

COMPREHENSIVE STUDY REPORT

**DEEP PANUKE OFFSHORE GAS DEVELOPMENT PROJECT
ENCANA CORPORATION**

PREPARED BY

**THE CANADA-NOVA SCOTIA
OFFSHORE PETROLEUM BOARD,
THE NATIONAL ENERGY BOARD,
FISHERIES AND OCEANS CANADA,
TRANSPORT CANADA AND
INDUSTRY CANADA**

WITH INPUT FROM

**ENVIRONMENT CANADA
NATURAL RESOURCES CANADA**

JUNE 2007

FOREWORD

Sections of the following documents may have been reproduced in whole or in part during the preparation of this report:

- Deep Panuke Offshore Gas Development Environmental Assessment Report, EnCana Corporation, November 2006.
- Joint Environmental Report, Deep Panuke Offshore Gas Development Project, Deep Panuke Coordinated Public Review Secretariat, April 11, 2007
- Deep Panuke Offshore Gas Development Comprehensive Study Report, October 2002

Information derived from the written submissions and oral transcriptions of the concurrent Public Review (CNSOPB/NEB regulatory review) was also used to prepare this report.

Executive Summary

As required by the *Canadian Environmental Assessment Act* (CEAA), this Comprehensive Study Report (CSR) was prepared by the Responsible Authorities (RAs) for EnCana Corporation's proposed Deep Panuke Offshore Gas Development Project (Deep Panuke, or the Project) with input from expert Federal Authorities.

The RAs are:

- The Canada-Nova Scotia Offshore Petroleum Board (CNSOPB);
- The National Energy Board (NEB);
- Fisheries and Oceans Canada (DFO);
- Transport Canada (TC); and
- Industry Canada (IC).

Expert input was provided by Environment Canada (EC) and Natural Resources Canada (NRCan). EC initially participated in the comprehensive study as a potential RA in the event that a Disposal at Sea permit may be required for the Project. However, EC recently concluded that the proposed Project does not include any activities that would require a permit and has withdrawn as an RA.

The Canadian Environmental Assessment Agency (the CEA Agency) is the Federal Environmental Assessment Coordinator (FEAC), and also provided funding to assist the public in participating in the comprehensive study. The public participated during the scoping stage, and during the concurrent public regulatory review by the CNSOPB and the NEB.

Deep Panuke was previously assessed as a comprehensive study in 2002. The five RAs were the CNSOPB, the NEB, DFO, EC and IC. At the conclusion of the 2002 comprehensive study, the Minister of the Environment (the Minister) determined that the Project was not likely to cause significant adverse environmental effects and referred the Project back to the RAs for regulatory decision-making. In early 2003, shortly after the Minister's decision, but before the coordinated CNSOPB and NEB regulatory review process commenced, EnCana Corporation (EnCana) requested, and was granted, a regulatory 'time-out', while it re-evaluated the Project.

In 2005, EnCana indicated that it wished to have the Project re-considered. However, the project design was modified from the one that was originally proposed and assessed. The new project is generally smaller in scale than the 2002 proposal. For the modified project design, EnCana proposes to use a jack-up mobile offshore production unit (MOPU) in a water depth of approximately 44 m as the project's central facility. The MOPU would be located approximately 250 km southeast of Halifax, Nova Scotia (N.S.) and about 48 km west of Sable Island, on the Scotian Shelf.

Deep Panuke is a sour gas reservoir, with raw gas containing approximately 0.18% hydrogen sulphide (H₂S); therefore, gas sweetening is required. Processing will be performed offshore on the MOPU to remove the H₂S, as well as carbon dioxide (CO₂), collectively known as acid gas. After its removal from the raw gas stream, the acid gas will be disposed of underground, via an acid gas injection well, into a suitable reservoir.

The Project will initially include re-completing four previously drilled wells and drilling two new wells; one for gas production, the other for acid gas disposal. The well locations range from 1 to

10 km from the MOPU. Up to three additional production wells could be drilled during the life of the project. All wells will be connected individually to the MOPU using subsea flowlines and control umbilicals. Gas produced in the wells will flow to the MOPU via the flowlines, which will be buried in the sea bottom.

The main difference between the 2002 and 2006 proposals is the means of transporting the gas to shore: the 2002 proposal included the construction of a dedicated pipeline on the sea bottom, approximately 175 km long, to transport the gas to shore, and connect to the existing Maritimes & Northeast Pipeline. The new proposal retains that option (now referred to as the M&NP Option), but with a slightly modified route, but also considers a new option; subsea tie-in to the existing Sable Offshore Energy Project (SOEP) pipeline at a point along its length, about 15 km from the MOPU (referred to as the SOEP Subsea Option).

Other differences between the current Project and the proposal assessed in the approved 2002 CSR include:

- a single integrated installation (MOPU) versus three fixed platforms;
- production design capacity reduced from 11.3×10^6 to 8.5×10^6 m³/day;
- revised field centre location (moved approximately 3.5 km to the east);
- subsea wellheads with subsea tie-backs versus platform wells; and
- maximum estimated produced water discharge rate increased from 1,600 to 6,400 m³/day.

The RAs concluded that the new proposal involves components that were not previously assessed, and that some new components may require approvals or permits named in the *Law List Regulations* of the Act. Thus, a new environmental assessment (EA) is required. Because both the M&NP Option and the SOEP Subsea Option are described in the *Comprehensive Study List Regulations* of the CEAA, the RAs determined that the new EA must be conducted by means of a comprehensive study, using the 2002 CSR to the extent that is appropriate, as required by Section 24 of the CEAA. Thus, the new comprehensive study is focused on taking into account any significant changes in the environment, in the circumstances of the Project and any significant new information relating to the environmental effects of the project (including changes in policy or legislation) that have arisen since the 2002 review. In that context, the CSR describes the project, its environmental setting, potential project-specific environmental interactions, proposed mitigation and follow-up measures, and offers the RAs determination of the significance of the Project's residual adverse environmental effects. This review, along with the 2002 CSR, ensures that the RAs have carefully considered the environmental effects of the Deep Panuke project before making any decisions that would allow it to proceed.

The CSR includes consideration of the environmental effects related to: new accidental release scenarios, increased produced water discharges, air emissions, the presence and construction of new sub-sea structures, drilling waste discharges, near-shore and onshore effects, wildlife and habitat, impediments to navigation, species at risk, cumulative effects, and the effects of the environment on the project.

Potential environmental effects identified and assessed in the CSR include, among others effects of/on:

- accidental releases on benthos, marine fish, marine mammals, sea turtles and marine birds;

- discharged produced water on larval organisms, invertebrates and marine birds;
- current use of lands and resources for traditional purposes by Aboriginal persons;
- air emissions, including flaring, on ambient air quality and greenhouse gas concentrations;
- fishing access and gear;
- construction activities on fisheries in the area;
- hydrostatic testing fluid discharge on marine water quality and benthos;
- Species at Risk;
- drilling waste discharge on marine benthos;
- near-shore construction activities on fish habitat and terrestrial wildlife and habitat;
- cumulative effects of the Project; and
- the environment on the Project.

Mitigation measures, as identified in the 2002 CSR and this CSR, are a combination of standard best construction and operation practices (e.g. ramp-up of pile-driving activity to minimize noise effects on marine mammals), compliance with recognized standards and guidelines (e.g. Offshore Waste Treatment Guidelines, which require treatment of discharges) and Project-specific mitigation measures (e.g. buffer zones around the Betty's Cove Brook wetland area, requiring a professional archaeologist to be on call during construction). Furthermore, as part of its Environmental Management Framework for the Project, EnCana will be required to produce an Environmental Protection Plan, an Environmental Effects Monitoring Plan, and a Spill Response Plan; all documents will require review by appropriate regulatory agencies prior to acceptance.

In considering the significance of the project's environmental effects after mitigation, the RAs note that, in general, the effects of the project are predicted to be similar to or less than, those presented in the approved 2002 CSR. This is consistent with the reduced scale of the Project. With the exception of accidents or malfunctions (which could result in significant adverse effects, but are unlikely to occur), the potential adverse environmental effects will be short term and localized. Therefore, *the RAs have determined that, taking into account the implementation of identified mitigation measures, the project is not likely to cause significant adverse environmental effects.*

A follow-up program will be implemented to verify the accuracy of the environmental assessment predictions and to determine the effectiveness of the measures taken to mitigate the adverse environmental effects of the project. The results of the follow-up program will be made available to the public.

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List of Abbreviations

ACDCC	Atlantic Canada Data Conservation Centre
As	Arsenic
AVC	annular velocity control
BOP	blowout preventor
bpd	barrels per day
CA	certifying authority
CCME	Canadian Council of Ministers of the Environment
CEA Agency	Canadian Environmental Assessment Agency
CEAA	<i>Canadian Environmental Assessment Act</i>
CEAR	Canadian Environmental Assessment Registry
CNG	Compressed natural gas
CNSOPB	Canada-Nova Scotia Offshore Petroleum Board
CPAWS-NS	Canada Parks and Wilderness Services
CO ₂	carbon dioxide
COOGER	Centre for Offshore Oil and Gas Environmental Research
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CSR	Comprehensive Study Report
Deep Panuke	Deep Panuke Offshore gas Development Project
DPA	Development Plan Application
DPEMP	Deep Panuke Emergency Management Plan
EA	environmental assessment
ECM	environmental compliance monitoring
EEM	environmental effects monitoring
EIS	Environmental Impact Statement
EMOBM	enhanced mineral oil-based mud
EnCana	EnCana Corporation
ENGO	environmental non-governmental organization
EPP	environmental protection plan
ESD	emergency shutdown
ESSIM	Eastern Scotian Shelf Integrated Management
FAC	Fisheries Advisory Committee
FEAC	Federal Environmental Assessment Co-ordinator
DFO	Fisheries and Oceans Canada
GCRDA	Guysborough County Regional Development Authority
GHG	greenhouse gas
GSC	Geological Survey of Canada
H ₂ S	hydrogen sulphide
HDD	horizontal directional drilling
Hg	Mercury
HP	high pressure
IC	Industry Canada
JER	Joint Environmental Report
KCl	potassium chloride

LNG	liquefied natural gas
LP	low pressure
M&NP	Maritimes & Northeast Pipeline
MAARS	Maritime Aboriginal Aquatic Resources Secretariat
MARLAND	Maritime Forces Atlantic
MARPOL	International Convention for the Prevention of Marine Pollution from Ships
MBCA	<i>Migratory Birds Convention Act</i>
NCNS	Native Council of Nova Scotia
MMscfd	million standard cubic feet per day
MODU	mobile offshore drilling unit
MOPU	mobile offshore production unit
MPA	marine protected area
MW	Megawatt
NaCl	sodium chloride
NEB	National Energy Board
NGL	natural gas liquids
NO	nitrogen oxide
NO ₂	nitrogen dioxide
NORM	naturally occurring radioactive material
NRCan	Natural Resources Canada
NSDNR	Nova Scotia Department of Natural Resources
NWPA	<i>Navigable Waters Protection Act</i>
NWPP	Navigable Waters Protection Program
OCSG	Offshore Chemical Selection Guidelines
OSEA	Offshore Strategic Energy Agreement
OWTG	Offshore Waste Treatment Guidelines
ppm	parts per million
ppmw	parts per million by weight
ppmv	parts per million by volume
PSU	Practical Salinity Unit
RA	Responsible Authorities
ROV	remotely operated vehicle
RoW	right-of-way
SARA	<i>Species at Risk Act</i>
SBM	synthetic-based mud
SC-SSSV	surface-controlled subsurface safety valve
SIPT	Sable Island Preservation Trust
SOEP	Sable Offshore Energy Project
SPANS	Seafood Producers Association of Nova Scotia
SSIV	sub-surface isolation valve
TEG	triethylene glycol
TC	Transport Canada
The Minister	The Minister of the Environment
TSP	total suspended particulate
TVD	true vertical depth

US OCS	United States Outer Continental Shelf
VEC	valued environmental component
WBM	water-based muds
WHRUs	Waste heat recovery units
WMP	Waste Management Plan
WWF- ARO	World Wildlife Fund – Atlantic Region Office

1.0 General Information

Project Name: EnCana Corporation – Deep Panuke Offshore Gas Development Project (Project).

Project Location: Approximately 250 km southeast of Halifax, Nova Scotia, and 48 km west of Sable Island, on the Scotian Shelf. The approximate coordinates are Latitude: 48.9 degrees N; Longitude: 68.8 degrees W.

Project Proponent: EnCana Corporation

Responsible Authority Environmental Assessment Triggers:

- Canada-Nova Scotia Offshore Petroleum Board (CNSOPB) authorizations under sub-sections 142(1)(b) and 143(4)(a) of the *Canada-Nova Scotia Offshore Petroleum Resources Accord Implementation Act*;
- National Energy Board (NEB) section 52 Certificate of Public Convenience and Necessity, or Section 58 Order, pursuant to the *National Energy Board Act*;
- Fisheries and Oceans Canada (DFO) authorization under section 35(2) of the *Fisheries Act* for the harmful alteration, disruption or destruction (HADD) of fish habitat. Depending on the methods used to install the pipeline, the project may also require a section 32 *Fisheries Act* authorization for the destruction of fish by means other than fishing (e.g., use of explosives);
- Transport Canada (TC) approval under paragraph 5(1) of the *Navigable Waters Protection Act* for a work to be built or placed in, on, over, under, through or across any navigable water; and
- Industry Canada (IC) approval under paragraph 5(1)(f) of the *Radiocommunication Act* for sites on which radio apparatus may be located as well as the erection of such things as towers and masts, and for which Exclusion List paragraph 13 (Schedule I, Part I General) does not apply.

The project as proposed is described in Section 11.1(b) of the *Comprehensive Study List Regulations*.

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1.1 Background

The CNSOPB is the responsible authority (RA) for offshore oil and gas development projects in the Nova Scotia Offshore Area as defined in the *Canada-Nova Scotia Offshore Petroleum Resources Accord Implementation Act* (Accord Acts). In accordance with the *Canadian Environmental Assessment Act* (the CEAA), EnCana Corporation (EnCana) submitted a project description to the CNSOPB on August 28, 2006. The Deep Panuke project is an offshore gas development project, located on the Scotian Shelf. Although in a different configuration, the Project was the subject of a comprehensive study conducted in 2001-02. At the conclusion of that study the Minister of the Environment (the Minister) determined that the Project was not likely to result in significant adverse effects and referred the Project back to the RAs to make their respective regulatory decisions.

Upon receipt of the project description, in August 2006, the CNSOPB declared itself a RA because the project cannot proceed without an authorization under sub-sections 142(1)(b) and 143(4)(a) of the *Accord Acts*. Issuance of the authorization is described in the Law List Regulations of the CEAA.

Following the requirements of the Regulations Respecting the Coordination by Federal Authorities of the Environmental Assessment Procedures and Requirements, the project description was distributed to the following federal authorities to determine their role, if any, in the assessment: IC, Health Canada (HC), the NEB, NRCan, Environment Canada (EC), TC, DND, Human Resources Development Canada (HRDC), and DFO. Responses from NEB, DFO, IC, and TC indicated that they would likely require an environmental assessment (EA) of the Project and, therefore, are also RAs for the comprehensive study. HC, HRDC and DND indicated that they would have no role in the EA.

EC responded that it could be a RA in the eventuality that a permit may be required under paragraph 127(1) of the *Canadian Environmental Protection Act* for the disposal of a substance at sea. While it has since been determined that such a permit is not required in relation to the Project as currently proposed, EC also indicated it was in possession of specialist knowledge and information. NRCan indicated they possess specialist knowledge and information as well which should be considered in the assessment of the proposed undertaking.

In accordance with the CEAA, the Canadian Environmental Assessment Agency (CEA Agency) is the Federal Environmental Assessment Coordinator for the project, as the project is described in the Comprehensive Study List Regulations. The CEA Agency established a federal EA committee for the Deep Panuke project. Committee members include a representative each from the CEA Agency (chair), the CNSOPB, NEB, IC, NRCan, TC, EC and DFO.

As required under CEAA, the RAs provided opportunities for public participation throughout the EA. Consultation with the public is required at three stages of a comprehensive study: during the preparation of the scope of EA, during the preparation of the comprehensive study report (CSR), and by the CEA Agency, on receipt of the CSR, prior to a decision by the Minister.

The public was provided with a 21-day review period to provide written comment on the draft Scoping Document and their views on the ability of a comprehensive study to address issues relating to the Project. Public comment on the EA was coordinated in accordance

with a joint regulatory process established by the CNSOPB and the NEB for the review of the Deep Panuke Project. This process included initial public consultation sessions by the CNSOPB appointed commissioner and NEB member, written evidence and information request/response process and an oral hearing.

Prior to the commencement of the joint regulatory process, the RAs prepared a report, commonly referred to as the 'track report', required by subsection 21 (2) of the CEAA for submission to the Minister. This report provides the basis for the Minister's decision to refer the project back to the RAs to continue EA by means of a comprehensive study, or refer the Project to a mediator or review panel. The report describes and discusses the scope of the Project; the factors to be considered in its assessment; public concerns in relation to the Project; the potential of the Project to cause adverse environmental effects; and the ability of the comprehensive study to address issues relating to the Project. The public comments on the draft Scoping Document were taken into account during the preparation of the track report and during the Minister's consideration of the report. The track report was submitted to then Minister of the Environment the Honorable Rona Ambrose on October 20, 2006 and on November 8, the Minister Ambrose released her decision to continue with the comprehensive study.

The CNSOPB delegated the preparation of a technical Environmental Assessment Report to the proponent. On November 9, 2006, EnCana submitted the "Deep Panuke Offshore Gas Development Environmental Assessment Report". On the same day the report was published on the CNSOPB website and forwarded to CNSOPB appointed commissioner and NEB Member. The public could comment and participate in the oral hearings in accordance with the Joint Directions on Procedure. A notice of public participation was published on November 13, 2006. Participant funding was made available from the Government of Canada, through the CEA Agency to assist the public to participate in the comprehensive study. Funding was provided to the Native Council of Nova Scotia, the Canadian Parks and Wilderness Society, the Seafood Producers Association of Nova Scotia and the Sierra Club of Canada, Atlantic Canada Chapter.

During the preparation of this CSR the RAs considered EnCana's 2006 EA Report and the 2002 CSR, as well as the information obtained through the CNSOPB's appointed Commissioner and NEB Member regulatory review process (the Public Process), which included the following:

- public comments;
- EnCana's responses to government and public submissions; and
- the Environmental Report prepared by the CNSOPB's commissioner and NEB Member at the end of the Public Process.

In addition, expert input received from EC and NRCan, was considered by the RAs. All documents used in the preparation of the CSR are available on-line either at the CNSOPB's website (www.cnsopb.ns.ca) or the Deep Panuke Coordinated Public Review Secretariat's website (www.deeppanukereview.ca).

Purpose of this Comprehensive Study Report

The purpose of this CSR is to describe EnCana's proposed offshore gas development project, the environmental setting, the potential project-environment interactions, the potential adverse environmental effects, the proposed mitigation measures and the significance of any adverse residual environmental effects. As described in section 24 of the CEEA, the RAs have used the 2002 CSR to the extent that is appropriate, and thus this new CSR is focused on taking into account any important changes in the environment, in the circumstances of the project and any significant new information (including new legislation/policies) relating to the environmental effects of the project that have arisen since the 2002 review. A copy of the 2002 CSR may be obtained at http://www.ceea-acee.gc.ca/010/0003/0057/report_e.htm,

This CSR is submitted to the Minister and to the CEA Agency. The CEA Agency will make the report available for public comment. Following the public review, the Minister will issue an EA decision statement which may include additional requirements for mitigation measures or a follow-up program. The Minister can also request additional information or direct that public concerns be addressed prior to issuing a decision on the environmental effects of the Project.

1.2 Need for and Purpose of the Project

The purpose and need for the Project do not differ from that previously stated in the approved 2002 CSR. The primary purpose is to allow EnCana to exercise its rights under, and obtain economic benefits from, the licenses issued to it under the *Canada-Nova Scotia Offshore Petroleum Resources Accord Act* and the *Canada-Nova Scotia Offshore Petroleum Resources Accord Implementation (Nova Scotia) Act*. By recovering the value of the resources EnCana can provide a return to its shareholders on the capital invested in the Project. The value of the Deep Panuke resources will be obtained by exploiting the opportunity presented by the considerable and growing demand for natural gas in markets in Canada and the United States.

2.0 Project Description

2.1 Project Overview

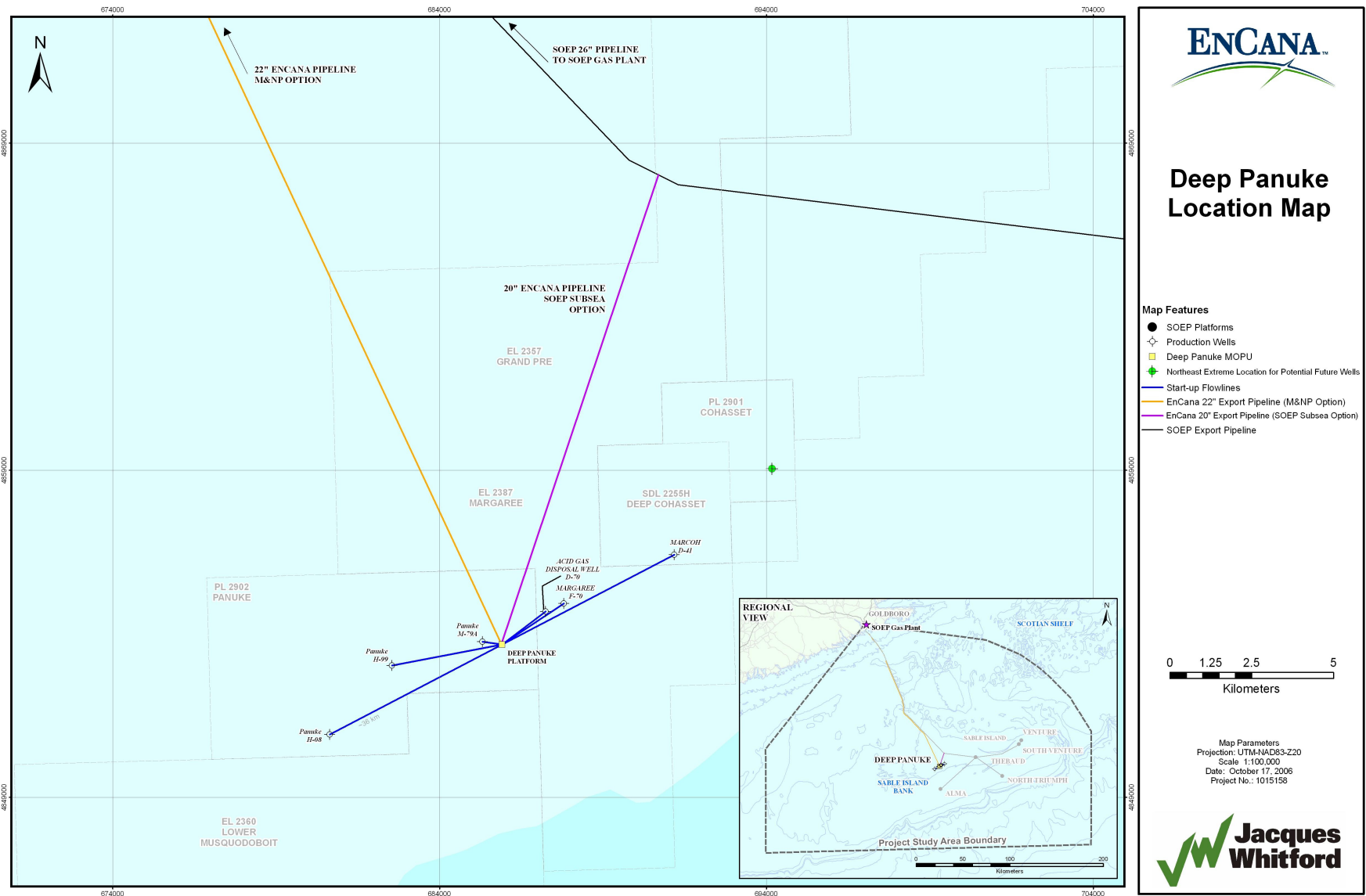
The proposed Deep Panuke Offshore Gas Development Project (Deep Panuke) consists of a jack-up mobile offshore production unit (MOPU) in a water depth of approximately 44 meters (m), located on the Sable Bank. The Project will initially include drilling one production well and one acid gas injection well, and re-completing four previously drilled wells. Also, following production start-up and based on reservoir performance, up to three additional subsea production wells could be drilled. All subsea wells will be tied back individually to the MOPU with subsea flowlines and control umbilicals. The Project location, facilities and study area are illustrated in Figure 2.1. Deep Panuke is located approximately 250 km southeast of Halifax, Nova Scotia (N.S.) and about 48 km west of Sable Island on the Scotian Shelf.

Two project options are proposed for the transportation system to deliver Deep Panuke sales product, either:

- through a new 176 km subsea pipeline to an onshore interconnection near Goldboro, N.S., with the existing Maritimes & Northeast Pipeline (M&NP Option), or
- through either a new single pipeline or twinned 15 km subsea pipelines to an interconnection with the existing Goldboro Sable Offshore Energy Project (SOEP) subsea pipeline (SOEP Subsea Option).

The production facility will have a design capacity of 8.5×10^6 m³/d sales gas with turndown capability to 0.13×10^6 m³/d. The gas processing system on the facility will include inlet compression, separation, sweetening, dehydration, export compression, and measurement. Deep Panuke is a sour gas reservoir with raw gas containing approximately 0.18 percent hydrogen sulphide (H₂S); therefore, gas sweetening equipment is required. Acid gas processing will be performed offshore to remove H₂S and carbon dioxide (CO₂), also known as acid gas. Following its removal from the raw gas stream, the acid gas will be disposed of by injection into a suitable offshore underground reservoir.

Figure 2.1: Location of the Project and Study Area



The major differences between the new options and the 2002 proposal are: one installation (MOPU) versus three fixed platforms, a new field center location; sub-sea wellheads and sub-sea tie-backs versus platform wells; a reduction of gas export capacity and an increased produced water discharge rate. Additionally, the SOEP Subsea Option differs from the original proposal by using either a single or twinned export pipeline(s) tied into the SOEP 26 inch pipeline at a sub-sea location downstream of the Thebaud Platform.

Table 2.1 provides a more detailed comparison of the Project basis for the approved 2002 CSR and the revised Project basis.

Table 2.1 Comparison of the Approved 2002 CSR Project and the Revised Project

Project Item	Base Case (Approved 2002 CSR)	M&NP Option	SOEP Subsea Option
Well Count and Configuration	<ul style="list-style-type: none"> • Maximum of 8 – platform wells • 5-6 new drilled production wells: H08, P11B, M79A, PP3C and 1-2 future wells • 1-2 new drilled injection wells 	<ul style="list-style-type: none"> • Maximum of 9 – subsea wells • 4 re-entry wells: H-08 (PL 2902), M-79A (PL 2902), F-70 (EL 2387), and D-41 (SDL 2255H) • 1 new production well: H-99 (PL 2902) • 1 new injection well D-70 (EL 2387) • Up to three future wells (currently undefined locations on PL 2901, SDL 2255H, PL 2902 or EL 2387) • Buried flowlines and umbilicals from wellheads to installation 	
Project Life	Expected mean case: 11.5 years	<ul style="list-style-type: none"> • Expected mean case: 13.3 years • Expected range: 8-17.5 years 	
Field Centre	Base Case	Relocated 3.6 km NNE	
Base Structure	Three fixed platforms including: <ul style="list-style-type: none"> • Production platform • Utilities/quarters platform • Wellhead platform 	<ul style="list-style-type: none"> • 1 MOPU • Integrated facility 	
Discharge of Muds / Cuttings for New Wells	<ul style="list-style-type: none"> • Drilled from field centre • WBM/cuttings overboard • SBM/cuttings skipped and shipped or injected 	<ul style="list-style-type: none"> • Drilled from individual well locations • WBM/cuttings overboard • No SBM 	
Delivery Point	<ul style="list-style-type: none"> • M&NP tie-in • Onshore, adjacent to SOEP gas plant 		<ul style="list-style-type: none"> • SOEP subsea tie-in • SOEP 660 mm pipeline
Export Pipeline	<ul style="list-style-type: none"> • 610 mm, 176 km • Single phase • Trenched ~ 50% of route 	<ul style="list-style-type: none"> • 560 mm, 176 km • Single phase • Trenched ~ 50% of route 	<ul style="list-style-type: none"> • Single 510 mm or two 324 mm, 15 km • Multi-phase • Trenched 100% of route
Export Gas	<ul style="list-style-type: none"> • 11.3×10^6 m³/day [400 MMscfd] • Sales quality 	<ul style="list-style-type: none"> • 8.5×10^6 m³/day [300 MMscfd] • Sales quality 	<ul style="list-style-type: none"> • 8.5×10^6 m³/day [300 MMscfd] • Sweet and dehydrated
Export Condensate	N/A		<ul style="list-style-type: none"> • Maximum of 220 m³/day • Sweet and stabilized, commingled with gas
Condensate Use	Fuel, surplus injected		Sales product
Produced Water	<ul style="list-style-type: none"> • Maximum 1,100 to 1,600 m³/day [7,000 to 10,000 bpd] • Treated and discharged overboard 	<ul style="list-style-type: none"> • Maximum 6,400 m³/day [40,000 bpd] • Treated and discharged overboard 	
Acid Gas	<ul style="list-style-type: none"> • Dedicated injection well • $\sim 180 \times 10^3$ m³/day [6 MMscfd] 	<ul style="list-style-type: none"> • Dedicated injection well • $\sim 130 \times 10^3$ m³/day [4.5 MMscfd] 	

2.2 Project Equipment

The main Project infrastructure components include a mobile offshore production unit (MOPU), subsea wells and flowlines, and a subsea pipeline to transport sales product to either Goldboro, N.S. (M&NP Option) or the SOEP 660 mm pipeline tie-in (SOEP Subsea Option).

2.2.1 Mobile Offshore Production Unit (MOPU)

The MOPU comprises the hull and topsides facilities. The hull includes all facilities and equipment that would normally be supplied with a mobile jack-up unit including jacking systems, legs, foundations, accommodations, helideck and utilities. The topsides facility will include all equipment required for processing hydrocarbon fluids from the reservoir.

The topsides facility will contain processing equipment to separate, measure, dehydrate, and sweeten the raw gas. Acid gas and water handling equipment will also be installed on the MOPU. Hydrocarbon dew pointing will be required for the M&NP Option and the condensate will be used as the primary fuel for power generation and compression. Currently, it is estimated that there will be no surplus condensate produced beyond fuel usage; however, in the event of excess condensate, it will be injected down-hole with the acid gas stream. For the SOEP Subsea Option, condensate separated from the gas will be dehydrated, sweetened, and recombined with the export gas for delivery to the tie-in for the SOEP Subsea Option. The production facility is designed to export $8.5 \times 10^6 \text{ m}^3/\text{d}$.

2.2.2 Subsea Wells and Flowlines

The initial development well program will consist of re-completing four existing production wells (H-08, M-79A, F-70, and D-41), drilling one new injection well (D-70), and one new production well (H-99). Up to three new production wells could be drilled after first gas.

All wells will be completed with horizontal subsea trees and tied back to the MOPU with individual subsea flowlines and control umbilicals. All subsea flowlines and control umbilicals will be trenched and buried.

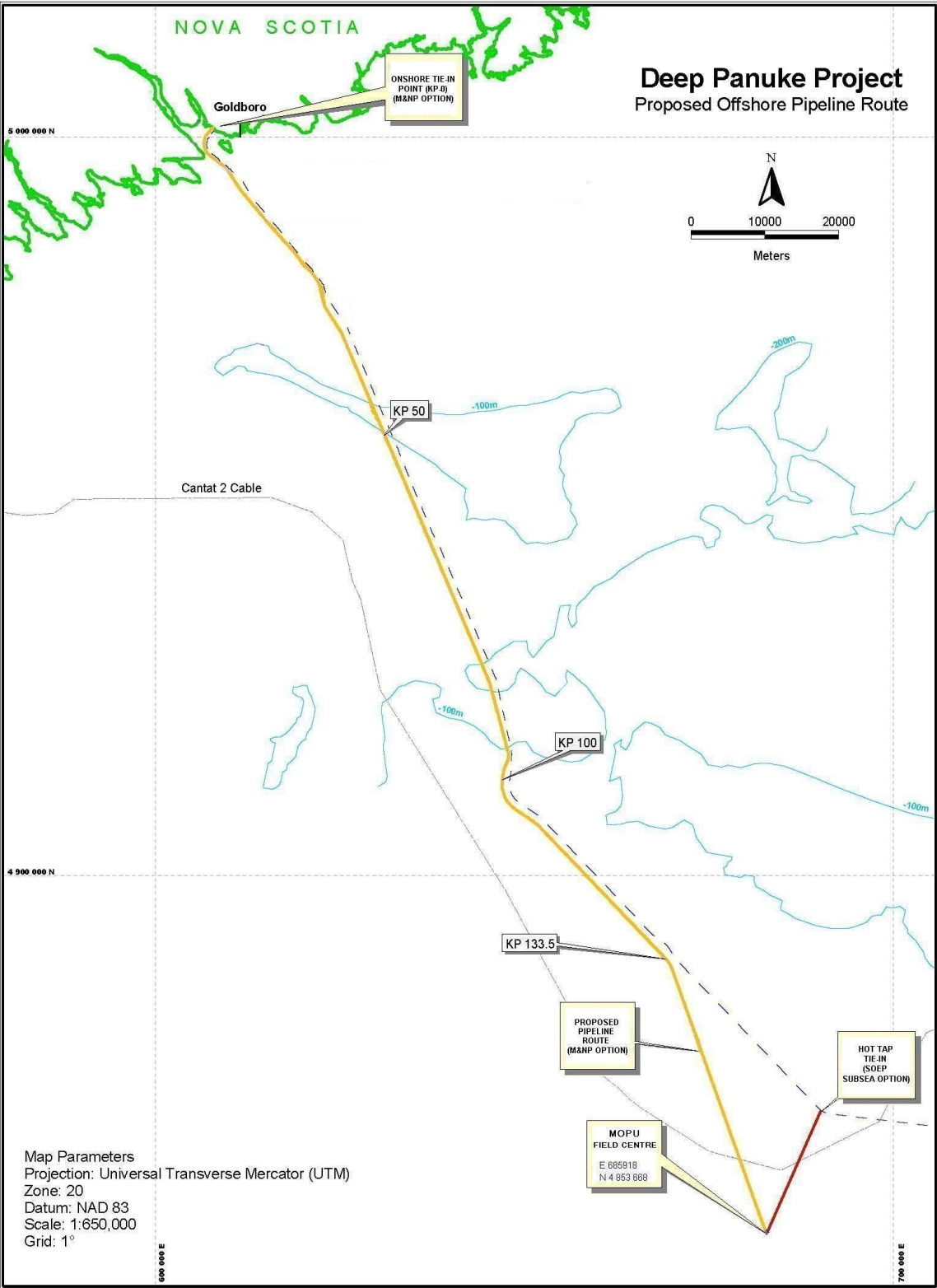
2.2.3 Export Pipeline

The Deep Panuke export pipeline will have a capacity of $8.5 \times 10^6 \text{ m}^3/\text{d}$ at mean environmental conditions. The proposed routes of the export pipeline will minimize their footprint(s) by using existing pipeline and flowline corridors where practical. The pipeline details for both options are presented in Table 2.2. All values are approximate.

Table 2.2 Export Pipeline			
	Pipeline Diameter (mm)	Pipeline Length (km)	Pipeline Phases
M&NP Option	560	176 (including approximately 3 km onshore)	Single phase
SOEP Subsea Option	510 or two 324	15	Multi-phase

The proposed offshore pipeline routes for both the M&NP Option and the SOEP Subsea Option are presented on Figure 2.2.

Figure 2.2 Proposed Offshore Pipeline Route



M&NP Option

The proposed pipeline route for the M&NP Option extends 173 km and closely follows the existing SOEP gas pipeline. With the exception of a slight route change offshore due to the revised location of the field centre, the offshore pipeline routing for this option remains unchanged from the route outlined in the approved 2002 CSR. The onshore corridor has changed slightly as well.

The pipeline will be trenched where the water depth is shallow, as illustrated in Figure 2.3. This will also reduce the potential for sediment scour to the pipeline. The pipeline will be designed to withstand impacts from conventional mobile fishing gear in accordance with the Det Norske Veritas (DNV) *RP-F111, Interference Between Trawl Gear and Pipelines*, October 2006.

SOEP Subsea Option

The export pipeline(s), either the single or twinned pipeline alternatives, to the SOEP Subsea Option tie-in point will be approximately 15 km long. The water depth ranges from approximately 20 m to 45 m and the seabed is relatively featureless. The entire SOEP Subsea Option export pipeline(s) will be buried and designed to withstand impacts from conventional mobile fishing gear. The pipeline(s) will traverse a region of Sable Island Bank noted for its heterogeneous surficial geological characteristics. The dominant substrates along the proposed route are well-sorted Sable Island sand and, to a lesser extent, gravel. Sand ripples and mega-ripples are common due to the influence of waves and currents. The surficial sediments of the pipeline route are under the influence of dynamic sediment transport regimes, with large volumes of sand moved during storm events. In contrast to the M&NP Option, the SOEP Subsea Option pipeline(s) will not traverse areas of rock outcroppings, basins or other notable geological features.

Final processing of the gas and condensates will be done by SOEP at the onshore plants near Goldboro, N.S. and Point Tupper, N.S.

Onshore Pipeline and Facilities

Onshore facilities are required for the M&NP Option only. In this option, EnCana's onshore facility will consist of the physical components necessary for interconnection of EnCana's natural gas pipeline with M&NP's facility. EnCana will install a pig launcher/receiver facility and a safety/emergency shutdown valve system. The onshore facility will interface with the M&NP owned facility, which will include custody transfer meters, the final section of pipeline, and the tie-in to the existing M&NP pipeline. This facility is estimated to be 60 m x 45 m in area and will be enclosed by a security fence. The onshore pipeline will be located within the pipeline corridor indicated on Figure 2.4.

Figure 2.3: Offshore Pipeline Burial Sketch

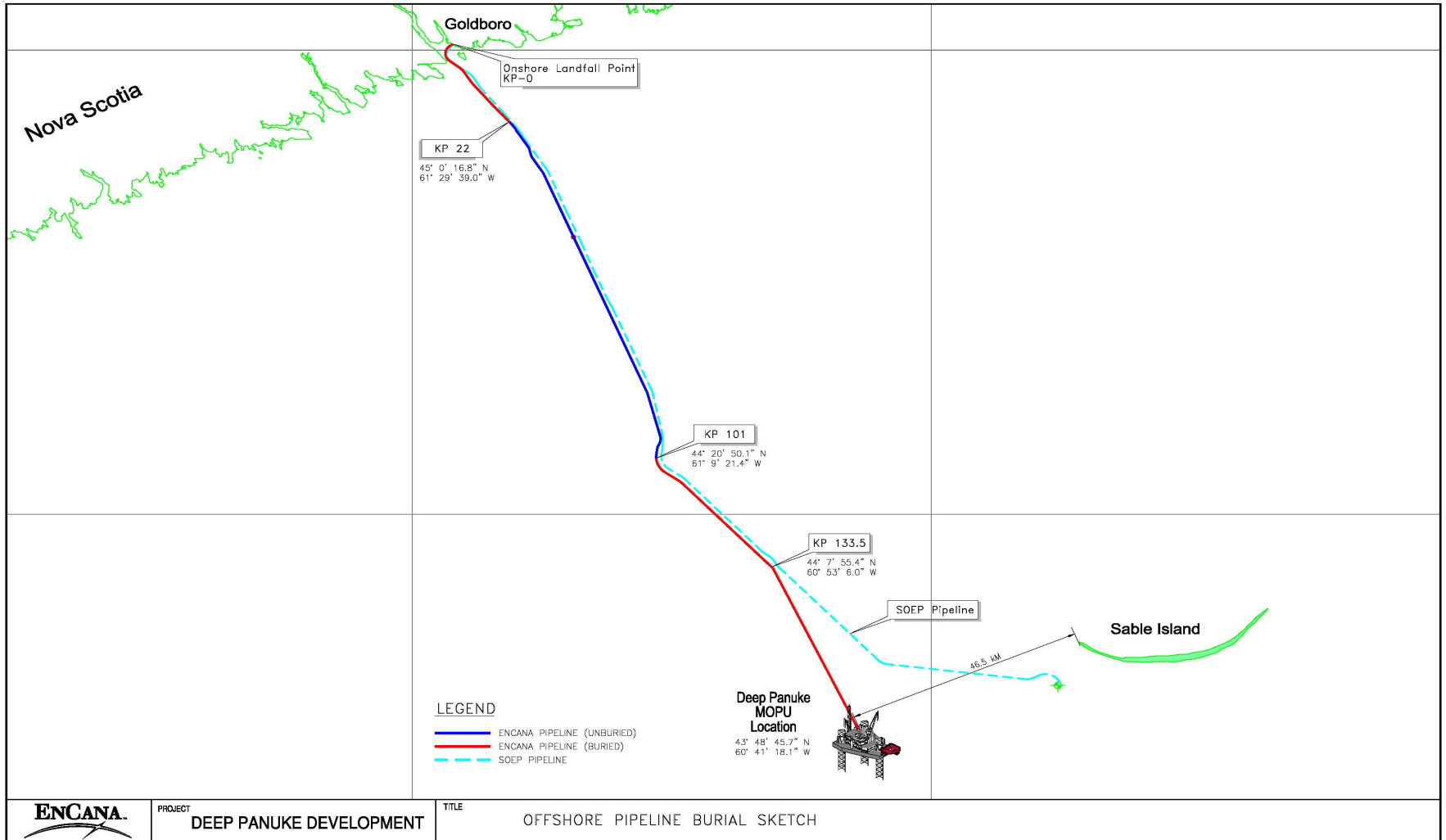
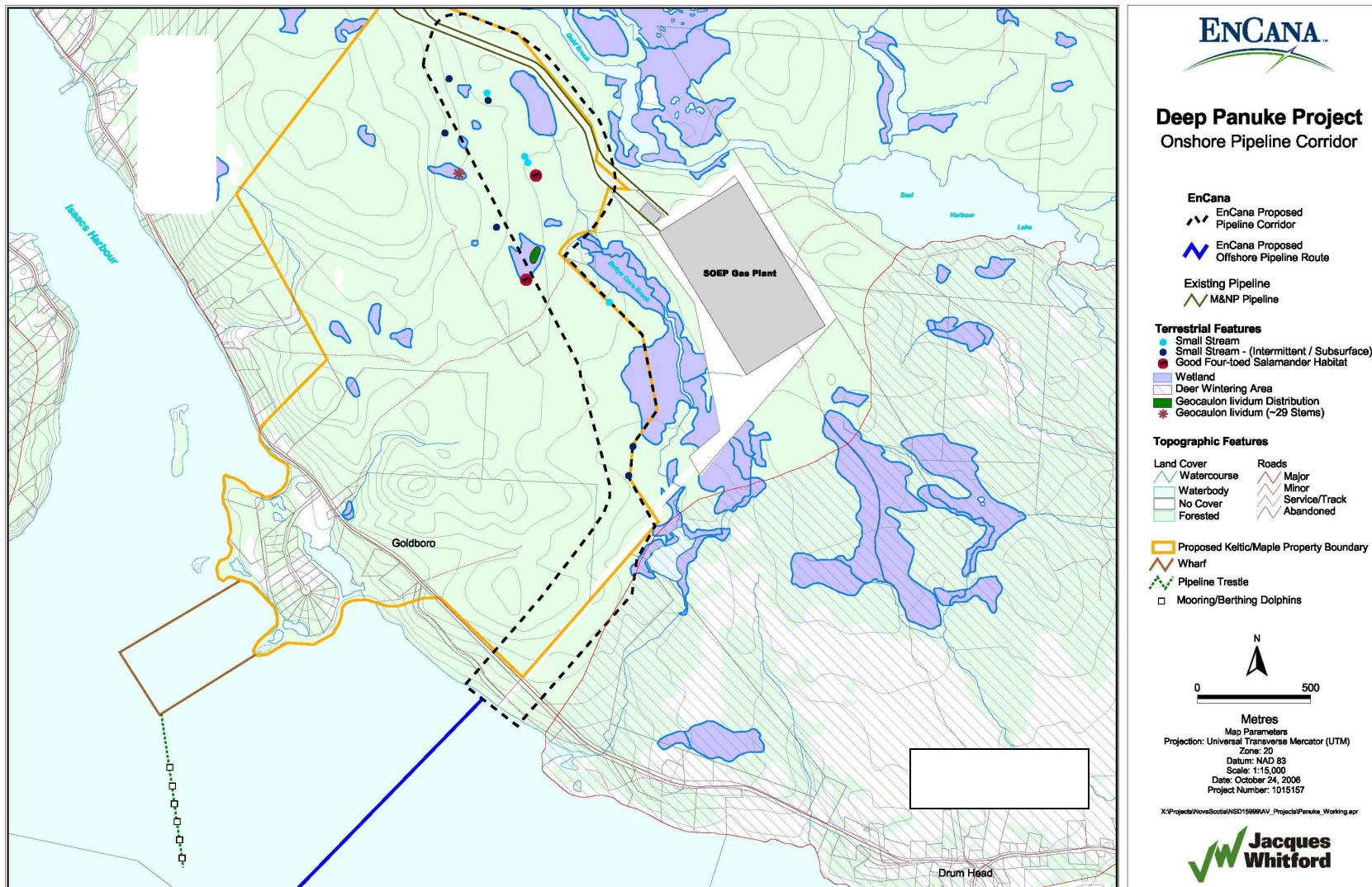


Figure 2.4 Revised Onshore Pipeline Corridor



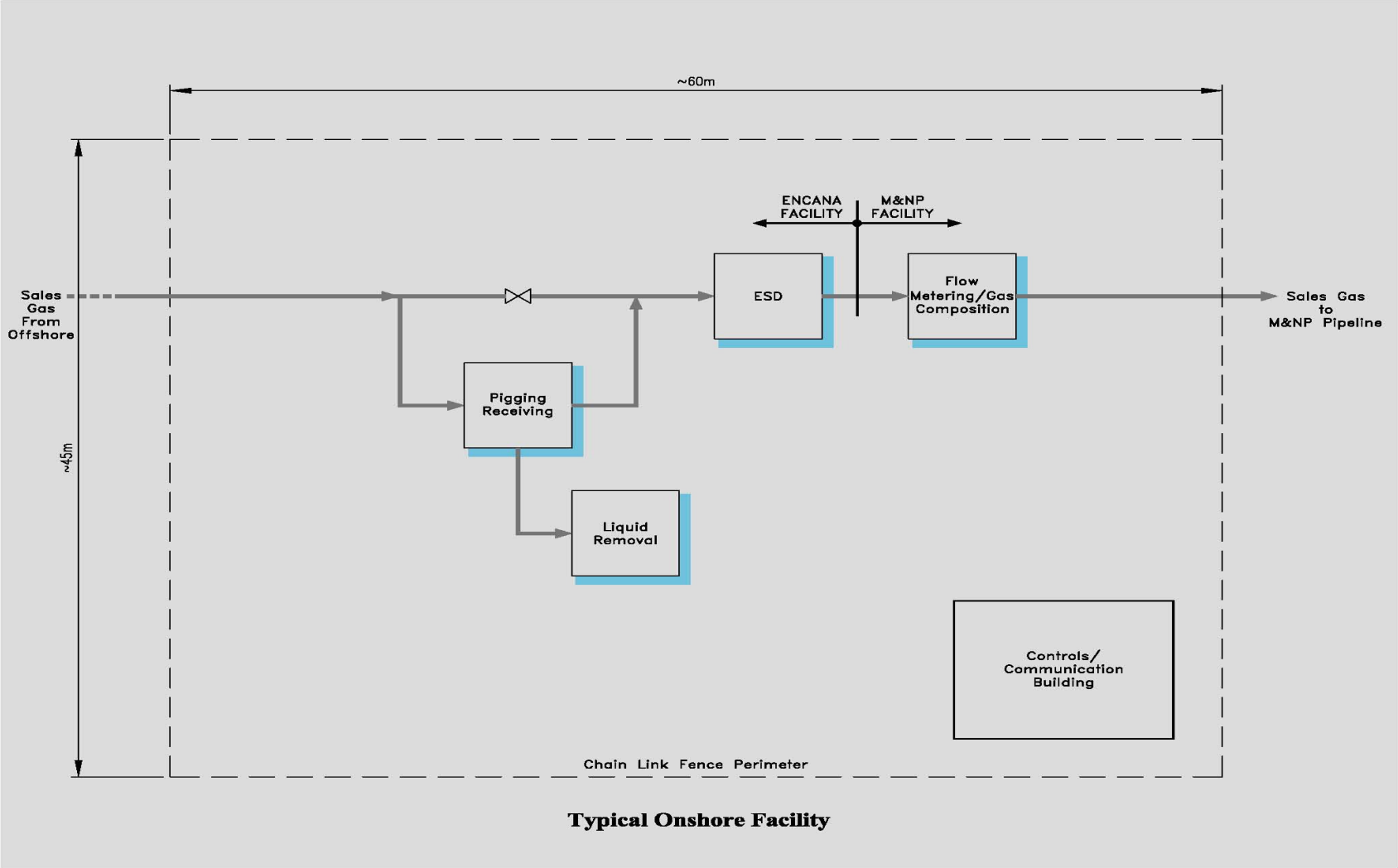
The onshore portion of the pipeline will be approximately 2 to 4 km long. Design criteria for the onshore pipeline include: minimizing environmental effects through avoidance of Deer Wintering Areas; minimizing impacts on species at risk and migratory birds; minimizing impacts from potential mining contamination; minimizing pipeline length; minimizing impact on wetlands through avoidance where feasible; minimizing impact on stream crossing by use of dry crossing techniques; minimizing effects on landowners' properties through which the pipeline will run; and ensuring best use of industrial park land consistent with the Municipality's conceptual plan for the park.

The environmental constraints on the pipeline route and expected mitigation measures to manage these constraints will be included in the Request for Quote for the onshore pipeline installation package. Additionally, onshore environmental constraints will be considered in the Project's Environmental Protection Plan (EPP).

An access road may be required which will likely run parallel to the new pipeline. The final location of the onshore facilities will depend on the final pipeline routing and access, as well as biophysical, socio-economic and engineering constraints. When additional survey work is completed, EnCana will consult with the land owners in the Goldboro Industrial Park to determine the location of the onshore facilities, as well as the onshore pipeline route.

Although layout of the onshore facilities was not complete during the preparation of the CSR, Figure 2.5 is a schematic of the typical onshore facility that would be required for the Deep Panuke Project.

Figure 2.5 Typical Onshore Facility



2.3 Construction and Installation

2.3.1 MOPU Facilities

The MOPU will be fabricated onshore, towed to the field, and jacked up on location. The MOPU will be situated on specifically designed footings, similar to typical drilling jack-up rig footings. The topsides facilities will be fabricated separately and installed on the MOPU at an onshore location. The Project has no requirement for an offshore heavy lift.

The hull portion of the MOPU is expected to utilize the basic design premise of an existing mobile offshore drilling unit (MODU) jackup design with the minimum number of changes required to accept the topsides production facilities. The intent will also be to minimize the deviations to the standard MODU design so that re-conversion of the unit back to a drilling unit in future can be readily accommodated if desired. The hull designs must be structurally capable of withstanding the environmental design conditions for offshore Nova Scotia on a year round basis.

The production topsides will house all the production equipment and will be located on the hull. The topsides will be constructed in modular format. The topsides module(s) and the MOPU hull will likely be fabricated at separate locations and then brought to a common yard where they will be integrated. The expected weight of the production facilities is 6,000 tonnes.

The accommodations unit will be designed for a minimum of 68 persons on board (POB) and steady state POB of approximately 30 persons; however, it could also be larger if the MOPU contractor chooses to use a standard MODU accommodations design.

The flare structure is expected to be a tubular lattice type structure and may be vertical or a boom type configuration. It will be in the order of 70 m above the topsides production facilities top-most deck and will house the high pressure and low pressure flare lines and flare tips.

During the early stages of the detailed design phase of the Project, it will be important to ensure that the MOPU is designed to be transportable by the most economical means. Accordingly, until the MOPU fabrication yard is known, it will be essential to maintain design flexibility.

The actual installation of the MOPU at the offshore location is the same as the installation of a typical jack-up drilling rig. That is, the MOPU jacking system will be activated to lower the legs to the seabed and then to raise the hull above the sea level to its final design elevation. Installation will be in accordance with installation manuals that will provide full details of the sequence and content of each operation. The Project's EPP will be integrated with the development of the installation manuals.

2.3.2 Export Pipeline

The proposed pipeline corridor is described in Section 2.2.3 and shown on Figure 2.2.

For the M&NP Option, the route will head towards the existing SOEP pipeline and then follow the previously approved route paralleling the existing SOEP pipeline to shore. The two lines will be approximately 1 km apart, except where bottom topography necessitates close proximity. In the near shore area, approximately 7 km from land, the two lines will be approximately 100 m apart.

For the SOEP Subsea Option, the route will head towards a close tie-in location. For the twinned pipeline alternative, the pipelines will run in parallel to each other separated by a distance that will enable sufficient room for installation and post trenching activities to occur for each individual pipeline. This distance is estimated at 50 m or less.

Preliminary route studies for the SOEP Subsea Option as well as the M&NP Option pipeline route affected by the field centre change have been completed. Detailed route studies will be conducted during detailed design to confirm and refine preliminary routing and construction methods. Pipelines will be hydrostatically tested during commissioning.

Nearshore and offshore installation activities for a single pipeline were assessed in the 2002 CSR which considered the M&NP Option. This assessment remains valid and is assumed to cover the much shorter alternatives of either the single or twinned pipeline for the SOEP Subsea Option as well (impacts are expected to be substantially less than the M&NP Option). Additional details on these alternatives are presented in Section 3.2.10. Details of methods involving sediment disposal are described in Section 2.3.5. Impacts to the marine environment are considered in Sections 9.2, 9.5 and 9.6.

The use of twinned 324 mm nominal pipelines will allow them to be installed by either the “S-lay” barge method, “reel lay” technique or flexible flowline method due to their reduced diameter. Thus, the installation options for the twinned pipeline will be the same as for the in-field flowlines. In comparison, the single 510 mm pipeline option can only be installed using the “S-lay” method.

2.3.3 Subsea Tie-In Facilities

For the SOEP Subsea Option, sales product will be transferred from the Deep Panuke MOPU via one 510 mm export pipeline or two 324 mm pipelines to the existing SOEP 660 mm pipeline. The pipeline(s) will be 15 km long.

For either pipeline alternative, the connection to the SOEP pipeline will be by a subsea tie-in, referred to as a “hot tap”. The hot tap installation process involves the connection of a tee (i.e., branch nipple) and an isolation valve onto the existing pipeline through which a “coupon” can be cut out of the existing pipeline while the pipeline is still operational. The branch nipple connection can be attached either by welding or by installing a mechanical clamp. Both “hot tap” methods involve exposing the buried pipeline section by airlifting sediments.

The equipment housed at the hot tap location includes a manual isolation valve, a check valve and provision for a temporary subsea pig receiver. The tie-in assembly will be

secured to the seabed using piles. A protection structure will be placed around each of the SOEP pipeline hot tap equipment and the Deep Panuke pipeline tie-in equipment.

Section 2.3.5 provides additional detail on methods involving sediment disposal for the hot tap installation.

2.3.4 Subsea Flowlines and Umbilicals

A total of six to nine subsea flowlines will be installed on the seafloor to tie-in the five to eight production wells and one injection well. It is expected that the subsea production flowlines will be 200 to 250 mm in diameter and range from 1 to approximately 10 km in length. The injection flowline is expected to be 75 mm in diameter and approximately 1.7 km in length. The flowlines may be a flexible or rigid design and may be installed by reel-lay or s-lay pipelay methods. The flowlines will be trenched and buried. Flowline lengths, diameters, and installation method will be confirmed during detailed design.

A dedicated subsea umbilical will be required for each well in order to control, monitor, and supply chemicals to the wells. All umbilicals will be trenched and buried.

Offshore pipeline installation activities as presented in the approved 2002 CSR are applicable to the subsea flowline as well as umbilical installation and therefore are not included in the scope of this CSR as there is no need to re-assess them. It should be noted that, while pipeline installation by reel-lay for flexible lines was not specifically addressed in the approved 2002 CSR, there is no change in the assessment as both reel-lay and s-lay pipelay methods simply refer to the methods used to feed the pipeline from the vessel to the seabed.

2.3.5 Construction Methods Involving Sediment Displacement

The Deep Panuke project requires the installation of three infrastructure components that will require some form of sediment disturbance during the construction/installation phase. These components are as follows:

- export pipeline (either M&NP Option or the SOEP Subsea Option);
- flowlines; and
- umbilicals.

The activities, location, techniques, duration and amount of sediment disturbance are described in Table 2.3. A summary for each component is described in the following paragraphs.

Export Pipeline

For the M&NP Option, the first kilometre from shore could either be pre-trenched and covered with native material, or be a horizontal directional drill (HDD) section where the cuttings will be disposed of onshore. Approximately 50% of the remaining 173 km offshore section will be trenched approximately 1 m into the seabed with natural or mechanical replacement of native sediments.

The drilling fluid to be used for HDD operations has not been finalized as yet. There is an option to use conventional water-based muds (WBMs), or a viscosified seawater (seawater combined with a thickening agent). If WBM is used, it will be composed primarily of bentonite which is a naturally occurring clay. Large quantities of drilling fluid are pumped into the hole to maintain the integrity of the hole and to flush out cuttings during drilling operations. A sump is created around the entrance point of the drilled hole to contain all of the drilling fluid as it returns carrying the drilled cuttings. The cuttings are then separated from the drilling fluid and the drilling fluid is recirculated through the drilling operation. It is expected that approximately 500 to 625 m³ of cuttings will be generated from this drilling program, and approximately 25 m³ of seawater will be required for each day of drilling.

During horizontal drilling operations, drilling is stopped several metres short of the subsea exit point, therefore containing all of the drilling fluid within the drilled hole. At this point, the drilling fluid can be circulated out of the hole and recovered onshore for reuse or disposal. The drilling fluid is then changed to viscosified seawater to complete the last few metres of drilling to the subsea exit point.

For the SOEP Subsea Option, the SOEP pipeline tie-in location will have to be exposed by airlift techniques. This involves pumping air from the surface to lift sediments away from the currently buried pipeline. The 15 km Deep Panuke export pipeline(s) will be trenched approximately 1 m into the seabed with natural or mechanical replacement of native sediments.

Flowlines and Umbilicals

Flowlines and umbilicals for the five to eight production wells (18-31 km in total length) and one acid gas injection well (1.7 km), as well as an umbilical for the gas buy-back valve which forms part of the subsea isolation valve (SSIV) assembly (150 m), will be trenched approximately 1 m into the seabed with natural or mechanical replacement of native sediments.

2.3.6 Subsea Equipment and Associated Protection Structures

The following subsea equipment will be protected by dedicated protection structures:

1. wellheads (up to 9);
2. hot tap (SOEP Subsea Option only, see Section 2.3.3);
3. tie-in (SOEP Subsea Option only, see Section 2.3.3); and
4. SSIV skid (protection structure may not be required since SSIV is located in MOPU Safety Zone).

These shall be separately deployed structures. The protection structures shall be designed to allow adequate access to the wells for all planned diver and remotely operated vehicle (ROV) intervention tasks. The SSIV assembly shall be designed to support the piping and valves and to provide protection against dropped objects. All subsea protection structures will be trawlable, cage-like, open tubular construction. The protection structures footprint is expected to be approximately 10 m x 10 m for the wellheads, 10 m x 6 m for the hot tap, 20 m x 15 m for the tie-in, and 5 m x 5 m for the SSIV skid.

Table 2.3 Construction Methods					
Category	Activity/Purpose	Location	Technique(s)	Duration	Amount
Export Pipeline – SOEP Subsea Option	Expose the existing SOEP 660 mm pipeline to perform “hot tap”	Approximately KP162 of SOEP pipeline. See Figure 2.2	Airlift	1-2 days (for mechanical hot tap) or 2-4 days (for welded hot tap)	Approx. 10 x 10 x 3m for welded hot tap Approx. 5 x 5 x 3m for mechanical hot tap
	Trenching of the export pipeline(s) for on-bottom stability.	15 km length from MOPU to SOEP hot tap location. See Figure 2.2	Multi pass plough (MPP), MPP with separate back fill plough (BFP), jetting, mechanical digger with natural or mechanical replacement of native sediments. For the twinned pipeline the techniques used for the flowlines would also be applicable	On average 150 to 400 m/hr (dependent on soil conditions)	Trench to allow 1m of cover
Export Pipeline – M&NP Option	Horizontal directional drilling* or trench of approximately first 1km of pipeline from onshore for on-bottom stability and protection.	KP0 to KP1.0. See Figure 2.2	For trenching, trench by a dipper/floating backhoe/floating grab dredge. Some blasting may be required in nearshore area (in the dry during periods of low tide)	3 to 4 months	Pipeline will be laid in pre-excavated trench and covered with native material
	Trenching of the export pipeline for on-bottom stability.	Approx. KP1.0 to KP22.0 and KP110.0 to the MOPU. See Figure 2.2	MPP, MPP with separate BFP, jetting, mechanical digger with natural or mechanical replacement of native sediments	On average 150 to 400 m/hr (dependent on soil conditions)	Trench to allow approximately 1m of cover
Flowlines	Trenching of approx. 31 km of 200 to 250 mm and 1.7 km of 75mm flowlines for insulation, protection and on-bottom stability	See Figure 2.2	MPP, MPP with separate BFP, jetting, mechanical digger with natural or mechanical replacement of native sediments	On average 150 to 400 m/hr (Dependent on soil conditions)	Trench to allow approximately 1m of cover
Umbilicals	Trenching of approximately 31 km of 100 mm umbilicals for flowlines and buy-back gas valve.	See Figure 2.2	MPP, MPP with BFP, jetting, mechanical digger with natural or mechanical replacement of native sediments	On average 150 to 400 m/hr (dependent on soil conditions)	Trench to allow approximately 1m of cover

* Horizontal directional drilling of this section would not displace surface sediments. HDD cuttings will be disposed of onshore.

Pile Driving

Table 2.4 presents a comparison of the potential pile driving requirements associated with the approved 2002 CSR and the revised Project basis.

The revised Project design basis is based upon having a MOPU with subsea production wells individually tied back to the MOPU. The MOPU does not require any piles for installation.

There may be up to eight subsea production wells and one acid gas injection well. Each wellhead will require a protection structure. A SSIV assembly will be required for both export options as per the design basis in the 2002 CSR. For the SOEP Subsea Option, the connection to the SOEP pipeline will be via a "hot tap" which will be connected to a Deep Panuke "tie-in" structure. As a result, the following subsea protection structures will be required for the revised Project design basis: wellhead (up to 9 in total); SSIV assembly skid (1); and tie-in (1) (SOEP Subsea Option only).

These subsea structures may be fastened to the seabed via four piles ranging in size from 610 mm to 910 mm driven approximately 8 to 12 m below seabed. These piles would be driven with an IHC S-90 (or equivalent) hammer which has a maximum energy output of 89,000 Newton-meters. The actual pile driving duration is estimated to be 0.5 to 1 hours per pile based upon the previous experience of driving the Panuke platform docking piles.

Although the total number of piles has increased for the revised Project design basis, the diameter and length of the piles is smaller requiring an overall shorter duration of the activity with a lower energy hammer. As a result, the potential pile driving requirements associated with the 2006 Project basis is less than the Project basis approved in the 2002 CSR.

Table 2.4 Pile Driving Details							
Project Design Basis of 2002 Approved 2002 CSR							
	No. Piles	Size [mm (in)]	Penetration [m]	Hammer Size	Max. Energy [N.m (ft. lbs)]	Actual Driving Duration/Pile	Actual Driving Duration
Wellhead Platform	4	2100 (84)	61	Menck MHU-1700 (or equivalents)	1,699,000 (1,253,000)	4 to 6 hr	16hr - 24hr
Production Platform	8	2100 (84)	68	Same as WHP	1,699,000 (1,253,000)	4 to 6 hr	32hr - 48hr
Utilities and Quarters Platform	4	2100 (84)	65	Same as WHP	1,699,000 (1,253,000)	4 to 6 hr	16hr - 24hr
SSIV Skid¹	4	610-910 (24-36)	8 - 12	IHC S-90 (or equivalents)	89,000 (66,000)	0.5hr - 1hr	2hr - 4hr
Estimated Total Duration ² (Menck MHU-1700)							64hr - 96hr
Estimated Total Duration ³ (IHC S-90)							2hr - 4hr
Revised Project Basis							
	No. Piles	Size [mm (in)]	Penetration [m]	Hammer Size	Max. Energy [N.m (ft. lbs)]	Actual Driving Duration/pile	Actual Driving Duration
Wellhead Protection (x9)	36	610-910 (24 - 36)	8 - 12	IHC S-90 (or equivalents)	89,000 (66,000)	0.5hr - 1hr	18hr - 36hr
Hot Tap	4	610-910 (24 - 36)	8 - 12	Same as Wellhead	89,000 (66,000)	0.5hr - 1hr	2hr - 4hr
Tie-in	4	610-910 (24 - 36)	8 - 12	Same as Wellhead	89,000 (66,000)	0.5hr - 1hr	2hr - 4hr
SSIV Skid¹	4	610-910 (24 - 36)	8 - 12	Same as Wellhead	89,000 (66,000)	0.5hr - 1hr	2hr - 4hr
							24hr - 48hr
							1d - 2d
¹ May not be required since in Platform/MOPU Safety Zone							
² Approximately 40 to 45% of the duration is under water hammer activities							
³ All the duration is underwater hammer activities							

2.3.7 Onshore Facilities and Pipeline (M&NP Option Only)

Onshore pipeline installation activities as presented in the original 2002 CSR have not changed; therefore, these activities are not described in this section.

2.3.8 Development Well Construction

Development wells will include five to eight production wells and one injection well, all of which will be subsea. A jack-up drilling unit will be used to complete the existing wells and to drill the subsea wells. A jack-up drilling unit is a MODU with legs that can be jacked up or down. Once towed to the site, the legs are jacked down until they are in contact with the seafloor, then the rig platform is elevated until it is approximately 25 m above the water surface. The jack-up drilling unit will remain on location during drilling and completion operations and then be removed. Well construction activities are expected to take approximately 430 days (five new drill wells at 60 days each plus four re-entry wells at 32 days each) in total to complete.

The normal drilling program for all Deep Panuke wells involves conventional hole and casing/pipe sizes. All casing designs are based on the *Nova Scotia Offshore Petroleum Drilling Regulations*.

For the new production and injection wells drilled, the conductor pipe (first string of pipe) will be set approximately 100 m below the seafloor. This is the same method that was used on the existing suspended wells. This section will be drilled primarily with seawater and viscosifiers to aid in ensuring cuttings removal from the wellbore. These cuttings are deposited at the seabed and are generally equivalent to the volume of the hole drilled, approximately 65 m³.

The conductor pipes will initially be run through the water column and tied back to the rig. They will serve as a conduit and the primary weather barrier to take environmental loading and protect the inner strings of casing (length of pipe) while drilling the well. Also, the conductors at the seafloor have a shoulder that supports the other inner strings of casing (i.e. the mudline suspension system). The conductor and surface casings from the seafloor up will later be removed as noted below when the subsea wellhead and production tree are installed.

All wells, including production and injection, will set the surface casing into the Wyandot formation at approximately 950 m below sea level in the general direction that the bottom of the well will be located. The BOP stack is then installed on the jack-up rig on the top of the surface casing prior to drilling the intermediate hole section.

For the re-entry wells, an intermediate hole section has been drilled just into the top of the limestone at approximately 3200m true vertical depth (TVD). An intermediate casing string has been set 20 m into the Abenaki 7/6 formation and cemented back just above any potential hydrocarbon bearing sands (~2300 m). The new production well(s) will be similarly constructed to the existing suspended delineation wells. Prior to drilling the reservoir section and with the well secured, the surface casing, wellhead and the conductor will be removed from the seafloor to surface and the well will be converted by running a subsea wellhead. The production tree will be installed on the wellhead at seafloor with a high pressure riser connected back to the surface BOP stack on the MODU.

A rotating BOP and an injection spool will be installed with the surface BOP stack in preparation for annular velocity control (AVC) drilling techniques and the main hole section will be drilled through the productive interval of the carbonate reef. On the re-activation wells, the reservoir section has been drilled to a total depth of circa 3650 m TVD which is about 150 m past the gas-water contact (GWC) at 3504 m TVD. On many of the delineation wells, this GWC was not clearly evident while drilling the section as the formation was not porous at this depth, however it was clearly identified while drilling the MarCoh D-41 well. On each of the wells to be re-used for production, a liner (string of pipe) has been installed across the reservoir section and cemented back to the previous casing shoe. For the new producing well(s), the reservoir section may be left open, with no liner in place, in order to maximize the flow potential of the well.

For re-entry of the existing wells, a “trash cap” will first be removed from the conductor stub 3 m above the seafloor. A “trash cap” is a cylindrical device closed on one end that covers the conductor to keep out marine organisms or falling debris. Once the trash cap has been removed, a running and retrieving tool is used to back off the temporary abandonment caps. Each of the wells then has a cement plug set that has to be drilled out.

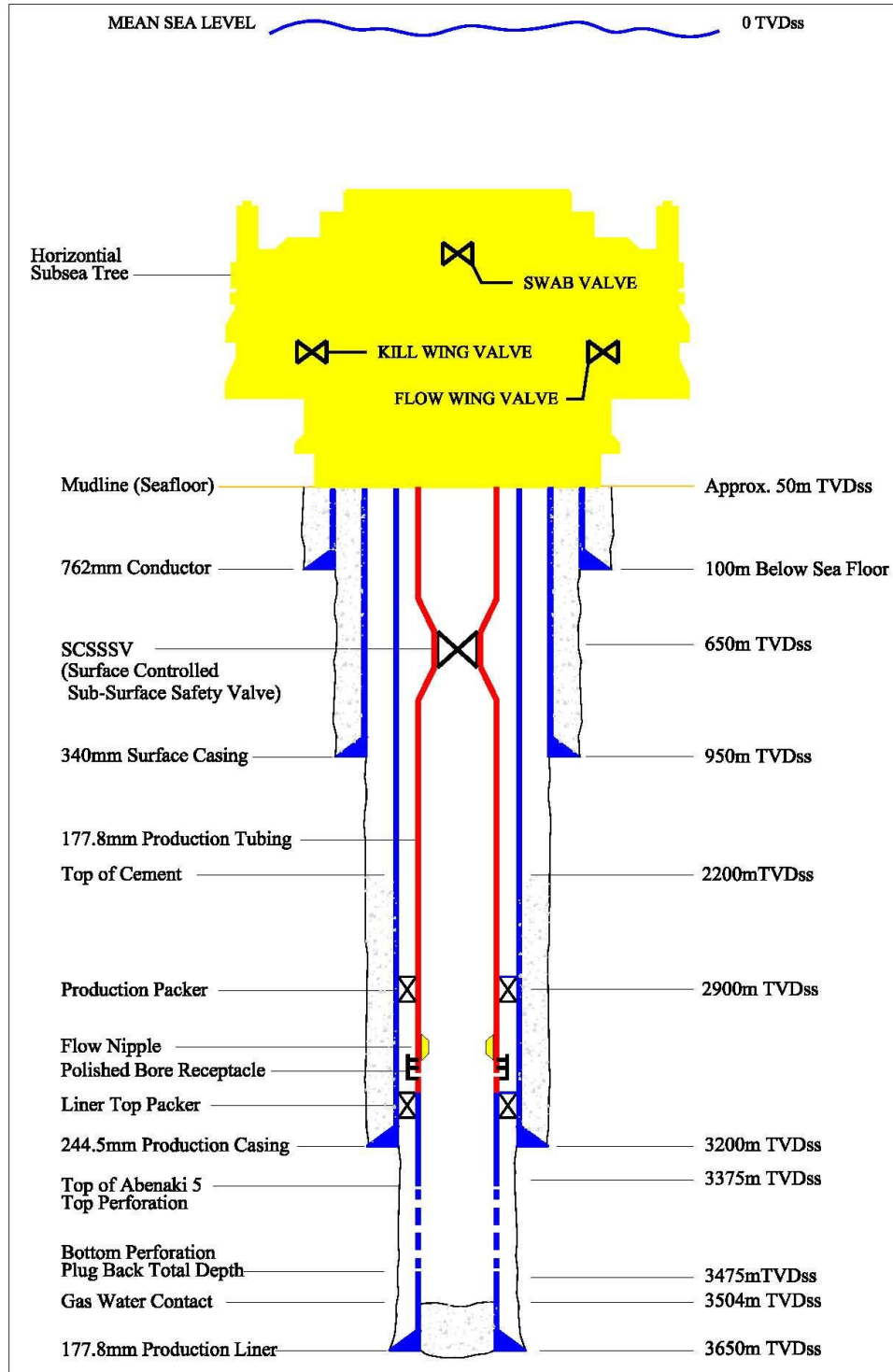
The production wells will all be completed with a downhole packer (plus other ancillary downhole equipment), production tubing, surface controlled subsurface safety valve, a tubing hanger, and a subsea production tree. Once all hydrostatic tests and function tests are performed, the production wells will be opened for clean-up flow on the drilling rig. This will remove any water or debris from the wellbore prior to handover for production operations on the MOPU. See Figure 2.6 for details on the production wells.

The injection well will be drilled using similar processes and procedures as with the production wells. Once the surface casing is set in the Wyandot formation, the main well bore will be drilled vertically to the injection zone in the Upper Mississauga formation located at approximately 2400 m TVD. Similar to the production well, the completion for the injection well will consist of tubing, downhole packer, subsurface safety valve, tubing hanger and injection tree.

For the M&NP Option, it is estimated that there will be no surplus condensate produced beyond fuel usage; however, the ability to inject condensate down-hole with the acid gas stream provides operational flexibility in times of maintenance and/or operational issues. It is currently planned to inject the condensate with the acid gas into the one injection well that will be drilled west of the MOPU field centre.

This injection well will be drilled into a porous and permeable zone in the Upper Mississauga Formation; the targeted injection zone is the Tidal-Fluvial Sandstone. The impermeable Naskapi shales located directly above will prevent any migration of injected acid gas or condensate. The Upper Mississauga Formation will be capable of containing the entire acid gas and surplus condensate volumes that will be produced over the life of the Project. Migration of injection fluids to other formations and/or to the surface is considered extremely unlikely. The possibility of acid gas injection souring the Panuke oil zone is also considered to be extremely low.

Figure 2.6 Typical Production Well Schematic



Typical Production Well Schematic

Drilling Fluid Program

Water-based muds (WBM) will be used in development drilling. Drilling muds are fluids used to protect and clean the drill hole, for overbalancing formation pressures, and for bringing cuttings to the surface. The selection of the drilling fluid is based on factors such as the hole angle, the formation types drilled (mudstone, sandstone, clays, etc.), and the time of exposure.

WBM is a suspension of solids and dissolved material in a carrier base fluid of water. WBM tends to be used for wells that do not encounter difficult geology. Based on the experience gained while drilling the Deep Panuke delineation wells, it was determined that only WBM will be used for any new development drilling activities.

The anticipated composition of WBM (seawater gel mud type), based on previous drilling experience in the area is as follows:

Table 2.5: Anticipated Composition of WBM based on Previous Wells

Constituent	Hole Section			
	914 mm	445 mm	311 mm	216 mm
	kg/m ³	kg/m ³	kg/m ³	kg/m ³
Fresh water		0.324		
Sea water	0.9	0.649		
Soda ash	0.3-0.5			
Caustic soda	0.5	0.5	As required	As required
Bentonite	70	40-50		
Barite	150			
Polymer			0.93	0.93
Starch			2.8	
Xantham gum			3.5	4.3
Potassium chloride			92	Deplete
Glydril MC			3%	deplete

During drilling of the new wells, the mud is circulated down the drillpipe from the drilling unit to the bottom of the wellbore and returned to the drilling unit in the annular space (between drill pipe and open hole/casing) carrying the cuttings from the well. Each hole section of a wellbore requires different fluid properties. Thus after each hole section, the mud is modified or changed out. WBM that is no longer required will be disposed of overboard, along with WBM cuttings in accordance with the Offshore Waste Treatment Guidelines (OWTG, NEB *et al.* 2002).

For the wells to be re-entered and completed, some drilling is required to remove cement suspension plugs. This will be done using a viscosified brine solution and so traditional drilling mud will not be required. Prior to removal of the last suspension plug on the existing wells, the well will be displaced with filtered completion brine which will act as an overbalanced annulus fluid for setting the production packer. Some viscous pills of polymer gelled brine may be used to ensure removal of all solid particles in the wellbore. Although not yet finalized, it is anticipated that the completion fluid will be clear brine with a number of additives including corrosion inhibitors (expected concentration 13.0 l/m³), oxygen scavengers (expected concentration 4.0 l/m³), bactericide (expected concentration 1.5

l/m³), caustic soda as required (to achieve pH of 10-10.5) and H₂S scavengers (expected concentration 0.3 l/m³).

Once the well completion is done and the production tree is in place, it will be necessary to flow the well to clean up and remove completion fluids from the reservoir using diesel or glycol or some combination of both. Typically this represents a very small volume of diesel in the order of 20 to 30 m³. The fluid column is caught by the well test equipment on the drilling rig and burned through the oil burner on the flare boom. There will be no residual diesel or glycol in the completion fluid.

Through the life of the field, workovers will be required in the wellbores. Completion brines may be used during these processes. These brines will be composed of water and a salt formulation kept in suspension using a viscosifier (polymer).

2.3.9 Hydrostatic Testing

The export pipeline(s) for both M&NP and SOEP Subsea Options and the production and injection flowlines will be hydrostatically tested. It may be necessary to treat the seawater introduced into the pipeline with corrosion inhibitors and biocides; these chemicals protect the interior surface of the pipeline. Leaving untreated seawater in the pipeline for more than one month can establish conditions which permit corrosion to occur at a later stage in the life of the pipeline.

The hydrostatic test plan for the export pipeline is detailed in Table 2.6 and the following paragraphs. For the M&NP Option, the discharge of hydrostatic fluids will occur at the MOPU. The cooling water pumps, running at 2400 m³/hr, will be flowing into the discharge caisson while discharging the hydrostatic fluid. This provides a dilution factor as outlined in the table below. There will be no dilution for the export pipeline(s) in the SOEP Subsea Option since the release point will be at the tie-in location. For the flowlines, hydrostatic fluids may be discharged at the MOPU or at the individual subsea wellheads. This will be confirmed during detailed design. Therefore, no dilution for the flowlines is assumed as a worst case scenario.

Case	Length [km]	Release Point	Release Volume [m³]	Release Rate [m³/hr]	Cooling Water Rate [m³/hr]	Dilution Factor
Export Pipeline (M&NP Option)	176	Field Centre	43,200	400	2400	6:1
Export Pipeline – single line (SOEP Subsea Option)	15	SOEP Subsea Tie-in location	3040	400	n/a	n/a
Export Pipeline – twinned line (SOEP Subsea Option)	2 x 15	SOEP Subsea Tie-in location	2470	300	n/a	n/a
Production Flowlines (at start-up)	18.2	Field Centre	590	175	n/a	n/a
Production Flowlines (after start-up)	12.4	Field Centre	402	175	n/a	n/a
Acid Gas Injection Flowline	1.7	Field Centre	8	24	n/a	n/a

Although assessed in the previously approved 2002 CSR, hydrostatic testing must be re-assessed due to changes in dilution factors, location of release, and additional pipeline and flowlines scenarios.

For both the M&NP Option and the SOEP Subsea Option, the pipeline will be installed, cleaned, gauged, flooded, and hydrotested. The pipeline spool between the pipeline and MOPU will be installed and the pipeline will be leak tested, dewatered, dried and nitrogen packed. For the M&NP Option, the fluid will be disposed at the MOPU location. For the SOEP Subsea Option, the fluid will be disposed at the SOEP subsea tie-in location.

The flowlines will be installed, cleaned, gauged, flooded and hydrotested. The flowline spool between the pipeline and MOPU will be installed and the flowline leak tested. For the flowlines, it is unknown at this time whether the fluid will be discharged at the MOPU location or at the individual wellhead locations. This will be determined during detailed design.

All water introduced into the line will be filtered to 50 microns. During filling, cleaning, gauging and hydrostatic testing, chemical inhibition package(s) will be continuously injected into the seawater. The chemical inhibition package may include: dye to aid in the detection of leaks; a biocide to control marine organisms and sulphate reducing bacteria; a corrosion inhibitor; and a dissolved oxygen scavenger to minimize corrosion on the interior of the pipeline. During the filling cycle, some spillage of this water may occur at the pig receiving station offshore. This occurs when excess hydrostatic water is required to push the pig into the pig receiver at the end of the pipeline.

A study, consisting of two components, will be undertaken to confirm predictions there will be minimal effects of the selected chemicals discharged into the environment. A toxicity bioassay program and a water dispersion study (first study component), will be undertaken prior to discharging hydrotest water. The bioassay will employ samples of the proposed chemical diluted in seawater to emulate the mixtures of chemicals and concentrations proposed for the hydrostatic test program. The purpose of the study is to ensure the release of any deleterious substances can meet the No Observed Effect Concentration (NOEC). Standard North Sea practice is to ensure the maximum toxicity will not exceed 1/100 of the 96 hour LC₅₀. The parameters and scope of the bioassay study will be submitted to regulators for review to ensure the proposed methodology meets accepted scientific criteria. The results will then be applied in a plume dispersion model (second study component) to confirm that there will be minimal effect to the marine environment around the platform.

The onshore section of the pipeline will also require hydrostatic testing, which may be conducted concurrently with the offshore section of the pipeline as discussed above, using the same seawater source and treatment chemicals. Should the schedule of the onshore section of the pipeline installation be changed, then a separate hydrostatic test may be required. Under this circumstance, the hydrostatic test water could be left in the onshore pipeline until the offshore testing is completed and the hydrostatic test water discharged with the offshore hydrostatic test water.

2.4 Operations

2.4.1 Production

The production facilities on the MOPU will be operated to optimize production while maintaining environmental protection, high safety standards and minimizing environmental impact. The production facilities will operate and be staffed on a 24-hour basis. Facility maintenance and inspection requirements will be managed through a maintenance management system that will incorporate proactive and predictive methods as well as intelligent condition monitoring techniques.

Production facilities will consist of equipment for separation, metering, amine sweetening, acid gas injection, dehydration, hydrocarbon dewpoint control (M&NP Option only), produced water treatment and disposal, condensate treatment, condensate injection (M&NP Option only), feed gas and export gas compression, and utilities.

For the M&NP Option, all production and treatment facilities are located offshore. For the SOEP Subsea Option, production and treatment facilities are primarily located offshore but the export gas and liquids will be routed to the existing SOEP facilities near Goldboro and, subsequently, Point Tupper for further processing.

For the M&NP Option, the export gas will be “on specification” sales gas meeting the hydrocarbon dewpoint and water content requirements for the M&NP pipeline. As a result, there is no onshore treatment required. Onshore facilities are related to metering/quality measurement and isolation valve requirements only. The liquids will be treated offshore and used as fuel. Currently it is estimated that there will be no surplus condensate produced beyond fuel usage. To allow flexibility in times of maintenance and/or operational issues, condensate can be commingled with the acid gas and re-injected for disposal.

For the SOEP Subsea Option, the export gas and condensate will be commingled and routed to the SOEP 660 mm pipeline and then to the existing SOEP Goldboro gas plant. At Goldboro, the gas and liquids will be separated and the gas further processed into sales gas by SOEP and shipped via the existing M&NP pipeline to market. The liquids will be routed to the SOEP Point Tupper liquids plant for processing and sale.

Separation

The well fluids will be processed through the production or test separator for separation of the gas, condensate, and water.

Amine Sweetening

The amine sweetening system is designed to remove the H₂S and CO₂ contained in the raw gas; which results in a waste acid gas stream. The H₂S content of the raw gas during the life of the Project will vary.

The Deep Panuke gas contains up to 3.5 mole % CO₂ and approximately 1,800 ppm H₂S. The amine sweetening unit is designed to be fed with gas that contains up to 2,500 ppmv of H₂S and up to 3.5 mole % CO₂ to provide some operational design flexibility. The sales gas specification requires the H₂S content to be a maximum of 6 mg/m³ (approximately 4 ppmv) and 3.0 mole % CO₂. The current design basis unit outlet is for an H₂S level of 2 ppmv and CO₂ at 2.8 mole %. Although the M&NP Option is the only option producing sales gas, the same product specification requirements will be met for SOEP Subsea Option as the SOEP facilities require a sweet feedstock.

The amine-sweetening unit is based on physical absorption using a solvent to absorb the impurities (H₂S and CO₂). The process is a closed loop system, in which the amine is continuously circulated through the absorber/contacter to pick up the impurities, then routed to a regenerator to release the impurities absorbed. Remaining CO₂ and H₂S amounts not removed during the amine sweetening process remain in the sales gas, which is sent to market.

The amine solvent used in the sweetening unit will be methyldiethanolamine, which will improve the selectivity between H₂S and CO₂ absorption. The cyclic process can result in a build-up of impurities in the amine solvent over time. If the amine solvent requires a change, whether complete or partial (dilute out the impurities), it is removed from the process and shipped to shore for reclaiming (manufacturer to clean and recycle). Production will be halted when a complete change-out of amine solvent is required. The change-out of the amine solvent will be subject to the EPP.

Acid Gas Handling

Acid gas from the amine regenerator will be compressed to approximately 15,100 kPa (from a feed pressure of 150 kPa) using a multi-stage compressor. Water condensing between the compressor stages will be recycled back to the processing facilities. The compressed acid gas will be injected into a suitable, subsurface reservoir. Table 2.7 describes the design flow and composition for the acid gas injection system.

The Project has the capability to flare acid gas, providing operational flexibility in times of maintenance and/or operational issues.

Table 2.7 Acid Gas Injection System – Composition and Flow	
Description	Design Data
Mass Flow (kg/h)	8100
STD Gas Flow (m ³ /hr)	5325
Molar Flow (kgmole/hr)	230
Pressure (kPa)	150
Temperature (C)	56
<i>Component Mole %:</i>	
CO ₂	63.2
H ₂ S	18.5
CH ₄	17.0
C2 ⁺	1.1
H ₂ O	0.24
Note: The flow represents the total feed to the acid gas management system including acid gas from the amine system and H ₂ S removed from the condensate fuel for the Mean Production Profile (Mean denotes the statistical Mean value of a probability distribution).	

Dehydration

Sweet gas from the amine-sweetening unit contains water that must be removed prior to hydrocarbon dewpoint adjustment (M&NP Option) or prior to export (both options). The gas dehydration unit is a liquid desiccant process utilizing a solvent to absorb the water. The solvent, triethylene glycol (TEG), is then regenerated via heating to release the absorbed water. The process is cyclic in which the TEG is continuously circulated through the absorber/contacter to pick up the water then routed to a regenerator to release the water.

Hydrocarbon Dewpoint Control

For the M&NP Option, the dehydrated gas from the TEG system is cooled by dropping the pressure of the gas. A portion of the gas stream condenses (condensate), which is then separated. This step will be done offshore as it is necessary to satisfy pipeline gas specification requirements.

For the SOEP Subsea Option, the export gas routed to the SOEP 660 mm pipeline need not meet sales gas specification requirements. For these cases, hydrocarbon dewpoint control operations will be done via the SOEP gas plant existing facilities.

Condensate Treatment for Fuel

Recovered condensate will be treated via stabilization to remove light ends and H₂S. The light ends and H₂S thus released are recycled back to the raw gas stream for processing.

For the M&NP Option, condensate is burned on the MOPU as the primary source of fuel. Operation of the condensate stabilizer will remove H₂S in order to minimize air emissions and to produce a fuel meeting the turbine driver requirements. The facility is expected to produce less condensate than that required for fuel thus no surplus condensate will exist for the M&NP Option. Given that the amount of condensate is a function of raw gas rate, which will decline over the life of the project, it will be supplemented with natural gas as necessary to maintain adequate fuel levels.

Under the SOEP Subsea Option, all recovered condensate will be routed to the shore based SOEP facilities for separation, processing, and sale.

The MOPU will have storage capacity for approximately 55 m³ of condensate, representing approximately five hours of consumption at full rate. The intent of this storage is to cover periodic production upsets with enough time to allow for short term troubleshooting and/or swinging fuel from condensate to either fuel gas or diesel. The storage tank is pressurized with inert gas with excess routed to the flare.

For the M&NP Option, it is estimated that there will be no surplus condensate produced beyond fuel usage; however, the ability to inject condensate down-hole with the acid gas stream provides operational flexibility in times of maintenance and/or operational issues. The probability of the acid gas injection well malfunctioning and becoming inoperable is very low (<1%). Any maintenance work for the well will be scheduled during planned shutdowns. If the injection well becomes unavailable at any time, additional condensate can be consumed through the operation of "spare" fired turbine equipment.

There is no capability to flare condensate with this Project.

Produced Water Treatment and Disposal

Water produced with raw gas and separated during the initial stages of processing is called produced water or formation water. This water contains residual hydrocarbons and other contaminants that must be reduced to an acceptable concentration prior to ocean discharge.

Table 2.8 indicates the P10 (value at the 10th Percentile) basis for produced water production. This water production forecast is a reasonable maximum water rate for the facilities.

Year	Cumulative Water Production (10³ m³)	Water Production (10³ m³/day)
0	0	0
1	180	0.5
2	1,000	2.4
3	2,900	5.3
4	5,200	6.4
5	7,500	6.4
6	9,700	6.4
7	12,000	6.4
8	14,300	6.4
9	16,500	6.4
10	18,800	6.4
11	21,100	6.4
12	23,300	6.2
13	25,300	5.8
14	27,300	5.5
15	29,400	5.8
16	31,300	5.5
17	33,100	5.0
18	33,500	1.2

The expected water composition is provided in Table 2.9 based on produced water samples taken at the Margaree F-70 well.

Component	Abenaki 5 Formation Water (mg/l)
Na ⁺	29,163
K ⁺	513
Ca ²⁺	5,885
Mg ²⁺	950
Ba ²⁺	8
Sr ²⁺	448
Fe ²⁺	0
Mn ²⁺	0
Cl ⁻	55,321
HCO ₃ ⁻	731
CO ₃ ⁻	0
SO ₄ ²⁻	1,570

EnCana also provided information on condensate which was tested at the Margaree D-70 well. Calcium was present at approximately 0.4 ppm by weight, while tin, lead, copper, aluminium, silicon, iron, chromium, silver, zinc, magnesium, nickel, barium, calcium, vanadium, phosphorus, molybdenum, boron, and manganese were all found to be below detectable limits (see EnCana's response to Information Request EC-ECA-1.2 (c)).

EnCana has stated that the above information reflects the only analysis available at this time. In particular, petroleum hydrocarbon concentrations (dispersed and dissolved) were not provided, however EnCana confirms that its target is to treat produced water to a dispersed oil concentration of 25 mg/L (30-day weighted average). It should be recognized that Berry and Wells (2004) estimated the typical concentration of the most abundant dissolved hydrocarbons in produced water as follows:

Group	Chemical	PW concentration (µg/L)
Aromatic Hydrocarbons	Benzene	80-4,300
	Toluene	80-2,560
	Ethylbenzene	20-100
	Xylene	13-720
Polynuclear aromatic hydrocarbons	Naphthalene	5.3-1000
	Anthracene	0-21.7
	Phenathrene	0-30

The RAs will consider this information as part of their analysis, in the absence of complete compositional data. It is recognized, however that this composition may be different than produced water in the Deep Panuke reservoir. The following is a brief description of the treatment process.

Prior to discharge, produced water is treated in several ways. Water from the inlet separator, test separator, condensate stabilizer surge drum, and stabilizer feed filter coalescers is commingled and routed directly into the produced water feed drum. Water from other LP vessels is typically routed to the closed drains header, which is routed to the LP flare drum. Liquids from the LP and high-pressure (HP) flare drums are routed to either the inlet or test separators.

The function of the water feed drum is to hold produced water until sufficient volume is available to route it to the hydrocyclones. The small amount of gas from this drum is routed to the acid gas injection compressor. At the start of the field life, the water rates are anticipated to be very low, such that batch processing in the hydrocyclones is likely. As the water rates increase, the flow will be continuous.

The hydrocyclones will remove all but trace (anticipated to be less than 30 mg/l) amounts of dispersed hydrocarbons. The hydrocyclones oil outlet is routed to the closed drains. The water is continuously routed to cartridge-style produced water polishers to reduce trace amounts of dissolved hydrocarbons.

The water is then heated in the produced water stripper feed preheaters prior to entering the produced water stripper. The amount of heat will be adjusted to aid in the H₂S removal capabilities of the stripper tower. The produced water stripper tower is a packed counter current gas/liquid stripping column in which sweet fuel gas flows upwards counter current to

the water to remove H₂S; preliminary indications suggest that H₂S will be lowered to a concentration between 1 to 2 ppmw. The gas from the stripper is routed to the acid gas injection compressor.

The flow to the stripper column will change dramatically over the field life. It may be necessary to provide flow via recycle or process in batches during low flow periods.

The water outlet of the stripper is sampled for oil and H₂S and routed overboard. The waste gas from the produced water stripper will be routed to the acid gas injection compressor for injection. This will be the normal mode of operation. The plant does have the capability to divert the produced water stripper gas to the flare in the event of a malfunction of the acid gas injection well and/or compressor. If the produced water stripper gas were flared, it would be a maximum of 980 kg/h of 19.7 MW gas containing 1.5 mole % H₂S.

The concentration of methyldiethanolamine (amine) and TEG in the produced water depends on a number of factors including: the unit (gas sweetening and gas dehydration) throughput/circulation rates, the unit operating conditions, the unit mechanical design, the MOPU produced water rate, and the MOPU seawater discharge rate from the cooling medium system. Quantitative estimates are not available at this time based on the current level of design, however, the carryover of both TEG and amine will be proportionally less than in the approved 2002 CSR (the typical concentrations estimated were 40 to 75 ppm of amine with a high of 400 to 500 ppm in the first year, and 30 to 60 ppm of TEG, with a high of 350 to 400 ppm in the first year) given the MOPU capacity has been reduced from 11.3 x 10⁶ m³/d to 8.5 x 10⁶ m³/d. In addition, studies on the eco-toxicity of methyldiethanolamine and TEG, undertaken by the manufacturers, indicate that these substances are of low toxicity to fish and invertebrates in the concentrations present in the produced water discharge and that these substances are readily bio-degradable (Woodburn and Stott, undated). Material Safety Data Sheet information for methyldiethanolamine also indicates that it is of low toxicity to marine species (growth inhibition EC50 for marine diatom *Skeletonema costatum* is 73 mg/L and acute LC50 for marine copepod *Arcatia tonsa* is 84 mg/L) (DOW Chemical Canada Inc, 2000).

EnCana's current design envisages platform-based laboratory facilities for verification of produced water measurements. To ensure timely and effective compliance monitoring the CNSOPB will require EnCana to have platform-based laboratory facilities, unless EnCana is able to demonstrate an alternative means of providing reliable and timely results.

The produced water will be routed overboard via the discharge caisson where it will mix with approximately 2,400 m³/hr of seawater from the cooling system.

Compression

For the M&NP Option, the sales gas will be compressed on the platform for delivery to shore. The expected sales gas discharge pressure on the platform is approximately 13,000 kPa. The Deep Panuke compressor system is composed of three 7 MW units. The compressors will be used for sales gas export and feed gas. The feed gas service will be to account for declining reservoir pressure. These compressors will be tri-fuel (condensate, fuel gas, and diesel).

For the SOEP Subsea Option, the export gas will be compressed on the platform for delivery to the existing SOEP 660 mm pipeline and subsequently routed to shore. The

expected export gas discharge pressure on the platform and the compressor system will be the similar to the M&NP Option. These compressors will be dual-fuel (fuel gas and diesel).

2.4.2 Utilities

Electrical Power Generation

Electrical power generation for the Deep Panuke MOPU will be provided by multiple redundant fuel turbine generating sets. For the M&NP Option, the turbines will be tri-fuel (condensate, fuel gas, and diesel). For the SOEP Subsea Option, the turbines will be dual-fuel (fuel gas and diesel). For the first production start-up, sufficient quantity of diesel will be available for power generation. Emergency power will be provided by a diesel engine driven generator set as per CNSOPB regulations.

Diesel will be transferred from ships to the MOPU storage tanks via loading hose. Bulk transfer/hose-handling procedures will be outlined in the EPP.

Battery back-up power will be provided for critical emergency services.

Platform Fuel

For the M&NP Option, condensate will be used as fuel. Supplemental fuel may also be used, as required. For the SOEP Subsea Option, fuel gas will be the primary fuel source. Diesel will be used as fuel for the crane and the emergency generator. Diesel will also be used for start-up and shutdown of the compressor and power generation turbines. The MOPU will have a diesel storage capacity of approximately 70 m³. The storage area will be dyked to collect diesel fuel in the event of a leak/spill. The dyked area will be routed to the open drains system within which the hydrocarbon is recovered. All fuel will be metered.

Heating Medium System

The processing facilities require heat input for a number of systems including amine regeneration, TEG regeneration, condensate stabilization, and produced water processing. The heating system is a “closed circuit” system in which a heating medium (essentially the same solution as per the cooling medium except it contains some stabilization additives) is pumped through waste heat recovery units (WHRUs). There are three WHRUs, one installed on each turbine exhaust of the compressors. The heating medium, circulating through the WHRUs, extracts heat that would be destined as waste to ambient and routes it to various users.

Cooling Medium System

Cooling water for process and utility systems will be done via an indirect seawater/cooling medium system. Seawater will be pumped through a filter then a heat exchanger. The exchanger will cool a mixture of ethylene glycol and water (cooling medium). The cooling medium will then be distributed to the equipment requiring cooling. The once-through seawater is returned to the ocean via the discharge caisson.

Deck Drainage

Deck drainage will be collected and treated according to the OWTG (NEB *et al.* 2002). Drainage from equipment areas on platforms will be directed through a header system to a collection tank to an oil/water separator treatment unit on the MOPU. Petroleum hydrocarbons and sludge in the oil/water separator will be transferred into containers for shipment to shore for disposal. The water from the oil/water separator will be treated using a cartridge-style water polisher and tested prior to discharge to ensure compliance with the discharge criteria of 15 mg/L or less.

The deck drainage system does have overflows to permit water to be routed directly overboard in the event of a deluge event or rain water in excess of the design condition. The open drains design is based on a water input rate of 166.1 mm/day over the entire collection area which is the 100-year environmental design criteria for a rain event. The system will remove hydrocarbons to at least the 15 mg/L limit prior to discharge for any event up to and including a 100-year event. Water in excess of the design rate is only anticipated to occur during a deluge event. The open drain collection system will be cleaned and maintained to limit exceedence of the 15 mg/L limit in deluge events.

Relief and Blowdown System

Safety systems and devices will be designed to meet Project standards and the requirements of all applicable standards, codes, and local regulations, including: API B31.3 – Piping; API 14C – Cause and Effects; API 520, 521 – PSV's/Rupture Discs; IEC 61508 – Functional Safety System; ANSI/ISA-84.01-1996 – Safety Instrumented Systems; NFPA 72E – Automatic Fire Detectors; and NORSOK-1-002 – Safety and Automation System.

The principal elements of the relief and blowdown system include the pressure relief devices, flare piping system, flare separator, flare structure and the flare burner. Application of all relevant codes will be followed for the system design. The system will be designed considering emergency shutdowns, blocked discharges, fire exposure, tube rupture, control valve failure, thermal expansion and utility failures.

Scheduled activation of the relief and blowdown system will occur for planned tests and inspection or maintenance work. When the system is commissioned and activated, hydrocarbons will be safely directed to the flare system. The flare will be designed to prevent any impact on the helideck and the living quarters during worst-case weather scenarios.

Facility Gas System

The Project will include an inert gas system. Inert gas is necessary for commissioning and start-up activities as well as ongoing operations. The main use of the inert gas is in the gas compressor seals. The inert gas may also be used as a blanketing or purging gas to displace hydrocarbon vapours and reduce the risk of explosion and fire.

Instrument air will be produced by electric driven air compressors and used in the instrumentation and controls system.

A breathing air system will be included in the design of the Project. Breathing air will be required for emergency purposes and for routine maintenance activities.

2.4.3 Support and Servicing

Supply vessels and helicopters will be used to supply personnel, fuel, food, well equipment and other materials required to maintain construction work and production operations. Typically, helicopters will be used for regular crew changes, visits from regulatory agencies, service personnel and other visitors that need to be transported to and from the offshore facilities.

Support Vessels

Supply vessels will be used to provide the platform operations with materials necessary for development and production operations. Supply vessels will hold liquid drill mud, drill water, potable water, barite (weighting material), fuel, cement, bentonite (fresh water gel), drill pipe, casing and other equipment necessary for well construction activities and production operations. It is anticipated that supply vessels will make periodic round trips from a dockside shorebase in Nova Scotia to the platform operation between two and four times a week during normal operations. It is anticipated that there will be approximately six trips a week during construction and heavy maintenance periods. In addition, a standby vessel is required near the platform at all times as per CNSOPB regulations.

Helicopters

Personnel will be transported to and from the MOPU via helicopters from the heliport located at the Halifax International Airport. During pipelay and heavy lift activities, the frequency of helicopter activity is estimated to be two to three trips per week. During hook-up and commissioning, the frequency is estimated to be seven to ten trips per week. The frequency will reduce to approximately six to ten flights per month during normal operations. Helicopters are used primarily to transport crew members, company personnel and service personnel. In some cases, helicopters will also transport small equipment and parts.

2.4.4 Project Safety Zones

EnCana will consult with the appropriate regulatory authorities to develop a safety zone around the Deep Panuke facilities in accordance with the *Nova Scotia Offshore Petroleum Drilling Regulations* and the *Nova Scotia Offshore Area Petroleum Production and Conservation Regulations*. This zone will include, as a minimum, an area extending in a 500 m radius around the MOPU and will likely include the interfield flowlines and wellheads. The exact configuration of the safety zone will be determined based on safety risk assessment studies and consultations with the regulatory agencies. There will also be a temporary 500 m safety zone around the drilling rig when it is on location for development drilling. A Notice to Mariners will be issued and appropriate mariner charts will be updated for the installations through the Canadian Hydrographic Service.

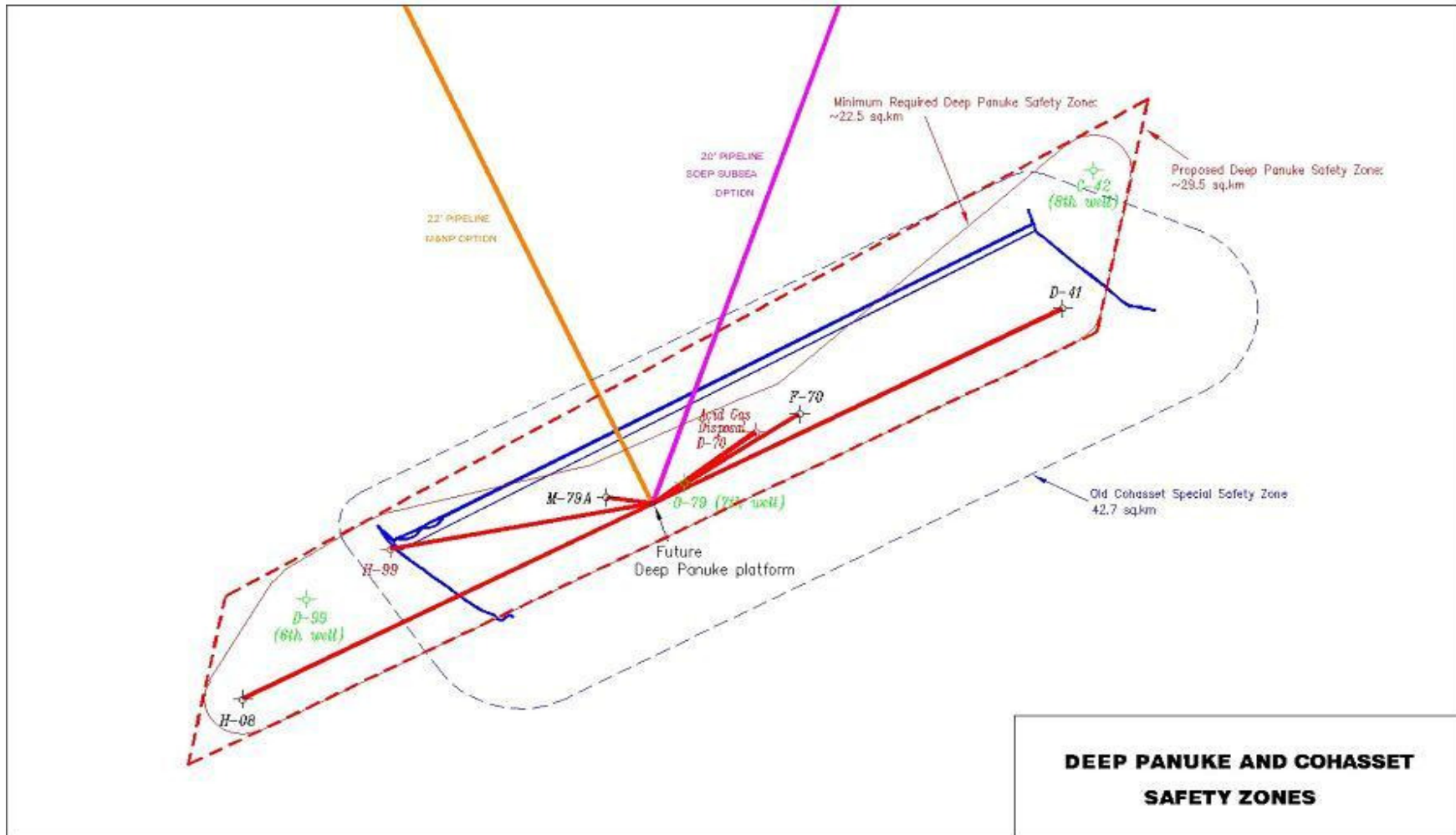
In December 2006, EnCana met with Transport Canada to discuss the safety zone. The proposed largest foreseeable safety zone was adjusted to a regular shape (trapezoid), which covers an area of approximately 29.5 km². This scenario is illustrated in Figure 2.7.

Standard operating procedures will be developed to lessen the risk of collisions between ships and Project infrastructure. These would include the following: presence of structures and safety zones would be indicated on nautical charts; Coast Guard Notice to Mariners would apply during construction; and radio operators would notify approaching vessels of the presence of the structures.

For activities of the pipelaying vessel, EnCana will request the Coast Guard issue a Notice to Mariners with regard to this temporary construction activity. Mariners will be informed as to the status of the pipelaying operation and the vessels taking part in the activity.

EnCana will be required to communicate directly with commercial fishing representatives that work in the area, to inform these groups of the planned dates and locations of construction equipment and activities.

Figure 2.7: Proposed Largest Foreseeable Safety Zone



The export pipeline's design takes into consideration fishing activity in the area so that once the pipeline is laid, there will be no restrictions with regard to safety zones over the pipeline although there will be fishing restrictions over the subsea connection to the SOEP pipeline for the SOEP Subsea Option. As with the installation and interfield flowlines, nautical charts will be updated for the export pipeline through the Canadian Hydrographic Service.

2.4.5 Onshore Facilities

In addition to the onshore pipeline, other onshore facilities will include a pig launcher/receiver facility (for cleaning and inspection of the pipeline) and a safety/emergency shutdown valve system. Periodic mechanical, electrical, instrumentation and general housekeeping maintenance will be performed. For example, valves, piping, or general lighting will require routine maintenance. Site visits will take place periodically.

EnCana will take care to avoid use of invasive species in post-construction re-vegetation and will place a clear priority on the use of native species. Vegetation management will be conducted mainly by mechanical means and will be confined to the RoW. Herbicide use will be restricted to valve sites and meter stations and will involve low application rates of compounds with low persistence and low ecological toxicity. Herbicides will not be used within close proximity (e.g., 30 m) of watercourses or wetlands.

2.5 Decommissioning and Abandonment

The mean production life of the Project is anticipated to be 13.3 years; however, the resource forecast show a probable production life ranging from 8 to 17.5 years. The design life is 20 years for the topsides and 25 years for the remaining Project structures. As is common in the industry, facility life could be extended beyond 20 years with appropriate technical and maintenance activities in the event reservoir productivity or additional resources prolong the life of the Project.

The following facilities will require decommissioning and abandonment:

- MOPU;
- subsea production and injection wells;
- subsea facilities;
- offshore gas export pipeline;
- onshore pipeline (M&NP Option only); and
- onshore facilities (M&NP Option only).

Decommissioning and abandonment of these facilities will be performed in accordance with the regulatory requirements applicable at the time of such activities.

EnCana's proposed decommissioning and abandonment activities which are detailed below are in-line with current standard industry practice. Any environmental effects associated with the abandonment phase of the project are likely to be similar to those caused by the construction phase.

Offshore Platform and Associated Infrastructure

Although technology, regulations, and accepted industry best practices potentially could change prior to the time of decommissioning and abandonment, current practices require a regulatory review prior to decommissioning that would typically result in the offshore facilities degassed, degreased and cleaned to applicable standards with the MOPU being towed to another location for re-use or retrofit (if economically feasible), and the wells abandoned and conductors cut below the seafloor.

Offshore pipeline, flowlines and umbilicals would be flushed, cleaned, and abandoned in place. This practice has been accepted in other jurisdictions, such as the United Kingdom, subject to the results of a detailed comparative analysis of feasible options. .

Onshore Facilities and Associated Infrastructure

With the exception of the pipeline, onshore facilities would be removed and the land restored in accordance with applicable regulations. Buried onshore pipelines would be flushed, capped, and abandoned in place. The onshore pipeline RoW would be allowed to return to a natural state.

Applications

EnCana's regulatory application includes provisions to abandon the pipeline, flowlines and umbilicals in-situ.

Pursuant to the NEB Act, an application would be required to abandon the facilities under NEB jurisdiction, at which time the environmental effects would be assessed by the NEB (further information is available in Section 5.2.2 of the Joint Environmental Report). Similarly, pursuant to Section 142 of the Accord Act, the CNSOPB would require an application be submitted to decommission and abandon the Deep Panuke facilities including the pipelines, flow lines and umbilicals. The environmental effects would be assessed during this process based on environmental programs and studies submitted by the proponent.

Decommissioning Plan

As part of the applications, a Decommissioning Plan will be submitted by EnCana to the appropriate regulatory authorities for approval prior to commencement of decommissioning and abandonment activities. EnCana states that this Plan will include a full review of options for the decommissioning and will be developed in consultation with key stakeholders, including fisheries interests. Such a plan should also include attention to the following elements:

- Follow-up and lessons learned (revisiting impact predictions set out in the planning-phase EA, and updated through the follow-up/EEM);
- Waste management and minimization (placing a priority on reuse and recycling, and management of any residual contaminants);
- Minimizing energy use; and
- Respecting the applicable regulatory regime (e.g., applicable federal and provincial legislation governing the management of dangerous goods and hazardous wastes).

Project Design

EnCana will also take into account requirements for eventual removal of facilities during detailed design. The Project should be designed so that it may be decommissioned in a manner that minimizes impacts to the marine environment. This can include designing Project components so that they are easily removed or recovered and reused rather than having to be unnecessarily abandoned on the seafloor (e.g., zinc anodes).

2.6 Project Schedule

Project regulatory approval is anticipated in the third quarter of 2007. Assuming approval and after contract awards, the Project will engage in detailed engineering and procurement. Subsequent onshore fabrication at existing facilities will occur prior to installation offshore.

Hull and topsides fabrication is scheduled to commence third quarter 2008, with the MOPU hull and topsides ready for at-shore integration first quarter 2010. Wells will be constructed and completed with a separate mobile offshore drilling unit between 2008 and 2010.

It is anticipated that the onshore and offshore sections of the export pipeline will be constructed either in 2009 or 2010. The tie-ins to the MOPU and to either the M&NP facilities or to the SOEP pipeline will be completed after the MOPU and the export pipeline installation is complete. Hook-up and offshore commissioning activities will commence third quarter 2010 once the MOPU has been transported to the field centre. First gas is anticipated to be produced in the fall of 2010.

2.7 Emissions and Discharges

EnCana will be required to adhere to the OWTG (NEB *et al.* 2002) and all applicable regulations for emissions and waste management. Where no standards exist, best industry practice will guide the regulators and EnCana. EnCana will minimize, to the extent practical, both the volumes of wastes being discharged and the concentration of contaminants entering the environment. A Waste Management Plan (WMP) (included in the EPP) will be developed for the Project that will address all phases of the Project including construction, installation, operation, decommissioning, and abandonment. The goal of this plan is to minimize offshore wastes, discharges, and emissions and specify appropriate mitigative measures.

Estimated quantities of wastes, discharges, and emissions that will be generated for both the construction/installation/drilling and production/operation phases of the Project are summarized in Table 2.10. The table also includes summary descriptions of the characteristics of the waste or emissions.

Table 2.10 Routine Project Emissions/Effluents			
Type	Emission/Effluent	Estimated Quantity	Characteristics
<i>Construction/Installation/Drilling</i>			
Atmospheric Emissions	Generator, engine and utilities exhausts	Temporary, minor	CO ₂ , CO, SO ₂ , NO _x , PM, VOC
	Flaring during well clean-up and completion	Expected ~1/2 day per production (new and re-entry) well, unless otherwise required by operating requirements.	Possible NO _x , CH ₄ , PM, SO ₂ , CO ₂ , H ₂ S, CO, VOC
Drill Waste Discharges	WBM	Bulk surface release of approximately 700 m ³ of WBM for production well; 600 m ³ for injection well. WBM on cuttings is expected to be 244 m ³ for each production well and 233 m ³ for injection well.	Anticipated composition provided in Table 2.5
	WBM associated cuttings	Approximately 558 m ³ of WBM associated cuttings discharged for each new production well to be drilled; 487 m ³ for injection well.	Rock cuttings coated with WBM
	Completion brine	Approximately 1000 m ³ of completion brine will be discharged at the surface for each new production well to be drilled; 300 m ³ for each well re-entry and the injection well completion.	Water-based brine, with additives including corrosion inhibitors, oxygen and H ₂ S, bactericide, caustic soda

Table 2.10 Routine Project Emissions/Effluents			
Type	Emission/Effluent	Estimated Quantity	Characteristics
Liquid Effluent for Ocean Discharge	Sanitary and food waste	Maximum capacity of the facility during operation is approximately 68 persons with an estimated volume of 20 L per person per day; amounts will increase during construction phase with increased presence of vessels and crews.	Macerated food, grey water and sanitary waste
	Deck drainage	As generated	Possible oily water with some particulate matter
	Bilge/ballast water (Construction/Support vessels)	As required	Water with hydrocarbons
	Hydrostatic test fluids (Pipeline commissioning water)	47,240 m ³ (over several days) see Section 2.3.4 for more details.	Seawater containing biocide and corrosion inhibitors
Solid Waste	Miscellaneous solid wastes (transported to shore)	As required	Construction materials, broken equipment components, packaging and shipping materials, damaged containers and general debris and refuse associated with construction
<i>Production/Operation</i>			
Air Emissions	Maximum continuous flaring (acid gas during routine maintenance)	2% of the time at a flare rate of 90,000 kg/hr	H ₂ S, SO ₂ , NO _x , PM, CH ₄ , CO, VOC, CO ₂

Table 2.10 Routine Project Emissions/Effluents			
Type	Emission/Effluent	Estimated Quantity	Characteristics
	Routine flaring, compression and power generation	98% of the time at a flare rate of 490 kg/hr, power generator (x2) rate of 2.18 g/s and compressor (x3) rate of 4.37 g/s	SO ₂ , NO _x , CO, PM, VOC, CH ₄ , CO ₂
Liquid Effluent for Ocean Discharge	Produced water	refer to Table 2.8	Hydrocarbon, H ₂ S in water (sour water)
		Cooling water	2,400 m ³ /h
	Deck drainage	Pump capacity is 150 m ³ /h	Rain and deluge water, may contain oily water with some particulates
	Bilge/ballast water	As required	Water with hydrocarbons
	Well treatment fluids/ Well completion and workover fluid	As required	Well completion fluids described above
	Water for fire control systems	As required	Excess deck drainage water
	Desalination brine	13 m ³ /hr	Estimated salinity of 35-40 ppt
	Waste production fluids and by-products	As required	Waste residues in the production system including oily sludge, scale, filters and filter residues and chemical wastes
Hazardous Liquids for Onshore Disposal	Miscellaneous liquid waste	As required	Domestic liquid waste
Solid Waste For Onshore Disposal	Miscellaneous solid waste	As required	Domestic solid waste and non-hazardous solids such as packing material

2.7.1 Air Emissions

The sources and types of emissions to air during routine Project construction and operation will include the following:

- exhaust from supply and stand-by vessels, and aircraft;
- short-term flaring of the produced fluid from production wells during clean-up;
- exhaust from machinery on the drill rigs and MOPU (*e.g.*, generators and compressors);
- fugitive emissions (*e.g.*, emission of volatile organic compounds from valves, filter changeouts, storage of hydrocarbons, lubricant spills);
- emissions associated with processing operations including continuous flaring for processing by-products from TEG and produced water treatment systems; and
- flaring of the full acid gas stream during routine maintenance of the acid gas management system (approximately 2% of operating time).

The specific emission types that would likely be associated with the Project include sulphur dioxide (SO₂), hydrogen sulphide (H₂S), nitrogen oxides (NO_x), volatile organic compounds (VOC), carbon monoxide (CO), carbon dioxide (CO₂), methane (CH₄), some trace products of incomplete combustion and particulate matter (PM). A further description of routine air emissions, including generation rates, is presented in Tables 2.10 and 2.11. Emission estimates are available for mobile sources in the 2002 CSR.

Table 2.11 Description of Emission Types Likely to be Associated with the Project and the Applicable Federal/Provincial Regulations, Standards and Agreements		
Emission Type	Effect	Regulation/Standard/Agreements that apply either directly or indirectly
SO₂	Contributes to acid rain Precursor to PM _{2.5} formation Air pollutant with direct health effects	a-g
H₂S	Air pollutant with direct health effects	f
NOx: NO₂ and NO	Contributes to acid rain Precursor to ground level ozone Air pollutant with direct health effects	a-g
VOC	Precursor to ground-level ozone	b, c
CO	Air pollutant with direct health effects	a, d, f
PM (TSP, PM_{2.5}, PM₁₀)	Air pollutant with direct health effects	a for TSP, b for PM ₁₀ , c and g for PM _{2.5}
CO₂	Contributes to climate change	b, h
CH₄	Contributes to climate change	b, h
a. CEPA 1999 National Ambient Air Quality Guidelines b. CEPA 1999 Schedule 1 Toxic Substances c. Canada Wide Standards d. CCME Guidelines for Stationary Combustion Turbines e. Air Quality Regulations of N.S. Environment Act f. N.S. Energy Strategy g. Acid Rain Plan (New England Governors and Eastern Canada Premiers) h. Climate Change Action Plan (New England Governors and Eastern Canada Premiers)		

It is also important to recognize that the federal government has issued a *Notice of intent to develop and implement regulations and other measures to reduce air emissions*. This Notice of intent, published in the *Canada Gazette* on October 21, 2006 (accessible at <http://canadagazette.gc.ca/part1/2006/20061021/html/notice-e.html#i3>), sets out the government's plan to develop and implement regulatory measures primarily, but not exclusively under CEPA, and as enabled by amendments set out in the proposed *Canada's Clean Air Act*. In this regard, the federal government intends to propose regulations to reduce emissions of air pollutants and greenhouse gases from key industrial sectors including chemicals production, upstream oil and gas, downstream petroleum, and fossil-fuel fired electricity generation.

Emissions of air contaminants (from normal operating/maintenance and accidental/malfunctions conditions) were estimated for both the M&NP and the SOEP Subsea Options. These estimates are summarized in Section 9.4, as part of the assessment of impacts to air quality. Additional information may also be obtained from EnCana's

response to Information Request EC-ECA-1.2 (d) and 1.4, including a description of the methods and assumptions used in estimating air emissions.

In order to predict the dispersion and subsequent effect of air emissions, CalPuff and Screen3, standard air dispersion models were used to estimate the maximum ambient concentrations that would be expected from the project. These predicted concentrations enable both comparison with regulatory criteria, and the defining of potential effects boundaries. Modelling results and environmental effects associated with significant air emissions are discussed further in Section 9.4.

2.7.2 Noise Emissions

Noise emissions will mainly be generated offshore during pile driving, blasting, and drilling operations. Other noise generating activities will include ship and air traffic of materials and personnel to offshore facilities. Onshore noise will be limited primarily to construction of the pipeline and other onshore facilities. The discussion presented in the approved 2002 CSR regarding noise emissions (offshore and onshore) remains valid. An updated discussion on noise associated with pile driving is presented in Section 2.3.6.

2.7.3 Electromagnetic Emissions

The description of electromagnetic emissions presented in the approved 2002 CSR remains valid.

2.7.4 Drill Waste Discharges

Use of Drill Muds

All drilling fluids (mud) go through a cyclic process during the drilling of a well. Prior to drilling a specific hole section, the required type of mud must be prepared. Once the mud is ready for use, the drilling may begin for that hole section. The following describes the simple cycle that all drilling fluids follow:

1. the mud is pumped down the drillpipe to the bit on the bottom;
2. the mud comes out the bit and picks up the cuttings that the bit has produced and carries these cuttings back to the rig on the outside of the drillpipe;
3. once back on the drilling rig, the cuttings (solid materials) are separated from the mud using solids control equipment. Linear vibrating shakers plus periodic use of centrifuges are the main components of the solids control equipment used to separate solids (cuttings from the wellbore) from the drilling mud;
4. the clean mud returns to the original tanks for any minor modifications (additional products) before starting the cycle again; and
5. the cycle continues until the hole section reaches final depth.

Once the final depth of the hole section is achieved, the mud is cleaned for re-use on the next hole section or it is removed from the rig to allow for the next drilling fluid for the subsequent operation. Bulk mud releases will be minimized by re-using mud on the next hole section or well if possible. WBM will be released overboard during bulk releases. Spent WBM and associated drill cuttings will be discharged in accordance with the OWTG (NEB *et al.* 2002).

The conservative case of five new wells using WBM for all hole sections has been modelled with results presented in Appendix D of EnCana's EA report, and is discussed in the following subsection.

Drill Waste Discharge Behaviour and Modeling

When cuttings and mud are discharged, the fine materials in the discharge form a turbidity plume near the sea surface, but the bulk of the material (cuttings) drops to the seabed with the fine materials being stripped from the plume as it descends. Typically, a cuttings pile forms on the seabed near the discharge point. However, in high energy environments, like the Deep Panuke site, cuttings and fine particles and associated metals, such as barium, are more likely to disperse rather than settle (refer to Appendix D of EnCana's EA report).

Barite is typically used to increase the density of the drilling fluid. It is also used to build small volumes of high density slugs used to trip drill pipe out of the hole dry. Drilling fluids used for Deep Panuke wells will be salt-based and the density will be adjusted by increasing the concentration of salt in the drilling fluid. Therefore, the use of barite will be minimized and generally only used for the preparation of high density slugs to pull the drill pipe out of the hole dry.

Oceanographic plume modelling for discharge of mud and cuttings at sea was conducted for surface discharge of WBM. The modelling of drill mud and cuttings discharges is based on the assumed operational processes and volumes shown in Table 2.12. The total amount of cuttings and WBM are significantly smaller for the revised project than those considered in the 2002 CSR. In addition, for the new project, drilling wastes are going to be discharged at the site of each individual well being drilled instead of all released at the site of the field centre in the 2002 CSR. Modelling results of ocean disposal of drill waste discharges are presented in Appendix D of EnCana's EA report. Overall, smaller cutting piles and lower mud concentrations are to be expected for the new project than in the 2002 CSR.

Table 2.12 Deep Panuke Potential Drilling Waste Discharge Summary				
	Each New Production Well	One New Injection Well	Each Re-entry Production Well	Total Discharges
Seabed release of WBM associated cuttings (m ³)	131	131	0	656
Surface release of WBM associated cuttings (m ³)	427	356	0	2062
Seabed release of WBM on cuttings (m ³)	180	180	0	900
Surface release of WBM on cuttings (m ³)	64	53	0	309
Surface release of WBM (bulk mud release) (m ³)	700	600	0	3400
Surface release of completion fluid (m ³)	1000	300	300	5500
<p>Notes: All volumes are approximations that represent each well's discharges. Using a conservative approach to dispersion modelling, it is assumed four existing wells will be re-completed using completion fluid ("re-entry" production wells), and four new production wells and one new injection well will be drilled using WBM with overboard discharge. The completion fluid is a brine (NaCl) with various additives for oxygen scavengers, H₂S scavengers and corrosion protection in some cases. Prior to use, all chemicals will be screened using the CNSOPB Offshore Chemical Selection Guidelines.</p>				

2.7.5 Effluent Discharges

Produced Water

Produced water management is described in Section 2.4.1. Produced water will be treated to a target dispersed oil concentration of 25 mg/L (30-day weighted average). The OWTG specify a 30-day weighted average of 30 mg/L. Refer to Appendix D of EnCana's EA Report for results of produced water dispersion modeling. The results of the dispersion modeling are presented in Table 2.13 and the conclusions are considered conservative.

Distance from Discharge Site	Dilution (Discharge/Background Waters)	Temperature Anomaly (°C)	Salinity Anomaly (PSU)	Hydrocarbon Concentration (mg/L)	H₂S Concentration (ppmw)	Oxygen Concentration Relative to Background (%)
End of Pipe*	No dilution	25	6.25	2.8	0.2	0
Site (seafloor)	10:1	2.5	0.6	0.28	0.02	90
500m	70:1	0.4	0.1	0.04	0.003	98
1km	100:1	0.25	0.06	0.03	0.002	99
2km	400:1	0.06	0.02	0.007	0.0005	100

*End of the discharge caisson at a depth of 10 m

Cooling Water

The cooling system will use seawater to indirectly cool a circulating medium (40% ethylene glycol, 60% water (volume) solution). The cooling water flow rate will be constant at 2,400 m³/hr and will have a temperature approximately 15°C above background water temperature. It will be mixed with produced water before discharge.

The seawater is treated with chlorine to prevent/reduce the growth of marine biological growth. The design chlorine concentration at the seawater lift pump inlet is 2 ppm (1 ppm during normal operation with an increase during periods of high larval mussel concentration). The residual free chlorine concentration at the outlet will normally be below 0.25 ppm. The combined produced water and cooling water stream exit temperature will not exceed 25°C above ambient.

Deck Drainage

During construction and installation, prior to operation of the drains system, deck drainage will be discharged overboard. Deck drainage water might contain traces of petroleum hydrocarbons, such as lube oils, helicopter fuel, and diesel fuel. Every effort will be made to prevent chemical contamination on decks, which could be entrained into deck drainage. Storage areas for totes containing chemicals and petroleum products will have secondary containment to prevent discharge onto deck surfaces.

During the operation phase, deck drainage will be collected and treated according to the OWTG (NEB *et al.* 2002). Drainage from equipment areas on the topsides will be directed through a header system to a collection tank to an oil/water separator treatment unit on the MOPU. Petroleum hydrocarbons and sludge in the oil/water separator will be transferred into containers for shipment to shore for disposal. The water from the oil/water separator will be treated using cartridge-style water polishers and tested prior to discharge to ensure compliance with the discharge criteria of 15 mg/L or less. The deck drainage system does have overflows to permit water to be routed directly overboard in the event of a deluge event or rain water in excess of the design condition.

Any spills of petroleum products (or other chemicals) will be cleaned up immediately and any discharges overboard will be reported to the regulatory authorities. Spill kits will be located at strategic sites on the platforms, to remove petroleum products from deck surfaces. The used absorbent materials and any other oily wastes will be placed in sealed containers and returned to shore for treatment and disposal at an approved waste management facility.

EnCana will develop a Deep Panuke Emergency Management Plan (DPEMP) for the Project which will include a Spill Response Plan (refer to Section 5.3) that will be submitted to the CNSOPB for review and approval.

Other Ocean Discharges

Other ocean discharges (e.g., bilge/ballast, sanitary/food waste/testing waters, etc.) are summarized in Table 2.10 for the construction and operations phases of the Project. Each waste stream will be treated or managed in a manner that ensures compliance with applicable regulatory limits and EnCana's EPP.

The vessels to be used during construction and operation of the Deep Panuke Project may be mobilized from other parts of the world. The ballasting and de-ballasting of these vessels can introduce harmful aquatic organisms and pathogens to marine ecosystems. This has the potential to negatively impact marine benthos in the area. It can also contribute to the introduction of other types of ship-source contaminants. The primary method used to reduce the risk of invasive species introductions is the open ocean exchange of ballast water, as required in the Ballast Control and Management Regulations under the *Canada Shipping Act*.

2.7.6 Naturally Occurring Radioactive Material (NORM)

The description of NORM and appropriate management procedures presented in the approved 2002 CSR remain valid. Refer to Section 2.7.6 of the approved 2002 CSR.

2.7.7 Non-Hazardous Solid Wastes

The discussion of non-hazardous solid wastes presented in the approved 2002 CSR remains valid. Refer to Section 2.7.7 of the approved 2002 CSR.

2.7.8 Hazardous Materials and Waste

The discussion of management of hazardous materials and waste presented in the approved 2002 CSR remains valid. This includes, but is not limited to, commitments by EnCana to adhere to all applicable federal and provincial codes and regulations for the handling and transport materials. Refer to Section 2.8 of the approved 2002 CSR.

2.8 Environmental and Safety Protection Systems

2.8.1 Equipment Inspection and Maintenance

All Project equipment will meet the requirements of industry standards, and be certified as being safe and fit for its intended use. Purchase orders for such equipment will be suitably monitored during the manufacturing and testing processes for strict compliance to these

standards and to all applicable regulations as set out by the *Accord Act*. Where required, the Certifying Authority (CA) may provide additional surveillance. Once installed, equipment will be operated and maintained in accordance with documented processes and procedures. EnCana will submit inspection and monitoring programs, a maintenance program and a weight control program to the CA for approval. These regular inspection and maintenance programs will ensure continued equipment reliability and integrity. Subsea inspection programs allow for regular monitoring of critical subsea components such as pipelines.

As part of the maintenance of the Certificate of Fitness for the MOPU, the CA is required to conduct inspections and surveys during the operation phase of the Project (at least annually) to verify that installations are being operated in accordance with the approved programs noted above and provide further assurance that safety and protection of the environment are being upheld.

2.8.2 Pipeline Leak Prevention

In accordance with regulations as set out by the *Accord Act*, pipelines must be designed for: internal pressure containment; dropped objects protection; fatigue; spanning; and hook, pull or snag loads due to fishing activities. The pipeline will be designed to withstand impacts from conventional mobile fishing gear in accordance with the Det Norske Veritas (DNV) *RP-F111, Interference Between Trawl Gear and Pipelines*, October 2006. During the operational phase, inspections are carried out as part of the CA surveys to ensure that pipeline integrity is maintained.

Leak detection for the pipeline will be carried out by the use of mass balancing. This method uses process conditions at either end of the pipeline along with gas composition to calculate the mass entering the pipeline and exiting it. The M&NP custody transfer meter along with onshore instruments will be utilized to gather flow, temperature and pressure measurements. Similarly on the MOPU, the flow, temperature, and pressure will be used in conjunction with the gas composition to calculate the mass entering the pipeline. The onshore measurements along with the offshore gas composition will be used to calculate the mass exiting the pipeline. The mass entering and exiting the pipeline will be used to detect leaks.

In the event that a leak is confirmed, the pipeline has a series of shutdown valves that will isolate the pipeline from the M&NP pipeline and the MOPU to prevent additional hydrocarbons from entering the system.

2.8.3 Blowout Prevention Safeguards

There are many safeguards in place to prevent blowouts or uncontrolled releases of hydrocarbons during the various stages of a wellbore's life cycle. The equipment used to drill, complete and workover a wellbore is essentially the same regardless of whether it is an injection or production well. Also, there is a separate set of permanently installed equipment that is used during the production or injection phase of the life cycle.

The objective during the drilling of the well is to provide a wellbore through the selected reservoir interval in the safest and most efficient manner. Several strings of pipe (casing) are set at increasingly deeper depths to achieve this goal. The first section of pipe, the conductor, is set to approximately 75 m below the seafloor with no well control or blowout

prevention equipment. For the next hole section (surface hole), a large diverter assembly is installed on top of the conductor pipe. This provides a means to divert any shallow gas that may be encountered over the side of the rig in a controlled manner until the mud weight can be increased to control the flow. The probability of encountering shallow gas during this hole section is unlikely since the rig is positioned to avoid any shallow gas anomalies based on a shallow seismic survey.

Once the surface section has been drilled and cased, blowout preventers are installed which can withstand/holdback the reservoir pressures expected during the drilling process should a well control incident occur. The primary method of well control is the hydrostatic pressure exerted by the column of mud in the wellbore. The density of the mud that is used to drill the hole section is tailored to ensure that the ingress of wellbore hydrocarbons is prohibited.

These blowout prevention safeguards are well-known operational procedures for which standard industry practices are in place, and are described in EnCana's Well Control Manual (EnCana, 2003).

During the production or injection life of a well, there are several safety measures in place to insure no uncontrolled release of hydrocarbons occur. The primary prevention mechanism within an offshore wellbore is the surface-controlled subsurface safety valve (SC-SSSV). The fail-close valve has a control line to surface that is constantly pressured to keep the valve open. In the case of an accident, the valve would close as soon as the hydraulic pressure is removed from the line. All reservoir fluids are contained within the production or injection tree on top of the wellhead. This tree (series of fail-close surface valves) is connected to the tubing string within the wellbore that is used to transport the fluids to or from the reservoir.

2.8.4 Flowline Protection

The flowlines will be designed in accordance with CNSOPB regulations, and will incorporate designs for internal pressure containment, dropped objects protection, fatigue and spanning. The flowlines will be buried to avoid impacts from conventional mobile fishing gear and their locations will be charted. During the operational phase, inspections will be carried out as part of the Annual Survey to ensure that the pipeline integrity is maintained. Environmental and safety protection systems, such as emergency shutdown (ESD) valves, will be provided on the flowlines.

2.8.5 Subsea Protection Structures

The production and acid gas injection well trees and the hot tap (SOEP Subsea Option) will be protected by dedicated protection structures. These shall be separately deployed structures designed to withstand impacts from conventional mobile fishing gear. The wells and hot tap locations will be charted on Canadian Hydrographic Services Nautical Charts.

2.8.6 Project Safety Zones

Refer to Section 2.4.4 for information.

3.0 Project Alternatives

Section 16 (2)(b) of the CEEA specifies that every comprehensive study of a project shall include consideration of alternative means of carrying out the project that are technically and economically feasible and the potential environmental effects of any such alternative means. Also, under Section 16 (1)(e) of the CEEA the RAs have decided to consider alternatives to the project.

3.1 Alternatives to the Project

Alternatives to the Project are defined as functionally different ways of achieving the same end (CEA Agency 1997). The Alternatives to the Project as presented in the approved 2002 CSR have not changed. Accordingly, alternatives to the Project are not addressed in this CSR as there is no need to re-assess.

3.2 Alternative Means of Carrying Out the Project

Alternative means of carrying out the project are defined as methods of similar technical character or methods that are functionally the same (CEA Agency 1997). Since the approval of the CSR in 2002, EnCana has investigated options and alternatives that are more economically feasible based on resource estimates which are lower than those predicted in 2002. This section describes the Project design basis as originally conceived in 2002 and discusses the alternatives that were studied leading to the final concept selection.

The 2002 Project basis was designed to produce a sour gas reservoir via an offshore processing concept and transport sales quality gas to market via a 610 mm 176 km pipeline with an onshore tie-in to the M&NP pipeline near Goldboro, N.S. The producing reservoir was located in a relatively small aerial plot enabling production to be sourced from a cluster of directionally-drilled wells from a central wellhead platform. Offshore processing was to be performed on a second bridge-linked production platform, containing the main process-related utility systems. The production platform was also bridge-linked to a third platform which housed the central control room, non-hazardous utilities, and accommodations for offshore workers.

Key similarities in the design basis between the current Project basis and the Project basis for the approved 2002 CSR are as follows:

- fluid composition and properties;
- offshore gas processing;
- acid gas injection into a subsea reservoir;
- produced water treatment and ocean disposal; and
- condensate handling, (for the M&NP Option only).

Compared to the Project basis for the approved 2002 CSR, the current Project design basis has:

- a larger reservoir area requiring subsea completions with tie-backs;
- reduced resource estimate;
- reduced peak production capacity;

- increased volume of produced water; and
- a MOPU replacing the three fixed platforms.

For economic reasons EnCana did not evaluate alternative means of carrying out the project which will not take advantage of the existing M&NP pipeline. Also, if an alternative was deemed to be technically and economically unfeasible, further assessment of that alternative using other criteria was not considered.

The following development alternatives were evaluated:

- substructure type;
- topsides type;
- total number of platforms;
- re-use of existing platform
- processing location;
- acid gas handling;
- produced water disposal;
- condensate handling;
- production capacity alternatives;
- field centre structure type;
- export pipeline alternatives;
- subsea tie-back alternatives; and
- acid gas injection location.

For the 2002 Project basis, consideration was given to using oil-based muds, in addition to WBM, due to the drilling conditions associated with directionally drilled wells. However, based on the experience gained while drilling the Deep Panuke delineation wells, it was determined that only WBM will be used for any new development drilling activities. Therefore, the disposal options for oil-based mud drilling cuttings described in the approved 2002 CSR are no longer applicable to the Deep Panuke Project.

The methodology used to assess Project alternatives was:

- review the alternatives and supporting work for the 2002 DPA and determine which fundamental principles and decisions are still valid for the revised resource forecast and current concepts;
- consider concept alternatives for reduced peak production capacity;
- consider a subsea tie-in to the SOEP pipeline as a product export option;
- consider platform and processing facilities which could be leased to reduce capital expenditures; and
- reassess safety/occupational health and environmental criteria in light of revised concepts.

The decision to proceed with the project as described herein was based on evaluation of the following criteria:

- technical suitability (including operational factors, flexibility and ease of decommissioning);
- capital and operating costs, taking into consideration some leased arrangements;
- commercial risk;
- concept deliverability;
- safety; and
- environmental effects.

If an alternative was deemed to be technically and economically unfeasible, further assessment of that alternative using other criteria was not considered. It is also worth noting that development alternatives which will not allow EnCana to take advantage of the infrastructure installed by M&NP were not evaluated due to economic reasons.

The RAs are in agreement with EnCana's evaluation of alternate means to carry out the project, as described in section 2.10 of its 2006 EA Report, which is summarized in the following subsections.

3.2.1 Substructure Type

The environmental conditions at the field centre location are considered harsh, by offshore standards, but are well within the criteria which fit many world-wide accepted design solutions for substructures. Several types of substructures were investigated and were classed into three groups; floating structures; permanent bottom founded structures; and mobile structures. Each option was evaluated against the evaluation criteria summarized in Table 3.1.

The evaluation resulted in the preferred option being a jack-up type MOPU. The MOPU concept provides a facility that is designed to self-install, produce oil or gas at a given location and then demobilize for reuse at another location. This concept is in use world-wide for fields that have marginal reserves or are expected to have a short production life. Also, contractors may offer these types of structures on a lease basis; therefore the capital cost can be amortized over more than one project.

Two approaches for executing the jack-up concept were investigated: (1) build a new jack-up hull to a 'harsh environment' drill rig specification to accommodate new purpose-built topsides; or (2) refit/modify an existing harsh environment MODU to accommodate a new purpose built topsides. The final concept of a new build or re-fitted jack-up structure will be confirmed during the MOPU bid competition.

Table 3.1		Substructure Type Alternatives					
Alternative	Technical Suitability	Cost/Lease	Commercial Risk	Technically and Economically Feasible	Concept Deliverability	Safety	Environmental Impact
New build jack up	Existing proven designs are available for the Deep Panuke site conditions	Capital cost slightly higher than jackets Lease available	Low	Yes	Best	No specific concerns	Minimal due to small benthic footprint
Refit existing jackup	Existing harsh environment drill rigs exist, although none presently identified as available.	Capital cost higher than new build jackup Lease not available	High cost & schedule overruns to be expected	Yes	Poor	Existing rig may require significant upgrades to meet regulations	Minimal due to small benthic footprint
Jackdeck	Relatively new concept, no proven experience in these environmental conditions Technically acceptable, with risk	Capital cost higher than new build jack up	Medium (new design could lead to overruns, potentially single source supplier)	Yes	Risk involved	No specific concerns	Minimal due to small benthic footprint
Jacket	Proven for Deep Panuke site conditions	Lease option not available	Low	Technically feasible; not economically feasible			

Table 3.1

Substructure Type Alternatives

Alternative	Technical Suitability	Cost/Lease	Commercial Risk	Technically and Economically Feasible	Concept Deliverability	Safety	Environmental Impact
Steel Semi-Submersible Hull	<p>Technical concerns related to riser design and mooring, adjacent to other platforms and riser design</p> <p>Lack of experience in shallow/harsh conditions</p> <p>Only one semi in use for gas production (deeper water)</p>	Slightly higher than jacket option	Greater than jacket	No			
Concrete GBS	<p>Gravity based system (GBS) widely used – six examples in water this shallow</p> <p>Inshore topside analysis avoids large crane requirement</p>	Most expensive	Single source of supply could lead to high costs	No			

3.2.2 Topsides Type

The type of topsides for the revised Deep Panuke Project has not yet been confirmed. It will be largely dependent on the hull design of the jack-up structure. This design will be conducted by the MOPU contractor, selected through a competitive bid process, who will engineer all elements of the MOPU, including the topsides.

3.2.3 Total Number of Platforms

For the revised Project, the size of the topsides required for the revised production capacity is well within the weight and size limitations for placement on one jack-up type structure. However, there are specific concerns regarding personnel safety offshore because of the presence of H₂S in the fluids stream. A twin-platform arrangement employing a production platform and separate bridge-linked accommodations and control room platform was investigated by EnCana, but was found to increase capital cost significantly. Also, the installation activities and footprint of two platforms vs. one would have greater adverse effects on the environment.

A single platform solution was investigated on a single jack-up type structure. Target levels of safety were identified that are consistent for offshore installations within the industry. All types of hazards for the installation were identified, including fire, explosion, ship collision, helicopter crashes, and sour gas leaks. The work concluded that the Project facilities could be safely placed on one platform offshore provided additional special safety measures are put in place to protect workers against the effects of a potential sour gas leak. Thus, the Project has selected a single-platform solution to support the topsides facilities.

3.2.4 Re-use of Existing Platform

In the approved 2002 CSR, re-use of the existing Panuke platform, which was installed as part of the Cohasset Project was examined and rejected as a Project option. In any event, the Panuke jacket was removed during the decommissioning of the Cohasset Project in 2005, and therefore, re-use of the Panuke platform is no longer a valid alternative.

3.2.5 Processing Location

Onshore versus offshore processing was reviewed to determine which alternative provided the best option for the evaluation criteria noted above. Onshore versus offshore processing was assessed in 2002 with the following cases considered:

- full offshore processing;
- onshore processing with minimal offshore processing to allow transportation only; and
- split onshore/offshore processing (intermediate case).

Between 2002 and 2006, the following additional alternative was considered:

- full onshore processing via a long subsea tie-back.

The alternatives are summarized in Table 3.2.

EnCana's proposed solution is offshore processing. The alternate pipeline case will dictate the final configuration - full offshore processing under the M&NP Option or partial processing under the SOEP Subsea Option.

In summary, offshore processing was selected as the preferred option based on the following:

- treating and disposing of sour gas as close to source as possible and thereby reducing risk to the local population and environment near Goldboro;
- offshore injection of acid gas ensures that the marine environment is not exposed to safety and environmental risks;
- reduced risk related to subsea pipeline integrity with the removal of both water and H₂S prior to transport to shore; and
- capital and operating costs.

Table 3.2 Processing Location Alternatives							
Alternative	Technical Suitability	Cost	Commercial Risk	Technically and Economically Feasible	Concept Deliverability	Safety	Environmental Impact
Full Offshore Processing	Best technical solution (H ₂ S and condensate removal at source to produce natural gas)	Lower cost than onshore processing	No specific concerns	Yes	Equivalent	Deals with H ₂ S at source thereby minimizing safety risk related to pipeline transport of gas to shore	Deals with H ₂ S at source, thereby eliminating risks to the onshore environment. Fewer sensitive environmental receptors and greater acid buffering capacity in the offshore marine environment
Onshore Processing (with minimal offshore processing for transportation)	Higher risk than offshore processing associated with pipeline integrity	Higher cost than offshore processing	Risk to Project economics should pipeline corrode and be out of service for an extended period of time Increased risk to project economics due to pipeline integrity concerns	Yes	Equivalent	Transports H ₂ S from offshore to populated area (increased safety risks)	A greater number of sensitive environmental receptors and therefore potential impacts onshore with regard to H ₂ S emissions Increased corrosion risk associated with transmission of H ₂ S in a 176 km pipeline increases risk of gas release
Onshore Processing (Long subsea tieback)	Technically not feasible						
Offshore/Onshore (Intermediate Case)	Duplication of some facilities onshore and offshore	Highest – must duplicate elements of processing offshore and onshore	No specific concerns	No			
Offshore/Onshore using SOEP Subsea Tie-in	Technically feasible	Yet to be determined	Yet to be determined	Yes	Marginal increased risk when compared to full offshore	Same as offshore processing	Marginal increased advantage over full processing by reduction of benthic disturbance resulting from a shorter pipeline

3.2.6 Acid Gas Handling

Removal of H₂S from the inlet gas stream results in a concentrated waste stream to be handled offshore. EnCana's FEED study investigated four options for handling acid gas offshore including flaring, seawater scrubbing, offshore sulphur recovery, and acid gas injection. The alternative chosen for the Project is the acid gas injection technology. A summary of the investigation is presented in Table 3.3.

Table 3.3

Acid Gas Handling Alternatives

Alternative	Technical Suitability	Cost	Commercial Risk	Technically and Economically Feasible	Concept Deliverability	Safety	Environmental Impact
Acid gas injection	Proven technology Used extensively in Western Canada – EnCana has existing installations	Approximately \$45 MM	No significant concerns	Yes	Moderate risk – specialized equipment and additional safety concerns	Incremental risk over flaring due to handling of high pressure acid gas	Significantly reduces air emissions and marine discharges compared with other feasible options
Flaring	Proven technology Used worldwide	Approximately \$1 MM* Fuel gas required to ensure efficient operation	Not applicable	Yes	Least risk	Some risk associated with handling acid gas	Highest air emissions
Seawater scrubber	Technology no longer available	Not assessed	Not applicable	No			
Offshore sulphur recovery	Offshore footprint required makes Option uneconomical	Very high	Not applicable	No			

Note: *Based on estimates prepared in 2002.

3.2.7 Produced Water Disposal

EnCana identified four potential alternatives for produced water disposal on the Deep Panuke Project. These alternatives were treatment and discharge overboard, injection into a dedicated well, simultaneous injection into the condensate/acid gas injection well, and injection into the annular space of an existing well. Each alternative carries different types and levels of risk to the Project and are summarized in Table 3.4. From a purely technical perspective, both treatment and disposal overboard as well as re-injection were feasible options. However, the economic costs of re-injection significantly outweigh treatment/discharge. After a thorough review of the alternatives, the treatment and discharge overboard option was deemed the best technical and commercial option.

Treatment and discharge overboard is a reliable technology that is used world-wide in offshore oil and gas facilities, including offshore Nova Scotia. The treatment technology, plus the EEM Program proposed for the Project, will ensure that the discharges do not have a significant environmental effect.

Table 3.4

Produced Water Disposal Alternatives

Alternative	Technical Suitability	Cost	Commercial Risk	Technically and Economically Feasible	Concept Deliverability	Safety	Environmental Impact
Treatment and disposal overboard	Proven technology Currently used worldwide in offshore oil and gas facilities Meets published CNSOPB guidelines	Base case for capital costs Annual operating costs for environmental monitoring	No significant concerns	Yes	No significant concerns	No significant concerns	Likely no significant impact to the marine environment due to hydrodynamically active discharge location Water will be treated and disposed according to existing regulations

Table 3.4

Produced Water Disposal Alternatives

Alternative	Technical Suitability	Cost	Commercial Risk	Technically and Economically Feasible	Concept Deliverability	Safety	Environmental Impact
Injection into dedicated well	<p>Proven technology onshore</p> <p>Will require duplication of overboard equipment in case well goes down</p>	<p>Base cost for disposal overboard plus approximately 60 MM to drill the dedicated injection well (excluding contingencies)</p> <p>Additional operational costs for well interventions, injection chemicals, equipment (e.g., topside pumps, filters etc), flowlines and umbilicals and increased power requirements for pumping</p>	No significant concerns	<p>Technically feasible</p> <p>Unattractive economically, add unnecessary cost and complexity</p>			
Simultaneous injection with acid gas into acid gas injection well	Concept is not technically feasible, due to varied produced water volumes	Not assessed	Not assessed	No			
Injection into an annulus	<p>Concept has significant technical risks</p> <p>If corrosion problem occurs, will shut down a producer well</p>	<p>Additional capital cost for injection equipment, additional piping, well construction, and wellhead modifications</p> <p>Additional operational costs for injection chemicals</p>	<p>Potential risk of shut-down of production well that is being injected into (corrosion)</p> <p>Uncertainty with regard to a suitable injection zone</p>	No			

3.2.8 Condensate Handling

The method employed for condensate handling is directly related to the sales product export alternatives.

For the SOEP Subsea Option, the condensate is transported to SOEP via the export pipeline and commingled with the export gas. Final condensate handling is done onshore at the SOEP gas plant at Goldboro and the fractionation plant at Point Tupper.

Handlings of the condensate stream either as the primary fuel on the platform or processing at the SOEP facilities are both technically feasible. Final selection of the condensate handling alternative will be made when discussions between EnCana and ExxonMobil are concluded.

For the M&NP option, the following three options for condensate handling were evaluated:

1. the use of a dedicated pipeline to shore;
2. use of condensate as a fuel; and
3. condensate storage and shipment by tanker.

All three alternatives were identified as technically feasible with different types and levels of risk (refer to Table 3.5); however, options 1 and 3 were deemed not to be economically feasible. After reviewing the alternatives, it was determined that use of condensate as the primary fuel is the preferred alternative for the M&NP Option.

Table 3.5

Condensate Handling for the M&NP Option

Alternative	Technical Suitability	Cost	Commercial Risk	Technically and Economically Feasible	Concept Deliverability	Safety	Environmental Impact
Dedicated pipeline to shore	Proven technology	High capital costs	No significant concerns	No			
Use of condensate as a fuel	Tri-fuel usage (gas/condensate/diesel) not widely used in offshore production, but feasible	Least expensive	No significant concerns	Yes	Specialized equipment which is not available in Canada has long lead delivery	Requires special design considerations however, technically achievable	Reduced transfers of diesel (required as a backup fuel) since a tri-fuel system will be in use
Storage and shipment by tanker	Proven technology	High capital costs	No significant concerns	No			

The quantities of condensate to be produced from the Deep Panuke field do not justify the costs associated with a dedicated condensate pipeline, or a seafloor subsea storage tank for holding a six-month volume of condensate offshore.

The use of condensate as the primary fuel on the MOPU was also considered. Using condensate as fuel eliminates the substantial capital and operating costs associated with a condensate pipeline to shore and associated onshore handling facilities. The use of condensate as fuel on the platform conserves the resource by maximizing the quantity of natural gas exported to shore and by utilizing all components of the Deep Panuke resource.

3.2.9 Production Capacity Alternatives

The 2002 Project basis for production capacity was $11.3 \times 10^6 \text{ m}^3/\text{d}$; however, alternatives for smaller facilities with peak production capacities of $8.5 \times 10^6 \text{ m}^3/\text{d}$ and $5.7 \times 10^6 \text{ m}^3/\text{d}$ were also considered by EnCana. Concepts were initially developed for jacket-supported structures for each alternative. It was found that the platform footprint, weight, and cost reduced considerably when the production capacity was reduced from $11.3 \times 10^6 \text{ m}^3/\text{d}$ to $8.5 \times 10^6 \text{ m}^3/\text{d}$. However, the reduction in topsides weight (and cost) when the production capacity was further reduced to $5.7 \times 10^6 \text{ m}^3/\text{d}$ is marginal since the size of processing equipment does not decrease in the same proportion as production capacity. The economic modelling case at the $5.7 \times 10^6 \text{ m}^3/\text{d}$ production rates showed that the payout period was too lengthy at this rate, severely impacting the economics. It was concluded that the $8.5 \times 10^6 \text{ m}^3/\text{d}$ plant size is more economically feasible for the mean reservoir case and therefore was selected for the plant production capacity rating.

3.2.10 Export Pipeline Alternatives

There are two options for the export pipeline. EnCana proposes to transport product for sale via a subsea pipeline from the offshore processing facility to one of two delivery points:

- Goldboro, N. S. (M&NP Option); or
- SOEP 660 mm pipeline tie-in (SOEP Subsea Option).

On February 26, 2007, EnCana filed “Deep Panuke Regulatory Applications Addendum No. 1” with the Deep Panuke Coordinated Review Secretariat. In its Addendum, EnCana requested that its original November 2006 Applications be amended to include, for the SOEP Subsea option, the following alternatives for connection to the existing SOEP pipeline:

- a single 510 mm [20-inch] pipeline; or
- twinned 324 mm [12-inch] pipelines.

As noted in Section 2.3.2, nearshore and offshore pipeline installation activities as described in the approved 2002 CSR have not changed, with the exception of the twin 324 mm pipelines for the SOEP Subsea Option. Therefore, the following discussion focuses on assessing the new twinned pipeline alternative for the SOEP Subsea Option. All three alternatives described in Table 3.6 are technically feasible with different types and levels of risk as well as environmental impact.

Table 3.6

Export Pipeline Alternatives

Alternative	Technical Suitability	Cost	Commercial Risk	Technically and Economically Feasible	Concept Deliverability	Safety	Environmental Impact
M&NP Option	Proven technology	Highest capital costs	No significant concerns	Yes		No specific concerns	<p>Longest construction period compared to SOEP Subsea Option resulting in greatest air emissions, SPM, localized water degradation, noise, and vessel presence. Largest footprint.</p> <p>Impacts to nearshore and terrestrial environmental and valued ecosystem components.</p>
SOEP Subsea Option - single 510 mm pipeline	Proven technology	Lower capital costs	No significant concerns	Yes		No specific concerns	<p>Shortest construction period and associated impacts and smallest footprint.</p> <p>No interaction with nearshore or terrestrial environment.</p>
SOEP Subsea Option – twinned 324 mm pipelines	Proven technology	Potentially least expensive, based on flexibility of installation	No significant concerns	Yes	Best due to flexibility of installation methodologies and equipment availability	No specific concerns	<p>Slightly longer construction period and larger footprint as compared to single 510 mm pipeline option.</p> <p>No interaction with nearshore or terrestrial environment.</p>

EnCana's regulatory application had determined that a single 510 mm outside diameter pipeline is required to deliver the sales product to the SOEP pipeline for the SOEP Subsea Option. However, inquiries related to pipelay vessels (both in terms of availability and capability) for the SOEP Subsea Option indicate that installing 15 km of 510 mm pipeline may not be the most cost-effective solution. As a result, EnCana conducted an investigation to determine if an alternate pipeline configuration could satisfy the Project requirements in more cost-effective manner.

Preliminary results of this investigation concluded that a twinned 324 mm nominal pipeline system could also deliver the required sales product to the SOEP pipeline. The two pipelines would run from the MOPU to a subsea isolation valve (SSIV) skid that is located approximately 150 m from the MOPU as per the single pipeline option. The function of the SSIV skid will be the same as the single pipeline option, except that there will be two pipelines each with a valve isolating the pipeline from the MOPU.

The two pipelines would then be routed to the SOEP hot tap location approximately 15 km away. The pipelines will run in parallel to each other, separated to allow sufficient room for installation and post trenching activities to occur for each individual pipeline. This distance is currently estimated at 50 m or less.

The two pipelines will connect via a tee connection on the Deep Panuke tie-in structure to the SOEP hot tap structure. The Deep Panuke tie-in structure will have a check valve and isolation valves. The SOEP hot tap tie-in will be the same as the single pipeline alternative. It is anticipated that the overall size of the SSIV and the Deep Panuke tie-in structures for the twin pipeline option will be approximately the same as for the single pipeline alternative.

The use of twinned 324 mm nominal pipelines will allow the pipeline to be installed by either the "S-lay" barge method, "reel lay" technique or flexible flowline method due to their reduced diameter. Thus, the installation options for the twinned pipeline will be the same as for the in-field flowlines, offering potential synergies between the installation of the export pipeline and flowlines. The single 510 mm pipeline option can only be installed by the "S-lay" method and there are a limited number of vessels capable of performing this installation.

Tables 3.7 and 3.8 summarize the variances in predicted biophysical and socio-economic environmental effects of the twinned pipeline alternative, as compared to the single pipeline alternative for the SOEP Subsea Option.

During the construction phase, the twinned 324 mm pipelines for the SOEP Subsea Option as compared to the single pipeline alternative would result in increased construction efforts (e.g., two separate passes of vessel for pipelaying/trenching two pipelines). Therefore, there is predicted to be an increase in air emissions from construction vessels; increased suspended particulate matter (SPM) and localized water degradation; and increased noise and vessel presence. Additional air emissions, increased SPM, noise and vessel presence would still be less than that assessed in the 2002 CSR and therefore these effects are still predicted to be not significant. This Project alternative would still contain one SSIV skid, one tie-in skid and one hot tap skid as for the single pipeline option; therefore, pile driving requirements are not expected to change. Hydrostatic test water discharges are expected to be similar.

During the operational phase of the project, both pipelines would be buried and there would be no additional unburied structures; therefore, there are no new predicted effects on biophysical valued environmental components associated with normal operations. Effects on fisheries associated with the presence of the twinned pipelines during operations and after decommissioning (i.e., potential for interference with quahog fishing) will be minimally increased as a result of the slightly larger footprint of the two pipelines.

The analysis of effects associated with malfunctions and accidental events remains essentially unchanged due to the conservative assumptions used in the modeling approach for the EnCana's 2006 EA Report. Spill probability, based on "total volume of product handled" is discussed further in Section 4; however, given that the total volume of product has not changed, there is no predicted change in spill probability.

The pipeline spill modeling presented in EnCana's 2006 EA Report uses a gas flow rate of $8.5 \times 10^6 \text{ m}^3/\text{d}$ [300 MMscfd] and condensate flow rate 1400 BOPD from a single rupture point (original single SOEP pipeline tie-in specification). This assumes that the worst case is the full flow of the pipeline until it is shut in. Considering these flows have not changed with the dual pipeline option, then the original spill modeling and conclusions regarding oil fate and effects on valued environmental components remain valid.

The alternative of exporting the gas through twinned 324 mm pipelines rather than a single pipeline of 510 mm diameter does not change the worst-case air quality assessment which is discussed further in Section 9.4.

Table 3.7 Interactions of Proposed Twinned 324 mm Pipelines with Biophysical Components Compared to Original Single Pipeline (SOEP Subsea Option)

		Biophysical VECs							
Project Component	Project Modification	Air Quality	Marine Water Quality	Marine Benthos	Marine Fish	Marine Mammals and Turtles	Marine Related Birds	Sable Island	Onshore Environment
Construction and Installation	Pipelaying/trenching of twinned 324 mm pipelines	Minimal increase in air emissions associated with construction traffic	More suspended particulate matter (SPM) from increased pipelaying/trenching activity	Larger benthic footprint	SPM and noise disturbance from increased pipelaying/trenching activity	Noise disturbance from increased pipelaying/trenching activity; longer vessel presence	Noise disturbance from increased pipelaying/trenching activity; longer vessel presence	N/A	N/A
Operations	Presence of two subsea pipelines	N/A	N/A	ND	ND	N/A	N/A	N/A	N/A
Decommissioning	Abandonment of two buried pipelines	N/A	Presence of abandoned subsea structures	ND	ND	N/A	N/A	N/A	N/A
Malfunctions and Accidental Events	Pipeline failure	ND	ND	ND	ND	ND	ND	ND	N/A
N/A = No interaction ND = negligible or no difference in effect from what was already assessed in EnCana's 2006 EA Report									

Table 3.8 Interactions of Proposed Twinned 324 mm Pipelines with Socio-Economic Components Compared to Original Single Pipeline (SOEP Subsea Option)

Project Component	Project Modification	Socio-economic VECs			
		Land Use	Economy	Commercial Fisheries and Aquaculture	Other Ocean Users
Construction and Installation	Pipelaying/trenching of twinned 324 mm (12 inch) pipelines	N/A	ND	Increased potential for interference with fishing activity due to increased Project vessel activity during pipeline installation; potential increased effects on quahogs and benthic habitat	Increased potential for interference from pipeline installation activities with other user activities
Operations	Presence of two subsea pipelines	N/A	N/A	Minimal increase in potential interference with anticipated quahog fishing activities	N/A
Decommissioning	Abandonment of two buried pipelines	N/A	N/A	Minimal increase in potential interference with anticipated quahog fishing activities	N/A
Malfunctions and Accidental Events	Pipeline failure	N/A	NA	ND	ND

N/A No interaction
 ND=negligible or no difference in effect from what was already assessed in EnCana's Zone EA Report

The twinned 324 mm pipeline option will result in a larger benthic footprint than the original SOEP Subsea Option; however, since pipeline construction (pipelaying/trenching) is a one-time event of relatively short duration (18-34 days), and these habitats are expected to be re-colonized by benthic organisms from adjacent areas, it is still unlikely to have more than a slight impact on local benthic habitat, including ocean quahog populations. There is not likely to be a significant effect on marine benthos as a result of Project construction.

More noise disturbance to marine fish, mammals, turtles and birds is predicted during construction of the two 324 mm pipeline option, compared to the original SOEP Subsea Option (longer noise exposure within the same general area), but remains less than what was assessed in the 2002 CSR (noise spread out over larger geographic area for longer time period). Therefore, the conclusions in the approved 2002 CSR remain valid; there is not likely to be significant adverse effect on marine wildlife as a result of pipeline construction noise.

Construction of two pipelines in the same area (< 50 m apart) will result in greater vessel presence along the SOEP Subsea Option pipeline route (i.e., longer exposure period). However, this interaction with marine mammals, turtles and birds will still be less than what was previously assessed in the 2002 CSR. Furthermore, this option will still remove interaction with Country Island and nearshore tern species. The conclusion that no significant effects are likely as a result of Project construction (including vessel presence) therefore remains valid.

Due to the increase in construction effort associated with the separate installation of two pipelines instead of one, the potential for interaction with commercial fisheries and other ocean users (i.e., vessel interference and physical effects on quahogs and benthic habitat) will increase. The increase in the duration of the construction (9-17 days) is small relative to the duration of the offshore fishing seasons and the additional area affected is small relative to the total fishable area. Thus, the assessment of construction impacts on commercial fisheries remains valid. Likewise, the incremental increase in area and construction duration does not change the assessment and conclusions for the impact assessment of other ocean users. The mitigation described in Sections 9.6 and 9.10 will still be implemented to minimize potential effects on commercial fisheries and other ocean users.

The environmental impact of the twin pipelines during operations and after decommissioning will be similar to the original SOEP Subsea Option. Therefore, the assessment presented in this CSR, and written and oral information during the Public Review, remains valid:

- The twinned 324 mm pipelines will be buried to a depth of approximately 1 m; therefore, there will be no fishing restrictions over the pipelines (with the exception of the portions of the pipelines located within the safety zone and the tie-in structure areas);
- The pipelines are located in an area of relatively low fishing activity; the only fishery expected to be affected by the abandoned pipelines is the Sable Island Bank ocean quahog dredging fishery due to the nature of its fishing equipment, which digs up clams with a cutting assembly into the sand;
- The additional footprint due to the twinned 324 mm pipelines represents a very small portion of the entire area available for harvesting quahogs on Sable Island Bank, and partially overlaps with areas containing existing subsea cables and pipelines that quahog dredges already likely avoid, which means there is minimal additional or new effect;

- The frequency of potential interaction with quahog dredging activity will be further limited by the fact that this resource is expected to be harvested only every 15 to 20 years, corresponding to the time for quahogs to reach commercial size;
- The locations of two decommissioned 324 mm pipelines will be clearly indicated on hydrographic charts, and any potential fishing gear damage will be addressed through the CNSOPB/C-NLOPB Compensation Guidelines Respecting Damages Relating to Offshore Petroleum Activity.

Both the M&NP and the SOEP Subsea (single or twinned) export pipeline options are technically feasible and routes have been chosen to minimize environmental impact. The selected alternative will be determined pending the outcome of commercial discussions between the operator of SOEP and EnCana.

3.2.11 Subsea Tie-back Alternatives

The Deep Panuke reservoir area extent has changed substantially from the 2002 Project basis of one license, PL2902, to the current Project basis covering PL2902, EL2387, SDL2255H, PL2901 and EL2360. The pool size estimate requires a minimum of five production wells for the P90 case (value at 90th Percentile) and a maximum of eight production wells for the P10 case (value at 10th Percentile) to effectively deplete the resources. The large extent of the pool necessitates the use of a subsea solution.

The Project plans to utilize four suspended wells from the exploration drilling program as production wells which allows for reduced capital costs and environmental interactions. One new production well will be drilled for the Project start-up. Up to three additional production wells could be drilled in future. A subsea tie-back study was carried out by EnCana to determine the optimal method of tying in the wells to the field centre. It should be noted that a new acid gas injection well must also be tied back to the field centre; however, this well was not considered as a driver for the layout study.

From a layout consideration, it was determined that a tie-back of individual wells to the field centre was the best technical solution. The proposed well locations do not suit a template or manifold arrangement. The field centre location was determined by minimizing the tie-back lengths of the wells to lower capital costs and improve flow assurance.

Three alternative methods for flowline installation were considered: (1) “S-lay” barge method; (2) “reel lay” technique; and (3) flexible flowline method. The “S-lay” lay barge method involves the use of an offshore barge to weld and then lay lengths of rigid pipe on the seabed by means of a “stinger” overhanging the stern of the barge. Subsequently, the pipe is trenched using a subsea trenching or ploughing spread. The “reel lay” method involves pre-welding rigid pipe lengths together at a specialized “spool base” onshore and then reeling the entire flowline onto a large diameter reel. The reel is taken offshore on a special lay vessel where it is straightened and laid on the seabed as a continuous length. The flowline is trenched in a similar manner to the lay barge method. The “flexible” solution uses a flowline of non-rigid type. Each flowline is manufactured in one single piece at a specialized factory and coiled on a large reel and taken offshore. A special lay vessel uncoils the flowline and lays it on the sea bed. Trenching methods are similar to the other schemes.

All three methods are technically acceptable with similar environmental effects.

3.2.12 Acid Gas Injection Location

As indicated above, the option chosen for acid gas handling for the Project is the acid gas injection technology. The location chosen for the acid gas injection well is D-70, which is shown on Figure 2.1. An alternative location considered for the acid gas injection well was H-82. A summary of the investigation is summarized in Table 3.9.

Based on the fact that both acid gas well locations are very similar in terms of technical feasibility and environmental impact, the acid gas well injection location at D-70 was selected due to lower costs and slightly lower risks associated with concept deliverability and safety.

Table 3.9 Acid Gas Injection Location Alternatives							
Alternative	Technical Suitability	Cost*	Commercial Risk	Technically and Economically Feasible	Concept Deliverability	Safety	Environmental Impact
D-70	Technically feasible	Base case for cost (as per Table 3.3)	Extremely low risk of souring the Panuke sands	Yes	Least risk	Least risk	Lower impact
H-82	Technically feasible	Additional cost from base case of approximately \$1-2 MM for installation of extra length (approx. 3.1 km) of flowline and umbilical	Risk of souring the Panuke sands extremely unlikely (slightly lower than D-70)	Yes	Increased operational risk associated with longer flowline (primarily increased risk of hydrate formation)	Increased safety risk associated with unlikely rupture of acid gas injection flowline due to larger volume of acid gas in flowline (4.8 km flowline instead of 1.7 km)	Higher impact due to longest flowline resulting in: <ul style="list-style-type: none"> • larger benthic footprint (greater area of benthic disturbance) • larger safety zone area and impact on fisheries (especially quahog) and other ocean users • increased impact to air quality in unlikely event of acid gas flowline rupture due to larger volume of acid gas in flowline

4.0 Malfunctions and Accidental Events

This section provides an overview of potential malfunctions and accidental events that may occur during the Project, with an emphasis on the effects of these events. Historically, malfunctions and accidental events are extremely unlikely and are predicted to be unlikely for the Project. Spill risk and behaviours have been modelled to determine the probability and degree of impacts and is presented in Appendix E of EnCana's EA Report. While a significant spill or release of gas is extremely unlikely, the potential consequences of such an event need to be understood so that safety, emergency response and contingency planning can be completed to ensure the risk is further mitigated.

Accidental air emissions and marine spill modelling presented in the approved 2002 CSR required updating due to the following Project modifications:

- re-location of the field centre;
- new production and acid gas injection subsea wells and flowlines;
- new multi-phase pipeline (carrying condensate) for SOEP Subsea Option; and
- revised Project life.

EnCana has presented the discussion on malfunctions and accidental events as originally included in the approved 2002 CSR, with updated scenarios and results as per the current project.

4.1 Potential Malfunctions and Accidental Events

Malfunctions and accidental events that have potential environmental effects include: platform-based spills; malfunction of the acid gas management system; blowouts and pipeline/flowline ruptures; and collisions. During the Public Process, concern was also identified related to the possibility of encountering abandoned UXO (unexploded ordnance), or chemical or biological warfare agents (e.g. mustard gas), or radioactive dumpsites.

Routine operations can be conducted with sufficient mitigation to ensure that effects on the environment are not significant. There is potential for significant adverse environmental effects to occur in the extremely unlikely event of a blowout of an injection or production well, or an acid gas flowline rupture. Design, inspection, maintenance and integrity assurance programs, as well as established engineering techniques, will be in place to prevent such events from occurring. EnCana will ensure that all safety procedures will be documented and in place prior to the commencement of routine operations.

All fuel, chemicals and wastes will be handled in a manner that minimizes or eliminates routine spillage and accidents. EnCana's EPP will include safe chemical handling and storage procedures as well as Project-specific spill response measures (refer to Appendix G of EnCana's EA Report). EnCana's Deep Panuke Spill Response Plan includes general measures for preparing for and responding to spills, including the use of cleanup equipment, training of personnel and identification of personnel to direct cleanup efforts, lines of communications and organizations that could assist cleanup operations (refer to Appendix G of EnCana's EA Report).

4.1.1 Platform-based Spills

Spill risk probability analysis and spill behaviour modelling have been updated to reflect the change in Project life and MOPU location (refer to Sections 4.2.1 and 4.4.1, and Appendix E of EnCana's EA Report).

4.1.2 Collisions

The risk of collision between platforms and vessels is anticipated to be extremely low based on compliance with standard procedures. A safety zone will be established in accordance with CNSOPB regulations and will most likely encompass the MOPU, subsea well, flowlines and umbilicals. For further detail, refer to Section 2.4.4. Surface facilities will contain navigational aids and anti-collision radar will provide early warning of a potential collision hazard. In the unlikely event that a collision cannot be avoided, EnCana's Environmental Management Plan will address response procedures.

4.1.3 Malfunction of Acid Gas Management System

Waste acid gas will be injected into a dedicated injection well. Malfunctions of compressors or other equipment associated with acid gas management could lead to circumstances that require diversions of the acid gas to the MOPU flare. Equipment downtime and flaring will also be required for routine maintenance and is expected to be a short period (*e.g.*, a few days to a week). In the unlikely event of major equipment malfunctions, equipment downtime and associated flaring could last approximately one year (in the event that a new injection well needs to be drilled). Flaring of acid gas results in emissions of SO₂; however, a flare malfunction resulting in failure to ignite will result in emissions of H₂S. Air emissions during upset conditions are described in detail in Section 9.4 of this CSR.

The acid gas injection well will be drilled into an appropriate geological formation. The intended reservoir for disposal of the acid gas does not contain sulphur; therefore it is likely that a blowout during drilling of the injection well would not contain significant amounts of H₂S. The primary prevention mechanism within the wellbore is the SC-SSSV. This is a failsafe valve that must be kept open by hydraulic pressure on a line from the surface. Interruption of pressure on this valve, either through control action on the platform, or by an accidental event, results in rapid closure of the valve. This would limit the possible discharge to the volume of gas within the pipe.

4.1.4 Blowout Releases

There is potential for a subsea blowout, in which discharged oil and gas emanate from the subsea well and rise through the water column to the water surface. Above-surface blowouts are also a possibility, in which oil and gas discharges into the atmosphere from some point on the platform above the water surface, and later falls onto the water surface some distance downwind.

The probability of blowouts is discussed in Section 4.2.2, and spill behaviour is discussed in Section 4.4.2. Design features to be used by EnCana to prevent or greatly minimize the chances of a serious spill are described in Section 2.10.

4.1.5 Pipeline and Flowline Releases

The export pipeline (both options) will be designed to withstand impacts from conventional mobile fishing gear in accordance with the Det Norske Veritas (DNV) *RP-F111, Interference Between Trawl Gear and Pipelines*, October 2006. The subsea tie-in structures for the SOEP Subsea Option can be trawled over with impact.

A leak system will be provided on the natural gas pipeline. In the event that a leak is confirmed, the pipeline has valves that will segregate the pipeline from either the M&NP pipeline or the SOEP pipeline and the MOPU to prevent further hydrocarbons spillage from entering the system. Section 2.10.2 provides additional detail on pipeline leak prevention.

Flowlines will be buried to avoid impacts from conventional mobile fishing gear and their locations will be charted. *Notices to Mariners* will be issued. It is also likely that the safety zone will also encompass all wellhead flowlines and umbilicals. Environmental and safety protection systems, such as ESD valves, will be provided on the flowlines. Section 2.10.4 provides additional detail on flowline protection.

Risks of onshore pipeline and subsea pipeline/flowline releases are described in Sections 4.3 and 4.4, respectively. Atmospheric emissions related to subsea pipeline and flowline failures are discussed in detail in Section 8.1.4.4 of EnCana's EA Report.

4.1.6 UXO or Other Warfare Agents

It is well known that a number of UXO and other warfare agents (e.g. mustard gas) have been disposed of at sea over the years since the two world wars. DND maintains a database of known locations, and has advised that there are none in the project area. However, it is not possible to completely discount the possibility that such materials could be encountered during construction of the project. During the Public Process, EnCana indicated that it will conduct further on-bottom surveys as pipelaying proceeds, and that any anomalies that are detected would be investigated before moving forward. EnCana will contact DND prior to commencing any activity to re-confirm that there are no known UXO, chemical or biological agents or radioactive dumpsites in the area. In the unlikely event that something is identified either during EnCana surveys or discussion with DND, the method of dealing with such will be addressed in EnCana's EPP, Emergency Management Program, Operations and Maintenance Programs, and Construction and Safety Manuals.

4.2 Marine Spill Risk and Probability

A detailed discussion of spill risk and probability connected to the Project is presented in Appendix E of EnCana's EA Report. The calculated spill frequencies for the Project are summarized in Table 4.1.

4.2.1 Platform-based Spills

Small and medium platform-based spills could contain diesel oil, hydraulic fluid, lubricants, other refined oils, or mineral oil. The highest frequencies for all spills are for the smaller, platform-based spills (<1 bbl). The Project's design will build upon lessons learned from previous spill events in order to minimize potential risk for spills, including small platform-based spills. Spill prevention methods will include state-of-the-art environmental protection

systems (Section 2.10) and treatment systems for the MOPU's effluents, including deck drainage (Section 2.8.5). One spill in the 1 to 49.9 barrels (bbl) range might occur over the course of the Project, although its average size can be expected to be less than 10 barrels. There is about a 5% chance that a platform-based spill larger than 50 barrels might occur over the course of the entire Project. The annual probability of having a large (>1000 bbl) or very large (>10,000 bbl) spill as a result of an accident on a platform is one in 10,000 and one in 28,000 respectively.

4.2.2 Blowouts

During the 12 months needed to drill five wells, the chances of an extremely large (>150,000 bbl) and very large (>10,000 bbl) oil well blowout from development drilling are extremely small. The prediction for Deep Panuke is as follows: during the initial 12 months when five wells will be drilled, there is a 0.12% chance per year (one-in-830) of having a deep blowout (one that could involve sour gas). Similarly, during production at Deep Panuke, gas blowouts might be expected to occur every 1,300 years, and blowouts involving small amounts of discharged oil (>1 bbl) might be expected to occur once every 15,000 years.

Table 4.1 Predicted Number of Blowouts and Spills for the Deep Panuke Project

Event	Historical Frequency	Deep Panuke Exposure	No. of Events over the Course of the Project	Annual Probability
BLOWOUTS				
1. Deep gas blowout during development drilling	2.4 x 10 ⁻⁴ /wells drilled	5 wells drilled over 12 months	1.20 x 10 ⁻³	one in 830
2. Gas blowout during production	1.17 x 10 ⁻⁴ /well-years	112 well-years	1.31 x 10 ⁻²	one in 1,300
3. Blowout during production involving some oil discharge >1 bbl	1.04 x 10 ⁻⁵ /well-years	112 well-years	1.16 x 10 ⁻³	one in 15,000
4. Development drilling blowout with oil spill > 10,000 bbl	5.3 x 10 ⁻⁵ /wells drilled	5 wells drilled over 12 months	2.67 x 10 ⁻⁴	one in 3,700
5. Development drilling blowout with oil spill > 150,000 bbl	2.7 x 10 ⁻⁵ /wells drilled	5 wells drilled over 12 months	1.33 x 10 ⁻⁴	one in 7,500
6. Production/workover blowout with oil spill > 10,000 bbl	2.0 x 10 ⁻⁵ /well-year	112 well-years	2.24 x 10 ⁻³	one in 7,800
7. Production/workover blowout with oil spill > 150,000 bbl	8.0 x 10 ⁻⁶ /well-year	112 well-years	8.96 x 10 ⁻⁴	one in 20,000
PLATFORM SPILLS (incl. blowouts)				
8. Oil spill > 10,000 bbl	5.5 x 10 ⁻⁶ /well-year	112 well-years	6.16 x 10 ⁻⁴	one in 28,000
9. Oil spill > 1000 bbl	1.5 x 10 ⁻⁵ /well-year	112 well-years	1.68 x 10 ⁻³	one in 10,000
10. Oil spill 50 to 999 bbl	4.8 x 10 ⁻⁴ /well-year	112 well-years	5.4 x 10 ⁻²	one in 330
11. Oil spill 1 to 49 bbl	1.0 x 10 ⁻² /well-year	112 well-years	1.12	one in 16
PIPELINE SPILLS				

12. Oil spill > 10,000 bbl	0.33 per Bbbl of condensate handled	3.95×10^6 bbl of condensate handled	1.30×10^{-3}	one in 13,000
13. Oil spill > 1000 bbl	1.33 per Bbbl of condensate handled	3.95×10^6 bbl of condensate handled	5.25×10^{-3}	one in 3,300
<p>Note: Platform spill frequencies are derived from US OCS experience and gas blowout frequencies are based on both US OCS and North Sea records. Blowout spill data for spills larger than 10,000 bbl are derived from worldwide data. The relatively better record in the US is one reason that the frequency for platform spills >10,000 bbl is smaller than the frequency for the blowout spills >10,000 bbl. As well, the blowout frequencies derived on the basis of worldwide data do not take into account falling trends, which are difficult to calculate because of lack of data. It is likely that the frequencies of blowout-based major spills predicted for Deep Panuke (items 4 through 7) are significantly lower than noted in the table, based on trends in the US OCS and North Sea.</p>				

4.2.3 Spills from Pipelines and Flowline Operations

Based on the maximum volume of condensate that may be handled as part of the Deep Panuke Project, and using historical spill frequencies from US offshore production data, the likelihood of a spill from interfield flowlines and export pipeline (SOEP Subsea Option) is estimated to be a 0.03% (one in 3,300) chance per year for spills greater than 1,000 barrels, and a 0.007% (one in 13,000) chance per year for spills greater than 10,000 barrels.

4.3 Onshore Pipeline Risk

A thorough risk assessment of the onshore portion of the pipeline has been updated in EnCana's EA Report to reflect the new proposed adjacent industrial land uses in the onshore study area. However, EnCana has also identified the requirement to conduct a detailed quantitative risk analysis taking into consideration potential risk synergies between the nearshore/onshore components of the Project with the proposed adjacent petrochemical and LNG facilities. This analysis will occur during detailed route design as it requires specific information on relative layout of project components (for both projects). The following sections summarize some of the key findings of the updated assessment considering only risks associated with the Deep Panuke Project.

4.3.1 Accident Scenarios

The only accident scenarios associated with the onshore pipeline that poses a threat to safety or environmental quality are accidental losses of containment. An accidental release of natural gas would result in either dispersion or ignition of the flammable gas. Dispersion without ignition poses no hazard to people or the environment. The size of a potential pipeline release can vary from a small corrosion pinhole leak to a full rupture across the pipeline diameter. In order to represent the range of potential release sizes, losses of containment have been characterized as leaks (very small hole), holes, or ruptures. The likelihood of leaks is 1 in 600 per year, the likelihood of holes is 1 in 1,500 per year; and the likelihood of ruptures is 1 in 5,000 per year.

4.3.2 Hazards

The released gas only becomes dangerous in the instance that it is ignited. Based on the population density and level of industrial activity in the direct vicinity of the pipeline, leaks can be ignited with a probability of 5%, while holes or ruptures are associated with probabilities of ignition of approximately 35% and 60%, respectively. A portion of this probability of ignition is auto-ignition, from the energy released and possible sparks generated in the occurrence of the hole or rupture.

In the case of immediate ignition, a jet fire would result, involving the generation of a flame up to several hundred metres in length for full ruptures. In the case that ignition is delayed, under the most unfavourable atmospheric and release conditions, a natural gas cloud could extend several hundred meters, until it ignites from an ignition source. The gas cloud would then ignite, flashing back to the origin, and resulting in a jet fire, lasting until the gas in the entire pipeline has been depleted. The probability of incidence of jet fires or flash fires from holes or ruptures give probabilities for potentially harmful scenarios are 1 in 10,000 per year for holes and 1 in 15,000 per year for release ignition.

4.3.3 Risks

In the instance of either a jet fire or a flash fire, environmental damage would likely result in the form of ignition and/or burning of vegetation. Such damage, however, would only result over the footprint of the jet or flash fire, unless humidity and wind conditions were conducive to secondary fire escalation. The associated risk of personal injury is slightly over 1 in 1 million-per-year at the pipeline, reducing to an insignificant level below 1 in 1 million-per-year within 200 m of the pipeline.

EnCana predicts that the risks from the proposed onshore pipeline segment are low both for public and worker safety and environmental integrity.

4.4 Marine Spill Release Behaviour

The following is a summary of the spill behaviour modelling results presented in Appendix E of EnCana's EA Report.

4.4.1 Platform-based Spills

Small batch spills of diesel fuel or condensates from hose ruptures during transfer operations from a supply vessel or from platform storage facilities may occur. The Project's design will build upon lessons learned from previous spill events in order to minimize potential risk for spills, including small platform-based spills. Spill prevention measures will include state-of-the-art environmental protection systems (Section 2.10) and treatment for the MOPU's effluents, including deck drainage (Section 2.8.5).

Batch spill fate modelling was conducted for diesel fuel spill and condensate (10 and 100 barrels spill scenarios for both). There was found to be very little difference in the behaviour of the winter and summer oil spill scenarios. The small differences that do exist can be attributed to the warmer summer temperatures and slightly higher evaporation amounts prior to the full dispersion of the slicks. The following summaries provide descriptions of the fate of the various spill scenarios that apply to both seasons.

Diesel

Errors in diesel spill fate results that have been identified in the approved 2002 CSR modelling are corrected in EnCana's EA Report. Most of the distances are shorter in the new model results when compared to those reported in the approved 2002 CSR; the only case where the distance has increased is in the dispersed oil cloud travel distance for the 100 barrel winter spill scenario.

The 100-barrel batch spill of diesel will also lose about 30% through evaporation, persist as a slick for about 19 hours and travel about 18 km prior to the complete loss of the surface oil. The maximum dispersed oil concentration for this spill will be about 4 ppm and this will drop to 0.1 ppm within about 43 hours. The dispersed oil cloud will travel about 54 km and have a maximum width of about 4 km. Prevailing water currents would take the dispersed condensate cloud in a southwest direction away from Sable Island (located approximately 48 km from Deep Panuke). No diesel is predicted to reach the shores of Sable Island.

The 10-barrel batch spill of diesel will lose about 30% through evaporation, persist as a slick for about 13 hours and travel about 12 km prior to the complete loss of the surface oil. The maximum dispersed oil concentration for this spill will be about 2 ppm and this will drop to 0.1 ppm within about 16 hours. The concentration of 0.1 ppm of total petroleum hydrocarbon is the exposure concentration below which no significant biological effects are expected, based on historical laboratory research. The dispersed oil cloud will travel about 14 km and have a maximum width of about 1 km.

Condensate

The condensate spill fate results have also been updated due to errors that were identified by EnCana in the approved 2002 CSR modelling. Most of the distances are shorter in the new, updated, model results when compared to those reported in the approved 2002 CSR; the only cases where the distance has increased are in the dispersed condensate cloud travel distance for the 10-barrel and 100-barrel winter spill scenarios.

Both the 10- and 100-barrel batch spills of condensate will evaporate and disperse very quickly. These batch spills are likely to persist on the surface for less than half an hour and travel only 400 to 700 m from the release point prior to dissipation under average wind conditions. The maximum condensate concentrations from these spills are estimated to be between 28 to 45 ppm. The dispersed oil concentration for the 10-barrel spill will drop to 0.1 ppm within about 15 hours. The dispersed condensate cloud will travel about 7 km and reach a maximum width of about 1 km. The dispersed oil concentration for the 100-barrel spill will drop to 0.1 ppm within about 41 hours. The condensate cloud for the larger release will travel about 24 km and reach a maximum width of 4 km.

4.4.2 Blowouts and Pipeline/Flowline Ruptures

The blowout liquid and gas flow rates were reduced for the new Deep Panuke modelling when compared to the approved 2002 CSR. Overall, lower flow rates reduced the size of potential impact zones. The spill fate described below can be applied to all of the well locations being considered in the Deep Panuke project. Only very minor differences in the fate of the condensate from spills at F-70, D-41, M-79A, H-08, H-99, and D-70 wells as well the northeast extreme location for future wells were evident when the subsea blowout scenario was run at these locations. The summary provided below in Section 4.4.2.1 is representative of the typical subsea blowout from all these sites. Pipeline and flowlines failure scenarios have been modelled as mini subsea blowouts, and are therefore also included in that section.

Fate and Behaviour of Subsea Well Blowout and Pipeline/Flowline Ruptures

The results of the production well subsea blowout modelling from the Deep Panuke formation indicate that thin condensate slicks or sheens will form initially over a width of about 1.8 km. The slicks will be about 3 μ m thick and will disperse within minutes under average winds. The preliminary in-water condensate concentrations from these releases will be less than 0.2 ppm. Condensate concentrations will drop to 0.1 ppm within 8 hours if the modelled evaporation estimates (27-34%) are used. If 50% of the condensate is assumed to evaporate, the in-water condensate concentrations will drop to 0.1 ppm within about 4 hours. The width of the condensate cloud will be 2 to 2.5 km when it reaches 0.1 ppm.

The outcome of the acid gas injection well subsea blowouts will be similar to the production well blowouts. These slicks will start out about 900 m wide and 8 µm thick and persist on the surface for a very short time. The initial in-water condensate concentrations from these releases will be about 0.6 ppm and will drop to 0.1 ppm within 15 hours. The width of the condensate cloud will be about 2 km when it reaches 0.1 ppm after traveling between 4 and 6 km from the release point.

The pipeline failure modelling assumes full production flow rates for the gas and condensate. The results of the modelling are valid for the case where the pipeline or flowline are not shut in and continue to flow for an extended period. This would be considered a worst case scenario. For example, a flowline could be ruptured and the SSIV in the well or valves on the subsea well tree fail when attempts are made to shut in the well feeding the flowline. The flowline would release product until the well flow is stopped. This would be a very low probability event.

The fate of the subsea production flowline releases will also be similar to the well subsea blowouts. These surface slicks will start out about 1340 m wide and 7 µm thick and persist on the surface for a very short time. The initial in-water condensate concentrations from these releases will be about 0.5 ppm and will drop to 0.1 ppm within 19 hours. The width of the condensate cloud will be about 3 km when it reaches 0.1 ppm after traveling for between 5 and 8 km from the release site.

The fate of the subsea acid gas injection flowline releases will also be similar to the well subsea blowouts. These slicks will start out somewhat narrower (520 m wide) and thicker (20 µm thick) but will also persist on the surface only for a very short time. The initial in-water condensate concentrations from these releases will be about 1.3 ppm and will drop to 0.1 ppm within 16 hours. The width of the condensate cloud will be about 2 km when it reaches 0.1 ppm after traveling for between 4 and 7 km from the release site.

The fate of the SOEP Subsea Option pipeline release will also be similar to the other subsea releases modelled. These slicks will start out about 1.5 km wide and 6.5 µm thick and persist on the surface for a very short time. The initial in-water condensate concentrations from these releases will be about 0.5 ppm and will drop to 0.1 ppm within 19 hours. The width of the condensate cloud will be about 3 km when it reaches 0.1 ppm after traveling about 5 km from the release site.

Surface Blowout Fate and Behaviour

Surface blowouts associated with production wells will generate relatively narrow (about 200 m wide) and relatively thin (7 µm) slicks. About 70% of the condensate will evaporate in the air prior to reaching the water surface and the remaining condensate will disperse into the water within minutes, under average wind conditions.

The fate of the acid gas injection well surface blowouts will be very similar to the production well blowouts. The initial slicks will be about 150 m wide and 15 µm thick. About 70% of the condensate will evaporate in the air prior to reaching the water surface and the remaining condensate will quickly disperse into the water. The resulting dispersed condensate clouds will diffuse to 0.1 ppm condensate concentration in 5-7 hours and have a width of about 600 m at this point about 1 to 2 km from the release point.

No condensate is predicted to reach the shores of Sable Island (approximately 48 km away) or mainland Nova Scotia. The distance the surface condensate slick will disperse is a

function of the evaporation and dispersion rate, and the surface drift speed of the slick. The condensate release from the Uniacke G-72 incident is an example of an accidental event where there was no detectable condensate (surface slicks, aerosols or in-water condensate) at distances greater than 10 km from the source (Martec Limited 1984).

The Uniacke blowout occurred February 22, 1984 and continued for 10 days. The gas and condensate aerosol plume was estimated to rise approximately 10 m above its point of exit at the rotary table on the drilling floor. The slick that formed from the condensate fallout was approximately 300 m wide near the source and spread to a width of approximately 500 m. It was estimated that between 50 to 70% of the condensate volume evaporated in the air prior to reaching the water. Seventy-five percent of the slick area was estimated to be 1.8 μm thick. Condensate was detected in the upper 20 m of the water column, up to 10 km from the well, in concentrations generally below 100 ppb. The maximum in-water condensate concentration measured was 1.5 ppm. The slick was observed to physically dissipate once the well was capped and there were no visual observations of a residual slick on over-flights the day after capping (day 11 after the blowout) (Martec Limited 1984).

Comparison of Modeling Results with Approved 2002 CSR

A general comparison of the new offshore spill modelling results with those presented in the approved 2002 CSR is provided in Table 4.2. In general, the new modelling results present potential impact zones similar to or less than those identified in the approved 2002 CSR.

Table 4.2 Comparison of New Modelling Results with Approved 2002 CSR Modelling Results	
Spill Scenario	New Spill Fate Results Compared to Approved 2002 CSR
Batch Diesel - 10 and 100 barrel	<ul style="list-style-type: none"> • Different travel distances (less in most cases) of surface slicks and oil clouds; otherwise fate of oil as in approved 2002 CSR
Batch Condensate - 10 and 100 barrel	<ul style="list-style-type: none"> • Different travel distances of surface slicks and oil clouds; otherwise fate of oil as in approved 2002 CSR
Subsea Well Blowouts (various sites)	<ul style="list-style-type: none"> • Lower condensate and gas flow rate reduces impact zone sizes when compared to approved 2002 CSR • New locations and depths result in insignificant differences in general fate and trajectory when compared to approved 2002 CSR
Surface Well Blowouts (various sites)	<ul style="list-style-type: none"> • Lower condensate and gas flow rates reduce impact zone sizes when compared to approved 2002 CSR • New locations and depths result in insignificant differences in general fate and trajectory when compared to approved 2002 CSR
Acid Gas Injection Well Blowouts (subsea and surface)	<ul style="list-style-type: none"> • Smaller condensate and gas flows reduce impact zone compared to approved 2002 CSR
Subsea Production Flowline Release	<ul style="list-style-type: none"> • Modelled as a mini blowout of full flowline flow release - short-lived event • Impact zone sizes similar to new subsea blowout results that are smaller than those presented in the approved 2002 CSR
Subsea Acid Gas Injection Flowline Release	<ul style="list-style-type: none"> • Modelled as a mini blowout of full flowline flow release - short-lived event • Impact zone sizes similar to new subsea blowout results that are smaller than those presented in the approved 2002 CSR
SOEP Subsea Option Pipeline Release	<ul style="list-style-type: none"> • Modelled as a mini blowout of full pipeline flow release - short-lived event • Impact zone sizes similar to new subsea blowout results that are smaller than those presented in the approved 2002 CSR

5.0 Environmental Management

Environmental protection is fundamental to offshore exploration, development and production operations and forms an integral part of an operators Environment, Health and Safety (EHS) Management System. EnCana has committed to the implementation of the international best practices for Environmental Management Systems. This section outlines EnCana's commitment to health, safety and environmental management, with an emphasis on environmental management for the Deep Panuke Project.

5.1 Environmental Management Framework

EnCana's environmental management framework is illustrated in Figure 5.1. These plans will be developed and continually revised as the Project moves through the phases of design, construction, installation, production, and decommissioning. Inherent in the environmental management system is the provision for continual improvement, and adaptability to allow the system to respond to environmental challenges so that predicted and actual effects are managed effectively.

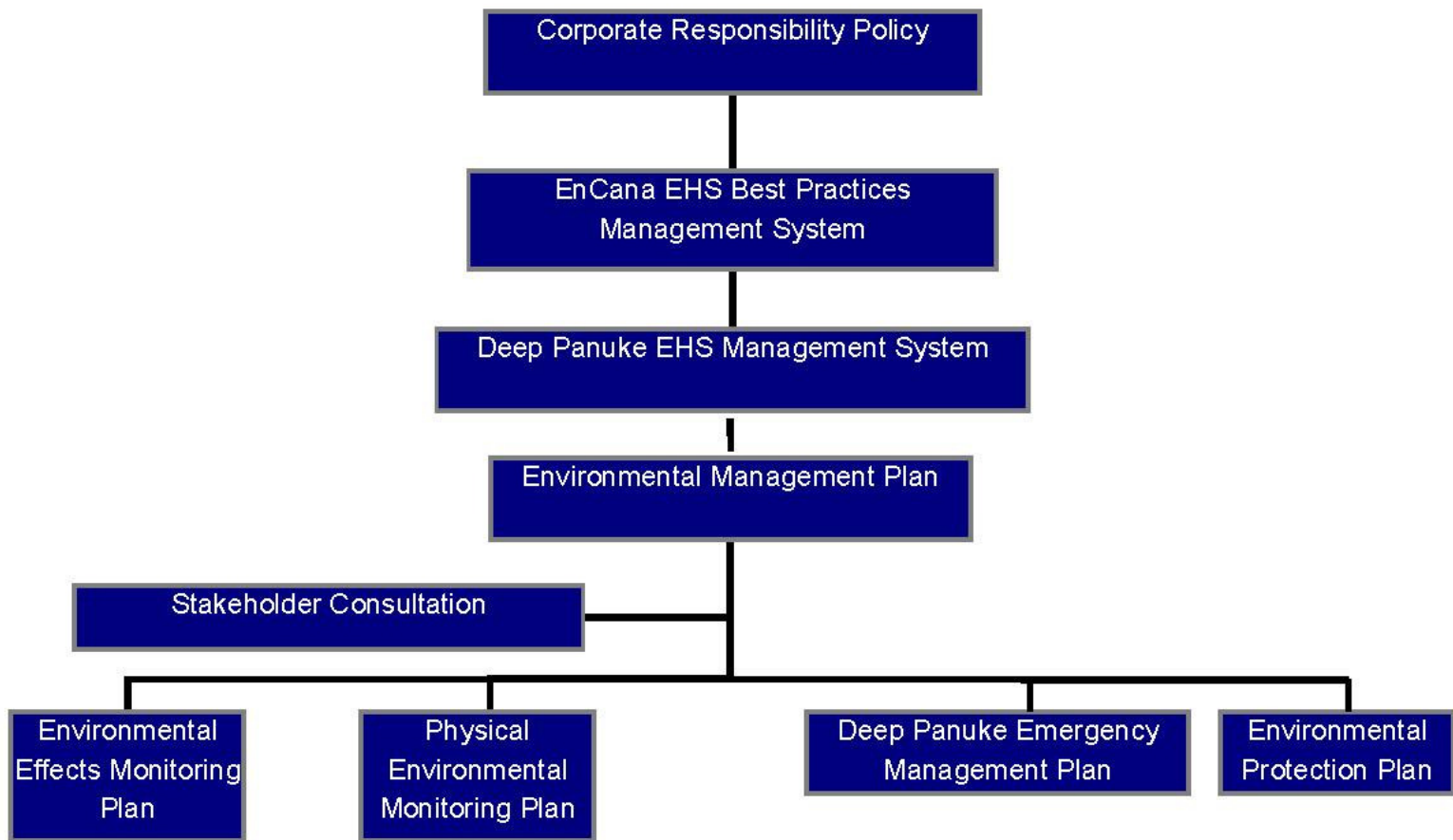
Proposed tables of contents for the following plans are provided in Appendix G of EnCana's EA Report:

- Deep Panuke Spill Response Plan;
- Deep Panuke Emergency Management Plan (DPEMP);
- Environmental Effects Monitoring Plan (EEMP); and
- Environmental Protection Plan (EPP).

This list of environmental plans for the Project has been modified from that presented in the approved 2002 CSR to accurately reflect the current Deep Panuke environmental management system.

Details of the plans will be finalized once the Project design is completed. The plans will be developed in consultation with the applicable regulatory agencies to ensure that their concerns are addressed in the planning process. Full versions of these plans will be provided to the regulators prior to Project start-up.

Figure 5.1 Deep Panuke Environmental Management Framework



5.1.1 Corporate Responsibility Policy

In EnCana's Corporate Responsibility Policy, it commits to:

- safeguarding the environment and operating in a manner consistent with recognized global industry standards in environment, health, and safety;
- striving to make efficient use of resources, to minimize its environmental footprint, and to conserve habitat diversity and the plant and animal populations that may be affected by its operations; and
- striving to reduce its emissions intensity and increase its energy efficiency.

5.1.2 EHS Best Practice Management System

The EnCana EHS Best Practice Management System is a corporate-wide safety and environmental management system designed to guide all levels of employees, contractors and sub-contractors in achieving the desired level of EHS performance. The ten elements that make up the best practices focus on areas that are applicable to all operating entities within EnCana, and consist of:

1. Leadership;
2. Managing risk;
3. Emergency preparedness and response;
4. Assuring competency;
5. Conducting our business responsibly;
6. Ensuring contractor and supplier performance;
7. Managing incidents;
8. Documentation management;
9. Reporting EHS performance; and
10. Evaluating system effectiveness.

5.2 Deep Panuke Emergency Management Plan

EnCana's Deep Panuke Emergency Management Plan (DPEMP) will contain specific provisions for the notification, assessment and response to environmental incidents. The DPEMP will provide emergency response command and control functions for both onshore and offshore emergency situations and will cover foreseeable emergencies during all phases of the Deep Panuke Project lifecycle. The DPEMP will take into account hazard identification and assessment, environmental considerations, consultation with government agencies, incorporation of industry best practice and use of external support resources.

5.3 Deep Panuke Spill Response Plan

The Deep Panuke Spill Response Plan will be subset of the DPEMP. The purpose of this plan is to respond to spills that may result during offshore activities related to the development of the Deep Panuke Project. The plan will include planning considerations, response, and spill environmental effects monitoring.

5.4 Deep Panuke Environmental Effects Monitoring Plan

EnCana will implement an EEMP for the lifecycle of the Project. The EEMP will take into account:

- environmental effects predictions in the approved 2002 CSR, EnCana's 2006 EA Report and this CSR;
- findings of the EEM program;
- recommendations of the Public Review Joint Environmental Report (JER);
- mitigation measures for various effects; and
- issues that may arise regarding environmental sustainability.

Specific programs to address these issues will be developed in consultation with the regulatory authorities having jurisdiction in such matters. This planning process will be facilitated by the CNSOPB, using the "Environmental Effects Monitoring Coordination Framework (April 12, 2005)", which was developed by CNSOPB, DFO and EC in consultation with CEAA.

5.5 Environmental Protection Plan

In accordance with CNSOPB requirements, EnCana will implement environmental protection measures to mitigate potential environmental effects arising from its activities, which will be documented in their EPP. The EPP will be developed by EnCana during the detailed engineering phase of the Project in consultation with regulators and key stakeholders. It will be developed to ensure the implementation of EnCana's environmental commitments and regulatory requirements. The EPP will be an integral component of environmental inspection under EnCana's Deep Panuke EHS Management System and will be updated as required over the life of the Project.

The EPP will include environmental protection procedures for general activities common to all phases in the Project lifecycle. The EPP will cover the various Project phases/activities/procedures to provide clear and specific instruction and guidance to employees and contractors during these short term, but critical, phases of Project development. The EPP will cover practices such as spill response, waste and chemical management; activities associated with onshore and offshore construction and decommissioning and compensation for fishing and aquaculture vessel and gear damage. Corporate environmental Codes of Practice (see Appendix G of EnCana's EA Report) will also be included in the EPP. Also, the strategy and overall approach to spill response will be dealt with in the DPEMP.

The EPP will be developed to provide detailed guidance, in particular for Project personnel (including contractors), on methods of eliminating or minimizing and mitigating adverse environmental effects from the Project.

An important aspect of the EPP is environmental compliance monitoring (ECM), which ensures compliance with all regulatory requirements and self-imposed environmental commitments. EnCana will use ECM to monitor performance standards developed for the Project. ECM will primarily involve monitoring for conformance with the discharge limits identified in the OWTG (NEB *et al.* 2002) and targets set by EnCana.

The EPP will address routine and abnormal conditions and emergencies that can reasonably be anticipated. Specifically, the CNSOPB's *Nova Scotia Offshore Area Petroleum Production and Conservation Regulations* stipulate the development of a program to monitor the effects on the natural environment of routine operations of a production installation, and identification of the measures adopted to minimize or mitigate these effects. Compliance monitoring programs ensure that the composition of operational discharges is in accordance with the limits specified in the EPP.

To ensure the successful implementation of environmental protection procedures, the EPP will include a clear description of the roles and responsibilities of all personnel having environmental responsibilities. This description will provide clear direction related to accountability, lines of communication and reporting relationships.

5.5.1 Chemical Management

The EPP will include chemicals management guidelines that will reflect regulatory and EnCana's own EHS Management System requirements, such as:

- a general commitment to use the safest and most environmentally friendly chemical products, and to minimize volumes of chemicals stored on the MOPU, used and discharged;
- screening of all chemicals expected to be discharged to the water through the most recent version of the OCSG to ascertain allowable discharge rates, their impact on the environment and/or determine other precautionary measures to be incorporated;
- compliance with the most recent guidance published under CEPA, including information gathering requested under EC's New Chemical Management Plan¹ (e.g., the industry challenge program) as well as potential chemical-specific risk management measures resulting from that initiative (e.g., virtual elimination, performance agreements);
- chemical handling, transportation and disposal requirements, such as TDG and WHMIS; and
- development of a chemical management database for the Project to track information such as product description (including MSDS) and use, supplier, chemical selection/approval process (including maximum allowable discharge rates when applicable), safety considerations and training requirements, maximum stock on hand and storage requirements, transport requirements, disposal requirements, volumes used and discharged, etc.

Additional guidance on disposal of chemicals will be provided under the waste management section of the EPP.

EnCana will contractually require that its contractors comply with these commitments and will verify compliance through periodic monitoring and auditing.

¹ http://www.ec.gc.ca/CEPARRegistry/subs_list/dsl/s1.cfm

6.0 Public and Aboriginal Participation

Overall, there has been considerable public participation in the Deep Panuke review (including input from Aboriginal groups), both during 2002 comprehensive study and during the current EA and regulatory review. This section describes the efforts undertaken during the current review. Should the project proceed, communication with key affected parties will continue as it moves through the construction and operation phases.

6.1 Responsible Authorities Consultation on the Environmental Assessment

The comprehensive study process requires that the public be given an opportunity to participate in the EA. Public participation is required during three distinct stages of the comprehensive study: during scoping, during the preparation of the comprehensive study and during the comment period administered by the Agency on the completed CSR.

A public registry has been established for the EA, and the EA is listed on the Canadian Environmental Assessment Registry (CEAR reference number 06-03-21748). Many of the EA documents are available on the Board's own Public Registry internet site located at <http://www.cnsopb.ns.ca/environment/registry.html>, in the "Deep Panuke Project" section.

In addition, the CNSOPB and NEB coordinated a public review (referred to as the Public Process) of Deep Panuke. A Secretariat was established to support the CNSOPB Commissioner and NEB Member Public Process. The Secretariat established a 'Public Record' on its website (<http://www.deeppanukereview.ca/publicrecord/index.html>) to facilitate public access to documents. The Public Process is discussed further in Section 6.1.2.

6.1.1 Scoping Document

The RAs invited written public comment on the draft scoping document and the ability of the comprehensive study to address issues relating to the project from September 22 to October 13, 2006. On behalf of all the RAs, the CNSOPB advertised in provincial and community newspapers explaining the process and providing details of how the public could submit comments. In addition, the CNSOPB issued a news release which was distributed throughout the province, and posted electronically to the CNSOPB website, with links to electronic copies of the Project Description and draft Scoping Document. The CNSOPB also directly notified its media, fisheries and industry contacts. The public was invited to contact the CNSOPB's offices for a printed copy if they did not have access to an electronic one.

On behalf of the RAs, the CNSOPB responded in writing to acknowledge receipt of all comments, and the RAs considered all comments in finalizing the Scoping Document and preparing the track report for the Minister. All comments received were posted on the CNSOPB web site.

Written comments were received from the Native Council of Nova Scotia, Myles and Associates, Municipality of the District of Guysborough, Guysborough County Regional Development Authority, the Canadian Parks and Wilderness Society (CPAWS), and Greyhawk Ridge Minerals Inc. and Mr. Kevin McAllister. In addition to requesting public comments, the CNSOPB requested comments from its Fisheries Advisory Committee (FAC). The FAC is comprised of representatives of the fisheries sector from across Nova

Scotia (including aboriginal groups), as well as federal and provincial government fishery department representatives. No comments were received from the committee.

After considering the comments from the public, the RAs modified the Scoping Document to include a requirement for the EA to examine the project in the context of the draft Eastern Scotian Shelf Integrated Ocean Management (ESSIM) Plan (final draft July 20, 2006). The Plan contains management goals and objectives which should be considered in the development of the EA.

6.1.2 Environmental Assessment

The second phase of the public consultation process was conducted through the coordinated regulatory process (Public Process) established by the CNSOPB and the NEB, for the public review of the project applications, which included EnCana's EA Report. This provided the public with an opportunity to participate in the preparation of the comprehensive study, as required by Section 21.2 of CEEA.

The CNSOPB appointed a Commissioner, and the NEB appointed one of its Board Members to conduct the Public Process. The "Deep Panuke Coordinated Public Review Secretariat" (the Secretariat), was established to support the CNSOPB Commissioner and the NEB Member.

EnCana's EA Report was submitted on November 9, 2006 and posted electronically on the Secretariat's website. Notices were placed in provincial and community newspapers explaining the process and inviting public comments on the Project, and advertising two Public Consultation sessions intended to answer the public's questions about how the process would work. One session was held in Halifax on November 27th, and another on November 29th in Guysborough.

The public was invited to submit written and oral comments on the proponent's EA Report during the Public Process, in accordance with the Directions on Procedures issued jointly by the two Boards (http://www.deeppanukereview.ca/publicprocess/CNSOPB_NEB_JDOP_Final.pdf). The Public Process included initial public consultation sessions by the CNSOPB Commissioner and NEB Board Member, a written evidence and information request/response process, and an oral hearing. Members of the public were able to choose the level and extent of involvement in the Public Process that best suited their interests and needs, including filing a letter of comment, providing an oral statement, seeking intervener status, or attending the hearing as an observer.

The Public Process included oral hearings that were conducted from March 5 to 9, 2007. The hearings considered all aspects of the project (environment, development plan, benefits plan, pipeline facilities, etc.), with the CNSOPB Commissioner and the NEB Member as joint chairs. The RAs considered the written and oral submissions relating to the EA made during the Public Process, and the Commissioner and NEB Member's JER, prior to finalizing this CSR. All public submissions, EnCana's responses, and the JER, are available on line at <http://www.deeppanukereview.ca/publicrecord/index.html>. The JER is also available at: <https://www.neb-one.gc.ca/leng/livelink.exe?func=ll&objId=441384&objAction=browse&sort=-name>

Public concerns raised during the Public Process are summarized in Appendices C and D of the CSR, along with an explanation of how the comments were considered by the RAs in the CSR.

Participant Funding

Participant funding is available from CEAA for every comprehensive study conducted under the CEAA. The availability of the funding for the Deep Panuke EA was published on November 13, 2006. The funding is intended to assist the public in participating in the comprehensive study. Funding was provided to the Native Council of Nova Scotia, CPAWS, Seafood Producers Association of Nova Scotia and the Sierra Club of Canada, Atlantic Canada Chapter. Further details are available on the CEA Agency's Internet site.

6.1.3 Review of Completed CSR

The public has its final opportunity to comment after the completed CSR is submitted to the CEA Agency and the Minister. At that time, the CEA Agency will invite public comment on the report, its conclusions, recommendations, or any other aspect. The Minister will consider the CSR and any public comments filed during this stage of the review before issuing an EA decision statement.

6.1.4 Responsible Authorities' Aboriginal Engagement

CEAA requires RAs to consider the effects of any change in the environment on: health and socio-economic conditions; physical and cultural heritage; the current use of lands and resources for traditional purposes by aboriginal persons; or any structure, site or thing that is of historical, archaeological, paleontological or architectural significance.

Toward fulfilling this obligation with respect to aboriginal persons, EC, IC, TC and DFO, in their capacity as RAs for the Deep Panuke EA, participated in meetings with the Kwilmu'kw Maw-klusauqn (KMK) and the Native Council of Nova Scotia. The RAs provided an overview of the CEAA process (including coordination with the NEB/CNSOPB public review), as well as additional regulatory requirements (e.g., Navigable Waters Protection/Disposal at Sea/HADD authorizations) that could be triggered after the CSR is completed. No potential environmental effects specific to aboriginal interests were identified at that time. However, the potential for further opportunities to engage Aboriginal persons was discussed. In addition, the Native Council of Nova Scotia applied for and received CEAA funding to support their participation in this Comprehensive Study, and participated as an Intervenor in the coordinated NEB/CNSOPB public review. The Confederacy of Mainland Mi'kmaq and the Union of Nova Scotia Indians were also Intervenors. Section 10.1 further discusses the results of the Public Process relative to Aboriginal Concerns. Discussions will continue to occur as required.

6.2 EnCana's Consultation Program

In addition to the public comments requested by the RAs, EnCana undertook a stakeholder consultation program focused on a diverse variety of groups and individuals, including nearshore and offshore fishing interests, local municipalities and regional development authorities, residents and businesses in the Guysborough County area, scientists, regulatory agencies, environmental non-governmental organizations (ENGOS), aboriginal groups and the interested general public.

EnCana conducted a substantial consultation process on the Project between 2000 and 2002 as part of the process culminating in the EA and the submission, review, and Ministerial approval of the CSR in December 2002. This consultation program facilitated stakeholder input to the preparation of the approved 2002 CSR and Project planning.

In 2006, EnCana initiated a public consultation program to ensure that stakeholders and the interested public received up-to-date information, specifically on the changes proposed by EnCana to the Project. In addition, the consultations were designed to offer the public an opportunity to respond to these Project changes and provide input into Project planning, including finalization of the EA Report. It targeted a similar set of stakeholders as the previous process, but also included several new or emerging organizations that had not been previously consulted. The consultation program also sought to identify any changes in stakeholders' activities or areas of interest (commercial, ecological, administrative, or regulatory) since the previous round of consultation in 2001. This process was also intended to advise stakeholders of future opportunities to engage in the regulatory process and form the basis for ongoing communication and consultation during the application review, post application follow-up process, and ultimately, Project construction, operation and decommissioning.

A detailed description of EnCana's consultation program is presented in Section 5 and Appendix H of EnCana's EA Report.

In general, it appears the proponent had a high degree of success in contacting, communicating with, and scheduling subsequent consultation sessions. Most groups were interested and able to participate during the EA. Table 6.1 lists stakeholders contacted by EnCana during the preliminary phases of its consultation program.

Table 6.1	Stakeholders Contacted During Phase I
Fisheries Groups	
Area 24 Crab Fisherman's Association	
Atlantic Aqua Farms, N.S. Limited (Country Harbour Sea Farms Ltd)	
Atlantic Herring Co-operative	
Clearwater Seafoods Limited Partnership	
Eastern Fishermen's Federation	
Eastern Shore Fishermens Protective Association	
Maritime Fisherman's Union Local 6	
Guysborough County Inshore Fishermen's Association	
Shelburne County Quota Group	
Nova Scotia Sword Fishermen's Association	
Seafood Producers Association of Nova Scotia (SPANS)	
Sambro Fisheries Limited	
Nova Scotia Fixed Gear 45-65	
Scotia Fundy Mobile Gear Fishermen's Association	
Sea urchin harvester (McGrath, Manthorne)	
Environmental Non-Governmental Groups (ENGOS)	
Canadian Parks and Wilderness Society	
Clean Nova Scotia Foundation	
Coastal Coalition	
Coastal Communities Network	
Ecology Action Centre	
World Wildlife Fund	
Sierra Club of Canada	
Sable Island Green Horse Society	
Sable Island Stakeholder Committee	
Nova Scotia Leatherback Turtle Working Group	
Nova Scotia Environmental Network	
Government	
Natural Resources Canada	
Department of Fisheries and Oceans	
Environment Canada	
Nova Scotia Department of Agriculture and Fisheries	
Guysborough County Regional Development Authority	
Municipality of the District of Guysborough	
Aboriginal Groups	
Maritime Aboriginal Aquatic Resources Secretariat	
Each of the Chiefs of the thirteen (13) Bands in Nova Scotia (Appendix I)	
Confederacy of Mainland Mi'kmaq (Appendix I)	
Union of Nova Scotia Indians (Appendix I)	

A summary of EnCana's consultation activities prior to preparing their EA is provided below:

- Two meetings were held with DFO (July 25 and August 9, 2006) to introduce the Project, address any comments, and determine the best way to gather information required for the EA, as well as how best to consult with other fisheries, scientific and other stakeholders.
- Several meetings were held with the Municipality of Guysborough and the GCRDA (between August and October 2006) to discuss Project plans, particularly the evaluation of routing options onshore, interactions with other land uses and plans, economic benefits and potential local access to gas for further industrial development.
- A meeting was held with ENGO representatives (August 15, 2006) to review the Project plan and discuss design and implementation of Project options, with particular focus on potential interactions with or impacts on valued environmental components. Eight of ten invited ENGOs were represented at this meeting.
- Fisheries and aquaculture interests were interviewed via telephone and in person meetings. Approximately ten substantive phone conversations or interviews were conducted and six face-to-face consultation meetings or group presentations took place.
- Open Houses were held in the Goldboro area (Isaacs Harbour Fire Hall) and Guysborough in September and November 2006. Comments and questions were considered in Project planning, environmental and socio-economic assessment, or to ensure follow-up.
- A meeting was held with the FAC of the CNSOPB on September 13, 2006. An update was provided on the Project plan, including a discussion of design and implementation of Project options. Discussions with fisheries stakeholders focussed on the regulatory process, consultation, environmental management, and EEM.
- A meeting was held with EC July 26, 2006 to discuss a variety of issues such as air quality, disposal at sea, migratory birds and species at risk.

The input and comments received by EnCana through this program were broad ranging and reflected a variety of perspectives about the value, need and scope of the Project, and about oil and gas development offshore Nova Scotia generally. This input was incorporated into the environmental and socio-economic assessment process. The following key topics were raised and are addressed as appropriate in the relevant EA sections:

- acid gas injection technology and sour gas;
- offshore pipeline/flowlines routing and installation;
- onshore pipeline routing and installation;
- drilling activities and use of drilling muds;
- effects on fishing activities;
- offshore safety zone, dimensions and fishing restrictions;
- effects on the ecosystem, particularly benthic communities, species at risk and commercial species;
- air quality impacts;
- impacts associated with greater levels of produced water;
- health and safety of workers and nearby fishers;
- large scale or consequential accidental or emergency events and spills;
- cumulative effects such as climate change;
- economic benefits, employment and training;

- monitoring of impacts; and
- residual effects resulting from and following decommissioning.

Aboriginal Communications

EnCana also communicated with Aboriginal groups to establish relationships and initiate discussions with respect to the currently proposed Project and to highlight the findings and conclusions of the approved 2002 CSR, respecting Aboriginal related matters, as well as EnCana's commitments on Aboriginal matters in its 2002 Project submissions. EnCana's current Aboriginal communication program (the Program) has been undertaken with the advice and recommendation of the Province of Nova Scotia, with guidance from the Province's draft policy on consultations with the Mi'kmaq, dated June 14, 2006.

Introductory letters were sent to the following organizations in July, 2006: each of the Chiefs of the thirteen (13) First Nations in Nova Scotia; the Confederacy of Mainland Mi'kmaq; and the Union of Nova Scotia Indians. EnCana received a reply to the letters from the Lead Negotiator for the Planning and Priorities Committee of the Assembly of Nova Scotia Mi'kmaq Chiefs, advising that the legal entities entitled to engage in consultation issues are the 13 First Nations through their Chiefs and Councils.

EnCana replied to the Lead Negotiator advising, among other things, of a prior Technical and Ecological Knowledge survey carried out in the area where the Deep Panuke onshore pipeline is anticipated to be located and of EnCana's commitments to Aboriginal people in its approved 2002 CSR to include Aboriginal representatives in pipeline right-of-way inspections.

Correspondence between EnCana and Aboriginal People regarding these communications is provided in see Appendix I of EnCana's EA Report.

EnCana also consulted with the Maritime Aboriginal Aquatic Resources Secretariat with respect to potential fisheries interactions with the Project.

7.0 Scope of the CSR

Based on the information contained in the project description the RAs prepared a scoping document entitled "Scope of the Environmental Assessment for the Proposed EnCana Corporation Deep Panuke Offshore Gas Development Project". The scoping document is included in Appendix A and is also available on the CNSOPB website (www.cnsopb.ns.ca) under the Environment section in the Public Registry or from the CNSOPB office. The scoping document directs the preparation of the comprehensive study to determine whether or not the project is likely to cause significant adverse environmental effects. In developing the scoping document, the RAs consulted with the CEAA, NRCan (expert Federal Department), fisheries groups and the public.

The Deep Panuke project, albeit in a different configuration, was the subject of a comprehensive study that was conducted in 2001-02, at the conclusion of which the Minister chose not to refer the project to a review panel, instead referring it back the RAs for regulatory decision-making. On November 9, 2006 the Minister recommended that assessment of the new project also be completed as a comprehensive study.

The CEAA requires that the previous EA be used to whatever extent is appropriate in conducting the EA of the new project. Section 24 states:

"24. (1) Where a proponent proposes to carry out, in whole or in part, a project for which an environmental assessment was previously conducted and

- (a) the project did not proceed after the assessment was completed,
- (b) in the case of a project that is in relation to a physical work, the proponent proposes an undertaking in relation to that work different from that proposed when the assessment was conducted,
- (c) the manner in which the project is to be carried out has subsequently changed, or
- (d) the renewal of a licence, permit, approval or other action under a prescribed provision is sought, the responsible authority shall use that assessment and the report thereon to whatever extent is appropriate for the purpose of complying with section 18 or 21.

(2) Where a responsible authority uses an environmental assessment and the report thereon pursuant to subsection (1), the responsible authority shall ensure that any adjustments are made to the report that are necessary to take into account any significant changes in the environment and in the circumstances of the project and any significant new information relating to the environmental effects of the project."

Furthermore, the new proposed Project shares many similarities with the original proposal. Therefore, a great deal of the information from the original EA remains applicable and was used. This new CSR focuses on undertakings differing from the Project originally proposed by the proponent (and assessed in the 2002 CSR), or those affected by information that has become available since 2002. Regulatory and policy changes since the original EA have also be taken into account, as well as any significant changes in the environment and any significant new information about the project's environmental effects.

The scope of the assessment includes a consideration of factors set out under subsection 16(1) and 16(2) of the CEEA. The scope of the EA for the proposed Project was determined to require consideration of environmental effects related to:

- Accidental Releases
- Increased Produced Water Discharge
- Air emissions
- Presence of new sub-sea infrastructures
- Construction work for subsea infrastructures
- Drill Waste Discharges
- Near-Shore and Onshore Effects
- Wildlife and Habitat
- Impediments to Navigation
- Species at Risk
- Cumulative Effects
- Capacity of renewable resources that are likely to be significantly affected by the project
- Effects of the Environment on the Project.

Section 6 of EnCana's EA Report provides details on the EA scoping implications on the assessment related to: variations between the revised Project basis and the Project basis presented in the approved 2002 CSR; changes to the regulatory environment since the approved 2002 CSR; changes to the biophysical environment since the approved 2002 CSR; changes to the socio-economic environment since the approved 2002 CSR; and cumulative effects.

The purpose of the scoping exercise was to clearly define the scope of the assessment (i.e., identify gaps from the approved 2002 CSR) and identify issues that require reconsideration in the updated EA Report.

8.0 Biophysical and Socio-economic Setting

8.1 Biophysical Setting

8.1.1 Marine Physical Environment

The description of the marine physical environment presented in the approved 2002 CSR remains valid for the purposes of this assessment (refer to Section 6.1.1 of the approved 2002 CSR). In particular, descriptions of climatology, air quality, physical oceanography, water quality, sediment quality and marine geology and geomorphology remain generally applicable and do not require updates, considering the change in field centre location and proposed pipeline associated with the SOEP Subsea Option.

However, new information has become available with respect to nearshore sediment contamination in Isaacs Harbour. 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 Isaacs and Seal Harbour areas. Although these findings have yet to be published, consultation with NRCan has revealed some sampling sites in Isaacs Harbour show sediments containing elevated levels of arsenic and mercury up to 60 ppm and 470 ppb, respectively (EnCana Corporation, 2006). These reported levels are in excess of the CCME Interim Marine Sediment Quality Guidelines, which stipulate that concentrations of arsenic and mercury in sediments should not exceed 7.24 ppm and 130 ppb, respectively (CCME 2005).

Arsenic and mercury concentrations in surface sediments at the sampling point nearest EnCana's proposed nearshore pipeline corridor indicated arsenic levels between 4-10 ppm and mercury concentrations between 5-43 ppb (EnCana Corporation, 2006). Furthermore, sampling during the Deep Panuke 2001 nearshore pipeline route survey found no evidence of sediments contaminated from old mine tailings (refer to Section 6.3.9.3 of the approved 2002 CSR). Therefore, it is not expected that sediments contaminated by old mine tailings will be encountered during construction of the M&NP Option pipeline.

Additionally, new information has become available with respect to the meteorological, climatological and physical oceanographic conditions influencing the project. This new information includes a more up-to-date and complete set of physical environment data available from a variety of sources including AES40/MS50 data sets, waveriders and equipment on platforms in the area. A revised Environmental Design Criteria Study takes this most recent information into account, the results of which are discussed in section 9.13 of this Report.

8.1.2 Marine Biological Environment

Marine Benthos

Benthic Habitat and Communities in the Offshore Environment

The evaluation of benthic communities and habitat in the offshore Project area in the approved 2002 CSR (Section 6.1.2.1) was derived from information presented in the SOEP EIS (SOEP 1996a, 1996b), data collected for the Cohasset Project (John Parsons & Associates 1994), and site specific benthic habitat surveys (JWEL 2000a, 2000b; JWEL 2003). These data remain valid for the description of benthic habitat and communities for the new proposed Project Options. In addition, wellsite surveys in the project area which were conducted by EnCana were reviewed. These surveys are of high relevance in terms of facilitating the assessment of benthic communities and habitats in the new proposed Project footprint. A more detailed description of benthic habitat is provided in the updated Baseline Benthic Report (JW 2006).

The relocation of the field centre by approximately 3.6 km to the northeast of the original production platform location as per the approved 2002 CSR Project basis and the new field subsea structures will not require changes to the description of benthic habitat and communities. Benthic communities contained within the footprints of the MOPU and subsea equipment are expected to be similar to the habitat described in the approved 2002 CSR in the area surrounding the 2002 Project location. Appendix E of Addendum 1 Volume 2 *Deep Panuke Offshore Gas Development Responses to Comments from Regulatory and Public Review*, September 2002 provided additional information on the benthic environment related to the Deep Panuke project, as does the *Baseline Benthic Study for the Deep Panuke Subsea Pipeline and Production Facility*, December, 2006. Both these reports indicated that existing data from benthic and wellsite surveys can be extrapolated with a high degree of confidence to describe the physical, chemical and biological attributes of unassessed areas due to the spatial proximity of components and habitat homogeneity of Sable Island Bank.

In addition, EnCana has committed to (in response to Information Request DFO-ECA-9) “a pre-construction route survey will be conducted to confirm the assumptions (i.e., no corals or other sensitive habitats) along the unsurveyed sections of the export pipeline and flowline routes. In the unlikely case of corals or sensitive habitats being found along the proposed route(s), avoidance or other mitigative measures will be developed to minimize environmental effects. The specific types of measures to be taken, if necessary, will be determined in consultation with DFO, in consideration of the specific resource identified, proximity to the pipeline, and sensitivity to Project activities.

The M&NP Option consists of a dedicated pipeline from the MOPU to shore, partially paralleling the SOEP pipeline. This route is relatively unchanged from the approved 2002 CSR Project basis, with the exception of the first 37 km from the new field centre. As discussed above, a review of data collected in the general Project area suggests the description of existing conditions provided in the approved 2002 CSR (Section 6.1.2.1) for the offshore pipeline route remains valid despite the minor modification in the offshore pipeline route, primarily due to the habitat homogeneity of the Sable Bank. However, since the publication of the approved 2002 CSR, an experimental sea cucumber (*Cucumaria frondosa*) fishery zone has been designated in an area that will be transected by the M&NP Option export pipeline. Although the approved 2002 CSR identified this species as being

present in the Project area, benthic surveys and seafloor video reconnaissance in this area have not revealed the presence of sea cucumbers in large numbers. Also, the export pipeline options are in close proximity to concentrations of ocean quahog (*Arctica islandica*) identified as being present in the Project area in the approved 2002 CSR on Sable Island Bank.

The pipeline(s) for the SOEP Subsea Option would cross a 15 km area of Sable Island Bank that was not sampled during previous benthic surveys conducted in support of the approved 2002 CSR. Sable Island Bank is known to be an area of relatively homogeneous, sandy benthic habitat (Amos and Nadeau 1988; Breeze *et al.* 2002; Carter *et al.* 1985; JWEL 2000a, 2000b; JWEL 2003; John Parsons & Associates Biological Consultants 1994). As a result of the regional homogeneity of surficial sediment characteristics coupled with similar physical, chemical and biological conditions, the benthic communities in the area of the SOEP Subsea Option export pipeline(s) are expected to be similar as those described in the approved 2002 CSR for the offshore (Sable Island Bank) environment. As such, the description of existing conditions for marine benthos provided in the approved 2002 CSR remains valid. However, similar to the M&NP Option, this export pipeline(s) option is known to be in close proximity to concentrations of ocean quahog.

In consideration of the sandy, shallow and dynamic benthic habitat found over Sable Island Bank, it is very unlikely that any corals or other sensitive habitats lay within the footprint of the Project. Nonetheless, a pre-construction route survey will be conducted to confirm the assumptions (i.e., no corals or other sensitive habitats) along the unsurveyed sections of the export pipeline and flowline routes. In the unlikely case of corals or sensitive habitats being found along the proposed route(s), avoidance or other mitigative measures will be developed to minimize environmental effects. The specific types of measures to be taken, if necessary, will be determined in consultation with the CNSOPB and DFO, in consideration of the specific resource identified, proximity to the pipeline, and sensitivity to Project activities.

Benthic Habitat and Communities in the Nearshore Environment

Benthic sampling was conducted in 2002 to characterize the benthic habitat along the nearshore sections of the pipeline route to shore. The current proposed pipeline route to shore (M&NP Option) follows the same general route as the 2002 Base Case pipeline. As such, the description of existing conditions for the 2002 Project basis remains valid. Please refer to Section 6.1.2.1 of the approved 2002 CSR for a description of marine benthos in the nearshore environment. Refer also to updated information on potential sediment contamination in the vicinity of the nearshore pipeline route in Section 8.1.3.

Marine Fish

The description of marine fish contained in the approved 2002 CSR (Section 6.1.2.2) remains valid for this CSR with the exception of the designation of some fish species at risk. Since the publication of the approved 2002 CSR, there have been updates to the list of fish species at risk. Most species at risk are generally uncommon and their rarity makes accurate sampling difficult. Therefore, the distributions of at risk marine fish species (Table 7.1 of the EA Report (Volume 4), as determined by commercial catches and scientific cruise records, may not truly reflect abundance levels and distribution. The Ocean Biogeographic Information System (OBIS) is the information component of the Census of Marine Life and is

a web-based provider of global geo-referenced information on marine species. The OBIS website contains georeferenced data records of at risk fish species that may be present in the Project area.

Distribution maps of at risk fish species that may be present in the project area were generated by OBIS to determine distribution and relative abundance of at risk fish species on Sable Island Bank in the vicinity of the proposed Project. The results of this review and a general description of habitat requirements and likelihood of occurrence for each at risk fish species potentially present in the Project area is presented in Table 8.1. None of these species are common to the Project area, nor is there any appreciable evidence of spawning activity by any of these species within the immediate Project area (COSEWIC 2003a, b, 2004, 2005, 2006a, b; Campana *et al.* 2005; Kulka and Simpson 2004; Simon *et al.* 2003).

A map of the most recent data available (EAISSNA 2003) related to cod spawning in the vicinity of the Project area is provided in Figure 8.1. As shown, there is no documented occurrence of cod spawning in the immediate vicinity of the Project, therefore this information does not alter the analysis, conclusions or recommended mitigation as found in the EA Report with respect to this species at risk.

Table 8.1

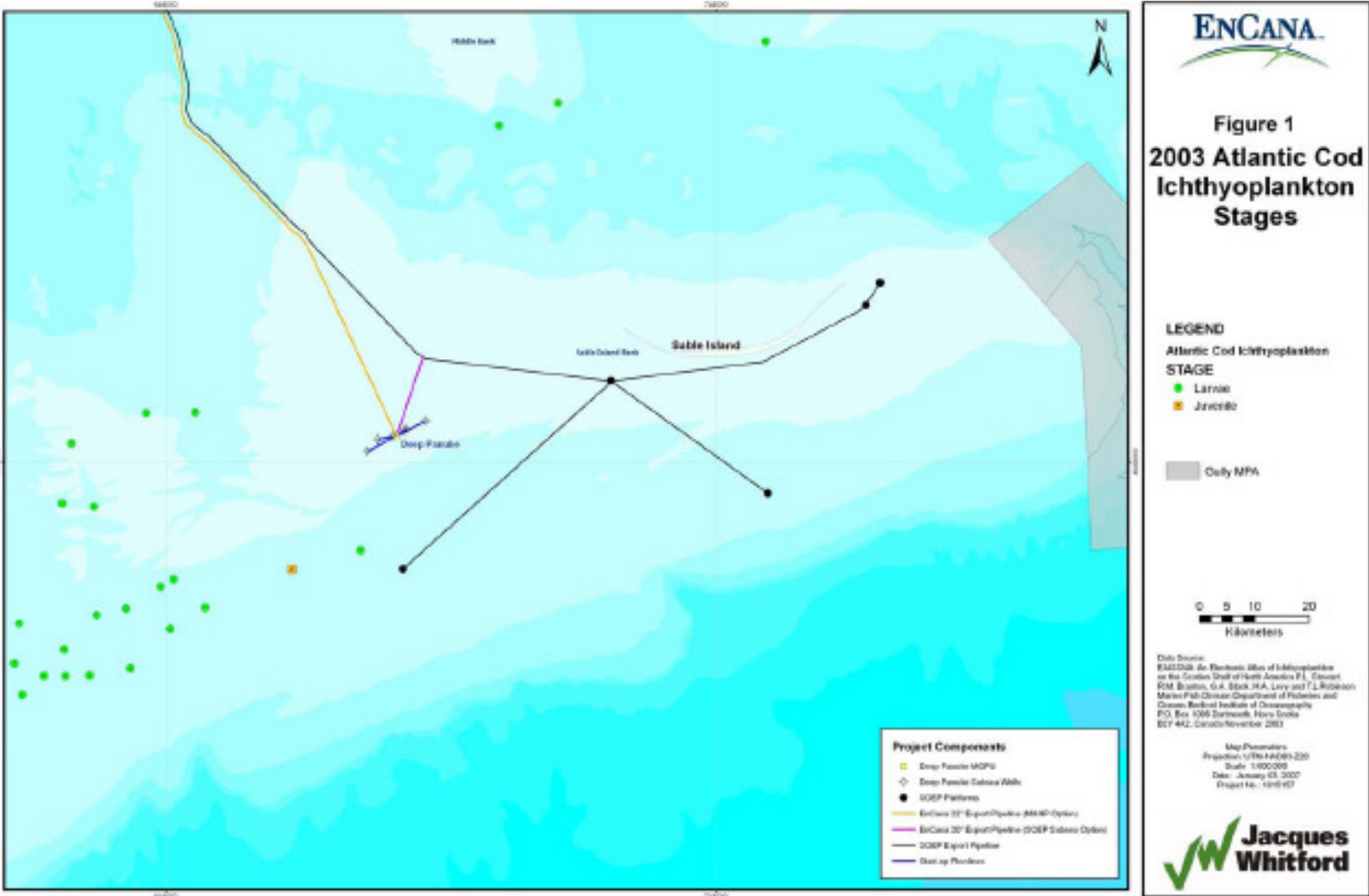
Habitat Requirements and Occurrence of at Risk Fish Species in the Project Area

Marine Fish Species	COSEWIC/ SARA Status	Distribution	Habitat	Spawning	Recorded within 10 km of field centre location	Occurrence in Project Area
Atlantic Cod (<i>Gadus morhua</i>) (Maritime Population)	COSEWIC Species of Special Concern (2003) SARA Recommended to not be listed under SARA (2005)	Inhabit all waters over the continental shelves of the Northwest and Northeast Atlantic Ocean (COSEWIC 2003a)	Adults found in diverse habitats including coastal waters and offshore banks (COSEWIC 2003a)	Not known if cod have specific spawning habitats Highly unlikely that spawning habitat is limiting (COSEWIC 2003a) Eggs are buoyant Spawning occurs on Sable Island Bank from September to May with a peaks November and May/June	Yes	Likely
Atlantic Wolffish (<i>Anarhichas lupus</i>) (Atlantic Population)	COSEWIC Species of Special Concern (2000) SARA Special Concern, Schedule 1 (2002)	Widely distributed across the North Atlantic and east coast of North America (Environment Canada 2006c)	Primary habitat includes cold deepwater of the continental shelf with rocky or hard clay bottoms. Rarely uses areas with sandy or muddy bottoms (Environment Canada 2006b)	Spawn in shallow inshore waters in spring and September (Environment Canada 2006c) No evidence of spawning in the Project area	No	Unlikely
Spotted Wolffish (<i>Anarhichas minor</i>) (Atlantic Population)	COSEWIC Threatened (2001) SARA Threatened, Schedule 1 (2002)	North Atlantic from Scotland to Cape Breton and in the Arctic Ocean. In Western North Atlantic it primarily occurs off northeast Newfoundland (Environment Canada 2006c)	Demersal; in cold continental shelf and slope waters ranging in depth from 20 to 600 m on sand substrates with large boulders (Environment Canada 2006c)	Spawns in summer, large eggs deposited en mass on sandy bottom. Young remain near bottom (Environment Canada 2006a) No evidence of spawning in the Project area	No	Highly unlikely

Marine Fish Species	COSEWIC/ SARA Status	Distribution	Habitat	Spawning	Recorded within 10 km of field centre location	Occurrence in Project Area
Northern Wolffish (<i>Anarhichas denticulatus</i>) (Atlantic Population)	COSEWIC Threatened (2001) SARA Threatened, Schedule 1 (2002)	Norway to Southern Newfoundland (Environment Canada 2006d)	In offshore cold waters < 5°C Depths of surface to 900 m primarily > 100 m (Environment Canada 2006d)	Spawning occurs late in the year with large eggs laid in nests and guarded No evidence of spawning in the Project area	No	Highly unlikely
Cusk (<i>Brosme brosme</i>) (Atlantic Population)	COSEWIC Threatened (2003) SARA Referred back to COSEWIC for further consideration (2005)	Inhabits subarctic and boreal waters Centre of abundance in the western Atlantic between 41 and 44°N (COSEWIC 2003b)	Occurs on hard, rough, and rocky substrates seldom on smooth sandy bottoms (COSEWIC 2003b)	Spawning from April to July with peak in later June on the Scotian Shelf Buoyant eggs Larvae in upper water column (COSEWIC 2003b) No evidence of spawning in the Project area	No	Unlikely
Porbeagle Shark (<i>Lamna nasus</i>) (Atlantic Population)	COSEWIC Endangered (2004) SARA Pending public consultation for addition to Schedule 1 listing date March 2006	Distributed across the North Atlantic and in a circumglobal band in the southern Atlantic, southern Indian, southern Pacific and Antarctic Oceans (COSEWIC 2004a)	Species is a pelagic, epipelagic or littoral shark most common on continental shelves In Canadian waters they occur in waters between 5-10°C (COSEWIC 2004a)	Mating in the Northwest Atlantic occurs from late September to November with parturition eight to nine months later (COSEWIC 2004a) No evidence of breeding in the Project area	No	Possible transient
Short-fin Mako (<i>Isurus oxyrubchus</i>) (Atlantic Population)	COSEWIC Threatened (2006) SARA Not listed	Circumglobally in all tropical and temperate oceans (EnCana Corporation, 2006)	Prefer temperate to tropical, littoral to epipelagic waters and are rarely found in waters of less than 16°C (EnCana Corporation, 2006)	Birth later winter to mid-summer after a 15 to 18 month gestation period (COSEWIC 2006c) No evidence of breeding in the Project area	No	Unlikely

Marine Fish Species	COSEWIC/ SARA Status	Distribution	Habitat	Spawning	Recorded within 10 km of field centre location	Occurrence in Project Area
Blue Shark (<i>Prionace glauca</i>) (Atlantic Population)	COSEWIC Special Concern (2006) SARA Not listed	Worldwide distribution Abundance peaks in western Canadian waters in late summer and fall (EnCana Corporation, 2006)	Offshore between surface and 350 m (EnCana Corporation, 2006)	Mating spring to early summer. Gestation 9-12 months (EnCana Corporation, 2006d) No evidence of spawning in the Project area	No	Possible transient
White Shark (<i>Carcharodon carcharias</i>) (Atlantic Population)	COSEWIC Endangered (2006) SARA Not listed	Globally sub-polar to tropical seas (EnCana Corporation, 2006)	Pelagic; inshore to offshore waters; surface to 1280 m (EnCana Corporation, 2006)	Little known of spawning Possible pupping grounds off the east coast of North America includes the Mid-Atlantic Bight (EnCana Corporation, 2006) No evidence of breeding in the Project area	No	Possible transient
Winter Skate (<i>Leucoraja ocellata</i>) (Eastern Scotian Shelf Population)	COSEWIC Threatened (2005) SARA Pending public consultation for addition to Schedule 1	Gulf of St. Lawrence and southern Newfoundland to Cape Hatteras in depths of 1 to 371 m (Simon <i>et al.</i> 2003)	Benthic feeders, usually found on sand and gravel in depths of 1 to 371 m (COSEWIC 2005a)	Egg release late summer and early fall west of Sable Island (Simon <i>et al.</i> 2003) No evidence of spawning in the immediate Project area Skate egg purses have been identified in the sea cucumber experimental fishery zone 1	Yes.	Likely

Figure 8.1: 2003 Atlantic Cod Ichthyoplankton Stages



Sea Turtles

The description of existing conditions for sea turtles in the approved 2002 CSR (Section 6.1.2.3) remains valid with the exception of recognizing the listing of leatherback sea turtle as endangered by SARA (refer to Section 8.1.4 for more information on SARA and requirements for listed species).

In 2006, a proposed recovery strategy for leatherback sea turtle was developed (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).

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 (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 the species. It is unlikely that juveniles venture into Atlantic Canadian waters, preferring to remain in waters warmer than 26°C until they exceed 100 cm (Atlantic Leatherback Turtle Recovery Team 2006).

Marine Mammals

The description of existing conditions for marine mammals presented in the approved 2002 CSR (Section 6.1.2.4) remains valid with the exception of the updated SARA and COSEWIC status for the species discussed in Section 8.1.4. Specific changes since the approved 2002 CSR include a status downgrade of the harbour porpoise and an elevated ranking status for the northern bottlenose whale.

There are three endangered marine mammal species that could potentially be present in the study area: blue whale, North Atlantic right whale, and northern bottlenose whale.

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 (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 2003c).

The COSEWIC *Assessment Summary for Northern Bottlenose Whale (Scotian Shelf Population)* (COSEWIC 2002) acknowledged that the exploitation of the “Cohasset/Panuke”

condensate fields which are 110 km from the Gully probably posed little threat to the bottlenose whales. The Deep Panuke Project is located in the same area as the Cohasset/Panuke site, approximately 100 km. from the Gully. In addition, DFO in 2004 designated the Gully as a Marine Protected Area under the *Oceans Act* and EnCana is a member of the Gully Advisory Committee. EnCana has developed, as part of its environmental protection planning, a Code of Practice for the Gully Marine Protected Area to protect the uniqueness and integrity of the Gully MPA.

Since the Deep Panuke Project (including new potential well locations) is more than 100 km from the Gully MPA and EnCana will abide by the Code of Practice for the Gully, any interaction between this project and the bottlenose whale population is expected to be insignificant.

Marine-Related Birds

The description of existing conditions of marine-related birds in the 2002 CSR (Section 6.1.2.5) remains valid with the exception of the updated SARA and COSEWIC status for the species discussed in Section 8.1.4. Marine-related birds refer to seabirds, shorebirds and other birds that use nearshore and offshore habitats in the vicinity of the Project at some point in their life cycle.

One bird species at risk not mentioned in the approved 2002 CSR was the Barrow's Goldeneye. Consideration of the Ivory Gull was limited to the accompanying document entitled *Additions and Errata for the Deep Panuke Comprehensive Study Report* (EnCana 2002).

Small numbers (about 400) of the Eastern population of Barrow's Goldeneye winter in the Atlantic Provinces and Maine. This species is not known to breed in the Maritimes. Population threats include oil spills and sediment contamination of key wintering areas. Therefore, limited interaction with Project activities is anticipated.

The Ivory Gull breeds in high-Arctic coastal areas (Environment Canada 2006e). No traditional nesting grounds have been identified in the study area and their presence in the study area is expected to be incidental; therefore limited interaction with Project activities is anticipated. EnCana committed to consider this species for protection in environmental management plans for the Project as applicable.

The remaining species listed in Table 8.5 were addressed in the approved 2002 CSR. However, with the enactment of SARA, there have been specific recovery strategies and/or management plans developed to help protect some of these species at risk. A recovery strategy is a planning document that identifies what needs to be done to arrest or reverse the decline of a species (Environment Canada 2006g). A management plan is an action-oriented planning document that identifies conservation activities and land use measures needed to ensure, at a minimum, that a species of special concern does not become threatened or endangered (Environment Canada 2006g).

The Harlequin Duck winters in two primary areas: the southwest coast of Greenland and the eastern coast of North America (from coastal areas of NL, south to Maryland). Wintering habitat consists of rocky coastline, exposed headlands, and subtidal ledges and Harlequin Ducks can also be associated with offshore islands. The proposed Management Plan for the Harlequin Duck (Environment Canada 2007) aims to maintain a wintering population of

3,000 individuals in eastern North America for three consecutive years. The Plan also indicates that in the wintering and moulting locations, fishing nets, aquaculture, illegal/accidental harvesting, boating, and chronic and catastrophic oiling are potential threats. In 2005, an estimated 615 individuals were observed during CWS surveys along the eastern shore of N.S. Although there have been some records of wintering Harlequin Ducks in the Country Harbour area in the past, limited interaction is anticipated given the proposed timing of the M&NP Option installation.

The Ipswich Sparrow nests almost exclusively on Sable Island and is the dominant landbird on the island. The species' localized distribution makes it particularly vulnerable to potential threats such as chance events (e.g., harsh weather and disease during breeding season), predation, human activity, and habitat loss. Available evidence suggests that aside from chance events, none of these factors currently threatens this particular population. The Management Plan for the Ipswich (Savannah) Sparrow (Environment Canada 2006h) aims to maintain the current breeding population at the current level, maintain the current amount and composition of breeding habitat, and remove or reduce threats to Ipswich Sparrows and their breeding and wintering habitat. The Plan also indicates that to date, offshore petroleum development near Sable Island has had no known effect on the sparrow or its habitat to date; with industry avoiding landing on the island, and adhering to visitor guidelines, including staying off vegetation; however, if offshore development continues, efforts to control its impact will have to be sustained.

The 2006 Recovery Strategy for the Roseate Tern (Environment Canada 2006g) has been reviewed and found to present information consistent with existing conditions for the species presented in the approved 2002 CSR (Section 6.1.2.5). This includes the confirmation that activities associated with the SOEP (i.e., laying of the pipe and support flights for offshore platforms) did not disturb or cause other adverse effects to Roseate Terns.

In terms of the Roseate Tern, the long-term goal of the Recovery Strategy (Environment Canada 2006g) is to have no fewer than 150 pairs nesting in at least three colonies in Canada. In the short-term, the objectives are to:

- maintain high numbers of breeding pairs at Country Island, N.S. (>40 pairs) and The Brothers, N.S. (>80 pairs);
- enhance productivity at managed colonies to high levels (i.e., 1.1 fledgling per pair);
- restore a broader distribution by establishing at least one more managed colony;
- remove or reduce threats to Roseate Terns and their habitat; and
- maintain small peripheral colonies of Roseate Terns nesting on Sable Island, N.S. and the Magdalen Islands, QC.

The Recovery Strategy recommends that Critical Habitat be identified as:

- Sites that currently support more than 15 pairs of Roseate Terns (The Brothers, N.S. and Country Island, N.S.); 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. The exception is Sable Island, where the terrestrial habitat designation is limited to polygons encompassing entire individual nesting tern colonies on the island. The 200 m is based on recommended buffer zones around tern colonies. Additional information on critical habitat designation is provided in the following subsection titled “Special Places” with respect to Sable Island and Country Island.

In addition to the Recovery Strategy, results of a recent study have been released on foraging habits of Common, Arctic and Roseate Terns in Country Harbour (Rock 2005).

Also, *an Act to amend the Migratory Birds Convention Act (1994) and the Canadian Environmental Protection Act (1999)* received royal assent on May 15, 2005. The most relevant changes to the *Migratory Birds Convention Act* (MBCA) are the strengthening of EC’s authority to prosecute violations of the MBCA and formalization of the application of the MBCA over the offshore area.

Special Places

Sable Island

The physical and biological description of Sable Island provided in the approved 2002 CSR (Section 6.1.2.6) remains valid. There have been updates, however, in terms of the administration and designation of the Island. In 2005, DFO and EC resumed management of Sable Island from the Sable Island Preservation Trust (SIPT). Another administrative update is the designation of Sable Island as critical habitat for the Roseate Tern. Further information on Sable Island Critical Habitat is presented in the previous sub-section.

Sable Island is located approximately 48 km from the revised field centre. There is no predicted interaction with Sable Island during routine Project operations. In the unlikely event that landing of vessels or aircraft or other activity is required near the Island, EnCana’s Code of Practice and the existing Sable Island Emergency Contingency Plan (Canadian Coast Guard 1994) will be adhered to for Sable Island. EnCana will seek permission from the Canadian Coast Guard for “special trips” to Sable Island for purposes which could possibly include environmental or emergency response planning or maintenance of any existing communication equipment on the Island that may be required for Deep Panuke. Such trips are anticipated to be infrequent (once or twice a year)

Gully MPA

The description of the Gully provided in the approved 2002 CSR remains valid, but there are updates with respect to conservation status. DFO designated the Gully as a Marine Protected Area (MPA) in May 2004, in part to reduce ship collisions and noise disturbance to the whales. Gully Marine Protected Area Regulations (*Oceans Act*) were published in the Canada Gazette in December 2003. The purpose of the MPA designation for the Gully serves to conserve and protect the natural biological diversity within the protected area and to ensure its long-term health. The area that defines the Gully includes three management zones, each with varying levels of protection based on conservation objectives and ecological vulnerability.

- Zone 1 consists of the deepest sections of the canyon and is preserved in a near-natural state with full ecosystem protection. This zone is highly restricted with few activities permitted.
- Zone 2 provides strict protection for the canyon sides and outer area of the Gully. Some fisheries are allowed in this region.
- Zone 3 includes the shallow water and sandy banks that are prone to regular natural disturbance. Some compatible uses are allowed subject to stringent review.

Given the location of the Gully relative to Deep Panuke (approximately 113 km from MOPU site and more than 100 km from the northeast extreme location for future wells) and EnCana's Code of Practice for the Gully MPA and commitment to avoid the Gully, there are not likely to be any Project interactions with the Gully.

Country Island

The description of Country Island and EnCana's Code of Practice for Country Island presented in the approved 2002 CSR, remain valid. As discussed above, Country Island and a seaward buffer of 200 m from the mean high tide mark, has been identified as Critical Habitat in the Recovery Strategy for the Roseate Tern (Environment Canada 2006g).

8.1.3 Onshore Environment

The proposed onshore pipeline corridor will likely change from that originally presented in the approved 2002 CSR due to future proposed land uses in the study area that have occurred since 2002. EnCana is currently in discussions with landowners to finalize the routing of the onshore pipeline and location of onshore facilities. A proposed corridor is presented in Figure 2.4. This revised corridor is located within the study area previously surveyed during field studies completed for the approved 2002 CSR.

Landform and Topography

The description of landform and topography provided in the approved 2002 CSR (Section 6.1.3.1) remains valid.

Geology and Soils

Despite the modification to the proposed onshore corridor, the description of geology and soils presented in the approved 2002 CSR (Section 6.1.3.2) remains valid. Since the approved 2002 CSR, however, there are new data available on the contamination of soil from past mining activities. Between 2003 and 2005, the Geological Survey of Canada (GSC) led multidisciplinary research activities near abandoned gold mines throughout Nova Scotia. These studies focused mainly on the environmental implications of historical gold mining and milling practices. Some of the data in the Goldboro area may be relevant to the onshore component of the Project. In particular, the GSC has identified areas within the Goldboro Industrial Park that contain mine waste from past gold-mining activities. Much of this waste contains high concentrations of arsenic and mercury. The environmental assessment for the Keltic/Maple Project (AMEC 2006) indicates the presence of three mine tailings disposal sites on the proposed Keltic/Maple site. One of these sites is likely within the proposed corridor for the Deep Panuke Project.

The GSC further indicates that bedrock and surficial materials in the Goldboro area contain naturally elevated levels of arsenic associated with the abundant arsenopyrite in the mineralized rocks throughout the Goldboro gold district. Bedrock and surficial materials exposed during blasting and excavation may therefore contain high levels of reactive, arsenopyrite-bearing rock and must be disposed of in a manner that does not lead to accelerated leaching and release of arsenic.

In the fall of 2006, samples were taken and levels of arsenic and mercury in sediments were measured and compared to CCME Interim Freshwater Sediment Quality Guidelines for the protection of aquatic life. The CCME limit for arsenic is 5.9 mg/kg. This level was exceeded in two of the five samples (7.6 and 21.0 mg/kg). Levels of mercury were at or below the CCME limit (0.17 mg/kg) for each of the five samples. These levels of arsenic and mercury do not indicate contamination from past gold mining activities. Levels reported were expected given the surficial geology and water quality of the area.

Vegetation

The description of vegetation in the study area obtained through field surveys conducted in 2001 and presented in the approved 2002 CSR (Section 6.1.3.3) remains valid in that it characterizes the general study area.

Since the approved 2002 CSR, it has been standard practice, during environmental assessment, to conduct a review of the Atlantic Canada Data Conservation Centre (ACDC) database in order to obtain a list of provincially rare (S1 to S3) species potentially occurring in the Project area. EnCana obtained a list of S1 to S3 species found within 100 km radius of the Project area from the ACDC. The ACDC listing and ranking system is useful since it provides a georeferenced outlook on rare or sensitive species and habitats. The ACDC list, however, is generated on a radius that is considered to be in excess of the onshore ecological footprint of the Project. A model was therefore employed by the EnCana to determine the likelihood of the presence of the ACDC listed species within the onshore study area. Likelihood of presence was determined by cross-checking the habitat requirements of the ACDC listed species with the habitat description within the onshore study area for the Project.

This rare plant modelling exercise gives direction for vegetation surveys in terms of habitat types and timing of surveys to identify rare plants. A detailed habitat survey will be conducted along the onshore pipeline route when the final routing has been determined. The results of the habitat modelling presented in Table 8.2 will be used to direct vegetation surveys at this time.

During terrestrial surveys conducted in 2001, in support of the approved 2002 CSR, only one rare plant species was recorded: the northern commandra (*Geocaulon lividum*). The northern commandra is ranked Yellow by the Nova Scotia Department of Natural Resources (NSDNR) and S2S3 in N.S. by the ACDC.

A total of 91 Red or Yellow-listed species have been recorded within 100 km of the Project area. Based on the results of the habitat model, 27 Red or Yellow-listed species could potentially be present in the Project area. Table 8.2 lists these species along with their ACDC and Nova Scotia Department of Natural Resources (NSDNR) rankings, and the habitats present in the study area where they could potentially be found.

Bionomial	Common Name	Preferred Habitat	Season for Identification	ACDC Rank	NSNDR Rank
<i>Vaccinium boreale</i>	Northern Blueberry	Exposed headlands and barrens; has been found by JW team in drier open bog near Moose River Gold Mines	Not given for N.S.; likely identifiable in early summer on to October	S2	Red
<i>Utricularia resupinata</i>	Northeastern Bladderwort	Pond, lake and river shores	Flowers July to September, likely little noticeable or identifiable out of flower	S1	Red
<i>Carex alopecoidea</i>	Foxtail Sedge	Moist, overgrown clear-cut woods near the coast	Not given for N.S.; likely identifiable in early summer to October	S1	Red
<i>Carex tenuiflora</i>	Sparse-Flowered Sedge	Wet woods and bogs	Not given for N.S.; most members of Heleonastesgroup flower June to August	S1	Red
<i>Iris prismatica</i>	Slender Blue Flag	Wet ground near the coast	Mid-July	S1	Red
<i>Listera australis</i>	Southern Twayblade	Among the shaded sphagnum moss of bogs or damp woods	June; quickly senesces after flowering	S1	Red
<i>Malaxis brachypoda</i>	White Adder's-Mouth	Moss cushions and wet, mossy cliff-edges, where there is little competition from other plant species	Late May and June	S1	Red
<i>Selaginella selaginoides</i>	Low Spike-Moss	Moist areas bordering bog tussocks, peat bogs, and stream margins	Produces spores in July and August; likely identifiable when not snow covered but very easily overlooked	S2	Red
<i>Bidens connata</i>	Purple-Stem Swamp Beggar-Ticks	Boggy swales, and the borders of ponds, thickets and in ditches behind brackish shores	August and September; can be identified when not in flower	S3?	Yellow
<i>Megalodonta beckii</i>	Beck Water-Marigold	Shallow, quiet waters, slow-moving streams, and ponds	August and September	S3	Yellow
<i>Proserpinaca pectinata</i>	Comb-Leaved Mermaid-Weed	Wet savannas, sphagnum swales, and the sandy, gravelly, or muddy borders of lakes or ponds	June to October; can be identified when not in flower	S3	Yellow

<i>Teucrium canadense</i>	American Germander	Gravelly seashores, generally at crest of beach, above direct tidal influence	Flowers July to September when easiest to identify but identifiable from June to October	S2S3	Yellow
<i>Utricularia gibba</i>	Humped Bladderwort	Shallow lake margins, small pools and small ponds in quagmires or peaty situations	Late June to September; can be identified without flowers, but is very cryptic	S2	Yellow
<i>Fraxinus nigra</i>	Black Ash	Low ground, damp woods and swamps	May and June; can be identified without flowers	S3	Yellow
<i>Epilobium coloratum</i>	Purple-Leaf Willow-Herb	Low-lying ground, springy slopes and similar locations	July and October; seeds required for identification	S2?	Yellow
<i>Epilobium strictum</i>	Downy Willow-Herb	Boggy areas and meadows	July to September	S3	Yellow
<i>Polygala sanguinea</i>	Field Milkwort	Poor or acidic fields, damp slopes, and open woods or bush	Late June to October	S2S3	Yellow
<i>Montia Fontana</i>	Fountain Miner's-Lettuce	Springy or seepy slopes, wet shores and brackish spots, coastal	Flowers June to September when most noticeable	S1	Yellow
<i>Ranunculus flammula</i> <i>var. flammula</i>	Greater Creeping Spearwort	Semi-aquatic, in bogs and cold streams	July to September	S2	Yellow
<i>Geocaulon lividum</i>	Northern Comandra	Sterile soils and damp sands, in acid or peaty locations, drier bog areas and mesic lichen barrens	Late May to early August; identifiable from May into October		Yellow
<i>Viola nephrophylla</i>	Northern Bog Violet	Cool mossy bogs, the borders of streams, and damp woods	May to July	S2	Yellow
<i>Eleocharis olivacea</i>	Capitate Spikerush	Peaty muck of bogs, wet sandy shores, and swales	June to October; mature achenes required for identification	S2	Yellow
<i>Eriophorum gracile</i>	Slender Cotton-Grass	Wet peat and inundated shores	Flowers and fruits early summer	S2	Yellow
<i>Juncus stygius</i> ssp. <i>Americanus</i>	Moor Rush	Open areas in wet moss, bogs and bog pools	July and August	S1	Yellow
<i>Sparganium hyperboreum</i>	Northern Bur-Reed	Peaty pools	Not Given for N.S.; likely identifiable in late summer	S1S2	Yellow
<i>Isoetes acadensis</i>	Acadian Quillwort	Water up to 1 m deep, bordering lakes or ponds, and occasionally along rivers	Megaspores required for identification	S3?	Yellow

<i>Botrychium simplex</i>	Least Grape-Fern	Usually on lakeshores or the mossy edges of streams or waterfalls although it has been reported in a wide variety of habitats	Late May and June	S2S3	Yellow
Refer to Key in Table 8.4 for definitions of rankings.					

Wildlife

The general description of wildlife (birds, mammals, herpetofauna) presented in the approved 2002 CSR (Section 6.1.3.4) remains valid for the purpose of this assessment.

Table 8.3 contains a list of bird species at risk identified by the ACCDC database as occurring within a 100 km radius of the onshore Project area that, based on their preferred habitat, could potentially be present in the onshore study area. None of these species were identified during the 2001/2002 bird surveys conducted in the study area, however, for the purpose of this assessment it will be assumed that these species could be present and potentially impacted by the Project. None of these species are listed by COSEWIC or SARA.

Table 8.3 At Risk Bird Species Potentially Present in the Onshore Study Area (ACCDC 2006)					
Common Name	Binomial	Preferred Habitat	Season for Identification	ACCDC Rank	NSDNR Rank
Northern Goshawk	<i>Accipiter gentilis</i>	Mature coniferous and mixedwood forest generally remote from human habitation	June	S3B	Yellow
Long-eared Owl	<i>Asio otus</i>	Various woodland habitats as well as open habitats	March	S1S2	Yellow
Barrow's Goldeneye (Eastern population)	<i>Bucephala islandica</i>	Freshwater lakes, coastal habitat (do not breed in study area)	November to April	S1N	Yellow
Refer to Key in Table 8.4 for definitions of rankings.					

In addition, terrestrial surveys conducted for the Keltic/Maple Project identified Greater Yellowlegs breeding habitat in the area of the Gold Brook Wetland and two Short-eared Owls were observed in the vicinity of the wetland associated with Betty's Cove Brook (AMEC 2006). The onshore pipeline is potentially located in the periphery of this area.

It is also noted that the status of Rusty Blackbird has changed since the 2002 CSR (see Table 8.5).

Wetlands

The description of wetlands in the study area presented in the approved 2002 CSR (Section 6.1.3.5) remains valid for the purpose of this assessment. EnCana's preference is to minimize environmental effects through avoidance of wetlands and minimize interaction with any other sensitive onshore environmental features. The proposed pipeline route may cross a small portion of the Betty's Cove Brook wetland; however, EnCana is still in discussions with landowner(s) to determine a final the route (and location of associated onshore facilities).

Freshwater Fish Habitat

The description of freshwater fish habitat presented in the approved 2002 CSR (Section 6.1.3.6) remains valid. However, the revised onshore pipeline corridor could cross Betty's Cove Brook. A fish habitat survey was undertaken in September 2006 along a 1.2 km reach (approximately 1.0 km upstream and 200 m downstream of the gas plant road) of Betty's Cove Brook to gather more site specific information on fish habitat within the proposed

onshore pipeline corridor. Several locations along the brook were identified as productive fish habitat and many juvenile unidentified fish fry were observed. Generally the brook was in healthy condition and supported abundant aquatic life.

8.1.4 Summary of Special Status Species (including Species at Risk and Species of Conservation Concern)

The discussion of special status species presented in Section 6.1.4 of the approved 2002 CSR has been updated based on regulatory consultations, literature review, and review of the ACCDC database. The results of this research are provided below.

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*).

Species at risk are federally protected under *SARA*, administered by Environment Canada, Parks Canada and DFO. From a strict compliance perspective, proponents are required to demonstrate that no harm will occur to listed species, their residences or critical habitat. *SARA* has been linked to *CEAA* through requirements in both Acts. The RA(s) must identify the adverse effects of the project on the species/critical habitat and, if the project is carried out, must ensure that measures are taken to avoid or lessen the effects and to monitor them. The measures must be taken in a way that is consistent with any applicable recovery strategy and action plan.

Species at risk are protected provincially through the *Nova Scotia Endangered Species Act*, administered by the Nova Scotia Department of Natural Resources (NSDNR).

Certain species are also ranked under systems established by the Atlantic Canada Conservation Data Centre (ACCDC) and the Nova Scotia Department of Natural Resources. These species are referred to as ‘species of conservation concern’.

Status ranking definitions for NSDNR, *Nova Scotia Endangered Species Act*, *SARA* and COSEWIC are provided in Table 8.4

Table 8.4 Nova Scotia and Federal Species Rarity Rankings	
NSDNR General Status (NSDNR 2006)	
Red (At Risk or May Be At Risk)	Species for which a formal detailed risk assessment has been completed (COSEWIC assessment or a provincial equivalent) and that have been determined to be at risk of extirpation or extinction. Species that maybe at risk of immediate extirpation or extinction and are therefore candidates for interim conservation action and detailed risk assessment by COSEWIC or the Province.
Yellow (Sensitive)	Species that are not believed to be at risk of immediate extirpation or extinction, but which may require special attention or protection to prevent them from becoming at risk.
Green (Not at risk)	Not believed to be sensitive, or at risk
Nova Scotia Endangered Species Act	
Endangered Species	Any species that faces imminent extinction or extirpation
Threatened Species	Any species that is likely to become endangered if the factors affecting its vulnerability are not reversed.
Vulnerable Species	Any species of special concern due to characteristics that make it particularly sensitive to human activities or natural events.
Species at Risk Act (SARA)/COSEWIC	
Extirpated	Wildlife species that no longer exists in the wild in Canada, but exists elsewhere in the wild.
Endangered	Wildlife species that is facing imminent extirpation or extinction.
Threatened	Wildlife species that is likely to become an endangered species if nothing is done to reverse the factors leading to its extirpation or extinction.
Species of Special Concern	Wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Atlantic Canada Conservation Data Centre (ACCDC 2006)	
S1	Extremely rare throughout its range in the province (typically 5 or fewer occurrences or very few remaining individuals). May be especially vulnerable to extirpation.
S2	Rare throughout its range in the province (6 to 20 occurrences or few remaining individuals). May be vulnerable to extirpation due to rarity or other factors.
S3	Uncommon throughout its range in the province, or found only in a restricted range, even if abundant at some locations. (21 to 100 occurrences).
S4	Usually widespread, fairly common throughout its range in the province, and apparently secure with many occurrences, but the species is of long-term concern.
S5	Common throughout its range in the province, secure with no indication of short or long-term
S#S#	Numeric range rank: A range between two consecutive numeric ranks. Denotes uncertainty about the exact rarity of the species (e.g., S1S2)
?	Qualifier to denote inexact or uncertain (the “?” qualifies the character immediately preceding it in the S-rank)

Species of Species at Risk and Species of Conservation Concern

Table 8.5 summarizes the species at risk and of conservation concern that may occur in the study area. The table also includes respective federal/provincial designations or rankings.

Table 8.5 Species at Risk and Species of Conservation Concern that May Occur in the Study Area						
Species	Habitat	SARA Status	COSEWIC Status	ACCDC	NSDNR Status	N.S. Endangered Species Act
Fishes						
Atlantic cod (<i>Gadus morhua</i>) (Maritime Population)	Marine; nearshore and offshore	Recommended to not be listed under SARA (2005)	Special Concern (2003)	NL	NL	NL
Spotted wolffish (<i>Anarhichas minor</i>) (Atlantic Population)	Marine; predominantly offshore	Threatened, Schedule 1 (2002)	Threatened (2001)	NL	NL	NL
Northern wolffish (<i>Anarhichas denticulatus</i>) (Atlantic Population)	Marine; predominantly offshore	Threatened, Schedule 1 (2002)	Threatened (2001)	NL	NL	NL
Atlantic wolffish (<i>Anarhichas lupus</i>) (Atlantic Population)	Marine; nearshore and offshore	Special Concern, Schedule 1 (2002)	Special Concern (2000)	NL	NL	NL
Cusk (<i>Brosme brosme</i>) (Atlantic Population)	Marine; predominantly offshore	Referred back to COSEWIC for further consideration. (2005)	Threatened (2003)	NL	NL	NL
Atlantic Salmon (<i>Salmo salar</i>) (Inner Bay of Fundy Population)	Anadromous; nearshore and offshore while at sea, most likely in the Gulf of Maine	Endangered (2006)	NL	S2 (Gulf of Maine)	Red	NL
Atlantic Salmon (<i>Salmo salar</i>) (Atlantic Population)	Anadromous; nearshore and offshore while at sea	NL	NL	S2	Red (all anadromous populations in Nova Scotia)	NL
Porbeagle shark (<i>Lamna nasus</i>) (Atlantic Population)	Marine; predominantly offshore	Pending public consultation for addition to Schedule 1 listing date March 2006	Endangered (2004)	NL	NL	NL
White shark (<i>Carcharodon carcharias</i>) (Atlantic Population)	Marine; predominantly offshore	NL	Endangered (2006)	NL	NL	NL
Shortfin mako (<i>Isurus oxyrinchus</i>) (Atlantic Population)	Marine; predominantly offshore	NL	Threatened (2006)	NL	NL	NL

Blue shark (<i>Prionace glauca</i>) (Atlantic Population)	Marine; predominantly offshore	NL	Special Concern (2006)	NL	NL	NL
Winter skate (<i>Leucoraja ocellata</i>) (Eastern Scotian Shelf Population)	Marine; nearshore and offshore	Pending public consultation for addition to Schedule 1	Threatened (2005)	NL	NL	NL
Birds¹						
Barrow's Goldeneye (<i>Bucephala islandica</i>) (Eastern population)	Migratory; winters in coastal areas	Special Concern, Schedule 1 (2002)	Special Concern (2000)	S1N	NL	NL
Harlequin Duck (<i>Histrionicus histrionicus</i>) (Eastern Population)	Migratory; winters in coastal areas	Special Concern, Schedule 1 (2002)	Special Concern (2001)	NL	Red	Endangered (2000)
Northern Goshawk (<i>Accipiter gentilis</i>)	Year-round resident	NL	NL	S1S2	Yellow	NL
Greater Yellowlegs (<i>Tringa melanoleuca</i>)	Breeds inland and migrates along coast	NL	NL	S2B	NL	NL
Ivory Gull (<i>Pagophila eburnea</i>)	Migratory; nearshore and offshore in winter	Special Concern, Schedule 1 (2002)	Endangered (2006)	NL	NL	NL
Roseate Tern (<i>Sterna dougallii</i>)	Breeds; coastal islands and nearshore	Endangered, Schedule 1 (2002)	Endangered (1999)	S1B	Red	Endangered (2000)
Common Terns (<i>Sterna hirundo</i>)	Breeds; coastal islands and nearshore	NL	NL	S3B	Yellow	NL
Arctic Tern (<i>Sterna paradisaea</i>)	Breeds; coastal islands and nearshore	NL	NL	S3B	Yellow	NL
Long-eared Owl (<i>Asio otus</i>)	Breeds; onshore	NL	NL	S1S2	Yellow	NL
Short-eared Owl (<i>Asio flammeus</i>)	Breeds; onshore	Special Concern, Schedule 3	Special Concern (1994)	S1S2B	Yellow	NL
Ipswich (Savannah) Sparrow (<i>Passerculus sandwichensis princeps</i>)	Breeds on Sable island; winters in coastal areas	Special Concern, Schedule 1 (2002)	Special Concern (2000)	S1S2B	NL	NL

Rusty Blackbird ² (<i>Euphagus carolinus</i>)	Breeds; onshore	Under consideration for addition to Schedule 1	Special Concern (2006)	S3S4B	Green	NL
Marine Mammals						
Blue whale (<i>Balaenoptera musculus</i>) (Atlantic Population)	Marine; predominantly offshore	Endangered, Schedule 1 (2005)	Endangered (2002)	S1 (Scotian Shelf)	NL	NL
Fin whale (<i>Balaenoptera physalus</i>) (Atlantic Population)	Marine; predominantly offshore	Special Concern, Schedule 3	Special Concern (2005)	S1 (Scotian Shelf)	NL	NL
Harbour Porpoise (<i>Phocoena phocoena</i>) (Northern Atlantic Population)	Marine; predominantly nearshore	Referred back to COSEWIC for further consideration (2005)	Special Concern (2006)	SU (Scotian Shelf)	NL	NL
North Atlantic right whale (<i>Eubalaena glacialis</i>) (Western Atlantic Population)	Marine; offshore and nearshore	Endangered, Schedule 1 (2005)	Endangered (2003)	S1 (Scotian Shelf & Bay of Fundy)	NL	NL
Northern bottlenose whale (<i>Hyperoodon ampullatus</i>) (Scotian Shelf Population)	Marine; offshore	Endangered, Schedule 1 (2006)	Endangered (2002)	S1 (Scotian Shelf)	NL	NL
Sowerby's Beaked Whale (<i>Mesoplodon bidens</i>) (Atlantic Population)	Marine; offshore	Special Concern, Schedule 3	Special Concern (1989)	SA (Scotian Shelf)	NL	NL
Reptiles						
Leatherback sea turtle (<i>Dermochelys coriacea</i>) (Atlantic Population)	Marine; nearshore and offshore	Endangered, Schedule 1 (2002)	Endangered (2001)	S1S2N	NL	NL
Terrestrial Amphibians						
Four-toed salamander (<i>Hemidactylium scutatum</i>) (Nova Scotia Population)	Onshore	NL	NL	NL	Yellow	NL

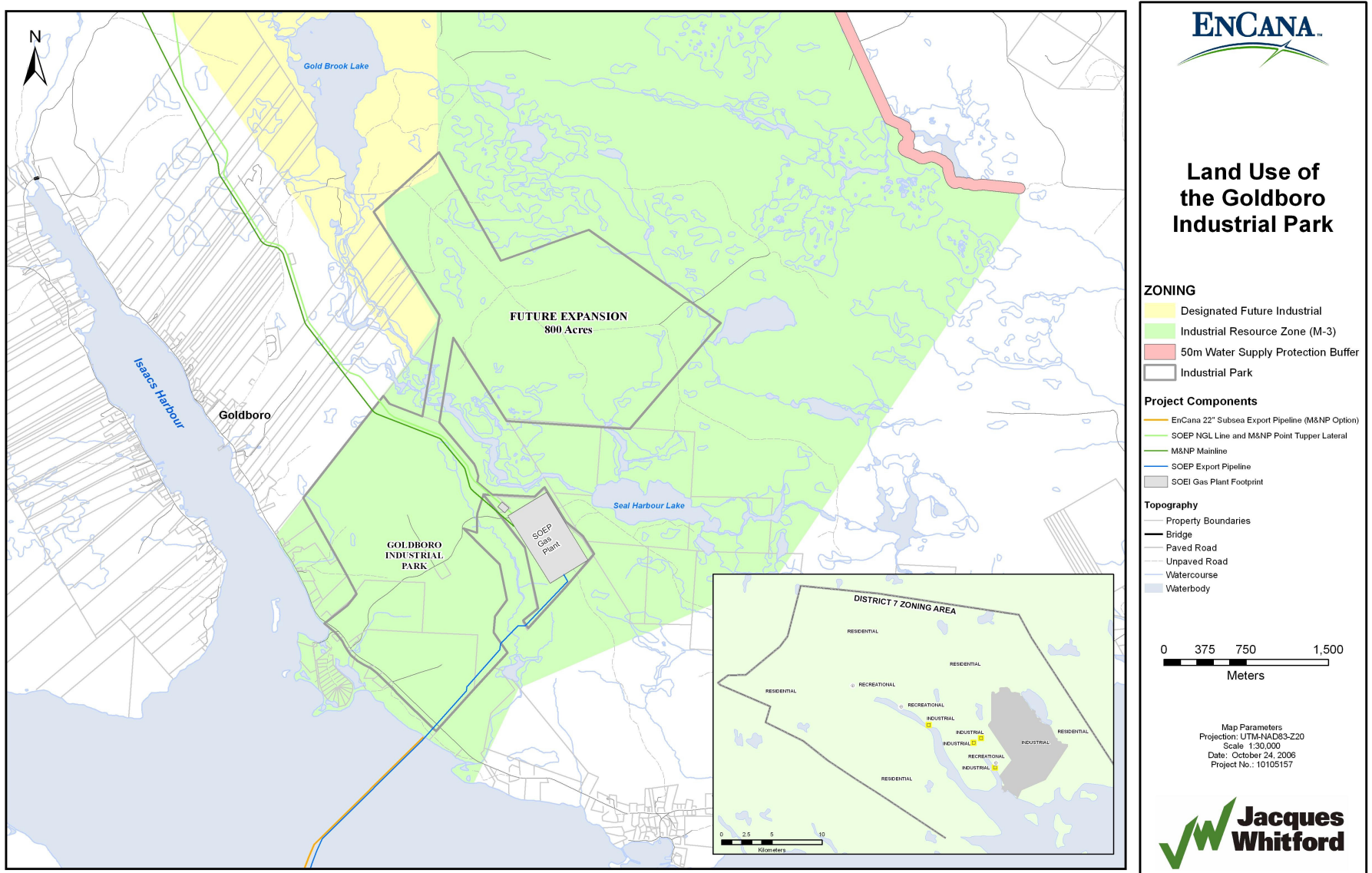
Terrestrial Mammals						
Moose (<i>Alces alces americana</i>) (Nova Scotia Mainland Population)	Onshore	NL	NL	NL	Red	Endangered (2003)
Little Brown Bat (<i>Myotis lucifugus</i>) (Nova Scotia Population)	Onshore	NL	NL	NL	Yellow	NL
NL = Not Listed						
Note: ¹ Refer to Table 8.3 for rare and sensitive plant species and Table 8.4 for bird species identified by ACCDC. ² Species was observed (non-breeding) in mature softwood forest in onshore study area during June 2002 breeding bird survey.						

8.2 Socio-economic Setting

8.2.1 Land Use

The proposed Project onshore pipeline (M&NP option) lies immediately to the east of Isaacs Harbour near the community of Goldboro, N.S. In the mid-1990s, the Council for the Municipality of the District of Guysborough initiated the preparation of a Municipal Planning Strategy and Land Use By-Law for this planning area as a result of an announcement by SOEP that the Goldboro area had been chosen as the landfall site for the offshore natural gas pipeline. To separate existing and future residential uses from incompatible development, and to provide designated areas for industrial development, the Planning Strategy introduced a Heavy Industrial Zone, including an Industrial Resource Zone (M-3). The Project lies within the M-3 Zone known as the Goldboro Industrial Park (Figure 8.2).

Figure 8.2 Land Use of the Goldboro Industrial Park



The Goldboro Industrial Park (Figure 8.2) was established in 1998. It occupies 700 acres of industrial land 2 km from the community of Goldboro. The park is administered by the Municipality of the District of Guysborough and marketed by the Petroleum Office of the Guysborough County Regional Development Authority.

Currently, the Goldboro Industrial Park is the landfall site for the SOEP subsea pipeline and home to the SOEP Gas Plant. Since approval of EnCana's 2002 CSR, Keltic Petrochemicals Inc., in association with Maple LNG have proposed to construct and operate an LNG terminal within the Park, to receive international shipments of LNG, regasify the LNG at the proposed facility, and ship natural gas to markets by a mainland pipeline. As part of the same project, Keltic Petrochemicals Inc. is also now proposing to develop, construct, and operate a petrochemical plant, as well as a potential cogeneration plant. The Maple LNG facility proposes to support the supply of feedstock for Keltic's petrochemical complex on the adjacent site.

No other formal or informal uses of the land have been identified to exist within the Goldboro Industrial Park or along the RoW for EnCana's proposed pipeline. There is no substantive recreational use of the area in the immediate vicinity of the Project; which is consistent with the approved 2002 CSR.

A recent archaeological review conducted by Davis Archaeological Consultants Limited (DAC 2006) confirmed results of the approved 2002 CSR that First Nations resources are unlikely to be present in the proposed landfall location and adjacent nearshore marine area.

A Mi'kmaq Ecological Knowledge Study recently undertaken in support of the environmental assessment for the Keltic Petrochemicals Inc. Proposed LNG and Petrochemical Facilities (AMEC 2006) indicates current use of lands for traditional purposes within the Goldboro Industrial Park. It is assumed for the purpose of this assessment that current use of lands for traditional purposes could occur in the study area for this Project. As stated in the approved 2002 CSR, EnCana has committed to include Aboriginal representatives in pipeline RoW inspections.

8.2.2 Economy

This section focuses on a description of the economy of N.S. and the local economies of the Halifax Regional Municipality (HRM) and the County of Guysborough, which includes the Municipality of the District of Guysborough and the Municipality of the District of St. Mary's, in the immediate vicinity of the landfall portion of the Project (M&NP Option). The description of existing conditions is based primarily on data derived from Census 2001 (Statistics Canada 2001) and Target Nova Scotia (2006).

Demographics

The total population of Nova Scotia in 2001 was 908,007, a decrease of approximately 0.1% from the 1996 level. The median age of the population was 38.8 years. The population of the HRM was 359,111, an increase of approximately 5% from 1996. The median age of the population was 36.6 years. The population of the Municipality of the District of Guysborough was 5,165, a decrease of approximately 13% from the 1996 level. The median age of the population was 44.2 years. The population of the Municipality of the District of St. Mary's was 2,766, which was virtually unchanged from the 1996 level. The median age of the

population was 43.5 years. Over 80% of the populations locally and provincially were 15 years of age or over; however, the rural populations of Guysborough and St. Mary's are older than the provincial and HRM averages.

Employment and Income

The median household income for N.S. in 2000 was \$39,908 and for the HRM was \$46,946, substantially higher than that of the Municipality of the District of St. Mary's (\$33,557) and of Guysborough (\$28,634). Relative to N.S., government transfers comprise a larger share of household income in the municipal districts. The unemployment rates for Guysborough and St. Mary's were both approximately 20%, which is considerably higher than N.S. rate of approximately 11% and the HRM rate of 7%. The labour force participation rates are also lower for the municipal districts of Guysborough and St. Mary's, than for either the HRM or N.S. as a whole.

Business and Industry

The industries of the municipal districts of St. Mary's and Guysborough are primarily resource based (Table 8.6). This includes fishery products processing and resource extraction. Manufacturing and construction industries, based primarily on the offshore petroleum resources, can be found within the municipal districts and Guysborough County in general. In contrast, for N.S. as a whole, the main businesses consist of those in the service industry, manufacturing, mining and agriculture. For the HRM, the experienced labour force is primarily in wholesale and retail trade, health and education, business and other services.

Industry	Nova Scotia	Halifax Regional Municipality	Municipality of the District of Guysborough	Municipality of the District of St. Mary's
Total experienced labour force	442,425	193,685	2,205	1,120
Agriculture and other resource-based industries (% of total experienced labour force)	7%	2%	20%	23%
Manufacturing and construction industries (% of total experienced labour force)	16%	10%	30%	21%
Wholesale and retail trade (% of total experienced labour force)	16%	16%	10%	12%
Finance and real estate (% of total experienced labour force)	5%	7%	2%	0%
Health and education (% of total experienced labour force)	18%	19%	15%	13%
Business services (% of total experienced labour force)	16%	21%	9%	9%
Other services (% of total experienced labour force)	22%	25%	14%	22%
Source: Statistics Canada (2001)				

8.2.3 Fisheries and Aquaculture

Offshore Commercial Fisheries

Between 2002 and 2005, there were 44 species commercially fished in the NAFO Unit Areas which intersect with the Project (4We, 4Wf and 4Wh). More detailed figures to show the amounts and locations of catch for the offshore commercial groundfish, pelagic and shellfish fisheries in the vicinity of the Project are presented in Section 7.2.3 and Appendix J of EnCana's 2006 EA Report. The locations of the catch are largely in NAFO Unit Areas 4Wh and 4We, while area 4Wf, which comprises the MOPU, subsea wells, flowlines, and

export pipeline to SOEP (SOEP Subsea Option), had a lower density of catch. Catch data includes fisheries data from commercial fisheries and from the Native Council and First Nations fisheries.

Prospects for groundfish fishing on the eastern Scotian Shelf have not improved in recent years. Stocks of cod, haddock, white hake and cusk remain at very low levels and commercial bycatch is kept as low as possible. There is no cod-directed fishery. However, in Areas 4Wf, 4Wh, and 4We, total landings of 3,200 tonnes of cod were recorded from 2002 to 2005, mostly as bycatch and through the sentinel survey, which is a partnership between fisheries organizations and DFO. The program uses commercial fishing vessels, following a pre-determined scientific protocol to assess the stock status of species for which data is no longer available through the commercial fisheries.

Shellfish, specifically snow crab, scallops and northern shrimp, have dominated the catch in the Sable Island Bank area. In general, these catches occur mostly in Unit Area 4We, north of the Project where the MOPU, subsea wells, flowlines and export pipeline to SOEP (SOEP Subsea Option) are located. Although the snow crab fishery is one of the most valuable fisheries in the area, snow crab habitat is primarily in gullies and in deeper areas along the Scotian Shelf and less so in the uniform habitat of the Sable Island Bank. Sea scallop catch has remained significant though variable in all three NAFO Unit Areas.

The data also includes commercial Aboriginal fisheries. There are a total of 13 Aboriginal snow crab licenses within Crab Fishing Area 24, held by Eskasoni First Nation, Chapel Island First Nation, Waycobah First Nation, Millbrook First Nation, Indian Brook First Nation, and the Native Council of Nova Scotia. In addition, a total of 10 shrimp licenses are currently held by Chapel Island First Nation, Waycobah First Nation, Membertou First Nation, and Eskasoni First Nation.

Nearshore Commercial Fisheries

The nearshore commercial fisheries in the vicinity of the Project (M&NP Option) predominantly include lobster, sea urchin, rock crab and sea scallop. Nearshore fishery areas and landing data are presented in Section 7.2.3 of EnCana's 2006 EA Report. Currently, four fishermen based in Goldboro and Drum Head and another four fishermen based in Fishermen's Harbour near Country Harbour actively fish lobster in the nearshore area, while Rock crab is harvested by one fisherman, along much of the existing SOEP pipeline route. Sea scallop is harvested in several nearshore locations where there is suitable bottom habitat. The species is harvested all year, with the exception of a spawning closure during the months of August and September. The sea urchin fishery is area-license based. Sea urchins may be harvested all year.

New and Experimental Fisheries

In 1989, the Offshore Clam Fishery Management Plan authorized a directed ocean quahog fishery on Sable Island Bank. In response to a proposal by Clearwater Seafoods Limited Partnership (Clearwater), DFO provisionally allocated in 2005, a total allowable catch of 11,587 tonnes of ocean quahogs to Clearwater on Sable Island and Western Banks although commercial harvesting has yet to begin (DFO 2006b). This bivalve will be fished with use of a hydraulic dredge, and current plans are for Clearwater to begin harvesting in early 2007 (EnCana, 2006). The species is unique in that it is long-lived and slow growing.

Once a given area is fished, it will take 15 years or more for individual clams to reach commercial size again.

The offshore sea cucumber fishery is an emerging fishery. DFO's New Emerging Fisheries Policy (2001), requires a three-stage approach be followed in the development of a new fishery (DFO 2006). Stage I (Experimental) is the preliminary feasibility stage during which it is determined if harvestable quantities of the target species are present in the particular fishing area, if the species can be captured by a particular gear type, if there are multi-species and habitat impacts, and if markets exist. Stage II (Exploratory) is the commercial and stock assessment stage, during which it is determined whether or not the target species or stock can sustain a commercially viable operation. During this stage, biological data is also collected on stock abundance and distribution. Stage III (Commercial) is achieved only if it is determined that the target species or stock can sustain a fishery, both commercially and biologically.

Six fishery zones have been established, of which Zones 1, 5 and 6 overlap with the Deep Panuke Project. Ocean Leader Fisheries Ltd. (Lower Wedgeport, N.S.) was granted a Stage I (Experimental) license for all six zones, and fisheries survey work was conducted under the licenses in 2004 and 2005. The surveys were conducted using a modified scallop drag (12.2 m deep, with an opening of 3 m wide by 0.2 m high). In April of 2006, a Science Expert Opinion (DFO 2006) recommended, based on the results of the experimental surveys, that the sea cucumber fishery in Zone 1 proceed to a Stage II (Exploratory) license. In 2006, Ocean Leader Fisheries was granted an exploratory license and fished the area. The company is currently waiting to hear from DFO regarding quota for the fishery in Zone 1 for 2007 (EnCana 2006). Zones 5 and 6 have not proceeded beyond Stage I (Experimental).

Aquaculture

In Country Harbour, there are currently five aquaculture leases and one new lease in the application process. The licensed species are blue mussel and sea scallops, but only mussels are cultivated currently.

8.2.4 Other Ocean Users

Marine Transportation

Commercial shipping on the Scotian Shelf area is generally in the form of tankers and bulk and containerized cargo carriers, as well as a range of fishing vessels, cruise ships and various government vessels. The *Scotian Shelf Atlas of Human Activities* (Breeze and Horsman 2005) shows the main shipping routes through the region. These routes are drawn from the internationally recognized Ocean Passages for the World issued by the United Kingdom Hydrographic Office. The closest vessel traffic service (VTS) zone to the Project area is the high density traffic area associated with the major ports of Halifax and Port Hawkesbury (Strait of Canso). Under the *Eastern Canada Vessel Traffic Services Zone Regulations*, administered by Transport Canada, commercial shipping must follow defined routes upon nearing Halifax Harbour and the Strait of Canso. Outside of these areas, mariners have discretion as to the selection of their preferred routing.

Submarine Cables

As noted in the approved 2002 CSR (Section 7.2.6.7), there are several active and inactive marine telecommunication and power cables on the Scotian Shelf (Breeze and Horsman 2005). Of particular note, the SITIFOG 2000 cable to Sable Island has recently become inoperable and has not been repaired.

Military Use

As noted in the approved 2002 CSR (Section 7.2.6.6), Maritime Forces Atlantic (MARLANT) has designated operational training areas (Ops Areas) that cover the entire offshore region of Nova Scotia. There have been no changes to the military activity including munition dump sites and unexploded ordnances (UXOs) since the approved 2002 CSR. The proposed pipeline routes traverse MARLANT Ops Areas I and J and there are no reported UXOs or munition dump sites in the Project area (including proposed pipeline routes) (Breeze and Horsman 2005; S. Brushett, EnCana Corporation, 2006).

Oil and Gas Activity

In the past decades, the eastern part of Sable Island Bank and the entire Scotian Shelf edge and Slope have become the focus of interest for oil and gas exploration offshore Nova Scotia. About 266 seismic programs have occurred on the Shelf between 1969 and 2005. Most programs were conducted from 1980 to 1984, with a prior cluster of activity in the early 1970s. As of the end of May 2006, 204 wells had been drilled in the offshore of Nova Scotia since 1967 (CNSOPB 2006). In addition to seismic and drilling programs, SOEP continues to operate offshore natural gas facilities south of Sable Island which include central processing, wellhead, and compression platforms (Thebaud) and several unmanned satellite platforms (Venture, South Venture, North Triumph, Alma) connected to the Thebaud complex by interfield flowlines. A 660 mm export pipeline extends from Thebaud to the SOEP gas plant in Goldboro, N.S.

Marine Conservation and Planning

There have been a number of recent changes to the status and management of conservation areas on the Scotian Shelf. This includes the establishment of the Gully MPA and the return of Sable Island management to Environment Canada and DFO from the Sable Island Preservation Trust (SIPT).

In addition, under the *Oceans Act*, the Eastern Scotian Shelf Integrated Management (ESSIM) Initiative has been established as a collaborative planning mechanism for the management of the Eastern Scotian Shelf. The current planning area is approximately 325,000 km², encompassing the offshore eastern Scotian Shelf beyond the 12-nautical-mile Territorial Sea and the adjacent slope area. The final draft Eastern Scotian Shelf Integrated Ocean Management Plan (ESSIM Plan) (DFO 2006c) has been released for review and is expected to be endorsed by the Minister of Fisheries and Oceans in 2007. The ESSIM Plan is a “multi-year, strategic plan to provide long-term direction and commitment for integrated ecosystem-based and adaptive management of all marine activities in or affecting the planning area” (DFO 2006c).

The three major goals of the Plan are:

- Collaborative governance and integrated management (effective governance structures and process; capacity among stakeholders; and knowledge to support integrated management);
- Sustainable human use (ecologically sustainable use of ocean space and resources; and sustainable communities and economic well-being); and
- Healthy ecosystems (resilient and productive ecosystems with diverse habitats; communities, species and populations; and strong marine environmental quality supports ecosystem functioning).

These high levels goals are supported by objectives for specific collaborative governance, human use, and ecosystem elements. The goals and objectives provide a mechanism for defining management strategies and measuring progress on Plan implementation (DFO 2006c).

The ESSIM Plan is not yet at the stage of identifying ocean use zones or a marine protected areas system plan, but it is likely that such provisions will be introduced in the future. EnCana is actively involved with the ESSIM Program as a member of the ESSIM Stakeholder Advisory Council.

DFO has also established a program to identify ecologically and biologically significant areas (EBSAs) in marine waters throughout Canada (DFO 2004). The EBSA approach is a management planning tool only and identification of EBSAs does not imply formal designation or any form of legal protection. However, future MPAs are likely to be centered around EBSAs. No EBSAs have been designated on the Scotian Shelf to date.

A Coral Conservation Plan for the Maritimes Region for 2006 to 2010 has been developed under the auspices of the ESSIM Initiative (DFO 2006c). The main aim of the Plan is to develop a comprehensive approach to coral conservation for the Maritimes Region, particularly the deep sea corals found on the Scotian Shelf and Slope.

9.0 Environmental Effects of the Project

This section considers the potential environmental effects of the Project, as well as the mitigation and follow-up measures required of the proponent. It reflects a summary of the analysis conducted by the proponent, information requests and responses, comments received during the public review process, and the supplementary analysis conducted by RAs.

Furthermore, this section includes assessment of the potential impacts on, or as a result of, the environmental components outlined in the *Scope of the Environmental Assessment* prepared by the RAs as well as an assessment of the effects on other ocean users (see “Impediments to Navigation and Other Ocean Users”). This assessment comprises only the undertakings differing from those originally proposed by the proponent, or components potentially affected by information that has become available since the approved 2002 CSR was completed. Mitigation and follow-up commitments determined in 2002 are presented in Appendix B. In addition, the following discussions include a consideration of comments obtained through the Public Process including the recommendations from the CNSOPB appointed Commissioner and the NEB Member, as presented in Appendices C & D.

9.1 Significance Criteria

Section 16(1)(b) of the CEAA requires that the significance of environmental effects be determined.

For each of the environmental components considered, the potential interactions are investigated and evaluated based on current scientific knowledge. Effects are analyzed qualitatively, and, where possible, quantitatively, using existing knowledge, professional judgment, and appropriate analytical tools.

Significant adverse environmental effects are those that will cause a change to an environmental component affected by the Project, such that its status or integrity is altered beyond an acceptable level. For physical components of the environment (such as habitat), a significant effect would alter an area physically, chemically, or biologically to an extent that there is a measurable decline in abundance or diversity of a species within the area beyond which natural recruitment of that species would restore within a short time. For air quality in particular, a significant adverse effect is one that involves a sustained exceedance (i.e. more than one exceedance per year) of any applicable regulatory or HSE criterion or standard.

For biological components of the environment, a significant effect would reduce the abundance of one or more species to a level from which population recovery is uncertain, or more than one season would be required to restore pre-project conditions. Project-related mortality exceeding natural variability within a population would be significant. For species listed as endangered or threatened, Project-related loss of an individual could be considered significant for some listed species.

For accidental releases, increased produced water discharge, air emissions, presence of new sub-sea infrastructure, construction work for sub-sea infrastructures, and drill waste discharges, a significant effect would result if these Project-related substances and structures would cause an area to be physically, chemically, or biologically altered to an extent that there is a measurable decline in abundance or diversity of a species within the

area beyond which natural recruitment of that species would restore within a short time, or would reduce the abundance of one or more species to a level from which population recovery is uncertain, or more than one season would be required to restore pre-project conditions.

For the impediments to navigation a significant effect would:

- due to a construction period of over a week, a fisher could argue their income has been reduced that week; however, over the course of a year there may be no measurable change; or
- unacceptably interfere with marine transportation (shipping), submarine cables, military use, or other oil and gas activities.

The significance evaluation of residual effects after mitigation for each of the factors to be considered is based on the criteria as specified by the CEA Agency (1994, 1997), including: magnitude, geographic extent, frequency, duration and reversibility. The level of scientific certainty of each effect was also considered.

To assess significance, each predicted effect was examined in light of the criteria. Ratings were systematically assigned based on available knowledge and professional judgment, then an overall significance rating was determined. The results of the analysis for each VEC are tabulated in Section 8 of EnCana's Report.

9.2 Accidental Releases

EnCana's Assessment

OFFSHORE ENVIRONMENT

EnCana's discussion of potential accidents and malfunctions in the offshore was revised to consider the relocation of the field center, new production and acid gas injection subsea wells and flowlines, the new multi-phase pipeline(s) option (for the SOEP Subsea Option) and the revised project life. An updated marine spill probability assessment and revised spill fate and behavior modeling are provided in Appendices E1 and E2 of EnCana's EA Report, respectively.

The revised spill fate and behavior modeling results compared to the approved 2002 CSR indicate that surface slicks and oil clouds from a batch diesel spill or a batch condensate spill (10 and 100 barrel spill scenarios) will have different travel distances (less in most cases) than the approved 2002 CSR. Other than surface slicks and oil clouds, the fate of the oil will be same as that in the approved 2002 CSR.

Subsea well blowouts and surface blowouts are predicted to have lower condensate and gas flow rates, which reduced the size of associated impact zones, when compared to the approved 2002 CSR. Based on the revised spill fate and behavior modeling, the new locations and depths do not cause significant differences in the general fate and trajectory when compared to the 2002 CSR.

Acid gas injection well blowouts (subsea and surface) are predicted to result in smaller condensate and gas flows, which reduce the impact zone compared to the 2002 CSR. As

well, subsea production flowline release, subsea acid gas injection flowline release and a SOEP Subsea Option pipeline release are predicted to be short lived events, with impact zone sizes similar to new subsea blowout results that are smaller than those in the approved 2002 CSR.

Onshore Environment

Malfunctions and accidents associated with the onshore pipeline has been updated to reflect the modified risk assessment which takes into account the proximity of proposed industrial developments and associated activity in the Goldboro Industrial Park. The likelihood of an uncontrolled pipeline release remains extremely low (further discussion on the probability of accidental releases is presented in Section 4.3). Malfunctions and accidents involving natural gas pipeline construction and operation have a low probability of occurrence, and are likely to be short term and localized. Mitigation measures in these events will include notifying relevant authorities and following specified emergency response and health and safety procedures which will be contained in the Deep Panuke Emergency Management Plan.

There is the potential for a pipeline rupture and fire to cause significant adverse effects on land use if the Keltic/Maple facilities become involved, causing further large scale fire and/or release of materials. A quantitative risk analysis considering potential risk synergies between the nearshore/onshore components of the Project with the proposed Keltic/Maple Project will be undertaken during detailed route design in conjunction with further Keltic/Maple Project planning and design. Compliance with all applicable design codes and standards will ensure that risks are extremely low.

Public Comments

Concern was raised about spills and other accidental events. Please refer to Appendices C & D for additional details.

View of the RAs

EnCana has committed to submitting an Emergency Management Plan and Spill Response Plan which will include preventative measures to help reduce the risk of accidental events, as well as response measures in the event of an accident or malfunction. These plans will be reviewed by the CNSOPB and the other RAs. EnCana's environmental management system also includes an EPP and EEM. EnCana has committed to conducting routine operation with sufficient mitigation to ensure that effects on the environment and human health and safety are not significant. EnCana has also stated that the design, inspection and maintenance and integrity assurance programs, as well as proven engineering techniques, will be in place to prevent blowouts of injection and production wells, and acid gas flowline ruptures. EnCana has also committed to handling all fuel, chemicals and wastes in a manner that minimizes or eliminates routine spills and accidents. As well, the CNSOPB requires that all drilling personnel working offshore N.S. have appropriate training as defined in the Canadian Association of Petroleum Producer's East Coast Offshore Petroleum Industry: Training and Qualification, which includes maintaining formal Well Control Certification.

The effects of accidental releases on benthos, marine fish, marine mammals and sea turtles and marine birds are considered equivalent to those discussed in the approved 2002 CSR and are further discussed in Section 9.11 Species at Risk or predicted to be not significant.

In addition, the RAs acknowledge that EnCana has generally considered spill events that have occurred in the Atlantic offshore including accidental releases of MEG, SBMs, diesel, condensate and crude oil. While some incidents are not entirely applicable to the Deep Panuke project (e.g. accidental loss of SBM and crude oil), EnCana maintains that through discussions with the CNSOPB and other operators, it intends to build upon 'lessons learned' from previous spill events. Equipment design and maintenance programs will serve to minimize the risk of equipment-related incidents in particular, recognizing that recent spills in the offshore have been attributed to equipment failure (see response to Information Request EC-ECA-1.19).

With respect to the potential interactions with the proposed Keltic Petrochemical and LNG facilities, EnCana has committed to conducting a detailed quantitative risk analysis to consider potential risk synergies between the near-shore/onshore components of the Project with these facilities. The RAs acknowledge that this analysis will not occur before more detailed route design is in place as it requires specific information on relative layout of project components (for both projects).

With respect to the onshore pipeline, EnCana's quantitative risk analysis will be used to verify the predictions that there is a low likelihood of a pipeline release that would result in significant adverse environment effects.

Mitigation and Follow-up:

No additional mitigation is required of the proponent beyond the relevant commitments identified in 2002.

In addition to the commitments identified in 2002 with respect to accidental releases, follow-up required of the proponent by the RAs shall include:

- completion of a quantitative risk analysis considering potential risk synergies between the near-shore/onshore components of the Project with the proposed Keltic/Maple Project.

Residual Effects and RAs Determination

Accidental releases have potential to cause adverse effects; however, taking into account the mitigation measures to be implemented the likelihood of an accidental release causing significant residual adverse effects is very low.

The RAs have determined that, providing the mitigation proposed by the proponent and the mitigation described in this CSR is implemented, accidental releases are unlikely to cause significant adverse environmental effects.

9.3 Increased Produced Water Discharge

EnCana's Assessment

The 2002 CSR was based on a produced water rate of 1080 to 1560m³/day (45 to 65m³/hour). The project as currently proposed has a design rate of a maximum of 6400m³/day (265m³/hour). The temperature of produced and cooling water, which are mixed together prior to discharge, is expected to be between 15°C-25°C above ambient sea water temperature, depending on the flow rate. There will be 1-2 ppmw of H₂S in the produced water, and a dispersed oil concentration target of 25mg/L (30 day weighted average; EnCana's target). EnCana estimates that combining the produced and cooling water streams will, at a minimum, result in a 9:1 dilution before being released to the marine environment.

The results of produced water dispersion modeling demonstrate that a non-buoyant plume is expected all year round between production years 3 and 7. For the entire life of the project, flow rates are high enough for a non-buoyant plume to form in the winter. Dilution of the plume will depend on the strength of the ambient current at the time of discharge. Dilution is predicted to be minimal at times with no or very weak currents. The "plume water" at the seafloor will be made of 10 volumes of background water for no more than 1 volume of discharge water. Further dilution will occur in the far-field as the "plume water" is moved away by ambient currents. Table 2 of Appendix D of EnCana's 2006 EA Report provides a summary of far-field dispersion modeling results. Regardless of the buoyancy of the plume, the predicted effect of discharged water on larval organisms is not considered to be significant since the proportion of the total population that is exposed to routine discharges at any time is small and any effect caused will be within natural variation for these populations. Larval populations have very high natural rates of mortality which vary with stochastic events (i.e., disease and environmental conditions) and the effects of discharged water will likely be localized within 100 meters maximum from the point of release.

Potential effects of discharged water on benthic invertebrates, such as snow crab are addressed in Section 8.3.4.2 of the EnCana's 2006 EA Report. Trace amounts of any toxic contaminants that may be present in discharged water will be rapidly dispersed with only transient exposure to benthic organisms such as snow crab and no measurable effects at the population level.

Worst case scenario analysis of hydrocarbon dispersion from produced water indicates the possibility of sheen at the surface with a thickness of 0.6µm near the discharge pipe and 0.1µm at a distance of 500m. The formation of sheen is expected to be episodic.

In response to an Information Request (IR No. DFO-ECA-7) to DFO, EnCana confirmed that as part of its Environmental Effects Monitoring Plan, predicted effects will be verified and any unforeseen effects will be adaptively managed in accordance with standard EA practice and follow-up requirements.

EnCana notes that snow crabs are unlikely to be present near the proposed Deep Panuke field centre since snow crab habitat is primarily in gullies and in deeper areas along the Scotian Shelf and less so in the uniform habitat of the Sable Island Bank (Section 7.2.3 of

the 2006 EA Report. This was verified by remotely-operated vehicle video camera observations at the former Cohasset production facilities located in the same area.

Public Comments

Concern was raised about produced water discharge. Please refer to Appendices C & D for additional details.

View of the RAs

Effects on Marine Benthos:

A non-buoyant plume will allow for produced water to come in contact with benthos, such that benthos may be exposed to temperature and salinity changes associated with residual contaminants of the produced water. Amine and TEG are present in concentrations that are of low toxicity to invertebrates (Woodburn and Stott, undated). The increase in produced water discharge is not expected to have significant adverse effects on populations of marine benthos.

Effects on Fish, Marine Mammals & Sea Turtles:

Concentrations of amine and TEG in produced water will be below those concentrations that would impact marine species. These substances are of low toxicity to fish in the concentrations present in the produced water discharge, and are readily biodegradable. The project is therefore unlikely to have significant adverse effects on fish, marine mammals or sea turtles.

Effects on Marine Birds:

The increase in produced water discharge may increase potential for sheens to adversely affect marine birds, by compromising their insulating ability. An ESRF study is currently underway to examine the effects of oil sheens on bird feathers in laboratory conditions. Potential impacts from produced water on avian species at risk are discussed further in Section 9.11.

Mitigation and Follow-up

EnCana has committed to the following mitigation, in addition to 2002 requirements, with respect to the potential effects of an increase in the amount of produced water:

- in addition to using a hydrocyclone to achieve the dispersed oil concentration target of 25 mg/L, EnCana will use of a dedicated full-time polishing unit (organophilic clay type) and stripping tower to reduce dissolved hydrocarbons (and potentially other chemicals) and H₂S in produced water prior to discharge.

As for follow-up, EnCana has committed to:

- reviewing the results of the ESRF study on the effects of oiling of birds, when published, and incorporating any associated changes into the EPP;

- co-operating with COOGER on investigating the fate and effects of produced water.

In additional, the following mitigation is required of the proponent by the RAs, with respect to increased produced water discharge:

- a platform-based laboratory facility, or equivalent (to be demonstrated by EnCana), to ensure timely and effective compliance monitoring to reduce to possibility of regulatory exceedences of oil in produced water discharges.

Residual Effects and RAs Determination

Taking into account the mitigation measures to be implemented, the residual environmental effects of discharge of produced water are predicted to be reversible and of limited duration, magnitude, and geographic extent.

The RAs have determined that significant adverse environmental effects on marine species, as a result of the increase in produced water discharge, are unlikely provided that the mitigation proposed by the proponent and the mitigation described in this CSR are implemented.

9.4 Air Emissions

EnCana's Assessment

EnCana's assessment of effects of the Project on air quality has been conducted using a modeling approach as described in Section 2.8.1. Current applicable provincial and federal air quality standards were used to assess environmental effects. For the most part, the boundaries identified in the 2002 CSR for the assessment of impacts on air quality remain valid; however, they have been updated to acknowledge the increase in Project life.

The analysis of impacts from construction-related and mobile sources on air quality as presented in the 2002 CSR remains valid. The increase in emissions due to the construction of new components (e.g. flowlines, umbilicals, subsea structures) is expected to be offset by the decrease in drilling and platform construction activities. Air emissions produced by vessel and aircraft engines will be essentially the same or less than those that were evaluated in 2002 given that there will only be installation of one MOPU instead of the intended three platforms.

In terms of the export pipeline specifically, emissions resulting from the installation of the M&NP Option are expected to be similar to the 2002 Project design while the SOEP Subsea Option would result in less emissions given it is a much shorter export pipeline. With the selection of either option, impacts to air quality from pipeline installation are predicted to be equivalent or less overall in comparison to the 2002 Project design.

Routine Operations and Maintenance Activities

Emissions Estimates and Dispersion Modeling Results

Routine operation and maintenance emissions from acid gas management (acid gas is either re-injected or directed to the flare during maintenance), flare systems, turbine driven equipment (including two power generators and three gas compressors), and the glycol

dehydrator system (TEG offgases are directed to the flare) were reconsidered in the EA Report. Annual emissions of criteria air contaminants (CAC) and greenhouse gases (GHG) were calculated for both pipeline options. The tables below summarize the annual estimations; giving a range over the 14 years for each contaminant (note the range does not correlate to years 1 and 14).

Table 9.1: Summarized Annual Estimated CO, PM, NO_x and SO₂ Emissions for the M&NP and SOEP Options for Normal Operations (tonne/year).					
M&NP Option					
Emission Type	Condensate Firing	Fuel Gas Firing	Normal Flaring	Maintenance Flaring	Total Annual Emissions
CO	0.7 - 3.5	0.6 – 37.5	13.9	114.8	132.9 – 167.4
PM	2.7 – 12.9	0.1 – 3.0	1.0	3.7	9.8 – 17.8
NO _x	99.7 – 482.3	1.9 – 112.7	2.5	21.1	214.4 – 509.7
SO ₂	0.01 – 0.04	0.01 – 0.16	0.0	0.11	0.15 – 0.29
SOEP Subsea Option					
CO	N/A	48.6 – 89.9	13.9	114.8	177.3 – 218.6
PM	N/A	3.9 – 7.2	1.0	3.7	8.6 – 11.9
NO _x	N/A	146.2 – 270.4	2.5	21.1	169.8 – 294.0
SO ₂	N/A	0.21 – 0.39	0.0	0.11	0.32 - 0.50

Table 9.2: Summarized Annual Estimated GHG Emissions for the M&NP and SOEP Options for Normal Operations (ktonne/CO₂ eq).					
M&NP Option					
Emission Type	Condensate Firing	Fuel Gas Firing	Normal Flaring	Maintenance Flaring	Total Annual Emissions
CO ₂ eq	35.1 – 169.6	0.8 – 50.3	5.3	43.4	124.5 -220.1
SOEP Subsea Option					
CO ₂ eq	N/A	65.3 – 120.7	5.3	43.4	114.0 – 169.4

Additional information regarding CAC and GHG estimates during normal operating/maintenance conditions as well as accidental/malfunction events can be found in Tables 1.1 and 1.2 of EnCana's response to Information Request EC-ECA-1.4 (a).

It is demonstrated that CAC emissions from routine operations were acceptable overall, falling within applicable air quality criteria levels and that CO₂ re-injection would achieve an 18% reduction in total annual CO₂ equivalent emitted.

In addition, dispersion modeling results below demonstrate that emissions from minimum and maximum continuous flaring during normal operations/maintenance activities are not expected to affect nearby receptors (i.e., Sable Island or SOEP platforms). Predicted maximum concentrations (µg/m³) were generated for a variety of Nova Scotia criteria concentrations including 1 hr, 24 hr and annual concentrations for SO₂, H₂S and NO₂ respectively. All predicted maximum concentrations were demonstrated to be negligible with the exception of NO₂. Modeling results, however demonstrate that NO₂ would be at

negligible concentrations before reaching a receptor such as Sable Island or a SOEP platform (see Tables 9.3 and 9.4 and Figure 9.1 and 9.2 below):

Tables 9.3 and 9.4 show modeling results NO₂ atmospheric effects compared to Nova Scotia standards for normal production under minimum and maximum continuous flaring.

Table 9.3: Atmospheric Effects from Normal Production (Minimum Continuous Flaring)				
Nova Scotia Criterion	Criterion Concentration [ug/m ³]	Predicted Maximum [ug/m ³]	Distance to Maximum GLC [m]	Percent of Criterion [%]
1 hour NO ₂	400	102.6	676	25.6
24 hour NO ₂	N/A	82.8	341	N/A
Annual NO ₂	100	3.37	344	3.4
Table 9.4: Atmospheric Effects from Normal Production with Routine Maintenance (Maximum Continuous Flaring)				
Nova Scotia Criterion	Criterion Concentration [ug/m ³]	Predicted Maximum [ug/m ³]	Distance to Maximum GLC [m]	Percent of Criterion [%]
1 hour NO ₂	400	102.6	676	25.6
24 hour NO ₂	N/A	82.8	341	N/A
Annual NO ₂	100	3.37	344	3.4
Note: 98% flare efficiency assumed in conversion of H ₂ S to SO ₂				
Neg. = Negligible predicted ground-level concentration of less than or equal to 1ug/m ³				

Figure 9.1: Minimum Continuous Flaring Mode – NO_x Average Concentrations

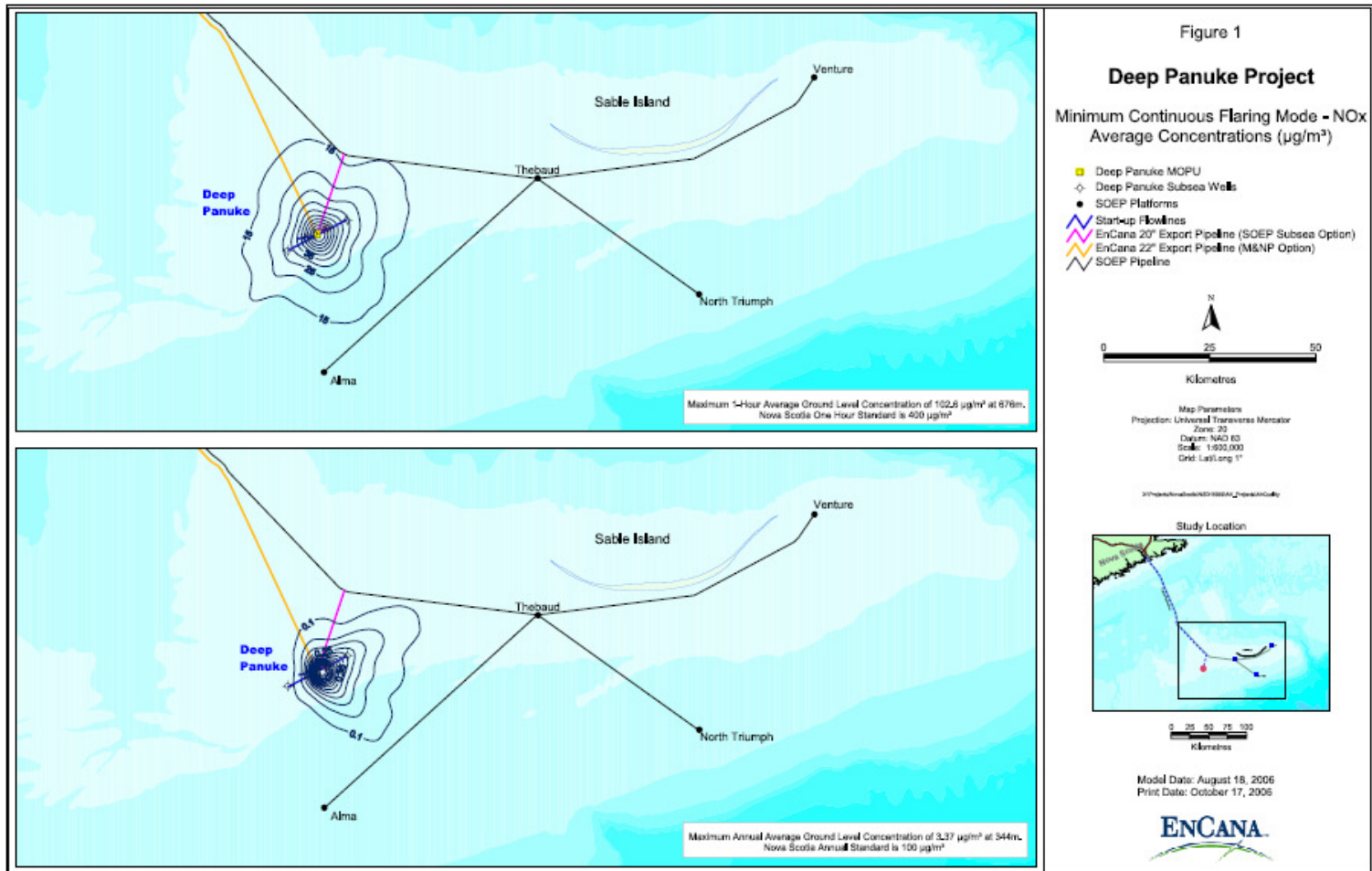
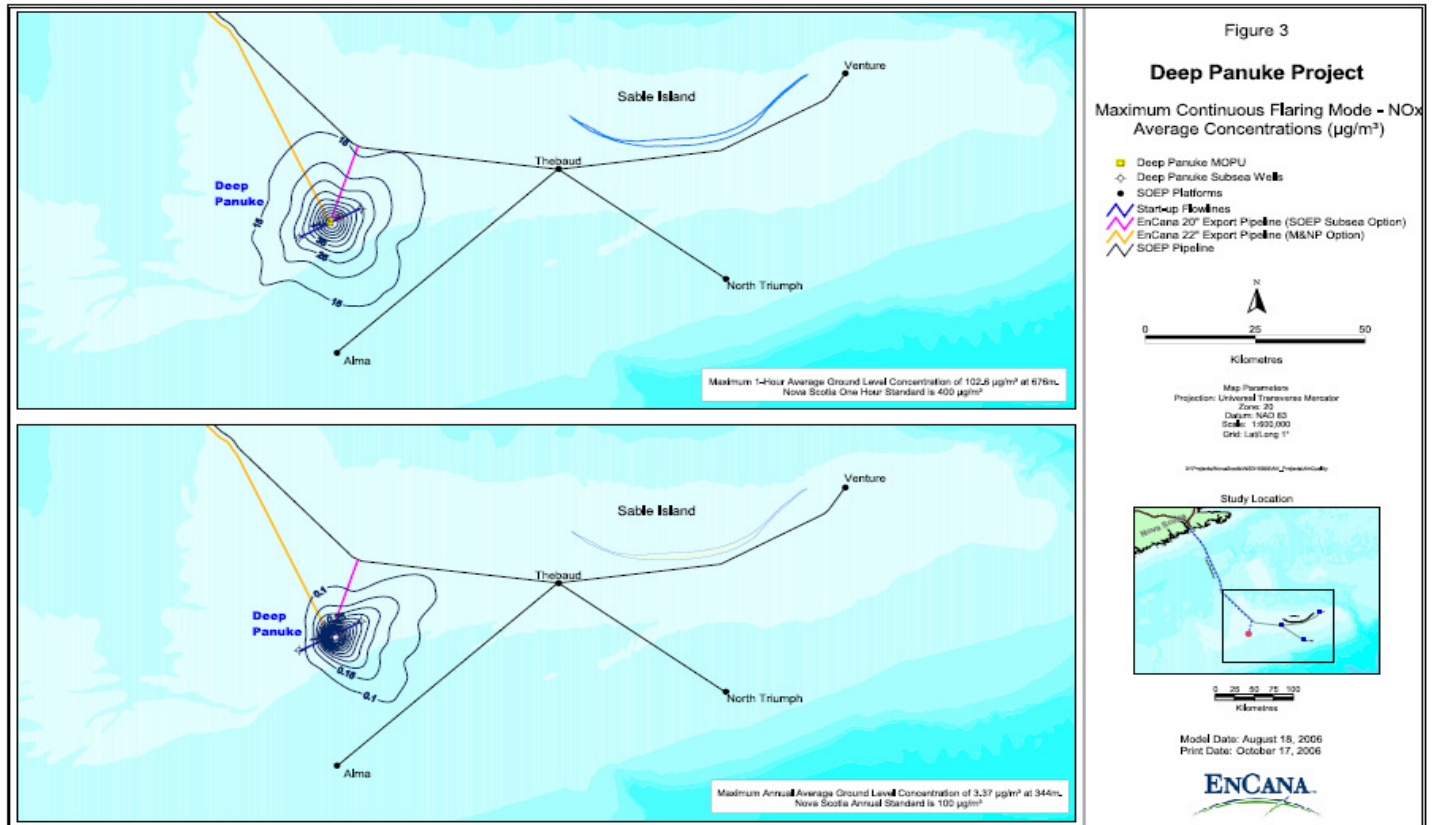


Figure 9.2: Maximum Continuous Flaring Mode – NOx Average Concentrations



Additional information can be obtained from Tables 8.4, 8.5 and Appendix F of EnCana's 2006 EA Report.

Malfunctions and Accidental Events

Emission Estimates and Dispersion Modeling Results

Various accident/malfunction scenarios are described in section 4 of the CSR. Emission rates that could result during malfunctions and accidental events for both pipeline options are summarized in the tables below:

Table 9.5: Total Emission Rates from various accident or malfunction scenarios – for the M&NP and SOEP Options

Operating Mode and Plant Status	Emission Rates (g/s)											
	CO		NOx		SO ₂		H ₂ S		CH ₄		CO ₂	
	M&NP	SOEP	M&NP	SOEP	M&NP	SOEP	M&NP	SOEP	M&NP	SOEP	M&NP	SOEP
Maximum Flaring	12.5	12.6	19.9	11.4	989	989	10.7	10.7	5.02	5.02	6139	4301
Emergency Depressurizing	112	112	38.2	30.2	798	798	8.7	8.7	42.7	42.7	6139	4301
Acid Gas Flaring	3.3	3.5	18.2	10.2	1780	1780	19.3	19.3	1.5	1.5	6139	4301
Flare Malfunction	0.1	0.3	17.6	9.6	0.001	0.02	0.2	0.2	116	116	6139	4301
Acid Injection Well Blowout	0	0	0	0	0	0	2772	2772	187	187	N/A	N/A
Production Well Subsea Blowout of Raw Gas	0	0	0	0	0	0	280	280	47800	47800	N/A	N/A
Production Well Surface Blowout of Raw Gas	0	0	0	0	0	0	280	280	47832	47832	N/A	N/A

In general, accidental and malfunction scenarios (e.g., emergency depressurizing, flare malfunction) would result in increased emissions of CAC and GHG. Surface or subsurface blowouts represent the greatest potential emission of GHG. It is estimated that up to 4,130 tonnes/day could be released. Mitigation is discussed below.

Dispersion modeling conducted using the emission rates identified above demonstrated that CAC concentrations remain within Nova Scotia ambient air quality criteria with the exception of two worst-case scenarios where Nova Scotia ambient air quality standards for H₂S could be exceeded: production and acid gas injection well blowouts.

EnCana predicts that a subsea or surface blowout of a production well or a subsea blowout of the acid gas injection well could result in Sable Island experiencing an exceedance of the maximum permissible ground level concentration criteria for H₂S (0.042 mg/m³) under worst case conditions (e.g., 0% dissolution of H₂S in the water column prior to reaching the atmosphere, worst possible meteorological conditions). In the event of an acid gas injection well blowout in particular, wildlife on Sable Island could be exposed to a maximum 1-hour ground level concentration of 0.82 mg/ m³ of H₂S. At this level, an H₂S gas odour might be perceptible but it would not pose a risk to health or safety of the residents or animals on Sable Island. Additional information may be obtained from EnCana Reply Evidence filed in response to the CPAWS Jan 29, 2007 Letter of Comment (Morykot to Noye, Feb 26, 2007).

These events, however, are extremely unlikely, and the exposure concentration is short term and at low observed lethal levels.

Mitigation and Monitoring Commitments

In general, EnCana intends to minimize the likelihood of significant adverse effects to air quality through design, inspection, maintenance, and integrity assurance programs and appropriate safety procedures.

More specifically, EnCana commits to undertaking a Concept Safety Analysis (to identify appropriate engineering design and material procurement procedures), and to developing training and detection procedure as well as an Emergency Management Plan. EnCana has also committed to testing emissions (during commissioning and operations phase) and conducting continuous monitoring to ensure that fugitive or emergency releases of gas are detected immediately and responded to in an appropriate manner.

A full list of commitments is presented in the **Mitigation/Follow-up** section below.

Public Comments

Concern was raised about air quality and climate change. Please refer to Appendices C & D for additional details.

View of RAs

EnCana has demonstrated that, all predicted ambient concentrations expected from this Project meet ambient air quality requirements with the exception of accidents and malfunctions. When compared to available CAC Inventory data for the province of N.S. (http://www.ec.gc.ca/pdb/cac/Emissions1990-2015/emissions1990-2015_e.cfm), the Deep

Panuke project (using either export pipeline option) would result in negligible annual CAC emissions overall:

CAC	2002 Total Annual Estimate for province of NS (tonnes/yr)	Total Annual Estimate Range Predicted for Deep Panuke – M&NP Option (tonnes/yr)	Total Annual Estimate Range Predicted for Deep Panuke – SOEP Option (tonnes/yr)
SO _x /SO ₂	154,353	0.15 - 0.29	0.32 – 0.50
NO _x	74,160	214.4 – 509.7	169.8 – 294.0
CO	294,676	132.9 – 167.4	177.3 – 218.6
PM	341,844	9.8 – 17.8	8.6 – 11.9

There is however some potential for significant adverse environmental effects to air quality (particularly regarding H₂S), but only in the extremely unlikely event of blowouts of injection or production wells. EnCana has demonstrated that prevention and response measures will be put in place to minimize the likelihood of these events occurring. It will be important that the Emergency Management Plan identify the necessary courses of action (i.e. exclusion zones, warnings) until systems are brought back under control.

With respect to GHG emissions, the RAs note that Canada is a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) as of 1992. Under the UNFCCC, developed nations, including Canada, committed to limiting emissions of greenhouse gases (GHGs) in order to address climate change concerns, although no specific reduction was agreed to. Also, as previously mentioned, the federal government intends to propose regulations to reduce GHG emissions from key industrial sectors through the *Clean Air Act*.

Like all emitters of GHGs regardless of scale, emissions from the Project will enter the atmosphere and contribute to cumulative effects upon the climate. While the impact of the contribution to global GHG levels by any single project may be difficult to discern, the cumulative effect of all projects producing GHGs is a dramatic rise in global atmospheric GHG levels.

The RAs acknowledge EnCana's commitment to reduce Project GHG emissions by 18% through stripping off and re-injecting the extra CO₂ from the sales gas. Options for reducing GHG emissions from the other, more substantial Project sources (e.g., flare and combustion systems) should also be considered as per the waste minimization provisions of the OWTG. The use of best available technologies and best management practices to reduce emissions is essential to achieving these reductions. For example, some best practices for reducing GHG emissions are described in the *Compendium of Methane and CO₂ Emission Reduction Measures for the Natural Gas Industry*.

Mitigation/Follow-up

In addition to the commitments identified in 2002 with respect to atmospheric emissions, follow-up required of the proponent by the RAs shall include:

- reporting of emissions annually as per the OWTG, as well as Sections 46 (GHG emissions inventory) and 48 (National Pollutant Release Inventory) of CEPA 1999;

Residual Effects and RAs Determination

Taking into account the mitigation measures to be implemented, the residual environmental effects of air emissions are predicted to be reversible and of limited duration, magnitude, and geographic extent.

The RAs have determined significant adverse environmental effects as a result of air emissions are unlikely provided that the mitigation proposed by the proponent and the mitigation described in this CSR are implemented.

9.5 Presence of New Subsea Infrastructures

EnCana's Assessment

EnCana will ensure *Notices to Mariners* are issued, and CHS navigation charts are updated with all applicable Project infrastructure and safety zones, to decrease the likelihood of interaction between fishing vessels and new sub-sea infrastructure. Safety zones around this infrastructure are small compared to available fishing grounds and are not located in areas with high fishing activity. With respect to the new quahog fishery that opened on Sable Bank in 2005, the Project is anticipated to be into the latter half of production at the anticipated time of this fishery start-up, and less than 10% of the fishing area will be affected by the Project. EnCana has also committed to adopting the Compensation Guidelines Respecting Damages Relating to Offshore Petroleum Activity to ensure full and fair compensation is provided should equipment damage occur as a result of interaction with Project infrastructure.

EnCana predicts that the effects of the Project on the health and viability of populations of commercially important organisms will not be significant, because the Project will be in compliance with the OWTG and will follow industry best practices. EnCana also indicates in their assessment that in inshore areas where lobster fisheries are present, pipelines will be buried such that they will not impede lobster movement. EnCana, therefore, also predicts that the effects of accidental events on commercially important fisheries and aquaculture will be minimized by preventative measures and contingency planning.

Project structures containing metal (e.g., pipeline) will gradually release metal ions into seawater; therefore there could be potential interactions with marine water quality following decommissioning of the pipelines. However, released metal ions would be rapidly diluted to background levels and would not be toxic to marine receptors. The conclusions of no significant residual environmental effects on marine water quality as a result of Project decommissioning from the 2002 CSR remain valid.

Public Comments

Concern was raised about impacts from new subsea infrastructures. Please refer to Appendices C & D for additional details.

View of the RAs

New subsea flowlines, umbilicals, subsea protection structures, and the export pipeline and associated subsea templates for the SOEP Subsea Option will result in minor loss of access to fisheries resources, mainly the new quahog fishery. Subsea equipment is also not likely

to pose a risk for gear damage, given that the 2002 CSR committed that *Notices to Mariners* will be issued, and Project infrastructure and safety zones will be charted. Also in 2002 EnCana committed to advising all fishers known to operate in the area, of the Project schedule and areas of activity during construction, and communicating directly with managers of fishing organizations.

The RAs have predicted that impacts will be of low magnitude and geographic extent and have therefore concluded that the presence of new subsea infrastructure is not likely to result in significant adverse environmental effects.

Mitigation and Follow-up

No additional mitigation or follow-up is required of the proponent beyond the commitments made by EnCana in the approved 2002 CSR.

Residual Effects and RAs Determination

The RAs have determined that significant residual adverse environmental effects as a result of the presence of new subsea infrastructure are unlikely, provided that the mitigation proposed by the proponent and the mitigation described in this CSR are implemented.

9.6 Construction Work for Subsea Infrastructure

EnCana's Assessment

During installation of the export pipeline there may be short-term effects on quahog, snow crab, shrimp, herring, halibut, and hagfish fisheries, due to the presence of vessels installing the pipeline, and localized short term disturbance to the seabed. In the nearshore pipeline landfall area, trenching/backfilling can be expected to affect the sea urchin and lobster fisheries along the pipeline corridor. Possible horizontal directional drilling (HDD) in the near-shore landfall area may have minor, or no interactions with lobster and sea urchin fisheries.

Noise and vibration generated during pile driving operations could lower fish catches. There will be a shorter duration of pile driving activity, with a lower energy hammer, than the activities described in the approved 2002 CSR. Thus, the amount of underwater noise associated with pile driving is significantly less (both in level and duration) for the current Project. EnCana predicts that a temporary, localized, effect on fish catches may occur due to pile driving and construction vessel activity. A description of the pile driving activity, and comparison to the 2002 CSR, is presented in Section 2.3.6, and Table 2.4 presents details of the pile driving for the Project.

EnCana states that the analysis of construction-related effects on air quality including the mitigation strategies identified in the 2002 CSR remain valid. Nonetheless, a flowline rupture has the potential to cause significant adverse environmental effects. A rupture is extremely unlikely, however, and EnCana has committed to put in place design, inspection, maintenance and integrity assurance programs, and appropriate safety procedures, to minimize the potential of a flowline rupture.

The sediment in the study area is composed of fine to coarse grain sand that settles quickly upon disturbance. Installation of the subsea infrastructure will result in localized increases of suspended particulate matter (SPM).

The proposed twinned 324 mm pipelines for the SOEP Subsea Option compared to the single 510 mm pipeline option, would result in increased construction efforts (e.g., two separate passes of vessel for pipelaying/trenching two pipelines). Therefore, an increase is predicted in air emissions from construction vessels, SPM and localized water degradation, and noise and vessel presence. Additional air emissions, increased SPM, noise and vessel presence would still be less than that assessed in the 2002 CSR. This Project alternative would still contain one SSIV skid, one tie-in skid and one hot tap skid as for the single pipeline option; therefore, pile driving requirements are not expected to change. Hydrostatic test water discharges are expected to be similar. In general, the impacts from installing either version of the SOEP Option are expected to be substantially less than the M&NP Option.

Since the 2002 CSR, EnCana has reduced its predicted volume of hydrostatic testing fluid to be discharged during the testing of the M&NP Option. 43,200 m³ of hydrostatic testing fluid will be released at a rate of 400 m³/hr over a period of 4 to 5 days, and will be diluted with cooling water prior to discharge, resulting in a 6:1 dilution. Comparatively, testing of the SOEP Option would involve discharging 3,040 m³ of hydrostatic testing fluid at a rate of 400 m³/hr with no dilution. It is assumed that hydrostatic testing of the flowlines may also be an undiluted discharge. However, even without initial combination with cooling water it is expected that these one time discharges would dilute rapidly upon entering the marine environment. Furthermore, since the 2002 CSR EnCana has committed to a toxicity bioassay program and plume dispersion modeling prior to hydrostatic testing, to confirm EA predictions.

There is potential for contamination of benthos from discharge of hydrostatic test fluid, and the placement of subsea infrastructure will temporarily interact with localized areas of benthic habitat.

In the 2002 CSR, it was confirmed by DND that the Project facilities at that time were not located in proximity to any known sites with Unexploded Ordnance (UXO). Shallow geophysical surveys undertaken at the Deep Panuke site and along the pipeline route confirmed this. In addition, EnCana contacted DND in 2006 to reconfirm the absence of known UXO sites in the Project area.

Public Comments

Concern was raised about impacts from construction work for new subsea infrastructure. Please refer to Appendices C & D for additional details.

View of the RAs

The potential adverse effect of construction of subsea infrastructure on fisheries in the area is reversible and of short duration, and is therefore unlikely to be significant. As committed in the 2002 CSR, during the construction phase, a *Notice to Mariners* will be issued to advise ship's captains of EnCana's schedule and areas of activity. Due to the homogeneous nature of the benthic community in the area, the benthic habitat in the area is expected to be re-colonized by benthic organisms from adjacent areas after construction is complete.

The discharge of hydrostatic testing fluid is unlikely to have significant adverse effects on the marine environment (water quality), given it is a one-time discharge that will be rapidly diluted (even without initial combination with cooling water) and that a toxicity bioassay program and dispersion modeling will be undertaken prior to pipeline/flowline testing.

Regarding benthos in particular, the RAs expect that hydrostatic testing fluid discharge is also unlikely to be significant given the expected re-colonization.

Water quality is not likely to be significantly adversely affected by construction of subsea infrastructure due to the nature of the sediment in the construction areas. Air quality is also not expected to be adversely affected by subsea infrastructure construction activities with the exception of the highly unlikely event of a flowline rupture, with respect to which EnCana has committed to the appropriate mitigation to minimize the likelihood of such an occurrence.

DND maintains a database of known UXO locations, and has advised that there are none in the project area. However, it is not possible to completely discount the possibility that such materials could be encountered during construction of the project. During the Public Process, EnCana indicated that it will conduct further on-bottom surveys as pipelaying proceeds, and that any anomalies that are detected would be investigated before moving forward. EnCana will contact DND prior to commencing any activity to re-confirm that there are no known UXO, chemical or biological agents or radioactive dumpsites in the area. EnCana's EPP, Emergency Management Program, Operations and Maintenance Programs, and Construction and Safety Manuals will include measures to address any issues identified as a result of EnCana's surveys or discussions with DND.

There may be significant adverse environmental effects from interactions between the Project and UXO or warfare agents; however, the likelihood of these interactions is very low.

Mitigation and Follow-up

In addition to the commitments identified in 2002 with respect to construction of subsea infrastructure, follow-up required of the proponent by the RAs shall include:

- EnCana's EPP, Emergency Management Program, Operations and Maintenance Programs, and Construction and Safety Manuals will include measures to address any issues identified as a result of EnCana's surveys or discussions with DND.

In addition, the following mitigation is required of the proponent by the RAs:

- shall ramp up when commencing pile driving to minimize the potential impacts on marine mammals.

Residual Effects and RAs Determination

The RAs have determined that significant residual adverse environmental effects as a result of the construction work for new subsea infrastructure are unlikely, provided that the mitigation proposed by the proponent and the mitigation described in this CSR are implemented.

9.7 Drill Waste Discharges

EnCana's Assessment

The Deep Panuke site is a high energy environment, such that cuttings and fine particles and associated metals are more likely to disperse rather than settle. Total amount of cuttings and WBM are significantly less for the Project than those originally considered in the 2002 CSR. Also, drilling wastes will be discharged at the site of each individual well instead of released at the site of the field center. This provides an increased initial dispersion of drilling wastes.

Cuttings discharged during the initial drilling phase will likely form a cone with a base radius determined by the range of particle settling rates. This results in a range of base radii of 20 m to 150 m depending on the weight of particles and their settling rates. Smothering of benthic organisms can potentially result if the thickness of the cuttings layer exceeds 1 cm. For each of four production wells and one injection well, the area of benthos affected would be in the vicinity of 1,256 m². In the case of fine particulate matter, the area of deposition in excess of 1 cm would extend to less than 150 m, corresponding to a seafloor area less than 70,685 m².

Cuttings released at the surface, for each of the four production wells and one injection well, will likely result in a cone having a radius between 30 m and 400m (for which the area of deposition in excess of 1 cm would extend to a radius of 160 m), covering areas of benthic habitat of 2,826 m² to 80,384 m², respectively. These are smaller volumes of cuttings than those predicted for approved 2002 CSR. Cuttings piles are not expected to persist for more than a year due to the dynamic and energetic environment (i.e., currents and storm events) of Sable Island Bank. Following dissipation of the cuttings pile, the benthic community is expected to recover within 2 to 3 years through recruitment from adjacent areas.

WBM discharged cuttings and bulk discharge of WBM are rapidly dispersed by wave action and currents. WBM will be released in a series of turbulent plumes at the bottom for each new production well and the injection well. It is anticipated that WBM will enter the benthic boundary layer. A volume of 180 m³ of WBM per well will be released during this phase of drilling over a period of several days.

Overall, the total amount of WBM predicted to be discharged during the current Project (4,609 m³) (seafloor and surface release) is significantly less than the amount anticipated for the 2002 Project basis (9,604 m³). This is primarily because in the original 2002 project a maximum of 8 new wells were anticipated to be drilled compared to a maximum of only 5 new well being drilled in the revised project. Due to the similarity of dispersion behaviour and the lesser quantity of discharged WBM, the effects as presented in the 2002 CSR remains valid.

During the completion phase at the end of each new production well, a bulk discharge of 1000 m³ of NaCl brine (completion fluid) with a density of 1200 kg/m³ will take place. Dilution during the turbulent descent, the minimum dilution (400:1; achieved in the absence of ambient current) guarantees a salinity anomaly of less than 1 PSU when the plume may be in contact with marine benthos.

Salinities outside the tolerance levels of organisms have the potential to cause health impacts and mortality due to disruption of cellular osmotic balance. Brine discharge is a one-time event that will occur at the surface for each well. Mortality of benthic organisms due to exposure of the diluted brine plume is unlikely due to the short duration of exposure coupled with the high dilution factor. Considering that benthic organisms of the Project area are physiologically able to withstand seasonal variation in salinity, it is unlikely that a salinity anomaly of a maximum of 1 PSU for short periods of time would cause mortality. In the case of limited mortality of benthic organisms, habitat would be re-colonized from adjacent areas.

Public Comments

Concern was raised about impacts from drilling waste discharges. Please refer to Appendices C & D for additional details.

View of the RAs

Drill waste discharges are likely to affect benthic marine animals more than other species in the Project area. Potential interactions between the project and marine benthos relate primarily to smothering of benthic communities by drill cuttings, potential toxicity from drilling fluids, potential change in the particle size of sediments following disposition of drill cuttings, and contamination from an accidental spill or blowout. Additionally, changes in sediment quality as a result of the addition of drilling wastes may affect the quality of habitat for demersal fish species, and other species that feed on benthos and demersal fish. Organic and inorganic contaminants in sediments may be ingested by benthic organisms or become eaten if re-suspended into the water column. Marine benthos can also be contaminated by an accidental spill or blowout.

The extremely low amounts of mercury expected in drilling fluids are not expected to result in measurable quantities released to the marine environment. The levels of mercury measured in sediments at drilling and production sites off the East Coast of Canada have consistently been very low, and in particular, environmental monitoring at SOEP did not find any detectable levels of mercury in surficial sediments (EnCana Reply Evidence to Sierra Club of Canada, February 26, 2007). The forms of mercury in drilling discharges are highly insoluble and do not appear to react or degrade. Studies have consistently shown that the mercury in drilling discharges poses no significant threat to the environment, human health, food safety, or water quality (Parker 2003).

The benthic environment in the Project area is comprised of common invertebrate species occurring in low density and abundance. The habitat within the project area is ubiquitous along the Scotian Slope. Any contaminants (hydrocarbons or metals) that are present in elevated levels from the drill waste discharges will not cause changes in biodiversity that will result in measurable effects on community structure outside the cutting pile. The effects from the presence of drill cuttings are predicted to be reversible and of limited duration, magnitude, and geographic extent.

Furthermore, a scientifically-sound EEM program to verify EA predictions and detect and assess Project-induced changes in the environment will be implemented. EEM goals will be defined and the program designed in consultation with the regulatory authorities. The results of the EEM program will be reviewed on an annual basis and adaptations to the program will be made as necessary. The EEM program will include testing of sediment chemistry and

toxicity, as well as appropriate sentinel species. Drilling waste indicators such as mercury will be included in the EEM program.

Mitigation and Follow-up

No additional mitigation or follow-up is required of the proponent beyond the commitments made by EnCana in the approved 2002 CSR.

Residual Effects and RAs Determination

In the absence of required mitigation, the residual environmental effects remain unchanged from the above analysis. Therefore the residual effects from the presence of drill cuttings are also predicted to be reversible and of limited duration, magnitude, and geographic extent.

The RAs have therefore determined that significant adverse environmental effects as a result of drill waste discharges are unlikely.

9.8 Near Shore and Onshore Contaminants

EnCana's Assessment

Acid rock drainage is a concern because it can negatively affect fish habitat, and can affect spawning and rearing habitat for salmonids. GSC indicates that bedrock and surficial materials in the Goldboro area contain naturally elevated levels of arsenic associated with the abundant arsenopyrite in the mineralized rocks throughout the Goldboro gold district. In the fall of 2006, samples were taken and levels of arsenic and mercury in sediments were measured and compared to CCME Interim Freshwater Sediment Quality Guidelines for the protection of aquatic life. The CCME limit for arsenic is 5.9 mg/kg. This level was exceeded in two of the five samples (7.6 and 21.0 mg/kg). Levels of mercury were at or below the CCME limit (0.17 mg/kg) for each of the five samples. These levels of arsenic and mercury do not indicate contamination from past gold mining activities. Levels reported were expected given the surficial geology and water quality of the area.

Public Comments

Concern was raised about impacts from near-shore and onshore contaminants. Please refer to Appendix C for additional details.

View of the RAs

With respect to the potential interaction and effects of the pipeline with onshore contamination related to past mining activities and acid rock drainage, the RAs are satisfied with EnCana's commitment to conduct a geotechnical testing program during detailed pipeline design and routing that will include analysis of soil chemistry and will identify potential areas of contamination and/or acidic drainage. More specifically, EnCana will test soils along the easement, and in the case of elevated levels of contamination, a detailed site assessment will be carried out to determine the extent and nature of contamination that could reasonably be affected by pipeline-related activity. EnCana will manage all contaminated materials according to regulatory requirements and standard practices

depending on the level and type of site contaminants. Mitigation measures to avoid contamination of adjacent terrestrial and aquatic systems will be applied, with the knowledge and guidance of applicable regulatory authorities. EnCana will abide by the NSEL *Guidelines for Management of Contaminated Sites in Nova Scotia*, the *Erosion and Sedimentation Control: Handbook for Construction Sites*, and the *Sulphide Bearing Material Disposal Regulations*, where applicable.

Furthermore, EnCana commits to consulting with regulatory authorities on matters related to remediation of contaminated sites and associated mitigation as required according to the appropriate regulatory jurisdiction within the pipeline easement.

The EPP will also include mitigation similar to that included in M&NP's Acid Drainage Construction Response Plan.

The RAs predict that the likelihood of potential interaction between the Project and any existing near-shore and/or onshore contaminants is low. However, in the event that near-shore and/or onshore contamination is encountered, the RAs predict that impacts will be of low magnitude and geographic extent, and reversible. It is therefore concluded that impacts are not likely to result in significant adverse environmental effects.

Mitigation and Follow-up

EnCana has committed to the following mitigation with respect to near-shore and onshore effects:

- developing a contaminants response plan to be implemented as part of the EPP, should it be determined that contaminant concentrations in sediments or soils pose an unacceptable risk to sensitive receptors. If necessary, these materials will be removed and disposed of in a manner that prevents potential contamination of the environment;
- adherence to the NSEL *Guidelines for Management of Contaminated Sites in Nova Scotia*, the *Erosion and Sedimentation Control: Handbook for Construction Sites*, and the Sulphide Bearing Material Disposal Regulations, where applicable;
- developing an Acid Rock Drainage Construction Response Plan should acid rock be encountered during the geotechnical testing program.

No additional mitigation or follow-up is required of the proponent beyond the above, and the mitigation and follow-up committed to by EnCana in the approved 2002 CSR, with respect to near-shore and onshore effects.

Residual Effects and RAs Determination

Taking into account the mitigation measures to be implemented, the residual environmental effects from near-shore and onshore contaminants are predicted to be reversible and of limited magnitude and geographic extent.

The RAs have determined that significant adverse environmental effects on the near-shore and onshore environments are unlikely, provided that the mitigation proposed by the proponent in and the mitigation described in this CSR are implemented.

9.9 Wildlife and Habitat

EnCana's Assessment

The analysis of impacts from construction, operation/maintenance and accidents/malfunctions on terrestrial wildlife and habitat in the 2002 CSR (including mitigation and follow-up proposed), remain valid, with the exception of:

- wetlands and watercourses (discussed below) and;
- species at risk (discussed in Section 9.11).

Wetlands

Avoidance of all wetland habitat (specifically the Betty's Cove Brook wetland area) may not be entirely possible, as was previously committed to in the 2002 CSR. While EnCana has committed to making every reasonable effort to minimize interactions with wetlands during pipeline routing, potential impacts to wetlands from the proposed M&NP Option could still include the following:

- alteration of wetland hydrology resulting in changes in plant and animal community structure and alteration of other wetland function;
- disturbance of wildlife species that use wetlands as habitats;
- introduction of non-native plant species; and
- increased sedimentation resulting in smothering of wetland plant communities, altering wetland fertility and/or infilling of the wetland.

Impacts from accidents/malfunctions on wetlands were assessed in the 2002 CSR.

If impacts to the Betty's Cove Brook wetland area cannot be avoided, a wetland evaluation, considering wetland function, will be undertaken and used in developing compensation and monitoring programs. If pipeline placement (i.e., trenching, pipe laying) takes place in the wetland, vehicle use will be required; however, traffic will be limited to necessary machinery and work room, and temporary access roads and laydown areas will be organized, where feasible, to minimize impacts from equipment movement and material storage. No project-related ATVs will be permitted within the wetland during construction or normal operations. Direct and indirect damage to the wetland will be monitored.

EnCana also states that the pipeline design will maintain existing drainage regimes where possible and in instances where there is potential for the buried pipeline to act as a conduit for water movement in or out of a wetland, trench blocks will be placed in the trench to impede the flow of water along the pipeline. Furthermore, clearing activities in wetlands and vegetation control will be conducted outside of the breeding period for most migratory bird species and the four-toed salamander (April 1 to mid-August).

If the Betty's Cove Brook wetland area can be avoided through final pipeline routing, an appropriate buffer zone will be established to minimize direct and indirect effects on this wetland. The extent of the buffer will vary in consideration of available land, hydrology, geotechnical conditions, pipeline length and other constraints.

Additional measures intended to mitigate impacts to both wetlands and watercourses are provided at the end of this section.

Watercourses

EnCana predicts that any environmental effects on fish and fish habitat in the onshore portion of the Project will be short term (1-2 days in the case of fish passage obstruction), and will occur at times that are least likely to impact fish populations. To protect aquatic life, EnCana has committed to minimize sediment releases during construction and from erosion. In the case of altered stream habitat, fish habitat quality will be the same, or better, after construction across a waterway. Habitat compensation will be provided, if necessary, according to the terms of any required subsection 35(2) Authorizations under the *Fisheries Act* to replace any potential loss of fish habitat caused by the Project.

In-stream work will be conducted during low flow periods (June to September) to avoid interference with fish migration and with spring and fall spawning activities. As well, fish will be removed from the area of planned construction activities prior to draining, and will be captured and removed with methods under any required conditions of Licence and Written Permission issued under Sections 52 and 56 of the Fishery (General) Regulations. Water pump intakes involved in dam and pump procedures will be in compliance with the DFO *Freshwater Intake End-of-Pipe Fish Screen Guidelines* (DFO 1995).

Stream crossings in acid drainage risk areas and/or areas contaminated by past mining activities will require surface water quality monitoring throughout the life of the Project. Samples taken after completion of the Project should be conducted at least four times annually (during each season) for two years. The results of water quality sampling programs will be used as criteria to evaluate the effectiveness of mitigation. (Refer to the mitigation on acid rock drainage areas in Section 9.8.)

Mitigation Measures Applicable to Both Wetlands and Watercourses

The likelihood of sedimentation will be reduced through construction planning and zoning activities. Erosion control structures will be used to mitigate long-term effects of erosion and sedimentation and will be monitored to ensure their efficacy. Care will be taken to maintain as much riparian vegetation as possible to mitigate risk from erosion, sedimentation and temperature fluctuations. Erosion control measures will not be removed until the exposed soils have been completely revegetated or otherwise permanently stabilized. Specific mitigation pertinent to erosion and sediment control will be specified in the EPP.

Approved herbicides will only be used in limited quantities around surface structures and not within 30 m of a watercourse or wetland and all equipment (e.g. bulldozers) will be cleaned of root fragments and seeds before working on site to minimize the introduction of invasive plant species.

Potential accidental discharges of fuel, lubricants, or hydraulic fluids in a wetland or watercourse will be addressed in the Spill Response Plan and the Emergency Management Plan.

Public Comments

Concern was raised about impacts to onshore wildlife and habitat. Please refer to Appendix C for additional details.

View of the RAs

Environmental aspects of the onshore environment within the Project area include freshwater fish and fish habitat, terrestrial plants and animals, and sensitive habitats, such as wetlands.

In terms of the onshore pipeline, the RAs accept that more detailed routing is not yet available as discussions with adjacent land owners are ongoing. It is acknowledged that appropriate mitigation was developed for terrestrial species in the 2002 CSR, including a commitment to conduct field surveys during the final pipeline design/routing to verify EA predictions related to species at risk and to make survey methods and results available to regulatory authorities for review. These verification surveys will also include new species recently recorded during the Keltic/Maple project baseline surveys (discussed further in section 9.11).

Under Section 6 of the Migratory Birds Regulations (MBR), it is forbidden to disturb, destroy or take a nest or egg of a migratory bird; or to be in possession of a live migratory bird, or its carcass, skin, nest or egg, except under authority of a permit. It is important to note that under the current MBR, no permits can be issued for the incidental take of migratory birds caused by development projects or other economic activities. It is the responsibility of the proponent to ensure that activities are managed so as to ensure compliance with the MBCA and associated regulations. EnCana has committed to conducting vegetation control outside of the breeding period for most migratory birds (April 1 to mid-August). In fulfilling its responsibility to comply with the MBCA, the proponent should take the following points into consideration:

- while the above window covers the breeding season for most migratory birds; some species protected under the MBCA nest outside this timeframe; and
- while most species of birds construct nests in trees and shrubs, a number of birds nest at ground level, and some species (e.g. Bank Swallows) nest in burrows in stockpiles of soil or the banks of pits.

The RAs recognize this as an important step by EnCana toward fulfilling its responsibility to comply with the MBCA. This approach is a simple method frequently used to minimize the risk of destroying bird nests by avoiding certain industrial activities during the nesting period of migratory birds in the region. Risk of impacting active nests or birds caring for pre-fledged chicks, discovered during Project activities outside the breeding season for most migratory birds, can be minimized by measures such as the establishment of vegetated buffer zones around nests, and minimization of activities in the immediate area until nesting is complete and chicks have naturally migrated from the area.

Regarding wetlands, the RAs note that EnCana has committed to making every reasonable effort to avoid impacts, but that avoidance of the Betty's Cove Brook wetland area may not be possible. The *Federal Policy on Wetland Conservation* (FPWC) (Government of Canada, 1991) was introduced "to promote the conservation of Canada's wetlands to sustain their ecological and socio-economic functions, now and in the future". The policy recognizes the

importance of wetlands to the environment, the economy and human health, and promotes a goal of no-net-loss of wetland functions. In support of this goal, the FPWC and related implementation guidance identify the importance of planning, siting and designing a project in a manner that accommodates a consideration of mitigation options in a hierarchical sequence - avoidance, minimization, and as a last resort, compensation (Milko, R. 1998). The RAs advocate application of the FPWC to the Project as a best practice

If impacts to the Betty's Cove Brook wetland area cannot be avoided, the RAs acknowledge that EnCana is committed to wetland compensation and monitoring as well as the numerous mitigation measures described above and listed below. The objective of the compensation program is to achieve no net loss of wetland function and the RAs expect that the evaluation methodology and results, as well as any necessary compensation and monitoring plans will be submitted for their review and approval in a timely manner. In addition, it is expected that:

- for greater clarity, a wetland functional analysis be conducted using appropriate methodology for functional assessments (e.g. Brinson ACE, Index to Biological Integrity, California Rapid Assessment Method); and
- if monitoring is required, regular reporting be submitted to regulatory authorities once monitoring has begun.

A detailed fish and fish habitat assessment will also be completed at each watercourse crossing prior to construction.

The RAs note that the possibility of employing alternative trenching techniques such as HDD has not been fully evaluated by EnCana at this point. HDD presents an alternative to conventional trenching methods and can provide several advantages because construction within wetlands is not required, thereby avoiding numerous impacts. While it is understood that past experience installing the existing SOEP onshore pipeline suggests that HDD may be unsuccessful in this particular geographic area, RAs still expect that alternatives to trenching be explored, if the Betty's Cove Brook wetland area cannot be avoided. This is supported by the NEB Recommendation H in the Joint Environmental Report which recommends a comparative review of the different potential wetland and watercourse crossing methods, including HDD,

In addition, any temporary access roads should be constructed in such a manner as to minimize impacts to soil and vegetation.

Overall, the Project will contribute to a cumulative loss of onshore habitat and wildlife; however, the RAs predict that any impacts will be of limited duration, magnitude, and geographic extent.

Mitigation and Follow-up:

In addition to the 2002 mitigation commitments, EnCana commits to the following mitigative measures with respect to wildlife and habitat:

General

- the area of disturbance will be limited to that which is absolutely necessary to complete the Project;

- a wet weather shut down policy will be in place and will include the minimum precipitation level which will trigger response measures;
- during the Public Review, EnCana committed that if acid rock is encountered, it would adhere to the Sulphide Bearing Material Disposal Regulations promulgated under the *Environment Act* of Nova Scotia;

Wetlands

- for wetland habitat that would potentially be affected by the Project, EnCana will conduct a wetland evaluation which will consider wetland functions. The evaluation will be used in developing compensation and monitoring programs to achieve no net loss of wetland functions and subsequent compensation/monitoring programs will be submitted to the appropriate regulatory authorities;
- if a wetland must be disturbed, EnCana will ensure that:
 - vehicle use in the area of wetland, required for pipeline placement, will be limited to necessary machinery and work room, access roads and project-related; otherwise, vehicles will be kept out of wetlands
 - ATVs will not be permitted within the wetland during construction or normal operations;
 - Laydown areas will be organized, where feasible, to minimize impacts from equipment movement and material storage; and
 - direct and indirect damage to the wetland will be monitored;
- ensuring that existing drainage patterns in wetlands are maintained as feasible, during construction and operation;
- only undertaking grubbing in wetlands immediately prior to installation of the pipeline;
- installing trench blocks to prevent water from draining into or out of wetlands via the buried pipeline. Substrate will be preserved, if feasible, where wetland restoration of the RoW is proposed;
- if the Betty's Cove Brook wetland area can be avoided through final pipeline rerouting, EnCana will establish an appropriate buffer zone, to minimize direct and indirect effects on this wetland;
- codes of practice around wetlands and watercourses will be described in the Project EPP;

Watercourses

- consulting with relevant regulatory authorities when choosing the method of watercourse crossing and when designing streambed substrate to be placed in the RoW;

- designing all culverts and temporary and permanent stream diversions associated with the Project works to allow for fish passage;
- maintaining as much riparian vegetation as possible to mitigate risk from erosion, sedimentation and temperature fluctuations in the watercourse;
- minimizing impact on stream crossing by using dry crossing techniques;

As for follow-up, EnCana has committed to:

- developing a Compliance Monitoring Plan prior to commencement of any construction activity;
- developing a monitoring program pertinent to freshwater fish and fish habitat which will include: post construction monitoring of erosion protection methods; monitoring of site runoff and stream flow during construction and operation if acid drainage risk is identified during the geotechnical program; water quality monitoring (TSS, acid drainage and contaminated sediments); and general assessment of the post-construction conditions in affected wetlands and watercourses;
- monitoring of fish habitat along the RoW to assess effectiveness and mitigative measures;
- conducting follow-up after clean up activities to accurately evaluate habitat restoration and the success of stream bank protection and stability;

In addition to the measures identified above and in 2002, the RAs require EnCana to implement the following mitigation:

- building on 2002 commitments regarding invasive species, EnCana shall inspect equipment prior to, during and immediately following construction in wetland areas and in areas found to support Purple Loosestrife to ensure that vegetative matter is not transported from one construction area to another;
- EnCana has committed to conducting vegetation control outside of the breeding period for most migratory birds (April 1 to mid-August). In fulfilling its responsibility to comply with the MBCA, EnCana shall take the following points into consideration:
 - some migratory bird species protected under the MBCA nest outside the April 1 to mid-August timeframe; and
 - while most species of birds construct nests in trees and shrubs, a number of birds nest at ground level, and some species (e.g. Bank Swallows) nest in burrows in stockpiles of soil or the banks of pits.

Also, risk of impacting active nests or birds caring for pre-fledged chicks, discovered during Project activities outside the breeding season for most migratory birds, can be minimized by measures such as the establishment of vegetated buffer zones around nests, and minimization of activities in the immediate area until nesting is complete and chicks have naturally migrated from the area; and

- constructing any temporary access roads in a manner that will minimize compaction of soils, destruction of vegetation and enable all materials to be removed once pipeline construction activities are completed;

- if the Betty's Cove Brook Wetland area can be avoided through final pipeline routing, the "appropriate buffer zone" mentioned above shall be determined in consultation with EC;
- once a more detailed pipeline route has been selected, submitting the following information to EC for review and approval:
 - a map showing the location of wetlands in relation to the proposed pipeline RoW,
 - an estimate of area of wetland (e.g., wetland in area of Betty's Cove Brook) that could be affected by the project,
 - supporting reasons for why the wetland is deemed unavoidable (i.e., the mapping and analysis employed which demonstrates why the wetland cannot be avoided);
 - a wetland functional analysis for the wetland habitat potentially affected by the Project (including adjacent and downstream of the pipeline route). The proposed methodology for this analysis shall reference the appropriate sources (e.g. Brinson ACE, Index to Biological Integrity, California Rapid Assessment Method);
 - if necessary, proposed wetland compensation and monitoring programs. It is expected that monitoring results also be submitted regularly for review; and
- exploring alternatives to pipeline trenching (e.g. HDD) in the event the Betty's Cove Brook wetland area cannot be avoided.

Residual Effects and RAs Determination

The RAs have determined that residual significant adverse environmental effects on onshore wildlife and habitat are unlikely, provided that the mitigation proposed by the proponent and the mitigation described in this CSR are implemented.

9.10 Impediments to Navigation and Other Ocean Users

EnCana's Assessment

Impediments to navigation are analyzed with respect to effects on other ocean users. Other ocean users include marine transportation (shipping), submarine cables, military use, and other oil and gas activities. There are a number of Project design changes that may change the nature of the interactions between the Project and other ocean users and have implications for ESSIM planning.

During construction and installation, changes in the Project's subsea equipment (flowlines, umbilicals, and subsea protection structures), construction of the SOEP Subsea Option pipeline, and the increase in the total number of wells, may all result in potential conflict not previously assessed with respect to other ocean users. The pile driving for the hot tap template and wellheads will generate noise at several locations, rather than only the field centre; this has the potential to conflict with military use. In the near-shore area, pipeline construction near landfall may require the creation of a temporary work area in the intertidal zone.

Changes in operations include a longer production period and relocation of the field centre. The longer production period will increase the temporal boundaries for interaction, while the relocation of the field centre will change the location of spatial interaction with marine transportation and military use.

Project design changes mean an increase in the spill risk to fisheries in the area, as spills may affect commercially fished species. However, the risk of a major spill remains extremely low, as described in Section 4.2. The Project's Safety Zone, in addition to the EMP, will reduce effects of a major spill or release on other ocean users. A large scale atmospheric release associated with a well blow-out, while extremely unlikely, could have health and safety consequences for platform workers as well as passengers of vessels within several kilometres. EnCana predicts that the effects of spills on commercially fished species of fish and benthos will not be significant, therefore the effects of spills on other ocean users is also predicted to be not significant.

Public Comments

Concern was raised about impacts to navigation and other ocean users. Please refer to Appendix D for additional details.

View of the RAs

The potential adverse effects on other ocean users can be effectively mitigated through the issuance of *Notice to Mariners*, as applicable, and the charting of all Project infrastructures. The location of the platform, subsea protection structures, flowlines and umbilicals, and the Project safety zone around these structures will be clearly indicated on nautical charts. In addition, EnCana has committed to notify MARLANT of its construction, production, and decommissioning activities and schedule so that military activities can avoid conflict. As well, the presence of the safety zone, plus emergency response and contingency planning, will limit the likelihood of effects on other ocean users. EnCana has also committed to put in place systems to protect worker safety in place to ensure that any adverse occurrence is of extremely short duration for adequate protection of human health and safety.

It shall be noted that the statements included in this CSR regarding navigation were made in consideration of the Project's environmental aspects (within the context of this assessment) which could significantly affect the public right of navigation. The determination, below, is not to be construed as a decision or authorization pursuant to the *Navigable Waters Protection Act* (NWPA) as administered by TC. The full effects on the public right of navigation will be considered by TC through the NWPA review process which has yet to be completed.

With respect to ESSIM, EnCana has committed to continue active involvement in the ESSIM process, to help ensure that Project activities take place in the larger context of integrated ocean management planning and activities of other ocean users. EnCana will also be required to adhere to the Compensation Guidelines Respecting Damages Relating to Offshore Petroleum Activity, to provide additional protection to other oceans users as well.

Based on the 2002 CSR commitments, the RAs predict that there is a low likelihood of interaction between the Project and navigation/other ocean users, therefore significant adverse environmental effects are not likely.

Mitigation and Follow-up:

In addition to the 2002 mitigation, EnCana commits to the following mitigative measures with respect to impediments to navigation and other ocean users:

- notifying the F SEMS Officer, DND (Halifax) prior to any pipeline laydown work commencement to determine MARLANT Ops activities in the area; as the proposed work may traverse through MARLANT Ops Areas I and J;
- continued participation in ESSIM.

In addition to the measures identified above and in 2002, the RAs require EnCana to implement the following mitigation:

- The proponent has submitted an application for authorization to the NWPP of TC for this project. Any prescribed requirements pursuant to the NWPA as determined by the NWPP shall be strictly adhered to.

Residual Effects and RAs Determination

The RAs have determined that the residual significant adverse effects on navigation and other ocean users are unlikely, provided that the mitigation described in this CSR is implemented.

9.11 Species at Risk

EnCana's Assessment

Table 8.5 lists species at risk and species of conservation concern that may occur in the study area.

In Accordance with Section 79 requirements of SARA, RAs notified the competent Ministers of several listed wildlife species that were likely to be affected by the proposed. Project Potential effects to these species are considered in the sections below and provisions to mitigate and monitor are identified as appropriate.

Marine Fish

Although several fish species at risk are wide-ranging on the Scotian Shelf, the Project area is not known to provide critical feeding or spawning habitat for any at-risk fish species. Winter skate may be present in the Project area as they are known to occur over Sable Island Bank, however no individuals have been observed during baseline surveys of the area and it is unlikely that the Project area provides critical habitat.

Pipelaying and trenching are not expected to have a measurable adverse effect on species at risk in the vicinity of construction activities. The increase in potential interaction with fish species at risk in the area is a short-term, one-time, localized event, and is not expected to result in a measurable impact.

The discharge of hydrostatic testing fluid during construction could have adverse effects on species at risk, due to the potential presence of various chemicals (such as corrosive

inhibitors and biocides). Such chemicals may not be required if the interval between laying the pipeline and hook-up is sufficiently short. The chemicals to be used in hydrostatic fluids will be selected from a list of chemicals approved for use in Canada. A study will be undertaken to assess the impact of the selected chemicals discharged into the environment to confirm that there will be minimal impact to the marine environment around the platform.

Noise and vibration generated during pile driving operations could interact with all life cycle stages of fish. The amount of underwater noise associated with pile driving is significantly less than that outlined in the approved 2002 CSR, therefore no adverse physical or behavioural effects are expected on any life stages of commercial and non-commercial fish species in the vicinity of pile driving, including fish species at risk.

Cutting piles are expected to disperse within one year. Effects will therefore be temporary and the marine community will rapidly recolonize affected areas and return to baseline conditions. There is no evidence of acute toxic effects (i.e., lethality) of WBM in the field. The area potentially affected by drilling wastes is small in relation to the habitats of most species in the study area. EnCana predicts that drill waste discharge will not have significant adverse effects on marine fish, including species at risk.

In contrast to the behaviour of the discharged plume assessed during the approved 2002 CSR, the plume of discharged water for the current Project is expected to sink, under most conditions. The potential for interaction between discharged water and pelagic fish and the eggs and larvae of most fish species is therefore decreased. The maximum end of pipe concentrations of H₂S in produced water remains well below levels that have been shown to be toxic to marine fish. The full-time “polishing” of produced water on the MOPU and the rapid dilution of the produced water plume will result in fish being exposed to extremely low concentrations of alkylphenols that are unlikely to elicit measurable effects.

The rapid dilution of heavy metals and the brief exposure periods (due to the mobility of adult fish and variable currents and discharge volumes) to potentially harmful concentrations of heavy metals mitigates the potential for significant effects of heavy metals in produced water to fish or invertebrates. As well, given the existing natural variability of water temperature in the Project area, the temperature anomalies cause by the Project are not predicted to exceed temperature tolerance thresholds of fish species except in the immediate area (i.e., tens of metres) from the end of pipe discharge.

EnCana predicts that neither project construction, nor operation, nor decommissioning will have significant adverse effects on marine fish populations, including fish species at risk.

Marine Mammals and Sea Turtles

Interactions between the Project and marine mammals and turtle species at risk could occur at any time during the life of the Project. The primary interaction between Project construction and marine mammals and sea turtles is related to the pile driving activity for installation of the subsea protection structures for the connection to the SOEP Pipeline (SOEP Subsea Option) and wellheads. The energy required for installation of these structures is much less than what was originally assessed for platform installation in the approved 2002 CSR and with the mitigation proposed is therefore unlikely that significant adverse effects on marine mammal or sea turtle species at risk will occur as a result of project construction.

EnCana predicts that there will be a minor increase in the reef/refuge effect for marine fish during project operations, such that there will likely be a minor increase in available food source for mammals and turtles. These food sources would potentially be subjected to greater volumes of produced water discharges and contaminants and therefore could have adverse effects on the health of marine mammals and turtles if eaten. However, no significant adverse effects on marine fish and benthos are predicted due to project discharges, such that there is predicted to be no significant effects on marine mammals and turtles as a result of eating marine fish and benthos. Any potential localized degradation in water quality associated with hydrostatic testing is predicted to not adversely affect marine mammals or sea turtles, including species at risk. This discharge will be in compliance with the OWTG, and will be subject to bioassay testing and discharge flow modelling to be developed in consultation with regulatory authorities. EnCana therefore predicts that project operations will not have significant adverse effects on marine mammal or turtle species at risk.

There will be less noise disturbance from decommissioning the MOPU than three platforms originally proposed in the approved 2002 CSR, and the potential adverse effects from decommissioning were predicted to not be significant in the approved 2002 CSR. Therefore, EnCana predicts that decommissioning of the MOPU will not have significant adverse effects on marine mammal and turtle species at risk.

EnCana predicts that neither project construction, operation, nor decommissioning will have significant adverse effects on marine mammals or sea turtles, including species at risk.

Marine-related Birds

Interactions between the Project and marine-related species could occur at any time during the life of the Project. During construction, installation of a single MOPU will result in less noise and disturbance to marine-related birds than the installation of three platforms considered in the approved 2002 CSR. Installation of flowlines, umbilicals and subsea protection structures will result in an overall increase in the area of disturbance; however, the disturbance will be temporary and construction vessels will avoid Sable Island and Country Island by 2km (as per the Codes of Practice) thereby avoiding interaction with Roseate Tern Critical Habitat and breeding habitat of the Ipswich Sparrow.

During operations, noise associated with drilling is predicted to have a minor effect on marine-related birds, as they are generally not repelled by drilling noise on the Scotian Shelf. Operational discharges such as hydrostatic testing and completion fluids, produced water and deck drainage, or small chronic spills may contain oil and can result in hydrocarbon sheens forming around the platform under certain oceanographic conditions. The potential therefore exists for marine birds to become oiled and it is recognized that small amounts of oil on a seabird's plumage can result in death or decreased reproductive success. These discharges however, will be treated in accordance with the OWTG and the formation of sheen is expected to be episodic. If sheen does occur, it would be very short-lived and would not likely reach any Critical Habitat for species at risk or important habitat for species of conservation concern. Furthermore, EnCana acknowledges that an ESRF study is currently underway which is examining the effects of oil sheens on bird feathers in laboratory conditions. EnCana commits to reviewing the results of this study once available and will incorporate any necessary changes in its EPP.

A significant spill is unlikely given the environmental protection systems of the Project. Oil spill trajectory modelling indicates that it is very unlikely that condensate from blowouts or diesel spills from the platform would reach Country Island or Sable Island. As well, EnCana is in the process of developing a spill response protocol for birds and will implement it once it is finalized and approved for use. This protocol outlines strategies for minimizing contact between marine-related birds and spilled materials (i.e., hydrocarbons), rehabilitation or other humane treatment of oiled birds, and post-spill monitoring requirements.

Terrestrial Species at Risk

Tables 8.3 and 8.5 respectively list terrestrial plant and bird species at risk and species of conservation concern that could potentially be present in the study area. In general it is assumed that the description and status of terrestrial plants and animals likely present in the pipeline corridor has not changed since the 2002 CSR. This is because the 2001/2 field surveys extended beyond the previously proposed corridor, into the current terrestrial study area. EnCana notes however that the Short-eared Owl has since been observed in the vicinity of the wetland associated with Betty's Cove Brook and that breeding Greater Yellowlegs were identified in the Gold Brook Wetland, both during baseline field surveys for the Keltic/Maple Project. EnCana is also aware that the Rusty Blackbird, identified in the project area during 2001/2 field surveys, has recently been listed as Special Concern by COSEWIC, and is currently being considered for listing on Schedule 1 of SARA.

There is only potential for effects on terrestrial species of conservation concern if the M&NP Option is chosen. If this is the case, EnCana has committed to conducting surveys (with a focus on species in Tables 8.3 and 8.5) during final pipeline design/routing to confirm their species lists and associated effects predictions. These surveys will include a terrestrial field survey in the spring with attention to habitat used by the Rusty Blackbird, Short-eared Owl, breeding and chick-rearing Greater Yellowlegs.

EnCana has also committed to consulting with EC on the methodology to be used for the surveys and has indicated that the earliest the field surveys would take place is in the spring of 2008.

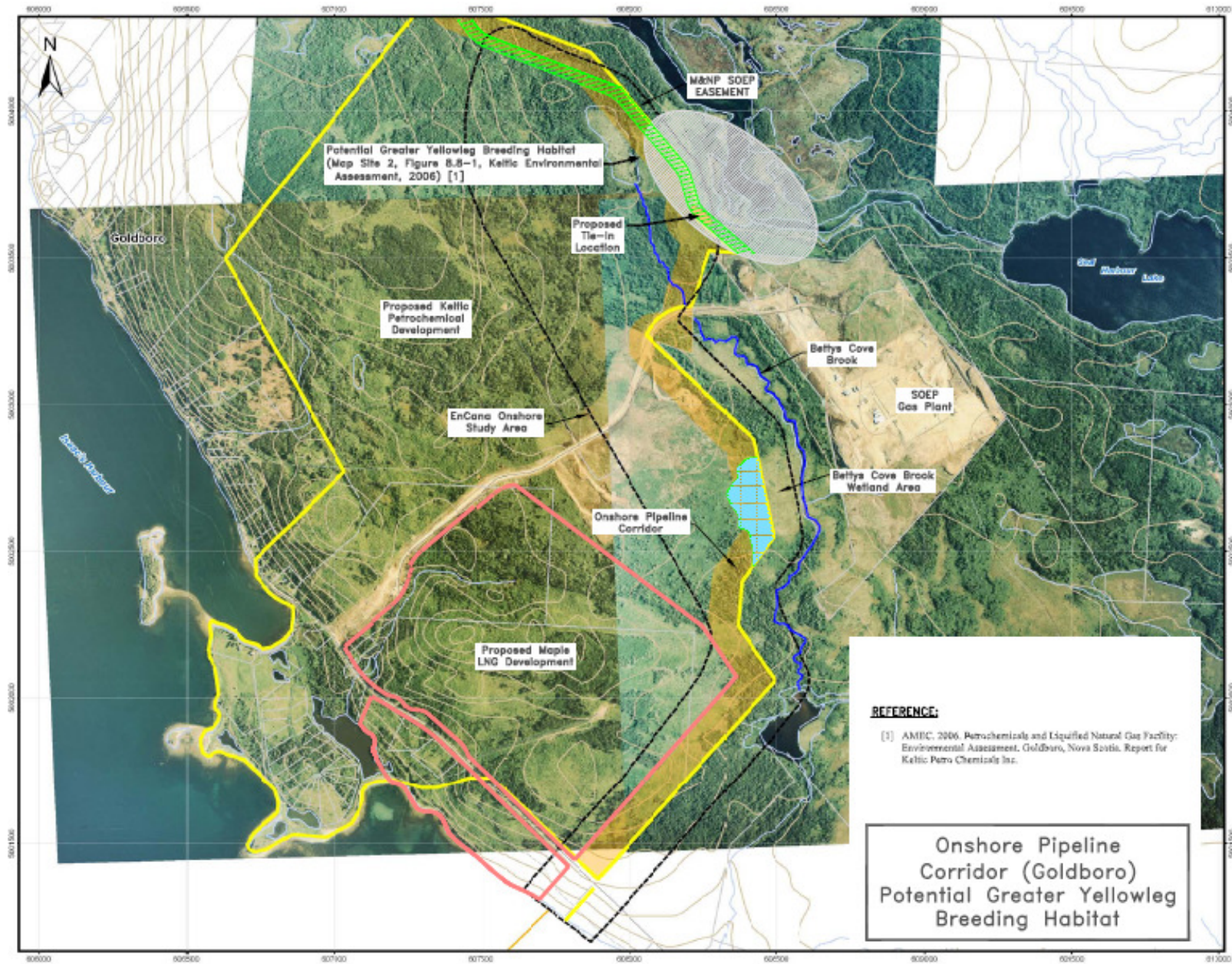
Should these species be found to occur in the pipeline route, EnCana expects that the impacts would be limited given that construction will be a one-time disturbance of limited duration (i.e. less than three months) and that grubbing/clearing will be conducted outside of the breeding period (April 1 to mid-August). Accidents and malfunctions (e.g. pipeline rupture and fire) could result in limited mortality to these species; however the likelihood of such events occurring is extremely low when considering the prevention and response mechanisms to be included in the Project design.

EnCana provides further explanation of why interaction with the Rusty Blackbird and Greater Yellowlegs are anticipated to be low. Regarding the Rusty Blackbird, EnCana notes that the 2001/2 surveys recorded a sighting in a mature softwood forest, with no indication of nesting activity and that no sightings were recorded during the Keltic/Maple Project baseline surveys. EnCana maintains that this species is regularly found in tall shrub swamps, a habitat which is not found within the proposed pipeline corridor so the potential to encounter the Rusty Blackbird is low.

With respect to Greater Yellowlegs, EnCana offers that an overlap is not expected between the proposed pipeline and nesting and chick-rearing habitat. The proposed pipeline tie-in is

located on the periphery of the potential Greater Yellowlegs breeding habitat identified in the Keltic EA, and therefore, interactions with this species during breeding activities are expected to be limited (see Figure 9.3).

Figure 9.3: Onshore Pipeline Corridor – Potential Great Yellowleg Breeding Habitat



Regarding the Short-eared Owl however, EnCana does recognize that if the Betty's Cove Brook wetland area is deemed unavoidable, a small portion of the species' habitat would be lost during pipeline installation.

Overall, the results of the terrestrial surveys will be used to refine mitigative measures and monitoring requirements with respect to final pipeline routing. If species at risk or species of conservation concern are identified within the pipeline route, the appropriate regulatory authorities will be contacted to discuss the proposed course of action. In addition, if a Rusty Blackbird or Short-eared Owl nest is located during the survey, a buffer of natural vegetation, to be determined in consultation with the NSDNR and EC, will be left.

Public Comments

Concern was raised about impacts to species at risk and species of conservation concern, including their habitats. Please refer to Appendices C & D for additional details.

View of the RAs

Marine Fish

It is unlikely that the Project study area is important for spawning, rearing or feeding for any of the listed fish species at risk including Winter Skate. As well, the area where discharges will occur during construction and operations is not defined as a critical spawning site for any at risk marine fish species. The release of routine discharges will not adversely affect populations of at risk marine fish species.

Although unlikely to occur, oil spills may affect water quality, which in turn may affect the health and survival of plankton, fish eggs and larvae, and juvenile and adult fish. The sensitivity of fish larvae to an oil spill varies depending on the type of oil; however, these effects are short lived. Oiled sites are unlikely to pose a long-term hazard to fish embryo or larval survival. Impacts on juvenile and adult fish exposed to an oil spill or blowout can be lethal, as fish gills can be coated with oil and oil can disrupt physiological processes.

Marine-related Birds

EnCana has stated that oiled plumage can result in the death of individually oiled birds. However, the probability of an oil spill is very low. Spills of diesel or condensate are unlikely to reach Sable Island and are therefore unlikely to affect species at risk nesting on or foraging in the shallow waters around the Island. Additional information regarding Roseate Tern foraging distances and depths is provided at the end of this section. In the event that an operational discharge resulted in sheen occurring around the MOPU, it would be very short-lived and unlikely to reach any critical habitat of avian species at risk. Furthermore, EnCana has committed to developing an appropriate bird protocol for inclusion in the Spill Response Plan.

In addition, construction and supply vessels will be required to avoid Sable Island and Country Harbour by 2km, thereby avoiding interaction with Critical Habitat of the Roseate Tern and breeding habitat of the Ipswich Sparrow.

Other potential interactions with marine-related birds including species at risk (e.g. attraction to lights/flares) were assessed and addressed through appropriate mitigation and monitoring commitments in the 2002 CSR. The RAs note however that standard pelagic seabird survey protocols are now available for stationary and moving platforms and will be made available to EnCana through EC.

The RAs also note that interactions with the Roseate Tern and other tern species in the *coastal foraging areas* of Country Harbour could occur for a short time (weeks) during the installation of the M&NP Option. This view is based on Rock (2005) where density plots resulting from kernel estimation of foraging location patterns in Country Harbour were calculated.

These density plots of tern foraging locations suggest that Roseate and Common Terns forage at or in close proximity to the proposed landfall area for the M&NP Option. It may also be prudent to assume that the foraging habitat of these species is even broader, given that Rock (2005) was limited in temporal scope (10 days [33 hrs] of data, collected over a 2 year timeframe during good weather only). Further work is needed to clarify how foraging terns use marine habitat in Country Harbour.

The RAs also recognize the relationship of Roseate Terns with Arctic and Common Terns. Roseate Terns preferentially nest in larger colonies with Arctic and/or Common Terns. Therefore, it is important to consider not only the potential effects of the project on foraging Roseate Terns, but also on its foraging “companion” species. Adverse effects on these species could result in adverse effects on the Roseate Tern.

The Recovery Strategy for the Roseate Tern (October 2006) points out that SOEP conducted pre, during and post pipeline construction monitoring that “did not detect any ill effects” on the Country Island Roseate Terns (p.18). The RAs recognize, however, that this study was primarily focused on evaluating impacts to breeding terns; impacts to tern foraging habitat/activities were not studied. Nonetheless, it is not anticipated that the proposed M&NP Option *alone* would result in significant adverse effects on foraging Roseate Terns or other tern species in the area. There is also potential for combined impacts from the M&NP Option and the adjacent Keltic/Maple project which, as currently proposed, could impact foraging terns through disturbance, spills and habitat loss (i.e. construction of coastal infrastructure such as the marginal wharf and continuous vessel traffic).

The RAs note that EnCana has reaffirmed its 2002 CSR commitment to develop a Roseate Tern monitoring program in collaboration with the CWS of EC. At that time, EnCana also stated that this program would likely consist of a number of elements including monitoring Roseate Tern foraging activities prior to, during and after pipelay activities (S. 6.3.6.6 of 2002 CSR). To address concerns with potential *cumulative* impacts to foraging terns in Country Harbour, it is expected that the program will include measures to ensure monitoring is conducted in conjunction with Keltic/Maple project monitoring, should that particular project be approved and the timing coincide with the M&NP installation.

Construction of the SOEP Subsea Option would obviously eliminate any interactions with Common, Arctic and Roseate Tern colonies nesting on or foraging near Country Island. The potential for interaction with nesting/foraging Common, Arctic and Roseate Terns on Sable Island, as well as Ipswich Sparrow is unlikely, given the SOEP tie-in point will be over 20km from the island. Although earlier studies of colonies in the northeastern U.S. show Roseate

Terns can forage from 300m to 25km from breeding colonies (Duffy 1986, Heineman 1992, Nisbet and Spendelov 1999), Safina (1990) and Heinemann (1992) also demonstrated that Roseate Terns forage in shallow water, often less than 1 km from shore. Furthermore, it is presumed that Roseate Terns forage along shorelines because sand lance (their main prey), are generally found inshore, in areas with sand or gravel substrate and water depths of 6 to 10 m (Meyer *et al.* 1979). The shallow waters around Sable Island extend out approximately 2 km at best, making interaction with the SOEP Subsea Option unlikely. Construction of the shorter export pipeline (15 km) will also result in less noise and disturbance associated with vessel traffic. Effects predicted for Project construction will generally be less than those predicted in the approved 2002 CSR regardless of which option is chosen, and no significant effects on marine-related birds, including species at risk, are predicted as a result of construction or operation.

Marine Mammals and Sea Turtles

This project is not located in critical habitat for marine mammals or sea turtle species at risk. Migration routes for a number of cetaceans and some turtle species at risk exist on the Scotian Shelf; however, the Project is unlikely to have a significant impact on migration routes. There is potential that spills or gas from a blow-out could impact marine mammals or sea turtles. However, there is a very low probability of a spill or blow-out, and marine mammals and sea turtles have the ability to avoid areas of a spill. Spills are unlikely to reach Sable Island and are therefore unlikely to have an effect on pinnipeds on Sable Island. Furthermore, EnCana will be required to implement well control and drilling procedures, and to submit a spill contingency plan to the CNSOPB. EnCana is also expected to follow their Code of Practice for the Gully with respect to any interactions with the MPA area; therefore, any interaction during the operational phase of this project and the bottlenose whale population is expected to be insignificant. The primary interaction between Project construction and marine mammals and sea turtles is related to the pile driving activity for installation of the subsea protection structures for the connection to the SOEP Pipeline (SOEP Subsea Option) and wellheads. The energy required for installation of these structures is much less than what was originally assessed for platform installation in the approved 2002 CSR and with the mitigation proposed it is unlikely that significant adverse effects on marine mammal or sea turtle species at risk will occur as a result of project construction.

The primary threat to leatherback turtles in Canadian waters is entanglement in fishing gear; however, there is little risk for entanglement in Project subsurface infrastructure as the structures are placed far enough apart such that there are few, if any spaces for head or flipper entanglement.

Marine Benthos

Vessels that will be used during the Project's construction may be mobilized from other parts of the world. The ballasting and de-ballasting of these vessels can introduce harmful aquatic organisms and pathogens to marine ecosystems. This has the potential to negatively impact marine benthos in the area. It can also contribute to the introduction of other types of ship-source contaminants. The primary method used to reduce the risk of invasive species introductions is the open ocean exchange of ballast water.

EnCana will conduct a pre-construction route survey to confirm the assumptions that no corals or other sensitive species or habitats exist along the unsurveyed sections of the

export pipeline and flowline routes. Should corals or other sensitive species or habitat be found, mitigative measure will be taken to minimize environmental effects.

Terrestrial Species at Risk

Since 2002, EnCana has committed to conducting terrestrial field surveys during final pipeline design/routing to confirm their species lists and associated effects predictions. It is understood that EnCana will consult with EC on the methodology to be used for these surveys. At this stage, the following specific survey design considerations are offered with respect to the Short-eared Owl and Rusty Blackbird:

- the survey for the Short-eared Owl should take into account the sensitivity of this species to human disturbance during egg-laying and incubation, the at risk status of the species, as well as the times of day when this species is more easily detected; and
- the survey for the Rusty Blackbird should take into account that this species breeds in a variety of habitats not limited to “tall shrub swamps” (see Avery (1995), COSEWIC (2006) and Erskine (1992)).

In terms of potential loss of Short-eared Owl habitat, the RAs note that this species is not necessarily limited to wetlands if other open habitats (e.g., old pastures, grasslands) are present. Furthermore, the pipeline installation will not permanently remove habitat, but will create open, low-shrub habitat which can be used by the Short-eared Owl for hunting and nesting.

The RAs note that if evidence of nesting by Rusty Blackbird or Short-eared Owl is found during the survey, EnCana proposes to establish a buffer of natural vegetation (in consultation with NSDNR and EC) as a means of mitigation (see response to Information Request EC-ECA-1.24 (b) and 1.25 (b)). Additional mitigation however, may also be required to minimize or eliminate potential adverse impacts on these species (e.g. timing of pipeline installation activities).

Should evidence of Greater Yellowlegs nesting or chick-rearing be encountered, RAs expect that a similar type of buffer would also be established (in consultation with NSDNR and EC) and that additional mitigation may be required to minimize or eliminate potential adverse impacts on nests or chick-rearing birds.

Furthermore, if any mitigation is required for any of these three species, a monitoring program would be required to confirm that mitigation measures are effective.

In general the RAs expect that if any of the species identified in Tables 8.3 or 8.5, or other species at risk or species of conservation concern, are encountered during terrestrial field surveys, EnCana will contact the regulatory authorities to determine the need for further mitigation and monitoring.

Predicted Effects Summary

Given the 2002 CSR commitments, the Project interactions with marine species at risk and species of conservation concern are not predicted to result in significant adverse environmental effects. However, significant adverse effects could occur in the terrestrial

environment if wetlands/watercourses are deemed unavoidable or certain species of conservation concern are encountered.

Mitigation and Follow-up

In addition to the 2002 mitigation, EnCana commits to the following mitigative measures with respect to species at risk and species of conservation concern:

- updating the Code of Practice for Sable Island as required to reflect changes to the administration or management of the Island and the Canadian Coast Guard Emergency Contingency Plan, new information on the critical habitat of Species at Risk, and revisions to EnCana's facilities maintenance and operations procedures which may impact the Island;
- building on the 2002 commitment to conduct terrestrial field surveys during final pipeline design/routing; if evidence of nesting Rusty Blackbird or Short-eared Owl is found, a buffer of natural vegetation, to be determined in consultation with the NSDNR and EC, will be left;
- conducting a pre-construction route survey to confirm the assumptions that no corals or other sensitive marine species or habitats exist along the unsurveyed sections of the export pipeline and flowline routes.

In addition to the measures identified above and in the 2002 CSR, the RAs require EnCana to implement the following mitigation:

- if evidence of Greater Yellowlegs nesting or chick-rearing is encountered during terrestrial survey, EnCana shall establish a buffer of natural vegetation similar to that committed to for the Rusty Blackbird and Short-eared Owl.
- if evidence of Rusty Blackbird, Short-eared Owl or Greater Yellowlegs is found during the terrestrial follow-up surveys, EnCana shall consult with NSDNR and EC to determine whether additional mitigation would be required. If this is the case, the onus will be on EnCana to provide proposed measures to the above regulatory authorities for their review and approval;
- if any of the remaining species in Table 8.3 or 8.5, or other species at risk or species of conservation concern, are encountered during the terrestrial survey, EnCana shall contact the regulatory authorities to discuss the need for mitigation and monitoring; and
- reviewing the results of the ESRF study on the effects of oiling of birds, when published, and will incorporate any associated changes into the EPP as necessary;

As for follow-up, the RAs require EnCana to commit to the following:

- EnCana shall employ CWS pelagic seabird survey protocols during marine-related bird monitoring; and
- EnCana shall coordinate Roseate Tern monitoring efforts with the adjacent Keltic/Maple project, provided it is approved and the timing overlaps with the installation of the M&NP Option,

Residual Effects and RAs Determination

The RAs have determined that residual significant adverse effects on species at risk and of conservation concern are unlikely, provided that the mitigation proposed by the proponent and the mitigation described in this CSR are implemented.

9.12 Cumulative Effects

EnCana's Assessment

Specific projects that the Project may interact with to produce cumulative effects include the Cohasset Project, the Sable Offshore Energy Project (SOEP) and the Maritimes & Northeast Pipeline Gas Transmission, and the Keltic Petrochemicals Inc. and Maple LNG Project.

Other activities that may interact with the Project to produce cumulative effects, but require no further assessment necessary beyond that in the approved 2002 CSR, include the Sable Island Wind Turbine Project, other offshore exploration drilling, seismic surveys, shipping, commercial fishing, tourism, use and occupation of Sable Island, and long range transport of air pollutants.

There is the potential for cumulative effects on near-shore water quality if the construction periods of the Project and the Keltic/Maple Project overlap, however, the effects on water quality would be short-lived and the cumulative effects on water quality would not likely have significant effects on marine receptors and or exceed relevant guidelines.

The Project pipeline (M&NP Option) will result in a cumulative disturbance and additional loss of near-shore benthic habitat in combination with construction and operation of Keltic/Maple Project marine facilities, particularly if those facilities involve infilling. However, there have been no significant effects on the benthos from construction and operation of the nearby SOEP pipeline in the near-shore, and recolonization of the Project right of way is expected to occur within a couple of years.

Historical mining activity in the area also has the potential to add to cumulative effects of the Project. Elevated levels of arsenic, mercury and other elements exist in surrounding terrestrial and marine environments. Prior to construction activities, EnCana will test marine sediments in the near-shore right of way to confirm levels of contaminants. If levels in sediments that are re-suspended as a result of the Project pose an unacceptable risk to sensitive receptors in the water column, these materials will be removed and disposed of in a manner that prevents potential contamination of the environment.

Potential cumulative effects on marine benthos include direct mortality of benthic organisms, possible toxicity and contaminant accumulation, and minor reef and refuge effects. Structures which are not cleaned during operation or remain on the seafloor after decommissioning, such as pipeline mattresses and other unburied Project components, may add to existing artificial benthic habitat created by the SOEP facilities or remnants of the Cohasset Project. There may also be a minor positive cumulative effect on marine benthos due to the addition of a restricted fishing zone, as well as a minor positive cumulative effect on marine fish due to the addition of reef and refuge effects associated with the addition of hard substrate and restricted fishing zones.

Potential cumulative interactions on marine mammals and turtles include direct mortality, injury and avoidance/attraction. Activities that may contribute to the cumulative effects of the

Project on marine mammal populations in the study area include historical commercial whaling, past and present sealing vessel collisions, noise disturbances from vessel and aircraft traffic, oil and gas exploration and production and commercial fishing.

Projects and activities that may interact to cause cumulative environmental effects on marine -related birds in the region include noise disturbance from vessel traffic and aircraft, oil and gas exploration and production, commercial shipping and commercial fishing, and oiling from illegal pumping of bilges by passing vessels and accidental spills from other sources. In addition to local disturbances marine-related birds may also be affected by projects and activities occurring elsewhere in their migratory ranges, such as offshore Newfoundland).

The nature of the activities that add to the cumulative effects as a result of the Project on Sable Island have not changed in the period of time between the approved 2002 CSR and the current Project, and no new development projects have been proposed that would potentially affect Sable Island, the discussion of cumulative effects on Sable Island in the approved 2002 CSR remains valid and requires no updating.

Although the Project may result in environmental effects on fish and fish habitat, they would be temporary (i.e., 1-2 days in the case of fish passage obstruction), will occur at times that are least likely to impact fish populations (i.e., during low flow periods) and will minimize sediment releases through erosion and sediment control to protect aquatic life. In the case of altered stream habitat, fish habitat quality will be restored after construction across a water body. Habitat compensation will be provided, if necessary, according to terms and conditions of the Authorization for the harmful alteration, disruption, or destruction of fish habitat under the *Fisheries Act* to remedy loss of the productive capacity of fish habitat caused by the Project.

There has been a cumulative loss of terrestrial habitat within the onshore study area due to land clearing, forestry, and industrial development. The onshore section of the Project pipeline (M&NP Option) will result in additional alteration of existing terrestrial habitat along the right of way through loss of vegetative cover, and may include some loss wetland habitat. The construction of the Keltic/Maple Project will result in the loss of a substantial amount of terrestrial habitat within the Goldboro Industrial Park. Mitigation for onshore vegetation in the pipeline construction area is discussed in section 9.9. The cumulative loss of wetland habitat for both projects will be mitigated.

The Project will result in a limited loss of forest production opportunities within the right of way, changes to land use and temporary restrictions to recreation opportunities. However, the land use changes associated with the Project and other projects and activities are consistent with planned industrial development in the Goldboro area. Unauthorized use of the RoW (e.g., ATV use) are expected to be insignificant, as the Project will not result in a significant increase in access opportunities. Mitigation along the right of way, such as fencing and signage, will minimize unauthorized access.

The presence of the existing safety zones around the SOEP and the proposed safety zone for the Deep Panuke Project marginally decrease the overall amount of fishable area, by approximately 30 km². However, the SOEP and the Deep Panuke Project are located in areas of relatively light fishing activity and the zones are small as compared to the total amount of similar fishing grounds available on Sable Island Bank. There will be increased vessel presence in the near-shore zone; however, official *Notices to Mariners* and

delineation of Project components on nautical charts will decrease potential for interactions with other vessels in the area. As well, any gear and vessel loss or damage will be compensated by EnCana in accordance with CNSOPB *Compensation Guidelines Respecting Damages Relating to Offshore Petroleum Activity* to ensure no lasting economic impacts to individual fishers.

The presence of platforms and pipelines decreases the area of Scotian Shelf available for military training exercises and shipping as well. Noise generated during Project construction and vessel noise associated with the SOEP may interfere with military training activities that rely on acoustics also. However, the Project area is small compared to available training areas and shipping lanes. There is potential for interaction with recreational boaters during the onshore pipeline construction phase as well, though this phase will be of relatively short duration, such that impacts are expected to be only for a limited amount of time. EnCana predicts that there will not be significant adverse effects on the environment or other ocean users as a result of cumulative effects caused by the Project.

Public Comments

Some issues were raised that were cumulative in nature (e.g. climate change, proximity to existing and future developments). See Appendices C & D for further detail.

View of the RAs

Cumulative effects as a result of interactions with the Cohasset Project include adding to the presence of buried pipeline, interfield flowlines, umbilicals and mattresses. There will also be cumulative reef and refuge effects on fish and benthic organisms, cumulative effects on the fisheries and public navigation through addition of another safety zones.

Cumulative effects as a result of interactions with the Sable Offshore Energy Project include adding to air emissions on the Sable Island Bank, effects on sediment and benthic communities, and loss of terrestrial habitat, an additional safety /no fishing zone, effects on public navigations, reef/refuge effects on fish, and increased industrial land use in the area.

The effects of air emissions from construction of the Project are localized, short in duration, and reversible, and are therefore, not expected to cause significant cumulative effects with construction of the Keltic/Maple Project, which will also have controlled construction air emissions. There will be routine atmospheric emissions with the potential to affect air quality during offshore operations, however significant adverse effects from the combination of CAC emissions with other projects are not considered likely to be significant, with the exception of the extremely unlikely possibility of a surface or subsurface well blow-out. The conclusion can be generally supported by the RAs knowledge of an ongoing air monitoring program that was initiated on Sable Island in 2003. This program was developed in response to concerns regarding exposure to atmospheric emissions from the nearby Thebaud platform and is designed to provide a better understanding of ambient air concentrations in the Sable Island area and any possible impacts from offshore oil and gas operations. A preliminary review of the air monitoring data from this program has shown that Sable Island can be affected by the long range transport of air pollution from the continental mainland; however there do not appear to be any exceedances caused by local sources in the area.

With respect to GHG emissions however, it is recognized that they are a cumulative, global issue and reducing GHG emissions from all Project sources, both large and small, is important to minimizing a significant adverse effect already in play. The use of best

available technologies and best management practices to reduce emissions is essential to achieving these reductions.

Cumulative effects as a result of interactions with the Maritimes and Northeast Pipeline include loss of terrestrial habitat, erosion and sedimentation, sensory disturbance to wildlife, and increased industrial land use in the area.

Cumulative effects as a result of interactions with the Keltic Petrochemical Plant and Maple LNG Facility include loss of terrestrial habitat, erosion and sedimentation, traffic, sensory disturbance to wildlife, air emissions, disturbance to near-shore benthos, accidental events, and increased industrial land use in the area, as well as navigational effects due to increased vessel traffic. Specifically with respect to Country Island Common, Arctic and Roseate Tern populations, as well as other coastal birds, cumulative impacts could potentially occur from installation of the M&NP Option and the construction and operation of the adjacent Keltic/Maple project which, as currently proposed, could impact foraging terns through disturbance, spills and habitat loss (i.e. construction of coastal infrastructure such as the marginal wharf and continuous vessel traffic).

With respect to cumulative near shore navigational effects with the Keltic LNG Marine Terminal project, the Keltic/Maple Project will be reviewed under the TC Marine Safety TERMPOLE Review Process (TRP), in addition to the CEAA process to appraise operational ship safety, route safety, management and environmental concerns associated with the location, construction and subsequent operation of the marine terminal system. The TRP will serve to minimize potential effects on / threats to, the environment, marine vessel traffic or to the safety of the communities along the proposed route(s) to and from the terminal or transshipment site.

There is also the potential for cumulative effects as a result of interactions with commercial fisheries, telecommunications cables and military exercises. DND has indicated that the proposed laydown areas for piping may traverse through MARLANT Op areas I and J, and request that EnCana contact DND prior to any laydown work commencement in these areas, to determine MARLANT Op use at that time. Cumulative effects as a result of interactions with commercial fisheries include collisions or entanglement with marine mammals and sea turtles, disturbance to benthic habitat, and mortality of fish. Cumulative effects as a result of interactions with telecommunications cable include increased presence of structures on the seafloor and reef/refuge effects. Cumulative effects as a result of interactions with military exercise include increased marine traffic, noise, and interactions with fisheries.

The potential for effects of the Project to interact cumulatively with other projects is acknowledged. However, the RAs predict that the effects will be of limited duration, magnitude and geographic extent, and therefore will not be significant.

Mitigation and Follow-up

In addition to the measures identified in the 2002 CSR, the RAs requires EnCana to:

- contact the DND prior to commencing work, if proposed laydown areas pipelay may traverse through MARLANT Op areas I and J; and

- coordinate Roseate Tern monitoring efforts with the adjacent Keltic/Maple project, provided it is approved and the timing overlaps with the installation of the M&NP Option.

Residual Effects and RAs Determination

The RAs have determined that, taking into account the mitigation measures to be implemented, the project is unlikely to cause residual significant adverse environmental effects, when considered in combination with other past, present or likely future projects.

9.13 Effects of the Environment on the Project

EnCana's Assessment

As stated in Section 8.1.1, the physical environment of the Deep Panuke site, including sea state, ocean currents, ice, winds, waves and weather variables generally remains valid for the revised Project description. However, the environmental design criteria have been revised to account for the change in project location and water depth at the field centre. The environmental design criteria have also been revised to account for the most recent physical environment data and modeling work now available including high resolution bathymetric data and higher resolution numerical modeling capacity. One year, 10 year and 100 year values were identified for the following parameters: winds, waves, currents, water levels, and temperatures (air and water). Values were also identified for design water depth, design ground snow load, superstructure icing, ice and icebergs, biofouling, scour, and seismic.

The proposed MOPU and subsea infrastructure will be subject to the following effects of physical environment conditions in the study area:

MOPU

- local leg member and global structure loading due to waves;
- local leg member and global structure loading due to currents;
- local leg member and global structure loading on MOPU hull and topsides structures due to winds;
- local leg member and global structure loading on MOPU hull and topsides structures due to ice accretion and snow;
- global structure loading due to seismic hazards; and
- local leg member and global structure loading due to scour induced settlement.

Subsea Infrastructure

- local leg member and global structure loading due to currents;
- global structure loading due to seismic hazards; and
- local leg member and global structure loading due to scour induced settlement.

These effects will be further considered during the detailed design stage. EnCana will provide all contractors with up-to-date, site-specific data based on the results of the Environmental Design Criteria study. Contractors will use these data to perform the analyses required to ensure the Project design can withstand various physical environment forces. The analyses will then be reviewed and approved by the EnCana engineering team and the Project CA, Lloyd's Register North America Incorporated. Once the specific foundation and preliminary structural design is complete, the scour evaluation will be

completed by the relevant contractor with the approval of the EnCana engineering team and Lloyd's Register North America Incorporated.

The Lloyd's Register North America Incorporated Scope of Work filed during the Public Review describes the assessments which will be performed in order to provide EnCana with a Certificate of Fitness required under the Nova Scotia Offshore Certificate of Fitness Regulations. Assessments will include a consideration of numerous factors such as physical environment data (e.g., water depth/tide/storm surge, maximum probable wave heights/associated periods, current distribution, mean wind speed/gust velocities), geotechnical data (e.g., scour predictions) and critical loadings for extreme storm conditions.

In terms of contingencies, EnCana will draw upon its past operating experience with the Cohasset Project and current practices from the area when developing measures to address various significant weather scenarios. Contingency planning will focus on three key areas:

- Weather monitoring, forecasting and notification procedures. EnCana subscribes to dedicated local meteorological services to obtain 24 hour site specific weather forecasting for all installations. In addition, the forecast office will immediately issue extreme weather notifications.
- Adverse weather operations planning. Prior to the commencement of any offshore activities the operator will ensure that adverse weather procedures are in place. Daily operations planning meetings include adverse weather contingencies as a standing agenda item.
- Severe weather emergency response planning. Emergency response plans will include procedures for dealing with severe weather conditions. These procedures will include consideration of down manning non-essential, or even all, personnel as a contingency measure.

Public Comments

No concerns were raised about the effects of the environment on the Project.

View of the RAs

While some detailed observations on the Environmental Design Criteria report were noted and presented for EnCana's consideration as project planning and design proceeds, the RAs are satisfied that overall, EnCana has revised its environmental design criteria to reflect the most current data available.

EnCana has also committed to developing contingency plans in the event of significant weather scenarios. These plans should include various storm scenarios with details of likely actions prior to and during the event. Storms which could result in rapid increases of wind speed and/or wave height to severe levels (i.e. tropical cyclones transitioning to extratropical cyclones, and explosively deepening extratropical cyclones) could have very short forecast lead times and therefore particularly important to consider in the development of contingency plans. These storms present significant forecast challenges.

Lastly, EnCana intends to meet the requirements of the Board's Nova Scotia Offshore Certificate of Fitness Regulations by obtaining a Certificate of Fitness through a recognized CA. The CA will verify that the MOPU is fit for the purpose for which it is to be used and can be operated safely. This certification process will help ensure the MOPU and associated

subsea infrastructure are designed in accordance with good engineering practice, taking into account the nature of the activities on and around the installation, the type and magnitude of functional loads, physical environment loads, as well as foreseeable accidental loads, operating and ambient temperatures, corrosion conditions that may be encountered, and soil conditions.

Mitigation and Follow-up

In addition to the 2002 CSR, EnCana commits to the following mitigation with respect to potential effects of the environment on the project:

- developing contingency measures and a response plan to address various significant weather scenarios;
- conducting periodic inspection of the MOPU, pipeline, flowlines, and subsea structures to ensure structural integrity; and
- modifying the biofouling management program as required to suit the differences between the MOPU and the bottom-founded structures.

Additional mitigation required of the proponent by the RAs includes the following:

- ensuring emergency response plans take into account the possibility of short forecast lead times for tropical cyclones transitioning to extratropical cyclones, and explosively deepening extratropical cyclones, that could result in rapid increases of wind speed and/or wave height to severe levels.

Residual Effects and RAs Determination

The RAs have determined that residual significant adverse effects as a result of the effects of the environment on the project are unlikely, provided that the mitigation and follow-up measures described in this CSR are implemented.

9.14 Capacity of Renewable Resources

The scope of the EA also requires the RAs to consider 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. It is predicted that the project is not likely to significantly affect any renewable resources; therefore the capacity of those resources to meet present and future needs will be unaffected.

10.0 Socioeconomic Effects of the Project

In accordance with the CEAA definition of environmental effect, the EA must consider the effect of any change that the project may cause in the environment on:

- health and socio-economic conditions,
- physical and cultural heritage,
- the current use of lands and resources for traditional purposes by aboriginal persons, or
- any structure, site or thing that is of historical, archaeological, paleontological or architectural significance.

These are generally referred to collectively as the socio-economic effects of the Project; they were assessed in 2002 and the conclusions (significant adverse effects not likely) remain unchanged. This CSR re-visits the 2002 information in two key areas that arose during the Public Process: effects on other land/ocean users, and effects on Aboriginal communities or resources.

EnCana's Assessment

EnCana has evaluated the potential interactions between the onshore portion of the Project and the existing proposed land uses in the onshore study area, and have determined that the Project will result in a positive effect on land use that will result in economic benefit to the region. The Goldboro Industrial Park will be developed with its intended use. EnCana will communicate with other stakeholders in the industrial park and other areas associated with the Project, as well as the Municipality of the District of Guysborough, to find satisfactory resolutions to any potential conflicts over land use. EnCana will mitigate the potential adverse effects of accidental events to every extent possible, including those that may have an economic impact on other users of the industrial park, and will adhere to the Deep Panuke Emergency Management Plan with respect to such very unlikely incidents.

Notices to Mariners and charts of Project infrastructure, near-shore work locations and safety zones will decrease the likelihood of interactions with other ocean users. No adverse effects to species that are commercially fished in the vicinity of the Project area are expected. In the case of economic losses experienced by fishers as a result of the interactions with infrastructure adoption of the *CNSOPB Compensation Guidelines Respecting Damages Relating to Offshore Petroleum Activity* will ensure that full and fair compensation is given, should accidents occur.

Public Comments

In the socio-economic context, public concerns centred on interference of the pipeline with fishing activity. Other industrial land users in the Project's onshore area raised concerns about potential adverse affect on their interests. See Appendices C & D for details.

View of the RAs

The potential for interference of the M&NP Option with other ocean users such as fisheries is essentially unchanged from the 2002 proposal. Therefore, the RAs 2002 conclusion remains the same: the Project is not likely to cause significant adverse effects on the ability of other ocean users to access resources. Effects of pipeline construction activity will be

short-term, of limited magnitude and reversible. Effects of the pipeline presence will obviously continue for its lifespan, but are expected to be of low magnitude, as the area affected is extremely small in comparison to the total area available for fishing activity and there are no resources that are unique to the affected area.

The RAs are satisfied with EnCana's commitments to alleviate potential interactions with other oceans users whose economic benefits may be adversely impacted by the Project. A separate Socio-Economic Impact Statement and Benefits Plan was included in the Project application, along with the EA Report. These documents further describe socio-economic effects and evaluate benefits that will come to the region as a result of the Project.

Mitigation and Follow-up:

There are no additional socio-economic mitigation or follow-up measures required of the proponent other than those approved in the 2002 CSR.

Residual Effects and RAs Determination

The RAs have determined that, taking into account the mitigation measures identified in the 2002 CSR , the Project is not likely to cause significant adverse environmental effects on other land and ocean economic uses.

10.1 Effects on Aboriginal Communities or Resources

No new effects on Aboriginal communities or resources have been identified since the 2002 CSR. However, both the NEB Member and the CNSOPB Commissioner made recommendations in the JER related to aboriginal involvement in the Deep Panuke Project. Those recommendations are itemized in Appendices C & D.

Public Comments

The Native Council of Nova Scotia and the Assembly of Nova Scotia Mi'kmaq Chiefs expressed concern about how construction could interfere with heritage resources, and traditional hunting, fishing, trapping and gathering activities. See Appendices C & D for details.

Views of the RAs

The potential for pipeline construction activities to interfere with heritage resources and Aboriginal uses in the Project area is unchanged from the 2002 proposal. Therefore, the RAs 2002 conclusion remains the same; the Project is not likely to cause significant adverse effects. Effects of pipeline construction activity will be short-term, of limited magnitude and reversible. Effects of the pipeline presence will continue for its lifespan, but are expected to be of low magnitude, as the area affected is extremely small and, to date, no heritage resources or current uses have been identified in the affected area.

Mitigation and Follow-up:

EnCana committed to a number of mitigation measures during the 2002 review which remain applicable. In response to the recommendations in the JER, these have been extended to include:

- EnCana will develop and deliver a required heritage resource awareness program for construction personnel;
- building on 2002 commitments regarding current and traditional use, EnCana will invite Aboriginal groups to review the applicability of previous Mi'kmaq land use / professional opinions, including the opinion of Davis Archaeological Consultants Limited, that Mikm'aq archaeological sites or resources are unlikely to be present in the nearshore marine pipeline landfall area.

EnCana and the RAs continue to work with the Aboriginal peoples of Nova Scotia to ensure that the recommendations in the JER are implemented, and that, if new issues emerge, they can be dealt with as they arise.

Residual Effects and RAs' Determination

The RAs conclude that, taking into account the mitigation measures to be implemented, the Project is not likely to cause significant adverse environment effects on heritage resources or current use of lands or resources for traditional purpose by Aboriginal persons.

11.0 Determination Of Effects Significance

The purpose of this comprehensive study is to assess the potential environmental effects of EnCana's proposed Deep Panuke Project that were not assessed in the approved 2002 CSR, or require updating from the approved 2002 CSR. As required under the CEAA, the comprehensive study is focused on establishing whether significant adverse environmental effects are likely to result from the proposed project, taking into account the identified mitigation measures.

The RAs have reviewed the environmental effects analysis presented by EnCana in its technical EA Report, as well as comments received during the public review process. EnCana assessed the environmental effects of the Project using a VEC based approach while following the *Scope of the Environmental Assessment*. The environmental assessment methodology and approach used by the proponent is acceptable to the RAs. The RAs are satisfied with the environmental information provided by EnCana regarding the potential for significant adverse effects as a result of the Project.

In accordance with sub-section 16(1)(b) of the Canadian Environmental Assessment Act, the RAs have considered the significance of the environmental effects of the Project and have determined that, taking into account the implementation of the following mitigation measures and those previously committed to by EnCana, and the assessment presented in this CSR, **the project (including both the SOEP Subsea and M&NP Options) is not likely to cause significant adverse environmental effects.**

11.1 Required Mitigation and Follow-up

In accordance with CEAA mitigation is defined as:

“the elimination, reduction or control of the adverse environmental effects of the project, including restitution for any damage to the environment caused by such effects through replacement, restoration, compensation or any other means”;

and follow-up as:

“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.”

The following subsection lists the mitigation measures and follow-up program that EnCana must adhere to if the proposed project goes ahead.

In addition, EnCana must also honor all relevant commitments made in the approved 2002 CSR, which are presented in Appendix B. It should be noted that some of the environmental commitments made by EnCana in 2002 have been slightly modified to reflect the revised Project. Also, some commitments and requirements are no longer valid, due to Project design modifications or other changed circumstances.

In general, any mitigation or monitoring requiring review and approval by regulatory authorities shall be submitted in a timely manner.

11.1.1 Mitigation

EnCana is required to adhere to the following mitigative measures to ensure no significant adverse environmental effects occur as a result of the Project:

Marine and Coastal Environment

Discharges

- in addition to a hydrocyclone, using a dedicated full-time polishing unit (organophilic clay type) and stripping tower to reduce dispersed hydrocarbons (and potentially other chemicals) and H₂S in produced water prior to discharge;
- installing a platform based laboratory facility, or equivalent (to be demonstrated by EnCana), to ensure timely and effective compliance monitoring for produced water;
- compliance with the Ballast Control and Management Regulations under the *Canada Shipping Act*;

Marine Mammals, Fish, Invertebrates, Birds, and Turtles

- ramp-up when commencing pile driving to minimize noise impact on marine mammals;
- reviewing the results of the ESRF study on the effects of oiling of birds and incorporating any associated changes into the EPP as necessary;

Special Places

- updating the Code of Practice for Sable Island as required to reflect changes to the administration or management of the Island and the Canadian Coast Guard Emergency Contingency Plan, new information on the critical habitat of Species at Risk, and revisions to EnCana's facilities maintenance and operations procedures which may impact the Island;

Effects of the Environment on the Project

- developing emergency response plans that deal with severe weather, taking into account the possibility of short forecast lead times for tropical cyclones transitioning to extratropical cyclones, and explosively deepening extratropical cyclones, that could result in rapid increases of wind speed and/or wave height to severe levels;
- modifying the biofouling management program as required to suit the differences between the MOPU and the 2002 proposed structures;

Safety, Navigation and other Ocean Users

- notifying the F SEMS Officer, DND (Halifax) prior to any pipeline laydown work commencement to determine MARLANT Ops activities in the area; as the proposed work may traverse through MARLANT Ops Areas I and J;
- pending the results of EnCana's application for authorization to the Navigable Waters Protection Program (NWPP) of TC, strict adherence to any prescribed requirements pursuant to the *Navigable Waters Protection Act* as determined by the NWPP;
- continued participation in ESSIM;

Terrestrial Environment

General

- limiting the area of disturbance to that which is absolutely necessary to complete the Project;
- implementing a wet weather shut down policy, which includes the minimum precipitation level which will trigger response measures;

Potential Contamination

- developing a contaminants response plan to be implemented as part of the EPP, should it be determined that contaminant concentrations in sediments or soils pose an unacceptable risk to sensitive receptors. If necessary, these materials will be removed and disposed of in a manner that prevents potential contamination of the environment;
- developing an Acid Rock Drainage Construction Response Plan, should acid rock be encountered during the geotechnical testing program;
- adherence to the NSEL *Guidelines for Management of Contaminated Sites in Nova Scotia*, the *Erosion and Sedimentation Control: Handbook for Construction Sites*, and the *Sulphide Bearing Material Disposal Regulations*, where applicable;

Wildlife and Habitat

- constructing any temporary access roads in a manner that will minimize compaction of soils, destruction of vegetation and enable all materials to be removed once pipeline construction activities are completed;
- consulting with relevant regulatory authorities when choosing the method of watercourse crossing and when designing streambed substrate to be placed in the RoW;
- designing all culverts, and temporary and permanent stream diversions associated with the Project works to allow for fish passage;
- maintaining as much riparian vegetation as possible to mitigate risk from erosion, sedimentation and temperature fluctuations in the watercourse;
- minimizing impact on stream crossing by using dry crossing techniques;
- developing codes of practice around wetlands and watercourses and describing them in the Project EPP;
- if a wetland must be disturbed, ensuring that:
 - vehicle use in this area of wetland, required for pipeline placement, will be limited to necessary machinery and work room, access roads and project-related; otherwise, these vehicles will be kept out of wetlands;
 - ATVs will not be permitted within the wetland during construction or normal operations;
 - laydown areas will be organized, where feasible, to minimize impacts from equipment movement and material storage; and
 - direct and indirect damage to the wetland will be monitored;

- once a more detailed pipeline route has been selected, submitting the following information to EC for review and approval:
 - a map showing the location of wetlands in relation to the proposed pipeline RoW,
 - an estimate of area of wetland (e.g., wetland in area of Betty's Cove Brook) that could be affected by the project,
 - supporting reasons for why the wetland is deemed unavoidable (i.e., the mapping and analysis employed which demonstrates why the wetland cannot be avoided);
 - a wetland functional analysis for the wetland habitat potentially affected by the Project (including adjacent and downstream of the pipeline route). The proposed methodology for this analysis shall reference the appropriate sources (e.g. Brinson ACE, Index to Biological Integrity, California Rapid Assessment Method);
 - if necessary, proposed wetland compensation and monitoring programs;
- exploring alternatives to pipeline trenching (e.g. HDD) in the event the Betty's Cove Brook wetland area cannot be avoided;
- establishing an appropriate buffer zone to minimize direct and indirect effects on Betty's Cove Brook wetland area if it cannot be avoided through final pipeline re-routing. This buffer zone shall be determined in consultation with EC;
- locating temporary work areas away from wetland habitat;
- ensuring that existing drainage patterns in wetlands are maintained as feasible, during construction and operation;
- undertaking grubbing in wetlands immediately prior to installation of the pipeline;
- installing trench blocks to prevent water from draining into or out of wetlands via the buried pipeline. Substrate will be preserved, if feasible, where wetland restoration of the RoW is proposed;
- building on 2002 commitments regarding invasive species, EnCana shall inspect equipment prior to, during and immediately following construction in wetland areas and in areas found to support Purple Loosestrife to ensure that vegetative matter is not transported from one construction area to another;
- conducting vegetation control outside the breeding period for most migratory bird species (April 1 to mid-August) to avoid contraventions of the MBCA and minimize the potential for destruction of eggs and young of migratory birds. Developing a compliance strategy for the MBCA shall also reflect an awareness of the following:

- some migratory bird species protected under the MBCA nest outside the April 1 to mid-August timeframe;
- a number of birds nest at ground level, and some species (e.g. Bank Swallows) nest in burrows in stockpiles of soil or the banks of pits, and
- risk of impacting active nests or birds caring for pre-fledged chicks, discovered during Project activities outside the breeding season for most migratory birds, can be minimized by measures such as the establishment of vegetated buffer zones around nests, and minimization of activities in the immediate area until nesting is complete and chicks have naturally migrated from the area;
- if evidence of Rusty Blackbird, Short-eared Owl or Greater Yellowlegs is found during the terrestrial follow-up surveys, EnCana shall consult with NSDNR and EC to determine:
 - an appropriate buffer of natural vegetation, and
 - whether additional mitigation would be required. If this is the case, the onus will be on EnCana to provide proposed measures to the above regulatory authorities for their review and approval;
- if any of the remaining species in Table 8.3 or 8.5, or other species at risk or species of conservation concern, are encountered during the terrestrial follow-up surveys, EnCana shall contact the regulatory authorities to discuss the need for mitigation and monitoring;

Accidents and Malfunctions

- conducting periodic inspection of the MOPU, pipeline, flowlines, and subsea structures to ensure structural integrity;
- developing design, inspection, maintenance and integrity assurance programs, and appropriate safety procedures, to minimize the potential of a flowline rupture;
- conducting a detailed quantitative risk analysis to consider potential risk synergies between the nearshore and onshore components of the Project with the proposed Keltic/Maple petrochemical and LNG facilities;
- EnCana's EPP, Emergency Management Program, Operations and Maintenance Programs, and Construction and Safety Manuals will include measures to address any issues identified as a result of EnCana's surveys or discussions with DND;

Aboriginal Considerations

- EnCana will develop and deliver a required heritage resource awareness program for construction personnel;
- building on 2002 commitments regarding current and traditional use, EnCana will invite Aboriginal groups to review the applicability of previous Mi'kmaq land use / professional opinions, including the opinion of Davis Archaeological Consultants Limited, that

Mikm'aq archaeological sites or resources are unlikely to be present in the nearshore marine pipeline landfall area.

11.1.2 Follow-up and Monitoring

EnCana is required to adhere to these follow-up measures to verify the accuracy of the predictions in the EA, and to determine the effectiveness of any measures taken to mitigate the adverse environmental effects of the project:

General

- implementing proactive maintenance procedures and environmental monitoring programs that are in compliance with environmental standards during operations;
- developing an EEM program following the intent of the CNSOPB EEM Framework;

Air Emissions

- reporting of emissions annually as per the OWTG, as well as Sections 46 (GHG emissions inventory) and 48 (National Pollutant Release Inventory) of CEPA 1999;

Marine and Coastal Environment

- co-operation with COOGER on investigating the fate and effects of produced water;
- should subsequent information surface to indicate an increased risk of encountering legacy sites containing conventional and/or chemical munitions (UXO) and/or radioactive materials, the Deep Panuke Emergency Response Plans will be modified to reflect the new information, and the new information will be discussed with relevant authorities;
- applying CWS pelagic seabird survey protocols during marine-related bird monitoring;
- coordinating Roseate Tern monitoring efforts with the adjacent Keltic/Maple project, provided it is approved and the timing overlaps with the installation of the M&NP Option;
- conducting a pre-construction marine route survey to confirm the prediction that no corals or other sensitive species or habitats exist along the unsurveyed sections of the export pipeline and flowline routes;

Terrestrial Environment

- developing a Compliance Monitoring Plan prior to commencement of any construction activity;
- developing a monitoring program pertinent to freshwater fish and fish habitat which will include: post construction monitoring of erosion protection methods; monitoring of site runoff and stream flow during construction and operation if acid drainage risk is identified during the geotechnical program; water quality monitoring (TSS, acid drainage and contaminated sediments); and general assessment of the post-construction conditions in affected wetlands and watercourses;

- monitoring of fish habitat along the RoW to assess effectiveness and mitigative measures;
- conducting follow-up after clean up activities to accurately evaluate habitat restoration and the success of stream bank protection and stability.

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Appendix A: Scope of Comprehensive Study

Scope of the Environmental Assessment For the Proposed EnCana Corporation Deep Panuke Offshore Gas Development Project

1. Purpose

This document provides scoping information for the environmental assessment (EA) of the proposed Deep Panuke Offshore Gas Development Project (Deep Panuke). The EA will be reviewed by the federal government, in accordance with the *Canadian Environmental Assessment Act* (the Act). Deep Panuke was previously assessed as a comprehensive study which concluded in 2002, at which time the Minister of the Environment determined that the project was not likely to cause significant adverse effects. This new assessment is required because the manner in which the project is proposed to be carried out has been modified from what was originally proposed.

Included in this document is a description of the scope of the project that will be assessed, the factors to be considered in the assessment, and the scope of those factors. These are based on the requirements for the federal EA process, as set forth in the Act. The rationale used to determine the scope of the project is related to the nature of the federal decisions (e.g. triggers) involved, as well as the requirements of section 24 of the Act, which oblige the use of the previously completed EA to the extent appropriate.

2. Regulatory Decisions

Deep Panuke is subject to federal environmental assessment in accordance with the Act and its regulations. Those requirements include identification of federal authorities that are likely to require an environmental assessment of the project, or are in possession of specialist or expert information or knowledge that is necessary to conduct the environmental assessment. This is referred to as the federal coordination process. The EA document should summarize the outcome of the Deep Panuke federal coordination process in its discussion of regulatory context.

In order to proceed, the project will or may require the various approvals listed below.

- Canada-Nova Scotia Offshore Petroleum Board (CNSOPB) authorizations under sub-sections 142(1)(b) and 143(4)(a) of the *Canada-Nova Scotia Offshore Petroleum Resources Accord Implementation Act*;
- National Energy Board (NEB) section 52 certificate of public convenience and necessity, or section 58 order, pursuant to the *National Energy Board Act*;
- Fisheries and Oceans (DFO) authorization under section 35(2) of the *Fisheries Act* for the harmful alteration, disruption or destruction (HADD) of fish habitat. Depending on the

methods used to install the pipeline, the project may also require a section 32 *Fisheries Act* authorization for the destruction of fish by means other than fishing (e.g. use of explosives);

- Environment Canada permit under paragraph 127(1) of the *Canadian Environmental Protection Act* for disposal of a substance at sea;
- Transport Canada approval under paragraph 5(1) of the *Navigable Waters Protection Act* for a work to be built or placed in, on, over, under, through or across any navigable water; and
- Industry Canada approval under paragraph 5(1)(f) of the *Radiocommunication Act* for sites on which radio apparatus may be located as well as the erection of such things as towers and masts, and for which Exclusion List paragraph 13 (Schedule I, Part I General) does not apply.

The above-named departments are hereafter collectively referred to as the Responsible Authorities. All authorizations named above are described in the Law List Regulations of the Act. Their issuance therefore constitutes a power as described in sub-section 5(1)(d) of the Act and results in the requirement to ensure that an EA is conducted.

In addition, there are other applicable federal statutes and regulations, notably the *Species at Risk Act* (SARA), the *Migratory Birds Convention Act* and the *Oceans Act*. The proponent must demonstrate how the project design will ensure compliance with all regulatory requirements.

3. Definitions

In this document,

“Environment” means the components of the earth and includes:

- (a) Land, water, air and 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).

“Environmental effect” means:

- (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 sub-section 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, paleonto-logical 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;

4. Scope of the Project

The proposed Deep Panuke project is a modified version of one that was previously assessed as a federal comprehensive study in 2002. For this EA, two project options are proposed, both of which differ from the original proposal:

- a mobile offshore production unit (MOPU) with a dedicated pipeline to shore, with connection to the existing Maritimes and Northeast Pipeline (M&NP Option); and
- a MOPU with a sub-sea tie-in to the existing SOEP 26 inch pipeline downstream of the Thebaud Platform (SOEP Subsea Option).

The main differences between the new options and the 2002 proposal are: wet trees with sub-sea tie-backs versus dry trees drilled from a wellhead jacket; one installation (MOPU) versus three platforms, a new field center; a reduction of gas export capacity, and an increased produced water discharge rate. Additionally, the SOEP Subsea Option differs from the original proposal by using a multiphase export pipeline tied into the SOEP 26 inch pipeline at a sub-sea location downstream of the Thebaud Platform. The M&NP Option may include minor onshore route modifications and possibly a stream crossing. A comparison of the original proposal and the two proposed project options is presented in Table 1 (at the end of the document). Figure 1 (also at the end) provides an overview of the field layout for both options.

The project to be assessed will comprise undertakings differing from those originally proposed by the proponent, or those affected by information that has become available since 2002. These include:

- Construction, operation, decommissioning and abandonment of:
 - A mobile offshore production unit, including the gas processing system and associated produced water discharge;
 - The new route portion of a sub-sea gas pipeline from the platform to both the intersection of the previous pipeline route to shore and to the tie-in point with the SOEP pipeline;
 - The onshore and offshore pipeline route in the vicinity of the proposed landfall, due to new information on environmental conditions (including new contamination data, new wildlife data and the recent Keltic Petrochemicals Inc. proposal) or as a result of consultation; and
 - All well-sites, including injection wells and sub-sea wells, and associated flow lines.
- Dredging, trenching, blasting and other activities related to installation and construction of pipeline portions along new routes, including activities for the management of the dredged

sediments. Any new information or methods being considered for the pipeline route assessed in 2002 should also be included.

5. Factors to be Considered

The assessment will include a consideration of the following factors as described in sub-sections 16(1) and (2) of the *Canadian Environmental Assessment Act*:

Factors to be considered in accordance with sub-section 16(1) are:

- The environmental effects of the project, including the environmental effects of malfunctions or accidents that may occur in connection with the project and any cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out;
- The significance of the environmental effects referred to above;
- Comments from the public that are received in accordance with the *Canadian Environmental Assessment Act* and its regulations; and
- Measures that are technically and economically feasible and that would mitigate any significant adverse environmental effects of the project.

In accordance with paragraph 16(1)(e) of the *Canadian Environmental Assessment Act*, the assessment will also include a consideration of the need for the project and alternatives to the project.

Factors to be considered in accordance with sub-section 16(2) are:

- The purpose of the project;
- Alternative means of carrying out the project that are technically and economically feasible and the environmental effects of any such alternative means;
- The need for, and the requirements of, any follow-up program in respect of the project; and
- 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.

The likelihood and significance of predicted adverse environmental effects should be considered in the context of sustainable development principles, as set forth in the *Canadian Environmental Assessment Act* and other legislation. Measures proposed for mitigating adverse environmental effects should be considered in a hierarchical sequence with a clear priority of avoidance of adverse environmental effects.

It is recognized that environmental assessment is conducted at the early phases of project planning when alternative means of carrying out the project are under study and project details have yet to be finalized. As set out in this scoping document, alternative means of carrying out the project must be considered in the environmental assessment.

It is expected that the project modifications, and alternative means of carrying them out, will reflect a consideration of sustainable development principles, incorporate the applicable best management practices and make provision for compliance with applicable legislative requirements. It is further expected that the consideration of alternative means will facilitate identification of site, configuration, design and management options for the revised project that would be preferable in terms of avoiding or minimizing adverse environmental effects.

Furthermore, the Offshore Waste Treatment Guidelines² complement EA needs in directing the proponent to examine and report upon the technical and economic feasibility of alternatives (e.g., produced water management options).

6. Scope of the Factors to be Considered

In accordance with section 24 of the Act, the Responsible Authorities are obliged to use the previous assessment to the extent appropriate, with adjustments as necessary to take into account any significant changes in the environment, in the circumstances of the project, and any significant new information relating to the environmental effects of the project.

Since the 2002 CSR was completed, there have been regulatory changes that may affect the significance thresholds for various potential effects. Key changes are designation of the Gully as a Marine Protected Area (MPA) pursuant to the *Oceans Act*, and the promulgation of the *Species at Risk Act* (SARA). The EA, in its consideration of the significance of the effects, must take these into account. The EA should also examine the project in the context of the draft Eastern Scotian Shelf Integrated Ocean Management Plan (final draft July 20, 2006). The Plan developed under the Eastern Scotian Shelf Integrated Management (ESSIM) Initiative contains management goals and objectives which should be considered in the development of the EA.

The EA must also verify commitments from the 2002 CSR and should provide any updates based on new scientific information/methods (e.g., recent studies on impacts of produced water or other discharges and monitoring results, pelagic seabird monitoring protocols, Sable Island monitoring efforts). Also, work undertaken by EnCana for other recent projects in the offshore, which would be applicable to the Deep Panuke project (e.g., bird protocol developed for the Cohasset decommissioning spill response plan) should be identified and considered in the EA.

The review will consider the potential effects of the proposed project within spatial and temporal boundaries that encompass the periods and areas during and within which the proposed project may potentially interact with, and have an effect on, components of the environment. Relevant factors in determining boundaries include such matters as ocean currents, wind conditions, and species migration patterns.

The EA should demonstrate how every reasonable effort to adopt best available technologies and best management practices is being taken. Specifically, the EA will include consideration of environmental effects related to:

- **Accidental Releases:** Accidental releases during the development drilling, construction and production phases of the project must be considered. The revised well count and project life, the new multiphase export pipeline (SOEP Subsea Option), the subsea tie-in

² "Offshore Waste Treatment Guidelines", National Energy Board, Canada-Newfoundland Offshore Petroleum Board and Canada Nova Scotia Offshore Petroleum Board, August 2002.

construction activity (SOEP Subsea Option), and the new subsea flowlines will change the probability of spills during the project. As a result, the spill probability assessment must be updated with these new parameters. The relocation of the field center, production wells and acid gas injection well, the presence of flowlines, and, for the SOEP Subsea Option, the multiphase pipeline to SOEP, result in new potential scenarios for marine spills and atmospheric releases which are closer to Sable Island and the workers at the SOEP sites. Marine spill probability and behaviour from new well locations, pipeline routes and inter-field flow lines should be analyzed and presented in the EA. Lessons learned from recent spill events in Atlantic Canada should also be considered in the assessment, as well as how the export of condensate (rather than its use as the primary project fuel) and the associated need to transport and store additional fuel on the MOPU affects conclusions of the 2002 spill assessment.

- **Increased Produced Water Discharge:** The approved CSR Base Case was based on produced water overboard rates of 1080 to 1560 m³/day (45 to 65 m³/hr). The proposed Project options now include a design rate of 6400 m³/day (265 m³/hr). This discharge rate must be used in a new produced water dispersion modeling study and the results used to update effects predictions. The new information must be presented in the EA. In addition to the new dispersion modeling that is to be conducted, the following should be discussed:
 - characterization of expected produced water constituents and a recognition of those sensitive environmental components which could be affected
 - consideration of potential effects of sheens from produced water and other sources on migratory birds (Reference could be made to the proposed Environmental Studies Research Fund study to examine the potential effect of sheens on seabirds); and,
 - additional monitoring that may be required based on outcomes of a revised analysis.
- **Air emissions:** Air dispersion modeling was conducted for the original design based on normal operation emissions data and the original flare design. If emission estimates and operating conditions (i.e. stack height, flow rates, temperatures) have not changed appreciably from 2002 assessment, it would be appropriate for the EA to reference this previous work and comment on the effects of the changes. If there are appreciable differences in emissions and operating conditions, new dispersion modeling must be performed and presented in the EA.

The following considerations need to be included in a revised assessment of impacts to air quality, based on relevant project modifications:

- revised emissions estimates for both options with emissions identified according to source; and
 - potential local effects and contributions to atmospheric loadings as they pertain to ambient air quality objectives in the immediate area.
- **Presence of new sub-sea infrastructures:** New sub-sea flowlines, umbilicals, sub-sea protection structures, and the export pipeline to the SOEP pipeline and associated sub-

sea templates for the SOEP Subsea Option will result in the loss of access to fisheries resources and risk for gear damage. In particular there is a new quahog fishery that opened on the Sable Bank in 2005. The EA should assess the effects of new sub-sea infrastructure on fishing activity, including the new quahog fishery.

- **Construction work for subsea infrastructures:** The installation of flowlines, umbilicals, subsea protection structures, pipeline to subsea tie-in, tie-in activities (SOEP Subsea Option) and new portion of the pipeline route resulting from the relocated field center (M&NP Option) will require assessment of fisheries interaction, noise, air emissions and marine discharges from construction activities, including hydrotest fluid discharge from the flowlines and pipeline. In addition, these new subsea installations will impact benthic habitat in areas that were not surveyed for the 2002 proposal. Therefore, an updated benthic report is required to serve as baseline data for the EA.
- **Drill Waste Discharges:** The EA must update the analysis of drilling waste discharge and associated effects in light of the modified number of wells, locations, and changes in the discharge of water-based drilling fluids and associated cuttings.
- **Near-Shore and Onshore Effects:** The EA must analyze potential interactions and effects of the pipeline (M&NP Option) with onshore contamination related to past mining activity and potential for acid rock drainage. Also, interactions related to the proposed Keltic Petrochemical and LNG facility need to be addressed. The need for additional consequence analysis should be considered, building on the onshore pipeline risk analysis work completed for the 2002 CSR. Also, consideration should be given to the outcomes of the risk assessment work conducted as part of the Keltic regulatory review process.
- **Wildlife and Habitat:** The EA must evaluate any modification to the previously assessed onshore pipeline route, including any stream crossing, and potential interactions and cumulative effects on wetlands taking into account the *Federal Policy on Wetland Conservation* (FPWC). Potential project effects on terns and other near-shore and onshore birds, including the endangered Roseate Tern, must be considered. Reference should be made to new data available on the Country Island Common, Arctic and endangered Roseate Tern colonies, specifically in relation to foraging activity and to the draft Recovery Strategy for the Roseate Tern. The wildlife information that was collected for the proposed pipeline corridor and summarized in the 2002 CSR (e.g. Terrestrial Field Survey Results from 2001 and 2002) should be re-interpreted based on updates to the conservation status of the identified species. Any wildlife information that has been collected since the 2002 CSR should also be presented and considered.
- **Impediments to Navigation:** The EA will evaluate the project's possible effects on navigation in the near-shore, with particular attention to safety.
- **Species at Risk:** Since the 2002 CSR was completed, several species in the project area have been newly listed, or re-designated under the SARA. The EA must evaluate project effects on SARA-listed species as required under section 79 of SARA. In addition to SARA-listed species, consideration of project effects on all species of conservation concern is required. EC's 2004 publication "*Environmental Assessment Best Practice for Wildlife at Risk in Canada*" should be considered for guidance.

- **Cumulative Effects:** The new EA must provide a revised cumulative effects assessment based on the project modifications and changes to the environmental setting. For example, consideration of the proposed Keltic project, and cumulative effects on seabirds from ongoing oil and gas activity in the Newfoundland and Labrador offshore (particularly along the NL-N.S. border) will be important to the analysis.
- **Effects of the Environment on the Project:** The EA must consider how the proposed mobile production unit could be affected differently by storms/winds/waves/ice than the previously proposed fixed platforms.

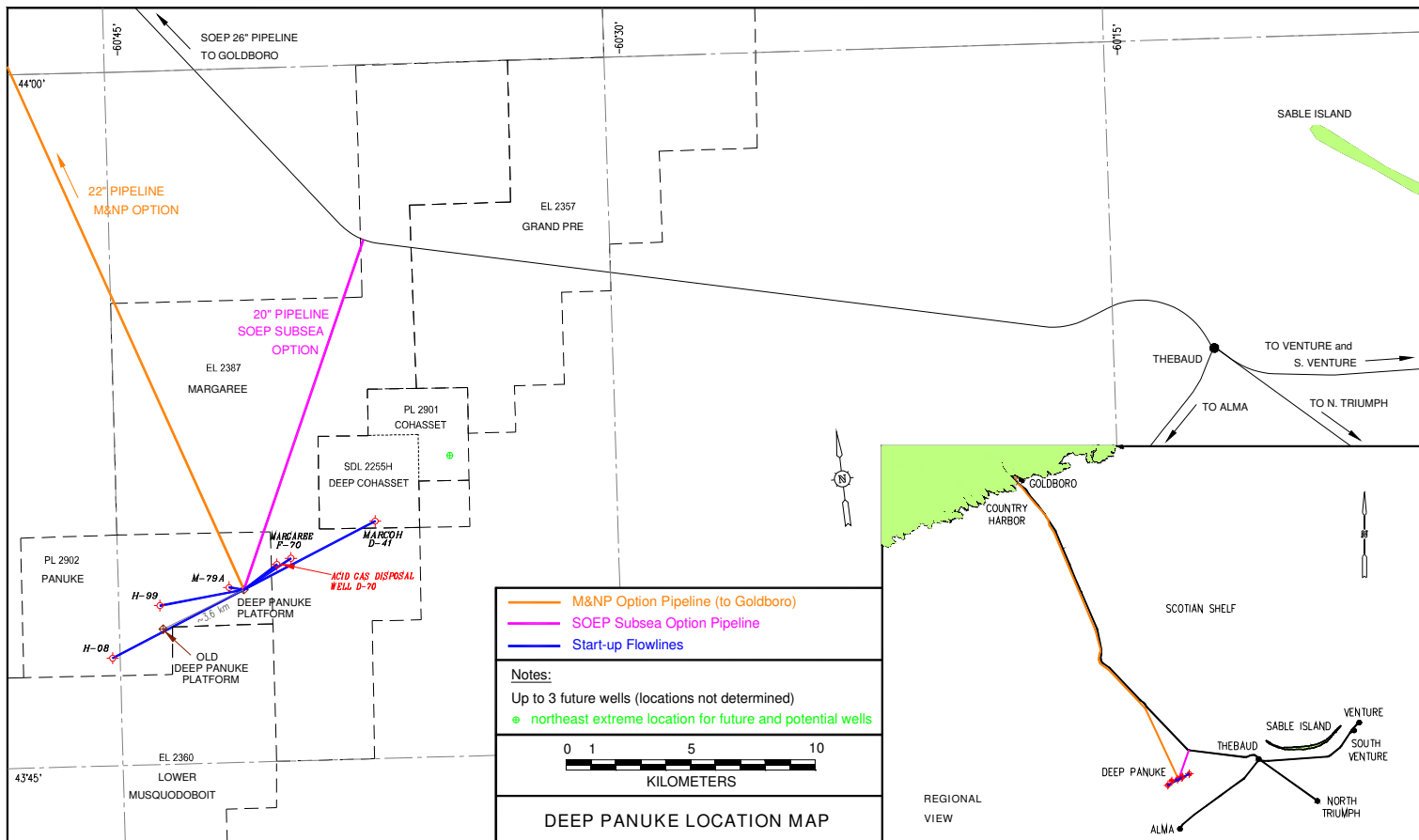
Table 1.1 Comparison of Approved Base Case and New Project Options¹

Table 1.1 Comparison of Approved Base Case and New Project Options			
Project Item	Base Case (Approved CSR)	M&NP Option	SOEP Subsea Option
Well count and configuration	Maximum of 8 – Platform Wells <ul style="list-style-type: none"> • 5-6 new drill prod wells: H08, PI-1B, M79A, PP3C and 1-2 futures • 1-2 new drill injection wells 	Maximum of 9 – Subsea Wells <ul style="list-style-type: none"> • 4 re-entry wells: H-08 [PL 2902], M-79A [PL 2902], F-70 [EL 2387], and D-41 [SDL 2255H] • 1 new production well: H-99 [PL 2902] • 1 new injection well: D-70 [EL 2387] • up to 3 future wells [currently undefined location on PL 2901, SDL 2255H, PL 2902 or EL 2387] • Buried flowlines and umbilicals from wellheads to installation 	
Project Life	Expected mean case: 11.5 years	Expected mean case: 13.3 years Expected range: 8 – 17.5 years	
Field Center	Base Case	Relocated 3.6 km NNE	
Base Structure	3 fixed platforms including <ul style="list-style-type: none"> • production platform • utilities/quarters platform • wellhead platform 	1 MOPU integrated facility	
Discharge of muds / cuttings for new wells	drilled from field center WBM/cuttings overboard SBM/cuttings skipped and shipped or injected	drilled from individual well locations WBM/cuttings overboard no SBM	
Delivery Point	M&NP tie-in onshore, adjacent to SOEP		SOEP subsea tie-in SOEP 26" pipeline
Export pipeline	24 inch, 176 km single phase Trenched ~ 50% of route	22 inch, 176 km single phase Trenched ~ 50% of route	20 inch, 15 km multiphase Trenched 100% of route
Export gas	11300 10 ³ m ³ /day 400 MMscfd sales quality	8500 10 ³ m ³ /day 300 MMscfd [at plateau production rate] sales quality	8500 10 ³ m ³ /day 300 MMscfd [at plateau production rate] sweet and dehydrated
Export condensate	N/A		200 m ³ /day sweet and stabilized, commingled with gas
Condensate Use	Fuel, surplus injected		Sales product
Produced water	1100 to 1600 m ³ /day [7000 to 10,000 bpd] discharged overboard	6,400 m ³ /day [40,000 bpd] discharged overboard	
Acid Gas	dedicated injection well approximately 180 10 ³ m ³ /day [6 MMscfd]	dedicated injection well approximately 130 10 ³ m ³ /day [4.5 MMscfd]	

1. Reproduced with the permission of EnCana Corporation.

Figure 1: Deep Panuke Field Layout¹

1. Reproduced with the permission of EnCana Corporation.



Appendix B: Relevant Commitments Made in the 2002 CSR.

The following are all the relevant commitments and requirements in the 2002 CSR, including the document titled “Additions and Errata for the Deep Panuke Offshore Gas Development Comprehensive Study Report October 2002”, that EnCana must also honour. Some of the environmental commitments made by EnCana in the 2002 CSR are no longer valid due to Project design modifications or other changed circumstances, and are not presented here. Also, the original wording of some of the 2002 commitments and requirements has been slightly modified to reflect the revised project.

Table B.1: Relevant Commitments from 2002 CSR
Onshore Pipeline Routing and Construction and Right of Way Management
<ul style="list-style-type: none"> • Once the routing of the onshore pipeline (and location of associated onshore facilities) is finalized, EnCana shall make every reasonable effort to minimize interactions with wetlands or other sensitive onshore environmental features.
<ul style="list-style-type: none"> • EnCana shall consult with the potential landowner(s), including the Municipality of the District of Guysborough, to determine the location of the onshore facilities as well as the onshore pipeline route.
<ul style="list-style-type: none"> • The Onshore Construction EPP will generally address environmental constraints on the pipeline route and expected mitigation. The EPP will be included in the Request for Quote for the onshore pipeline installation package and will include the following: <ul style="list-style-type: none"> ○ erosion and sediment control measures to prevent sediment-laden runoff and potential acidic run-off from reaching streams and/or marine waters. NSEL erosion and sediment control measures will be referenced. The plan will incorporate a monitoring program where warranted. ○ Mitigation of acid rock drainage in the event that sulphide-bearing bedrock is encountered. A geotechnical study will be conducted to identify potential acidic bedrock areas, providing the basis for mitigation. M&NP’s Acid Rock Drainage Construction Response Plan and Guidelines for Development on Slates in Nova Scotia (NSDOE and Environment Canada 1991) will be consulted as well as applicable regulations. EnCana will minimize encounters with acid bearing rock through routing and avoidance. ○ Clearing operations will be confined to the working width (RoW and Temporary Work Room (TWR)). Existing vegetation will be preserved where possible and a vegetated buffer zone will be maintained as appropriate to protect resources at risk. Merchantable timber will be salvaged. Vegetative debris will be chipped on-site, away from surface waters, for use as mulch or compost feedstock. Burning of vegetative debris will be prohibited. ○ Watercourse assessments will be conducted if the pipeline or any other facility, such as an access road, will cross a watercourse. This assessment would include a pre-construction survey to evaluate fish habitat and resources in the area of the crossing. The results will be forwarded to NSEL along with an application for Water Approval. ○ Mitigation procedures for blasting within 500 m of a well. Procedures would include interviewing the well owner prior to construction, and collecting and archiving water samples for comparison of water chemistry. ○ The open end of the pipeline section will be capped at night to prevent any material from infilling the pipe and/or the ingress of small animals. ○ Rare plant locations adjacent to RoW, access locations, and other areas will be flagged. ○ Workers and activities will be restricted to the RoW and designated work areas.

Table B.1: Relevant Commitments from 2002 CSR
<ul style="list-style-type: none"> ○ The construction period will be minimized. ○ Controlled access/signage. ○ Strict vehicle speed regulation and enforcement.
<ul style="list-style-type: none"> • Following installation of the onshore pipeline, the working width (RoW and TWR) will be restored. The working width will be stabilized, seeded and allowed to re-vegetate. EnCana will use native species in revegetation efforts and avoid use of invasive species. Construction debris will be transported to an approved disposal site.
<ul style="list-style-type: none"> • Deer wintering areas will be avoided. Construction activities conducted within 200 m of deer wintering areas will not occur, if feasible, between January and April if snow depths are greater than 30 cm.
<ul style="list-style-type: none"> • While not prohibited, use of ATVs on the pipeline RoW will be discouraged through posting of warning signs along the RoW, and consultations with local ATV clubs.
<ul style="list-style-type: none"> • Vegetation management will be conducted mainly by mechanical means and will be confined to the RoW. Herbicide use will be restricted to fenced valve sites and meter stations and will involve low application rates of compounds with low persistence and low ecological toxicity. Only approved herbicides will be used in limited quantities around surface structures and not within 30 m of a watercourse or wetland.
<ul style="list-style-type: none"> • Machinery will be washed and inspected before arriving on site to minimize potential for transfer of invasive plant species.
<ul style="list-style-type: none"> • All construction activities will be inspected and monitored to ensure that erosion and control structures are appropriately installed and maintained. Erosion control measures will not be removed until the exposed soils have been completely revegetated or otherwise permanently stabilized. Specific mitigation pertinent to erosion and sediment control will be specified in the EPP.
<ul style="list-style-type: none"> • A geotechnical testing program will be conducted during detailed pipeline design and routing, including analysis of soil chemistry to identify potential areas of contamination and/or acidic drainage.
<ul style="list-style-type: none"> • Terrestrial surveys will be conducted, prior to construction, along the onshore RoW to evaluate the present status of terrestrial species at risk (plants, birds, herpetiles, and mammals).
<ul style="list-style-type: none"> • There will be no change in the landfall location that would take it outside the study corridor identified in the CSR. There is virtually no potential change in the pipeline route that would cause the onshore portion of the pipeline to be greater than 5 km in length.
<ul style="list-style-type: none"> • Dust suppression techniques will be used if required. In selecting appropriate dust suppression techniques EnCana will comply with all applicable legislation.
<ul style="list-style-type: none"> • If blasting is required for the Project, EnCana will consult with affected landowners.
<p>Subsea Pipeline Routing and Construction</p>
<ul style="list-style-type: none"> • While laying in close proximity to the SOEP pipeline, a temporary exclusion zone shall be set up to eliminate the risk of damage. In addition, if an anchored vessel is used and if the anchor cables cross the SOEP pipeline, a buoy shall be placed on the anchor cable, if required, to prevent the cable from falling onto or damaging the SOEP pipeline should the cable break.

Table B.1: Relevant Commitments from 2002 CSR

<ul style="list-style-type: none">• The export pipeline and flowlines shall be hydrostatically tested during commissioning using treated seawater which will be drawn from a location near the landfall site in Goldboro for the pipeline to shore (M&NP Option); near the MOPU for the pipeline to SOEP (SOEP Subsea Option) and near the MOPU or near the individual subsea wellheads for the flowlines.
<ul style="list-style-type: none">• Conducting a toxicity bioassay program and plume dispersion modeling of hydrostatic test fluid prior to testing. (Parameters and scope will be discussed with regulatory authorities.)
<ul style="list-style-type: none">• A survey vessel with ROV will undertake pre-lay and as-laid surveys of the pipeline route.
<ul style="list-style-type: none">• EnCana will take into consideration the location of existing subsea cables when routing the pipeline. EnCana will notify and consult with all involved parties prior to and during construction of the proposed pipeline.
<ul style="list-style-type: none">• EnCana will ensure that DND is made aware of the pipeline routing to ensure that military training activities pose no threats.
<ul style="list-style-type: none">• The pipeline will be designed to withstand impacts from conventional mobile fishing gear in accordance with the Det Norske Veritas (DNV) Guideline No. 13, Interference between Trawl Gear and Pipelines, September, 1997.
<ul style="list-style-type: none">• The pipeline design and trenching in the nearshore area will take into account the potential for sea ice.
<ul style="list-style-type: none">• No pipeline construction activities will take place in the nearshore area during the lobster fishing season (April 19 – June 20) which also coincides with the period when the endangered Roseate Tern typically prospected for nests and lays eggs on Country Island (May 1 – June 20). EnCana will also maintain a 2 km buffer zone from Country Island at all times as per the Code of Practice for Country Island.
<ul style="list-style-type: none">• Silt curtains will be employed during nearshore dredging.
<ul style="list-style-type: none">• If blasting is required for pipeline installation, it will be conducted in accordance with all applicable regulations and with the Guidelines for Use of Explosives In or Near Canadian Fisheries Waters (Wright and Hopky 1998).
<ul style="list-style-type: none">• If the horizontal drilling (HDD) is carried out, drill muds and cutting will be collected on site. The drill mud will be recycled and cuttings will be disposed of onshore as required.
Safety Measures
<ul style="list-style-type: none">• The safety zone for the new Project will include, as a minimum, an area extending 500 m around the MOPU, and will likely also include the interfield flowlines and wellheads. The exact configuration of the safety zone will be determined based on safety risk assessment and consultations with regulatory agencies. There will also be a temporary 500 m safety zone around the drilling rig when it is on location for development drilling. There will be no safety zones over the export pipeline; although there will be fishing restrictions over the subsea connection to the SOEP pipeline (SOEP Subsea Option). A copy of the offshore site plan will be sent to the Canadian Hydrographic Service to update charts. Notices to Mariners will be issued.
<ul style="list-style-type: none">• A detailed Safety Case analysis will be undertaken by EnCana to ensure that appropriate engineering design and materials procurement procedures are incorporated to ensure a safe facility. A comprehensive training program and state-of-the-art detection systems will alert the facility in the case of an accident. Environmental and safety protection systems will be in place (e.g., leak detection, emergency shutdown valves, blowout prevention safeguards, etc.).

Table B.1: Relevant Commitments from 2002 CSR
<ul style="list-style-type: none"> • A Project Safety Plan will be developed and implemented that will ensure efficient and safe activities in all Project phases. The Safety Plan includes environmental risk assessments that will affect the design of the Project and develop the best design option to minimize environmental impact. The Project Safety Plan will be built upon a “Hazards and Effects Management Process” (HEMP).
Vessel and Helicopter Traffic
<ul style="list-style-type: none"> • Standard vessel operations procedures, including avoidance measures, will be adhered to.
<ul style="list-style-type: none"> • Vessel activities associated with the Deep Panuke Project will adhere to all applicable shipping regulations, including those with respect to the discharge of bilge/ballast water.
<ul style="list-style-type: none"> • Guidelines for Project aircraft and vessels operating in the vicinity of Sable Island and Country Island will be incorporated into the Project EPP as per respective EnCana Codes of Practice.
<ul style="list-style-type: none"> • Helicopters will avoid colonies and high concentrations of birds.
<ul style="list-style-type: none"> • To avoid potential adverse effects caused by vessel traffic, a buffer zone (approximately 2 km) surrounding Sable Island will be established for the Project. The Project will comply with the Sable Island Emergency Contingency Plan (Canadian Coast Guard 1994) and flying over the island will be avoided except in emergency or other non-routine situations (e.g., emergency refueling) as per EnCana’s Code of Practice for Sable Island.
<ul style="list-style-type: none"> • If a landing on Sable Island is required (i.e., at the existing helicopter refueling facility), helicopters will avoid flying over or landing in close proximity to large concentrations of horses and seals, and pilots will take advice from the Island manager on the position of breeding tern colonies. In addition, landing approaches will be made at right angles to the long axis of the Island and be as steep as safely possible to minimize the area of the island exposed to low-level flying.
<ul style="list-style-type: none"> • If non-routine Project related vessel or helicopter traffic must interact with Sable Island, any observed adverse animal reactions, or other adverse effects associated with the traffic, will be recorded and reported to appropriate regulatory agencies.
Decommissioning
<ul style="list-style-type: none"> • The decommissioning plan developed for the Project will provide detailed procedures for decommissioning onshore and offshore facilities. The plan will include a full review of options for decommissioning and will be developed in consultation with regulators and key stakeholders, including fisheries interests. Decommissioning will be performed in accordance with the regulatory requirements applicable at the time of such activities. Although regulatory requirements could change prior to the time of decommissioning, current practices would see the following activities implemented: <ul style="list-style-type: none"> • MOPU towed to another location for potential retrofit. • Wells abandoned in compliance with applicable drilling regulations and according to standard industry practices. • All potential snagging hazards will be addressed. • Onshore facilities removed and the land restored in accordance with applicable regulations. Buried onshore pipelines flushed, capped and decommissioned in place.
<ul style="list-style-type: none"> • Requirements for eventual removal of facilities will be taken into consideration in Project design (e.g., the potential presence of contaminants).
<ul style="list-style-type: none"> • Prior to the start of the decommissioning and abandonment phase, a risk assessment and other required studies will be conducted to verify and validate the assumptions made during the design phase.
Engineering Design

Table B.1: Relevant Commitments from 2002 CSR

<ul style="list-style-type: none"> • EnCana intends to collect the currently available seismic data for the Deep Panuke site. The fourth generation data will be expedited for the site, and a seismic hazard assessment will be performed. A probability level of 0.0004 per year will be used. Adjustment will be made to convert the data from rock to actual Deep Panuke soil for the pile foundation. If spectral hazard parameters are available for the Deep Panuke site, then a probabilistic analysis based on spectral data will be used to determine structural response to the earthquake.
<ul style="list-style-type: none"> • EnCana will adhere to applicable regulations under the <i>Accord Act</i> or other international standards as deemed acceptable to the Certifying Authority and the CNSOPB.
<ul style="list-style-type: none"> • All Project equipment will meet industry standards and be certified as safe and fit for its intended use. Equipment will be operated and maintained in accordance with documented procedures, with regular inspection and maintenance programs.
<ul style="list-style-type: none"> • Once final engineering design has been completed, appropriate regulatory agencies will be contacted to identify specific permitting requirements, if any.
<ul style="list-style-type: none"> • EnCana will reduce H₂S to "as low as reasonably practicable" (ALARP) before discharging produced water (current design is 1-2 ppm).
<ul style="list-style-type: none"> • Equipment, valves, and potential areas where hydrocarbon or chemicals could leak will be assessed to determine the need for secondary containment.
<ul style="list-style-type: none"> • A study to evaluate fugitive emissions will be conducted during detailed design. Equipment and procedures to reduce these releases to ALARP will be incorporated in the design.
<ul style="list-style-type: none"> • Engineering assumptions and options that are agreed upon and incorporated into final design and construction will be translated into operations and maintenance manuals for personnel use at the operations phase.
<ul style="list-style-type: none"> • Once installed, equipment will be operated and maintained in accordance with documented processes and procedures. EnCana will submit inspection and monitoring programs, a maintenance program and a weight control program for approval.
<ul style="list-style-type: none"> • Necessary critical spares will be maintained should equipment change-out be required.
<ul style="list-style-type: none"> • Stacks and flares will be designed to ensure that any air emissions of concern to worker health and safety will be discharged safely with exposures minimized to acceptable levels.
<ul style="list-style-type: none"> • The flare will be designed to reduce the potential for liquid carry-over.
<ul style="list-style-type: none"> • The flare stack will be designed to optimize plume dispersion (especially its height).
<ul style="list-style-type: none"> • EnCana will design and shield electrical devices that may generate electric and magnetic fields (EMF) to minimize worker exposure, and measure EMF levels around electrical devices to ensure compliance with health and safety standards (ACGIH 2001 and Health Canada's Safety Code 6).
<ul style="list-style-type: none"> • EnCana will design and construct devices that may generate radio frequency and microwave radiation to meet relevant safety guidelines and standards, and monitor these devices during commissioning to ensure worker health and safety is protected (ACGIH 2001 and Health Canada's Safety Code 6).
<ul style="list-style-type: none"> • Water intake will be designed and built at sufficient depth to reduce the entrainment of marine organisms (e.g., 10-15 m below surface).
<ul style="list-style-type: none"> • No flame-retardant chemicals will be used in the firewater deluge system.
<ul style="list-style-type: none"> • Details on fire suppression systems (water-based or gaseous) and a review of impacts associated with the selected firewater deluge system will be included in the EPP.

Table B.1: Relevant Commitments from 2002 CSR

Chemical Selection and Use
<ul style="list-style-type: none"> • EnCana has committed to a chemical management plan as part of the EPP (see Section 5.5.1 of this CSR for further details).
<ul style="list-style-type: none"> • The Deep Panuke facility will not use marine antifouling coatings on the structures.
<ul style="list-style-type: none"> • Change-out of the amine solvent will be subject to the EPP.
Environmental Protection Planning and Environmental Performance
<ul style="list-style-type: none"> • EnCana’s Environmental, Health and Safety Management System and its associated plans will be followed for the Deep Panuke Project. Environmental Awareness Training for employees and contractor personnel is a component of the Environmental Management System. EnCana will provide copies of applicable management system documentation (and revisions) to the appropriate regulatory authorities for review.
<ul style="list-style-type: none"> • EnCana will, in consultation with regulators and key stakeholders, develop onshore and offshore construction EPPs to address Project construction, drilling, production and decommissioning. The EPP will reflect the commitments made in the CSR and regulatory conditions of approval. The EPP will be strictly adhered to.
<ul style="list-style-type: none"> • Environmental performance will be reviewed at least annually during the life of the Project.
<ul style="list-style-type: none"> • A WHMIS program will be in place, and all employees will be WHMIS-trained.
<ul style="list-style-type: none"> • Protection of historic/cultural resources such as shipwrecks will be addressed in the Offshore Construction EPP.
<ul style="list-style-type: none"> • EnCana is a participant in the Voluntary Challenge and Registry (VCR) and will incorporate this Project into the overall VCR strategy. EnCana will consider all reasonable opportunities to reduce emissions from the Deep Panuke Project. Project emissions during the construction phase will be quantified in the annual VCR report.
<ul style="list-style-type: none"> • As part of its EPP, EnCana will implement environmental protection measures to mitigate potential impacts from Project activities, including the use of chlorine for the treatment of biological growth in cooling water.
Waste Management
<ul style="list-style-type: none"> • The treatment and disposal of wastes will be in accordance with the Offshore Waste Treatment Guidelines (OWTG) and EnCana’s environmental protection policies.
<ul style="list-style-type: none"> • To the extent reasonably practical, both the volumes of wastes being discharged and the concentration of contaminants in the environment will be minimized.
<ul style="list-style-type: none"> • All runoff collected from the open drains system will be treated to meet applicable regulations prior to discharge. All liquids collected in the closed drain system will be pumped back through the facility for separation and removal of hydrocarbons.
<ul style="list-style-type: none"> • During the operation phase, deck drainage will be collected and treated according to the OWTG. Drainage from equipment areas on platforms will be directed through a header system to a collection tank to an oil/water separator treatment unit on the production platform. Petroleum hydrocarbons and sludge in the oil/water separator will be transferred into containers for shipment to shore for disposal. The water from the oil/water separator will be treated using cartridge-style water polishers and tested prior to discharge to ensure compliance with the applicable discharge criteria.
<ul style="list-style-type: none"> • Every reasonable effort will be made to prevent chemical contamination on decks, which could be entrained into deck drainage. Storage areas for totes containing chemicals and petroleum products will have secondary containment to prevent discharge onto deck surfaces. Absorbents will be used to remove residual hydrocarbons from decks. Spill containment equipment will be available to address emergency spills.

Table B.1: Relevant Commitments from 2002 CSR
<ul style="list-style-type: none"> • Bilge/ballast water will be treated as necessary to meet applicable guidelines prior to discharge.
<ul style="list-style-type: none"> • Fluids (e.g., well treatment fluids, well completion and workover fluids) will be treated to meet applicable guidelines prior to ocean discharge.
<ul style="list-style-type: none"> • WBM and WBM-associated cuttings will be disposed of overboard, as permitted by the OWTG. Bulk releases on WBM will be minimized by batch drilling where possible.
<ul style="list-style-type: none"> • Produced water will be treated, tested and discharged overboard according to the OWTG. The OWTG specify an oil in water concentration limit of 30 mg/L (30 day average). EnCana will strive to meet a target dispersed oil in water concentration of 25 mg/L (30 day average) for produced water.
<ul style="list-style-type: none"> • Seawater used for indirect cooling will be mixed with produced water before discharge. Total residual chlorine in seawater used in indirect cooling will not normally exceed 0.25 mg/L.
<ul style="list-style-type: none"> • Sanitary and food wastes will be macerated to a particle size of 6 mm or less and disposed of overboard.
<ul style="list-style-type: none"> • Solid waste will be sorted and disposed of onshore in accordance with applicable regulations and standards. Waste materials will be recycled where possible.
<ul style="list-style-type: none"> • Hazardous wastes for onshore disposal will be accumulated in suitable containers and placed in appropriate shipping containers for return to shore for disposal and collected by licensed waste haulers. Applicable regulations and standards will be followed when handling and transporting hazardous waste, and staff will be appropriately trained to do so. A NSEL-approved hazardous waste contractor will be selected for the disposal of hazardous wastes, and will be regularly audited by EnCana personnel for compliance with regulations.
<ul style="list-style-type: none"> • Formation water (produced water) will be collected during drilling of the production wells, and these samples submitted for chemical analysis. The produced water treatment and disposal system will be reviewed following this analysis to ensure the system addresses the specific constituents found in the formation water.
<ul style="list-style-type: none"> • Surveys of gamma radiation will be conducted for the presence of naturally occurring radioactive material (NORM), as required.
<ul style="list-style-type: none"> • Maintenance of the injection equipment will normally be carried out during scheduled shut-down. Various options such as flaring and platform shut-down will be considered in discussion with the regulators for dealing with acid gas.
<ul style="list-style-type: none"> • Wastes accumulated at the onshore pigging station will be collected by tanker truck and removed to an approved waste disposal facility. Prior to shipping, these wastes will be tested to determine the concentrations of organic and inorganic compounds. The testing will identify whether the wastes qualify as hazardous substances and identify the appropriate documentation for transport and means of disposal.
<ul style="list-style-type: none"> • A Waste Management Plan (WMP) will be developed (as part of the EPP) to address all phases of the Project. The goal of the plan will be to minimize offshore waste and identify mitigative measures. The WMP will contain provisions for waste and wastewater treatment.
Atmospheric Emissions
<ul style="list-style-type: none"> • Atmospheric discharges will be tested periodically to verify the efficiency of the systems.
<ul style="list-style-type: none"> • A camera system will provide continuous visual monitoring of the flare.

Table B.1: Relevant Commitments from 2002 CSR
<ul style="list-style-type: none"> EnCana is committed to an immediate response to an unplanned change to flaring mode. It is proposed that within seven days of the mode shift, a written response would be submitted to the CNSOPB outlining the options, actions and schedule for resumption of normal operating mode. These procedures will be outlined in the Project flaring procedures to be included in the EPP.
<ul style="list-style-type: none"> EnCana will continually strive to reduce flaring to optimize process efficiency and to improve environmental performance.
<ul style="list-style-type: none"> EnCana will develop flaring mitigation procedures in the EPP to reduce, where practical, the temporary and localized emissions and potential effects associated with flaring events during construction and start-up. Procedures will specify: <ul style="list-style-type: none"> - procedures during perforating/well testing to minimize smoky plumes; - safe zones for vessels to occupy during the test flares; - go/no go zones for vessels; - safety gear and procedures on board platforms and vessels; - wind direction forecast requirements such as the need to be sure of sustained wind directions during the test; - visibility and other weather requirements; - real-time requirements to monitor the efficiency of the flare and downwind effects; - reporting requirements to document the safe conduct of the work and potential improvements; and - notification procedures for shipping, staff, and environmental staff.
<ul style="list-style-type: none"> Test flaring will be conducted according to the flare mitigation procedures included in the EPPs. Well test flaring will be scheduled with respect to weather conditions and the presence of marine craft and service vessels to the extent practical. Notifications to Mariners will be issued.
<ul style="list-style-type: none"> The emissions from stationary combustion turbines will meet the CEPA Ambient Air Quality Guidelines and the Provincial Regulations for Ground Level Emissions.
<ul style="list-style-type: none"> EnCana will discuss the final configuration of turbines with Environment Canada.
<ul style="list-style-type: none"> EnCana will put in place continuous monitoring systems to ensure that fugitive or emergency releases of gas are detected immediately and responded to appropriately.
<ul style="list-style-type: none"> EnCana will ensure the EPP contains procedures for reporting emissions in accordance with regulatory requirements and will outline procedures for monitoring of emissions and identification of opportunities for continual environmental improvement.
Monitoring and Follow-up
<ul style="list-style-type: none"> EnCana will develop a scientifically-sound EEM program to detect and assess Project-induced changes in the environment, providing essential feedback to operational managers to provide an early warning mechanism, so that necessary changes can be made to operational activities or discharges. EEM goals will be defined and the program designed through the regulatory approvals process, and consultation with the CNSOPB, regulators and stakeholders. The results of the EEM program will be reviewed on an annual basis and adaptations to the program will be made as necessary.
<ul style="list-style-type: none"> EnCana is committed to making EEM results publicly available and supports the archiving of environmental monitoring data in a regional database.
<ul style="list-style-type: none"> EnCana supports the creation of a regional EEM mechanism, which includes regulators, industry and other stakeholders.
<ul style="list-style-type: none"> A Physical Environmental Monitoring Program will be developed and implemented with reference to applicable regulations and guidelines. The Plan will include four main programs: <ul style="list-style-type: none"> - Weather and seastate data collection program;

Table B.1: Relevant Commitments from 2002 CSR

<ul style="list-style-type: none"> - Current measurement program; - Surface ocean wave measurement program; and - Weather forecasting.
<ul style="list-style-type: none"> • EnCana will monitor biofouling of the platform jackets during scheduled underwater ROV inspection surveys. Marine growth will be removed by hydrojetting if the equivalent marine growth thickness approaches the design threshold. Sodium hypochlorite will be used to control biofouling of seawater intakes and discharge caissons. The residual free chlorine concentration at the outlet under normal operating conditions will be below 0.25 ppm.
<ul style="list-style-type: none"> • In the case of an accidental hydrocarbon spill from the Project, it is highly unlikely that there would be any adverse effects on Sable Island. However, if such an interaction were to occur, then monitoring and follow-up will be undertaken to confirm clean-up and recovery.
<ul style="list-style-type: none"> • A survey of the mine workings in the landfall area will be conducted to determine if suitable hibernation habitat for little brown bats is present and EnCana will mitigate as detailed in this CSR.
<ul style="list-style-type: none"> • Prior to construction, a herpetile survey will be conducted to determine if four-toed salamanders are present in the areas identified as having high potential for breeding habitat and EnCana will mitigate as detailed in this CSR. Note: A herpetile survey was conducted in June 2002; no four-toed salamanders were found to be present.
<ul style="list-style-type: none"> • The subsea pipeline will be monitored as part of the certification and inspection process. Part of this information will be made available to the EEM as appropriate
<ul style="list-style-type: none"> • Independent observers have been contracted to provide observations of seabirds and marine mammals on EnCana's facilities and vessels. EnCana will consult with the EC in regard to an appropriated follow-up program for identification and verification of predicted impacts on marine birds, including provision of appropriate mitigation measures. EnCana's commitments to conduct marine bird surveys, and to develop and implement mitigation and follow-up programs (e.g., interactions of birds with lights, flares, and spills), will include consultation with the EC in regard to the specific design elements set out in Environment Canada's October 9, 2002 review of the Addendum (Volume 1).
<ul style="list-style-type: none"> • EnCana will put measures in place to manage small and large spills and resulting slicks. EnCana will ensure that the plan is acceptable to Regional Environmental Emergencies Team before construction commences. Based on consultations with Environment Canada, EnCana will ensure the spill response plan and other related management plans includes provisions for minimizing the potential for birds to be impacted by accidental releases and any resulting sheens or slicks.
<ul style="list-style-type: none"> • EnCana is committed to consulting with EC on emergency response for dealing with oiled birds. EnCana employees and contractors will adhere to a CWS-approved protocol for handling injured or stranded birds on vessels and offshore platforms. EnCana acknowledges the Williams and Chardine (1999) protocol and potential permitting requirements.
<ul style="list-style-type: none"> • EnCana will continue to support oiled bird surveys on Sable Island.
<ul style="list-style-type: none"> • The follow-up monitoring program developed in consultation with the EC will include identification and verification of potential effects of lighting and flaring activity and provision of appropriate mitigation measures.
<ul style="list-style-type: none"> • EnCana will consult with the CWS in regard to an appropriate follow-up program for identification and verification of predicted impacts on Roseate Terns; such consultation will include a consideration of the design elements set out in Environment Canada's October 9, 2002 review of the Addendum (Volume 1).
<ul style="list-style-type: none"> • EnCana will adhere to the provisions of the National Pollution Release Inventory (NPRI) for the project. In conjunction with the CNSOPB OCSG and its Waste and Chemical

Table B.1: Relevant Commitments from 2002 CSR
Management Plans, EnCana will strive to reduce or eliminate wastes and transfers of NPRI substances throughout the life of the Project.
<ul style="list-style-type: none"> • EnCana commits to consult with appropriate regulatory authorities with respect to EEM program design.
<ul style="list-style-type: none"> • Follow-up monitoring will include potential toxicity, fate and environmental effects of WBM and associated cuttings.
<ul style="list-style-type: none"> • Follow-up monitoring will include potential toxicity, fate and environmental effects of produced water. EnCana will conduct toxicity testing of organisms satisfactory to the CNSOPB Chief Conservation as required under the OWTG with respect to produced water.
<ul style="list-style-type: none"> • Follow-up monitoring will include consideration of contaminant transport and resident organisms.
Interactions with Fisheries
<ul style="list-style-type: none"> • The safety zone for the new Project will include, as a minimum, an area extending 500 m around the MOPU, and will likely also include the interfield flowlines and wellheads. The exact configuration of the safety zone will be determined based on safety risk assessment and consultations with regulatory agencies. There will also be a temporary 500 m safety zone around the drilling rig when it is on location for development drilling. There will be no safety zones over the export pipeline; although there will be fishing restrictions over the subsea connection to the SOEP pipeline (SOEP Subsea Option).
<ul style="list-style-type: none"> • Fishers will be notified well in advance of pipelay operations through Notices to Mariners, and by direct contact with key fisheries representatives.
<ul style="list-style-type: none"> • In the event that EnCana's activities damage the environment or cause others to suffer loss or damage, EnCana will address its liability through compliance with legislated compensation schemes.
<ul style="list-style-type: none"> • In the event of an interaction between the Project and a fishery it would be managed through a combination of measures, which could include Notice to Mariners, the use of fisheries observers, and consultation with local fishers.
<ul style="list-style-type: none"> • Both the proposed pipeline routing and the construction techniques will be discussed with fishers as part of the consultation process.
<ul style="list-style-type: none"> • Independent and trained observers representing fishing interests will conduct marine bird and mammal observations on Deep Panuke facilities and vessels beyond that required by law, as determined necessary by EnCana.
Socio-economic Commitments
<ul style="list-style-type: none"> • EnCana has developed a procurement process to ensure full and fair opportunity for all Nova Scotians and Canadians on the Deep Panuke Project
<ul style="list-style-type: none"> • EnCana will encourage its contractors and subcontractors during construction in the Goldboro area to work with local agencies to seek labour from the District of Guysborough.
<ul style="list-style-type: none"> • EnCana will continue to provide information on its planned activities, the opportunities associated with them, and the procurement process to the business community on a regular basis. Specifically, EnCana will contract an Aboriginal liaison person/ company to work with Aboriginal communities, businesses and individuals to ensure fair opportunity for contracts and services – based on competitiveness and the ability to meet EnCana's standards.
<ul style="list-style-type: none"> • EnCana will consult with the Energy Industry Liaison Committee established by the Municipality of the District of Guysborough at such time(s) as it considers its development will affect community matters coming within the mandate of the Committee.
<ul style="list-style-type: none"> • EnCana will notify the Municipality of the District of Guysborough, other pertinent agencies (e.g., the School Board responsible for the bussing local children) and the Energy Industry

Table B.1: Relevant Commitments from 2002 CSR
Liaison Committee whenever construction will disrupt traffic flow on Route 316 so that appropriate traffic management techniques can be applied.
<ul style="list-style-type: none"> • Known marine archaeological sites will be avoided.
<ul style="list-style-type: none"> • EnCana will have the onshore pipeline RoW inspected by an archaeologist, in association with an Aboriginal representative, after the survey line is marked and prior to any ground disturbance activities.
<ul style="list-style-type: none"> • A professional archaeologist and an aboriginal representative shall monitor onshore and near-shore marine pipeline construction. If a site is encountered, work will be halted and the Nova Scotia Museum will be contacted.
<ul style="list-style-type: none"> • A professional archaeologist and an aboriginal representative will be on call during subsea pipeline construction; if a previously unidentified wreck or subsea archaeological site is encountered, work will be halted and the Curator of Special Places at the Nova Scotia Museum will be contacted.
<ul style="list-style-type: none"> • EnCana will provide an awareness program with respect to archaeological sites for construction-related personnel.
Stakeholder Consultation
<ul style="list-style-type: none"> • EnCana's public communications and consultation program will continue through all phases of the Project.
<ul style="list-style-type: none"> • EnCana will contact all vessels approaching the 500 m safety zone.
<ul style="list-style-type: none"> • EnCana is committed to work collaboratively with other project developers when they are ready to proceed with their projects.
<ul style="list-style-type: none"> • EnCana will consult with fishers and other impacted stakeholders on the offshore pipeline route.
<ul style="list-style-type: none"> • EnCana will consult with DND regarding the known locations of UXO.
Emergency Response/Contingency Planning
<ul style="list-style-type: none"> • EnCana will develop and implement an Emergency Response Contingency Plan (AERCP) for all potential malfunctions and accidents. This plan will specifically address the minimization of blowout potential. Procedures will be developed to respond to a blowout that will include warning and alarm systems. These procedures will be based on the conservative assumptions (i.e., most protective) from the air quality analysis.
<ul style="list-style-type: none"> • The Sable Island Emergency Contingency Plan will be adhered to.
<ul style="list-style-type: none"> • EnCana's AERCP provides emergency response command and control functions for both onshore and offshore emergency situations, and is currently being used in its East Coast operations activities. The AERCP will be updated for Deep Panuke in compliance with applicable guidelines. This includes response to onshore pipeline releases including those potentially accompanied by fire and subsequent forest fire.
<ul style="list-style-type: none"> • EnCana will review and update its Hydrogen Sulphide Contingency Plan and Spill Response Plan for construction and operations of Deep Panuke.
<ul style="list-style-type: none"> • The operational EPP will contain chemical handling and storage procedures to ensure all fuel, chemicals and wastes will be handled in a manner that minimizes or eliminates routine spillage and accidents.
<ul style="list-style-type: none"> • EnCana's Spill Response Plan will be submitted to the appropriate regulators for review and approval. It will contain detailed measures for preparing for and responding to spills, including spill notification, the use of clean-up equipment, training of personnel, and identification of personnel to direct cleanup efforts, lines of communication and organizations that could assist cleanup operations.

Table B.1: Relevant Commitments from 2002 CSR

<ul style="list-style-type: none">• Spills of petroleum products (or other chemicals) will be cleaned up immediately and reported in accordance with regulations. Oil absorbent pads and "oil dry" compounds will be available at all times in spill kits located at strategic sites on the platforms, to remove petroleum products from deck surfaces. The used absorbent materials and any other oily wastes will be placed in sealed containers and returned to shore for treatment and disposal at an approved waste management facility.
<ul style="list-style-type: none">• It will be the responsibility of all EnCana employees and contractors to report any accidents, incidents or spills to the Offshore Installation Manager for immediate action in accordance with the EPP.
<ul style="list-style-type: none">• The standby vessel in the field will also be tasked as part of their regular duties to observe and report any spills from the facilities.
<ul style="list-style-type: none">• The control room would be staffed 24 hours a day, seven days a week monitoring the facilities.
<ul style="list-style-type: none">• An open-drain system supplemented by spill trays will ensure that small spills/leaks are contained.
<ul style="list-style-type: none">• Sheens caused by discharges will be recorded by operations personnel on the platform as a component of ECM. An industry-accepted sheen index will be used to estimate the quantity of oil observed on the water surface.

APPENDIX C: Summary of Public Comments Addressed by the NEB Member (adapted from Sections 7-9 of the JER)

Comment Providers	Summary of the Comments, Issues and Concerns	NEB Member's Recommendations	Views of RAs
<ul style="list-style-type: none"> ▪ SPANS 	<ul style="list-style-type: none"> ▪ Concerns relative to environmental impacts and potential harm to the fisheries resulting from the M&NP export pipeline option 		<p>The M&NP Option is essentially unchanged from the 2002 Project Proposal for which the 2002 CSR concluded that there would likely be no significant adverse environmental effects.</p>
<ul style="list-style-type: none"> ▪ Myles & Associates 	<ul style="list-style-type: none"> ▪ Concerns relative to marine environment impacts resulting from the M&NP export pipeline option (as opposed to the SOEP option) 		
<ul style="list-style-type: none"> ▪ SCC 	<ul style="list-style-type: none"> ▪ Concerns relative to ocean floor disruption resulting from the M&NP export pipeline option (as opposed to the SOEP option) 		
<ul style="list-style-type: none"> ▪ WWF-ARO ▪ CPAWS-NS ▪ SCC 	<ul style="list-style-type: none"> ▪ Concerns relative to Ecologically and Biologically Significant Areas (EBSAs) ▪ Concerns relative to ESSIM ▪ Concerns relative to Marine Protected Areas (MPAs) 		<p>See Appendix D. The RAs agree with the recommendation of the CNSOPB Commissioner that EnCana continue to be an active participant in the ESSIM process.</p>
<ul style="list-style-type: none"> ▪ Guysborough County Regional Development Authority 	<ul style="list-style-type: none"> ▪ Concerns relative to Eastern Scotian Shelf Integrated Management (ESSIM) 		
<ul style="list-style-type: none"> ▪ SCC 	<ul style="list-style-type: none"> ▪ Concerns relative to the effect of noise on marine mammals 		<p>The RAs expect the noise levels to be less than the assessed 2002 Project Proposal. However, EnCana will be required to implement a ramp-up procedure for pile-driving activities.</p>
<ul style="list-style-type: none"> ▪ WWF-ARO 	<ul style="list-style-type: none"> ▪ Concerns relative to the impacts of the proposed Project on groundfish communities (including cod and haddock) of the Eastern Scotian Shelf ▪ Concerns relative to impacts on the fish larvae diversity in the Scotia-Fundy region 		<p>Effects on marine fish were assessed in relation to various project activities such as produced water and drill waste discharge. The RAs have concluded that significant adverse environmental effects are not likely.</p>
<ul style="list-style-type: none"> ▪ Guysborough County Regional 	<ul style="list-style-type: none"> ▪ Concerns about the pipeline landfall 	<p><u>Recommendation I</u></p>	<p>The RAs support Recommendations I & J. These concerns are also addressed in</p>

Comment Providers	Summary of the Comments, Issues and Concerns	NEB Member's Recommendations	Views of RAs
Development Authority	<p>methodology; relative to:</p> <ul style="list-style-type: none"> ▪ Legacy contaminants ▪ Suspension of sediment in the water 	<p>EnCana shall file with the Board for approval, at least 45 days prior to construction, an HDD landfall feasibility assessment, which provides EnCana's landfall pipeline proposed installation method and rationale for the decision. This assessment shall include the following elements as a minimum:</p> <ol style="list-style-type: none"> a) a comparative review of the different potential landfall pipeline installation methods; b) geotechnical and construction feasibility assessments performed by persons with subject expertise to support the preferred and applied-for landfall pipeline installation method; c) reports on environmental impacts studies as completed; d) reports on geotechnical studies as completed; and e) a hazard analysis and contingency measures completed for the selected installation method. <p><u>Recommendation J</u></p> <p>If contamination or acidic drainage is encountered during the Geotechnical Testing Program along the easement:</p> <ol style="list-style-type: none"> a) EnCana shall file with the Board, at least 14 days prior to the commencement of the remediation: <ol style="list-style-type: none"> i. detailed description of the extent and nature of the contamination or acidic drainage encountered; ii. a detailed site assessment; 	Sections 9.8 and 9.9 of this CSR.

Comment Providers	Summary of the Comments, Issues and Concerns	NEB Member's Recommendations	Views of RAs
		iii. a remediation plan; and iv. evidence of consultation with relevant regulatory authorities that confirms satisfaction of the proposed remediation plan and associated mitigation. b) EnCana shall commence remediation within a year of encountering contamination.	
<ul style="list-style-type: none"> ▪ CPAWS-NS ▪ NCNS ▪ SCC 	<ul style="list-style-type: none"> ▪ Concerns relative to the Winter Skate ▪ Concerns relative to monitoring program ▪ Concerns relative to all the Species at Risk in the proposed Project area 	<p><u>Recommendation C</u> EnCana shall file with the Board for approval, at least 30 days prior to construction, a final and updated project-specific Environmental Effects Monitoring Plan (EEMP) and Compliance Monitoring Plan for the NEB regulated pipeline.</p>	<p>The RAs have assessed the potential impact on Winter Skate in Section 9.11 of this CSR and determined it is unlikely the project area provides critical habitat.</p> <p>The RAs support Recommendation C. An environment effects monitoring program will be developed and results will be publicly available.</p>

Comment Providers	Summary of the Comments, Issues and Concerns	NEB Member's Recommendations	Views of RAs
<ul style="list-style-type: none"> ▪ CPAWS_NS ▪ SCC 	<ul style="list-style-type: none"> ▪ Concerns relative to onshore wildlife and wildlife habitat. 	<p><u>Recommendation A</u></p> <p>EnCana shall file with the Board, at least 14 days prior to construction, a detailed breeding bird and nest survey. The survey shall include:</p> <ul style="list-style-type: none"> a) a special attention directed at locating: <ul style="list-style-type: none"> i. SARA listed species (such as the Short-eared Owl); ii. species currently considered for inclusion to the SARA list (such as the Rusty Blackbirds); and iii. migratory birds (such as the Greater Yellowlegs). b) evidence to confirm that relevant regulatory authorities had an opportunity to review and comment on the proposed methods for the survey; c) the results of the survey; and d) if applicable, evidence of consultation with relevant regulatory authorities, such as Nova Scotia Department of Natural Resources (NSDNR) and Environment Canada, regarding satisfaction with the proposed mitigation measures. 	<p>The RAs support Recommendation A. Onshore wildlife and wildlife habitat concerns are addressed in Section 9.9, 9.11 and Appendix B of this CSR.</p>
<ul style="list-style-type: none"> ▪ SCC 	<ul style="list-style-type: none"> ▪ Concerns relative to air emissions (greenhouse gas) resulting from construction and operation of the pipeline ▪ Concerns relative to air emissions resulting from the use of gas by end users 		<p>Effects from construction-related sources on air quality were considered in the 2002 CSR.</p> <p>Operational impacts to air quality (including accidents and malfunctions) are addressed in Section 9.4, 9.12 and Appendix B of this</p>

Comment Providers	Summary of the Comments, Issues and Concerns	NEB Member's Recommendations	Views of RAs
			<p>CSR.</p> <p>Effects of air emissions from end use of gas is outside the scope of the EA.</p>
<ul style="list-style-type: none"> ▪ SPANS ▪ Strait of Canso Superport Corporation Limited 	<ul style="list-style-type: none"> ▪ Potential effects on the commercial fishing industry ▪ Potential effects on fish stocks (refer to the "Marine Fish and Marine Fish Habitat" section of the JER for additional details). 		<p>Effects on marine fish were assessed in relation to various project activities such as produced water and drill waste discharge. The RAs have concluded that significant adverse environmental effects are not likely.</p>
<ul style="list-style-type: none"> ▪ Municipality of the District of Guysborough ▪ MapleLNG Limited 	<ul style="list-style-type: none"> ▪ The location of EnCana's onshore pipeline may constrain the location and operation of the proposed Keltic/Maple facilities 		<p>This concern is outside of the scope of the EA.</p> <p>The EA does however assess the cumulative environmental effects of Deep Panuke in combination with the Keltic/Maple facilities in Section 9.12 of this CSR.</p>

Comment Providers	Summary of the Comments, Issues and Concerns	NEB Member's Recommendations	Views of RAs
<ul style="list-style-type: none"> ▪ Assembly of N.S. Mi'kmaq Chiefs ▪ Native Council of N.S. 	<ul style="list-style-type: none"> ▪ Construction could interact with previously unidentified heritage resources and / or with identified heritage resources ▪ Construction activities could result in effects on the current use of lands and resources for traditional purposes by Aboriginal persons, such as hunting, fishing, trapping, gathering 	<p><u>Recommendation D</u> EnCana shall file with the Board, 30 days prior to the commencement of construction:</p> <ul style="list-style-type: none"> a) an update on EnCana's Current and Traditional Use Review with the Assembly of Nova Scotia Mi'kmaq Chiefs and the Native Council of Nova Scotia, including: <ul style="list-style-type: none"> i. a summary of the results of Phase 1 (i.e., a review by Aboriginal groups of the applicability of the findings of studies and opinions pertaining to the current and traditional use in the onshore pipeline corridor and nearshore marine landfall areas for the Deep Panuke Project); and ii. if necessary, a summary of the results of Phase 2 (i.e., a focused Mi'kmaq Ecological Knowledge Study to address any gaps in knowledge of Aboriginal current and traditional use the Deep Panuke onshore pipeline corridor and nearshore pipeline landfall area). b) an update of any outstanding issues arising from the Aboriginal consultation program, and for approval, a summary indicating how EnCana will incorporate the findings and address any issues from the current and traditional use review into the Project. 	<p>The RAs support Recommendation D as well as the Commissioner's Recommendation 8. The RAs' assessment of the Project's effects on the current use of lands and resources for traditional purposes by Aboriginal persons is contained in Section 10 of this CSR.</p>

Comment Providers	Summary of the Comments, Issues and Concerns	NEB Member's Recommendations	Views of RAs
<ul style="list-style-type: none"> ▪ Myles & Associates 	<ul style="list-style-type: none"> ▪ The potential human health effects associated with military dumpsites of chemical, biological and nuclear agents off the East Coast of Canada 	<p><u>Recommendation B</u> EnCana shall file with the Board, 30 days prior to construction, a record of consultation with the Department of National Defence - Formation Safety and Environment³ with respect to operational concerns and the presence of sites containing legacy munitions or unexploded ordnance, biological or chemical warfare agents and radioactive materials within the Project area.</p>	<p>The RAs agree with Recommendation B as well as the CNSOPB Commissioner's Recommendation 7. This issue is discussed in Section 9.6 of this CSR.</p>
<ul style="list-style-type: none"> ▪ ExxonMobil Canada Ltd. ▪ Shell Canada Limited ▪ Imperial Oil Resources 	<ul style="list-style-type: none"> ▪ Physical damage and/or rupture of the existing adjacent SOEP pipeline (especially where the existing SOEP pipeline and EnCana's proposed M&NP option pipeline would only be approximately 8m apart) resulting from construction activities or potential spanning during the operation of the pipelines 	<p><u>Recommendation K</u> EnCana shall file with the Board annually, unless the Board otherwise directs, a report describing exposed segments of the Offshore pipeline. The report shall, for the entire length of the pipeline, include the following information as a minimum:</p> <ol style="list-style-type: none"> a) a description of the monitoring methodology used; b) a description of all exposed pipeline segments and free spans, including the location, length, sea bottom geology, water depth and any associated issues; c) a description of observed coating or pipeline damage; d) proposed changes to the pipeline monitoring program; and e) as appropriate, proposed mitigative measures and follow-up actions 	<p>Damage to the SOEP pipeline is outside the scope of the EA; however, accidents and malfunctions as well as cumulative environmental effects were considered in Sections 9.2 and 9.12, respectively, of this CSR.</p>

³ Department of National Defence - Formation Safety and Environment or any successor or agency performing substantially similar functions with respect to legacy munitions or unexploded ordnance, biological and chemical warfare agents and marine radioactive dumpsites.

Comment Providers	Summary of the Comments, Issues and Concerns	NEB Member's Recommendations	Views of RAs
		with regards to proposed pipeline exposure and free spanning conditions	
<ul style="list-style-type: none"> ▪ Municipality of Guysborough 	<ul style="list-style-type: none"> ▪ Concern relative to the selection of the onshore route and potential interaction with the adjacent Goldboro Industrial Park 		Interaction with Goldboro Industrial Park is outside the scope of the EA; however, accidents and malfunctions as well as cumulative environmental effects were considered in Sections 9.2 and 9.12, respectively of this CSR.
<ul style="list-style-type: none"> ▪ Guysborough County Regional Development Authority 	<ul style="list-style-type: none"> ▪ Concern relative to potential interaction between adjacent projects ▪ Concerns relative to pipeline routing and the separation distance between adjacent projects 		The RAs considered the effects of the presence and construction of subsea structures in Sections 9.5 and 9.6 of this CSR.
<ul style="list-style-type: none"> ▪ SPANS ▪ SCC 	<ul style="list-style-type: none"> ▪ Concerns relative to interaction between subsea structures and fishing activities and equipment 		

Comment Providers	Summary of the Comments, Issues and Concerns	NEB Member's Recommendations	Views of RAs
<ul style="list-style-type: none"> ▪ Myles & Associates 	<ul style="list-style-type: none"> ▪ Concerns relative to potential (marine) environment and marine life effects related to the presence of sites containing legacy munitions or unexploded ordnance, biological or chemical warfare agents and radioactive materials off the East Coast of Canada 	<p><u>Recommendation B</u></p> <ul style="list-style-type: none"> ▪ EnCana shall file with the Board, 30 days prior to construction, a record of consultation with the Department of National Defence - Formation Safety and Environment⁴ with respect to operational concerns and the presence of sites containing legacy munitions or unexploded ordnance, biological or chemical warfare agents and radioactive materials within the Project area. 	<p>The RAs agree with Recommendation B as well as the CNSOPB Commissioner's Recommendation 7. This issue is discussed in Section 9.6 of this CSR.</p>
<ul style="list-style-type: none"> ▪ CPAWS-NS ▪ SCC 	<ul style="list-style-type: none"> ▪ Concerns relative to climate change 		<p>Climate change was assessed in the 2002 CSR and in general air emissions are expected to be less compared to the 2002 Project.</p>
<ul style="list-style-type: none"> ▪ NCNS 	<ul style="list-style-type: none"> ▪ Concerns relative to impacts resulting from air emissions 		<p>Operational impacts to air quality are addressed in Sections 9.4, 9.12 and Appendix B of this CSR.</p>

⁴ Department of National Defence - Formation Safety and Environment or any successor or agency performing substantially similar functions with respect to legacy munitions or unexploded ordnance, biological and chemical warfare agents and marine radioactive dumpsites.

APPENDIX D: Summary of Public Comments Addressed by the Commissioner (adapted from Sections 12-14 of the JER)

Comments Providers	Issues and Concerns	Commissioner's Conclusion or Recommendation	Views of RAs
<ul style="list-style-type: none"> ▪ CPAWS-NS ▪ WWF-ARO ▪ SCC 	<ul style="list-style-type: none"> ▪ Concerns were expressed about the potential impact of the proposed Project on: <ul style="list-style-type: none"> ▪ The eastern Scotian Shelf ecological and biological communities in general and on designated and candidate sensitive communities in particular ▪ The ESSIM Initiative ▪ The identification of EBSAs ▪ Priority Area # 24 which may qualify as an EBSA under ESSIM ▪ Marine Protected areas - Gully MPA 	<p><u>Section 13.1 JER</u> The Commissioner recommends that EnCana continue active participation in ESSIM (Recommendation 1)</p>	<p>The RAs agree with Recommendation 1. See Section 9.10 of this CSR for further discussion.</p>
<ul style="list-style-type: none"> ▪ CPAWS-NS ▪ WWF-ARO 	<ul style="list-style-type: none"> ▪ Concerns were expressed about the direct and indirect impact on Sable Island ecosystems from: <ul style="list-style-type: none"> ▪ Oil spills ▪ Damage to marine life in the larval retention zone from waste discharges and noise 	<p><u>Section 13.3 JER</u> The Commissioner concludes that the project will not have any significant effect on the resources of Sable Island.</p> <p>The Commissioner recommends that EnCana include measures in its EPP and Spill Response Plan to protect the Roseate Tern from possible impacts of development and production activities. (Recommendation 4)</p> <p><u>Section 13.1 JER</u> Commissioner recommends that EnCana continue active participation in ESSIM. (Recommendation 1)</p> <p><u>Section 13.2 JER</u> The Commissioner is satisfied that EnCana will be required to produce an EEMP before regulatory approval is given and that the</p>	<p>The RAs agree with the Commissioner's conclusions and Recommendations 1, 2 and 4 which are addressed through the mitigation and follow-up commitments summarized in Sections 9.2, 9.10, 9.11 and Appendix B of this CSR.</p> <p>With regard to Recommendation 3, the RAs are confident that EnCana's public consultation commitments outlined in Section 6.2 and Appendix B of this CSR will be effective.</p>

Comments Providers	Issues and Concerns	Commissioner's Conclusion or Recommendation	Views of RAs
		<p>results of the monitoring will be made public.</p> <p>The Commissioner recommends that EnCana make the results of its monitoring available to the public on a timely basis and that the presentation of these results pay particular attention to the effects on marine life in the vicinity of the proposed Project and the direct and indirect effects of the proposed Project on the resources of Sable Island. (Recommendation 2)</p> <p>The Commissioner recommends that approval of the proposed Project be contingent upon effective consultation. (Recommendation 3)</p>	
<ul style="list-style-type: none"> ▪ CPAWS-NS 	<ul style="list-style-type: none"> ▪ Concern expressed that EnCana did not adequately assess the potential impacts of the proposed Project on the Haddock Box 	<p><u>Section 13.4 JER</u></p> <p>The Commissioner is satisfied that there is little likelihood of potential interactions between the proposed Project and the Haddock Box.</p>	<p>The RAs agree with the Commissioner's conclusion. Effects on marine fish were assessed in relation to various project activities such as produced water and drill waste discharge. The RAs have concluded that significant adverse environmental effects are not likely.</p>
<ul style="list-style-type: none"> ▪ CPAWS-NS ▪ NCNS ▪ SCC 	<ul style="list-style-type: none"> ▪ Concern about impact on Winter Skate which is a Species of Special Status pending public consultation for addition to the SARA listed species; in particular because its spawning habits are not well known 	<p><u>Section 13.5 JER</u></p> <p>The Commissioner is satisfied that the EEMP will meet the requested monitoring requirements.</p>	<p>The RAs agree with the Commissioner's conclusion. The RAs have assessed the potential impact on Winter Skate in Section 9.11 of this CSR and determined it is unlikely the project area provides critical habitat.</p>
<ul style="list-style-type: none"> ▪ SCC ▪ CPAWS-NS 	<ul style="list-style-type: none"> ▪ Concern that noise from the proposed Project, especially when combined with the noise emanating from other anthropogenic activities, will adversely affect the behaviour of cetaceans, particularly their ability to communicate; 	<p><u>Section 13.6 JER</u></p> <p>The Commissioner is satisfied with EnCana's response to this issue.</p>	<p>The RAs agree with the Commissioner's conclusion. See Section 9.6 of this CSR for further discussion.</p>

Comments Providers	Issues and Concerns	Commissioner's Conclusion or Recommendation	Views of RAs
	<p>special concern for the endangered bottlenose whale</p>		
<ul style="list-style-type: none"> ▪ CPAWS-NS ▪ SCC 	<ul style="list-style-type: none"> ▪ Concern that toxic substances in drilling muds will be distributed over a wide area and have an adverse effect on demersal fish ▪ Concern that mercury in discharged drilling muds may contaminate sediment and marine life as well as humans who consume fish products 	<p><u>Section 13.7 JER</u> In the Commissioner's opinion, the evidence presented does not indicate that mercury contamination of fish will result from the proposed Project.</p> <p><u>Section 13.9 JER</u> While the Norwegian zero discharge goal is a goal that one might aim for, the evidence does not indicate that there will be any significant environmental effects arising from routine drilling and production activities. In addition, EnCana has committed to preparing a Spill Response Plan, EEMP, an EPP and an Emergency Management Plan. By complying with these plans, EnCana should reduce the potential for significant or irreversible damage to the environment arising from routine or accidental events.</p>	<p>The RAs agree with the Commissioner's conclusion. Effects on marine fish were assessed in relation to toxic substances in drill waste discharges including mercury. The RAs have concluded that significant adverse environmental effects are not likely.</p> <p>See Section 9.7 of this CSR for further discussion.</p>
<ul style="list-style-type: none"> ▪ CPAWS-NS ▪ SCC 	<ul style="list-style-type: none"> ▪ Concern that toxic elements in produced water may have an impact on the reproductive success and growth of fish and invertebrates 	<p><u>Section 13.8 JER</u> The Commissioner is satisfied with EnCana's response to this issue.</p>	<p>The RAs agree with the Commissioner's conclusion. Effects on marine fish were assessed in relation to various project activities such as produced water. The RAs have concluded that significant adverse environmental effects are not likely. See Section 9.3 of this CSR for further discussion.</p>
<ul style="list-style-type: none"> ▪ CPAWS-NS 	<ul style="list-style-type: none"> ▪ Concern about the practice of discharging wastes into the environment 	<p><u>Section 13.9 JER</u> While the Norwegian zero discharge goal is a goal that one might aim for, the evidence does not indicate that there will be any significant environmental effects arising from routine</p>	<p>The RAs agree with the Commissioner's conclusion. Waste discharged from the Deep Panuke Project will be in compliance with the OWTG and EnCana's approved EPP.</p>

Comments Providers	Issues and Concerns	Commissioner's Conclusion or Recommendation	Views of RAs
		drilling and production activities.	
<ul style="list-style-type: none"> ▪ SPANS 	<ul style="list-style-type: none"> ▪ Concern about the impact on fisheries and fish stocks under moratorium 	<p><u>Section 13.10 JER</u> The Commissioner understands that EnCana did not agree to enter into a bilateral agreement with SPANS and others engaged in the offshore fisheries.</p> <p>The Commissioner has indicated above that the matter of the Fisheries Observer Program will be dealt with in the Commissioner's Report to the CNSOPB.</p> <p>The Commissioner recommends that EnCana's compensation commitments be made a condition of the approval of the proposed Project. (Recommendation 5)</p>	<p>The RAs agree that EnCana adhere to the CNSOPB Compensation Guidelines Respecting Damages Relating to Offshore Petroleum Activity and encourage EnCana to continue discussions with the fishing industries on issues outside the CNSOPB Guidelines.</p>
<ul style="list-style-type: none"> ▪ SCC ▪ SPANS 	<ul style="list-style-type: none"> ▪ Concern that adoption of the M&NP option in preference to the SOEP option would result in unnecessary environmental and socio-economic impacts 	<p><u>Section 5.5.1.1 JER</u> While it would appear that the better option from an environmental perspective would be to build the shorter line, in the absence of a full assessment of the condition of the existing SOEP pipeline, it would not be prudent to limit EnCana's options at this stage. The Commissioner and NEB Member encourage EnCana to give meaningful consideration to the relative environmental impacts of the two options in its ultimate weighing of its options, and to explain its decision to all stakeholders.</p>	<p>The RAs agree with the Commissioner and NEB Member's conclusion.</p>
<ul style="list-style-type: none"> ▪ CPAWS-NS ▪ Guysborough County Regional Development Authority 	<ul style="list-style-type: none"> ▪ Concern about the impacts of drilling, laying pipes and flowlines on 2 different benthic seascape types ▪ Concern about impacts on benthic organisms which serve as the main food source for some commercial fish species 		<p>The RAs conclude that the presence of new subsea structures and drill waste discharges are unlikely to have significant adverse environmental effects on benthic habitats and organisms. Please see Sections 9.6 and 9.7 of this CSR for further</p>

Comments Providers	Issues and Concerns	Commissioner's Conclusion or Recommendation	Views of RAs
			discussion.
<ul style="list-style-type: none"> ▪ SPANS ▪ SCC 	<ul style="list-style-type: none"> ▪ Concern about the abandonment of pipelines, flowlines and umbilicals and its impact on fishing 	<p><u>Section 5.5.2.1 JER</u> At this time it is recommended that no decision on abandonment be rendered.</p>	<p>The 2002 CSR and the assessment of the presence of new structures in the 2007 CSR conclude that there would be no significant environmental effects of abandoning the pipeline, flowlines and umbilicals in place. Applications for authorization to decommission and abandon facilities are required prior to performing such work which will include addressing environmental impacts at that time. Further environmental assessment will be required if plans are changed and such facilities are to be removed.</p>
<ul style="list-style-type: none"> ▪ CPAWS-NS 	<ul style="list-style-type: none"> ▪ Concern about the impact of increased use of the SOEP pipeline 	<p><u>Section 5.5.1.1 JER</u> While it would appear that the better option from an environmental perspective would be to build the shorter line, in the absence of a full assessment of the condition of the existing SOEP pipeline, it would not be prudent to limit EnCana's options at this stage. The Commissioner and NEB Member encourage EnCana to give meaningful consideration to the relative environmental impacts of the two options in its ultimate weighing of its options, and to explain its decision to all stakeholders.</p>	<p>The RAs agree with the Commissioner's conclusion and have determined that both options are not likely to result in significant adverse environmental effects.</p>
<ul style="list-style-type: none"> ▪ CPAWS-NS 	<ul style="list-style-type: none"> ▪ Concern expressed that the impact of removing and exporting natural gas from the environment was not investigated 	<p><u>Section 13.11 JER</u> The Commissioner is not satisfied that there is a sufficient basis to direct that EnCana engage in studies of this nature.</p>	<p>The RAs agree with the Commissioner's conclusion.</p>

Comments Providers	Issues and Concerns	Commissioner's Conclusion or Recommendation	Views of RAs
<ul style="list-style-type: none"> ▪ SCC ▪ CPAWS-NS 	<ul style="list-style-type: none"> ▪ Concern about the impact of greenhouse gas emissions arising from the production and use of hydrocarbons arising from the proposed Project 	<p><u>Section 13.12 JER</u></p> <p>The Commissioner recommends that the CNSOPB give consideration to conducting a study of the issue of requiring a proponent to include an assessment of the potential impact of greenhouse gas emissions by end-users of the product. (Recommendation 6)</p>	<p>The RAs have determined that this recommendation is outside the scope of this Project EA.</p>
<ul style="list-style-type: none"> ▪ Myles & Associates 	<ul style="list-style-type: none"> ▪ Concern that the proposed Project could disturb legacy munitions, or unexploded ordnance, biological or chemical warfare agents and radioactive materials 	<p><u>Section 13.13 JER</u></p> <p>The Commissioner recommends that EnCana consult fully with the Department of National Defence with respect to the possible presence of legacy munitions or unexploded ordnance, biological or chemical warfare agents and radioactive materials within the proposed Project Area. (Recommendation 7)</p>	<p>The RAs agree with Recommendation 7 as well as the NEB Member's Recommendation B. This issue is discussed in Section 9.6 of this CSR.</p>
<ul style="list-style-type: none"> ▪ NCNS ▪ The Confederacy of Mainland Mi'kmaq ▪ Union of N.S. Indians 	<ul style="list-style-type: none"> ▪ Concerns about the Aboriginal: <ul style="list-style-type: none"> ▪ Rights to fish for food for social and ceremonial purposes ▪ Fulfilling the need to promote environmental stewardship ▪ Recognizing the need for an Aboriginal Liaison position ▪ Identifying the socio-economic effects on the off-reserve Aboriginal community ▪ Requirement for a MEK Study 	<p><u>Section 13.14 JER</u></p> <p>The Commissioner will address the issue of Aboriginal Consultation in the Commissioner's Report to the CNSOPB.</p> <p>The Commissioner recommends that EnCana continue to work with the Aboriginal organizations to develop the Aboriginal Liaison position and complete the MEK Study. (Recommendation 8)</p>	<p>The RAs support Recommendation 8 as well as the NEB Member's Recommendation D. The RAs' assessment of the Project's effects on the current use of lands and resources for traditional purposes by Aboriginal persons is contained in Section 10 of the CSR.</p>