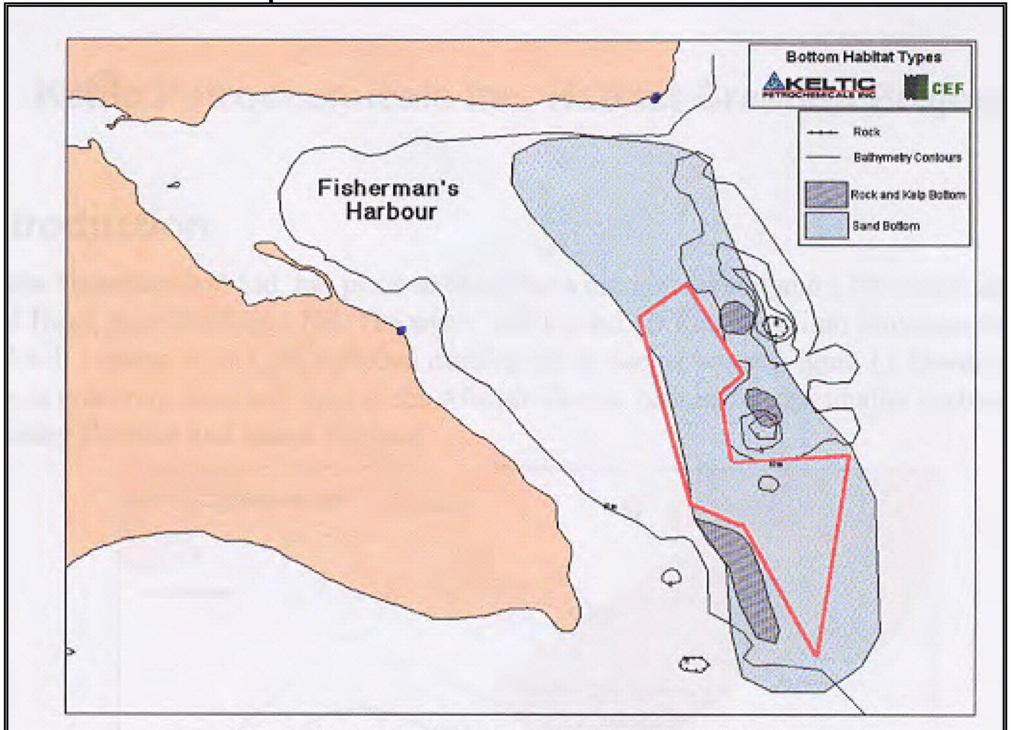
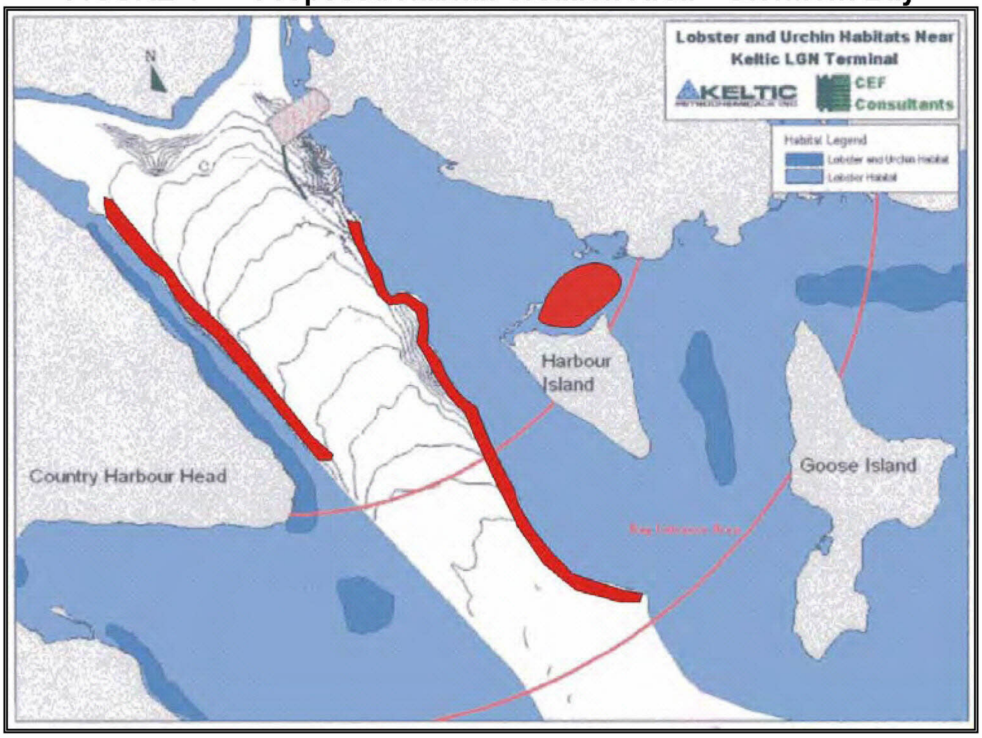


Figure 3: Area Proposed for Habitat Creation

FIGURE 4 Proposed Habitat Creation Area – Stormont Bay



The piles need to be only a few rocks in height as the laboratory trials showed that lobsters tend to dig into the substrate under the rocks and are not interspersed among the crevices (Miller et al, 2006).

The rock size used in the experiment is approximately 55% larger than what would be predicted based on a regression presented by Wahle (1992, in Miller et al, 2006). As such, rock sizes for larger adult lobster (average of 140 mm CL) would be roughly 75 cm long. Reefs of variable rock sizes will establish lobster habitat for several sizes and life stages. As noted above, it can be expected that these reefs will also be used by juvenile crabs, urchins, and fish. The depth in Fisherman's Harbour is excessive for many marine plants to establish but kelp are known to grow in deeper water and it can be hypothesized that some will establish here. Structures placed in shallower areas can be expected to provide habitat for a wider variety of marine plants.

As noted, successful colonization of artificial rock reefs has been seen and is a more cost effective methodology when compared with other methods such as reef balls (G. Sharp, pers. comm.).

Monitoring by remote operated vehicle (ROV) or divers should be completed prior to the placement of any rock structures in order to obtain baseline information. Following the installation of the artificial reefs monitoring should be undertaken at 3, 6, and 12 month periods for the first year and annually thereafter for 5 years. The monitoring should focus on the integrity of the structures, including possible sedimentation and the presence or absence of colonizing individuals.

The total area encompassed by these proposed sites would create additional habitat of approximately 200 ha throughout the Stormont Bay area.

3.2 ESTUARINE

Keltic is proposing to support the Mulgrave and Area Lakes Enhancement Association (MLEA) in their initiative to restore the inter-tidal river pools at St. Francis Harbour, Nova Scotia. The background information and project description are borrowed from the plan developed by Thaumus Environmental Consultants Ltd. on behalf of the MLEA.

To lure anchor industries to the Strait of Canso, in 1959 the province of Nova Scotia dammed the outflow from the three Goose Harbour lakes, creating an 865 ha water impoundment that would later supply the Stora Enso paper mill with fresh water for paper making.

It was recognized that this would reduce river flows and change the size and frequency of flood flows in the St. Francis Harbour River. These changes have altered the meander pattern, changing the location of pools and riffles, and over-widening the river in many reaches. The result has been an increase in the bed load movement of gravel. This gravel has been deposited at the head of tide and combined with the change in meander length has filled in the pools in the inter-tidal section of the river.

These projects will be the latest in a series of successful improvements made to the St. Francis Harbour River over the last number of years. These improvements have included

- Construction of a fish passage over the dam;
- Habitat improvements including constructing pools and riffles;
- Installation of in-stream habitat improvement structures to create deeper pools;
- Installation of a siphon over the dam to increase water flow through the main channel; and,
- Stabilization of the outer channel bank of the estuary.

The restoration of pools in the St. Francis River (Figure 5) is important for migrating fish as they change from salt to freshwater habitats. Work in the winter of 2007 restored the outlet chaneel through the barrier beach. The re-establishment of the outlet channel in the estuary has restored the full tidal range and brought the tide further up the river. This has exposed a greater length at low tide providing the opportunity to establish several in river pools and greatly increasing the fish holding capacity of the inter-tidal river pools.

The changes in the river resulted in the loss of the natural run of Alewife (*Alosa pseudoharengus*) lowering the quality of the food supply in the estuary for sea trout and migrating grilse and adult salmon. With fish passage at the dam and effective migration habitat in the barrier beach the only significant impediment to restoring the run is the staging pools in the estuary. Stocking of adult Alewife for a five year period would restore this run and the associated habitat food supply productivity. Alewife will also contribute to the bait fishery along this coast.

The compensation/ restoration project will restore the thalweg and pools in the inter-tidal section of the St. Francis Harbour, Guysborough County, Nova Scotia (Figure 6).

Work is proposed for the summer of 2007 when site access roads are dry and will handle the heavy trucks and equipment with a minimum of disruption. The site can be accessed by a private dirt road parallel to the river then walk down a trail adjacent to a nearby home.

The work involves the installation of deflectors and associated bank stabilization. The design width of the river at this location is 18 m with a meander length of approximately 108 m.

There is a bedrock outcrop at the upper end with a well-established right hand pool (looking downstream).

The first deflector structure will be placed on the right bank approximately 108 m below the head of the pool above. It will extend into the watercourse at bank height to a point 20 m from the opposite bank. This left bank will be rocked to bank height for approximately 40 m. This will give an 18 m finished stream width.

FIGURE 5 Section of Topographical Chart 11f/6 Showing the Project Location

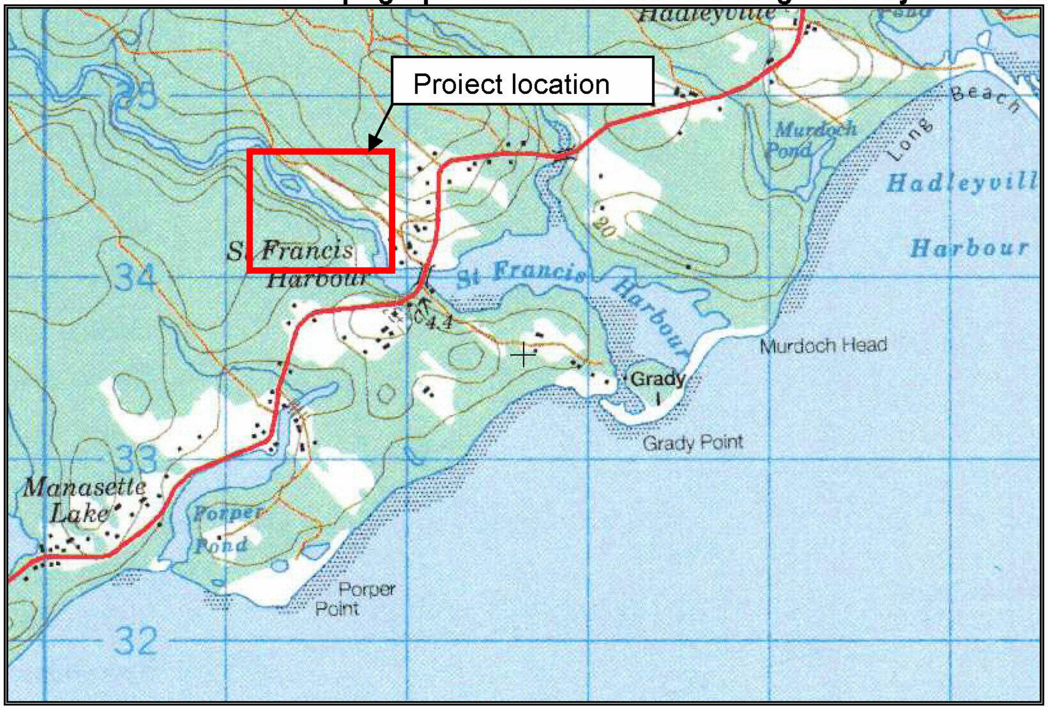
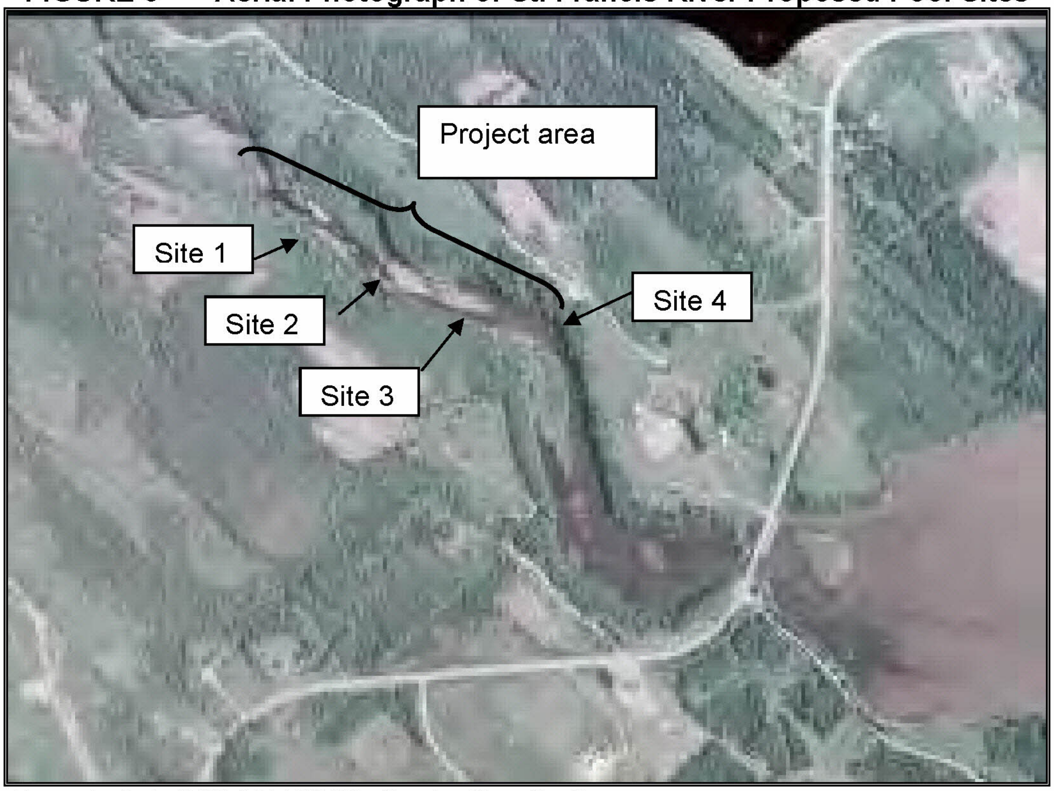


FIGURE 6 Aerial Photograph of St. Francis River Proposed Pool Sites



From air photo 9700-141-500 TN - Service Nova Scotia

The second deflector structure will be located on the left bank approximately 108 m downstream and extend into the watercourse at bank height to a point 18 m from the rock outcrop on the right bank. The left bank upstream of this site will be rocked as needed including the side channel that cuts off to the left.

The third deflector structure will be on the right bank approximately 108 m downstream and will extend into the river to a point 18 m from the opposite bank at a height equal to or greater than the one in two year bank full channel. The right bank will be rocked downstream of this structure to tie into a second deflector 18 m further downstream. These paired deflectors on the right bank will steer the channel across the existing over widened section toward the left pool below.

A fourth deflector will be on the left bank approxinmately 108 m downstream just below the small tributary. This deflector will direct the flow toward a centre pool.

This work will restore 4 pools and restore the thalweg to five sections of river. The excess gravel will be deposited by river and tidal flows on the point bar areas and will not move further into the estuary.

The improvement made by rocking the bank and installing deflectors for the development of migration pools and allowing the currents to deepen the channel will improve the overall productive capacity of the river. The Alewife restocking program will improve the productive capacity by improving the diversity of the estuary and improving the food supply for larger forage fish. The total area that will see an increase in its productive capacity is approximately 13 ha.

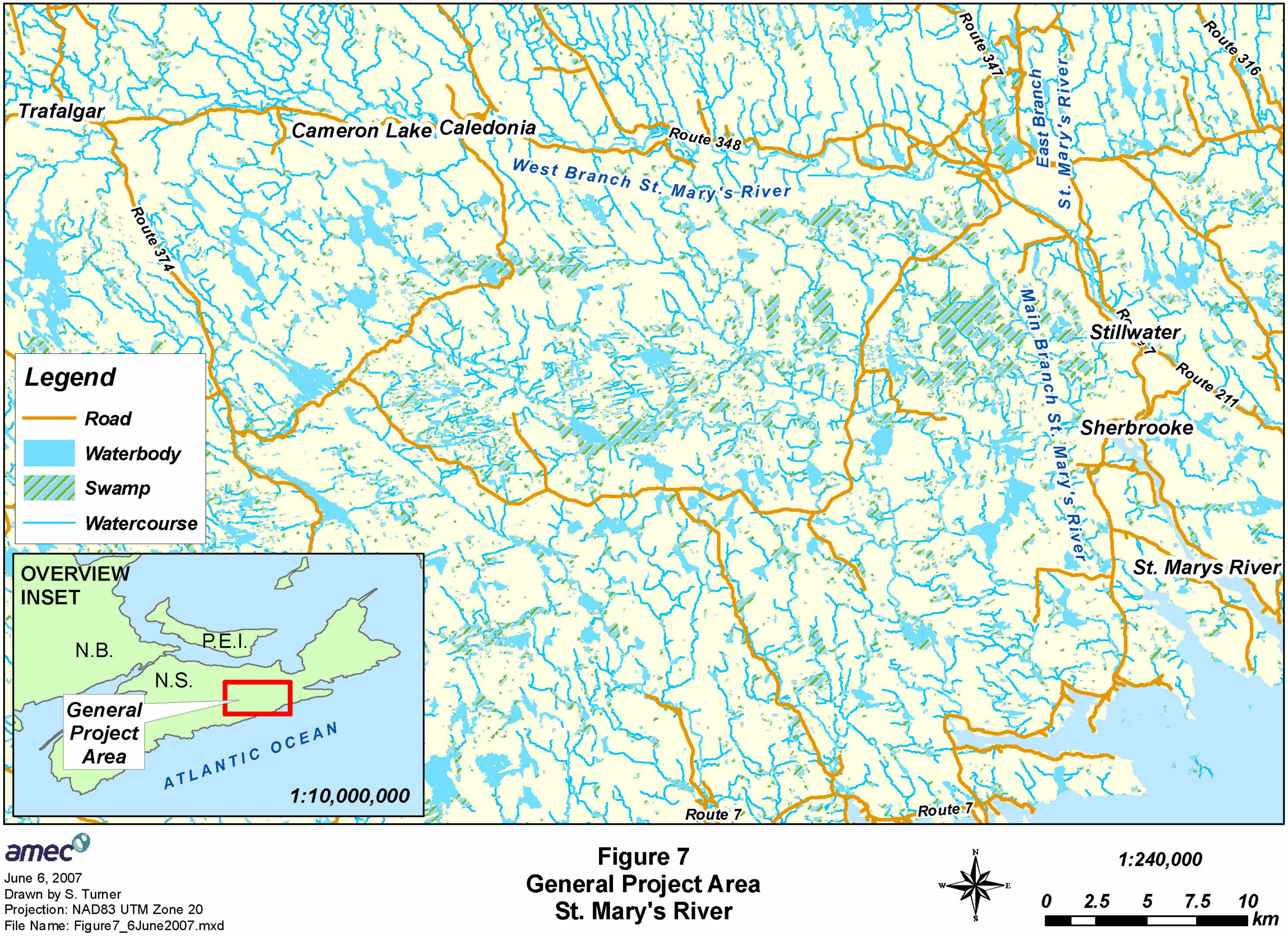
3.3 FRESHWATER

Keltic is proposing to support the St. Mary's River Association (SMRA) in their initiative to restore the fish habitat in three branches (West, East, and Main) of the St. Mary's River. The background information and project description are borrowed from the plan developed by Bob Rutherford of the Nova Scotia Salmon Association Adopt-A-Stream Program.

The St. Mary's River is Nova Scotia's largest river system with a watershed that spreads over five counties and drains an area approximately 135,000 ha. The river system is composed of the West Branch (56 kilometres (km)), the East Branch (35 km) and the Main Branch (14 km) (Figure 7). The East and West Branches are home to genetically unique Atlantic salmon populations. The watershed habitat has degraded over the past two centuries due to impacts from mining, agriculture, forestry, road construction, and human settlement.

Despite these impacts the river is still largely intact, and although salmon runs have declined significantly it has only been over the last 15 years. The SMRA believes that the river can, with the proper rehabilitation, be restored with a corresponding rebound in depleted salmon runs.

A preliminary assessment of both historical and current impacts on the watershed has been undertaken. Historically impacts from mining, agriculture, forestry, road construction, and human settlement have been detrimental to the health of the ecosystem. This is mainly due to nonexistent or poor practices when putting infrastructure in place. These impacts have been highly reduced today because of tighter environmental controls over work being done in and around a water course. Current impacts can be narrowed down to site-specific sewage issues



amec

June 6, 2007
Drawn by S. Turner
Projection: NAD83 UTM Zone 20
File Name: Figure7_6June2007.mxd

Figure 7
General Project Area
St. Mary's River

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C0115-754

and climate change. Climate change has caused a decrease in the number of summer storms affecting the area. This has resulted in short duration, high intensity storms that are prone to cause flash floods and negative impacts on the physical nature of the river. These climate change issues have been taken into account in the design for the restoration plan so the work undertaken will be effective for years to come.

This plan focuses mainly on the West and Main Branches of the river. Further plans will be developed to rehabilitate the East Branch and intertidal areas of the river. The restoration project has targeted seven parameters that need to be addressed in order to properly bring the river back to a more productive state.

Pools

Properly developed pools provide cover, help regulate water temperature, aid in fish passage, and are refuges for juvenile fish during low flow periods. A lack of pools is a clear indicator that something is wrong in the watershed.

There are extensive areas of this watershed that do not have this level of pool development particularly in the main river and the West branch below Trafalgar. All of the tributaries crossed by a highway are impacted for 500m to 1500m both upstream and downstream.

Thalweg

The thalweg is the deepest part in a cross-section of the main channel of a waterway; it provides fish passage, maintains a minimal water depth during low flow periods to keep the water cool, and provides habitat for juvenile salmon and insects. There are many sections of the West and Main Branch that have a highly degraded thalweg.

Cover

Shallow water depths limit the density and size of fish that can use and be supported by the habitat. Due to decreased water depths the amount of cover available is reduced and larger parr and adults are forced to move to the pool areas where there is limited cover making them vulnerable to predation.

Embeddedness

The spaces between rocks and boulders in a streambed are essential habitat for aquatic invertebrates and they form the base of many key food chains and cover for small fish. Therefore, it is important that cobble, rocks, and boulders are minimally embedded (set in sand and silt).

The shifting channels and eroding banks have set much of the bed material in sands and silts. This has limited secondary productivity reducing the food supply of the fish and suitable cover for the juveniles.

Bank Stability

Bank erosion usually means the watercourse is unstable and realigning itself to adjust to changes in flow volumes or other disturbances. Its presence is a clear indicator that something is wrong in the watershed. Bank erosion is a major contributor of silt that can lead to high embeddedness in a stream.

Bank erosion is a major problem on the Main River, West branch below Trafalgar, and the lower sections of the East branch. This of course provides silt to the river infill in interstitial spaces in the gravel thus lowering overall insect productivity and damaging spawning beds and over wintering habitats.

Bank Vegetation

Bank vegetation is important for cover, nutrient input, bank stability etc. It has been observed that in many sections of the watercourse the vegetation is being under cut and falling in due to ice scour and erosion having proceeded at a pace faster than the vegetation can recover.

Water Quality

The higher the water quality in a watercourse the higher the potential for success for any fish population. The pH is low in some tributaries due to acid rain and geology that lacks buffering capacity. Temperatures are a problem in the main and west branches due to shallow over widened sections and warm dry summers.

Water quality in the St. Mary's River is rated as marginal for the protection of aquatic life. Water quality consistently failed the guideline for pH, frequently exceeded the guideline for copper and occasionally exceeded it for aluminum, lead, and iron.

It is believed that with the improvements being proposed to restore the watercourse, the water quality will improve.

The plan for the restoration of the St. Mary's River is presented below, first with comments on the general habitat needs and then focusing on particular sections of the watercourse.

General Habitat Needs

There is a need to improve the fish passage in the main river, the lower part of the West Branch and the lower parts of the West Branch tributaries. The intent is to get spawners into the river early and as far up the system as possible before spawning. The plan includes holding and resting pools and a thalweg designed to concentrate the low flows. Concentrating the low flow will improve water quality by moderating the summer temperatures, reduce the development of ice that leads to bank souring and erosion, and preventing damage to physical habitats by ice scouring. The pool development will provide refuge for parr in extreme conditions and over winter habitat for pre smolts.

The channel size and shape for the thalweg low flow channel can be designed based on the one in two year mean daily flood flows and the summer low flows expected in an average year. This calculation would be made for each section of river/stream to be restored and sited in the river based on existing locations of pools and riffles. The creation of the channel for migration also creates the conditions for spawning and good juvenile habitats. The latter may require some fine-tuning on a site-specific basis or some adjustment to make a good angling pool but the fundamentals are the same.

To create these conditions in low flow periods the shape of the channel needs to be changed so that summer flows are collected in one channel that has the optimum depth and flow characteristics for fish migration and rearing.

Below the Stillwater Bridge to the Main River Estuary

The actual width of the main river at the Stillwater Bridge is 55 to 60 m which is the natural width for this section of river, based on flow data at Stillwater. Normally the pools would be located approximately every six channel widths or 330 m apart but the bedrock outcroppings restart this pattern so the pools would be located immediately below the 15 major bedrock gradient controls then 330 m downstream if another control has not been reached. Within this channel there should be a thalweg channel approximately 25 m wide and 0.5 m deep as a riffle/run between the pools. This channel would have near optimum flow and depth characteristics from June through October during all flows except the lower quartile (lowest 25%) of the flows in August and September. During these months passage would be possible but without optimum depths and velocities. Rearing habitats would still be in the optimum range. Currently good migration conditions do not exist for the period July through October except in above median flows in June and October and top quartile flows in July, August and September. This may require the placement of pools into the bedrock.

Main River above the Stillwater Bridge to the confluence of the East and West Branches

The area around the Stillwater Bridge is fine and appears to be a favourable holding area.

Upstream, the river needs to be stabilized using rip rap rock to create gradient controls that will realign the riffles and re-establish pools. These structures will normally be rock sills but in some cases will be combined with deflectors or deflectors used on their own. They will also direct the flows to establish a single main channel and thalweg. Additional rocking will be required at most of the pools. Again the natural channel width is 55 m with pools on alternate sides approximately 330 m apart. The work will be designed to establish this channel with a low flow thalweg with a width of approximately 25 m within a 55 m wide normal flow channel with a low flood plain extending to the existing banks to carry high flows. There are 22 estimated sites of this sort in this section.

West Branch to Caledonia / Chisholm Brook

The lower half of this section is very wide and as stated before it does not appear to have enough material for the gradient controls and deflectors to work to restore a proper channel and flood plain. Since little elevation change is required between the channel and the flood plain it is proposed that gradient controls be tried with a lower than normal profile on the flood plain area. If the channel scours to bedrock in the pool areas without forming proper pools then they will have to be built by excavating the bedrock. It is likely that holding pool locations will have to be selected based on the depth of cobble over the bedrock or specifically built into the bedrock. At Archibald Brook, just above the confluence with the East Branch, the natural channel width is

30 m (with pool spacing of approximately 180m). This is just under half of the current width of 76 m. The natural channel will narrow at each tributary as you move up stream, narrowing to approximately 20 m at Chisholm brook, which is close to the current width. There are an estimated 246 sites starting at the lower end.

West Branch above Caledonia / Chisholm Brook

This area is not as over widened as the lower area but does have areas of braided channels and diagonal bars. Standard techniques of gradient controls and deflectors can be designed to improve this section of the river. In braided areas, the low flows can be directed into one channel where there is a channel of adequate size to handle the flows without erosion which appears to be the case at all sites.

Above the Community of Trafalgar

These tributaries have not been surveyed due to a lack of easy access but from a preliminary assessment revealed good habitat. Restoration work would be local sites and of low priority at this time.

West Branch Tributaries

Some sections of the tributaries can be restored using standard techniques including digger logs but many have streambeds armoured with rocks too big for the stream flows to move. These streams need to be shaped by hand to provide the thalweg and pools in the over widened and degraded areas. This methodology has worked very well in some streams with very large rock but still needs some fine-tuning in streams like these tributaries that have a mixture of substrate sizes.

The priority is to do the sections impacted by past road construction but longer sections could be done in log driven streams.

East Branch and Tributaries

Generally the East Branch habitat is in much better shape. Work on this branch is site specific and a more detailed survey is needed to specify the site locations and extent of the work needed. Spot checks have noted some over widened sections but generally the width is what you would expect. Siltation is serious in some sections but it is site specific.

The restoration plan proposed for the St. Mary's River is to take place along approximately 150 km of the river and encompasses 300 ha of habitat (Table 1). These estimates are strictly for the direct restoration work and do not account for the improved access to habitats further up the watershed. The estimates of area of the East Branch and the West Branch above Trafalgar are based on work that needs to be completed in association with substandard road crossings.

TABLE 1 Approximate Area Available for Restoration in the St. Mary's River

Section	Estimated Length (m)	Average Estimated Width (m)	Habitat Area available for restoration (ha)
Below the Stillwater Bridge to the Main River estuary	4,550	55	24.75
Above the Stillwater Bridge to the confluence of the East and West Branch	7,200	55	39.60
West Branch to Caledonia / Chisholm Brook	37,000	25	92.50
West Branch above Chisholm Brook	24,000	15	36.00
Above Trafalgar (site specific)			5.00
West Branch Tributaries (51 in total)	76,500	5	38.25
East Branch (site specific)			64.00
Total	**149,250**		**300.10**

4.0 CONCLUSIONS

In conclusion, Keltic proposes a three pronged approach to the compensation required for the HADD as a result of the construction of the marginal wharf. This document presents plans to address compensation in three different areas; marine, estuarine, and freshwater. The total area proposed for compensation measures approximately 513 ha (Table 2) which represents an area 24 times that which is being removed.

TABLE 2 Total Compensation Area Presented in this Plan

Ecosystem	Total Area (ha)
Marine	200
Estuarine	13
Freshwater	300
Total	**513**

REFERENCES

Miller, J.A., Sharp, G.J., and O'Brien, E.M. 2006. Laboratory Experiments on Artificial Reefs for American Lobsters. Journal of Crustacean Biology. Volume 26, Issue 4. Pg 621-627