NEWFOUNDLAND AND LABRADOR
REFINING CORPORATION

PROJECT REGISTRATION

In accordance with the Requirements of the Newfoundland and Labrador Environmental Protection Act

for

NEWFOUNDLAND & LABRADOR REFINERY PROJECT

at

SOUTHERN HEAD AT THE HEAD OF PLACENTIA BAY, NL

October 16, 2006

NEWFOUNDLAND AND LABRADOR
REFINING CORPORATION

PROJECT REGISTRATION

IN ACCORDANCE WITH THE REQUIREMENTS OF THE NEWFOUNDLAND AND LABRADOR ENVIRONMENTAL PROTECTION ACT

FOR

NEWFOUNDLAND & LABRADOR REFINERY PROJECT AT SOUTHERN HEAD, PLACENTIA BAY, NL

Submitted to:
Environmental Assessment Division
Department of Environment and Conservation
P. O. Box 8700
St. John's, NL A1B 4J6

Submitted by:
Newfoundland and Labrador Refining Corporation
P. O. Box 385
St. John's, NL A1C 5J9

OCTOBER 16, 2006

NEWFOUNDLAND & LABRADOR
REFINING CORPORATION

OUR COMMITMENT

Health, Safety, Environment and Social Responsibilities

Newfoundland and Labrador Refining Corporation intends to become a leader within the global refining industry with respect to health and safety procedures, environmental protection measures and community benefits.

- NLRC is committed to developing health and safety procedures and protocols at all levels of its business that are both meaningful and effective. Excellence in this area will be a top priority for the Company.
- Oil refining comes with an inherent risk for environmental damage to land, air and ocean. NLRC intends to invest in the most advanced technologies available to minimize its daily operating impacts. It will also take a leadership role in ensuring that all areas of potential environmental impacts within the Placentia Bay region are understood and properly addressed. It will also make investments in infrastructure that will enhance the response capacity of Placentia Bay to environmental threats or accidents.
- NLRC understands that its planned operations will be situated within a region that includes several communities and that its ability to operate successfully will be dependant on an open, interactive and positive relationship with its neighbors. It commits to open communication in order to ensure understanding at all times of community level needs. NLRC will participate in the well being and overall strengthening of communities within the region.

The ultimate pride of NLRC will hinge upon its performance in the areas described here.

Signed: _____
Brian Dalton, Managing Director

TABLE OF CONTENTS

Page No.

APPENDICES:

EXECUTIVE SUMMARY

This document provides the Project Registration for a proposed new oil refinery, submitted to the Provincial Government of Newfoundland and Labrador under the *Newfoundland and Labrador Environmental Protection Act*.

Worldwide there is a shortage of crude oil refining capacity. Hurricane damage to the Gulf coast refineries in 2005 dramatically demonstrated the vulnerability of the oil products supply in North America. As well, existing refineries in North America are more than twenty years old and not built to today's environmental and technology standards.

Crude oil is a global commodity and the world market will move quickly to fill the gap in refining capacity. Feasibility and market studies have confirmed that there is a time-limited opportunity for the development of a new refinery within the Placentia Bay region. The timeline proposed for the refinery project will ensure that Newfoundland and Labrador is in the forefront of efforts to provide the needed refining capacity.

Placentia Bay provides a strategic location for a new refinery. The Bay is located on major international shipping routes, is ice-free and, along with deep water allowing passage of large tankers, has a well established vessel traffic management system.

Newfoundland and Labrador Refining Corporation (NLRC) proposes to construct and operate a new, privately financed, crude oil refinery, to be located at the head of Placentia Bay, NL.

This project provides Newfoundland and Labrador with the opportunity to develop a petrochemical industry; provides a local market for offshore stranded gas; and can form a key element in the future economic development of the Province of Newfoundland and Labrador. The refinery itself will provide in the range of 750 permanent jobs as well as the associated indirect employment. A second refinery would prompt spin-off opportunities in the region that would allow the creation and expansion of companies to supply goods and services to the petroleum industry.

Two sites, the undeveloped land between the existing refinery and the transhipment terminal, and a greenfield site at Southern Head have the 'preferred site' attributes. However, the undeveloped land is presently under lease to Newfoundland Transhipment Limited, and hence the site for the new refinery is Southern Head. The over $4.0 billion project will have an initial production capacity of 300,000 barrels per day with the option to expand to 600,000 barrels per day in the future should market conditions allow. The selected site has sufficient area for future expansion. The primary products of the refinery will be gasoline, kerosene/jet fuel, ultra-low sulphur diesel and refining by-products.

The refinery infrastructure will include the process facilities, a marine terminal, crude and product storage tanks, an access road and utilities.

The environmental regulatory approvals and processes for this project fall under a variety of federal and provincial assessment regimes. Initial meetings have been held with both levels of government in an effort to coordinate, facilitate and expedite these reviews. These discussions have also served to identify key issues and field studies, several of which are underway in the project area.

The project will incorporate state-of-the-art methods with "Best Available Technology that is Economically Available (BATEA)" for the limitation of environmental impact, including process and plant design, comprehensive waste management practices during construction and operation, and safeguards against atmospheric, terrestrial and marine pollution to ensure meeting all applicable regulatory requirements. The project will be carried out in an environmentally-responsible manner, with minimum adverse impact on the environment, human health and safety.

NLRC has also met extensively with communities and interest groups in the surrounding area and is working with them to identify and address concerns. NLRC will continue to provide project information and consultation as the Environmental Assessment is developed.

The location of the proposed refinery, near the existing refinery and the transhipment terminal at Whiffen Head, allows the environmental assessment to benefit from

existing, baseline environmental and associated data to supplement site-specific efforts. The refinery will also benefit from the infrastructure and communication mechanisms in Placentia Bay for the management of tanker traffic, commercial fisheries and other activities.

The project will create significant employment for the region, with approximately 3000 employees during construction and approximately 750 during operation.

In order to meet market demand and timelines, NLRC will be ready to start construction as soon as possible. Site preparation will commence immediately upon receipt of the environmental approvals and necessary permits.

Construction is expected to be complete within three years, with production by late 2010 or early 2011.

1 NAME OF UNDERTAKING

Newfoundland and Labrador Refinery

1.1 INTRODUCTION

Newfoundland and Labrador Refining Corporation is a locally-based, private company registered in Newfoundland and Labrador. In February 2006, the Company initiated a Feasibility Study into a new refinery in the Province of Newfoundland and Labrador. As a result of positive market studies, Newfoundland and Labrador Refining Corporation undertook a site selection process and is now in position to begin environmental assessment of the new refinery.

The proposed refinery location is Southern Head, a peninsula between North Harbour and Come-by-Chance Bay, at the head of Placentia Bay, in the Province of Newfoundland and Labrador (Figure 1-1).

This document provides a Project Registration of the proposed new refinery based on the requirements defined under the Newfoundland and Labrador Environmental Protection Act. The Project Registration is submitted to the Department of Environment and Conservation in order to initiate the provincial environmental assessment process.

This Project is subject to both federal and provincial environmental assessment (EA) processes and must satisfy the conditions of both. Newfoundland and Labrador Refining Corporation (NLRC or 'the Proponent') will make best efforts to assist the governments to coordinate the two assessment processes.

The federal assessment process, managed by the Canadian Environmental Assessment Agency (CEAA) requires an initial 90 day review period, while the provincial process provides for a 45 day review period, including time for public review and comment. On the advice of senior officials in CEAA and the provincial government, NLRC has submitted the Project Description to CEAA in advance of the Project Registration required by the provincial process in order to facilitate

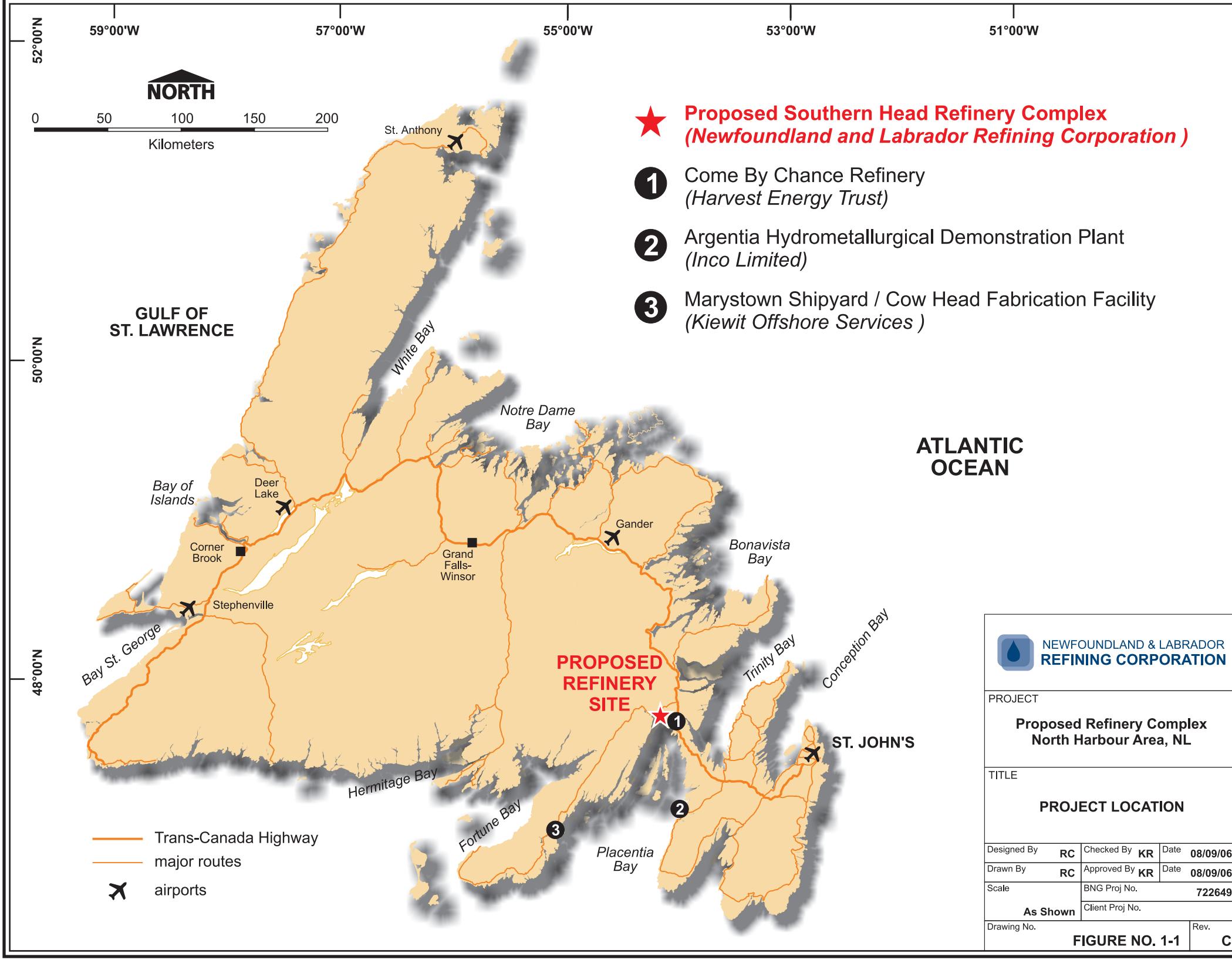
coordination of the federal and provincial Ministers' decisions on assessment requirements.

NLRC recognizes that, in addition to the EA approvals, the Project must obtain all of the required environmental approvals, licences and permits through the federal and provincial permitting processes. A list of relevant legislation and associated permits is contained in Appendix A.

As stated in Newfoundland and Labrador Refining Corporation's Commitment, a framework for a public consultation program has been developed that will continue throughout the environmental assessment process and form the basis for monitoring at all phases of the Project. Effective lines of communication between the proponent and the residents of nearby communities are in place and will provide the basis for ongoing liaison throughout all phases of the project.

In the process of identifying the potential environmental effects arising from the project and associated activities, features of the local environment that are valued due to their ecological, scientific, cultural, socio-economic or aesthetic importance have been identified by the proponent, members of the public, scientists and government agencies. These provide a focus for the assessment as Valued Ecosystem Components (VECs). Within the context of this project, both biological and socio-economic VECs have been proposed.

Environmental protection; application of high standards for heath and safety; and application of best practises are paramount to the successful development of this project. Mitigation measures to minimize any adverse impacts of the project on the environment and communities, while maximizing local benefits, have been and will be continued to be NLRC's Policy for this project throughout all stages of the development.



NEWFOUNDLAND & LABRADOR
REFINING CORPORATION

PROJECT
Proposed Refinery Complex
North Harbour Area, NL

TITLE
PROJECT LOCATION

Designed By	RC	Checked By	KR	Date	08/09/06
Drawn By	RC	Approved By	KR	Date	08/09/06
Scale	As Shown	BNG Proj No.	722649		
		Client Proj No.			

Drawing No. **FIGURE NO. 1-1** Rev. **C**

2 PROPONENT

Name of Corporate Body:

Newfoundland and Labrador Refining Corporation (NLRC)

Address:

Newfoundland & Labrador Refining Corporation
P. O. Box 385
St. John's, NL A1C 5J9

Chief Executive Officer:

Name:	Brian Dalton
Official Title:	Managing Director
Address:	P. O. Box 385 St. John's, NL A1C 5J9
Telephone No.:	(709) 576-3442

Principal Contact Persons for purposes of environmental assessment:

Proponent Contact

Mr. Kjell Rustad
Project Director
Newfoundland and Labrador Refining Corporation (NLRC)
P. O. Box 385
St. John's, NL A1C 5J9
Phone: (709) 576-3442
Email: kjell@nlrefining.com

Mr. Roland Butler
Community Inquiries
Newfoundland and Labrador Refining Corporation (NLRC)
P. O. Box 385
St. John's, NL A1C 5J9
Phone: (709) 576-3442
Toll Free : 1-888-570-3442
Email: roland@nlrefining.com

Consultant Contact Mr. Nick Gillis
Project Manager
BAE-Newplan Group Limited
A division of SNC-Lavalin Inc
1133 Topsail Road
Mount Pearl, NL A1N 5G2
Phone: (709) 368-0118
Fax: (709) 368-5410
Email: Nick.Gillis@snclavalin.com

Dr. Bassem Eid
EA Manager
BAE-Newplan Group Limited
A division of SNC-Lavalin Inc
1133 Topsail Road
Mount Pearl, NL A1N 5G2
Phone: (709) 368-0118
Fax: (709) 368-5410
Email: Bassem.Eif@snclavalin.com

Newfoundland and Labrador Refining Corporation (NLRC) is a private company registered in Newfoundland and Labrador and based in St. John's. The founding investors in NLRC include Newfoundland and Labrador based Altius Resources Inc. and a core group of distinguished European entrepreneurs with proven track records in both equity and debt finance arrangements for development projects. The intent of NLRC is to finance the Project through private equity investment and bank debt facilities. A summary description of the proponents follows and is also available on the NLRC website, www.nlrefining.com.

Altius Resources Inc.

Altius is a Newfoundland and Labrador based company that was founded in 1997 and is primarily focussed on natural resource opportunities within Newfoundland and Labrador. It has a royalty interest in the Voisey's Bay nickel-copper-cobalt district, where metal concentrate production has recently commenced. It holds approximately 15% of Aurora Energy Resources Inc. and 30% of Rambler Metals and Mining plc. Altius is also included in a shortlist of candidates to participate in the financing of Newfoundland and Labrador Hydro's proposed Lower Churchill hydroelectric project.

Dermot Desmond

Mr. Dermot Desmond is the Chairman and founder of International Investment and Underwriting (IIU) based in Dublin, Ireland. This and other associated companies invest actively in a variety of businesses, including those involved in the leisure, technology, food, mining and transportation industries. Before forming IIU he worked with Citibank and the Investment Bank of Ireland and formed NCB, which became Ireland's largest independent corporate finance house. Mr. Desmond spearheaded the International Financial Services Centre, which now has over 400 companies operating in Dublin's docklands.

D.H.W (Harry) Dobson

Mr. Harry Dobson is a Scottish born entrepreneur and financier with extensive interests in the natural resources sector. He began his career in Australia and Canada and now pursues merchant banking and venture capital opportunities globally. He is actively involved with several companies that are exchange listed in Canada and/or the United Kingdom, including Kirkland Lake Gold Inc., Rambler Metals and Mining plc and Borders and Southern Petroleum plc. Mr. Dobson also has extensive investment property holdings throughout Europe, most notably in Ireland.

Stephen Posford

Mr. Stephen Posford is based in Britain and his early career included several positions within the financial sector in that country, specializing in the Gilt-Edged market (UK and Irish government bonds). He was the head of Greenwell Montague Gilt Edged before joining Salomon Brothers in 1989 and was the CEO of Salomon Brothers European operations when he retired in 1996. He is active now as a private venture capitalist and a corporate director.

3 THE UNDERTAKING

3.1 NATURE OF THE UNDERTAKING

3.1.1 Overview

Newfoundland and Labrador Refining Corporation proposes to construct and operate a new 300,000 barrels per day refinery that could be expanded to 600,000 barrels per day (bbl/d) at some future date, at Southern Head, between North Harbour and Come-by-Chance Bay, at the head of Placentia Bay, Newfoundland and Labrador.

The refinery will require a marine terminal, crude and product storage tank farm, as well as a new access road. The Project will process imported medium and heavy, high sulphur crude oils into fuel products suitable for the export market. The main products of this refinery will be gasoline, kerosene/jet fuel, and Ultra-low Sulphur Diesel with by-products including Liquefied Petroleum Gas (LPG - C3/C4), Sulphur and Petroleum Coke.

The Project will require a private capital investment in excess of $4.0 billion US for the construction of the facility. The facility will employ up to 3000 trades people during the 3 to 4 year construction phase and approximately 750 permanent staff during the operational phase. The project provides Newfoundland and Labrador with the opportunity to develop a petrochemical industry, provide a local market for offshore stranded gas and can form a key element in the future positive economic development of the Province.

The Project will take place in four stages: (1) pre-construction phase, including feasibility study, engineering, and environmental assessment; (2) construction; (3) operations; and (4) decommissioning. An overall policy of the Proponent is to meet or exceed applicable national and provincial standards and regulations and follow best practices in the industry.

3.1.2 Authorizations Required

The Project will require federal, provincial and municipal approvals and permits for various activities during construction, operation and demobilization. Anticipated approvals required are listed in Appendix A.

Approval and permitting requirements under provincial legislation and regulation will govern much of the physical activity at the site, from the environmental assessment process to activities such as site clearing, quarrying, road construction, bog in-filling, etc., through operations, such as for air emissions, and decommissioning. Government requirements and policy also affect socio-economic aspects of refinery construction and operation, such as occupational health and safety, training, and employment programs. A Historic Resources Impact Assessment will be conducted at Southern Head this fall.

Areas of the preferred site for the new refinery, including the wharf and jetty, are within the boundaries of the Town of Come-By-Chance. The Project will meet requirements of town by-laws. Available information is shown in Appendix A.

3.1.3 Public Consultations

NLRC has made efforts to ensure that information on the proposed refinery is readily available. Efforts include press releases at key milestones and a project website. In particular, Newfoundland and Labrador Refining Corporation has been working with communities in the project area for a number of months to ensure that residents are aware of the feasibility study and the study's findings. Tables 3-3 and 3-4 shows the community consultations and presentations held to date on behalf of the proponent. NLRC and their representatives have also met with various federal and provincial agencies to discuss the proposed project and obtain guidance on regulatory approvals and processes. Meetings with government representatives and either NLRC or its engineering or environmental consultants are shown in Tables 3-1 and 3-2.

The Proponent has established effective working relationships with communities in the project area. Public consultations will continue throughout all stages of the project and form the basis for monitoring.

The framework identifies the various stakeholders and the means and materials to allow for effective and timely information flow between the public and the Project.

Table 3-1: Initial Meetings & Discussions with Provincial Government Agencies

Date	Government Department	Key Points & Issues
June 12, 2006	NL Department of Environment and Conservation and Canadian Environmental Assessment Agency (CEAA)	• Project is subject to both the federal and provincial environmental assessment processes. Allow for differing time frames in the initial steps in each process to assist in informal coordination of the two processes.
June 30, 2006	NL Department of Environment and Conservation, Pollution Prevention Division	• Best Available Control Technology (BACT) will be required. • Air emissions: air dispersion model used by the Proponent must be approved. • Oil spill regulations are outdated: Proponent must consider spill prevention as well as spill response preparedness. • The National Framework for Petroleum Refining Emissions Reduction (CCME) can be used as a guide in terms of comparing the new refinery with the rest of the country. • Flaring should only be used in emergences. • Water supply: Proponent must ensure water supply is adequate.
July 7 , 2006	NL Department of Environment and Conservation, Wildlife Division	• Wetlands: minimize impacts. • Riparian buffers must be established and maintained. • Eagle nest sites should be identified and monitored. • Rare flora and fauna surveys will be necessary: *Erioderma pedicellatum* has been found in the general area.
August 10, 2006	NL Department of Natural Resources	• Air emissions and public health: these continue to be the main topics of discussion between the existing refinery and surrounding communities. • Species at risk is an important aspect of the EA process.
August 11,	NL Department of Environment and	• Infilling of any water bodies including

Date	Government Department	Key Points & Issues
2006	Conservation, Water Resources Division	marine infilling: require permits. • Water supply/use: Proponent must provide a good level of detail regarding water needs/use in the registration, separating domestic and industrial needs. • A water rights licence will be required.
September 21, 2006	NL Department of Fisheries and Aquaculture	• Alien / invasive species are of concern • Increased traffic may affect the availability of aquaculture sites and affect insurance rates • Increasing level of tanker traffic means an increased risk of an oil spill
September 26, 2006	NL Department of Natural Resources	• Interest in local benefits of project • Existing SO2 Caps must be considered in project design
September 26, 2006	Rural Secretariat	• How will the Project meet requirements for skilled labour for construction and for operations • Regional Councils are preparing communities to be able to better assess development opportunities and make informed decisions (i.e. they want jobs but not at any cost)
September 26, 2006	NL Department of Transportation	• A new interchange has been designed to service the communities of Sunnyside and Come By Chance (could accommodate new refinery as well) • Construction would take between 3 to 4 months
September 28, 2006	NL Department of Innovation, Trade and Rural Development	• Potential second refinery could be a catalyst for expansion of existing small business capability and the encouragement for new companies in the area
October 4, 2006	Women's Policy Office	• Project should address: wage gap, specificity of positions available for women, federal equity guidelines, develop a Women's Employment Plan and seek to implement family friendly policies
October 11, 2006	NL Department of Business	• Potential for growth of service industry in the area with a second refinery

Table 3-2: Initial Meetings & Discussions with Federal Government Agencies

Date	Government Department	Key Points & Issues
August 10, 2006	Department of Fisheries and Oceans, Canadian Coast Guard	• Vessel Traffic Management; changes may be necessary to the current management system • Loss of fishing grounds: if additional anchorages are required, this area will be lost to fishing. • Labour force availability.
August 15, 2006	Department of Fisheries and Oceans, Habitat and Environmental Assessment and Major Projects	• No net loss of habitat policy will apply to both freshwater and marine Project work: any in-stream survey work for fish habitat characterisation and quantification must be completed before mid-September
August 16, 2006	Environment Canada	• Cumulative effects (air emissions, vessel traffic, labour force availability): CEAA website offers guidance regarding addressing cumulative effects • Air emissions and community health will likely be an issue for public. • Labour force availability: will the work force for Newfoundland and Labrador be sufficient to construct and operate a new refinery, especially senior staff. • Hazardous Waste management must be addressed. • The power supply should be included in Project Description. • EC (Ottawa) and CPPI are working on a Refinery Emissions Reduction initiative that would set regional, sector specific targets.
August 23, 2006	Department of Fisheries and Oceans, Habitat and Environmental Assessment and Major Projects	• Minimize the amount of freshwater that needs to be used for the project. This reduces the effects on habitat and HADD and compensation needed. • A strategy for habitat compensation must be provided in the EA under the CEAA process. • A detailed fish habitat compensation plan will have to be developed in order to obtain authorisation to proceed.
August 30, 2006	Transport Canada	• Transport Canada will be a Responsible Authority (RA) in the assessment. • Transport Canada has to be made aware of all stream crossings, bridges, etc. associated with the project. • TERMPOL review: may be more than one review under way at the same time in the

Date	Government Department	Key Points & Issues
		same area – will need to be some coordination between projects. • Vessel traffic management issues will include: the number of anchorages in Placentia Bay; approaches to Placentia Bay; holding patterns, delays, weather, number of pilots, increased vessel traffic, manoeuvrability of vessels, risk assessment, vessel vetting process to be used. • The problems will not be in the traffic lanes themselves but at either end, i.e. the mouth of the Bay during weather delays and the head of the Bay, with manoeuvrability and anchorages. • Oil spill response preparedness: there are concerns from residents regarding the adequacy of the level of oil spill response preparedness in the Bay. and required by regulation.
September 14, 2006	Canadian Environmental Assessment Agency (CEAA)	• RAs self identify within 30 days of Project Description submittal

Table 3-3: List of Meetings / Visits to Communities and Organizations in the Study Area by NLRC (between February and April 2006)

Town / Organisation or Community	Individuals/Groups Met
Arnold's Cove	Town Manager, Wayne Slade Deputy Mayor Herb Brett Meeting with Town Council Long Term "2020" Planning Session for Town of Arnold's Cove at invitation of Deputy Mayor
Come By Chance	Town Manager, Brenda Mulrooney, Mayor Joan Cleary and Deputy Mayor Reg Bungay
Sunnyside	Town Manager, Phil Smith Robert Snook, Town Councillor
Southern Harbour	Town Manager Bernadette Power Mayor John Penney
Little Harbour	Local Service District and community representative for Trinity Placentia Development Association Solomon Upshaw Local Service District Blanche Upshaw
Garden Cove	Chair of Local Service District Don Brinston, and members Stanley and Jean Wareham
North Harbour	Chair of Local Service District Earl Johnson and members Wesley

Town / Organisation or Community	Individuals/Groups Met
	Manning and Clarence Eddy
Swift Current	Chair of Local Service District Roger Beck and Chair of Trinity Placentia Development Association
Goobies	Chair of Local Service District Bill Goobies and member Sadie Goobies
Guest Speaker	Arnolds Cove Chamber of Commerce; Minster Ed Byrne was also a guest speaker
Tricentia Academy	Sandy Baker (Guidance Counsellor) and Russell Peddle (Principal)
Regional Advisory Committee (RAC) for Transport Canada	Earl Johnson
Marystown Town Council	Deputy Mayor Julie Mitchell of Schooner Development Board roundtable meeting chaired by Executive Director Paul McGinn
St. Lawrence Town Council	Mayor Wade Rowsell
Newfoundland and Labrador Environmental Association and Regional Advisory Committee (RAC) for Transport Canada	Stan Tobin
Executive Director of Avalon Gateway Development Corporation and Chair of Placentia Bay Integrated Management Planning Committee	Calvin Manning
One Ocean and Marine Institute	Maureen Murphy
North Atlantic Refining Ltd.	Gloria Warren-Slade, Communications Director

Table 3-4: List of Meetings by NLRC between April and October 2006

Date – 2006	Organization	Person
April 27	Bull Arm Site	Joan Cleary, CEO
May 01	Discovery Regional Economic Development Board	Jeff Green
May 01	Dept. of Industry, Trade and Rural Renewal	Dennis Sullivan
May 03	ACOA and Schooner Regional Development Board for tour of Mortier Bay/Marystown	Representatives
May 04	Town council offices of Come By Chance and Arnold's Cove	Councils to meet potential investors
May 31	Interim Placentia Bay Integrated Management Planning Committee Meeting	Representatives for presentation

Date – 2006	Organization	Person
May 31	Tricentia Academy	Level 3 students for prevention on career information with Project Manager Kjell Rustad
June 05	Arnold's Cove Chamber of Commerce	Dinner meeting
June 09	Tricentia Academy	Students and NFFAW for Fisheries Stewardship/Lobster Conservation Day
June 28	Clarenville	Chamber of Commerce Presentation
June 28	Clarenville	Town Council meeting
June 28	Clarenville	Clarenville-Bonavista Rural Secretariat
June 29	Placentia	Bill Hogan, Mayor of Placentia (by phone)
June 29	Argentia	Placentia Marine Traffic and Communications Services centre meeting with staff
June 29	Joint Councils of the Isthmus	Presentation to Joint Councils on the Isthmus (representing communities from Markland to Sunnyside
July 08	Arnold's Cove	Transport Canada's Oil Spill Risk Assessment public meeting
September 01	Marystown	Meeting with ACOA and PKS Kiewit
September 19	One Ocean	Maureen Murphy
September 25	Come-By-Chance Chamber of Commerce	Annual Dinner / Meeting
October 7	Women in Resource Development Committee (WRDC)	Maria Moran, Industrial Outreach
October 8	Icewater Seafoods Ltd.	Bruce Wareham

3.1.3.1 Communities and Interest Groups

Newfoundland and Labrador Refining Corporation (NLRC) strongly believes that the communities and industries of Placentia Bay should have timely and accurate information about the proposed refinery project. The founding shareholders of the Corporation believe that early and sustained communication with people in the area that may be affected by a major development is a priority.

People should be able to access information that is important to them and NLRC can, in turn, gain important local knowledge and expertise from people who live and make their livelihoods in the project area. To this end, senior members of the NLRC project team have spent considerable time in the communities in the immediate

project area since the decision and announcement of the refinery feasibility project in early 2006.

NLRC met with communities in the immediate vicinity of the project area prior to and following the announcement of the feasibility study for a second refinery in the Province of Newfoundland and Labrador (see Tables 3-1 to 3-4). NLRC intends to continue to work to maintain an effective information and consultation process with communities and key interest groups in the project area.

Informal visits and meetings have been held between NLRC and the mayor and councils, and development associations of Arnold's Cove, Come-by-Chance, Sunnyside, Southern Harbour, Little Harbour, Garden Cove, North Harbour, Swift Current, Goobies, St. Lawrence, Marystown and Clarenville.

As well, NLRC has met with representatives of key groups such as the Placentia Bay Integrated Management Planning Committee, Tricentia Academy, One Ocean, North Atlantic Refining Ltd. and the Regional Advisory Council on Oil Spill Preparedness. NLRC will also approach other existing groups such as the Placentia Bay Traffic Committee; Fish, Food and Allied Workers; the Newfoundland Aquaculture Industry Association; and the regional Canadian Marine Advisory Committee to exchange information (see Tables 3-3 and 3-4).

In addition to the face-to-face meetings and presentations, NLRC has also established a website to provide up-to-date information about the Project (www.nlrefining.com) and issues press releases at milestone points in the feasibility study.

Once the Project Registration has been submitted, NLRC will host additional information and consultation sessions in the project area and possibly other locations in order to provide project information to the interested public and to seek their input to issue scoping and to define Valued Ecosystem Components for the project environmental assessment.

NLRC's policy of effective and sustained communication with people in the area that may be affected by a major development will continue to be implemented throughout

all phases of the Project, from feasibility study through environmental assessment, construction, operations and decommissioning.

While informal communication will be ongoing and project information will be provided on the website, specific information and consultation efforts will be made at milestone points in the Project, such as following the Registration of the Project as part of ensuring timely and accurate information about the proposed refinery project.

Public consultation by the Proponent will include individuals, groups and agencies outside government. Examples are the fishing industry, environmental associations, businesses and industry, women's groups, aquaculture industry, development associations, and education and training institutions.

3.1.3.2 Government Agencies

NLRC initiated their assessment of the feasibility of a second refinery in the Province in consultation with senior levels of the provincial government and communities. As the feasibility study advanced and the decision was made to proceed with an environmental assessment of the proposed refinery, a series of meetings with federal and provincial regulatory agencies was initiated.

The objective of the meetings was to introduce the proposed project and project schedule and to seek early guidance as to the issues, concerns and data gaps that should be addressed.

The first meeting was with the senior officials involved with the environmental assessment processes for the Canadian Environmental Assessment Agency (CEAA) and the Province of Newfoundland and Labrador. The project will be reviewed under both processes and NLRC sought guidance as to practical ways to assist in coordination of the two processes. An immediate action suggested was earlier submission of a Project Description to CEAA to account for the longer initial review period required under the CEAA process.

Initial meetings with the following federal groups and agencies have been held:

Federal Departments and Agencies:

- Fisheries and Oceans Canada
  - Canadian Coast Guard
  - Environmental Assessment and Major Projects
  - Habitat
- Transport Canada
  - Environmental Assessment
  - Navigable Waters Protection Act
- Environment Canada
  - Environmental Protection
  - Emergency Response
  - Canada Wildlife Service
- Canadian Environmental Assessment Agency

Initial discussions have also been held with several of the key provincial government agencies and these continue to be scheduled. Meetings have been held with:

- Department of Environment and Conservation
  - Pollution Prevention
  - Environmental Assessment
  - Water Resources
  - Wildlife
- Department of Natural Resources
- Transportation and Works
- Fisheries and Aquaculture
- Innovation, Trade and Rural Development
- Rural Secretariat

- Tourism, Culture and Recreation
    - Provincial Archaeology Office
- Women's Policy Office
- Business

and are being scheduled with:

- Human Resources, Labour and Employment
- Education
- Health and Community Services

Initial discussions with government agencies have already served to identify key issues and field studies, several of which have been underway since July 2006.

3.1.4 Preliminary Issues Scoping

Tables 3-1 to 3-4 provide lists of meetings and visits with various stakeholders, including government departments, communities, NGO's and others. The following is a summary of key areas of interest and issues identified to date. Initial discussions have not yet been held with all pertinent agencies and groups. The issues list will be updated accordingly.

- Communities in the Project area are generally positive about the potential economic benefits of the refinery. Local businesses are interested in having a preferred status for site opportunities. The Proponent is addressing this during current procurement activities and will follow up with communities on this suggestion.
- Communities also remember the early operations at the existing refinery when extensive emissions from the refinery caused odour, pollution and health concerns. They do not want these to happen again. Concerns about long term health implications still exist among some residents in surrounding communities. Environment Canada and the Provinces have also identified air emissions and

public health as an issue. In consultation with the Department of Environment and Conservation, the Proponent will be commissioning site-wide air dispersion modelling as input to refinery engineering design - this same modelling will also provide a basis for both compliance and effects monitoring during operations. Additional information about air dispersion modelling is found in Section 4.4.6. As well, NLRC is working with Memorial University's Health Research Unit to develop a health profile for communities in the general project area.

- There is concern voiced around the Bay about increases in the level of vessel traffic - a frequent comment is '... the Bay is busy enough now'. However, experienced members of Transport Canada and Canadian Coast Guard suggest that the traffic can be managed, perhaps with changes to the existing system. An ongoing oil spill risk assessment commissioned by Transport Canada in 2005 and due to be completed this fall, will provide additional information to help address this concern. The Proponent plans to work with existing committees and councils in place to address vessel traffic, such as the Placentia Bay Traffic Committee chaired by the Canadian Coast Guard.
- As well, the Proponent will request review of its marine facilities and plans for shipping under the TERMPOL process which reviews operational safety aspects of the project. (http://www.tc.gc.ca/MarineSafety/TP/Tp743/menu.htm)
- Fish harvesters contacted to date are also concerned about the potential loss of fishing grounds, in particular if additional anchorages are necessary. The Proponent is designing the marine terminal and tankage to ensure there is adequate capacity at the refinery site to minimize use of the anchorages.
- An issue of concern, associated with the vessel traffic, is the level of oil spill prevention and response preparedness in the Bay. Transport Canada, the agency responsible for the oil spill regime in Canada, has contracted for an oil spill risk assessment and the results are expected to be available this fall (2006). The results of the risk assessment will be used by Transport Canada to determine if changes to the regime are needed. The Proponent has committed to addressing this concern (see Our Commitment at the front of the document).

- Environment Canada identified the need to address cumulative effects, identifying both air emissions and vessel traffic. For example, the additional traffic from the proposed new refinery will add to that associated with, the existing operations at the refinery and transshipment terminal plus potential new projects such as the INCO hydromet nickel plant in Long Harbour to the south and east of the new refinery and other possible ventures, such as in aquaculture and LNG transshipment. It must be recognized that the effects of activities from one project may interact with others to cause aggregate effects that may differ in nature or extent from the effects of individual project activities.
- Concerns have been raised over the potential interference of increased vessel traffic with aquaculture sites around the Bay.
- Considering the potential development of several large-scale projects in this province in the upcoming years, questions have been raised over the availability of the necessary skilled workforce. The Proponent has scheduled an initial meeting with two of the Province's ongoing initiatives to address the shortage of skilled labour, the Skills Taskforce and the Labour Market Development Strategy. The Women's Policy Office provided several examples of innovative approaches to training being used in other projects in the province.
- The Project has been encouraged to develop a Women's Employment Program to ensure equitable participation by women in this project. Such a program would address concerns, such as opportunities available for women, wage equity, the specificity of positions available for women, and the implication of federal equity guidelines. NLRC will consult with various organizations on the development of 'family friendly' policies for the project.

In the process of scoping the potential environmental effects arising from the project and associated activities, parts of the local environment that are valued due to their ecological, scientific, cultural, socio-economic or aesthetic importance have been identified. These features of the environment that are considered to be important by the proponent, members of the public, scientists and government agencies involved in the environmental assessment process can be considered as Valued Ecosystem

Components (VECs). Within the context of this project, both bio-physical and socio-economic VECs will be considered.

VECs for the refinery will be determined based on scoping with government agencies, input from residents of the communities in the area, the experience of consultants, and through the comparison of VECs selected in similar assessments previously completed in Atlantic Canada. The suggested VECs will be confirmed following open houses, public consultations and review of the Project Description and Registration.

3.2 RATIONALE FOR THE UNDERTAKING

Worldwide there is a shortage of crude oil refining capacity. Hurricane damage to the Gulf cost refineries last year dramatically demonstrated the vulnerability of the oil product supply market in North America.

Crude oil is a global commodity and the world market will move quickly to fill the gap in refining capacity. Feasibility and market studies have confirmed that there is a time-limited opportunity for the development of a new refinery within the Placentia Bay region. The timeline proposed for the refinery project will ensure that Newfoundland and Labrador is in the forefront of efforts to provide the needed refining capacity.

This project provides Newfoundland and Labrador with the opportunity to develop a petrochemical industry, provide a local market for offshore stranded gas and can form a key element in the future positive economic development of the Province of Newfoundland and Labrador.

As stated in the recent Energy Plan Discussion Paper by the Provincial Government and the Williams' election platform document, *Our Blueprint for the Future*, the Provincial Government has made a strong effort to attract and encourage investment in the oil and gas industry in this province. Strong commitments have also been made to expand the refining and petrochemical industry.

Considering Placentia Bay's strategic location on major international shipping routes, along with the Province's oil and gas expertise, the expansion of our oil refining capabilities will further enhance and strengthen the sector, leading to positive economic implications for the Province. Construction and fabrication during the construction of the refinery will provide opportunities for businesses and industry to acquire new skills and expertise, increasing the marketability of the province's infrastructure and workforce. The refinery itself will provide in the range of 750 permanent jobs, as well as indirect and induced employment. A second refinery would prompt spin-off opportunities in the region that would allow the creation and expansion of companies to supply goods and services to the petroleum industry.

Both the federal and provincial environmental assessment processes specify that the climate change implications associated with the proposed project be addressed.

The Province released a Climate Change Action Plan in 2005 that outlines a framework for climate change mitigation, including such efforts as equipment specifications and selection. The inventory of air emissions that will be done to support air emissions dispersion modelling for the new refinery will also include greenhouse gases, especially carbon dioxide. The refinery facilities will be designed for a 25 year life span and will incorporate climate change considerations, such as sea level change and increased frequency and severity of storms.

The proponent is also aware that the federal government is proposing a Clean Air Act and will monitor the implications for the refinery engineering and design.

The Province is moving toward establishing a Sustainable Development Act and issued a Discussion Paper and held pubic consultations over the past several months. While the proposed refinery is not intended to process the crude oil that is a non-renewable resource from the Province's offshore areas, the project is being developed in alignment with the intent of the Sustainable Development Act – to integrate social and environmental considerations into project planning.

4 DESCRIPTION OF THE UNDERTAKING

Sections 4.1-4.5 provide an overview of site selection; the biophysical and socio-economic environment; the construction, operation and decommissioning phases of the project; and information on the workforce.

4.1 PROJECT SITE INFORMATION

4.1.1 Overview

The Placentia Bay area is a very active location, with commercial fishing and fish processing, aquaculture, tourism, an oil refinery, an oil transhipment terminal, shipbuilding, offshore fabrication, passenger and cargo vessels and locations of ecological significance, such as the world renowned Cape St. Mary's Seabird Reserve.

Market studies have confirmed the economic basis for the development of a new refinery within Placentia Bay. Year-round access by road and sea; access to water depths of greater than 30 metres to accommodate very large crude carriers; enough available land for present needs and future expansion; and adequate water available to support processing were important attributes provided by the selected site for the refinery.

The presence of a skilled local workforce; established ice-free, deepwater shipping lanes; and proximity to both potential oil supplies and large markets for refined products along the east coast of North America and in Europe were also important attributes found within this region.

A Placentia Bay Integrated Management Planning Committee has been put in place over the last couple of years and a pilot project, SmartBay has been initiated to develop and implement an integrated electronic data and information management system for mariners. In addition, with recent real and proposed developments, such as the transhipment terminal and the VBNC proposed hydromet plant or smelter in Long Harbour, there has been considerable environmental research, field studies

and monitoring resulting in a good understanding of the socio-economic and biophysical environment.

4.1.2 Geographical Location

The Project, identified as the Newfoundland and Labrador Refinery Project (referred to in this document as 'the Project'), will be located at Southern Head, a peninsula between North Harbour and Come-by-Chance Bay at the head of Placentia Bay, Newfoundland and Labrador (Figure 4-1). Although there is considerable industrial infrastructure nearby in this area of Placentia Bay, Southern Head is a greenfield site, accessible only by boat. Information to date indicates that uses of the area is for limited recreational fishing and hunting occur on the peninsula (supported by a site visit September 8/06).

The land at Southern Head is Crown Land, owned by the Province, and has a temporary land freeze in place for this project. However, the marine facilities will extend below the high tide mark and be in federal jurisdiction. Figure 4-2 shows the land ownership map of the proposed project site and neighbouring industrial land use.

Placentia Bay was the focus for the site selection investigations. The strategic advantages of Placentia Bay include the presence of skilled local workforce; established ice-free, deepwater shipping lanes; and proximity to both potential oil supplies and large markets for refined products along the east coast of North America and in Europe.

The head of Placentia Bay (the innermost areas) already has significant infrastructure that is an integral part of the petroleum industry of Newfoundland and Labrador. A successful 105,000-barrel per day oil refinery operates near the communities of Come-By-Chance and Arnold's Cove. The complex includes one of the largest docks in North America and refines lower cost sour crude oil to produce premium refined petroleum products for markets around the globe.

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REV.	REVISIONS	REVISED BY	APP. BY	DATE
A	ISSUED FOR ENVIRONMENTAL REGISTRATION			06/09/08

NORTH

PROFESSIONAL STAMP

PERMIT HOLDER STAMP

BAE • NEWPLAN GROUP

BAE • NEWPLAN GROUP LIMITED
1133 TOPSAIL RD., MOUNT PEARL, NF, A1N 5G2
TEL: (709) 368-0118, FAX: 368-3541

CLIENT

NEWFOUNDLAND & LABRADOR REFINING CORPORATION

PROJECT

NEWFOUNDLAND & LABRADOR REFINERY

TITLE

REFINERY LAYOUT, ACCESS ROAD & ASSOCIATED MARINE FACILITIES

DESIGNED BY	CHECKED BY	DATE
DRAWN BY	APPROVED BY	DATE
SCALE AS SHOWN	BNG PROJ. No. 722649	
	CLIENT PROJ. No.	
DRAWING No. FIGURE 4-1		REV. A

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NORTH

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kilometres

NLRC Landfreeze
Hibernia Development Corporation
Newfoundland Transhipment Limited
LNG (pending)
Harvest Energy Trust
other

Waterbody
River / Stream
Topographic Elevation Line
Primary Access Route
Secondary Access Routes
Power Transmission Line
Loading Pier
Municipal Boundary

Goobies
TCH
Swift Current
Sunnyside Town Limits
Come By Chance Town Limits
Sunnyside
Come By Chance
North Harbour
Bull Arm
Haddock Cove
Sound Island
Come By Chance
Site A
Come-By-Chance Refinery
Site B
TCH
Arnold's Cove
Woody Islands
Placentia Bay

NEWFOUNDLAND & LABRADOR REFINING CORPORATION

PROJECT

Proposed Refinery Complex
North Harbour Area, NL

TITLE

SITE LOCATION & LAND OWNERSHIP
Placentia Bay, NL

DESIGNED BY	RC	CHECKED BY	KR	DATE	08-09-2006
DRAWN BY	RC	APPROVED BY	KR	DATE	08-09-2006
SCALE	1/100,000	BNG PROJ No.	722649		
		CLIENT PROJ No.			

DRAWING No. **FIGURE NO. 4-2** REV. **C**

Nearby is the Whiffen Head transhipment facility, which is owned by a consortium of major oil companies. The facility temporarily stores crude oil from producing fields in offshore Newfoundland and Labrador and makes shipments to oil refineries, primarily throughout eastern North America. The Bull Arm industrial site is located a few kilometres north (although facing another bay, Trinity Bay). The Hibernia gravity-based oil production platform was constructed and assembled at Bull Arm and is now producing oil offshore Newfoundland and Labrador. The Marystown Shipyard and adjacent Cow Head fabrication facilities located in western Placentia Bay continue to be an active service and supply centre for the province's offshore oil industry. As well, there is a potential industrial site at Argentia, the previous location of a USA military base.

Once the market studies confirmed the economic basis for the refinery, several sites in Placentia Bay were investigated. Attributes of importance in site selection for the new refinery included: year-round access by road and sea; access to water depths of greater than 30 metres to accommodate very large crude carriers; enough available land for present needs and future expansion; and adequate water available to support processing. There is a preference for a brownfield site (already with industrial activity ongoing or previous) to reduce environmental impacts and access to nearby industrial infrastructure.

The sites considered are:

- Expansion of the North Atlantic Refinery Site: Site selection was underway when the existing refinery was put on the market. The Proponent investigated the potential synergies between the existing operations and a new refinery; however, NARL was ultimately sold to a third party.
- Undeveloped land between the existing Come-By-Chance refinery and the transhipment terminal: Adequate land area, good potential synergies with neighbouring facilities and access to deep water; however, the land is presently under lease to Newfoundland Transhipment Limited. This would be the preferred site should this land become available.

- Southern Head: This is a green field site at the head of Placentia Bay, on a peninsula separating North Harbour and Come-by-Chance Bay. Road access would have to be created, but the site has adequate land, water resources and sites suitable for the wharf and jetty.

Two sites, Southern Head and the undeveloped land between the existing refinery and the transhipment terminal, have the preferred attributes. However, the undeveloped land is presently under lease to Newfoundland Transhipment Limited. Hence the preferred site for the new refinery is Southern Head.

4.1.3 Physical Environment

4.1.3.1 Geology & Surface Water

The general geology of the North Harbour area site for the proposed refinery complex consists mainly of bedrock and bedrock concealed by vegetation. The vegetation mat is developed on a thin layer of angular frost-shattered and frost-heaved rock fragments overlaying the bedrock; includes areas of shallow (less than 1 m), discontinuous overburden. There is also a small area of Colluvial deposit less than 1.5 m thick. Colluvium consists of coarse-grained bedrock derived materials, but may include sand, silt or clay, accumulates on the lower parts, or at the base of steep rock faces, transported by gravity (Catto et. el., 1998) (see Figure 4-3).

The project site area has one major drainage basin to the north of the proposed site that makes up the head waters for Watson's Brook. This basin drains most of the peninsula north of the project site from the high voltage transmission line south to Watson's Brook. This area has many small shallow ponds and streams that flow into this particular brook. To the south of the Watson's Brook drainage basin in the proposed project site, there are several small drainage areas that collect surface water and direct it toward the sea. There are only small quantities of surface water on the proposed project site outside of the Watson's Brook watershed. There is no specific data available on groundwater resources at this time, but given the geography of the area there may not be large quantities of groundwater available. Surveys are underway.

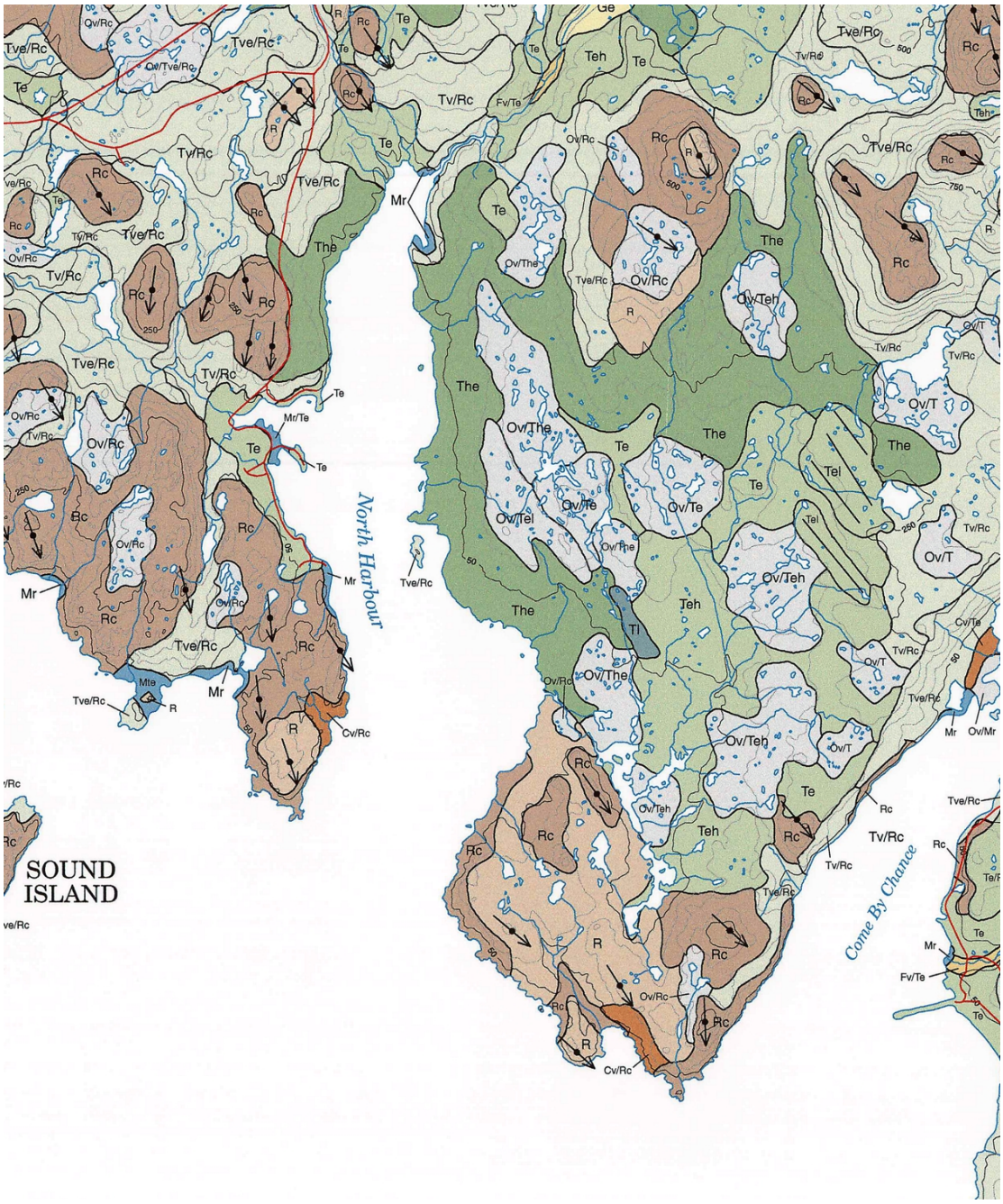


Figure 4-3: Surficial Geology of Study Area

4.1.3.2 Meteorology & Climate

The Atlantic Provinces have a climate that is heavily influenced by the ocean and predominating westerly winds resulting in relatively cool springs and summers and

relatively mild winters (Environment Canada, 1994). The climate of the study area is highly dependent upon its close proximity to water with Placentia Bay to the south and Trinity Bay to the North. During the winter months Trinity Bay is cooler than Placentia Bay due to the effects of the Labrador Current and Gulf Stream respectively. This close proximity to water has a mitigating effect on the climate of the study area, in particular temperature extremes.

Temperature

Newfoundland's temperature range (the difference between the average temperature of the warmest and coldest months) is 20°C with Come-By-Chance having a temperature range of 21.2°C. Daily maximum and minimum temperatures at Come-By-Chance during the period from 1971-2000 averaged –1.4°C to –7.1°C in February to 19 °C to 11.7 °C in August.

Winter temperatures in Newfoundland are characteristic of a stormy maritime climate due to its day-to day variability. Incursions of moist, mid Atlantic air are frequent. On the southeast coast, where the moderating influence of the ocean is greatest, the winter average is between -2°C and -4°C (Environment Canada, 2004).

Monthly air temperature statistics for Arnold's Cove are presented in Figure 4-4. These statistics are based on records from 1971 to 1994. As shown in Figure 4-4, mean air temperatures range from -5°C in winter to 15°C in summer. The daily maximum air temperature range from -1°C in winter to 19°C in summer. Temperatures as high as 11°C have been recorded in January and February (typically the coldest months) and extreme maximums of 28°C have been recorded in August.

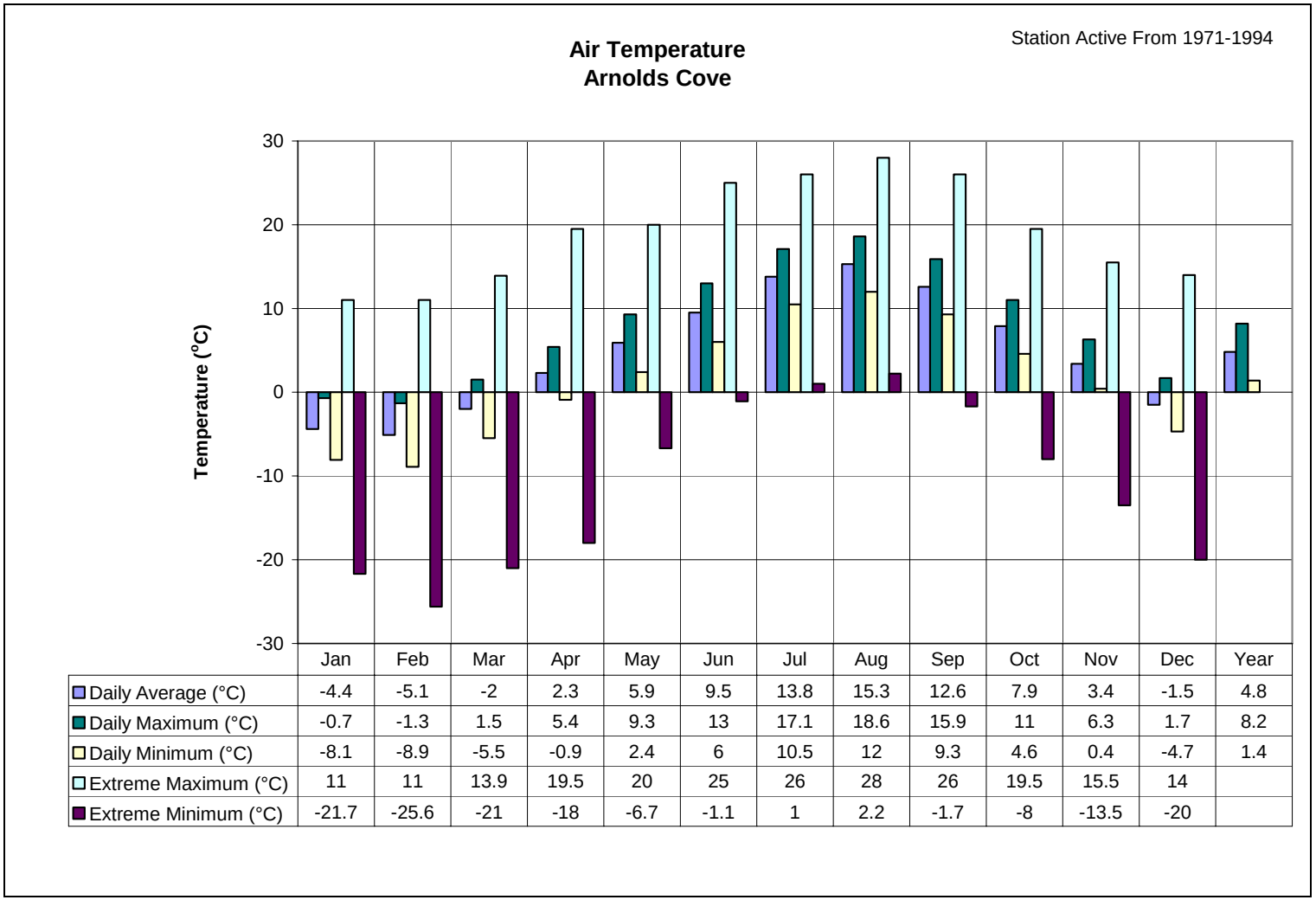
Precipitation

Figure 4-5 presents the precipitation statistics for Arnold's Cove. The average yearly rainfall (1971-1994) is 1,195 mm with 124.5 cm of snow. February is the most severe winter month with the minimum amount of rainfall (72.8 mm), the maximum snowfall (35 cm) with the highest daily extremes precipitation (108 mm).

Precipitation, in the form of rain, is heaviest during the fall in Newfoundland, with November being the wettest month. Snowfall dominates the winter precipitation, with normal amounts exceeding 300 cm in most place on the island (Environment Canada). Newfoundland also has the most frequent freezing rain storms in Canada. The area between St. John's and Gander usually has prolonged periods of freezing precipitation that lasts for several hours or intermittently for two to three days. This interrupts everyday activities and causes damage to trees and property. Freezing rain or freezing drizzle occurs an average of 150 hours each winter, with March being the worst month (Environment Canada, 2004).

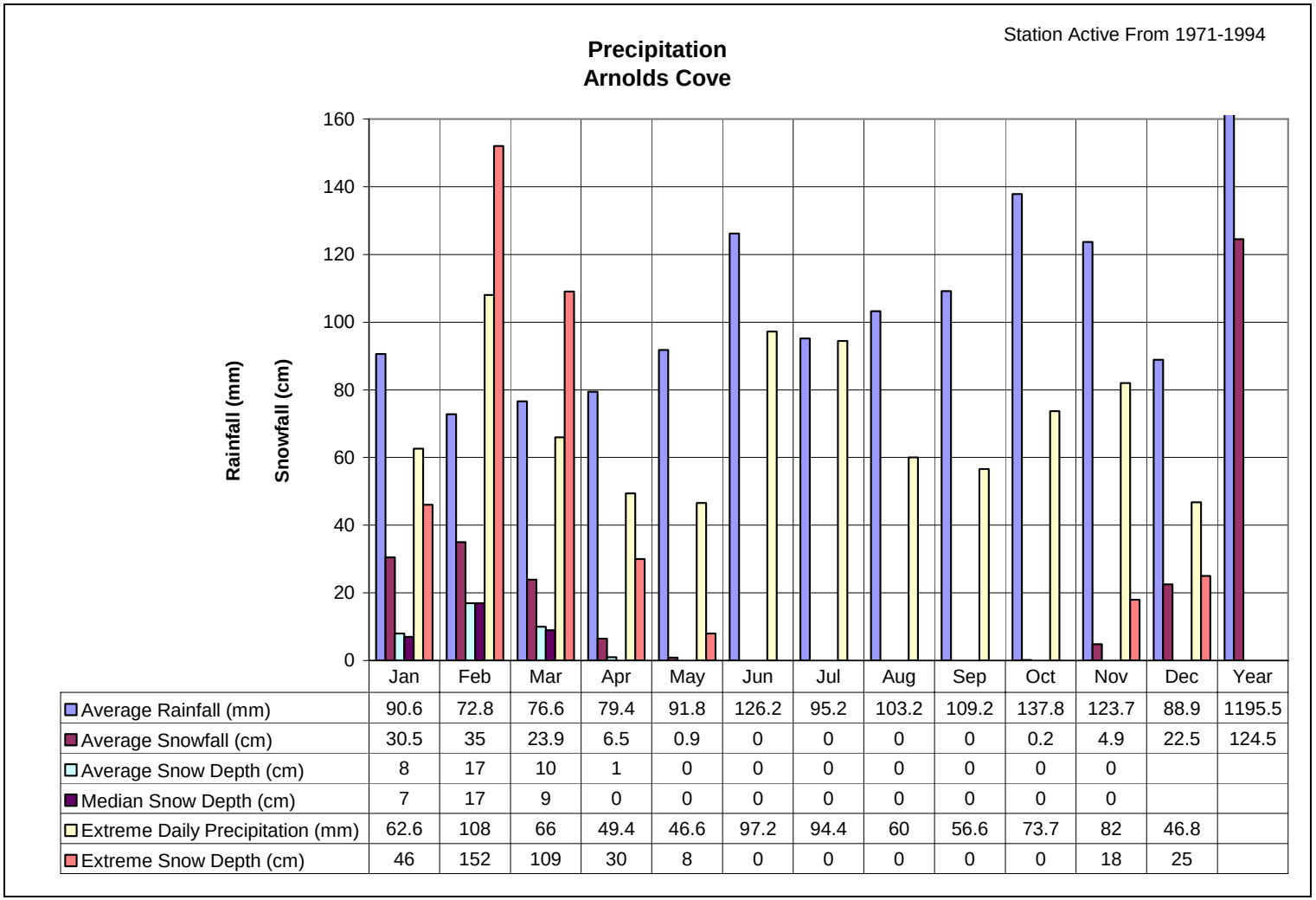
The waters of the Avalon Peninsula and the Grand Banks are among the foggiest in the world. Fog, which is prevalent in the Placentia Bay area, develops when warm humid air from the south strikes the cold waters of the Labrador Current. Although these fogs are most frequent during spring and early summer when the contrast between sea temperature and air temperature is greatest, anywhere between 5°C and 15°C, they can occur during any season. The Southeast Newfoundland climate is unusual because strong wind may accompany heavy fog (VBNC, 2006).

Figure 4-4: Air Temperature – Arnold's Cove



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Daily Average (°C)	-4.4	-5.1	-2	2.3	5.9	9.5	13.8	15.3	12.6	7.9	3.4	-1.5	4.8
Daily Maximum (°C)	-0.7	-1.3	1.5	5.4	9.3	13	17.1	18.6	15.9	11	6.3	1.7	8.2
Daily Minimum (°C)	-8.1	-8.9	-5.5	-0.9	2.4	6	10.5	12	9.3	4.6	0.4	-4.7	1.4
Extreme Maximum (°C)	11	11	13.9	19.5	20	25	26	28	26	19.5	15.5	14	
Extreme Minimum (°C)	-21.7	-25.6	-21	-18	-6.7	-1.1	1	2.2	-1.7	-8	-13.5	-20	

Figure 4-5: Precipitation – Arnold's Cove



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average Rainfall (mm)	90.6	72.8	76.6	79.4	91.8	126.2	95.2	103.2	109.2	137.8	123.7	88.9	1195.5
Average Snowfall (cm)	30.5	35	23.9	6.5	0.9	0	0	0	0	0.2	4.9	22.5	124.5
Average Snow Depth (cm)	8	17	10	1	0	0	0	0	0	0	0		
Median Snow Depth (cm)	7	17	9	0	0	0	0	0	0	0	0		
Extreme Daily Precipitation (mm)	62.6	108	66	49.4	46.6	97.2	94.4	60	56.6	73.7	82	46.8	
Extreme Snow Depth (cm)	46	152	109	30	8	0	0	0	0	0	18	25	

Wind

Newfoundland has the strongest winds of any province in Canada, with most stations recording average annual wind speeds greater than 20 km/h. Generally, coastal areas tend to have stronger winds than inland stations. Winds are predominately from the west year-round; however, variations are common both from month to month and location to location (Environment Canada, 2004).

Digital hourly wind speed and direction data have been obtained from the Meteorological Service of Canada (MSC) for the Arnold's Cove station from 11 July 1971 through 1 July 1993. Results are shown in Appendix D.

The monthly mean hourly wind speeds range from 17 km/h in July to 26 km/h in December. The lowest monthly maximum wind speed is 65 km/h in June and the highest is 93 km/h in December. In spring and summer, typical maximum values range from 72 to 80 km/h while fall and winter values range from 83 to 94 km/h. The upper 95% wind speed limit ranges from 30 km/h in July to 51 km/h in December.

The most predominant wind direction is from the southwest in most months. Annually 28% of the winds are from the southwest while 13 to 15% are from the northeast, northwest and south.

Wind roses for the area offshore Placentia Bay are shown in Figure 4-6 (Wind and Wave Climate Atlas, Volume 1 – The East Coast of Canada). The annual mean wind speed for the south east coast is 34 km/h with the prevailing direction being west. The maximum recorded wind speed in a gust is 147 km/h blowing from the west.

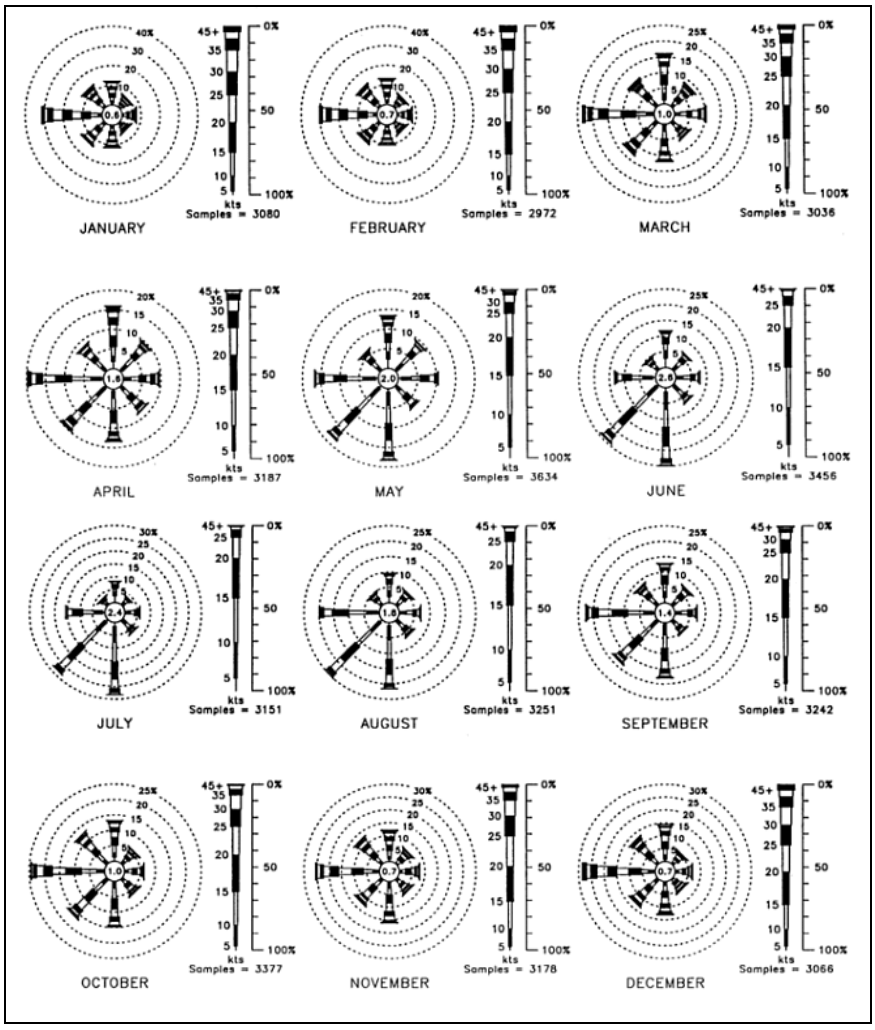


Figure 4-6: Monthly Wind Statistics for the South East Coast, Frequency of Wind Speed by Direction

4.1.3.3 Physical Oceanography

There are at least three water types found in Placentia Bay:

- a deep water layer with limited seasonal variation;
- a surface water layer with seasonal variability; and
- a surface/freshwater mixture which is seasonally variable.

A thermocline develops in the warmer months at a depth of 50 to 60 meters which results in a stable water column with little mixing in the summer. More extensive mixing occurs during the winter due to winter storms. The Western Channel have lower salinities than the Eastern Channel, the area around Come By Chance is influenced by the freshwater input from Swift Current, which is a major source of freshwater into Placentia Bay.

See Appendix D for additional information.

4.1.3.4 Bathymetry

Placentia Bay is a major embayment of the south coast of Newfoundland, bounded by the west by the Burin Peninsula and on the east by the Avalon Peninsula. The bay faces onto the western reaches of the Grand Banks of Newfoundland. The opening at the mouth of the bay is approximately 87 km wide, with a depth at the middle of approximately 240 m, shoaling towards the middle (Chevron et al., 1996). The distance, along the eastern shore, from the mouth of the bay at Cape St. Mary's to the head of the bay at Come By Chance is about 105 km, and along the western shore from the head of Ferryland to Come By Chance is about 143 km (Chevron et al., 1996). There are many islands and shoals located in Placentia Bay. The eastern half of the bay is characterized by a well-defined channel, Eastern Channel, with depths of approximately 200 m, which run from the mouth to almost the head of the bay. The western half of Placentia Bay is characterized by numerous banks, shoals and reefs. The top end of the bay contains many islands including Merasheen Island, Long Island and Red Island. Placentia Bay is exposed to winds, waves and currents propagating in from the Atlantic Ocean due to the orientation of its mouth (Chevron et al., 1996).

4.1.3.5 Current

Currents in Come By Chance Harbour have speeds in the range of 5 cm/s to 30 cm/s and are weak and variable. The general surface circulation pattern in Placentia Bay is counter-clockwise, with an inward flow along the eastern shore and southwesterly flow on the western shore. Measurements also indicate that current flow exhibits diverse directions at the head of the bay, near Whiffen Head (Chevron et al., 1996).

4.1.3.6 Tides

Tides in Placentia Bay are semi-diurnal with a typical mean tidal range of 1.6m and a large tide of 2.4m (Placentia Bay Hydrographic Chart 4839).

4.1.3.7 Sea Ice and Icebergs

Placentia Bay is generally ice-free and capable of year-round shipping operations. The maximum mean sea ice edge rarely (<15%) extends far into Placentia Bay (VBNC, 2006).

Icebergs are unlikely to drift to the head of Placentia Bay. Icebergs have been sighted in the Eastern Channel and near Argentia and are more likely to appear near the mouth of the Bay. Only once since 1960 have greater than eight icebergs entered the Bay - in 1961 32 icebergs entered. Most often there are no icebergs in Placentia Bay however, when they do drift in there are usually between one and three (Chevron et al., 1996).

4.1.3.8 Climate Change

Climate warming is expected to cause warming of the oceans and the partial melting of glaciers and ice-caps, resulting in global rise in sea level. By the end of this century, the global mean sea-level rise could amount to 0.09 to 0.88 meters (Intergovernmental Panel on Climate Change 2001 Natural Resources Canada Website). Sea level rise in Canada is a significant issue because the coastline exceeds 203,000 km.

See Figure 4-7 for a map showing the sensitivity of the coastlines of the south east coast of Newfoundland and Labrador to sea level, due to climate warming. Sensitivity here indicates the degree to which a coastline may experience physical changes such as flooding, erosion, beach migration, and coastal dune destabilization. It is measured by a sensitivity index, which is obtained by manipulating scores of 1 to 5 attributed to each of the seven values: relief, geology, coastal landform, sea-level tendency, shoreline displacement, tidal range, and wave height. This index is a modified version of the coastal vulnerability index of Gornitz (1990).

The blue-shaded area on the map shows the expansions of the submerging areas in Canada's coasts due to climate warming.

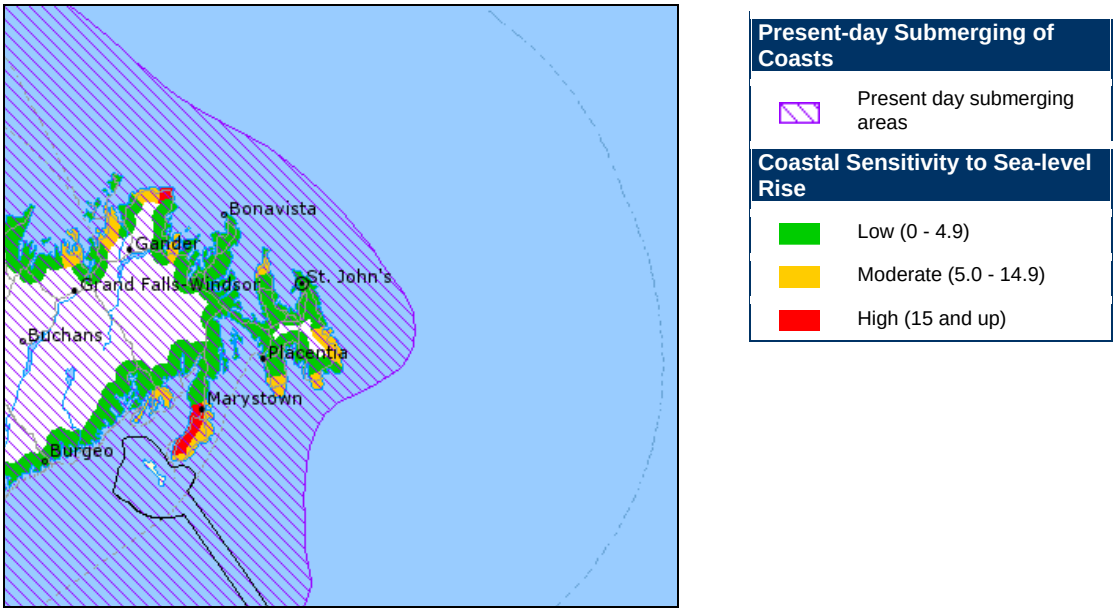


Figure 4-7: Coastal Sensitivity to Seal Level for South East Coast of Newfoundland and Labrador

Storm surges will cause more damage to the communities located close to the level of the ocean as sea level rises. Placentia, Newfoundland and Labrador is one of the communities that will be affected by this.

4.1.3.9 Effect of Physical Environment on the Undertaking

The physical environment will provide the dominant set of design criteria for the project and will govern the design of many aspects of the proposed facility. The area is subject to high winds, large amounts of precipitation both in the form of rain and snow, fog seasonally and cold temperatures seasonally. Seasonally the head of Placentia Bay can experience high winds that generate heavy seas with large waves. All structures either located on land or in the marine environment will be designed to withstand the maximum expected environmental loads with the appropriate safety factors to provide a robust design.

Measures will be taken to minimize the effect of the environment during the construction and operation stages of the project. The physical design of temporary structures for the aid of construction, will take into account winter conditions, maximum wind and wave action and extreme sea state. Construction activities will be scheduled to avoid environmental impacts if there is a safety concern. A local weather office and wind monitoring station will be established for major heavy lifts and for marine construction. The SmartBay project will also play a role in this process, by providing real-time water quality and oceanographic/meteorological information.

4.1.4 Biological Environment

This section provides an overview of the Placentia Bay biological setting including those species considered at risk by the Species at Risk Act (SARA) and the Provincial Endangered Species Act.

As a result of discussions with researchers and regulators familiar with the Placentia Bay area, the Proponent has initiated studies to address identified information gaps and needs. These include freshwater and marine fish habitat, seabird and marine mammal surveys and coastal surveys for shorebirds and waterfowl.

4.1.4.1 Terrestrial Mammals

Most species of terrestrial mammals are localized in the Placentia Bay area. Moose (*Alces alces*) were introduced to Newfoundland in the early 1900s and have since occupied most of the island. There is a moose population in the isthmus area of the Avalon Peninsula, and they tend to be most abundant in the areas supporting more protected boreal habitats, such as river valleys. Overall, the isthmus does not provide optimal habitat to moose because there are extensive areas of barrens and exposed bedrock. Their preferred habitat is coniferous forest, especially near swamps and lakes in areas of secondary growth (Northcott 1974).

Fubearers in the Placentia Bay area include beaver (*Castor canadensis*), American mink (*Mustela vison*), long-tailed weasel (*Mustela erminea*), red fox (*Vulpes vulpes*), lynx (*Lynx canadensis*) and muskrat (*Ondatra zibethicus*). Black bear (*Ursus*

americanus) have been sighted recently in the Southern Head area (O. Johnson, personal communication, 2006). Rodents, including domestic rats and mice, would be expected as well as meadow voles (*Microtus pennsylvanicus*), snowshoe hares (*Lepus americanus*), and masked shrews (*Sorex cinereus*). The river otter (*Lutra canadensis*), a species of particular interest in Placentia Bay, is discussed below.

4.1.4.2 Otters

An important mammal in the Placentia Bay area, traditionally considered a terrestrial species, is the northern river otter, which is a year-round resident. River otters in Placentia Bay are unusual because they spend a great deal of time in coastal marine environments (Petro-Canada 1980). In areas such as Long Island and Merasheen Island, they occur in relatively large numbers. They are known to range up to 60 to 70 km, and may even move between Placentia Bay and Trinity Bay. Adults breed inland or along watersheds of the marine islands and exploit coastal foods, including lobsters, flounder, cunners and herring. These otters are known for their relatively large size and diverse food habits (E.H. Miller, MUN, pers. comm.), and are the focus of significant traditional trapping harvest. There is little documented information on this species, and its concentrated populations in the Placentia Bay area.

Voisey's Bay Nickel Company are currently carrying out surveys for river otters in Placentia Bay, including parts of the bay near the refinery project area.

4.1.4.3 Marine Mammals

Thirteen species of marine mammals are known to occur in Placentia Bay, including ten species of whales and three species of seals. Several additional species may occur, but because of their rarity in the area are not considered in this document. Although most species are seasonal inhabitants, the waters of Placentia Bay and surrounding areas are important feeding grounds for some. Data on marine mammal abundance and distribution in Placentia Bay are lacking. Marine mammal data were collected in Placentia Bay in 1993 and 1994 (Marques 1996) but these data are limited in scope. Of the marine mammal species that are may or are likely to occur in Placentia Bay, only the blue whale and harbour porpoise are considered at risk under SARA.

The Proponent has commissioned seasonal surveys of marine mammal occurrence and abundance in the project area and around the vessel traffic lanes.

Mysticetes (Baleen Whales)

Five species of baleen whales or *mysticetes* occur in Placentia Bay including humpback (*Megaptera novaeangliae*), blue (*Balaenoptera musculus*), fin (*B. physalus*), sei (*B. borealis*), and minke whales (*B. acutorostrata*). Based on surveys conducted in 1993 and 1994, it appears that humpback, minke, and fin whales occur regularly in Placentia Bay and that sei and blue whales occur less frequently (Marques 1996).

Each summer, whales arrive in Placentia Bay in late spring or early summer and the more abundant species remain until September or October. They feed primarily on capelin, but also feed on krill, squid, herring, and sand lance. The whales follow the migration of capelin and are common around inshore Newfoundland during the summer. The arrival of capelin to the head of Placentia Bay generally occurs in June and July and it is likely that baleen whales are most abundant during these months. Most whales have moved offshore and have begun to migrate south by late October (Lien 1985).

Odontocetes (Toothed Whales)

Five species of *odontocetes* or toothed whales have been regularly sighted in the Study Area including harbour porpoise (*Phocoena phocoena*), long-finned pilot whale (*Globicephala melaena*), Atlantic white sided dolphin (*Lagenorhynchus acutus*), white beaked dolphin (*Lagenorhynchus albirostris*), and common dolphin (*Delphinus delphis*). It appears that harbour porpoise, Atlantic white-sided dolphin, and white-beaked dolphin are sighted more regularly in Placentia Bay than pilot whale and common dolphin. The harbour porpoise is considered of “Special Concern” by COSEWIC and has no schedule or status under SARA given the recent (April 2006) re-assessment by COSEWIC.

Most *odontocetes* occur seasonally in Placentia Bay and little is known regarding their distribution and population size. Some species may remain in waters of

southern Newfoundland throughout the autumn and winter, but the seasonal movement patterns of most species are unknown. Most toothed whales that occur in Placentia Bay are known or thought to eat squid, fish (capelin, cod, sand lance, herring, mackerel), and/or amphipods. It is likely that the distribution patterns of most *odontocetes* are related to the occurrence of their prey.

Phocids (Seals)

Three species of seals are known to occur in and near Placentia Bay including harbour (*Phoca vitulina*), grey (*Halichoerus grypus*) and harp seals (*Phoca groenlandica*). Little is known about their distribution and abundance within Placentia Bay. Harbour seals are year-round residents along the south coast of Newfoundland. In 1973, approximately 930 harbour seals were estimated to be present in coastal areas in St. Mary's and Placentia Bay (Boulva and McLaren 1979). Small numbers of harbour seals are known to breed on the Island of Miquelon, just south of Placentia Bay (Renouf et al. 1983). In general, harbour seals have a varied diet, including pelagic and demersal fish as well as cephalopods and crustaceans (see, for example, Boulva and McLaren 1979; Bowen and Harrison 1996).

Grey seals that may occur in the Placentia Bay area are migrants from the Sable Island and Gulf of St. Lawrence breeding populations. The number of grey seals that migrates into the Study Area is unknown, but is believed low. This species may occur in the Placentia Bay area year-round, but are thought to be most common in July and August (Stenson 1994). The food of grey seals in the western North Atlantic includes at least 40 species, some of which are commercially important (for example, Atlantic cod, herring, and capelin) (Benoit and Bowen 1990; Hammill et al. 1995).

Harp seals in Placentia Bay are migrants from the Gulf of St. Lawrence and the "Front" breeding populations. The number of harp seals that migrates into the Placentia Bay area is unknown, but numbers may be increasing as the range of this species appears to be expanding southward (e.g., McAlpine et al. 1999). Harp seals would likely be most common in autumn and winter as individuals summer in the Arctic. Harp seals eat a variety of prey; on the Grand Banks, capelin predominate,

followed by sand lance, Greenland halibut and other pleuronectids (Wallace and Lawson 1997; Lawson et al. 1998).

4.1.4.4 Birds

More than 70 species of birds regularly use Placentia Bay from the tidal zone to the offshore zone. Seabird breeding colonies are numerous on headlands and islands along the entire perimeter of the bay. Four seabird colonies rank as Important Bird Areas (IBA) (Table 4-1): Cape St. Mary's at the south east corner of Placentia Bay, and Corbin Island, Middle Lawn Island and Green Island off the southern Burin Peninsula. Cape St. Mary's supports the third largest Northern Gannet (12,156) colony in North America, third largest Common Murre colony (10,000 pairs) and fifth largest Black-legged Kittiwake colony (10,000 pairs) in Newfoundland and Labrador. Middle Lawn Island supports the only known active breeding colony of Manx Shearwater in North America. A significant portion of the world population of Greater Shearwaters spend the summer months moulting on the Grand Banks including Placentia Bay. The eastern half of Placentia Bay has been designated an IBA because of the large numbers of Greater Shearwaters (concentrations of up to 100,000) that occur in the summer. In winter, large numbers of Common Eiders winter at headlands, rocky islets and shoals in Placentia Bay. Cape St. Mary's supports the largest known concentration of wintering Harlequin Ducks in eastern North America.

The Proponent has initiated seasonal surveys of seabirds in the eastern areas of Placentia Bay, as well as waterfowl and shorebird surveys in the Southern Head area.

Table 4-1: Number of Pairs of Breeding Birds at Important Bird Areas (IBA) of Placentia Bay

	Cape St. Mary's, Avalon Peninsula	Middle Lawn Island, Burin Peninsula	Corbin Island, Burin Peninsula	Green Island, Burin Peninsula
Manx Shearwater	-	11 [4]		
Leach's Storm-Petrel	-	13,879 [3]	100,000 [2]	65,280 [3]
Northern Gannet	12,156 [1]			

	Cape St. Mary's, Avalon Peninsula	Middle Lawn Island, Burin Peninsula	Corbin Island, Burin Peninsula	Green Island, Burin Peninsula
Black-legged Kittiwake	10,000 [2]		50[2]	
Common Murre	10,000 [2]			
Thick-billed Murre	1,000 [2]			
Razorbill	100 [2]			
Black Guillemot	present	present	present	

Sources: [1] Chardine 2000; [2] IBA web site: www.bsc-eoc.org/iba/IBAsites.html; [3] Robertson et al. 2002; [4] Robertson 2002

Offshore Birds

Procellariiformes (fulmars, shearwaters and storm-petrels)

Northern Fulmar is a common species of the north Atlantic. Large numbers breed in the eastern Arctic and occur offshore Newfoundland in winter. However, relatively low numbers breed in eastern Newfoundland. Sub-adult Northern Fulmars remain in eastern Newfoundland waters through the summer. Northern Fulmar is expected to be present year-round in Placentia Bay, being less numerous in the summer months.

Three species of shearwater (Greater, Manx, Sooty) occur annually in Placentia Bay. The Manx Shearwater is the only species known to breed in Placentia Bay and Middle Lawn Island, off the southern Burin Peninsula contains the only known colony in North America. This European nesting species was discovered nesting at Middle Lawn Island in 1977. This satellite colony continues to maintain an existence. A census in 2000 resulted in totals of 11 active nests (Robertson 2002). The large number of empty nesting burrows (102) and the estimated 360 birds attending the island are indications the environmental conditions for breeding success are not optimal. In 2006, there were 13 nests with eggs or chicks (G. Robertson, CWS, pers comm.). Greater Shearwater and Sooty Shearwater breed in the Southern Hemisphere and spend the summer months in the Northern Hemisphere. A significant portion of the global population migrates to Newfoundland waters and occurs there from May to October (Brown 1986; Lock et al. 1994). Counts of 100,000 Greater Shearwater and numerous Sooty Shearwaters have been recorded

at the Cape St. Mary's area (P. Linegar, pers. comm.). Concentrations of spawning capelin are an important food source for shearwaters while moulting flight feathers during June and July.

Leach's Storm-Petrel is an abundant seabird in eastern Canada from April to October. More than three million pairs, greater than a third of the world's population breed on Baccalieu Island on the northeast Avalon Peninsula (Sklepkovych and Montevecchi 1989). Significant nesting colonies in Placentia Bay are located off the southern Burin Peninsula at Corbin Island (100,000 pairs), Middle Lawn Island (13,789 pairs) and Green Island (65,280 pairs) (Table 4-2) (Robertson et al. 2002). In addition, 100,000 pairs nest on Grand Colombier Island in the St. Pierre et. Miquelon Archipelago (Cairns et al. 1989).

Wilson's Storm-Petrels nest in the Southern Hemisphere and fly to the Northern Hemisphere from May to October. It is uncommon in southern Newfoundland waters, including Placentia Bay.

Table 4-2:
Significant Leach's Storm-Petrel Breeding Colonies in the Placentia Bay Area

Colony	Location	No. of Pairs	Census Year	Source
Corbin Island	46.97º N 55.22º W	100,000	1974	CWS data base
Middle Lawn Island	46.87º N 55.62º W	13,879	2001	Robertson et al. 2002
Green Island	46.52º N 56.05º W	65,280	2001	Robertson et al. 2002
Grand Colombier Island, St. Pierre et Miquelon	46.49º N 56.10º W	100,000	1989	In Cairns et al. 1989

Pelecaniformes (gannets)

Northern Gannet is the only member of this group to occur regularly in Newfoundland. There are six Northern Gannet breeding colonies in Canada. There are three in Quebec and three in Newfoundland. Cape St. Mary's is the largest of three Newfoundland breeding colonies containing 12,156 pairs in 1999 (Chardine

2000). This is about 51% of the total Newfoundland breeding population and 15% of the Canadian breeding population. Northern Gannets are common in Placentia Bay where they prey on capelin, herring, mackerel and squid throughout the area.

Phalaropodinae (phalaropes)

Two species of phalaropes occur regularly in the pelagic zones of Placentia Bay. Red Phalarope and Red-necked Phalarope use Placentia Bay to feed on zooplankton during spring and fall migrations and small concentrations can be expected in late May to early June and again from mid July to September.

Laridae (gulls and terns)

Four species of large gulls occur regularly throughout Placentia Bay. They are Herring Gull, Great Black-backed Gull, Glaucous Gull and Iceland Gull. Herring and Great Black-backed Gulls are common year-round residents. They breed on islands and headlands around the perimeter of Placentia Bay and forage in coastal and pelagic areas of the bay. Glaucous Gulls and Iceland Gulls breed north of Newfoundland and occur in Placentia Bay mainly during the winter season. Iceland Gulls outnumber the larger but similar plumaged Glaucous Gull.

Smaller gulls which occur in Placentia Bay include Black-legged Kittiwake and Ringed Bill Gull. About 10,000 pairs of Black-legged Kittiwake nest at Cape St. Mary's and a colony of 788 pairs nests on Goose Island near Arnold's Cove (CWS, unpubl. data, 2005); this species is a common year round resident in Placentia Bay. Ring-billed Gulls nest in several closely packed colonies around Placentia Bay including 992 pairs on Crawley Island and 304 pairs on Goose Island (CWS, unpubl. data, 2005). Ring-billed Gulls feed close to shore and in tidal areas and are less frequently encountered offshore.

Common Tern and Arctic Terns nest in numerous colonies of varying size around the entire coastline of Placentia Bay. Tern colonies were identified at 22 sites with an estimated 1,635 individuals during aerial surveys in 2005 by CWS. These aerial surveys only sampled a portion of the available nesting habitat in Placentia Bay. Additional tern breeding colonies are known to exist in Placentia Bay. Both species

are common near shore with smaller numbers occur offshore from late May to mid September.

Stercorariidae (skuas and jaegers)

There are two species of skua and three species of jaeger occurring in Placentia Bay and the North Atlantic. Great Skua and South Polar Skua occur in low densities in Placentia Bay from late spring to mid fall. The three species of jaeger, Pomarine, Parasitic and Long-tailed Jaeger nest in the Arctic and winter at sea in the middle latitudes. They migrate through Newfoundland waters in spring and fall. Non-breeding sub-adult birds summer south of the breeding range including Newfoundland waters. The jaegers occur in low densities in Placentia Bay from May to October. Pomarine is generally the most numerous species and Long-tailed the least numerous.

Alcidae (auks)

There are six species of auks in the North Atlantic. All of them are common during part of the year in Placentia Bay. Dovekie nests by the millions in Greenland, Iceland and Norway. Newfoundland waters, including Placentia Bay, are an important wintering area for the Dovekie (Lock et al, 1994). It is common in Placentia Bay from October to April. There are two species of murre: the Common Murre and Thick-billed Murre; one or both are common in Placentia Bay throughout the year. Ten thousand pairs of Common Murres nest at Cape St. Mary's (Cairns et al 1989). These birds use Placentia Bay as part of their feeding area during the breeding season. Common Murres from other colonies in eastern Newfoundland may be present in Placentia Bay during migration and winter. Thick-billed Murre is abundant during winter. Small numbers breed in Newfoundland but the majority of birds present during the winter season (October to April) are from large Arctic breeding colonies. Razorbill Murres are much less common than the other murre species. At least 100 pairs nest at Cape St. Mary's. The majority of the Razorbill population winters south of Placentia Bay, mainly in the Bay of Fundy and Georges Bank. Black Guillemot is a ubiquitous breeding and winter resident of the coastal zone area of Placentia Bay. Atlantic Puffin is a locally abundant breeder on the

eastern Avalon Peninsula. The closest known breeding population to Placentia Bay is the 400 pairs breeding on Grand Colombier, St. Pierre et. Miquelon. Atlantic Puffins are fairly common in Placentia Bay from May to October.

Near Shore and Tidal Zone Birds

Anatidae (geese and ducks)

Both diving and non-diving species of geese and ducks occur in Placentia Bay. Canada Goose, Black Duck, Northern Pintail and Green-winged Teal are the non-diving members of this group. They feed mainly in shallow fresh water but also in rich tidal areas. Arnold's Cove has designated full protection against hunting to a shallow tidal barachois where several hundred Black Ducks spend the non-breeding season. Smaller numbers of the aforementioned species may be found at variety of locations in coastal Placentia Bay, particularly during spring and fall migration. Diving ducks are more adapted to salt water conditions than non-diving waterfowl. Common Eider is a common winter sea duck in Newfoundland. Wintering concentrations of several thousand birds are known to occur at Cape St. Mary's, Virgin Rocks and several island locations off the Burin Peninsula. The eastern North American population of the Harlequin Duck is currently listed as a 'species of special concern' by COSEWIC. The largest concentration of wintering Harlequin Ducks in Atlantic Canada occurs at Cape St. Mary's. Up to 200 individuals wintered there in the winters of 2004/2005 and 2005/2006. Other species of sea ducks found regularly during the fall, winter and spring seasons in Placentia Bay are the three species of scoter (White-winged, Surf and Black), Long-tailed Duck and Red-breasted Merganser.

Gaviidae, Podicipedidae and Phalacrocoracidae (loons, grebes and cormorants)

Common Loon is a common breeder in inland Newfoundland and birds breeding near the coast will fly to sea to feed. Although there have been no official surveys for wintering loons, good numbers of common loon winter along the south coast of Newfoundland including Placentia Bay. Red-throated Loons breed north of insular Newfoundland but migrate through Newfoundland coastal waters in spring May and

June and in September and October. Red-necked Grebe is the only regularly occurring species of grebe found in Placentia Bay. The species nests in western Canada but there is a small, though relatively substantial wintering population on the southern Avalon Peninsula and Placentia Bay. There are two species of cormorant occurring in Atlantic Canada and both are locally common breeders in Placentia Bay. Double-crested Cormorants migrate south of Newfoundland in winter but the Great Cormorant is a year-round resident. Both species of cormorant nest in small isolated cliff side colonies on the eastern shore of Placentia Bay.

Accipitridae (Bald Eagle and Osprey)

One of the densest breeding concentrations of Bald Eagles in eastern North America is in Placentia Bay, Newfoundland (Dominguez 1998). The Wildlife Division of the NL Department of Environment and Conservation has conducted Bald Eagle surveys in Placentia Bay most years since 1983. Since the early 1990s, permanent survey plots in the area of high nesting density of Bald Eagles was established on Long Island, Merasheen Island, Ragged Island and a section of coastline along the adjacent western Placentia Bay. This area contains 20-30 active nests annually (J. Brazil, Department of Environment and Conservation, Wildlife Division, pers. comm.). Bald Eagles are year round residents in Placentia Bay. Osprey is less numerous than the Bald Eagle in Placentia Bay but occurs regularly from late April to September.

Charadriiformes (shorebirds)

There are seventeen species of shorebirds that occur regularly in Placentia Bay (Table All Species). Most of these are migrants from breeding areas north of Newfoundland. The largest numbers of shorebirds migrate through Newfoundland during the fall migration period from mid July to mid November when they feed in tidal areas. Come By Chance and Arnolds Cove are two of the more significant areas for shorebird migration. Concentrations of up to 200 shorebirds have been recorded at Arnolds Cove. Purple Sandpiper is the only shorebird that winters in Placentia Bay.

4.1.4.5 Benthos

Benthic communities within Placentia Bay vary with habitat type, especially as it relates to substrate characteristics and water depth. Flora of the rocky intertidal zone is typified by rockweeds (*Fucus spp*.) and knotted wrack (*Ascophyllum nodosum*). Intertidal fauna are characterized by gastropods (*Littorina obsusata*, *Thais lapillus* and *Skena planorbis*), bivalve mollusks (*Mytilus edulis, Volsella modiolus*), amphipods (*Hylae nilssoni, Gammarus accidentalis*), isopods (*Jaera marina*) and species of platyhelminthes, polychaetes, oligochaetes and copepods. Typical subtidal flora includes various filamentous algal and kelp species. Common benthic fauna in the subtidal zone includes various invertebrate groups including crustaceans (e.g., crabs, lobster), echinoderms (e.g., sea stars, sand dollars), and molluscs (mussels, scallops), and fish that live on the bottom (e.g., flatfish).

Some commercially important benthic species are discussed in the following sections.

4.1.4.6 Marine Finfish and Shellfish

Examples of the numerous species of finfish and shellfish occurring in Placentia Bay are indicated in the following Table 4-3:

Table 4-3: Fish Species: Groundfish, Pelagic and Shellfish Species in Placentia Bay (adapted from DFO 2003)

Common Name	Scientific Name
GROUNDFISH	
Atlantic cod	*Gadus morhua*
White hake	*Urophycis tenuis*
American plaice	*Hippoglossoides platessoides*
Lumpfish	*Cyclopterus lumpus*
Winter flounder	*Pleuronectes americanus*
Cunner	*Tautogolabrus adspersus*
Radiated shanny	*Ulvaria subbifurcata*
Arctic shanny	*Stichaeus punctatus*
Arctic eelpout	*Lycodes reticulates*
Ocean pout	*Macrozoarces americanus*
Wrymouth	*Cryptacanthodes maculates*
Sculpins	*Myoxocephalus* sp.
Skate	*Raja* sp.
Tomcod	*Microgadus tomcod*
Sea snail	*Liparis* sp.
PELAGIC FISH	
Sand lance	*Ammodytes* sp.
Smelt	*Osmerus mordax*
American eel	*Anguilla rostrata*
Brown trout	*Salmo trutta*
Atlantic salmon	*Salmo salar*
Atlantic herring	*Clupea harengus*
Capelin	*Mallotus villosus*
Atlantic mackerel	*Scomber scombrus*
Stickleback	*Gasterosteus* sp.
SHELLFISH	
American lobster	*Homarus americanus*
Blue mussel	*Mytilus edulis*
Scallop	*Placopecten magellanicus*
Snow crab	*Chionoecetes opilio*

Several of the finfish and all of the shellfish listed in the above table spawn in Placentia Bay. Commercially-important finfish known to spawn in Placentia Bay include Atlantic cod (Hutchings et al. 1993), capelin, lumpfish, and Atlantic mackerel.

4.1.4.7 Commercial Fisheries

Several species of finfish and shellfish are harvested commercially in Placentia Bay. Historically, prior to the moratorium, the inshore fixed-gear cod fishery dominated the catch landings (i.e., weight) and value (dollars). Since the moratorium, the importance of the cod fishery has been quite variable. Some years have been characterized by negligible landings while in others cod has accounted for the highest landings. In recent years, the catch value of the cod fishery has been rivaled by the snow crab. Other important commercial species include herring, lumpfish, lobster, white hake (*Urophycis tenuis*) and American plaice (*Hippoglossoides platessoides*).

There are several sites (e.g., Placentia, Merasheen Island) in Placentia Bay that support commercial or developmental aquaculture ventures. Blue mussels and Atlantic cod are the primary farmed species and most aquaculture sites are small, family-run operations.

See Section 4.1.5.12 and Appendix C for more information about the commercial fishery, including processing, and aquaculture.

4.1.4.8 Freshwater Resources

In the inner portions of Placentia Bay, lakes and ponds are numerous, and small watersheds drain the many catchments basins of this landscape. Larger watersheds support significant rivers that typically form bar lagoons (barasways) at the estuary, notably Come-By-Chance River, Arnolds Cove Brook, Southern Harbour Brook. The water in these bar lagoons is brackish and probably with seawater intrusion from Placentia Bay through the ‘gut’ and/or cobble ridge between the pond and the ocean, and by waves and spray overtopping the gravel bar during severe storms or high tide events.

Bar lagoons often support enriched habitats with flora and fauna associated with intertidal mud flats, eelgrass (*Zostera marina*), and saltmarsh (including *Spartina alterniflora*). Diverse invertebrates provide a food base for fish and waterbird

populations, for example, the large numbers of waterfowl using the Arnolds Cove 'sanctuary' area.

Atlantic salmon, an anadromous fish that live in freshwater rivers for the first two years of life before migrating to sea occur in Placentia Bay and its adjacent brooks and rivers. Lesser numbers of resident and anadromous brook trout (*Salvelinus fontinalis*) and catadromous American eel are present in these rivers.

Come-By-Chance River, Watson Brook, North Harbour River, Black River and Pipers Hole River are five of twenty scheduled salmon rivers in Placentia Bay. Come-By-Chance River has an established run of Atlantic salmon, and is the focus of a local angling tradition. This river accounts for annual salmon catches <1% of the total in Newfoundland. A management strategy has been adopted for the region based on a river classifications system where individual rivers are rated Class I (highest) to Class IV (lowest), according to their ability to sustain angling activity and retention. All rivers in Placentia Bay are classified as III or IV and, in 2006, seasonal bag limits are set at two salmon and hook and release, respectively (DFO 2006). The aforementioned rivers are classified as Class III, and generally report low annual catches.

Canada's Department of Fisheries and Oceans (DFO) has established a policy of no net loss of habitat, applicable to both the freshwater and marine environments. In recognition that development can and does affect environments, over the years, DFO has developed a mechanism to address this policy – Habitat Alteration, Disruption or Destruction (HADD). This policy requires characterisation of the habitat that is anticipated to be impacted before any development related work and an assessment of the impacts on that habitat: this provides the basis for habitat compensation.

The Proponent's representatives have met with DFO fish habitat and HADD implementation officials to begin to address HADD for the refinery Project. The necessary field studies have been initiated in order that a fish habitat compensation strategy can be described in the Environmental Assessment.

The methodology being used for the field program is as outlined in several key guidance documents developed by DFO:

- 'Standard Methods Guide for the Classification and Quantification of Fish Habitat in Rivers of Newfoundland and Labrador'
- 'Life History Characteristics of Freshwater Fishes Occurring in Newfoundland and Labrador with Major Emphasis on Riverine Habitat Requirements'
- 'Standard Methods Guide for the Classification/Quantification of Lacustrine Habitat in Newfoundland and Labrador'
- 'Life History Characteristics of Freshwater Fishes Occurring in Newfoundland and Labrador, with Major Emphasis on Lake Habitat Requirements'

DFO is currently developing comparable information for habitat classification in the marine environment and will provide information from this work to assist design of the marine habitat characterisation field program.

4.1.4.9 Species at Risk

One species of plant, six species of fish, four species of bird, two species of marine mammals, and one reptile species considered at risk by SARA are known to occur, or potentially may occur, in the Placentia Bay area (Table 4-4). Seven of these species are also protected under the Provincial Endangered Species Act (see Table 4-4). This list will be re-evaluated and monitoring of status reports and candidate lists by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), the authority recognized by SARA for assessing the status of species at risk in Canada, will occur on a regular basis.

Table 4-4: SARA and Endangered Species Act Listed Species Known or Potentially Occurring in the Placentia Bay Area

Species	SARA Status	Provincial Endangered Species Act Status
Boreal felt lichen (*Erioderma pedicellatum*) (Boreal population)	Schedule 1: Special Concern	Schedule C: Vulnerable
Atlantic salmon (*Salmo salar*) (Bay of Fundy)	Schedule 1: Endangered	Not Listed
Atlantic cod (*Gadus morhua*) (NL population)	Schedule 3: Special Concern	Not Listed
Northern wolffish (*Anarhichas denticulatus*)	Schedule 1: Threatened	Not Listed
Spotted wolffish (*Anarhichas minor*)	Schedule 1: Threatened	Not Listed
Atlantic wolffish (*Anarhichas lupus*)	Schedule 1: Special Concern	Not Listed
Banded killifish (*Fundulus diaphanous)*	Schedule 1: Special Concern	Schedule C: Vulnerable
Barrows Goldeneye (*Bucephala islandica)*	Schedule 1: Special Concern	Schedule C: Vulnerable
Harlequin duck (*Histrionicus histrionicus*)	Schedule 1: Special Concern	Schedule C: Vulnerable
Red Crossbill (*Loxia curvirostra percna*)	Schedule 1: Endangered	Schedule A: Endangered
Short-eared Owl (*Asio flammeus*)	Schedule 3: Special Concern	Schedule C: Vulnerable
Blue Whale (*Balaenoptera musculus*)	Schedule 1: Endangered	Not Listed
North Atlantic Right Whale (*Eubalaena glacialis*)	Schedule 1: Endangered	Not Listed
Leatherback Sea Turtle (*Dermochelys coriacea*)	Schedule 1: Endangered	Not Listed

The only remaining viable populations in the world of the Boreal felt lichen occur in Newfoundland, and especially the forests on the Avalon Peninsula. It is listed as Special Concern under SARA. It has been reported from stands in the Long Harbour area and in the southeast section of the Avalon Peninsula (E. Conway, pers. comm., 1997).

There are no known critical nesting, feeding, staging or over-wintering areas for bird species considered at risk in the immediate area of inner Placentia Bay. In the outer reaches of Placentia Bay, notably the area of Cape St. Mary's and Jude Island archipelagos, significant numbers of the listed (Special Concern) eastern population of Harlequin Ducks occur.

It is possible that several species of fish species considered at risk may occur in Placentia Bay. However, the most likely species to occur is the Atlantic cod (Special Concern).

The blue whale is listed under Schedule 1 of SARA. The DFO marine mammal sightings database does not have any records of blue whales in Placentia Bay but it is possible that they occur there (J. Lawson, DFO, pers. comm., 2006). Fin whales are under consideration for addition to Schedule 1 of SARA; this species occurs regularly in Placentia Bay during summer months. (J. Lawson, DFO, pers. comm., 2006).

Leatherback sea turtles are listed on Schedule 1 of SARA. This species is known to occur in Placentia Bay, primarily in the outer reaches of the bay.

4.1.5 Existing Socio-Economic Environment

The following sections describe the current socio-economic environment within the Study Area. Data collection and analysis was undertaken at three geographic scales:

- The Isthmus, Clarenville and Placentia/Argentia region within a 50 km radius of Come-By-Chance;
- The Avalon Peninsula, and
- The Province of Newfoundland and Labrador.

The focus of the analysis is on the Isthmus area, in particular Come-By-Chance, Sunnyside, Arnold's Cove, Southern Harbour and Little Harbour on the east side of the head of Placentia Bay as well as North Harbour, Garden Cove and Swift Current on the west side of the head of Placentia Bay. Data was gathered from secondary

sources including the province of Newfoundland's Community Accounts, the Internet and telephone interviews.

The proposed project has the potential to impact the socio-economic environment through employment, the purchase of goods and services, as a source of revenue for the three levels of government, through the use existing land and the need for municipal, provincial and federal infrastructure. While final VEC selection will follow public consultation and review of the Project Description/Registration, the following five key valued components have been suggested for use in the Project Registration:

- Demography,
- Economy and business,
- Employment and income levels,
- Land use,
- Municipal, provincial and federal infrastructure and services

4.1.5.1 Demography

The population of the Province has been declining since 1991. Between 1996 and 2001, it decreased 7%. This drop is attributable to a number of factors, primarily out-migration due to a lack of diversified employment opportunities in the province, particularly in the rural areas, as well as declining birthrates. Table 4-5 shows the population statistics (2001, 1996) for the 50 incorporated and unincorporated communities within the 50 km commuting area of Come-By-Chance.

Table 4-5: Population Change for the Communities in the Clarenville, Isthmus of Avalon, Placentia and Whitbourne/Blaketown Area, 1996-2001

Town	2001	1996	% change from 2001	Pop. loss
Clarenville Area				
Clarenville including all communities on Random Island except Britannia, Hickman's Harbour and Lower Lance Cove. Also includes communities from Milton to Waterville	5,670	6,245	-9.2%	-575
Shoal Harbour	1,330	1,120	18.8%	=210

Town	2001	1996	% change from 2001	Pop. loss
Hillview including Adeytown, Butter Cove, Caplin Cove, Deep Bight, Hatchet Cove, Ivany Cove, Long Beach, Queen's Cove, Southport, St. Jones Within and parts of Gooseberry Cove, Hodge's Cove and Little Heart's Ease	1,620	1,890	-14.3%	-270
Sub-total	*8,620*	*9,255*	*-6.9%*	-635
Isthmus of Avalon Area				
Swift Current	275	285	-4%	-10
Garden Cove	115	160	-28.1%	-45
North Harbour	290	315	-7.9%	-25
Come-by-Chance	385	440	-12.5%	-55
Sunnyside	470	620	-23.4%	-150
Arnold's Cove including Arnold's Cove Station	1,060	1,150	-7.8%	-90
Southern Harbour	590	635	-7.1%	-45
Little Harbour	150	175	-14.3%	-25
Chance Cove	335	395	-15.2%	-60
Tickle Harbour	N/A	N/A	N/A	NA
Fair Haven	120	145	-17.2%	-25
Bellevue	395	510	-22.5%	-115
Norman's Cove including Long Cove and parts of Thornlea	860	985	-12.7%	-125
Chapel Arm	500	575	-13%	-75
Long Harbour	265	345	-23.2%	-80
Mount Arlington Heights	N/A	130	N/A	N/A
Sub-total	*5,810*	*6,865*	-15.4%	-1,055
Placentia Area				
Placentia/Argentia	2,115	2,455	-13.8%	-341
Dunville	1,475	1,600	-7.8%	-125
Freshwater	750	945	-20.6%	-195
Jerseyside	520	590	-11.9%	-70
Ship Harbour	180	190	-5.3%	-10
Fox Harbour	345	395	-12.7%	-50
Sub-total	5,385	6,175	-12.8%	-790
Whitbourne/Blaketown Area				
Whitbourne	1,265	1,330	-4.9%	-65
Blaketown	560	585	-4.3%	-20
Sub-total	1,825	1,915	-4.7%	-90
Total	21,640	24,210	-10.6%	-2,570
Avalon Region	242,875	251,523	-3.4%	8,648
Province	512,930	551,795	-7%	-38,865

Source; Community Accounts, Government of Newfoundland and Labrador

Within a 50 km community range of Come-By-Chance are approximately 50 incorporated and incorporated communities. Between 1996 and 2001, the population

in this area dropped from 24,210 to 21,640, representing a 10.6% decline in population compared with a 7% population decline for the province as whole for the same time period. Eight communities including Come-By-Chance (Come-By-Chance, Sunnyside, North Harbour, Garden Cove, Swift Current, Arnold's Cove, Southern Harbour, and Little Harbour) are located on both the east and west side of the head of Placentia Bay. Between 1996 and 2001 the population of these communities dropped from 3,780 to 3,335 representing a decline of approximately 11.8% (445 people).

On the Isthmus of Avalon are a total of 16 incorporated and unincorporated communities . Between 1996 and 2001 the population of the Isthmus dropped from approximately 6,865 to 5,810, a decline of 15.4%. Thus, for the entire area, the population between 1996 and 2001 has been declining at more than double the rate of the province as a whole. The eight communities near and including Come-By Chance have declined less on a percentage basis than the total population of the 19 communities on or near the Isthmus of Avalon and the Placentia area, but more than the Clarenville area and Whitbourne/Blaketown.

On an anecdotal basis, the population decline of all 50 incorporated and unincorporated communities has continued since 2001, but until the 2006 census statistics are released, it will be difficult to determine the extent of that population decline. As discussed earlier, this population loss is attributed to lack of employment opportunities in the traditional industries (e.g. fishing and fish processing) as well as the closure of some of the larger industries in the immediate area (e.g. ERCO at Long Harbour, Bull Arm Fabrication Site) and the current draw of other better economies such as Alberta. The population loss is compounded by continuing declining birth rates. Unfortunate to any future industry in the area is that many of those who have out-migrated from the Isthmus area are skilled workers who may have worked at ERCO or the Bull Arm Fabrication Facility. This region of the province as well as the Conception Harbour area is known for its skilled trades' people.

Due to its more diversified economy, the Avalon Peninsula has experienced less of a population decline than all other areas of the province, losing only 3.4% of its

population during the 1996-2001 period. Out-migration from many of the smaller communities within the Study Area has occurred to other parts of Canada, but also to the St. John's region, thereby minimizing the overall population drop of the Avalon, although helping to maximize it within the Study Area.

4.1.5.2 Economy and Business

The following describes the baseline economic conditions of the three study areas.

Relatively speaking, Placentia Bay has considerably more industry (e.g. Whiffen Head, Come-By-Chance Oil Refinery, Marystown Shipyard and Cow Head Offshore Fabrication Facility as well as the industrial cluster at Argentia) than other parts of the Island of Newfoundland. Both the Marystown Shipyard and the fabrication facility as well as the Bull Arm Site are currently experiencing a slowdown, but the proposed VBNC nickel processing plant at Long Harbour will add to a positive economic industrial mix within the Placentia Bay region.

The Avalon Peninsula will continue to be the driving force in the province due to its diversified economic base and will lead the province in terms of business expansion and development. Housing investment in the province has been robust in recent years increasing 3.1% in 2005 although decreasing by 13% in actual units reflecting the higher valued houses and strong renovation spending, the majority of which has occurred on the Avalon Peninsula and, in particular, in the greater St. John's region. Housing starts, again primarily on the Avalon Peninsula and, in particular, the St. John's region, are expected to decline in 2006 with the pent-up demand for residential housing now satisfied. This should free up some of the province's skilled workers for other opportunities.

The province as whole has continued to do well primarily as a result of oil and gas revenues. In 2005, the GDP experienced a modest 1.7% growth in consumption, government spending, investment and exports, but it is expected to increase by 6.2% due to higher mineral and oil production. However, capital investment is projected to decrease by 6.9% to $4.0 billion as a result of completion of the very large Voisey's Bay and White Rose construction projects. In 2006 construction investment is projected to drop by 7.6% to $2.9 billion and non-residential spending is expected to

decrease by 10.7% to $1.9 billion, both due to declining mega-project investment and spending.

The majority of non-residential investment in construction (73%) was in mining and oil and gas industries. Current major projects underway in 2006 include refinery upgrades at North Atlantic Refining, Husky Oil capital expenditures, Iron Ore of Canada's multi-year capital investment program in Labrador West, Terra Nova and Hibernia capital drilling costs in 2006, ongoing Voisey's Bay mineral development expenditures in 2006, upgrades at both of Memorial's campuses (i.e. St. John's and Corner Brook) as well as significant investment in health care facilities in Labrador and Corner Book; infrastructure funding to municipalities, ongoing St. John's harbour clean-up and highway upgrade programs.

Natural resources continue to define this province's growth. Mineral exports including iron ore shipments will increase in 2006, but newsprint as a result of the Stephenville closure, tourism as a result of recent world airplane terrorism threats, manufacturing as a result of lower newsprint and the completion of the White Rose project are expected to decrease and fisheries landings will decrease as a result of lower crab quotas and, therefore, lower landings (Government of Newfoundland, Department of Finance, 2006).

4.1.5.3 Employment and Income

The provincial unemployment rate has dropped from 18.6% in 1997 to 15.3% in 2001 to 14.6% in 2006 while the size of the labour force has grown from 251,900 in 2001 to 369,400 in 2006. Labour participation rates rose during this period from 52.% in 1997 to 57.3% in 2001 to 62.12% in 2006 (Government of Newfoundland, Department of Finance). Table 4-6 and 4-7 shows selected statistics for population, income Levels, labour market and education for selected Communities on the Isthmus of Avalon using 2001 Statistics Canada Census data.

The provincial unemployment rate will continue to fall as more and more people leave the province. In fact, a current shortage of skilled labour for certain trades and professions currently exists in pockets of this province, notably in western Labrador and the Avalon region. If any of the proposed projects come to fruition, the province

and associated industries will need to escalate their recruitment efforts to attract many of our skilled workers and professionals back to this province.

The proponent is committed to the employment of residents of Newfoundland and Labrador. Pending approval of this project, hiring plans and policies will be put into place to ensure that first consideration for training and employment opportunities are to residents of this province. Initial meetings with key provincial initiatives addressing skilled labour supply in the province have been scheduled. See Section 4.6.1 for greater detailer.

Table 4-6: Population, Income Levels, Labour Market and Education for Selected Communities on the Isthmus of Avalon (2001 Statistics Canada Census)

	Come-by-Chance/Goobies		Sunnyside		Arnold's Cove		Southern Harbour		Little Harbour		Province	
Population												
Population	385		470		1,060		590		150		512,930 (521,986-2001)	
Population change (1996-2001)	-12%		-24.2%		-8%		-7.1%		-14.3%		-7%	
Age/Sex distribution	195(M)	185(F)	245(M)	230(F)	525(M)	530(F)	310(M)	285(F)	80(M)	65(F)	253,439 (257,177 2001)	262,522 264,809 (2001)
Less than 20 yrs.	21%		20%		20%		29%				25%	
More than 65 yrs.	14%		12%		16%		8%				12%	
Migration rate	-4.0%		-0.9		N/A		-15.3%		-6.6%			
Income levels												
Personal Income per capita	$20,900		$21,300		$21,400		$20,100		$20,400		$19,800	
Average couple family income	$57,600		$64,300		$64,700		$65,700		$51,200		N/A	
Employment Insurance Incidence	43.2%		48.2%		58.8%		70.8%		58.9%		37%	
Social Ass't Incidence	6.4%		10.4%		4.1%		3.1%		5.3%		13%	
Labour market												
Employment rate	77.8%		71.7%		81.7%		77.5%		72.0%		74%	
Change in employment	0.%		-6.7%		1.6%		-2.8%		-10%			
Education												
High school or above	61.7%		32.4%		47.1%		49.4%		46.4%		60%	
Bachelor's degree or higher	N/A		7.5%		5.0%		3.6%		N/A		13%	
Self-reliance ratio**	77.9%		77.7%		76.3%		61.5%		58.6%		77.0%	

Source: Government of Newfoundland and Labrador, Community Accounts
*Includes surrounding communities of Angels Cove, Cuslett, Great Barasway, Patrick's Cove, Point Verde and Ship Cove
**A measure of community's dependency on government transfers (e.g. Canada Pension, Old Age Security, employment Insurance, social assistance, etc.) the higher the % of income that comes from t4rnsers, the lower the self reliance ratio.

Table 4-7: Population, Income Levels, Labour Market and Education for Selected Communities on the Isthmus of Avalon (2001 Statistics Canada Census)

	Placentia*/ Argentia		Dunville		Freshwater		Jerseyside		Province	
Population										
Population	2,115		1,475		750		520		512,930 (521,986-2001)	
Population change (1996-2001)	-13.8%		-7.8%		-20.6%		-11.9%		-7%	
Age/Sex distribution	1,010(M)	1,100(F)	735(M)	745(F)	355(M)	390(F)	260(M)	260(F)	253,439 (257,177 2001)	262,522 264,809 (2001)
Less than 20 yrs.	25%		29%		24%		245		25%	
More than 65 yrs.	17%		11%		15%		16%		12%	
Migration rate	-13.0%		-11%		-11.1%		-11.1%			
Income levels										
Personal Income per capita	$17,100		$17,400		$15,700		$15,800		$19,800	
Average couple family income	$55,800		$57,600		$48,400		$49,000		N/A	
Employment Insurance Incidence	45.6%		39.7%		51.0%		56.2%		37%	
Social Ass't Incidence	14.1%		13.1%		19.3%		12.1%		13%	
Labour market										
Employment rate	75%		78.8%		66.0%		70.5%		74%	
Change in employment	2.0%		-2.7%		0%		0.0%			
Education										
High school or above	58.7%		73.4%		55.9%		57.5%		60%	
Bachelor's degree or higher	3.6%		7.6%		4.7%		N/A		13%	
Self-reliance ratio**	69.0%		74.9%		67.0%		63.6%		77.0%	

Source: Government of Newfoundland and Labrador, Community Accounts
*Includes surrounding communities of Angels Cove, Cuslett, Great Barasway, Patrick's Cove, Point Verde and Ship Cove
**A measure of community's dependency on government transfers (e.g. Canada Pension, Old Age Security, employment Insurance, social assistance, etc.) the higher the % of income that comes from t4rnsers, the lower the self reliance ratio.

4.1.5.4 Community Health

A community health survey will be completed by the Health Research Unit through the Faculty of Medicine at Memorial University of Newfoundland. This study will allow an overall picture of the current health levels of residents in communities near the project site to be obtained. This survey will provide population-level baseline data on the health status of the residents in the area and potentially indicate health determinants, allowing for the potential impact of the project to be determined in future years.

4.1.5.5 Land Use

The general area where the Project will be located is in the vicinity of the existing Come-By-Chance Oil Refinery and transhipment terminal which are brown field sites, however Southern Head is a greenfield site. There are a variety of industries located within a 50 km radius of the proposed refinery site. They are described in the following sections. The site is accessible only by boat and it is not anticipated that uses other than limited recreational fishing and hunting occur on the peninsula (supported by a site visit September 8/06). In addition, no domestic/commercial cutting occurs near the proposed site. See map in Figure 4-8 - Industrial Study Area for Proposed Refinery in Newfoundland and Labrador.

Petroleum and Refining Industries

Placentia Bay, where both the Come-by-Chance oil refinery and Whiffen Head transhipment terminal are located, has become an important location for the Newfoundland Petroleum Industry – an industry that began in the Bay in the 1960s and has seen substantial growth in the past 15 years. In fact, by 2004 it had become Canada's largest petroleum transshipment centre. Part of the reason for its growth is its depth and ice-free characteristics. It is also one of a limited number of places in eastern North America that can accommodate supertankers, also known as Very Large Crude Carriers (VLCC), that can hold between 100 000 and 326 000 deadweight tonnes (dwt) (North Atlantic Petroleum, www.na-refining.nf.ca, 2006).

Industrial Study Area for Proposed Refinery

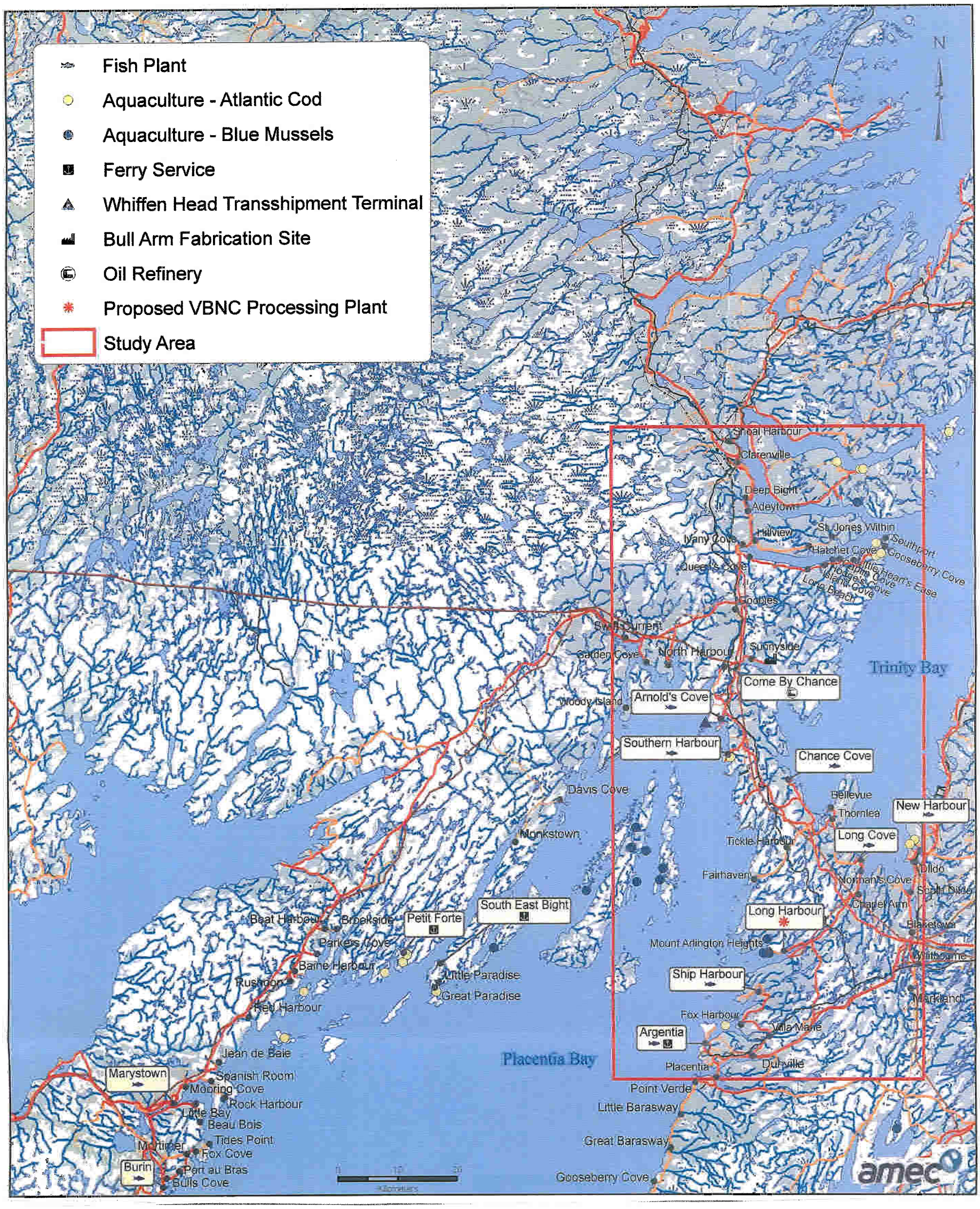


Figure 4-8: Industrial Study Area for Proposed Refinery in Newfoundland
Resource mapping provided by the Government of Newfoundland and Labrador

1:800,000
World Geodetic System 1984
Zone 22N

North Atlantic Refining

The North Atlantic Refining facility in Come-by-Chance was built in 1971 by Procon Limited for Shaheen Natural Resources, but went through a bankruptcy and closure in 1976 as well as several owners including Petro-Canada before North Atlantic Refining Limited (NARL) bought and reopened it in 1994. One of the competitive advantages of this facility is its position on international shipping routes that are relatively close to important suppliers of crude oil in the North Sea, West Africa and the Arabian Gulf. Also these ships can tie up for extended time periods at the facility's deep water ice-free port. Annually the refinery receives deliveries of about 40 million barrels of input (5.5 million tonnes) and exports a similar amount of refined oil. 7.2 million barrels (a million tonnes) can be stored there at a time. The primary market of NARL is the Northeastern United States. The facility employs between 500 and 700 workers (North Atlantic Petroleum, www.na-refining.nf.ca, 2006).

Whiffen Head Marine Oil Terminal

The Whiffen Head Newfoundland Transshipment Ltd. facility located approximately 12 km south of Come-By-Chance by road was built by the oil companies involved with the Hibernia and Terra Nova oil fields in 1998 for the purpose of year-round temporary storage and transshipment of crude oil from these fields. Major marine facilities located at the terminal site include: a causeway, tug basin, approach trestle, jetty with berthing and two loading platforms with marine topside facilities (crude transfer and control system). Major onshore facilities include a tank farm, tank heating system, interconnecting flow-lines, supporting facilities, waste-water handling system and a fire protection system. It is operated by the American company International Matex Tank Terminals (IMTT), which is a consortium associated with the oil companies.

Oil from Newfoundland's offshore production areas is shipped there year-round by three shuttle tankers built specifically for this purpose, each with about 850,000 barrel capacity. From Whiffen Head the crude oil is shipped to markets by ships owned by those purchasing the oil. In 2004 the terminal employed 21 people and received about 325 incoming vessels. During its life the terminal is expected to

receive approximately 60 loads of 850,000 barrels of crude oil from its two shuttle tankers and another 90 trips per year from second-leg tankers. This activity totals 25% of the current crude oil tanker trade in Canada (Community Resource Services Limited & Jacques Whitford Environmental Limited, 2001: 54).

Bull Arm Fabrication Site

The Bull Arm Fabrication Site was developed in 1990 to meet the needs of the growing offshore oil industry. The site has been used for the Hibernia, White Rose, and Terra Nova oil field projects and continues to change to accommodate the oil industry. Currently the site is internationally certified to receive any vessels or rigs.

Features of the site include a 16 km paved access road, self-sustained power supply and communications, onsite water system for drinking water, fire fighting and industrial water, and a sanitary system with a sewage treatment plant.

The Bull Arm site contains three major areas. The dry dock construction and fabrication site expands over an area of 140,000 m^2 and includes a 9,000 m^2 superpipeshop/ warehouse with ten overhead cranes. Also included are a carpentry/ warehouse building, a concrete batch plant, a high strength concrete testing laboratory, administration/office buildings, and marine facilities including the former drydock and seven quays located inside and outside the drydock area. The topsides fabrication and assembly area encompasses a 120,000m^2 area. Facilities include an administration building, pipe shop, cutting shop, assembly hall, blast/paint shop, heated warehouse and a large fully equipped module fabrication hall. The final area at the Bull Arm site is the back cove industrial area and deepwater site. This area features extensive lay-down and docking areas used to facilitate deepwater construction.

Employment at the site varies depending on the needs of the project. During the construction of Hibernia the work force peaked at 2400, where as subsequent projects have averaged about 250 employees (Bull Arm Site Corporation, 2006).

Mining and Mineral Processing

Long Harbour Commercial Nickel Processing Plant

Voisey's Bay Nickel Company (VBNC), a subsidiary of INCO, submitted a proposal in the winter of 2006 to build and operate a commercial nickel processing plant in the town of Long Harbour, Placentia Bay, which is about 50 km from Come-by-Chance by road. The processing plant is proposed to be built on a green field site on the south side of Long Harbour. Currently, the objective is to build a hydrometallurgical plant that would produce 50,000 tonnes of finished nickel product annually, as well as copper and cobalt products. The plant will require 65 hectares, as well as 85 hectares for residue ponds and pipelines. The port of the former phosphorous plant owned by ERCO and Albright and Wilson Americas will be upgraded to accommodate the new infrastructure.

If VBNC finds that the 'hydromet' plant is not technically or economically feasible, a traditional smelting plant or 'matte' plant will be built instead that will require different infrastructure. Regardless of which type of processing facility is finally chosen, construction is slated to begin in 2009 with operations beginning in 2012. Labour projections for the operations phase are 400 personnel for the "hydromet" plant and 350 personnel for the "matte" plant.

Long Harbour is the former site of a phosphorous plant operated by the Electric Reduction Company of Canada (ERCO). Built in 1968, it closed in 1989 due to declining world markets as well as high pollution rates (Voisey's Bay Nickel Company, 2002: 3-5).

Other - Quarries

The only producing mine in the immediate vicinity of the Come-By-Chance area has been a small granite producing operation in the Piper's Hole River area that has been operated by Dimension Stone Inc. Numerous small quarries operate within the immediate vicinity of Come-By-Chance. Table 4-8 describes these quarries and their operators.

Table 4-8: Quarries in the Immediate Study Area

Location	Operator
Off Tower Road	Kevin Wareham Ltd.
Northeast of TCH, Near Arnolds Cove Intersection	Terra Nova Industries Ltd.
0.5 km North of Arnolds Cove Intersection & TCH	J-1 Contracting Ltd
North of Spur Line Near Mill Building, Come-By- Chance	Three R. Enterprises
¼ mile from Old Mill Building, Come-By-Chance	Town Council of Come-By-Chance
Come-By-Chance	William Best
West Side of TCH 4 km North of Come-By-Chance	Derek Short Equipment Rentals
Behind Transport Weigh Scales, East of Goobies	Municipal Construction Ltd.
750m South of Goobies Weigh Scales, Off Route 1	J-1 Contracting Ltd.
Loadstar Pit, 3.5 km East of Goobies	Keith Green Ltd.
Behind Highway Depot, Goobies	Dept. Transportation and Works, Goobies
4 km West of the TCH off 210	Dept. Transportation and Works, Goobies
400m South of North Harbour Intersection	Dept. Works Services and Transportation, Burin Bay Arm
12 km from TCH toward Swift Current	Carew Services Ltd.
3 km West of Piper's Hole River Bridge	Mirkey Construction
Piper's Hole	10250 NFLD Ltd.
Piper's Hole	Hickey's Contracting
Piper's Hole	Hickey's Contracting
Piper's Hole	Nortech Construction
Piper's Hole	Dean Clarke
Piper's Hole	Dept. of Transportation, Goobies
Piper's Hole	Cluetts Construction
Piper's Hole	Goobie Rentals & Contracting
Piper's Hole	Provincial Paving

Source: Government of Newfoundland, Department of natural Resources, Mining Division

4.1.5.6 Marine Industry

Fish Processing

Currently, seven fish plants are located within approximately 50 km of Come-By-Chance by road. The largest of these, Icewater Seafoods Ltd., is located in Arnold's Cove. A variety of seafood is processed there, including Atlantic cod, redfish, mackerel, herring and flounder. The other fishplants in the area are located in Clarenville, Chance Cove, Southern Harbour, Fairhaven, Norman's Cove-Long Cove and Ship Harbour. Additional information is available in Appendix C.

Shipbuilding

Although no shipbuilding or related industries currently exist within 50 km by road of Come-by-Chance, two such industries are located on the western side of Placentia Bay: the Cow Head Offshore Fabrication Facility, located in Spanish Room, and the Marystown Shipyard, located approximately seven kilometers to the south of the fabrication facility. Both of these industries are owned by Kiewit Offshore Services Ltd. (KOS) that had involvement in the construction of the White Rose project (2002 – 2005). Marystown Shipyard has 300 m of water frontage and a 9,358 m2 in-house fabrication area. Work at the yard ranges from construction and repair of fishing vessels to the commissioning, maintenance and decommissioning of offshore oil rigs. The Cow Head fabrication facility, completed in the early 1990's includes approximately 81,000 m2 of land area and on which is situated a 14,000 m2 of covered in-house fabricating area (Community Resource Services and Jacques Whitford, 2001).

4.1.5.7 Other Businesses

A few larger businesses are located in the Study Area. One of these is Smith Snack Service Ltd., in Norman's Cove, which has existed for about 30 years. This company manufacturers and distributes food, such as subs and sandwiches, to schools, stores and institutional cafeterias throughout Newfoundland. The company currently employs 25 people year-round and has plans to expand, creating possibly 15-20 more jobs.

Another larger business in the Study Area is Avalon Ocean Products Inc. in Arnold's Cove. Established in 1989, the company distributes products such as sea scallops, squid, Atlantic cod, blackback, flounder, capelin and lobster to markets in Canada, Europe and the United States. The company is seasonal, working from March to December of each year, with employment varying from 25-40 workers. The company operates a fish plant in Fairhaven and a storage facility in Arnold's Cove.

Although outside the 50 km radius of Come-By-chance, a variety of industries are located on both the North and South sides of the Argentia Harbour besides the Marine Atlantic Ferry. These include Argentia Freezers (EIMSKIP), Collin's Contracting, Penny Industrial, Public Works Canada, Argentia Management Authority, Argentia Property Management, Argentia Dry Cleaning, Stellar Woodworks, Town of Placentia, St. Lawrence Cement, Tacamor, Rogers International, Pier Water Sales, Northland Contracting, Fusion Services and Voisey's Bay Nickel Company. Approximately 180 people are employed on the Argentia Peninsula, totaling 3,540 person months.

4.1.5.8 Agriculture

The primary agriculture area on the Isthmus is located in Whitbourne and Markland. Whitbourne has acted as a railway junction, sawmill centre and during the Commission of Government it became a centre for government services. Today the Newfoundland Youth Centre is located there as well as some agriculture operations. However, Markland is one of the primary agriculture areas in this province (Cormack and Lethbridge are the other two) established for ex-service men and other interested parties during Commission of Government in the 1930's. Today the area has a number of farms, including some involved in experimental crops, and the very successful Rodrigues Winery located in the former Markland Hospital that produces more than 300,000 cases of berry based wine a year to Newfoundland, Canada and internationally.

With a growing interest in agriculture and an increase in the number of older people in the province including the Isthmus area, a small but increasing interest in agriculture has occurred for growing flowers and vegetables as well as raising

livestock on a small commercial as well as hobby basis. One of the largest fox farms in North America is located in North Harbour and several other fur and sheep farms are located near Cape St. Mary's. Within zone 18 (east side of Placentia Bay) are located dairy, sheep, beef, medicinal root farms, root farms, hay and crop, winery, greenhouse-floral, fox, cattle, emu, ostrich, and Christmas tree. Sheep farming represents 43.2% of the farming activity within Zone 18 (http://www.avalongateway.ca/).

4.1.5.9 Transportation

Marine

Ferry

Marine Atlantic, a Canadian Federal Crown Corporation, operates a ferry service between Newfoundland and Nova Scotia. One of the two terminals in Newfoundland is located on the Argentia Peninsula near the site of the former Argentia Naval Base. Service is provided three days per week between Argentia and North Sydney, Nova Scotia from mid June to late September each year. At its peak, Marine Atlantic employs about 1,200 people between its three terminals (Argentia and Port-Aux-Basques, Newfoundland and Sydney, Nova Scotia. The ferry takes approximately 14 hours to travel between Argentia and North Sydney (Marine Atlantic, 2006)

Harbours and Shipping

Within Placentia Bay are several major harbours capable of accommodating large ocean-going vessels such as oil tankers, ferries, container and bulk carriers, general cargo vessels, Canadian Coast Guard (CCG) boats, and naval and fishing vessels. The main ports are Argentia, Burin, Cow Head, Come-By-Chance, Marystown, and Whiffen Head. There are also 44 small craft harbours, two of which are maintained by Transport Canada and the rest by DFO. Larger vessels use the eastern Channel of Placentia Bay to travel to and from Come-By-Chance and Whiffen Head.

In some Placentia Bay ports (i.e. Come-By-Chance and Whiffen Head), pilotage is required and all tankers or vessels must pay a fee for the service. This service is

provided by the Atlantic Pilotage Authority (APA) which employs two pilot vessels and eight harbour pilots. A “Pilot Boarding Station” (PBS) is located at Red Island, where vessels carrying oil must be boarded by the pilots and then accompanied into port. Additionally, at Come-By-chance and Whiffen Head, the two mandatory ports, purpose-built tugs help oil tankers discharge or load product.

CCG is responsible for vessel traffic management in Placentia Bay and has a Marine Traffic Communications and Traffic Services facility in Argentia that maintains a voluntary traffic management scheme.

The need for the services of the APA and CCG has increased over the past few years, along with an increase in vessel traffic. In 2001, for example, monitored vessel traffic in the area totaled 6,906, and by 2003 the count had increased to 9,009. Oil tanker traffic increased by 136% during this time period from 570 to 1,345 movements (Canning & Pitt Associates, Inc., 2004).

Land

Highway

Route 1, the Trans Canada Highway, connects all communities on the Isthmus. This is the main route used by bus services. DRL Coachlines operates a daily bus service along the entire Trans Canada in Newfoundland from St. John’s to Port-aux-Basques with scheduled stops at Whitbourne Junction, Goobies Junction and Clarenville. Other private transportation companies that service the Isthmus include Marsh’s Taxi, which operates between St. John’s and Bonavista, with stops in Whitbourne and Clarenville, and Newhook’s Taxi, that operates between St. John’s and Placentia (and Argentia in the summer when the ferry is running), and makes a stop in Whitbourne.

4.1.5.10 Tourism and Recreation

The Isthmus of Avalon offers a number of attractions and recreational opportunities to visitors and residents, including Sunnyside’s hiking trail, lookout point and museum; Arnold’s Cove look out point, walking trail and Big Pond Bird Sanctuary;

and near by Norman's Cove's and Long Cove's walking trails. Swift Current has the 4 Star Kilmory Resort and Whitbourne has a Heritage Museum. Blaketown is known for its Beothuck Site. Clarenville is a service hub and gateway to the increasingly popular Bonavista Peninsula. Winter recreation is focused on the White Hills ski resort just outside of Clarenville as well as the numerous cross country trails in the vicinity of Clarenville.

Outside of the 50 km radius of Come-By-Chance, but within the Placentia Bay area are a number of other cultural and tourism sties including the Castle Hill National Historic Site where lies the remains of an old French Fort, O'Reilly House Museum and significant archaeological digs in Placentia. There is also a Heritage Trail. At the eastern entrance to Placentia Bay is Cape St. Mary's Ecological Reserve, where the third largest nesting colony of gannets in North America is located. North of the community of Placentia is Ship Harbour where the Atlantic Charter Monument is located that commemorates the drafting of the Atlantic Charter in 1941 by then British Prime Minster, Sir Winston Churchill and United States President, Franklin Roosevelt. The Charter, which was signed just offshore of Ship Harbour, is a joint declaration on the purposes of the war against fascism.

The greater Placentia Bay area is of interest to both the tourist and residents in terms of recreational opportunities including pleasure cruising, sea kayaking, cruising/remote island stay experience, bird watching, national historic sites, and provincial parks.

The 2004 Product Development study of the province, (A Special Place, A Special People, 2004) does not discuss the Isthmus of Avalon as a potential or growing tourism area, but the Cape Shore drive from Argentia to Cape St. Mary's is rated as a tier two destination area (i.e." have some, but not sufficient critical mass of anchor attractions, secondary attractions and/or service, but has the potential to rate well on the criteria if some identifiable and feasible things can be done to enhance their rating), is considered a priority themed touring route and Argentia/Placentia has been designated as a service centre/hub and gateway. and is rated as a two star attraction by the Michelin guide, 'worth a Detour". The top priority influencers in attracting visitors to this province are regional and provincial packages and tours and key

natural attractions and selected ecological reserves including Cape St. Mary's Ecological Reserve.

4.1.5.11 Municipal, Provincial, and Federal Infrastructure and Services

Local infrastructure and services in the Study Area are shown in Figure 4-9.

Educational Facilities and Capacity

Twelve schools located within the 50 community Study Area are listed in Table 4-9 along with their enrolment increase/decrease between the school years of 2001-2002 and 2004-2005 as well as the number of teachers in the school as of the school year 2005-2006.

Additionally, the College of the North Atlantic (CNA) has a campus in both Placentia and in Clarenville. The Placentia campus has an enrollment of about 130 full-time and 25 part-time students per semester and offers teaching programs such as Welding and Heavy Duty Equipment Technology. The Clarenville campus has about 250 full-time and 50 part-time students per semester and provides programs such as Adult Basic Education and Business Administration. The Clarenville campus also houses the province's Distributed Learning Centre.

As is the case throughout the province, with a substantial decrease in school enrolment due to out-migration and declining birth rate, a rationalization of schools has occurred and will continue to occur. This is true for the isthmus area. Overall, sufficient classroom capacity exits in all schools, but the ratio of teachers to students has not dropped.

Local Infrastructure in Study Area for Proposed Refinery

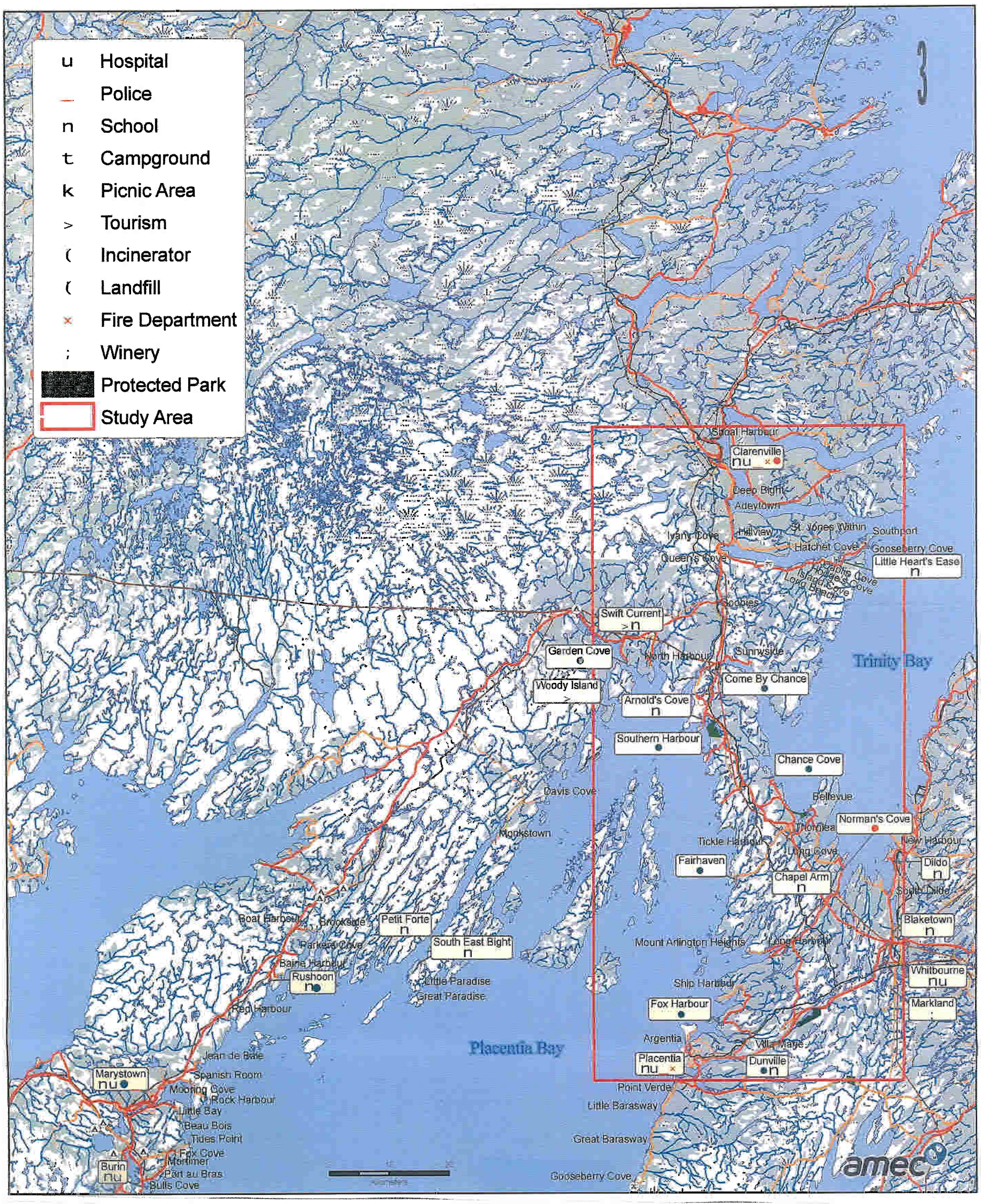


Figure 4-9: Local Infrastructure in Study Area for Proposed Refinery in Newfoundland
Resource mapping provided by the Government of Newfoundland and Labrador

1:800,000
World Geodetic System 1984
Zone 22N

Table 4-9:
Schools Located Within the 50 km Radius of Come-By-Chance, Their Enrolment and Number of Teachers

Town	School	Enrolment		No. of teachers
		2004-05	2001-02	2006
Arnold's Cove	Tricentia Academy (K-12)	379	382	26
Blaketown	Crescent Collegiate (7-12)	743	782	45
Chapel Arm	Holy Family Elementary (K-6)	139	92	45
Clarenville	High School (9-12)	402	412	25
	Middle School (4-8)	299	280	25
	Primary School (k-3	228	213	18
	Balboa Elementary (K-8)	341	380	25
Dunville	St. Ann's Academy (K-9)	268	359	22
Placentia	Laval High School (9-12)	282	305	25
	St. Edward's Elementary(K-8)	243	304	25
Swift Current Academy	Swift Current Academy (K-12)	82	99	12
Whitbourne	Whitbourne Elementary (K-12)	91	95	7
	Perlwin Elementary (closed)		150	
	NL Youth Centre	25		

Source: Individual Schools

Medical and Emergency Services/Capabilities

The Dr. G.B. Cross Memorial Hospital in Clarenville services the Study Area. This facility has 49 acute care beds, 14 long-term care beds and two respite care beds. Many services are provided including: anesthesia; chemotherapy; diabetes education; family practice; general surgery; gynecology; ICU/cardiac; internal medicine; laboratory; long-term care; mammography; nursing; rehabilitation; CT services; nutritional services; obstetrics; occupational therapy; palliative care; pastoral care; pathology; pediatrics; pharmacy; phototherapy; psychiatry; physiotherapy; padology; recreation therapy; respiratory therapy; social work; speech language pathology; ultrasonography; visiting specialty clinics; and 24-hour emergency services. The full complement for the hospital is 22 doctors, of which, 17 are specialists. Currently the hospital is operating 2 doctors less than their full complement.

The Dr. William H. Newhook Community Health centre is located in Whitbourne and is used as a teaching facility for Memorial University's Faculty of Medicine. The facility maintains 3 observation/holding beds and a full range of services including diagnostic, environmental, outreach programs, visiting disciplines in audiology, dietetics, and occupational therapy, and 24-hour emergency services. The Placentia Health Centre maintains 10 acute care beds, 75 nursing home beds (Level II and III care), two respite care beds and 40 independent living units. This facility also offers a full range of services similar to the Whitbourne facility. Additionally, some of the communities have specialized health services such as dentists (i.e. Placentia, Clarenville).

As is the case throughout the province, it is becoming increasingly difficult to attract medical professionals to the rural areas of this province and as the population increasingly declines to out-migration and a lower birthrate, this situation will become exacerbated.

Fire Fighting and Police

All of the Study Area is policed by the Royal Canada Mounted Police (RCMP). Headquartered in St. John's, the RCMP also has regional detachments. The Clarenville detachment is responsible for the Clarenville to Bonavista district, and the Placentia detachment covers the Placentia to Whitbourne district. The Clarenville detachment includes a highway unit and employs 14 officers. The Placentia detachment employs seven officers.

As is the case in other rural Newfoundland and Labrador communities, those in the Study Area receive fire protection services through volunteer fire departments. Even smaller communities, such as Come-By-Chance, Sunnyside and Southern Harbour have their own volunteer fire department. Additionally, an industrial fire department is located at the North Atlantic Refinery in Come-By-Chance.

In addition to residential fire services fire protection of natural areas is provided through the provincial Department of Natural Resources. One of the duties of conservation officers throughout the province is to respond to emergency fire

situations. A district office is located in Clarenville and a satellite office is located in Whitbourne.

Water and Sewer

Most towns within the Study Area provide water and sewer services to residents. Homes and businesses in Come-By-Chance, Southern Harbour and Arnold's Cove are all connected to their town's system, while Sunnyside is in the process of connecting all homes to the services, with about 75% complete to date. The rate charged for this service varies by community, but in Arnold's Cove, for example, water for residential use is $144/year and for commercial use is $240/year. The cost for connection to the sewage system is $48/year for both residences and businesses.

Waste Management

Waste pick-up and disposal is a service provided by almost all towns in the Study Area. Arnold's Cove, Sunnyside and Southern Harbour have their own waste disposal sites, while Come-by-Chance uses the one in Sunnyside.

Communications

All of the communities in the Study Area have access to the Internet. Arnold's Cove, Southern Harbour, Come by Chance and Sunnyside, as well as other small communities, have dial-up connections. However, the larger centres (i.e. Clarenville and Placentia) have access to both dial-up and high-speed Internet connections.

Community Spill Response Capabilities

According to the Placentia Bay Project Benefits Study (2004), significant investment has been made in Newfoundland in oil spill response equipment and technology. Much of this is focused on the Placentia Bay area, due to its importance to the oil industry and its general high volume of. CCG can respond to spills of 10 00 tonnes or less. The North Atlantic Refining Ltd. facility has equipment on-site to deal with spills of <50 tonnes, as does the Whiffen Head terminal. Additionally, the Eastern Canada

Response Corporation (ECRC) has capacity to respond to a spill of 2,500 tonnes and, if needed, 7,500 tonnes using equipment from other ECRC centres. The corporation also maintains a "sub-depot" at Whiffen Head with capability to deal with a 150 tonne spill.

4.1.5.12 Commercial Fisheries and Aquaculture

A brief description of these the commercial fisheries and aquaculture industries within Placentia Bay follows. A detailed outline of the existing commercial fishery and aquaculture industry is included with this report in Appendix C.

Commercial Fisheries

Drastic changes occurred in the Placentia Bay commercial fisheries in the early 1990s when fisheries moratoria were imposed because of declining groundfish stocks. For example, within 3PSc for the period 1984-1990, 74% of the catch by quantity was cod while snow crab made up just 3%; during 1994-1995, immediately after the moratoria were imposed, cod made up only 6% of the harvest and snow crab catches had increased to 24%. In terms of value, cod accounted for nearly 60% of the value of the 3PSc harvest (1984-1992), but only a negligible amount in 1994-1995 (see Figure 4-10).

Between the landings highpoint in 1986 and the 1995 harvest, the quantity of biomass taken from Placentia Bay declined from more than 19,000 tonnes to under 3,000 tonnes, a drop of 85%. However, the landed value of the 3PSc fishery did not experience a similar decline, owing to the changed composition of the catch, made up - in 1995 - primarily of high-priced species such as lobster, snow crab and lumpfish roe. Total value continued to rise after 1995 and, by 2002, the harvest from 3PSc was worth more than $18 million; this was nearly 180% of the value of the harvest in 1986 - the peak harvesting year within the 1986-2005 timeframe. Even with weaker prices in recent years, snow crab is still a very valuable species in this area.

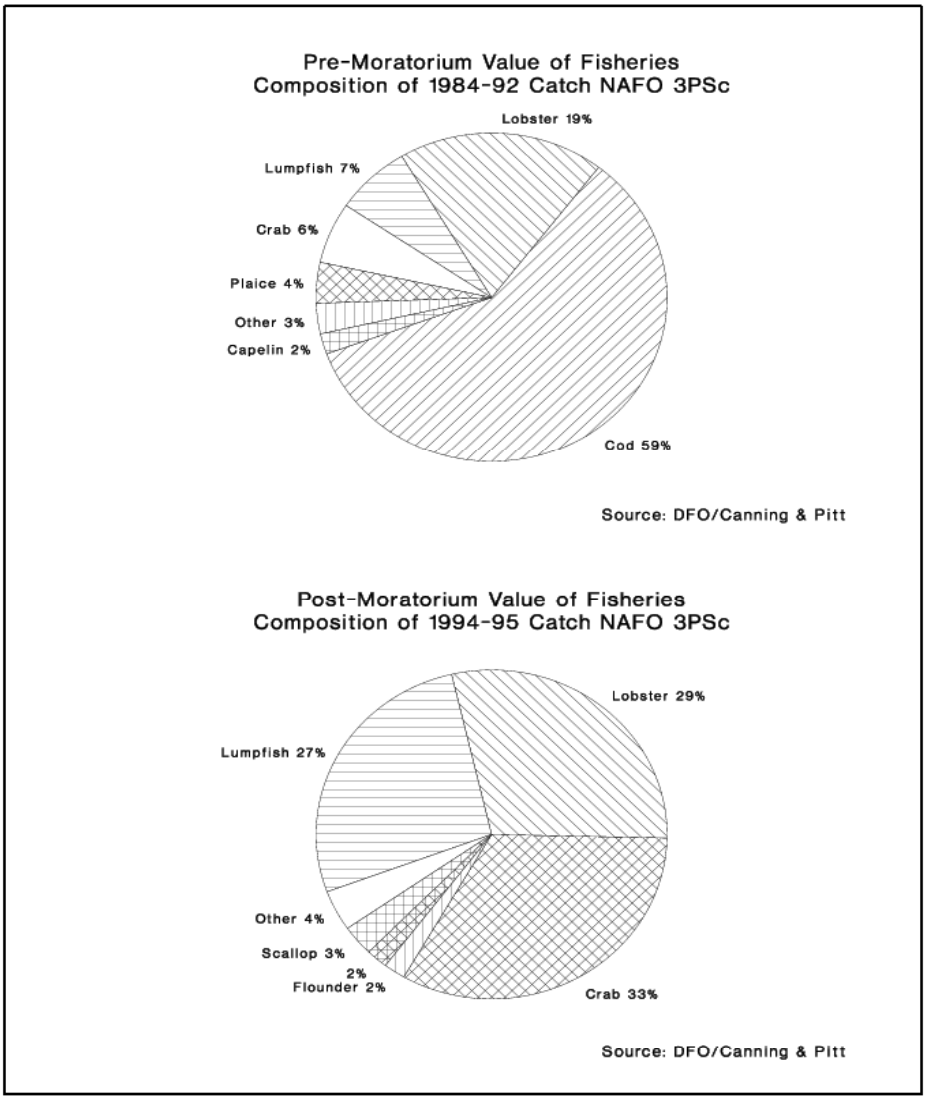


Figure 4-10: Value of Fisheries

Figure 4-11 shows the overall quantity harvested (all species), and Figure 4-12 contrasts groundfish and shellfish harvests (mainly snow crab, scallops and lobster) over this period.

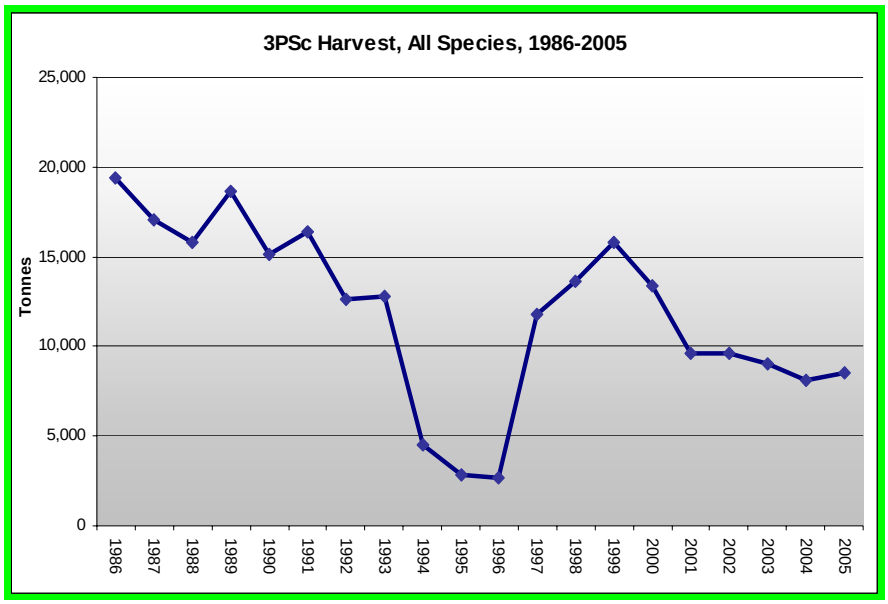


Figure 4-11: 3PSc Harvest, All Species, 1986-2005

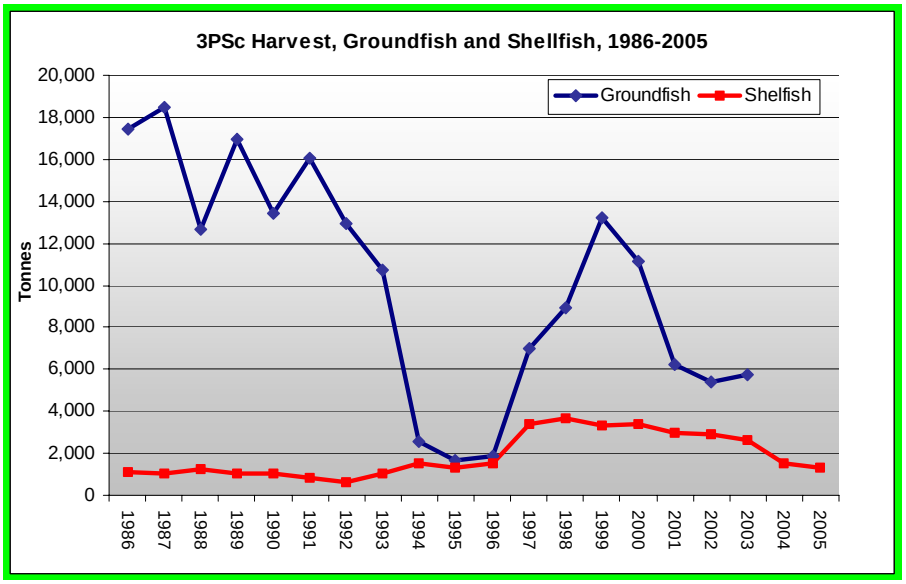


Figure 4-12: 3PSc Harvest, Groundfish and Shellfish, 1986-2005

Since the mid-1990s, the fisheries and fisheries management and licencing regimes in Placentia Bay have continued to evolve. Most significantly, a fish harvesting rationalization strategy was implemented in the province that reduced the number of participants in the harvesting sector, and a professionalization process was introduced which prescribed specific levels of experience and training required to be a professional fish harvester. Along with this system, DFO introduced the "core"

harvesting enterprise designation, with restrictions on harvesting by those who are not part of such an enterprise.

In present-day Placentia Bay fisheries, cod is still by far the most important species harvested in the area, with snow crab, herring and lumpfish (roe fishery), scallops and a few other groundfish species making up most of the remainder.

Some harvesting is conducted year-round, however, since 1996, the peak harvesting months have been June and July with a fairly strong fishery in the late fall (primarily for cod).

In terms of economic value, the area's commercial fishers currently depend on three, high-value species - lobster, snow crab and cod - for the bulk of their annual fishing income. While lobster accounts for only a small percentage by weight of the annual catch, given its high value this species remains very important to many study area fishers.

Aquaculture

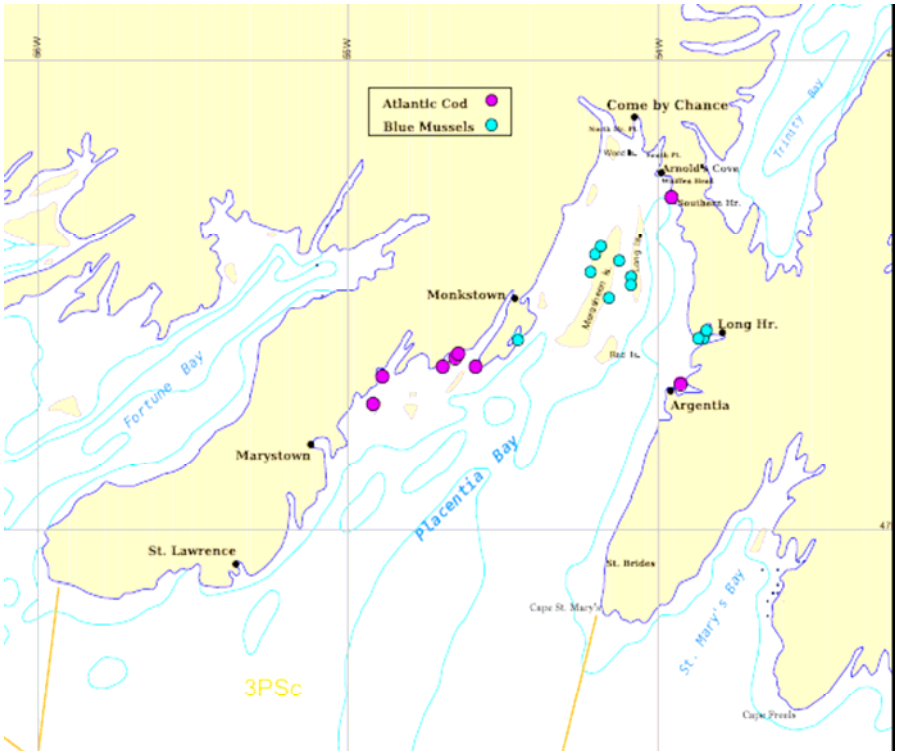
The development of aquaculture resources in Placentia Bay has been underway since about the mid-1990s. In 1997 there were about seven licenced aquaculture operations, and several applications pending to investigate and/or develop additional sites.

However, DFA reports that, during 2000-2003, there was significant level of expansion in the Placentia Bay aquaculture sector, and a considerable interest in the development of new sites - particularly on the Burin Peninsula side of the bay, and around Merasheen Island.

At present, there are 19 "active" (commercial or "developmental") aquaculture operations in the Placentia Bay area. DFA managers note that several 2006 sites are still awaiting final approval and discussion by the Proponent with Transport Canada indicate that up to a dozen applications for aquaculture sites are in progress. Transport Canada also commented that the size of individual farms is increasing

considerably, up to as much as 600 hectares and that sites are increasingly farther from shore.

Figure 4-13 shows the geographic location of existing aquaculture activities in Placentia Bay.



Source: DFA site location data in Table 1.1 (from T. Budgell, August 2006)

Figure 4-13: Existing Aquaculture Sites in Placentia Bay (2006)

4.2 PHYSICAL FEATURES OF UNDERTAKING

The Project will import crude oil feedstocks and refine them into value-added petroleum products for export and domestic consumption. Figure 4-14 shows the footprint of the refinery and the associated marine facilities. The area required for the refinery site is approximately 5 km^2 and the two-lane access road is approximately 8 km in length. The Come-By-Chance River will be crossed by a single span bridge as part of the site access road. This will be located well upstream and away from major tidal influences. As part of the Department of Transportation

and Works' long-term planning, a new interchange has also been designed for the Trans Canada Highway, near the existing intersection, to deal with the increased traffic that will result from development of the project in this area.

The Project's initial planned capacity will be 300,000 bbl/d expandable to 600,000 bbl/d in the future if market conditions allow. The Project will provide a new state-of-the-art oil refinery that is safe, efficient and environmentally in tune with today's expectations for a modern industrial development. The Project will be designed and constructed in a manner that will minimize the impact on the environment and will meet or exceed all applicable National and Provincial Acts, regulations and standards.

The main Project components are discussed in more detail in Section 4.4 and are:

- Refinery Processing Facility
- Storage Tanks and Pipelines
- Sulphur and Coke Storage and Export Facilities
- Utilities, Infrastructure and Support Systems
- Water Treatment and Discharges and Emissions Control Facilities
- Marine Terminal

Greater description of the physical and biological environments within the area potentially affected by the project can be found in Sections 4.1.3 and 4.1.4.

The main Project Activities are discussed in Sections 4.3 - 4.5 and are:

- Site Preparation
- Construction and Fabrication
- Operations

CONTRACTOR MUST VERIFY ALL DIMENSIONS AND CONDITIONS ON SITE BEFORE PROCEEDING WITH ANY PORTION OF THIS WORK. REPRODUCTIONS OF THIS DRAWING MAY HAVE BEEN REDUCED OR ENLARGED. REFER TO GRAPHIC SCALE. DO NOT SCALE DRAWINGS FOR CONSTRUCTION.

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A	ISSUED FOR ENVIRONMENTAL REGISTRATION			06/09/08

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CLIENT

NEWFOUNDLAND & LABRADOR REFINING CORPORATION

PROJECT

NEWFOUNDLAND & LABRADOR REFINERY

TITLE

REFINERY FOOTPRINT & ASSOCIATED MARINE FACILITIES

DESIGNED BY	CHECKED BY	DATE
DRAWN BY	APPROVED BY	DATE
SCALE: AS SHOWN	BNG PROJ. No.	722649
	CLIENT PROJ. No.	

DRAWING No. FIGURE 4-14

REV. A

File name: BNG-DTXT-2000-TEST.DWG Date: 2005/04/07 @ 10:20
REFERENCE FILES:

4.3 CONSTRUCTION

The proposed project is quite large and will demand a significant number of construction trades and construction activities to complete. The magnitude of this project means that off-site fabrication of many components will take place within the province, nationally, and internationally. It is expected that all major fabrication yards in the province will participate in the project at some stage. Given the size and complexity of some of the components, there will be some prefabrication of large modules outside the province. Project components fabricated or manufactured elsewhere would be brought to site both by road and by sea transport.

Construction activities will generally include such things as;

- Clearing and grubbing.
- Access road and bridge construction.
- Major earth works to level the site which may involve the use of explosives.
- Site grading.
- Road construction in the plant area.
- Construction of earth works for the dyking around the tank farm.
- Surface drainage around the project area.
- Construction of water treatment plant and containment ponds.
- Construction of a desalination plant.
- Construction of all buried utilities.
- Construction of concrete foundations for tanks in the tank farm.
- Construction of equipment foundations in the process areas.
- Construction of transmission lines.
- Construction of marine facilities that will include a rock fill causeway, sheet pile cell construction, steel piles supported concrete decks for access trestle, mooring

dolphins, breasting dolphins and offloading and receiving platforms as well as cooling water intakes and effluent discharge structures.

- The construction of process plant infrastructure including the installation of very large prefabricated heavy wall pressure vessels, pumps and compressors, large crude heaters, pipe racks, piping, instrumentation and electrical cabling.
- Construction of a high voltage electrical distribution system, including switch gear, transformers and substations.
- Construction of support buildings including, administrative and engineering offices, warehouses and maintenance buildings, laboratory and other support buildings.

Mitigation measures to reduce noise, dust, and silt-runoff will be implemented to minimize the impacts through application of proper construction methods and implementation of the proposed environmental management plans.

The resources required to support the refinery construction and operation have been identified to the extent practical at this point in Project development, in particular the land area required (Section 4.1.2, Figures 4-1 and 4-2); the volume and type of crude and resulting volume and types of products to be produced (Section 4.4.2.1); the workforce needed during construction and operation (Section 4.6); and the supply and source of water and power (Section 4.4.5.3). Additional detail will be available as the engineering design progresses and will be presented in the Environmental Assessment.

The project schedule shows that approvals and permits must be in place to allow for construction start no later than January 2008. This start date enables a production start date of late 2010/early 2011. With the large number of refineries currently conducting feasibility studies, the economic viability of this refinery depends on an early entry into the market.

4.3.1 Construction Period

Pre-construction activities will commence immediately upon receipt of the environmental approvals and necessary permits. Clearing and grubbing of the access road and site would begin as soon as possible. Other site preparation activities include levelling/in-filling and installation of temporary housing and offices with associated services (power, potable water, water and sewer).

Construction of the refinery and associated utilities and support systems is proposed to begin in January 2008 and is expected to be complete within three years of start. Construction of the marine terminal will also occur during this time frame. Commissioning will require another few months and it is anticipated that the first shipments of crude will be in early 2011. For greater detail on the schedule of activities, see Master Schedule (Figure 4-15).

Accommodation for workers during the construction stage has not been finalised, but the Proponent is familiar with the Bull Arm site and the potential of using this site for temporary accommodations. The Bull Arm site was used very effectively during the construction of the Hibernia offshore platform, housing a comparable workforce.

4.3.2 Environmental Considerations

Environmental Protection Plans and procedures will be in place for all construction activities such as: clearing; grubbing; quarrying and aggregate removal (at the Project site or other areas); buffer zones; erosion and silt-runoff control; excavation, embankment and grading; stream and river crossings; dust; noise; blasting; groundwater; drilling, including geotechnical drilling in the marine environment; sewage disposal; waste management. No blasting is planned for marine construction. Booms and silt curtains, etc, will be employed where necessary to eliminate or minimize adverse impacts on the marine environment. For each of these activities during the construction stage, mitigation measures will be put into place to reduce the impact of such activities on the environment and other resource-users in the area. For more information on the Environmental Protection Plan see Section 4.4.10.5.

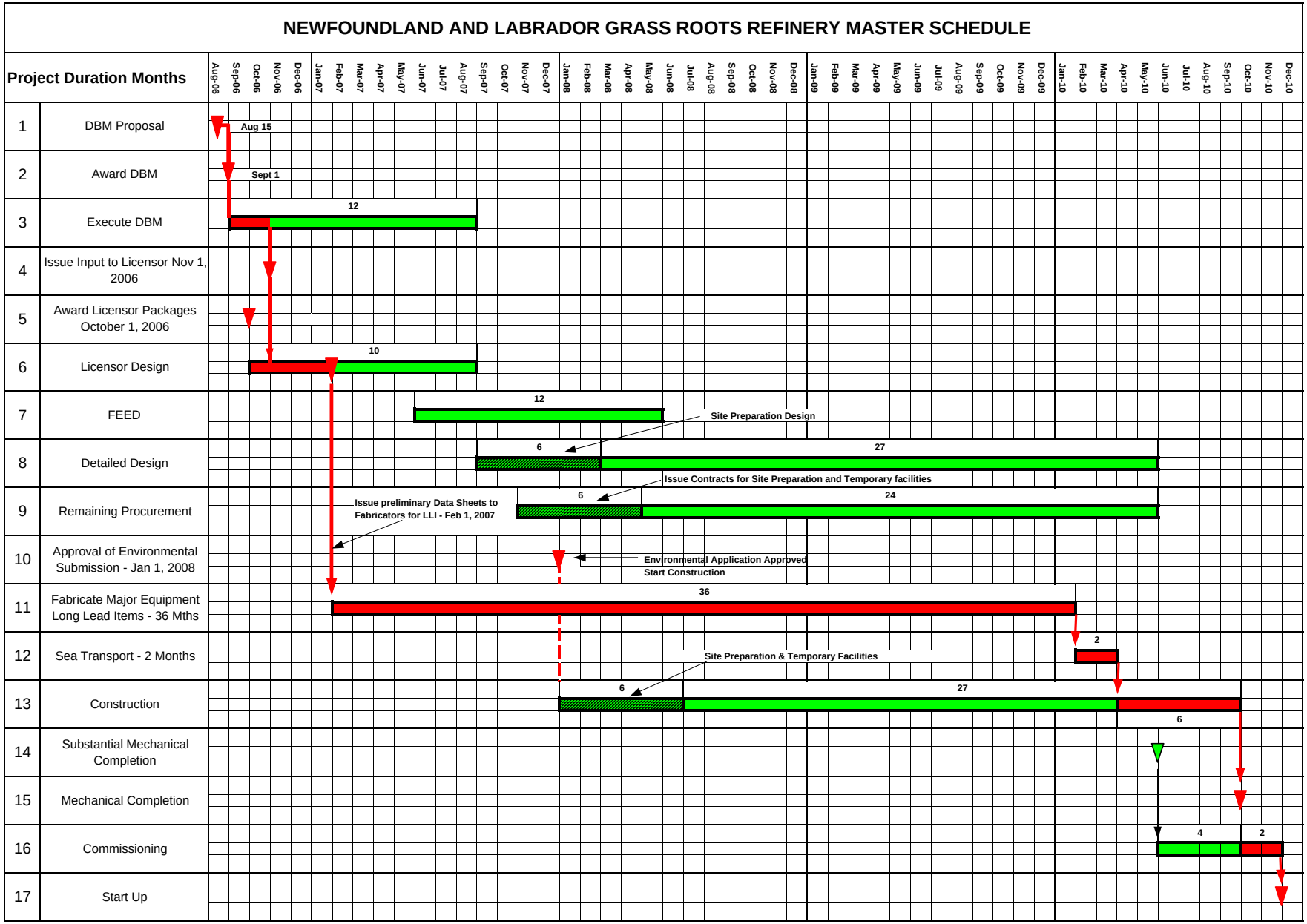

NEWFOUNDLAND AND LABRADOR GRASS ROOTS REFINERY MASTER SCHEDULE
Project Duration Months
Aug-06 Sep-06 Oct-06 Nov-06 Dec-06 Jan-07 Feb-07 Mar-07 Apr-07 May-07 Jun-07 Jul-07 Aug-07 Sep-07 Oct-07 Nov-07 Dec-07 Jan-08 Feb-08 Mar-08 Apr-08 May-08 Jun-08 Jul-08 Aug-08 Sep-08 Oct-08 Nov-08 Dec-08 Jan-09 Feb-09 Mar-09 Apr-09 May-09 Jun-09 Jul-09 Aug-09 Sep-09 Oct-09 Nov-09 Dec-09 Jan-10 Feb-10 Mar-10 Apr-10 May-10 Jun-10 Jul-10 Aug-10 Sep-10 Oct-10 Nov-10 Dec-10
1 DBM Proposal
Aug 15
2 Award DBM
Sept 1
3 Execute DBM
12
4 Issue Input to Licensor Nov 1, 2006
5 Award Licensor Packages October 1, 2006
6 Licensor Design
10
7 FEED
12
Site Preparation Design
8 Detailed Design
6
27
Issue Contracts for Site Preparation and Temporary facilities
9 Remaining Procurement
6
24
Issue preliminary Data Sheets to Fabricators for LLI - Feb 1, 2007
10 Approval of Environmental Submission - Jan 1, 2008
Environmental Application Approved
Start Construction
11 Fabricate Major Equipment Long Lead Items - 36 Mths
36
12 Sea Transport - 2 Months
2
Site Preparation & Temporary Facilities
13 Construction
6
27
6
14 Substantial Mechanical Completion
15 Mechanical Completion
16 Commissioning
4
2
17 Start Up

FIGURE 4-15

4.3.3 Potential Causes of Resource Conflict

Potential interactions with the Project during construction activities may include those associated with:

- Fish and Fish Habitat (both freshwater and marine)
- Air Quality
- Resource Harvesting (eg: fisheries, hunting)
- Birds and Wildlife
- Provincially and/or Federally protected “Species at Risk”, if present
- Water Quality (with regards to human and ecosystem health)
- Socio-Economic Environment

Other potential resource conflicts may be identified during further public consultation and scoping.

Terrestrial and Freshwater

Site Environmental Protection Plans will be put in place to avoid, minimize or mitigate potential conflicts between project activities and freshwater streams and ponds and wetlands to the extent possible during site development and refinery construction.

It is anticipated that most of the freshwater bodies of water on the site itself and in the watershed of Watsons Brook will be excluded from the actual refinery footprint and, as such, unaffected: however, part of the area of the footprint is bog with some isolated small ponds and these will be impacted. As well, it is anticipated that site freshwater for both domestic and industrial uses may come from desalination if existing sources are not sufficient, avoiding demands and effects on the watershed.

The new project access road will allow easier access to the peninsula for recreational activities, including fishing and hunting.

Surveys are ongoing to determine the occurrence of rare or endangered plant and animal species (See Table 4-4) at the refinery site. Surveys have also been

commissioned to determine occurrence and use of the area by seabirds, waterfowl and shorebirds.

The Environmental Protection Plan will also address the potential issues of dust, lights, noise, emissions, siltation control, and accidental discharges associated with heavy machinery operation.

Construction activity is expected to take approximately three years and require as many as 3 000 workers. There is a recognized shortage of skilled labour and, as well, there may be second large project under construction in the same time period in Placentia Bay, the Voisey's Bay nickel processing plant.

Marine

There is the potential for marine construction activities to interfere with commercial fishing, marine fish habitat, tourism and recreation.

Mitigation measures will be taken to ensure the elimination or reduction of impacts on these resources due to activities associated with construction of the project. Prior to commencement of the construction stage, NLRC will consult with stakeholders in the area. Compensation programs may be developed to allow due reimbursement to stakeholders for loss of resources or loss of income should project activities affect their livelihoods, if applicable.

The EPP will address marine construction activities and required mitigation measures will be taken.

4.4 OPERATION

To ensure minimum impacts occur during daily operations of the refinery, the most advanced technologies "Best Available Technology that is Economically Available (BATEA)" will be integrated into the operations of the refinery. All measures will be taken to ensure operations of this refinery have as few adverse impacts on the environment in the area as possible.

The resources required to support the refinery operations have been identified to the extent practical at this point in Project development. These requirements are discussed throughout this document, notably, in particular the land area required (Section 3.1, Figures 4-1 and 4-2); the volume and type of crude and resulting volume and types of products to be produced (Sections 4.4.2.1 and 4.4.2.2); the workforce needed during construction and operation (Section 4.6); and the supply and source of water and power (Section 4.4.5.3). Additional detail will be available in the Environmental Assessment.

4.4.1 Operation Period

It is intended that the Southern Head refinery will operate for at least 25 years, commencing in late 2010 or early 2011.

4.4.2 Refinery Facility and Process

A description of the refinery process follows. Please note that a glossary of technical terms is provided in at the end of this document in Section 9.

Refer to Figure 4-16 - Overall Block Flow Diagram BFD-49-0001. A more detailed description of the refinery process is found in Appendix B.

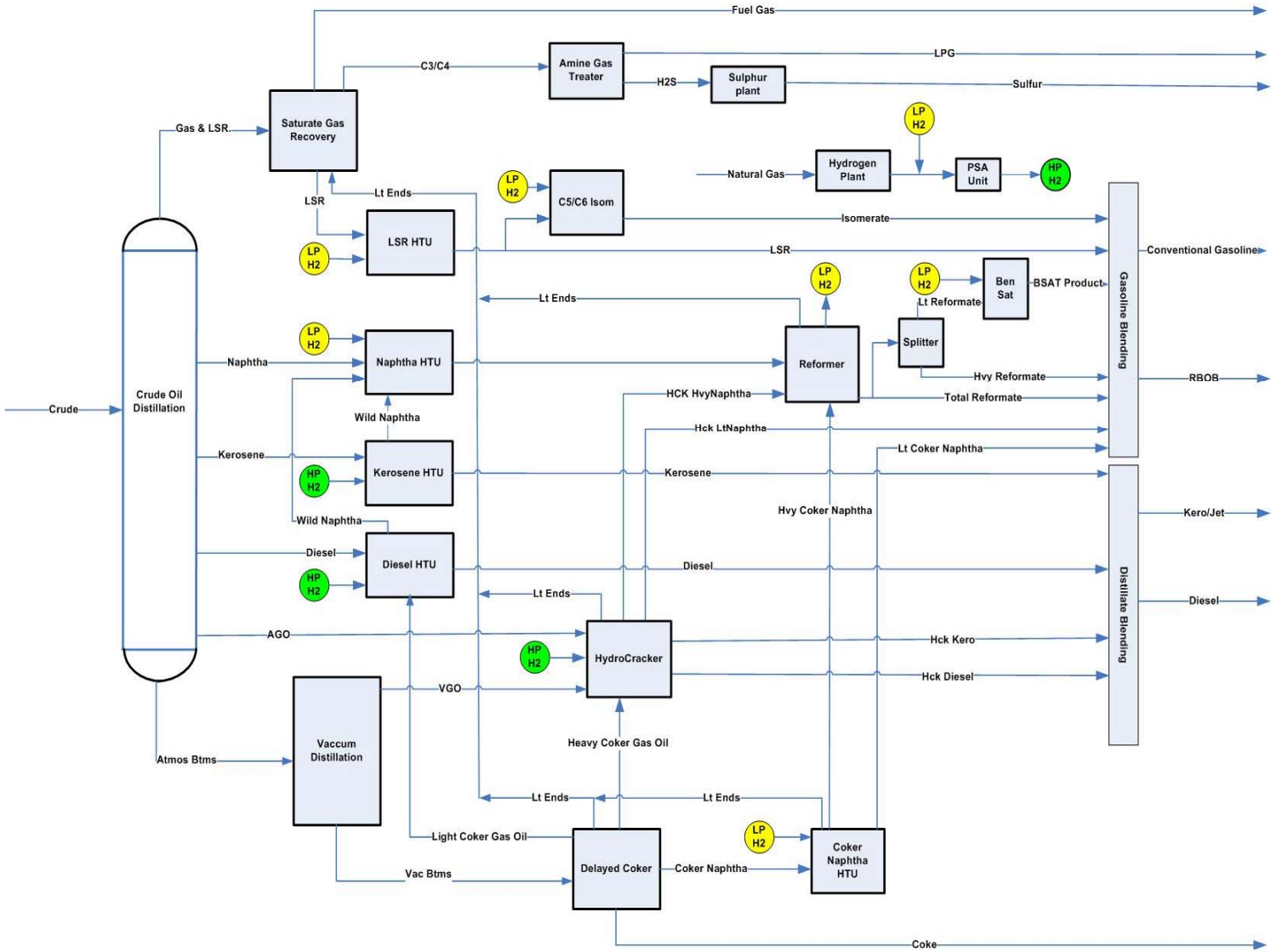


Figure 4-16: Block Flow Diagram BFD-49-0001

4.4.2.1 Process

Crude oils are complex mixtures containing many different hydrocarbon compounds and vary in appearance and composition from one oil field to another. Crude oils range in consistency from water-like liquids to tar-like solids, and in color from clear to black. An "average" crude oil contains about 84% carbon, 14% hydrogen, 1%-3% sulphur, and less than 1% each of nitrogen, oxygen, metals, and salts.

The design basis for the Southern Head Refinery feedstock is a range of crudes from Arab Medium and Arab Heavy. This will allow the new refinery to process a wide range of crudes from various parts of the world and provide greater flexibility for operational and economic success. It is expected that the primary sources for the projects feedstock crudes will be the Middle East, Russia, South America and Africa. The Project will be capable of processing crude feedstocks with a sulphur content up to 3%.

Crude from on-site tankage is blended and is fed to the Atmospheric Distillation Unit (ADU) for preheating prior to desalting by an electric grid. After desalting, the crude oil is re-heated and enters the Crude Tower. In the Crude Tower the oil is fractionated into tower overhead, naphtha, kerosene, diesel, atmospheric gas oil (AGO) and crude tower bottoms.

Light gases are recovered and are separated into fuel gas and components for blending or sales. Light naphtha is stabilized, hydrotreated and separated for further treatment for blending with gasoline. Heavy naphtha is hydrotreated to remove sulphur and further treated to improve its octane quality.

Kerosene and diesel stocks are first steam stripped to remove light components and are then sent to the hydrotreating units to produce Jet fuel and Ultra-low Sulphur Diesel (ULSD). Atmospheric gas oil (AGO) is also steam stripped before it goes to the Hydrocracker for conversion to gasoline and middle distillate blending stocks. The Crude Tower Bottoms are sent to the Vacuum Distillation Unit (VDU) for further separation into Vacuum Gas Oil (VGO) for either blending or gasoline and, in the case of the residuals, are converted into petroleum coke, gases, naphtha and light and heavy gas oils.

The Hydrocracker processes AGO, VGO, and Heavy Coker gas oil over a catalyst in the presence of hydrogen at a high pressure (2500 psig) and a moderate temperature (800 °F) to produce high quality fuel blending components. The Heavy Hydrocracker naphtha is sent for octane improvement. The light naphtha, kerosene, and diesel from the Hydrocracker go directly to product blending.

4.4.2.2 Products

Gasoline:

Gasoline is a blend of hydrocarbons with boiling ranges from ambient temperatures to about 400 °F. The important qualities for gasoline are octane number (antiknock), volatility (starting and vapor lock), and vapor pressure (environmental control). Additives are often used to enhance performance and provide protection against oxidation and rust formation. The quality of the product slate will be suitable for supplying Conventional and "Reformulated Blendstock for Oxygenated Blends" (RBOB) into the Eastern seaboard of the United States. RBOB will not meet finished gasoline specifications until it has been blended with 10% Denatured Fuel Ethanol. Ethanol blending will take place after the gasoline has been shipped and NOT at the refinery.

Table 4-10: Conventional Gasoline Specification

Gasoline	
RVP	10.0
MON	82.0
(R+M)/2	87.0
Benzene (%)	4.90

Table 4-11: RBOB Specification

RBOB	
RVP	8.6
RON	87.4
MON	80.0
(R+M)/2	83.7
Aromatics (%)	50.0
Benzene (%)	0.667

Kerosene/Jet Fuel:

Kerosene is a refined middle-distillate petroleum product that finds considerable use as a jet fuel and around the world in cooking and space heating. When used as a jet fuel, some of the critical qualities are freeze point, flash point, and smoke point. Commercial jet fuel has a boiling range of about 375°-525° F, and military jet fuel 130°-550° F. Kerosene, with less-critical specifications, is used for lighting, heating, solvents, and blending into diesel fuel.

Table 4-12: Kerosene/Jet Fuel Specifications

Kerosene/Jet Fuel	
Degree API	≥51
Sulphur content wt%	0.30
Flash Point °C	≥38
Freeze Point °	-40
Smoke Point mm	25

Liquefied Petroleum Gas (LPG):

LPG consists principally of propane and butane. It is produced for use as fuel and is an intermediate material in the manufacture of petrochemicals. The important specifications for proper performance include vapour pressure and control of contaminants.

Distillate Fuels:

Diesel fuels and domestic heating oils have boiling ranges of about 400°-700° F. The desirable qualities required for distillate fuels include controlled flash and pour points, clean burning, no deposit formation in storage tanks, and a proper diesel fuel cetane rating for good starting and combustion. Diesel streams will be treated to remove sulphur to the very low levels required for European ULSD standards (10 ppm).

Table 4-13: Ultra Low Sulphur Diesel (ULSD) Specifications

ULSD	
API	>30
Sulphur, ppm	<15
Flash Point °C	52
Cetane	>51

Petroleum Coke:

Petroleum Coke is a by-product of the delayed coking process. Petroleum Coke or simply “Coke” is almost pure carbon with a variety of uses from electrodes to charcoal briquets.

Sulphur:

Sulphur is a by-product of the refinery process whereby sulphur recovery converts hydrogen sulphide in sour gases and hydrocarbon streams to elemental sulphur.

Due to the presence of sulphur in crude oil, and the coking/ hydrocracking/ hydrotreating of hydrocarbons, a significant amount of H_2S is produced throughout the entire facility. H_2S is found in many gas streams in the refinery and in sour water. H_2S is removed from gas streams by using Amine. Rich amine, i.e. amine containing H_2S, is regenerated in Amine Regeneration Unit and gaseous H_2S stream from the top of the regenerator is routed to the Sulphur Recovery Unit. Sour water is routed to a Sour Water Stripper Unit where sour water is preheated and then steam stripped to remove H_2S and NH_3. Acid gas stream with mostly H_2S and some ammonia is routed to the Sulfur Recovery Unit. Stripped sour water will be sent to the waste

water treatment facility to be processed for recycle to the process units or discharged to the environment. All discharged water will conform to Environmental Guidelines.

In the Sulphur Recovery Unit (SRU), H_2S is converted to elemental sulphur with a high degree of conversion (required 98.8% conversion). Subject to meeting environmental requirements, remaining sulphur will be burned in a tail gas incinerator and be vented to the atmosphere through the incinerator stack. Elemental sulphur is degassed and then exported.

Process waters that have potentially come in contact with H_2S and NH_3 will be collected and sent to a sour water stripper where the contaminant gases will be thermally stripped from the water. The stripped water will be sent to the waste water treatment facility to be processed for recycle to the process units. The H_2S rich gas will be sent for sulphur recovery.

The H2S rich streams from the amine unit and sour water stripper will be sent to a Claus type recovery plant where the H_2S will be converted to elemental sulphur, degassed, and sent to storage. Subject to environmental approvals, any unconverted H_2S will be oxidized to SO_2 before being discharged to atmosphere through a stack.

4.4.3 Tanks and Pipelines

Atmospheric storage tanks and pressure storage tanks will be used throughout the refinery for storage of crudes, intermediate hydrocarbons (during the process), and finished products. Tanks are also provided for fire water, process and treatment water, acids, additives, and other chemicals. The type, construction, capacity and location of tanks will depend on their use and materials stored. Special attention will be given to designing the tankage to control odours and the escape of volatile organic components (VOC's). Tanks will be built to API 650 or API 620 standard, as applicable. Modern tank design ensures that the odour and health issues associated with the older refineries will not occur at the Southern Head facility.

The Project will have a tank farm that will accommodate 21 days of crude feed storage and 14 days of product storage. Ensuring a volume of storage that matches

the processing capability of the refinery and the design of the marine facility of sufficient handling facility will eliminate the present issue of long-term anchoring by tankers and add to the ease and safety of tanker manoeuvring at the head of the Bay.

The initial 300,000 bbl/d phase of the project will have a storage volume of approximately 1,100,000 barrels (m3) for crude oil and 620,000 barrels (m3) for product. The second 300,000 bbl/d phase of the project, should it proceed, will have a storage volume of approximately 700,000 barrels (m3) for crude oil and 260,000 barrels (m3) for product. LPG will be stored in spheres. Tank design will follow API 650 or API 620 standard, as applicable. Storage tank selection and design will be based on safety and reliability of the system and minimum environmental impact due to vapor or liquid release.

As per regulations, the tank storage area will be dyked and lined to provide containment in the case of an accidental spill and to prevent hydrocarbon escape into the surrounding environment. An oil water separator will be fitted to the drainage system from the tank farm containment area, to separate hydrocarbon products from drainage water before being discharged to the environment.

4.4.4 Sulphur and Coke Storage and Handling

4.4.4.1 Sulphur

Sulphur is a by-product of the refinery process whereby sulphur recovery converts hydrogen sulphide in sour gases and hydrocarbon streams to elemental sulphur. It is estimated that 1,000 tonnes per day will be produced for 300,000 bbl/d production. Sulphur will be stored in a purpose built storage yard and loaded via a covered conveyor system to the designated export wharf onto bulk carriers for export.

4.4.4.2 Coke

The new refinery will be fitted with a Coker Unit. Petroleum Coke is a by-product of the delayed coking process. Petroleum Coke or simply “Coke” is almost pure carbon with a variety of uses from electrodes to charcoal briquets. Coke production will be approximately 5,000 tonnes per day for 300,000 bbl/d production. Coke will be

stored in a purpose built yard and transported via closed conveyor system to bulk carriers for export.

4.4.5 Utilities, Infrastructure and Support Systems

4.4.5.1 Process Infrastructure and Support Systems

Instrumentation and Control

A state of the art control room for the Project will be installed with instrumentation, control and information facilities. These facilities will be used to monitor the process units to ensure the safety of the plant and its personnel and to optimize plant performance

Steam Plant

Steam is generated in main steam generation plant, and/or at various process units using heat from flue gas or other sources. Heaters (furnaces) include burners and a combustion air system, the boiler enclosure in which heat transfer takes place, a draft or pressure system to remove flue gas from the furnace, soot blowers, and compressed-air systems that seal openings to prevent the escape of flue gas. Boilers consist of a number of tubes that carry the water-steam mixture through the furnace for maximum heat transfer. These tubes run between steam-distribution drums at the top of the boiler and water-collecting drums at the bottom of the boiler. Steam flows from the steam drum to the superheater before entering the steam distribution system.

Pumps, Piping and Valves

Pumps: Centrifugal and positive-displacement (i.e., reciprocating) pumps will be used to move hydrocarbons, process water, fire water, and wastewater through piping within the refinery. Pumps will be driven by electric motors. The pump type, capacity, and construction materials depend on the service for which it is used.

Piping: Process and utility piping distribute hydrocarbons, steam, water, and other products throughout the facility. Their size and construction depend on the type of

service, pressure, temperature, and nature of the products. Vent, drain, and sample connections are provided on piping, as well as provisions for blanking.

Valves: Many different types of valves will be used in the plant depending on their operating purpose. These include gate valves, bypass valves, globe and ball valves, plug valves, block and bleed valves, and check valves. Valves can be manually or automatically operated.

Turbines:

Turbines will be either gas- or steam-powered and are used to drive pumps, compressors, blowers, and other refinery process equipment. Steam enters turbines at high temperatures and pressures, expands across and drives rotating blades while directed by fixed blades.

Compressors:

Reciprocating and centrifugal compressors are used throughout the refinery for gas and compressed air. Air compressor systems include compressors, coolers, air receivers, air dryers, controls, and distribution piping. Blowers are used to provide air to certain processes.

Cooling Towers:

Cooling towers remove heat from process water by evaporation and latent heat transfer between hot water and air.

4.4.5.2 Process Utilities

The following are the major process utilities of this new refinery:

- Fuel Gas
- Raw Water
- Cooling Water
- Process Water

- Boiler feed water
- Steam (different levels)
- Plant Air/Instrument Air
- Nitrogen

Fuel Gas

A combination of light hydrocarbon gases containing some hydrogen will makeup the fuel gas under normal refinery operation. This will be supplemented with refinery gas and/or natural gas.

Raw Water

Raw water (both freshwater and seawater) will be used to meet the need for cooling water make-up, process water, steam generation etc.

Cooling Water

Cooling water use will be minimized and limited to those services where air cooling is not applicable. Recirculated cooling water will be treated to remove impurities and dissolved hydrocarbons. Seawater will be used for cooling water.

Process Water

Process water will be used in different plants mostly to dissolve salts (chlorides, ammonium sulfides etc.) to prevent deposition at cooler parts of different equipment (top of tower, at exchanger/ air-cooler etc.). The final process water specification will be decided based on Licensor's requirements.

Boiler Feed Water

Water used in steam generation must be free of contaminants including minerals and dissolved impurities that can damage the system or affect its operation. Suspended materials such as silt, sewage, and oil, which form scale and sludge, must be

coagulated or filtered out of the water. Dissolved gases, particularly carbon dioxide and oxygen, cause boiler corrosion and are removed by deaeration and treatment. Dissolved minerals including metallic salts, calcium, carbonates, etc., that cause scale, corrosion, and turbine blade deposits are treated with lime or soda ash to precipitate them from the water. Recirculated cooling water must also be treated for hydrocarbons and other contaminants.

Steam System

Steam/ Boiler Feed Water: Steam will be generated at 3 levels (LP, MP & HP: 350 kPag, 1040 kPag & 4140 kPag). Some process units will produce steam from BFW.

The steam distribution system consists of valves, fittings, piping, and connections suitable for the pressure of the steam transported. Steam leaves the boilers at the highest pressure required by the process units or electrical generation. The steam pressure is then reduced in turbines that drive process pumps and compressors. Most steam used in the refinery is condensed to water in various types of heat exchangers. The condensate is reused as boiler feedwater or discharged to wastewater treatment.

Plant Air/Instrument Air

Plant Air/Instrument air will be produced in conventional method to ensure adequate supply to all areas.

Plant air is provided for the operation of air-powered tools, catalyst regeneration, process heaters, steam-air decoking, sour-water oxidation, gasoline sweetening, and other uses. Instrument air is provided for use in pneumatic instruments and controls, air motors and purge connections.

Nitrogen

Nitrogen will be supplied to the plant as required by an outside vendor. Nitrogen will be stored on site in pressurized tanks rated for the service.

Process Chemicals

These will be defined during the Design Basis Memorandum stage of the Project and will be available for the EIS.

4.4.5.3 Site Utilities, Infrastructure and Support Systems

- Site Water Supply (Process and Potable)
- Fire Water Supply
- Storm Water Drainage System
- Oily Water/Process Water Drainage System
- Sanitary Sewerage System
- Waste Water Treatment System
- Electrical Power Supply

Site Water Supply

Uninterrupted water supply is an important part of the refinery process. Water is used in many refinery processes, including de-saltation and steam generation. Depending on the characteristics of boiler feedwater, some or all of the following stages of treatment will be used: clarification, sedimentation, filtration, ion exchange, and aeration/de-aeration. The proposed water supply may be from a desalination plant constructed on site, if on site freshwater resources are not sufficient.

Of the more than 7,500 desalination plants in operation worldwide, 60% are located in the Middle East. The world's largest plant in Saudi Arabia produces 128 MGD of desalted water. In contrast, 12% of the world's capacity is produced in the Americas, with most of the plants located in the Caribbean and Florida. To date, no desalination plants have been built along the Newfoundland and Labrador coast, primarily because the cost of desalination is generally higher than the costs of other water supply alternatives available in the province (e.g., lakes, ponds, rivers and groundwater pumping). However, due to the relatively small supply of surface water at the proposed site and concern over water quality and local salmon resources in

Watson's Brook, desalination is an attractive source of water given the availability of waste heat and the unlimited supply of sea water.

Desalination is a process that removes dissolved minerals (including but not limited to salt) from seawater, or treated wastewater. A number of technologies have been developed for desalination, including reverse osmosis (RO), distillation, electrodialysis, and vacuum freezing. Two of these technologies, RO and distillation, are being considered by the project for development of seawater desalination.

During the Design Basis Memorandum phase, the total water demand will be determined. A hydraulic model of the distribution, pumping and storage system will be developed to size major components and pipelines.

Depending upon the level of treatment required for various water usages, a central treatment plant versus individual treatment plants will be evaluated. Intake and outfall structures will be incorporated into the new marine construction for the Jetty where possible.

The potable water supply will feed off the raw water supply. Potable water will be treated to Canadian Drinking Water Guidelines (CDWG). Normally, the potable water demand is small compared to the process and cooling water requirements; however, the treatment level can be considerably higher. If this is the case, then consideration will be given to separate treatment of the potable water and a stand-alone piping system. Consideration will also be given to developing groundwater for potable water which may require less treatment and reduce capital and operating costs.

Fire Water System

The fire water system will feed off the new water supply and will be developed strictly in compliance with NFPA Guidelines. A hydraulic model of the piping, pumping and storage system will be developed to size the major components. Consideration will be given to using treated and non-treated water for fire requirements.

Storm Water Drainage System

The storm water drainage system consists of a network of drains and catch basins and interconnected with an underground piping system. This system will surface drainage channels and handle all clean water runoff from non process areas. This water will be discharged to the storm water outfall into Placentia Bay.

Volumes of storm water generated from the site will be estimated using a computer model (HEC or HYSYS). The model will be used to size the underground piping network and above-ground channels required to collect and convey the storm water from the site. A sedimentation pond will likely be required and will be located and sized.

Oily Water/Process Water Drainage System

The oily water/process water drainage system consists of a network of surface drainage channels and catch basins interconnected with an underground piping system. This system will drain and handle all dirty water runoff and expended process water from process areas. This water will then be discharged to the wastewater treatment system.

Sanitary Wastewater Disposal

The Sanitary Sewerage system consists of a network of underground pipes and manholes that connect all of the buildings on site. Sanitary waste and grey water will be collected from washrooms and utility rooms in site buildings and transported through the sanitary system to the water treatment system.

A model of the sanitary sewer system (SANSYS) will be developed to size the underground piping collection system and discharge outfall. The level of treatment required will also be evaluated.

Wastewater Treatment

Wastewater treatment will be used for process, bilge water, runoff, and sewerage water prior to discharge or recycling. Wastewater will typically contain hydrocarbons, dissolved materials, suspended solids, phenols, ammonia, sulfides, and other compounds. Wastewater includes condensed steam, stripping water, spent caustic solutions, cooling tower and boiler blowdown, wash water, alkaline and acid waste neutralization water, and other process-associated water.

Pre-treatment will be used for the separation of hydrocarbons and solids from wastewater. API separators, interceptor plates, and settling ponds remove suspended hydrocarbons, oily sludge, and solids by gravity separation, skimming, and filtration. Some oil-in-water emulsions may need to be heated to assist in separating the oil and water. Gravity separation depends on the specific gravity differences between water and immiscible oil globules and allows free oil to be skimmed off the surface of the wastewater. Acidic wastewater will be neutralized using ammonia, lime, or soda ash. Alkaline wastewater will be treated with sulphuric acid, hydrochloric acid, carbon dioxide-rich flue gas, or sulphur.

After pre-treatment, suspended solids will be removed by sedimentation or air flotation. Wastewater with low levels of solids may be screened or filtered. Flocculation agents may be added to help separation. Secondary treatment processes biologically degrade and oxidize soluble organic matter by the use of activated sludge, unaerated or aerated lagoons, trickling filter methods, or anaerobic treatments. Materials with high adsorption characteristics may be used in fixed-bed filters or added to the wastewater to form a slurry which is removed by sedimentation or filtration. Additional treatment methods may be used to remove oils and chemicals from wastewater. Stripping may be used on wastewater containing sulphides and/or ammonia, and solvent extraction is used to remove phenols.

Tertiary treatments may be required to remove specific pollutants to meet regulatory discharge requirements. These treatments include chlorination, ozonation, ion exchange, reverse osmosis, activated carbon adsorption, etc. Compressed oxygen may be diffused into wastewater streams to oxidize certain chemicals or to satisfy

regulatory oxygen-content requirements. Wastewater that is to be recycled may require cooling to remove heat and/or oxidation by spraying or air stripping to remove any remaining phenols, nitrates, and ammonia.

Electrical Power Supply

The project requires an uninterrupted power supply of 170MW for the first phase of the project. This power will delivered from Newfoundland and Labrador Hydro from a combination of spare capacity on the inter-provincial grid and/or with the construction of new electrical generation capacity.

The main electrical substations will receive power from the utility for distribution throughout the facility. These main substations will be located in non-classified areas, away from hazardous sources or cooling-tower water spray. Transformers, circuit breakers, and feed-circuit switches will be located in the main substations. The main substations will provide power to distribution stations within the process unit areas. Generally, the distribution stations will be located in non-classified rooms or buildings within the facility. Power transmission from the main substations to the distribution substations will be by a combination of overhead and underground cables. The main stations will have an outdoor, liquid-filled transformer(s) and oil-filled or air-break disconnect devices. The distribution substations will have dry type transformers, and medium and low voltage distribution equipment as required by the process equipment.

4.4.6 Emissions and Discharges

The major sources of potential atmospheric pollution include combustion gasses exhausted from process furnaces and boilers, as well as hydrocarbon vapours vented from process equipment and storage tanks. The major sources of liquid discharges are from the processing facilities as well as offices and storm sewers.

Control and management of air emissions has been identified as an issue of interest to communities near the Project area (as is seen in Section 3.1.4). Site-wide modelling will be carried out and the information provided in the Environmental Assessment. The refinery would be among the first to be built to modern standards in

North America. Using advanced technology will greatly decrease the emissions from the refinery. The Province has indicated that Best Available Control Technology (BACT) will be required.

Emissions modelling will be incorporated into equipment selection and process and plant design, as well as compliance and effects monitoring. The Province has indicated that the CALPUFF air dispersion model is approved for use in the province. NLRC intends to initiate air quality monitoring on site following project approval to establish baseline conditions.

The Canadian Council of Ministers of the Environment (CCME) issued a report in 2005, National Framework for Petroleum Refinery Emission Reductions. Both the Department of Environment and Conservation and the Department of Health and Community Services participated in development of the report and/or its background studies. This report and associated background reports provide useful guidance regarding health indicators, benchmarking and emission monitoring. NLRC is working with Memorial University's Health Research Unit to establish a health profile for the communities in the general vicinity of the project site (See Section 4.1.5.4).

The National Framework primarily addresses the emissions of 'criteria air contaminants' and these will be the focus of the air dispersion modelling for the proposed refinery: sulphur oxides, nitrogen oxides, volatile organic compounds (VOCs), particulate matter, carbon monoxide and benzene.

Air dispersion modelling will consider both the new refinery alone and the combined or cumulative emissions from the new and existing refineries.

The air emissions modelling will be based on an air emission inventory for the new refinery. The inventory will consider:

- Plant and Process Description
  - Number of units and process description of each
  - Plant production capacity
  - Plant location

- Plant layout, including major buildings and structures (to be considered for plume downdraft problems)
- Specifications of typical crude oil to be refined
- List of process emission sources (stacks, vents, etc.) with their characteristics (height, diameter, exit speed, emission rate and/or pollutants concentrations)
- Quantity and nature of combustibles to be used (oil, natural gas, diesel, etc.)

➢ Tank Farm Operations

- Number of tanks
- Service of tanks
- Open or closed roof?
- Are floating roofs used? Which type?
- Any air pollution control (APC) devices to be installed? Which type? With what operations conditions?
- Operation information for each tank

➢ Wastewater treatment

- API separators specifications
- API separators to be covered?
- Oily water sewer to be capped?
- Oily water sewer to be separate from storm water sewer?
- Amount of water to be treated and typical hydrocarbon content

➢ Loading/Unloading Operations

- Monthly quantity and nature of material transferred for a typical year
- Vapour recovery system to be installed?
- VOC reduction units such as oxidizers or adsorbers to be installed? With what specifications?

➢ Process Fugitive Emissions

- Any "leakless" design components to be used?
- Number of components of each of these types: pumps and compressors

- Mobile Sources
  - Type and number of vehicules to be used in the refinery (operation)
  - Total amount of kilometres to be traveled
- Other Sources
  - Cooling towers, combined cycle power plants, refrigeration units, etc.

The results of the air dispersion modelling will be presented and discussed with communities as soon as they are available. This information will provide important input to equipment selection and to monitoring programs.

The National Pollutant Release Inventory (NPRI) has been established under the Canada Environmental Protection Act (1999). NPRI requires that companies report annually on release and transfers of pollutants. The Project will participate in NPRI reporting throughout its lifecycle. NPRI information is publicly available. Examples of activities that will be included in the NPRI report are wastewater treatment plants, diesel generators, any open burning of wood during site clearance and grubbing, quarrying and crushing, crude and product storage tanks, and refinery emissions.

As stated above air - as well as water - monitoring will begin prior to construction, to obtain baseline data, and will continue during the construction and operations stages. Water monitoring will be completed for both marine environments and freshwater sources in the area.

Sulphur

Due to the presence of sulphur in crude oil, and the coking/hydrocracking/ hydrotreating of hydrocarbons, a significant amount of H2S is produced throughout the entire facility. H2S is found in many gas streams in the refinery and in sour water. H2S is removed from gas streams by using Amine. Rich amine, i.e. amine containing H2S, is regenerated in Amine Regeneration Unit and gaseous H2S stream from the top of the regenerator is routed to the Sulphur Recovery Unit. Sour water is routed to a Sour Water Stripper Unit where sour water is preheated and then steam stripped to remove H2S and NH3. Acid gas stream with mostly H2S and

some ammonia is routed to the Sulphur Recovery Unit. Stripped sour water quality will conform to environmental guidelines.

In the Sulphur Recovery Unit (SRU), H2S is converted to elemental sulphur with a high degree of conversion (required 98.8% conversion). Remaining sulphur is burned in a tail gas incinerator and is vented to the atmosphere through an incinerator stack. Elemental sulphur is degassed and then exported.

The use of modern technology and clean fuels will eliminate the issues associated with the volumes and types of air emissions characteristic in the early days of the existing refinery's operations. The Proponent is aware of the concerns this caused (see Sections 3.1.3 and 3.1.4).

Hydrocarbons

All hydrocarbon drains will be routed to a closed drain system. The number of drain vessels will be decided based on the topography of the facility and the location of different units. All maintenance drains can be routed to a single header, if required. Automatic process drain/ process blowdown requirements, if any, will be identified and routed separately. Hydrocarbon collected from these vessels will be returned to the slop tank. Vessels will be vented to a flare.

The Amine system will have separate closed drain; the requirement for separate drain vessels in individual units will be identified.

Produced Sour Water

Process sour water will have a separate closed drain; the requirement for separate drain vessels in individual units will be identified.

Oily Water

An Oily Water Sewer (OWS) system will be considered for collecting oily water from steaming and water washing of different equipment. Oily water will be collected in an Oily water pond. Oil will be removed from water and returned to the slop tank. Treated water (quality as per environmental regulations) will be discharged.

Consideration will be given to installing oil/water separation systems within individual process units to minimize oil entering the sewer system.

Brine

Brine from the desalting operation will be skimmed for removal of oil. Subsequent treatment and/or disposal of brine will be evaluated.

Noise

Noise on the project will originate from rotating machinery such as cooling fans, turbines, compressors, engines and motors. High velocity flow of fluids through valves, nozzles, and piping also contributes to general noise level. To control these noises, equipment causing the noise is enclosed or insulated. Proper intake and exhaust silencers are provided on blowers, combustion engines, and turbines. For any piece of equipment, maximum allowable noise will be 80 dBA at 1.0 m distance. In the event of higher noise, adequate measures will be taken to minimise noise pollution (i.e. installed noise muffler etc.). During engineering of the project, a noise map of the entire facility will be developed to check noise level at perimeter and within plant working area.

During construction noise will be generated by construction activity, equipment operation, blasting, pile driving, operation of electric and gas powered tools.

Light

The refinery will operate 24 hours a day and be well-lighted at all times. Light during night-time periods can affect birds, particularly during migration. Light itself may be considered by some as a form of pollution. Light will be discussed fully in the Environmental Assessment.

Waste Management

Solid wastes will be produced during all phases of the project. During construction, waste produced will be primarily solid waste which will be managed either on-site or

by contractors in the local area. Any contaminated waste, such as petroleum contaminated soil can also be handled by accredited local contractors.

During site clearing, merchantable crown timber (9 cm in diameter or greater, 1.3 m above mean ground level) will be salvaged. Harvesting will take place by a commercial permit holder in the area to be used for sawlogs, fuelwood, or pulpwood.

Three types of solid wastes during operations are produced: (a) process waste, (b) non-process hazardous waste, and (c) non-hazardous waste. The requirements for handling, storage and disposal of all these waste materials will be developed and a storage area will be identified in the plot plan. There are landfills located in the nearby communities of Sunnyside and Southern Harbour. Liquid waste will be treated on site to acceptable levels before discharge to the environment. Hazardous waste, both liquid and solid, will be managed by accredited contractors.

Volumes of waste anticipated will be determined during the detailed design phase and will be discussed in detail in the Environmental Assessment.

4.4.7 Marine Infrastructure

The Project will require new marine facilities. The new facilities will consist of the following components:

Heavy Lift Construction Dock

A heavy lift construction dock will be constructed north of the new Jetty. The new dock will be extended out to provide a minimum 15 m draft at the berth. The dock is expected to be constructed with sheet pile cells and will be designed to accept large pre-fabricated modules and construction supplies for the construction phase of the Project. This dock will be expanded to form the sulphur/coke loadout dock.

New Tug Berth

The tug berth will be constructed to the north of the new construction dock. Berthing facilities will be provided for three tug vessels. Tugs will be sized

appropriately for handling VLCC tankers (350,000 DWT) in the sea conditions characteristic of Placentia Bay.

New Causeway

The new causeway will form the connection from land out to the new jetty trestle to accept new crude and product piping required by the Project. A single lane roadway, complete with curbs and guardrail, will also be provided. The construction of the causeway will be done using rock fill from site excavations and protected with armour stone similar to the existing causeway at North Atlantic Refinery.

Access Trestle

The access trestle will form the connection between the causeway and the jetty. It will be of sufficient width to allow for similar equipment and services as the causeway. The trestle will be constructed of steel pipe piles with either steel or pre-stressed concrete girders. A pipe rack will run along side of the roadway to carry electrical and piping facilities.

Project Jetty (Phase 1)

The Phase 1 jetty will consist of the construction of two vessel berths connected to the access trestle. The northern berth will be designed to accommodate vessels ranging in size up to 100,000 DWT. This berth will primarily be used for the export of petroleum products. The southern berth will be designed to accommodate vessels ranging in size up to 350,000 DWT (VLCC size tankers) and will be used as a crude import and product export berth. These berths will have sufficient water depth for the largest design vessel when considering fully-loaded draft with wind, wave and tidal conditions at the site. The berths will have mooring dolphins and breasting dolphins sized to accept the full range of vessels expected at the berths. The Jetty structures will be constructed with steel piles or steel jackets supporting the concrete deck and will be connected to the existing causeway and access trestle. The berths will be equipped with energy absorbing fenders, quick release mooring hooks and product loading/unloading arms.

Jetty Expansion (Phase 2)

The Phase 2 Jetty expansion will consist of the construction of a jetty connected to and south of the Phase 1 Jetty. This new Phase 2 jetty will have two berths. The inside berth will be designed to accommodate vessels ranging in size up to 150,000 DWT and the outside berth will be designed to accommodate vessels ranging in size up to 350,000 DWT (VLCC size tankers). Both berths will be used as crude import and product export berths.

These berths will have sufficient water depth for the largest design vessel when considering fully-loaded draft with wind, wave and tidal conditions at the site. The berths will have mooring dolphins and breasting dolphins sized to accept the full range of vessels expected at the berths. The Jetty structures will be constructed with steel piles or steel jackets supporting the concrete deck and will be connected to the existing causeway and access trestle.

With respect to operational and functional aspects, the expansion jetty will be outfitted with similar equipment as the Phase 1 jetty.

Vessel Loading/Off-loading

Offloading of Crude will be accomplished through the import piping systems. The pipeline systems will be routed along the existing access trestle and causeway, through the existing plant to the new tank storage areas. Onboard ship pumps will pump the crude to the crude storage tanks. Connection to tankers will be made with marine crude oil/product loading arms specially designed for the full range of vessel sizes and motions at the berth similar to the existing facility. Product loading will be performed through the product export pipelines along a similar routing. Product flow will be via gravity with pump assist as required.

Loading of the sulphur and coke materials will be carried out via a closed conveyor system to eliminate fugitive dust emissions. The conveyor system will be connected to a ship loader on the berth. The ship loader will be designed for the full range of vessel sizes and motions at the bulk materials berth.

Oil Handling Facility

The new marine terminal will meet the criteria for designation as an Oil Handling Facility under the Canada Shipping Act. As such, oil spill prevention and oil spill preparedness/response plans will be developed, meeting or exceeding the requirements of regulations. The Proponent recognizes the importance of the traditional uses of the coast and waters of Placentia Bay and is aware that fishers in the area have been trained in spill response. The Proponent will ensure these plans are developed in consultation with fishers and other residents.

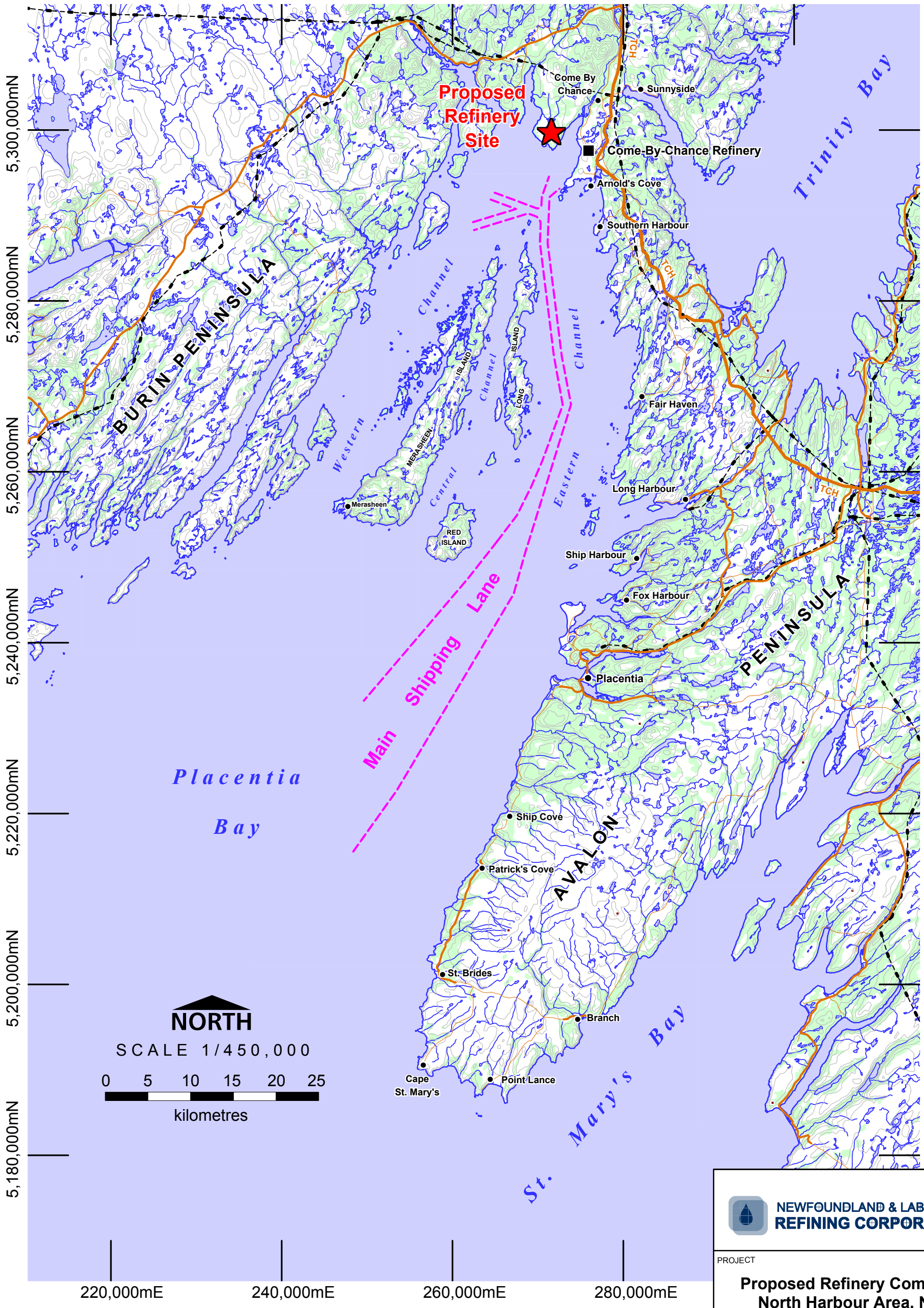
4.4.8 Vessel Traffic

There is extensive use of the waters of Placentia Bay itself. The Bay supports a healthy commercial fishery, aquaculture, oil tanker traffic associated with the existing refinery and transhipment terminal, cargo vessels, passenger ferries, recreation, significant ecological areas and tourism.

Initially, the new refinery will be processing 300,000 bbl/day (approximately 50,000 Mt/day), which will require a total of approximately 400 ships per year and possibly as many as 450 ships per year. This will depend on the vessel size profile of the incoming feed stock crude oil tankers and the size of the outbound product tankers. Generally, to service the eastern seaboard of the United States, product tankers are generally not larger than 80,000 DWT. If servicing areas with larger port capacities product tankers could be as large as 150,000 DWT.. Crude delivery will be made in VLCC tankers (2 million barrels/300,000 DWT, i.e. one VLCC tanker per week) and/or in Suezmax size tankers (1 million Mt/150,000 DWT; i.e. one tanker every 3 days).

The Coke (at 5,000 t/day) and Sulphur (at 800-1000 t/day) will be shipped out by bulk carriers of various capacities (10,000 - 50,000 DWT).

The present refinery processes approximately 108,000 bbl/day with 220 ships in 2005, and the Newfoundland Transhipment Terminal at Whiffen Head receives approximately 300 tankers per year.



NEWFOUNDLAND & LABRADOR REFINING CORPORATION

PROJECT

Proposed Refinery Complex
North Harbour Area, NL

TITLE

SHIPPING ACCESS
Placentia Bay, NL

DESIGNED BY	RC	CHECKED BY	KR	DATE	08-09-2006
DRAWN BY	RC	APPROVED BY	KR	DATE	08-09-2006
SCALE	1/450,000	BNG PROJ No.	722649		
		CLIENT PROJ No.			
DRAWING No.	**FIGURE NO. 4-17**			REV.	**C**

Tankers will use existing designated traffic lanes and anchorages and comply with the vessel traffic management system (see Figure 4-17) well established in Placentia Bay. All marine structures will be outfitted with applicable navigation lights and the jetty facilities will be equipped with life safety equipment. The Project will add to the traffic volume and will add additional marine infrastructure, the wharf and jetty, and possibly additional anchorages to the area. See Figure 4-14 for greater detail concerning the location and layout of the proposed jetty.

Vessel traffic is currently managed through a vessel traffic separation system that runs the length of the Bay and includes calling-in points and compulsory pilotage. A Canadian Coast Guard chaired committee, the Placentia Bay Traffic Committee, is a long established forum for vessel operators. Both the old refinery and the transhipment terminal have liaison committees with fishers and nearby communities. The Proponent will also monitor the ongoing Smart Bay initiative to integrate electronic information and data sources for enhanced information access for marine operations.

4.4.9 Waste Handling and Disposal

NLRC is committed to ensuring that appropriate waste management be implemented during all phases of the project. Waste Management programs will be in place for all activities under the Environmental Management System (see Section 4.4.10). The main objectives of the plans will be a practical framework of process and infrastructure to allow for effective use of waste management techniques such as waste minimization, waste segregation and the three R's (Reduction; Re-use/Recovery; and Recycling). Plans will ensure that adverse environmental impacts are avoided or minimized and that waste management complies with provincial regulations.

Air emissions and effluent discharges are discussed in Section 4.4.6 and waste management is discussed in several sections such as Section 4.1.5.11 and 4.4.6. The Environmental Management System described in Section 4.4.10 indicates that there will be a site specific waste management plan developed. Additional information on wastes, and their management will be available and provided in the

Environmental Assessment. There are accredited hazardous waste management companies in the province and several waste disposal areas in the Project area.

4.4.9.1 Waste Management Plan

There are landfills located in the nearby communities of Sunnyside and Southern Harbour. Liquid wastes will be treated on site to acceptable levels before discharge to the environment. Hazardous waste, both liquid and solid, will be managed by accredited contractors. For more detail, also see Section 4.4.6.

Purpose

The proponent is committed to taking all steps necessary for the proper collection, storage, transportation and disposal of all wastes generated by the construction and general operations of this project. A comprehensive Waste Management Plan will be developed f or all phases of the project. This is a working document to be used by all employees and contractors on the refinery site, which will be updated and improved throughout all stages of the project

Implementation

A Waste Management Plan will be developed and implemented for each stage of the project (construction, operations and decommissioning) to deal with specific waste management issues unique to that particular stage. Revisions and additions will be made as necessary and the structure of the Plan will allow for updates and revisions to be made easily as further detail of the engineering design and work methods become available. The implementation of the plan will ensure activities are compliant with all applicable Acts, Regulations and Guidelines.

Waste Management Plan Content

Section 1 of the Waste Management Plan will provide an introduction, responsibilities of project personnel and implementation procedures.

Section 2 of the Waste Management Plan will provide a detailed description of the disposal plan and measures necessary for proper disposal of the following waste types:

- Recyclable and Non-Recyclable Hazardous Wastes
  - Petroleum Waste Stream
    - Used Oil
    - Used Hydraulic Oil
    - Contaminated or Expired Fuels
    - Used Oil Filters
    - Soil Contaminated with Petroleum Products
  - Chemicals and Miscellaneous Hazardous Wastes
    - Glycol
    - Waste Batteries
    - Aerosol Cans
    - Paints
    - Spent Cleaning Fluids
    - Laboratory Chemical Wastes
    - Biological Waste
- Inert Solid Waste
  - Conveyer Belts or Tires
  - Vehicles
  - Bulk Construction Debris
  - Plastics
  - Corrugated Cardboard, Paper, Formwork
  - Scrap Metal
  - Waste Lumber
  - Sandblasting Residues
- Domestic Wastes
  - Food Wastes
- Sewage Sludge

Section 3 of the Waste Management Plan will provide references to key sources of information to enable high levels of waste management performance, such as:

- Water Resources Act
- Storage and Handling of Gasoline and Associated Products Regulations
- Used Oil Control Regulations
- Dangerous goods Transportation Act and Regulations
- Waste Management Regulations
- Fisheries Act
- Air Pollution Control Regulations
- Environmental Protection Act
- Environmental Control Water and Sewage Regulations

Section 4 of the Waste Management Plan will provide contingency plans for occurrences such as improper disposal of wastes, fire, extreme weather conditions, and accidental spills for example.

Section 5 of the Waste Management Plan will provide the names and numbers of key contacts for the project.

4.4.10 Health, Safety and Environmental Management Systems

4.4.10.1 Scope

A comprehensive Project-specific Health, Safety and Environmental Management System (HSEMS) will be developed as an early stage of the project as possible. The HSEMS document provides the Proponent's policy statement and commitments, it defines the Environmental, Health and Safety responsibilities and procedures to be applied to all project activities from engineering, procurement and construction activities to operations and closure of the facilities for the Newfoundland & Labrador Refinery Project.

4.4.10.2 Objective

To ensure that all project activities are carried out in an environmentally-responsible manner, with minimum adverse impact on the environment, human health and safety during all phases of the project.

To ensure that all project personnel, including the owner, their consultants, vendors, contactors, and operators are aware of and understand their environmental responsibilities when conducting their respective activities associated with the Project.

The local environmental conditions will affect, and must be considered in, the design of the project components, the construction methods, and operations and decommissioning of the Project. The Project will be designed and constructed with full consideration of the environmental setting and sensitivities.

4.4.10.3 Relevant Codes and Standards

Section 3.1.2 references applicable Federal, Provincial, and Municipal legislation as they may apply to specific Project activities. Appendix A contains a preliminary list of permits, approvals and authorizations, including the responsible agency, that may be required to undertake specific project activities. This list will be revised as detail design advances and additional project requirements are identified.

4.4.10.4 Health, Safety & Environmental Management System Components

The Proponent's Health, Safety and Environmental Management System (HSEMS) is the principal mechanism by which Newfoundland and Labrador Refining Corporation will integrate the project activities including design and engineering, construction, operation and decommissioning with the environment. The Permitting, Approval and Authorization requirements, Environmental Protection Plan (EPP), Emergency Preparedness Plan and Reclamation Plan are key elements of this HSEMS and the Proponent representatives, contractors/vendors and other project personnel are responsible for ensuring they are familiar with these requirements.

Detailed Project–specific Environmental Management Plans will be developed as part of the proposed Project Environmental Management System, including, but not necessarily limited to:

- Environmental Protection Plan (EPP)
- Environmental Monitoring Plan (EMP - Effects and Compliance Monitoring)
- Waste Management Plan (WMP)

- Water Management Plan
- Noise and Dust Control Plan
- Air Emission Control Plan
- Marine Safety Plan
- Emergency Preparedness Plan
- Reclamation Plans
- Community Liaison Plan

The above environmental management plans will be prepared and implemented for all project activities (i.e. Construction, Operations, and Decommissioning).

An Occupational Health and Safety Plan will also be developed, to ensure the undertaking is carried out in accordance with the *Occupational Health and Safety Act* and *Regulations*. These measures will provide the necessary equipment, systems and tools to a ensure a safe workplace is maintained. Proper information, instruction, training, supervision, and facilities will also maintain the health and safety of personnel for all stages of the project.

4.4.10.5 Environmental Protection Plan

Purpose

The EPP is the cornerstone for implementing environmental protection measures during the construction and subsequent phases of the project, providing documentation of environmental protection procedures (general and site-specific), against which performance can readily be assessed and, if appropriate, the need for additional corrective measures can be determined. It is a working document to be used by project personnel and contactors in the field, as well as at the corporate level for ensuring environmental requirements and commitments made in policy statements are implemented and monitored.

Implementation

An EPP will be implemented for each phase (construction, operations, and decommissioning) of the project to deal with environmental issues specific to each

individual phase. Revisions/additions to the EPP will be made to reflect new and site-specific construction sequences, work methods and environmental protection requirements and responsibilities. The EPP will be structured to allow for updates and revisions as required to meet the requirements of the reviewers, and as engineering design and work methods are further defined. Each EPP and revision thereof will be reviewed and approved by the Owner/Proponent.

Drawings – EPP Notations

All "issued for construction"(IFC) drawings will be annotated with environmental considerations and/or EPP notation boxes referencing specific sections of the EPP to be consulted by contractors/field personnel when carrying out activities in the area defined by the IFC drawing.

EPP Content

The style and format of the EPP is intended to enhance its use by project personnel in the field and to provide an important support document between the overall approach to environmental protection planning and the specific requirements contained in various permits, approvals and authorizations issued for project development and activities. The following is a generic contents of the Project EPP.

Section 1 of the EPP provides an introduction, responsibilities of various project personnel and implementation procedure.

Section 2 of the EPP provides an overview of the environmental concerns and the standard environmental protection measures associated with a variety of specific activities anticipated to occur in relation to each specific phase. Standard environmental protection procedures have been or will be developed for:

- Clearing of vegetation
- Grubbing and disposal of related debris
- Storage, handling and transfer of fuel and other hazardous material
- Sewage disposal
- Solid waste disposal

- Quarrying and aggregate removal
- Buffer zones
- Erosion prevention
- Excavations, embankment and grading
- Stream crossings
- Dust control
- Trenching
- Dewatering – work areas
- Marine vessels
- Pumps and generators
- Noise control
- Blasting
- Winter trails
- Groundwater development and use
- Drilling – Geotechnical/Water well/marine
- Concrete production
- Linear developments
- Vehicular traffic
- Works in/around marine environment
- Construction camp
- Surveying
- Equipment operations
- Drilling – Geotechnical Drilling in the Marine Environment
- Miscellaneous - Others

Section 3 of the EPP references key sources of information for the purposes of HS&E performance including for example Department of Fisheries and Oceans (DFO) fact sheets and a list of Proponent's background technical data reports compiled during the environmental assessment.

Section 4 of the EPP provides contingency plans for:

- Fuel and Hazardous Materials Spills

- Wildlife Encounters
- Discovery of Historic Resources
- Forest Fires
- Vessel Accidents

Section 5 of the EPP provides the names and numbers of key contacts for the project.

Section 6 of the EPP contains the site-specific EPPs for the principle work areas for the construction of the Project. These areas include:

- Access and Service Roads
- Process Plant Site Development
- Marine Terminal Area and Marine Operation
- Quarry Development and Cement Works
- Utilities (solid waste, sewage, water supply, fire water, power, etc.)

Site-specific EPPs, in Section 6 of the EPP, will be modified or expanded as needed throughout the various phases of the Project as engineering design, work methods and overall schedule progress. The site-specific EPPs contain information on local environmental issues and concerns; potential effects and sensitive areas/periods; general environmental protection measures; relevant drawings and documents; and a listing of applicable permits, approvals and authorizations and associated compliance monitoring requirements.

4.4.10.6 Environmental Monitoring

Environmental Monitoring Plan will be developed and implemented during the project Phases. It will include Environmental Effects and Compliance Monitoring. The Environmental Effects Monitoring Plan will be developed in consultation with regulators and the Community Liaison group.

The plan will detail the methods and procedures to be used by contractors on-site when conducting their activities. The Environmental Monitoring Plan will allow

Vendors/Contractors to ensure that all the activities carried out under their direction or by their subcontractors/suppliers is in compliance with the permit, approval and authorization requirements, the Proponent/Owner's site EPP, the Emergency Preparedness Plan and, where applicable, the Reclamation Plan. The Proponent/Owner's HS&E On-site Supervisor (or designate) and/or Company`s Representative has the right to monitor and/or audit any work in progress, or completed, at any time to ensure compliance with the EPP.

4.4.10.7 Permits, Approvals and Authorizations

An initial list of the required permits, approvals and authorizations has been identified (Appendix A). Contractors will submit a list of all required permits, authorizations, licences and certificates to the Company's Representative upon award of contract.

Contractors will be responsible for obtaining all permits, approvals, authorizations and certificates directly related to their contract activities, which were not identified as being the responsibility of the Proponent/Owner or Company`s Representative. The Vendors/Contractors will also identify any additional permits, approvals, authorizations and certificates that do not appear on the above mentioned list. The Contractor will submit their respective applications to the Company`s Representative, in sufficient time prior to the date required to commence on-site activities.

4.4.10.8 Documentation

Documentation submitted in support of, and copies of the permits, approvals and authorizations obtained by the Proponent/Owner, Company`s Representative and Contractors will be maintained at the site and at the offices of the Owner and/or Company`s Representative.

4.4.10.9 On-Site Monitoring and Control

The Contractor including all their sub-contractors/suppliers and associated personnel will be responsible for the implementation and compliance with all conditions specified on the permits, approvals or authorizations and practices and procedures identified in the EPP.

The Proponent/Owner or the Owner's Representative will have full-time monitors on-site to monitor and enforce environmental protection measures and to ensure all activities are conducted in accordance with the EPP and the conditions specified in all permits, authorizations or approvals. In addition, the Contractor is required to have a full-time Environmental Coordinator on-site for the duration of the contract activities.

4.4.10.10 Environmental Orientation

The Proponent or its Representative is committed to providing a Site Orientation Program as part of the overall HS&E Management System. Upon arrival at site a Site Orientation will be provided to all new site workers/visitors prior to commencing activities at the Proposed Refinery Site. The orientation will provide information on a broad range of site rules and policies, worker health and safety, workplace health and safety, environmental protection planning, historic resources management planning and wildlife harassment issues The effectiveness of environmental orientation has been proven at other projects in the province, such as the Bull Arm construction site during development of the site and building of the Hibernia platform, and the on-going Voisey's Bay mine/mill site in Labrador.

4.4.10.11 Emergency Preparedness Plan

As part of NLRC's Environmental, Health & Safety Management System, an Emergency Preparedness Plan will be developed and implemented during all phases of the Refinery Project.

The Emergency Preparedness Plan will provide an appropriate and consistent response to emergency situations that may occur during the construction, operation, and decommissioning of the Project. As stated in NLRC's commitment, the proponent is dedicated to making investments in infrastructure to enhance the response capacity to environmental threats or accidents within Placentia Bay.

Purpose

The main purpose of the Emergency Preparedness Plan is to ensure the protection of life, environment and property/equipment and to identify predetermined courses of

action for accidents, oil spills and release of hazardous/toxic substances, system failure, or other emergency situations arising at the site. This plan defines the responsibility of key personnel and outlines the general procedures to be followed when responding to emergencies in a way that will avoid or reduce health and safety risks, minimize trauma, safety hazards and environmental damage, and reduce cleanup cost.

This Emergency Preparedness Plan outlines the emergency response protocols to be followed by all site management, engineering and environmental staff and all contractor's site workforce. It provides easy access to information needed in dealing with emergency situations involving personnel, as well as spills or incidents involving release of hazardous or environmentally damaging substances.

Scope

The Emergency Preparedness Plan will apply to all personnel working at the Refinery site, and describes the emergency procedures that will be implemented immediately upon the discovery of a situation that may endanger:

- safety and/or health of individuals;
- environment; and
- property and/or equipment.

The Emergency Preparedness Plan will cover the following possible emergency situations:

- Injury (Major/Minor)
- Fatalities
- Fire/Explosion
- Forest Fires
- Vehicle Accidents
- Vessel in Distress
- Oil/Hazardous Materials Spills
- Person Overboard
- Wildlife Encounters

- General Evacuations
- Natural Disasters

Due to the fact that oil spills have been identified as an area of concern, special attention will be paid to spill prevention, as well as response preparedness and clean-up.

Training

While the above possible incidents have been recognized, it is important to note that the implementation of safety education and training initiatives are essential in minimizing their potential of occurrence.

Effectiveness of emergency response relies heavily on training and instruction to ensure that all aspects of the plan are communicated and understood. Additionally, to ensure that individuals perform emergency response safely and efficiently, specific training programs are required to develop an understanding of tasks required.

All site employees and visitors entering the project site must have an understanding of emergency response procedures for the project, and become familiar with their role in an emergency situation. Site employees/visitor training for emergency response will be presented in the project site orientation.

4.4.11 Fire Fighting/ Emergency Preparedness

Emergency Preparedness and fire-fighting will be addressed in the site Environmental Protection Plan. Existing emergency infrastructure in the nearby communities is identified in Section 4.1.5 in the Socio-economic Setting. Site plans will be developed in conjunction with the provincial standards and in consultation with the Fire Commissioner and Emergency Measures Office. The site will have trained personnel and state-of-the-art equipment on site. Accommodations established for the construction phase will meet all provincial and company safety standards.

4.4.12 Potential Causes of Resource Conflict

Potential interactions with the Project during operation activities may include those associated with:

- Fish and Fish Habitat
- Air Quality (Emissions)
- Resource Harvesting (eg: fisheries, hunting)
- Birds and Wildlife
- Provincially and/or Federally protected “Species at Risk”, if present
- Socio-Economic Environment
- Water Quality (with regards to human and ecosystem health)

Other potential resource conflicts may be identified during further public consultation and scoping.

Terrestrial and Freshwater

The refinery will be designed and built to moderns standards and requirements thus avoiding some of the potential conflicts associated with older industrial complexes. The use of Best Available Technology that is Economically Available will avoid or minimize air emissions from the refinery and greatly reduce or eliminate emissions of concern for public health, such as sulphur oxides, nitrogen oxides, volatile organic compounds, particulate matter, carbon monoxide and benzene.

Surveys will have identified any species of plants or animals listed, either provincially or federally, as ‘at risk’ and amendments made to site Environmental Protection Plans.

Monitoring programs will be in place for potential conflicts identified during the environmental assessment.

Marine

In addition to review under the environmental assessment processes, the marine facilities and marine operations will undergo review under the TERMPOL process which examines operational safety issues.

There are potential conflicts with commercial fishing, due to increased tanker traffic and if there is a need for additional anchorages. There are also potential conflicts resulting from accidental events which could affect commercial fishing, processing and aquaculture.

Surveys are ongoing to characterise the fish habitat in the area of the marine terminal. The design and construction of marine facilitates will be completed in such as way that impacts on fish and fish habitat will be minimized. The construction and operation of these facilities will comply with the Fisheries Act and Navigable Waters Protection Act (See Appendix A for a list of permits required). If significant residual impacts still persist after all mitigation measures have been taken, there may be a need for habitat compensation as result of the jetty, wharf, desalination facility and water treatment discharge.

There is already concern about the risk of a marine oil spill from commercial vessel traffic along the south coast of Newfoundland and any additional tanker traffic, such as is associated with the refinery project will be seen as increasing this risk. Further information about this risk will be available as a result of a spill risk assessment study ongoing for Transport Canada (expected by year end). A major marine oil spill would have wide-ranging effects on both the natural and socio-economic environments in the area.

Mitigation measures will be taken to ensure the elimination or reduction of impacts on these resources due to activities associated with operations of the project. Prior to commencement of the operations stage, NLRC will consult with stakeholders in the area. To prepare for a potential situation in which mitigative measures do not perform as effectively as planned, compensation programs will be developed to

ensure due reimbursement to stakeholders for loss of resources or income should project activities affect their livelihoods.

The Proponent has already met with several of the other users of the Bay and intends to continue to work with them, including using such forums as the Placentia Bay Traffic Committee and the Integrated Management Planning Committee. As well, NLRC is aware that Transport Canada has commissioned an oil spill risk assessment for the south coast and will use the results of this study in their planning. NLRC also intends to request review under the TERMPOL process. The Project's interactions with the commercial fishery and the expanding aquaculture industry will be thoroughly addressed in the Environmental Assessment.

4.5 DECOMISSIONING

It is intended that the Southern Head refinery will operate for at least 25 years, commencing in 2011. The project will be designed for ease of decommissioning. As well a comprehensive decommissioning plan will be developed for the Project, indicating the length of post-decommissioning monitoring based on an assessment of the site and the requirements to restore it to a state that is acceptable with appropriate regulatory authorities.

A Rehabilitation and Closure Plan will be developed at the design phase of the project. The plan will focus on protecting public health and safety, improving or eliminating environmental damage and liabilities, and allowing the land use to be similar to its original use or an acceptable alternative.

- The following will occur prior to decommissioning of the site:
  - The plant will be designed to mitigate environmental impacts.
  - The plant will be operated to mitigate environmental impacts.
  - Inspection of the property pre-closure
  - Preliminary site contamination/facility inventory will be developed
  - Draft conceptual plan will be developed which will identify information needs
  - Site characterization will occur and concerns will be identified
  - Options will be considered and a preliminary plan will be developed

- The following activities will be addressed in the Rehabilitation and Closures Plan:
  - Hazardous chemicals, reagents and materials will be removed for proper disposal
  - Pipelines and equipment will be drained and cleaned
  - Buildings and other infrastructure which will no longer be required once the refinery is closed will be properly demolished and removed
  - An assessment of soil contamination in the facility of the buildings and other facilities will be completed and appropriate remediation measures will be implemented to address contaminated soil
  - Fencing will be removed, road surfaces scarification will be completed, culverts and stream crossings will be removed and natural drainage patterns will be restored wherever practical
  - Re-vegetation will occur where practical, including seeding and reforestation through the introduction of vegetation and organic material on site

The Rehabilitation and Closure Plan will be submitted to appropriate government agencies for review and comments prior to finalization. A post-closure monitoring program will be developed for appropriate government agencies.

It is anticipated that refineries elsewhere will have been decommissioned by the time of decommissioning the Southern Head refinery and information will be available re best practice. As well, information is available from decommissioning of sites in this province that can provide information and lessons learned. A rigorous program of environmental protection integrated into design, construction and operation will assist the planning and process of decommissioning.

4.6 OCCUPATIONS

4.6.1 Hiring Plans and Policies

The proponent is committed to the employment of residents of Newfoundland and Labrador. Pending approval of this project, hiring plans and policies will be put into place to ensure that first consideration for training and employment opportunities are to residents of this province. Initial meetings with key provincial initiatives addressing skilled labour supply in the province have been scheduled.

The proponent is committed to the advancement of women in occupations where they have been and are currently underrepresented. Women's Employment Plans and Employment Equity Plans will be developed by the proponent following approval of the project. There has been a shortage of opportunities available for women to enter into work traditionally done by men, such as in the trades, technology and operations . Due to this imbalance, and also considering the potential for a shortage of skilled workers in the province, efforts will be made to promote the training and hiring of women throughout the duration of this project. A Women's Employment Program or equivalent will be developed and monitored during the construction, operation, and decommissioning stages. "Family Friendly" policies will also be developed within the refinery project to ensure the establishment of a working environment that attracts and retains a stable workforce.

4.6.2 Occupation Breakdown

4.6.2.1 Construction

The peak workforce during construction will be approximately 3000 people. Details known thus far in the project have allowed the following estimates of occupation breakdowns for the construction stage of the project, along with the number of personnel required for each category and the appropriate National Occupational Classification (NOC) codes.

Table 4-14: Breakdown of Occupations Anticipated for the Construction stage of the Undertaking (Engineering and Design Phase)

Occupation	NOC Code	# of People
Process Engineers	2134	20
Mechanical Engineer	2132	40
Civil/Structural Engineer	2231	20
Control Systems & instrumentation Engineer	2133	30
Electrical Engineer	2133	20
Metallurgist	2142	5
Loss Prevention, Safety Engineer	2141	4
Designer (Drawing Office)	2252	50
CAD Operator	2253	60

Occupation	NOC Code	# of People
Buyer (procurement)	0113	20
Expeditor (Procurement)	1473	10
Document Controller	1413	15
Secretary	1241	10
Engineering Management	0211	15
Engineering Technologist	2232	20
HSEQ	2263	20
Project Management	0711	10
Project Controls	2131	20
Administration	1221	30
Total	**-**	**419**

Table 4-15: Breakdown of Occupations Anticipated for the Construction stage of the Undertaking

Occupation	NOC Code	# of People
Pipefitter	7252	690
Millwright	7311	280
Construction Management	0711	280
Labourer	7611	270
Electrician	7242	240
Equipment Operator	7421	230
Pipe Welder	7265	200
Insulator	7293	200
Painter	9496	140
Boilermaker	7262	100
Carpenter	7271	90
Ironworker	7264	90
Sheetmetal Worker	7261	90
Welder- Structural	7265	70
Concrete Finisher	7282	30
Total	-	3000

4.6.2.2 Operations

Estimates have been given as to the number of personnel required for each occupation during the operations stage of the project, along with the corresponding National Occupational Classification (NOC) code. The peak workforce during operations will be approximately 750. These estimates do not include out sourced/contracted services or construction personal for turn around, which is estimated range from 300 to 750 depending on activities at the refinery.

Table 4-16: Breakdown of Occupations Anticipated for the Operation stage of the Undertaking

Occupation		NOC Code	# of People
Management	Plant Manager	9212	1
	Maintenance Manager	0721	1
	SH&E Manager	2263	1

Occupation		NOC Code	# of People
	Corporate Services Manager	0016	1
	Planning & Technical Services Manager	2233	1
	Marketing Manager	0611	1
	Commercial Manager	0711	1
Maintenance	Reliability/Field Services	2243	200
	Inspection	2262	25
	Warehouse	1471	38
	Turn Around (pipefitters and welders)	7252 & 7265	35
Production	Chief Steam Engineer	9212	1
	Area Managers	0016	20
	DCS	7242	5
	Training	9232	7
	Process Operators	9232	200
SH&E	Environment	2263	8
	Safety, Fire Protection and Security	2263	20
	Industrial Hygiene	2211	4
Corporate Services	Accounting	1431	24
	Human Resources	0112	6
	Information Technology	2171	9
	Purchasing	0113	10
Planning & Technical Services	Operations Scheduling	9212	6
	Long Term Planning	9212	4
	Operations Support Engineering	9212	4
	Technical Services & Projects	9212	50
	Laboratory	2211	40
	Marine	2232	30
Total	-	-	750

4.7 PROJECT-RELATED DOCUMENTS

See Section 8 –References for a complete list of project-related documents.

5 APPROVAL OF UNDERTAKING

The project will be subject to the following federal and provincial environmental legislation. Appendix A contains a preliminary list of permits, approvals and authorizations, including the responsible agency, that may be required to undertake specific project activities. This list will be revised as detail design advances and additional project requirements are identified.

The project schedule shows that approvals and permits must be in place to allow for construction start no later than January 2008. This start date enables a production start date of late 2010/early 2011. With the large number of refineries currently conducting feasibility studies, the economic viability of this refinery depends on an early entry into the market.

Government of Canada

- Canadian Environmental Assessment Act
- Canadian Environmental Protection Act
- Fisheries Act
- Species at Risk Ac
- Migratory Birds Conservation Act
- Navigable Waters Protection Act
- Transportation of Dangerous Goods Act

Government of Newfoundland and Labrador

- Environmental Protection Act
  - Air Pollution Control Regulations
- Water Resources Act
  - Environmental Control Water and Sewage Control Regulations
- Endangered Species Act

- Occupational Health and Safety Act
- Boiler, Pressure Vessel and Compressed Gas Act
- Dangerous Goods Act
- Public Health Act
- Urban and Rural Planning Act Schedule

6 FUNDING

No government funding will be required, as the project will be developed through private funding. The founding investors in NLRC include Newfoundland and Labrador-based Altius Resources Inc. and a core group of distinguished European entrepreneurs with proven track records in both equity and debt finance arrangements for development projects. The intent of NLRC is to finance the Project through private equity investment and bank debt facilities.

October 16 '06.
Date

Signature of Project Director

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Mike Warren, Executive Director, Policy and Planning

Todd Budgell, Manager of Aquaculture Licencing and Inspections

Shawn Robinson*, Director of Aquaculture

Brent Tompkins*, Aquaculture Development Officer

Elizabeth Barlow*, Salmonid Aquaculturalist

Steve Moyse*, Aquaculture Planning Analyst

Paul James*, Aquaculture Development Officer

8 GLOSSARY

ABSORPTION The disappearance of one substance into another so that the absorbed substance loses its identifying characteristics, while the absorbing substance retains most of its original physical aspects. Used in refining to selectively remove specific components from process streams.

ACID TREATMENT A process in which unfinished petroleum products such as gasoline, kerosene, and lubricating oil stocks are treated with sulfuric acid to improve color, odor, and other properties.

ADDITIVE Chemicals added to petroleum products in small amounts to improve quality or add special characteristics.

ADSORPTION Adhesion of the molecules of gases or liquids to the surface of solid materials.

AIR FIN COOLERS A radiator-like device used to cool or condense hot hydrocarbons; also called fin fans.

ALICYCLIC HYDROCARBONS Cyclic (ringed) hydrocarbons in which the rings are made up only of carbon atoms.

ALIPHATIC HYDROCARBONS Hydrocarbons characterized by open-chain structures: ethane, butane, butene, acetylene, etc.

ALKYLATION A process using sulfuric or hydrofluoric acid as a catalyst to combine olefins (usually butylene) and isobutane to produce a high-octane product known as alkylate.

API GRAVITY An arbitrary scale expressing the density of petroleum products.

AROMATIC Organic compounds with one or more benzene rings.

ASPHALTENES The asphalt compounds soluble in carbon disulfide but insoluble in paraffin naphthas.

ATMOSPHERIC TOWER A distillation unit operated at atmospheric pressure.

BENZENE An unsaturated, six-carbon ring, basic aromatic compound.

BLEEDER VALVE A small-flow valve connected to a fluid process vessel or line for the purpose of bleeding off small quantities of contained fluid. It is installed with a block valve to determine if the block valve is closed tightly.

BLENDING The process of mixing two or more petroleum products with different properties to produce a finished product with desired characteristics.

BLOCK VALVE A valve used to isolate equipment.

BLOWDOWN The removal of hydrocarbons from a process unit, vessel, or line on a scheduled or emergency basis by the use of pressure through special piping and drums provided for this purpose.

BLOWER Equipment for moving large volumes of gas against low-pressure heads.

BOILING RANGE The range of temperature (usually at atmospheric pressure) at which the boiling (or distillation) of a hydrocarbon liquid commences, proceeds, and finishes.

BOTTOMS Tower bottoms are residue remaining in a distillation unit after the highest boiling-point material to be distilled has been removed. Tank bottoms are the heavy materials that accumulate in the bottom of storage tanks, usually comprised of oil, water, and foreign matter.

BUBBLE TOWER A fractionating (distillation) tower in which the rising vapors pass through layers of condensate, bubbling under caps on a series of plates.

CATALYST A material that aids or promotes a chemical reaction between other substances but does not react itself. Catalysts increase reaction speeds and can provide control by increasing desirable reactions and decreasing undesirable reactions.

CATALYTIC CRACKING The process of breaking up heavier hydrocarbon molecules into lighter hydrocarbon fractions by use of heat and catalysts.

CAUSTIC WASH A process in which distillate is treated with sodium hydroxide to remove acidic contaminants that contribute to poor odor and stability.

CHD UNIT See Hydrodesulfurization.

COKE A high carbon-content residue remaining from the destructive distillation of petroleum residue.

COKING A process for thermally converting and upgrading heavy residual into lighter products and by-product petroleum coke. Coking also is the removal of all lighter distillable hydrocarbons that leaves a residue of carbon in the bottom of units or as buildup or deposits on equipment and catalysts.

CONDENSATE The liquid hydrocarbon resulting from cooling vapors.

CONDENSER A heat-transfer device that cools and condenses vapor by removing heat via a cooler medium such as water or lower-temperature hydrocarbon streams.

CONDENSER REFLUX Condensate that is returned to the original unit to assist in giving increased conversion or recovery.

COOLER A heat exchanger in which hot liquid hydrocarbon is passed through pipes immersed in cool water to lower its temperature.

CRACKING The breaking up of heavy molecular weight hydrocarbons into lighter hydrocarbon molecules by the application of heat and pressure, with or without the use of catalysts.

CRUDE ASSAY A procedure for determining the general distillation and quality characteristics of crude oil.

CRUDE OIL A naturally occurring mixture of hydrocarbons that usually includes small quantities of sulfur, nitrogen, and oxygen derivatives of hydrocarbons as well as trace metals.

CYCLE GAS OIL Cracked gas oil returned to a cracking unit.

DEASPHALTING Process of removing asphaltic materials from reduced crude using liquid propane to dissolve nonasphaltic compounds.

DEBUTANIZER A fractionating column used to remove butane and lighter components from liquid streams.

DE-ETHANIZER A fractionating column designed to remove ethane and gases from heavier hydrocarbons.

DEHYDROGENATION A reaction in which hydrogen atoms are eliminated from a molecule. Dehydrogenation is used to convert ethane, propane, and butane into olefins (ethylene, propylene, and butenes).

DEPENTANIZER A fractionating column used to remove pentane and lighter fractions from hydrocarbon streams.

DEPROPANIZER A fractionating column for removing propane and lighter components from liquid streams.

DESALTING Removal of mineral salts (most chlorides, e.g., magnesium chloride and sodium chloride) from crude oil.

DESULFURIZATION A chemical treatment to remove sulfur or sulfur compounds from hydrocarbons.

DEWAXING The removal of wax from petroleum products (usually lubricating oils and distillate fuels) by solvent absorption, chilling, and filtering.

DIETHANOLAMINE A chemical ($C_4H_{11}O_2N$) used to remove H_2S from gas streams.

DISTILLATE The products of distillation formed by condensing vapors.

DOWNFLOW Process in which the hydrocarbon stream flows from top to bottom.

DRY GAS Natural gas with so little natural gas liquids that it is nearly all methane with some ethane.

FEEDSTOCK Stock from which material is taken to be fed (charged) into a processing unit.

FLASHING The process in which a heated oil under pressure is suddenly vaporized in a tower by reducing pressure.
FLASH POINT Lowest temperature at which a petroleum product will give off sufficient vapor so that the vapor-air mixture above the surface of the liquid will propagate a flame away from the source of ignition.

FLUX Lighter petroleum used to fluidize heavier residual so that it can be pumped.

FOULING Accumulation of deposits in condensers, exchangers, etc.

FRACTION One of the portions of fractional distillation having a restricted boiling range.

FRACTIONATING COLUMN Process unit that separates various fractions of petroleum by simple distillation, with the column tapped at various levels to separate and remove fractions according to their boiling ranges.

FUEL GAS Refinery gas used for heating.

GAS OIL Middle-distillate petroleum fraction with a boiling range of about 350°-750° F, usually includes diesel fuel, kerosene, heating oil, and light fuel oil.

GASOLINE A blend of naphthas and other refinery products with sufficiently high octane and other desirable characteristics to be suitable for use as fuel in internal combustion engines.

HEADER A manifold that distributes fluid from a series of smaller pipes or conduits.

HEAT As used in the Health Considerations paragraphs of this document, heat refers to thermal burns for contact with hot surfaces, hot liquids and vapors, steam, etc.

HEAT EXCHANGER Equipment to transfer heat between two flowing streams of different temperatures. Heat is transferred between liquids or liquids and gases through a tubular wall.

HIGH-LINE OR HIGH-PRESSURE GAS High-pressure (100 psi) gas from cracking unit distillate drums that is compressed and combined with low-line gas as gas absorption feedstock.

HYDROCRACKING A process used to convert heavier feedstock into lower-boiling, higher-value products. The process employs high pressure, high temperature, a catalyst, and hydrogen.

HYDRODESULFURIZATION A catalytic process in which the principal purpose is to remove sulfur from petroleum fractions in the presence of hydrogen.

HYDROFINISHING A catalytic treating process carried out in the presence of hydrogen to improve the properties of low viscosity-index naphthenic and medium viscosity-index naphthenic oils. It is also applied to paraffin waxes and microcrystalline waxes for the removal of undesirable components. This process consumes hydrogen and is used in lieu of acid treating.

HYDROFORMING Catalytic reforming of naphtha at elevated temperatures and moderate pressures in the presence of hydrogen to form high-octane BTX aromatics for motor fuel or chemical manufacture. This process results in a net production of hydrogen and has rendered thermal reforming somewhat obsolete. It represents the total effect of numerous simultaneous reactions such as cracking, polymerization, dehydrogenation, and isomerization.

HYDROGENATION The chemical addition of hydrogen to a material in the presence of a catalyst.

INHIBITOR Additive used to prevent or retard undesirable changes in the quality of the product, or in the condition of the equipment in which the product is used.

ISOMERIZATION A reaction that catalytically converts straight-chain hydrocarbon molecules into branched-chain molecules of substantially higher octane number. The reaction rearranges the carbon skeleton of a molecule without adding or removing anything from the original material.

ISO-OCTANE A hydrocarbon molecule (2,2,4-trimethylpentane) with excellent antiknock characteristics on which the octane number of 100 is based.

KNOCKOUT DRUM A vessel wherein suspended liquid is separated from gas or vapor.

LEAN OIL Absorbent oil fed to absorption towers in which gas is to be stripped. After absorbing the heavy ends from the gas, it becomes fat oil. When the heavy ends are subsequently stripped, the solvent again becomes lean oil.

LOW-LINE or LOW-PRESSURE GAS Low-pressure (5 psi) gas from atmospheric and vacuum distillation recovery systems that is collected in the gas plant for compression to higher pressures.

NAPHTHA A general term used for low boiling hydrocarbon fractions that are a major component of gasoline. Aliphatic naphtha refers to those naphthas containing less than 0.1% benzene and with carbon numbers from C3 through C16. Aromatic naphthas have carbon numbers from C6 through C16 and contain significant quantities of aromatic hydrocarbons such as benzene (>0.1%), toluene, and xylene.

NAPHTHENES Hydrocarbons (cycloalkanes) with the general formula CnH2n, in which the carbon atoms are arranged to form a ring.

OCTANE NUMBER A number indicating the relative antiknock characteristics of gasoline.

OLEFINS A family of unsaturated hydrocarbons with one carbon-carbon double bond and the general formula CnH2n.

PARAFFINS A family of saturated aliphatic hydrocarbons (alkanes) with the general formula CnH2n+2.

POLYFORMING The thermal conversion of naphtha and gas oils into high-quality gasoline at high temperatures and pressure in the presence of recirculated hydrocarbon gases.

POLYMERIZATION The process of combining two or more unsaturated organic molecules to form a single (heavier) molecule with the same elements in the same proportions as in the original molecule.

PREHEATER Exchanger used to heat hydrocarbons before they are fed to a unit.

PRESSURE-REGULATING VALVE A valve that releases or holds process-system pressure (that is, opens or closes) either by preset spring tension or by actuation by a valve controller to assume any desired position between fully open and fully closed.

PYROLYSIS GASOLINE A by-product from the manufacture of ethylene by steam cracking of hydrocarbon fractions such as naphtha or gas oil.

PYROPHORIC IRON SULFIDE A substance typically formed inside tanks and processing units by the corrosive interaction of sulfur compounds in the hydrocarbons and the iron and steel in the equipment. On exposure to air (oxygen) it ignites spontaneously.

QUENCH OIL Oil injected into a product leaving a cracking or reforming heater to lower the temperature and stop the cracking process.

RAFFINATE The product resulting from a solvent extraction process and consisting mainly of those components that are least soluble in the solvents. The product recovered from an extraction process is relatively free of aromatics, naphthenes, and other constituents that adversely affect physical parameters.

REACTOR The vessel in which chemical reactions take place during a chemical conversion type of process.

REBOILER An auxiliary unit of a fractionating tower designed to supply additional heat to the lower portion of the tower.

RECYCLE GAS High hydrogen-content gas returned to a unit for reprocessing.

REDUCED CRUDE A residual product remaining after the removal by distillation of an appreciable quantity of the more volatile components of crude oil.

REFLUX The portion of the distillate returned to the fractionating column to assist in attaining better separation into desired fractions.

REFORMATE An upgraded naphtha resulting from catalytic or thermal reforming.

REFORMING The thermal or catalytic conversion of petroleum naphtha into more volatile products of higher octane number. It represents the total effect of numerous simultaneous reactions such as cracking, polymerization, dehydrogenation, and isomerization.

REGENERATION In a catalytic process the reactivation of the catalyst, sometimes done by burning off the coke deposits under carefully controlled conditions of temperature and oxygen content of the regeneration gas stream.

SCRUBBING Purification of a gas or liquid by washing it in a tower.

SOLVENT EXTRACTION The separation of materials of different chemical types and solubilities by selective solvent action.

SOUR GAS Natural gas that contains corrosive, sulfur-bearing compounds such as hydrogen sulfide and mercaptans.

STABILIZATION A process for separating the gaseous and more volatile liquid hydrocarbons from crude petroleum or gasoline and leaving a stable (less-volatile) liquid so that it can be handled or stored with less change in composition.

STRAIGHT-RUN GASOLINE Gasoline produced by the primary distillation of crude oil. It contains no cracked, polymerized, alkylated, reformed, or visbroken stock.

STRIPPING The removal (by steam-induced vaporization or flash evaporation) of the more volatile components from a cut or fraction.

SULFURIC ACID TREATING A refining process in which unfinished petroleum products such as gasoline, kerosene, and lubricating oil stocks are treated with sulfuric acid to improve their color, odor, and other characteristics.

SULFURIZATION Combining sulfur compounds with petroleum lubricants.

SWEETENING Processes that either remove obnoxious sulfur compounds (primarily hydrogen sulfide, mercaptans, and thiophens) from petroleum fractions or streams, or convert them, as in the case of mercaptans, to odorless disulfides to improve odor, color, and oxidation stability.

SWITCH LOADING The loading of a high static-charge retaining hydrocarbon (i.e., diesel fuel) into a tank truck, tank car, or other vessel that has previously contained a low-flash hydrocarbon (gasoline) and may contain a flammable mixture of vapor and air.

TAIL GAS The lightest hydrocarbon gas released from a refining process.

THERMAL CRACKING The breaking up of heavy oil molecules into lighter fractions by the use of high temperature without the aid of catalysts.

TURNAROUND A planned complete shutdown of an entire process or section of a refinery, or of an entire refinery to perform major maintenance, overhaul, and repair operations and to inspect, test, and replace process materials and equipment.

VACUUM DISTILLATION The distillation of petroleum under vacuum which reduces the boiling temperature sufficiently to prevent cracking or decomposition of the feedstock.

VAPOR The gaseous phase of a substance that is a liquid at normal temperature and pressure.

VISBREAKING Viscosity breaking is a low-temperature cracking process used to reduce the viscosity or pour point of straight-run residuum.

WET GAS A gas containing a relatively high proportion of hydrocarbons that are recoverable as liquids.

Appendix 'A'
Relevant Legislation & Associated Permits

Potentially Applicable Provincial and Municipal Authorizations

Government Agency	Permit, Authorization, Approval	Activity Requiring Compliance
Department of Environment and Conservation		
Environmental Assessment Division	Release from Environmental Assessment	General
Pollution Prevention Division	Certificate of Approval to Operate a Refinery	General
Water Resources Division	Alteration to a Body of Water (Schedule A to H). This application form is required as well as the appropriate Schedule application form (see below).	Any activity in or near any body of water Permit required for any infilling of any water bodies including marine infilling.
Water Resources Division	Schedule A - Environmental Approval of Culverts	New road construction
Water Resources Division	Schedule B - Environmental Approval of Bridges	New road construction
Water Resources Division	Schedule C - Environmental Approval of Dams	
Water Resources Division	Schedule D - Environmental Approval of Fording	
Water Resources Division	Schedule E - Environmental Approval of Pipe Crossing – Water Intake	
Water Resources Division	Schedule F - Environmental Approval of Stream Modification or Diversion	New road construction
Water Resources Division	Schedule G - Environmental Approval of Small Bridges	New road construction
Water Resources Division	Schedule H - Environmental Approval of Other Alterations	Other works within 15 meters of a Body of Water.
Water Resources Division	Certificate of Approval for Site Drainage	Water run-off from the project site.
Water Resources Division	Permit for Construction of a Non-Domestic Well	
Water Resources Division	Water Use Authorization	
Water Resources Division	Certificate of Approval – Water & Sewer Distribution System	
Water Resources Division	Certificate of Approval for Temporary AGM (ARD) Storage	

Government Agency	Permit, Authorization, Approval	Activity Requiring Compliance
Pollution Prevention Division	Certificate of Approval for Industrial Facilities or Processing Work	A certificate of Approval may be required for any industrial or processing works.
Pollution Prevention Division	Certificate of Approval – Waste Disposal Facility	
	Environmental Protection Plan (EPP) – Construction	General
	Emergency Response Plan	General
	Environmental Effects Monitoring Plan	Also has to be submitted to Department of Fisheries and Oceans.
Department of Natural Resources		
Forestry Resources Branch	Commercial Cutting/ Operating Permit	
Forestry Resources Branch	Burning Permit	
Mines and Energy Branch	Magazine Licence	
Mines and Energy Branch	Explosives Transportation Permit	
Mines and Energy Branch	Application for Exploration Approval and Notice of Planned Mineral Exploration Work	
Mines and Energy Branch	Quarry Permit	
Mines and Energy Branch	Reclamation Plan (Including Financial Assurance)	
Department of Government Services		
Government Services	Licence to Occupy Crown Land	
Government Services	Certificate of Approval – Sewage Treatment Plant	
Government Services	Certificate of Approval – Water Supply >4,500 L/day	
Government Services	Certificate of Approval – Storage and Handling of Gasoline and associated products.	
Government Services	Permit for Flammable and Combustible Liquid Storing and Dispensing (Above or Below Ground) and for Bulk Storage (above ground only)	
Government Services	Storage Tank System Application	All Storage Tanks on Site Including Waste Oil Tanks.

Government Agency	Permit, Authorization, Approval	Activity Requiring Compliance
Government Services	Compliance Standards – National Fire Code, National Building Code and Life Safety Code	All Buildings on Site.
Government Services	Building Accessibility Exemption	All Building on Site
Government Services	Statutory Declaration for Registration of Boiler and Pressure Vessel Fittings Fabricated in Newfoundland and Labrador	
Government Services	**Certificate of Plant Registration** for Power, Heat, Refrigeration, Compressed Gas or Combined Plant	
Government Services	Contractor's Licence – Pressure Piping System	
Government Services	Examination and Certification of Welders and Blazers	
Government Services	Examination and Certification of Propane System Installers	
Government Services	Food Establishment Licence	If a cafeteria is located on site.
Government Services	Waste Management Plan	General
Department of Transportation and Works		
Transportation and Works	Compliance Standard – Storing, handling and transporting dangerous goods	General
Department of Human Resources Labour and Employment		
Human Resources Labour and Employment	Compliance Standard – Occupational Health and Safety	Project-related employment
Department of Tourism, Culture and Recreation		
Tourism, Culture and Recreation	Compliance Standard – Historic Resources Act	Construction and operation.
Tourism, Culture and Recreation	Archaeological Investigation Permit	
Department of Human Resources, Labour and Employment		
Human Resources, Labour and Employment	Occupational Health and Safety Manual	General
Town of Come By Chance		
Town of Come By Chance	Compliance Standard/ Development Plan	Project Construction and Operation

Potentially Applicable Federal Authorizations

Government Agency	Permit, Authorization, Approval	Activity Requiring Compliance
Transport Canada		
Transport Canada	Permit to Store, Handle and Transport Dangerous Goods	
Department of Fisheries and Oceans		
Marine Environment and Habitat Management Division	Authorization for Harmful Alteration, Disruption of Destruction (HADD) of Aquatic Habitat	Marine - Wharf construction and marine infilling. Freshwater - any in-stream work that will impact fish habitat.
Marine Environment and Habitat Management Division	Letter of Advice	
Marine Environment and Habitat Management Division	Project Referral	
Canadian Coast Guard	Navigable Waters Protection Act (NWPA)	Wharf Construction or any activity affecting navigable waters.
Canadian Coast Guard	Letter of Assessment for Stream Crossings (NWPA)	(any stream crossings)
DFO	Environmental Effects Monitoring Plan	Also has to be submitted to Department of Environment and Conservation.
Environment Canada		
Environment Canada	Compliance Standard – *Fisheries Act*, Section 36(3), Deleterious Substances	Any project-related water run-off
Environment Canada	Scientific Research Permit (Wildlife Permit)	
Canadian Wildlife Service	Compliance Standard, Migratory Birds Convention Act and Regulations	Any activities which could result in the mortality of migratory birds and endangered species and any species under federal authority.
Industry Canada		
Industry Canada	Communications Licence	General
Industry Canada	Radio Station Licence	Use of radios on site
Canadian Nuclear Safety Commission		
Canadian Nuclear Safety Commission	Nuclear Substances and Radiation Devices	General

Appendix 'B'
Refining Process

PROCESSING EQUIPMENT

PROCESS UNITS

Crude Blending Unit

A blending facility will be incorporated at the beginning of the process stream to provide the means to physically mix two or more different crude feedstocks to produce a feedstock with desired characteristics to produce the most efficient operation of the plant. Crude will be blended with either in-line through a manifold system, or batch blended in tanks depending to the type, quality and volumes of crudes to be blended.

Atmospheric and Vacuum Distillation Unit

This primary refinery unit will process the crude oil feed stock using desalting and fractional distillation equipment under both atmospheric and vacuum conditions to:

- Remove potentially corrosive salts to protect downstream process units;
- Recover pentanes and lighter materials for further processing;
- Separate the crude oil into naphtha, distillate, gas oil, and residual streams for further processing.

Distillation separates the various hydrocarbon constituents of the crude oil based on their boiling points. Light hydrocarbons can be vapourized (boiled) at relatively low temperatures. Higher temperatures are required to vapourize heavier materials and vacuum conditions are often used to prevent thermal decomposition of heavy stocks at high temperature. Desalting, atmospheric, and vacuum distillation are proven processes, widely used throughout the hydrocarbon processing industry.

The pentane and lighter material will be sent to the Saturate Gas Recovery Unit for separation.

Saturate Gas Recovery Unit

The Saturate Gas Recovery Unit receives pentane and lighter streams from the Atmospheric Distillation Unit, the hydrotreating units, and the hydrocrackers and separates the components for further processing, sales, or other uses within the refinery.

The pentanes (C5) will be sent to the Isomerization Unit for upgrading to gasoline. Propane (C3) and butane (C4) will be separated for from the ethane (C2) and lighter material. The C2 and lighter will be used for refinery fuel. Propane will be produced to LPG specification for domestic sales. Butane will be separated for gasoline blending.

Surplus volumes of C3 and C4 my be used to supplement the feedstock requirements of the Hydrogen Generation Unit.

Hydrotreating Units

In the hydrotreating units, contaminants, principally sulphur and nitrogen, are removed from the specific feedstock to produce high quality hydrocarbon products for product blending or downstream processing. In hydrotreating, the feedstock is mixed with hydrogen, heated, and passed through a catalyst bed where the contaminants are removed and the product quality is improved. These units operate at moderate temperatures and moderate to high pressure. The refinery will have five (5) hydrotreating units:

1) The Light Straight Run Naphtha Hydrotreater (LSR HTU) removes sulphur from the Atmospheric Distillation Unit Light Naphtha to make it suitable for gasoline blending.

2) The Naphtha Hydrotreater (Naphtha HTU) removes sulphur from the heavy naphtha streams from the Atmospheric Distillation Unit and the Kerosene and Diesel Hydrotreaters to prevent the poisoning of the catalyst in the Reformer.

3) The Kerosene Hydrotreater (Kerosene HTU) removes sulphur and nitrogen from the Atmospheric Distillation kerosene and produces a product for blending into Jet A1 or product kerosene.

4) The Diesel Hydrotreater (Diesel (HTU) operates under high pressure to improve the cetane quality of the Atmospheric Distillation Unit diesel stream and to reduce its sulphur content to a level that will allow its sale as Ultra-Low Sulphur diesel (ULSD).

5) The Coker Naphtha Hydrotreater removes sulphur from the naphtha streams produced by the Delayed Coker and saturates the olefinic and di-olefinic components to levels that allow the to be processed in downstream refinery units or blended to directly to gasoline.

Isomerization Unit

The Isomerization Unit, using a catalyst and hydrogen, combines the C5 and C6 material from the Saturate Gas Recovery Unit into a low volatility, high octane stock for gasoline blending.

Hydrocracker

The Hydrocracker, operating at high pressure and moderate temperature, uses hydrogen and catalyst remove the sulphur and nitrogen from the heavy gas oil streams from the Atmospheric and Vacuum Distillation Unit and the Delayed Coker. It also breaks these heavier materials into lighter components for use in commercial fuels. The quality of the Kerosene and Diesel produced will allow them to be used directly for product blending. The naphtha stream will be sent to the Reformer for octane improvement.

Delayed Coker

In the Delayed Coker, the heavy residual oil from the bottom of the Vacuum Distillation Unit is heated and charged to a coke drum where time and the heat from the feed cause the heavy oil to break down. The vapours from this thermal

decomposition are condensed and separated into fractions for further processing. The light gases are recovered primarily for refinery fuel. The naphtha fraction is treated in the Coker Naphtha Hydrotreater. The light gas oil is sent to the Diesel Hydrotreater and the heavy gas oil to the Hydrocracker. The solid coke remaining in the drum is periodically cooled and mechanically removed.

Reformer

Operating with a noble metal catalyst and at high temperature, the Reformer rearranges the molecular structure of components of the various naphtha streams to generate a stream that provides high octane for gasoline blending. As a result of the molecular rearrangement, the Reformer also produces hydrogen which supplements the volumes required by the various hydroprocessing units.

Integral to the operation of the Reformer are the Reformate Splitter and the Benzene Saturation Unit. The Splitter separates the Reformer product stream into a light fraction high in benzene and a heavier fraction. The light fraction is sent to the Benzene Saturation Unit where hydrogen is catalytically added to reduce the benzene content to safe levels. The heavy fraction is sent directly to gasoline blending.

Hydrogen Plant

High purity hydrogen (95%-99%) is produced beginning with the Hydrogen Generation Unit (HGU). First hydrogen is produced by the catalytic reforming of natural gas in the presence of steam. The raw hydrogen produced is purified using Pressure Swing Absorption (PSA) technology. Consideration will be given to recovering additional hydrogen from purge gas and fuel gas streams to minimize the investment required in the HGU. The HGU will be designed to produce hydrogen from feedstock other than natural gas.

Sulphur Recovery Facilities

The Sulphur Recovery Unit (SRU) will use the following three (3) processes:

1) Gas Treating

2) Sour Water Stripping

3) Sulphur Recovery

Sour gases, those containing H2S, NH3 and CO2, from the process units will be treated in an amine system to remove the contaminants. A lean amine solution will be circulated to the various process units where it will be contacted with the sour gases. The resulting rich amine solution, containing the contaminants, will be returned to a central regeneration system where the contaminants, principally H2S will be stripped out and sent for sulphur recovery. The stripped lean amine will be recirculated.

Process waters that have potentially come in contact with H2S and NH3 will be collected and sent to a sour water stripper where the contaminant gases will be thermally stripped from the water. The stripped water will be sent to the waste water treating facility to be processed for recycle to the process units. The H2S rich gas will be sent for sulphur recovery.

The H2S rich streams from the amine unit and sour water stripper will sent to a Claus type recovery plant where the H2S will be converted to elemental sulphur, degassed, and sent to storage. Any unconverted H2S will be oxidized to SO2 before being discharged to atmosphere through a stack.

Gasoline/ Distillate Blending Unit

A blending facility will be incorporated at the end of the process steam to provide a physical mixture of a number of different liquid hydrocarbons to produce a finished product with certain desired characteristics. Products will be blended in-line through a manifold system. In-line blending of gasoline, distillates, jet fuel, and kerosene is accomplished by injecting proportionate amounts of each component into the main stream where turbulence promotes thorough mixing. Additives including octane enhancers, metal deactivators, anti-oxidants, anti-knock agents, gum and rust

inhibitors, detergents, etc. are added during and/or after blending to provide specific properties not inherent in hydrocarbons.

HEAT EXCHANGERS, COOLERS, AND PROCESS HEATERS

Heaters

Process heaters and heat exchangers preheat feedstock in distillation towers and in refinery processes to reaction temperatures. Heat exchangers use either steam or hot hydrocarbon transferred from some other section of the process for heat input. The heaters are usually designed for specific process operations, and most are of cylindrical vertical or box-type designs. The major portion of heat provided to process units comes from fired heaters fuelled by refinery and/or natural gas, distillate, and residual oils. Fired heaters are found on crude and reformer preheaters, coker heaters, and large-column reboilers.

Coolers

Heat also needs to be removed from some processes by air and water exchangers, fin fans, gas and liquid coolers, and overhead condensers, or by transferring heat to other systems. The basic mechanical vapor-compression refrigeration system, which may serve one or more process units, includes an evaporator, compressor, condenser, controls, and piping. Common coolants are water, alcohol/water mixtures, or various glycol solutions.

PRESSURE-RELIEF AND FLARE SYSTEMS

Pressure-relief systems will control vapors and liquids that are released by pressure-relieving devices and blow-downs. Pressure relief is an automatic, planned release when operating pressure reaches a predetermined level. Blowdown normally refers to the intentional release of material, such as blowdowns from process unit startups, furnace blowdowns, shutdowns, and emergencies.

Safety relief valves, used for air, steam, and gas as well as for vapor and liquid, will allow valves to open in proportion to the increase in pressure over the normal operating pressure.

The pressure release and flare system will include relief valves and lines from process units for collection of discharges, knockout drums to separate vapors and liquids, seals, and/or purge gas for flashback protection, and a flare and igniter system which combusts vapors. Discharging directly to the atmosphere is not permitted.

The new facility is expected to have 3 flares; HP Flare, LP Flare and Acid Gas flare. While the acid gas flare will be an integral part of the sulphur recovery unit, the HP & LP Flares will be installed in offsite area. It is envisaged that relief discharges from the high pressure systems in the hydroprocessing units will be routed to the HP Flare while relief discharges from the rest of the facility will be routed to the LP flare. Each flare will be equipped with its own knock-out vessel, pumps, pilots and seal system. Hydrocarbon from the knock-out vessel will be returned to the slop tank. Emergency power will be made available for Flare K.O. Drum pump.

Appendix 'C'
Commercial Fishery & The Aquaculture Industry

NL Refinery Registration Document: Overview of Placentia Bay Commercial Fisheries and Aquaculture Activities

Prepared by Canning and Pitt Associates, Inc., 15 August 2006

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1. Study Purpose and Scope

This report provides an overview and description of commercial fisheries and aquaculture activities in Placentia Bay. Its purpose is to provide background information for the Registration stage of the proposed NL Refinery facility (the Project) and the context for a more detailed assessment of potential impacts on project-area fisheries activities and aquaculture to be undertaken in later stages of the project assessment process.

For the purpose of this analysis, the study area is all of Placentia Bay encompassed by NAFO Unit Area 3PSc.

Discussion of Placentia Bay's commercial fisheries includes a historical overview of those activities, recent changes in the area's fisheries management regime and a description of key species and harvesting patterns and locations. Current aquaculture operations and sites are also described, including a brief summary of development trends within this sector during the past decade.

As further discussed in the next section, in addition to relevant historical data, the commercial fisheries analysis relies on existing (2003- 2005) DFO data on study area fisheries resources and catches. The overview of past and current aquaculture activities is based on information obtained from the Provincial Department of Fisheries and Aquaculture (DFA). The report also draws on background information from existing agency reports, other research studies and the consultant's files.

2. Data Sources

2.1. Fisheries Data

The statistical data and analysis in this report are based primarily on time-series data from the Department of Fisheries and Oceans, Newfoundland and Labrador Region and Maritimes Region[1] describing the quantity, month and location (fisheries management Unit Area) of fish harvesting. The datasets also include information on fishing gear, vessels and other information. They have been acquired from DFO in digital form, for the period from 1984 to 2005. The analysis for this registration document presents historical information about the Placentia Bay fisheries and then focuses on the current fisheries environment, i.e. the 2003-2005 period, which has the most recently-available data.

[1] Although only a very small proportion of the harvest from within 3PSc is landed in Maritimes (Nova Scotia) Region (less than 15 tonnes in 2005); these datasets are included within the Newfoundland Region data and are used in this analysis.

About 2% of the harvest by quantity from 3PSc was specifically georeferenced in 2005 and 15% in 2004. Though this represents quite a small portion of the harvest overall, this section also provides maps of the georeferenced data that are available to indicate some part of the harvesting locations[2] in Placentia Bay.

The main analysis of harvesting activities describes fish caught within the waters of fisheries management (NAFO) Unit Area 3PSc (see Figure 1). This management and data area encompasses all of Placentia Bay, and captures species harvested from 3PSc wherever they were landed or processed. Thus catches by fishers who are not based in Placentia Bay are included while catches made by Placentia Bay-based vessels are excluded if they were harvested beyond the 3PSc area. For example, some of the larger (>35') vessels based in the area take a portion of their annual catch on fishing grounds farther offshore, such as St. Pierre Bank, whereas catches by fishers based in other areas of the province, e.g. in Fortune Bay, are included in the analysis if taken within 3PSc.

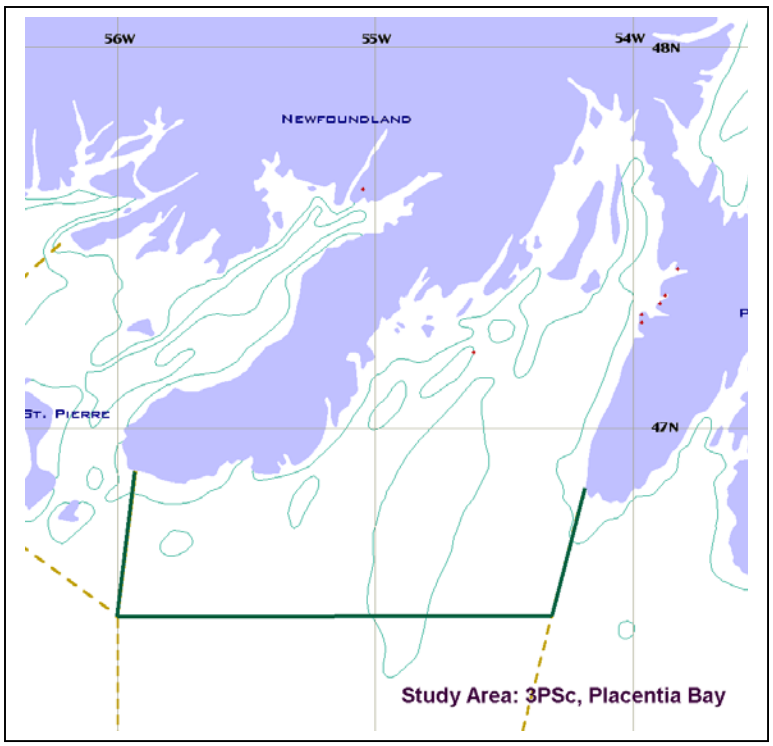

Figure 1: Study Area

The calculation of the value of the fisheries is much more complex. In addition to variability that results from changes in the quantity of harvest from year to year (whether

[2] The location given is that recorded in the vessel's fishing log, and is reported in the database by degree and minute of latitude and longitude; thus the position is accurate within approximately 0.5 nautical mile of the reported co-ordinates. It should be noted that for some gear, such as mobile gear towed over an extensive area, or for extended gear, such as longlines which may be several miles long, the reference point does not represent the full distribution of the gear or activity on the water. However, over many data entries, the reported locations create a fairly accurate indication of where such fishing activities occur.

due to natural variability or changing quotas), prices also vary from year to year, and even within the fishing season, driven primarily by market conditions, which in turn are determined by supply and demand, currency exchange rates and other market factors. Quality issues also affect the prices paid for many species. Consequently, most of the analysis provided in this section involves quantity of harvests (tonnes of fish landed), which is directly comparable from year to year.

Other data sources include fisheries management plans and data tables (e.g. fishing enterprises) provided by DFO. Information on Aquaculture was provided by the provincial Department of Fisheries and Aquaculture, including its **AguaGIS.com** database.

2.2. Consultations

The terms of reference did not require the consultants to undertake any new consultations with commercial fisheries participants or aquaculture operators in the study area. However, where required, relevant DFO and DFA managers were contacted to obtain current information on the area's fisheries and aquaculture sector activities.

Annex 1 provides a list of all persons consulted for this report, and references and information sources are listed in Appendix *.

3. Commercial Fisheries

This section presents a detailed review of the commercial fisheries harvesting environment in the Placentia Bay study area. Topics addressed include the historical context, species harvested, the monthly distribution of fishing activities, fishing gears used and geographic location of fishing activities where that information is available.

3.1. Historical Context, 1980s to the Present

Drastic changes occurred in the Placentia Bay commercial fisheries in the early 1990s when fisheries moratoria were imposed because of declining groundfish stocks. For example, within 3PSc for the period 1984-1990, 74% of the catch by quantity was cod while snow crab made up just 3%; during 1994-1995, immediately after the moratoria were imposed, cod made up only 6% of the harvest and snow crab catches had increased to 24%. In terms of value, cod accounted for nearly 60% of the value of the 3PSc harvest (1984-1992), but only a negligible amount in 1994-1995 (see Figure 2).

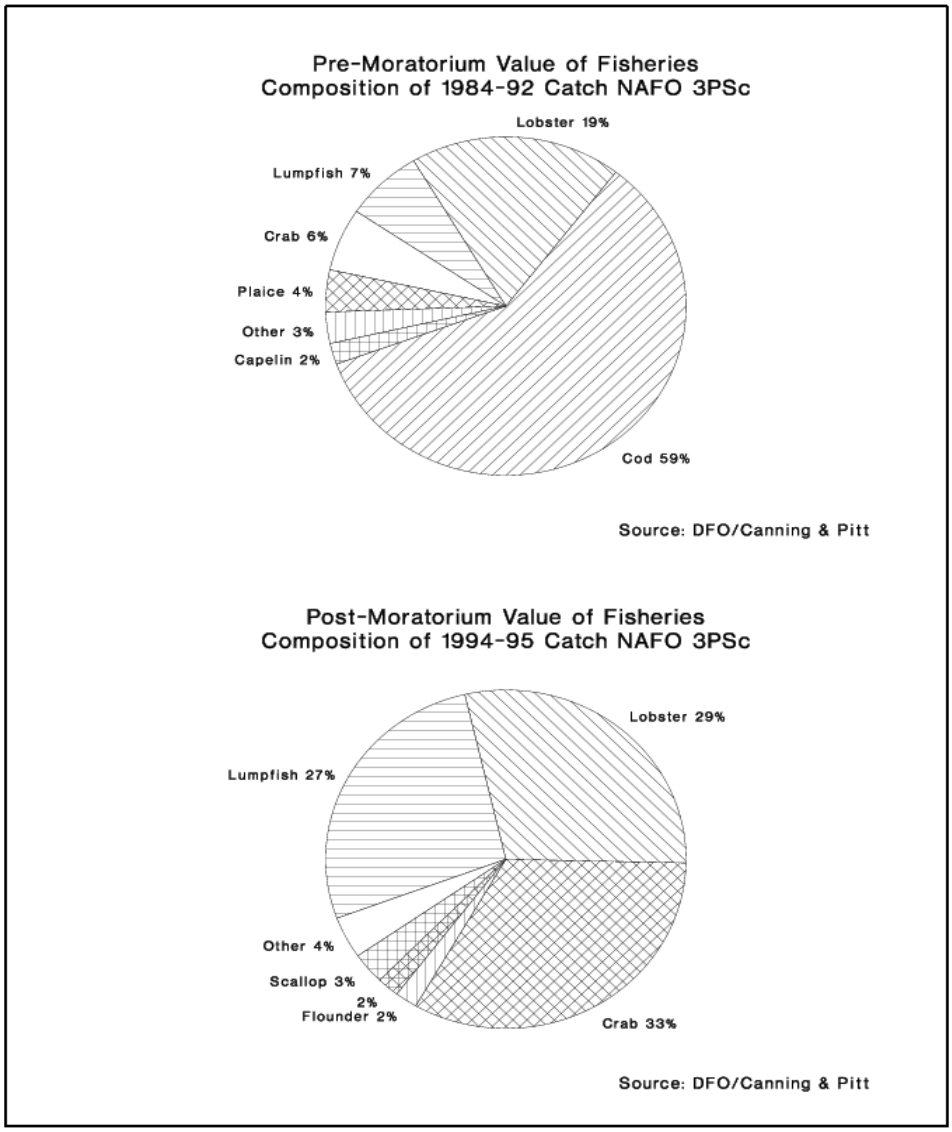

Figure 2

Between the landings highpoint in 1986 and the 1995 harvest, the quantity of biomass taken from Placentia Bay declined from more than 19,000 tonnes to under 3,000 tonnes, a drop of 85%. However, the landed value of the 3PSc fishery did not experience a similar decline, owing to the changed composition of the catch, made up - in 1995 - primarily of high-priced species such as lobster, snow crab and lumpfish roe. In that year, the value of the fishery was only 8% lower than in 1986 ($9,740,000 vs. $10,634,000). Total value continued to rise after 1995 and, by 2002, the harvest from 3PSc was worth more than $18 million; this was nearly 180% of the value of the harvest in 1986 - the peak harvesting year within the 1986-2005 timeframe. Even with weaker prices in recent years, snow crab is still a very valuable species in this area.

A limited cod fishery was reinstated in 3PSc in 1997 under a strict management regime, and during 2000-2002 cod again accounted for nearly 60% of the harvest by quantity,

though in recent years quotas have been reduced once more. The following graphs show the changes in the quantity of the harvest from 3PSc over the last 20 years (1986 – 2005). Figure 3 shows the overall quantity harvested (all species), and Figure 4 contrasts groundfish and shellfish harvests (mainly snow crab, scallops and lobster) over this period.

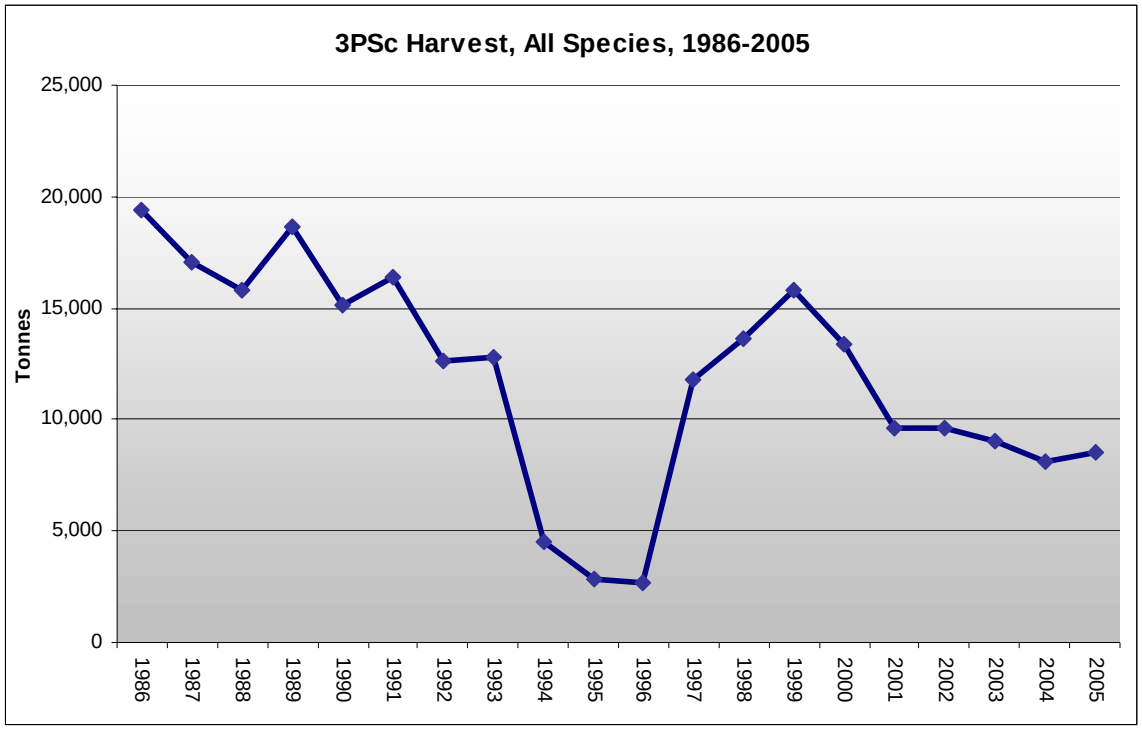

Figure 3

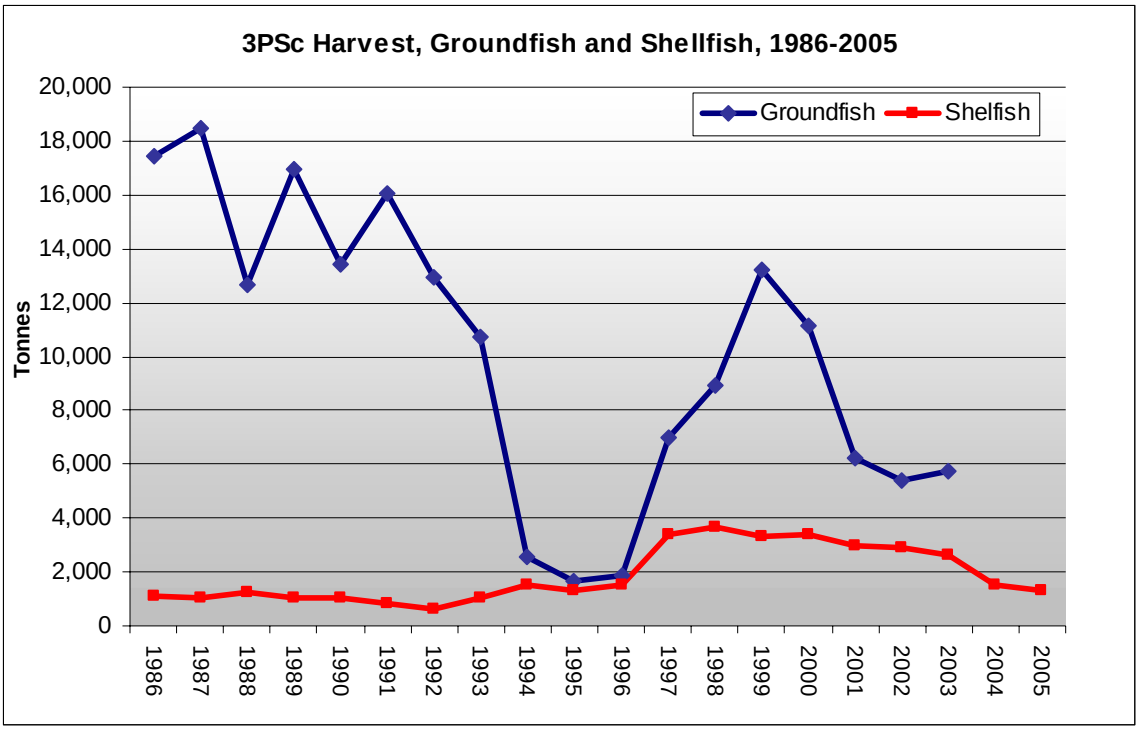

Figure 4

Since the mid-1990s, the fisheries and fisheries management and licencing regimes in Placentia Bay have continued to evolve. Most significantly, a fish harvesting rationalization strategy was implemented in the province that reduced the number of participants in the harvesting sector, and a professionalization process was introduced which prescribed specific levels of experience and training required to be a professional fish harvester. Along with this system, DFO introduced the "core" harvesting enterprise designation, with restrictions on harvesting by those who are not part of such an enterprise.

3.2. Current Commercial Fisheries

The following sections provide more information on key aspects of present-day Placentia Bay fisheries.

3.2.1. Harvesting

The following Table shows the composition of the harvest in 3PSc in recent years, based on 2003-2005 landings (averaged). As these data show, cod is still by far the most important species harvested in the area, with snow crab, herring and lumpfish (roe fishery), scallops and a few other groundfish species making up most of the remainder.

Table 1: 3PSc Harvest, 2003-2005 (Annual Average)

Species	Tonnes	% of Total
Atlantic Cod	4,805.2	56.3%
Haddock	16.1	0.2%
Redfish	5.1	0.1%
Halibut	4.4	0.1%
American Plaice	198.0	2.3%
Yellowtail Flounder	6.5	0.1%
Winter Flounder	86.1	1.0%
Skate	56.8	0.7%
Pollock	48.8	0.6%
White hake	198.9	2.3%
Monkfish	55.6	0.7%
Hagfish	60.2	0.7%
Lumpfish (roe weight only)	379.9	4.5%
Herring	754.6	8.8%
Mackerel	12.3	0.1%
Capelin	25.1	0.3%
Scallops	17.9	0.2%
Icelandic Scallops	100.6	1.2%
Sea Cucumbers	192.54	2.3%
Whelks	28.4	0.3%
Sea Urchins	31.5	0.4%
Lobster	71.9	0.8%
Snow Crab	1,367.6	16.0%
All others	7.9	0.1%
Total	8,532.1	100.0%

[1] Although the DFO data identify this harvest as "sea cucumbers" (*Cucumaria frondosa*), DFO managers consulted believe this is an error in the dataset, either associated with the incorrect Unit Area designation (sea cucumbers are harvested off St. Pierre Bank in 3PS), or the incorrect species code was used when the data were entered. If the latter, these may be scallops (code 618 vs. code 619).

Currently, some harvesting is conducted year-round, as it was in the pre-moratorium (1984-1992) period, though in recent years it has been much less evenly distributed throughout the months as it once was (see Figure 5). Since 1996, the peak harvesting months have been June and July, but there has also been a fairly strong fishery in the late fall (primarily for cod), as indicated in the graph.

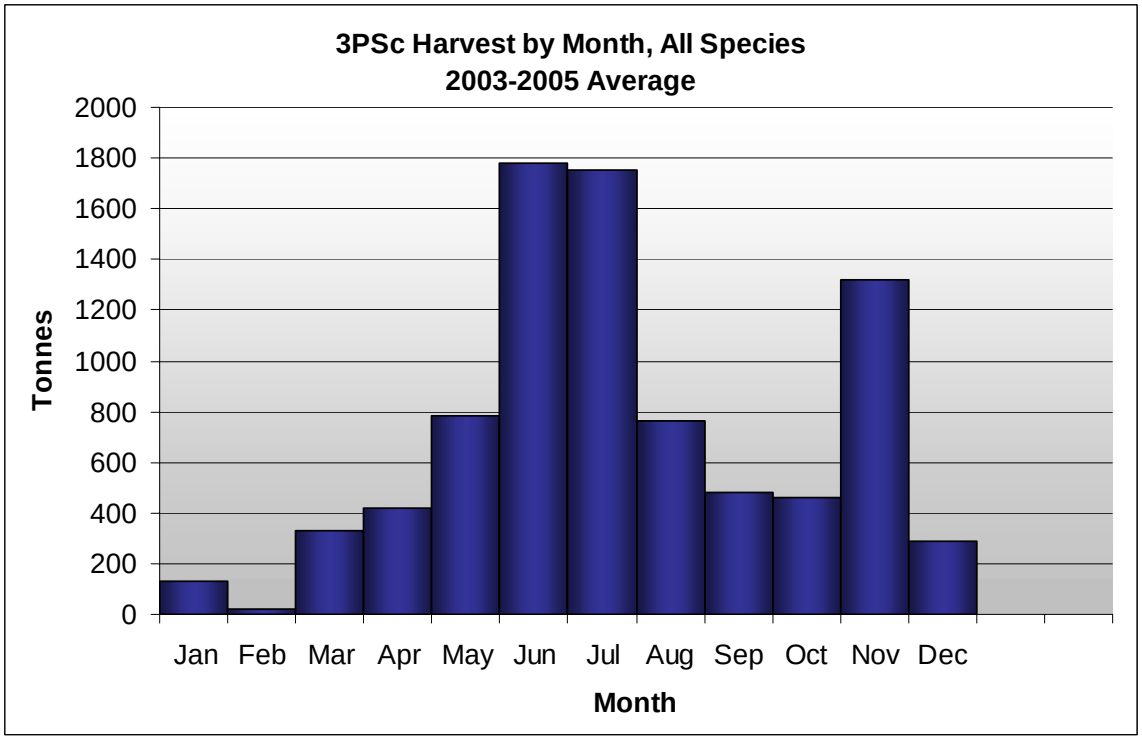

Figure 5

The following graphs show the timing of the 2003-2005 cod and snow crab harvests separately.

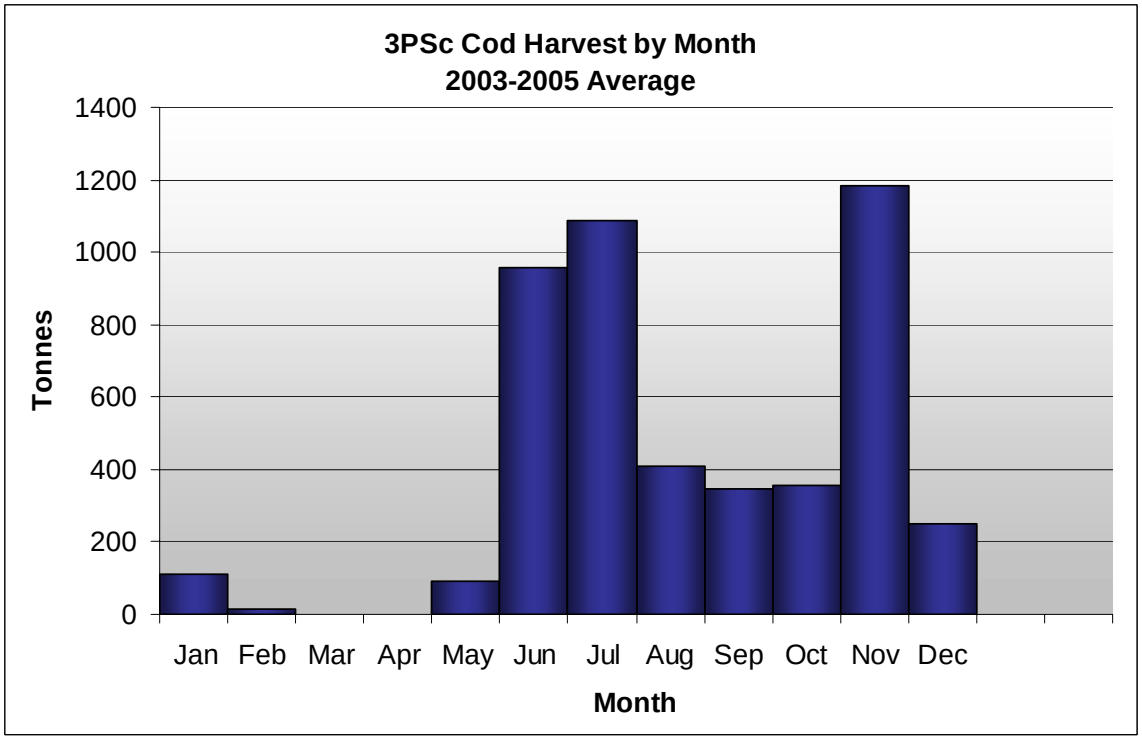

Figure 6

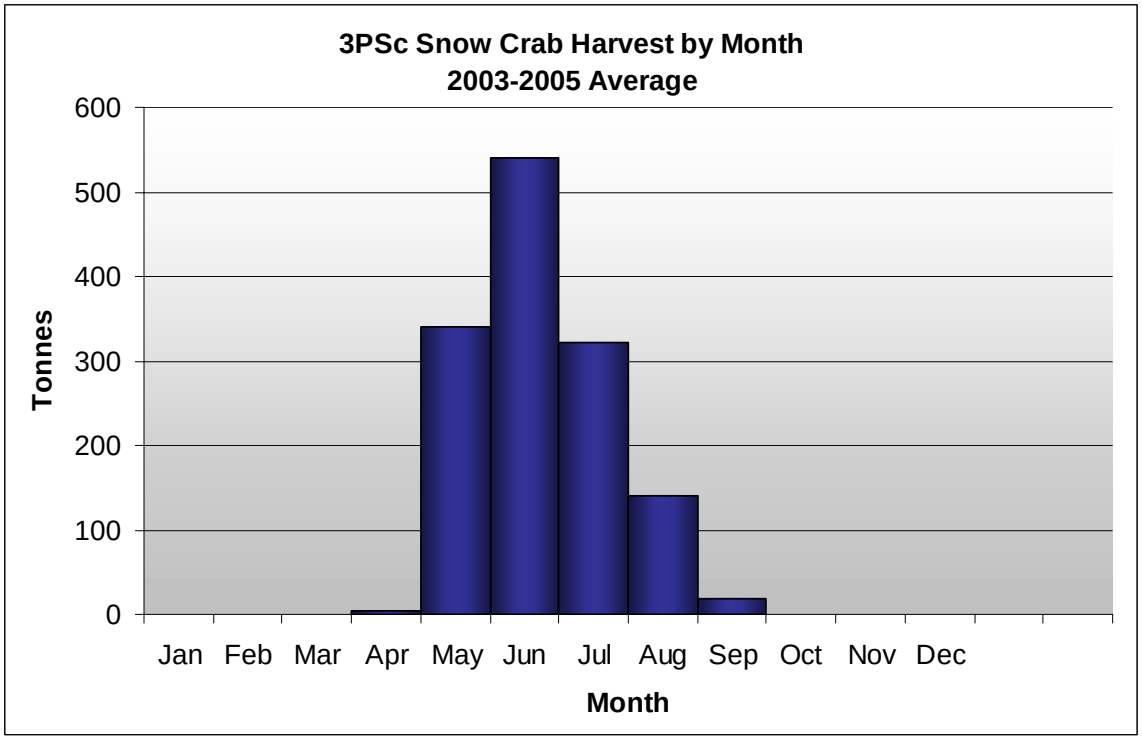

Figure 7

In terms of economic value, the area's commercial fishers currently depend on three, high-value species - lobster, snow crab and cod - for the bulk of their annual fishing income. While lobster accounts for only a small percentage by weight of the annual catch, given its high value this species remains very important to many study area fishers. Although the herring fishery is important (especially as bait), it does not have the direct economic value of the other three fisheries.

In many cases the fishing gear used is specific to the species harvested: pots for snow crab, scallop drags for scallops, diving for sea urchins. Cod is harvested using several gear types, but primarily (87% , 2003-2005) it is harvested with gillnets in this area. Table 2 shows the quantity of the harvest by each gear type for the 2003-2005 period.

Table 2: 3PS Harvest by Gear Type, 2003-2005 Average

Gear	Tonnes	% of Total
Stern Otter Trawl	58.8	0.7%
Danish Seine	1.2	0.0%
Beach/Drag/Bar Seine	37.5	0.4%
Purse Seine	644.7	7.6%
Gillnet	5,266.7	61.7%
Longline	329.2	3.9%
Hand Line	267.4	3.1%

Gear	Tonnes	% of Total
Trap Net	56.5	0.7%
Trap/Pot	1,465.5	17.2%
Drag/Dredge	311.1	3.6%
Diving	31.5	0.4%
Hagfish Barrel	60.2	0.7%
All Other	1.9	0.0%
Total	8,532.0	100.0%

The following maps show the locations recorded in the DFO georeferenced dataset for all species, 2003 - 2005. As noted, however, this represents a small sub-set of the 3PSc harvest. Some species (e.g. lobster) are not represented at all in these data.

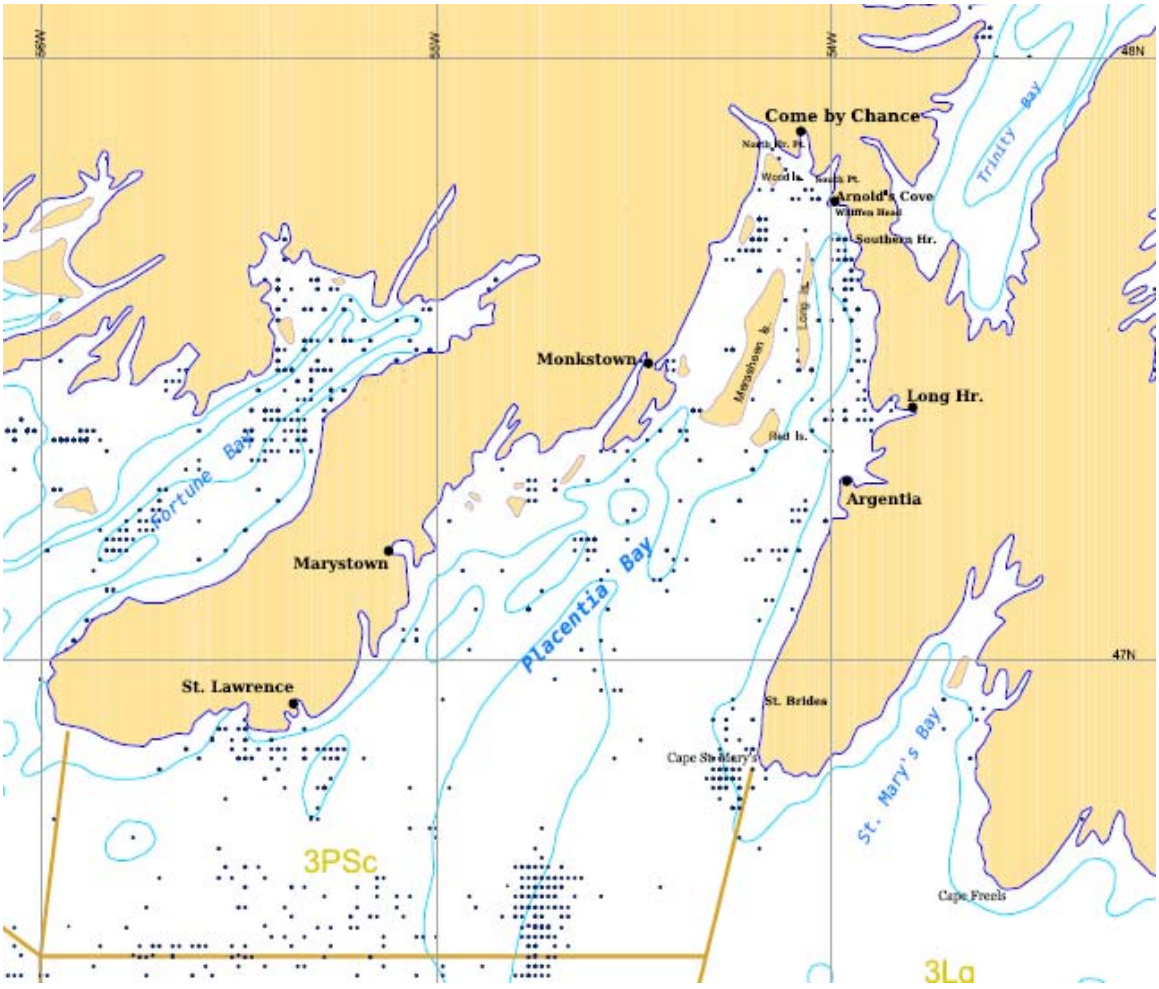

Figure 8: 3PSc Harvesting Locations, January - December 2003 (All Species in Geo-Referenced Sub-Set)

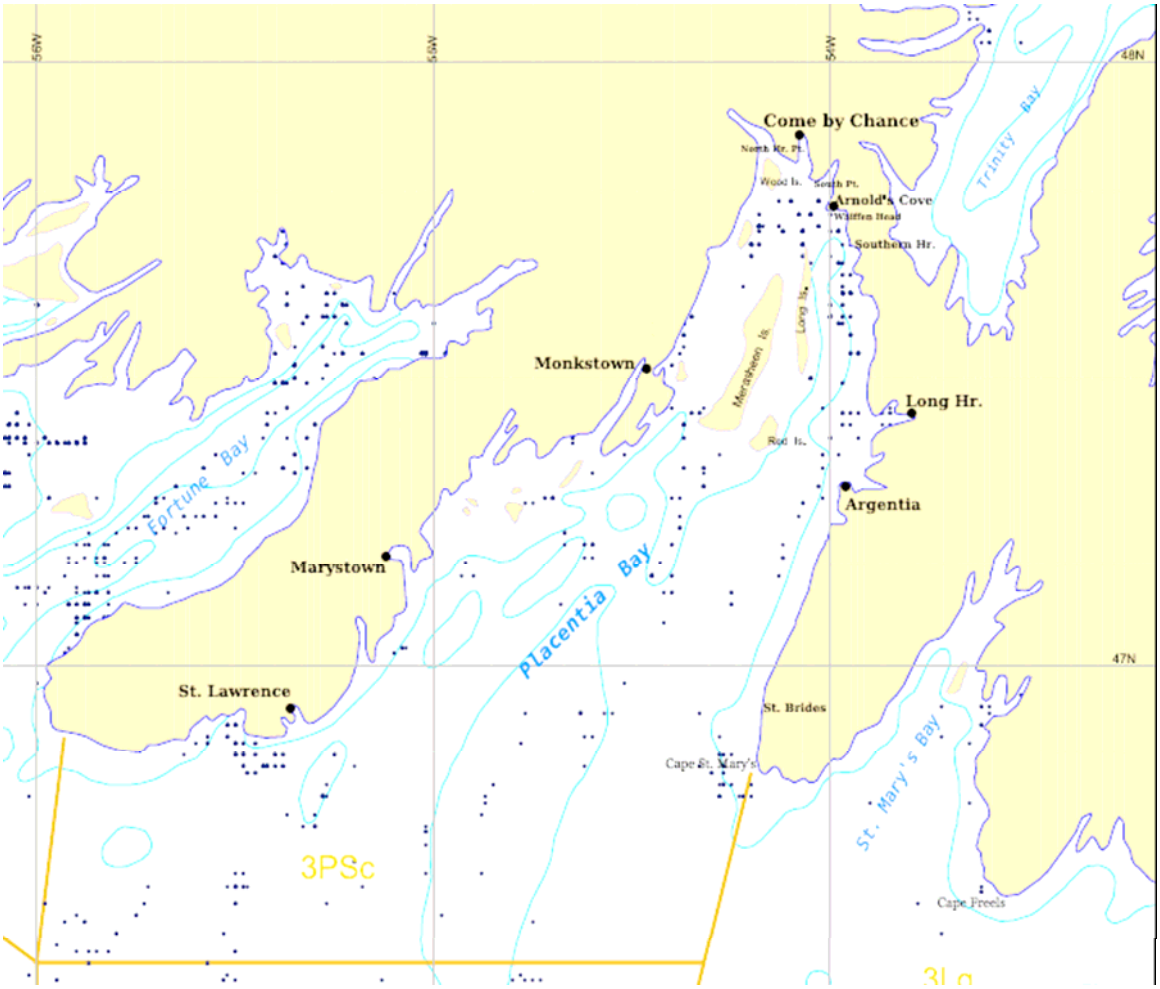

Figure 9: 3PSc Harvesting Locations, January - December 2004 (All Species in Geo-Referenced Sub-Set)

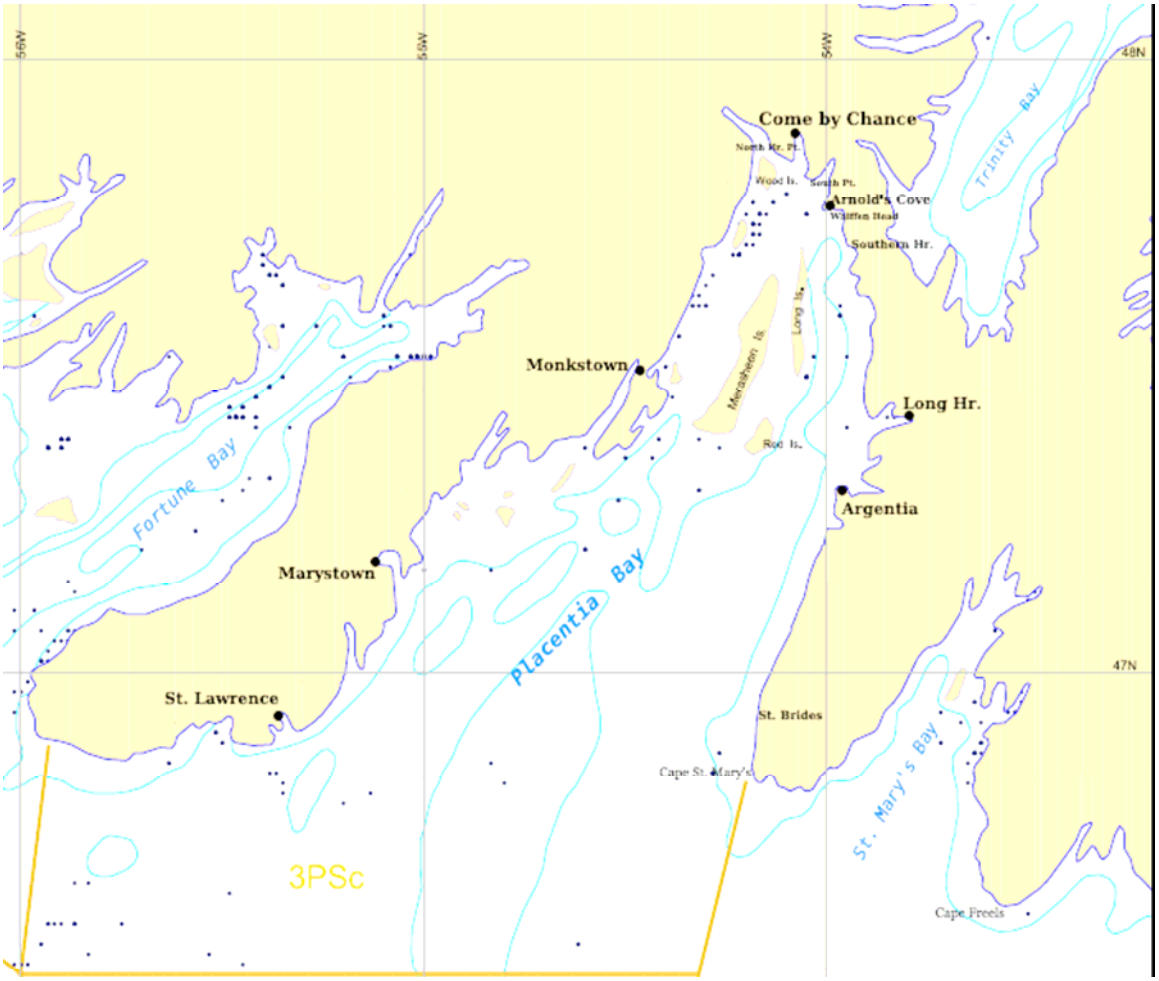

Figure 10: 3PSc Harvesting Locations, January - December 2005 (All Species in Geo-Referenced Sub-Set)

3.2.2 Fishing Enterprises, Fishers and Fishing Licences

Data on the number or core and non-core fishing enterprises in the study area, as well as information on the distribution of species licences, were provided by DFO's Licensing Branch in St. John's. The latest data readily available for the purpose of this background report was for the year 2003. It is likely that these data adequately reflect the current (2005-2006) situation in the study area.

Tables 3(a), 3(b) and 3(c) show the number of core and non-core enterprises by community and vessel length for Placentia Bay (Fishing Area 10) in 2003.[3] Table 4 lists the numbers of licences.

[3] A "core" fishing enterprise is a commercial fishing enterprise holding key species licences, under a system established by DFO in 1996. New core enterprises are not normally created, though existing enterprises may be transferred to a new eligible harvester. DFO requires that the transfer go to a Level II

Table 3(a): Number of Core Enterprises and Vessel Size, Placentia Bay (2003 Data)

Home Port	<35 ft	35-64 ft	Total
St. Bride's	30	10	40
Patrick's Cove	1		1
Placentia (Incl Southeast)	10	11	21
Dunville	5		5
Jerseyside	2	1	3
Freshwater, P. Bay	1		1
Fox Harbour	5	3	8
Ship Harbour	6	1	7
Long Harbour	2	1	3
Mt. Arlington Heights	2		2
Fair Haven	13	1	14
Little Harbour East P.B.	12	5	17
Southern Harbour	28	16	44
Arnold's Cove	21	3	24
Come By Chance	4		4
North Harbour, P.B.	13	1	14
Garden Cove	6		6
Swift Current	2	1	3
Prowseton & Sand Hr. (Vacated)	4	1	5
Davis Cove (Vacated)	6	1	7
Old Cove-Woody Island (Vacated)	1		1
Bar Haven (Vacated)	2		2
Haystack (Vacated)	1		1
Red Island (Vacated)	4		4
Brewley (Vacated)	1		1
Merasheen (Vacated)	5		5
Tack's Beach (Vacated)	2		2

professional fish harvester as certified by the Professional Fish Harvesters Certification Board (PFHCB) of Newfoundland and Labrador. A non-core enterprise is one holding other (perhaps single) species licences.

Home Port	**<35 ft**	**35-64 ft**	**Total**
Isle Au Valen (Vacated)	3		3
Little Paradise (Vacated)	2	2	4
Great Paradise (Vacated)	2		2
South East Bight	23	2	25
Monkstown	5	1	6
Petite Forte	17	3	20
Port Ann (Vacated)	1		1
Boat Hr (Inc. Brookside)	8		8
Parkers Cove	11		11
Baine Harbour	8	3	11
Rushoon	2	1	3
Oderin (Vacated)	2		2
Red Harbour	16	1	17
Jean De Baie	1		1
Rock Harbour	1		1
Little Bay, P.B.		1	1
Beau Bois	1		1
Fox Cove (Near Burin)	1		1
Port Au Bras	1	1	2
Burin	17	7	24
Little St. Lawrence	1		1
St. Lawrence	9	7	16
Lawn	10	11	21
Lord's Cove	13	1	14
Point Au Gal	10		10
Lamaline	17	1	18
Point May	8		8
Total	**379**	**98**	**477**

Table 3 (b): Number of Non-core Enterprises and Vessel Size, Placentia Bay (2003 Data)

Home Port	**<35 ft**	**35-64 ft**	**Total**
Placentia (Incl Southeast)	3		3
Jerseyside	1		1
Freshwater, P. Bay	2		2
Fox Harbour	2		2
Ship Harbour	1		1
Long Harbour	1		1
Mt. Arlington Heights	1		1
Fair Haven	3		3
Little Harbour East P.B.	4		4
Southern Harbour	6		6
North Harbour, P.B.	2		2
Garden Cove	2		2
Swift Current	1		1
Red Island (Vacated)	1		1
Merasheen (Vacated)	1		1
South East Bight	1		1
Monkstown	1		1
Boat Hr (Inc. Brookside)	2		2
Parkers Cove	1		1
Burin	2		2
Little St. Lawrence	2		2
St. Lawrence	4		4
Lawn	4		4
Lord's Cove	2		2
Lamaline	1		1
Total	**51**		**51**

*Key Licence Holders Only

Table 3(c): Number of Core and *Non-core Enterprises and Vessel Size, Placentia Bay (2003)

Home Port	<35 ft	35-64 ft	Total
St. Bride's	30	10	40
Patrick's Cove	1		1
Placentia (Incl Southeast)	13	11	24
Dunville	5		5
Jerseyside	3	1	4
Freshwater, P. Bay	3		3
Fox Harbour	7	3	10
Ship Harbour	7	1	8
Long Harbour	3	1	4
Mt. Arlington Heights	3		3
Fair Haven	16	1	17
Little Harbour East P.B.	16	5	21
Southern Harbour	34	16	50
Arnold's Cove	21	3	24
Come By Chance	4		4
North Harbour, P.B.	15	1	16
Garden Cove	8		8
Swift Current	3	1	4
Prowseton & Sand Hr. (Vacated)	4	1	5
Davis Cove (Vacated)	6	1	7
Old Cove-Woody Island (Vacated	1		1
Bar Haven (Vacated)	2		2
Haystack (Vacated)	1		1
Red Island (Vacated)	5		5
Brewley (Vacated)	1		1
Merasheen (Vacated)	6		6
Tack's Beach (Vacated)	2		2
Isle Au Valen (Vacated)	3		3
Little Paradise (Vacated)	2	2	4

Home Port	<35 ft	35-64 ft	Total
Great Paradise (Vacated)	2		2
South East Bight	24	2	26
Monkstown	6	1	7
Petite Forte	17	3	20
Port Ann (Vacated)	1		1
Boat Hr (Inc. Brookside)	10		10
Parkers Cove	12		12
Baine Harbour	8	3	11
Rushoon	2	1	3
Oderin (Vacated)	2		2
Red Harbour	16	1	17
Jean De Baie	1		1
Rock Harbour	1		1
Little Bay, P.B.		1	1
Beau Bois	1		1
Fox Cove (Near Burin)	1		1
Port Au Bras	1	1	2
Burin	19	7	26
Little St. Lawrence	3		3
St. Lawrence	13	7	20
Lawn	14	11	25
Lord's Cove	15	1	16
Point Au Gal	10		10
Lamaline	18	1	19
Point May	8		8
Total	**430**	**98**	**528**

*Key Licence Holders Only

Table 4 : Core, Non-core and Recreational Licences (832 Fishers), Placentia Bay (2003)

Species	**Total Licences**
Bait	371
Capelin Fg	100
Capelin Ps	1
Eel	6
Groundfish Fg	518
Herring Fg	124
Herring Ps	10
Lobster	345
Mackerel Fg	105
Mackerel Ps	8
Salmon Atlantic	5
Scallop	225
Scallop Recreational	265
Seal	53
Seal Personal Use	42
Snow Crab Inshore	401
Snow Crab Supplementary	68
Squid	245
Tuna Bluefin	4
Whelk	86
Total	2,982

4. Overview of Placentia Bay Aquaculture Sector

4.1 Aquaculture Development and Current Activities

To date, the majority of the aquaculture development and investment activities in southern Newfoundland have been concentrated in the Bay d'Espoir and Fortune Bay areas. The province's aquaculture Strategic Plan notes "The Newfoundland salmonid industry is located in Bay d'Espoir, the only area of the province that is suitable for the growing of steelhead trout and salmon."[4] However, DFA aquaculture managers believe that Placentia Bay has many of the desirable characteristics of Bay d'Espoir. As such, they are confident that Placentia Bay has significant growth opportunities, including possibilities for the development of salmon and rainbow trout farming, as well as further expansion of existing cod and mussel operations.

The development of aquaculture resources in Placentia Bay has been underway since about the mid-1990s. In 1997 there were about seven licenced aquaculture operations, and several applications pending to investigate and/or develop additional sites. (Two sea urchin sites were later approved but by 2003 these were no longer active. A cod hatchery was also established in Placentia Bay in the early 1990s, but this was subsequently destroyed by fire.)

DFA reports that, during 2000-2003, there was significant level of expansion in the Placentia Bay aquaculture sector, and a considerable interest in the development of new sites - particularly on the Burin Peninsula side of the bay, and around Merasheen Island. During this period, DFA deployed thermographs in numerous locations to monitor water temperatures in order to assess whether such areas might be suitable for aquaculture.

By 2003 there were 15 approved aquaculture operations, including six blue mussel sites and nine cod grow-out facilities.[5] At that point, most of these aquaculture sites were still at a "developmental" stage, i.e. they had product in the water, but no significant amount of commercial sales. In 2004, DFA reported that only four operators were selling their product on a commercial basis.[6] Nevertheless, based on discussions with DFA experts and 2004 production and sales data obtained from selected aquaculture enterprises, the annual value of aquaculture production (after primary processing) in Placentia Bay was estimated at $500,000.[7]

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[4] Burke Consulting. 2000. Strategic Plan: Newfoundland and Labrador Aquaculture. Prepared in collaboration with Resource Development Associates.

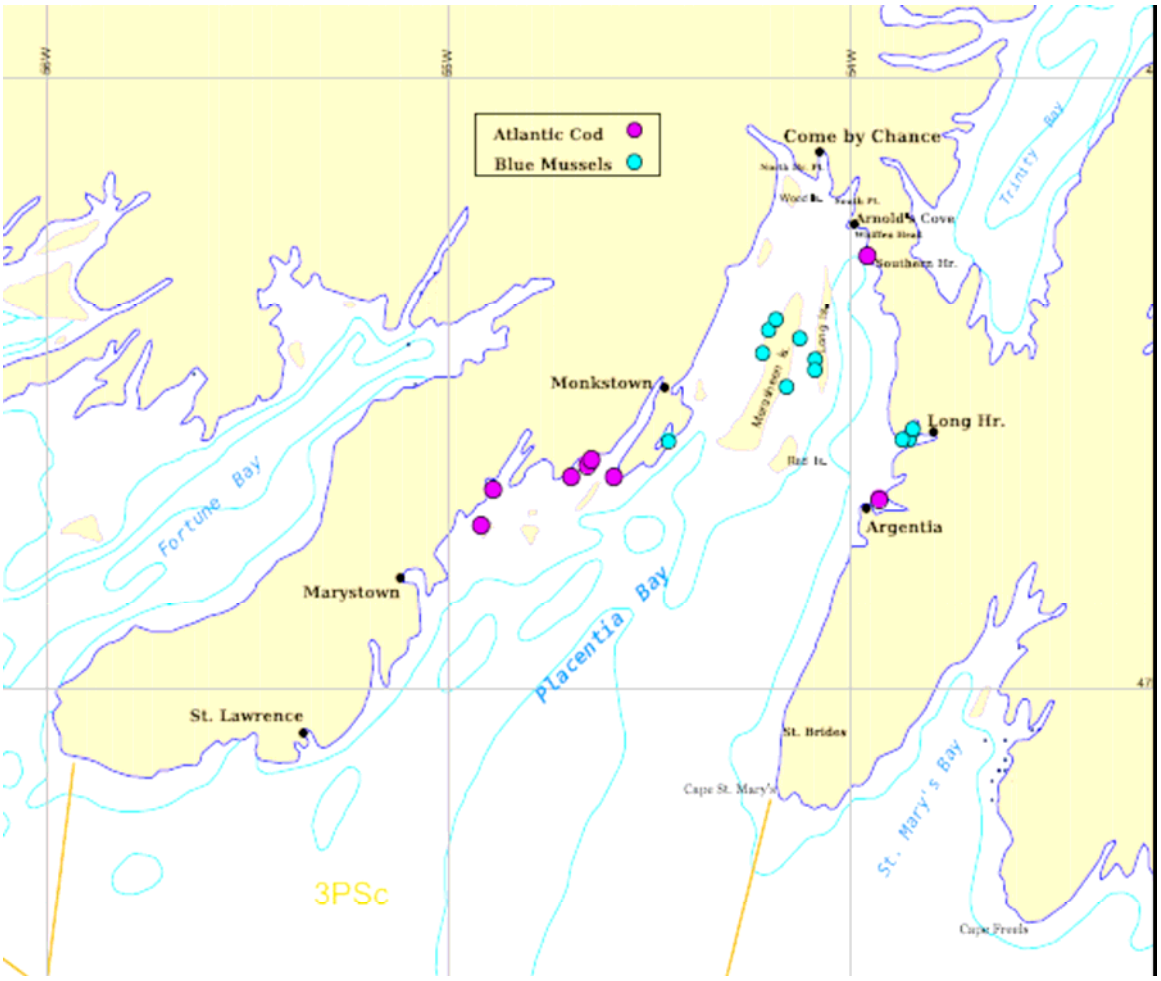
[5] As of 2004, there were still no full-cycle ("egg to plate") cod aquaculture operations in the province, and all cod enterprises are thus "grow-out" facilities. However, current production of farmed cod is limited because of restrictions on taking wild cod for any purpose (DFA managers, pers comms., 2004)

[6] These included a cod farming facility on Jerseyman Island, two blue mussel farms at Crawley Island/St. Croix Bay and another mussel operation on Merasheen Island.

[7] Canning and Pitt Associates. 2005. Placentia Bay Project Benefits Study: Marine Institute Canadian Centre for Marine Communications.

At present, there are 19 “active” (commercial or “developmental”) aquaculture operations in the Placentia Bay area.[8] However, DFA managers note that several 2006 sites are still awaiting final approval.[9] Figure 11 shows the geographic location of existing aquacultural activities in Placentia Bay, and Table 5 provides relevant, more detailed information on these 11 blue mussel farms and 8 Atlantic cod grow-out operations.

Figure 11 – Existing Aquaculture Sites in Placentia Bay (2006)



Source. DFA site location data in Table 1.1 (from T. Budgell, August 2006)

[8] DFA managers report that, if an aquaculture site is licenced, it is deemed to be "active", even though it may not be at the commercial production stage, i.e. currently selling its product. It was also noted that, although their licences have been renewed annually, most of the Atlantic cod operations have had little or no activity over the past several years due to moratoria. Further, most of the area’s cod sites are classed as “developmental” licences (for reasons related to the original intent of the cod grow-out sector and associated land tenure issues). Managers also note that even “developmental” mussel licences are considered active since these operations have gear deployed in the water, and hence “aquaculture” is being conducted (T. Budgell, pers comm., August 2006).

[9] DFA notes that there is no guarantee that all of these applications will receive final approval.

Table 5. Placentia Bay Aquaculture Sites (2006): Enterprise Name, Location and Species

Company	Site Location	Lat Deg	Lat Min	Lng Deg	Lng Min	Species
Hollett, Mervin *	Port Royal Arm	47	32.5	54	5.62	Blue Mussels
Jones, Ambrose	Petite Forte	47	23.4	54	39.99	Atlantic Cod
Keating, Joseph (Baie Sea Farms)	Crawley Island, Long Harbour	47	25.5	53	51.33	Blue Mussels
Keating, Joseph (Baie Sea Farms)	Crawley Island	47	25.5	53	52.43	Blue Mussels
Keating, Joseph (Baie Sea Farms)	St. Croix Bay	47	26.8	53	51.57	Blue Mussels
Leonard, Peter W.	Southern Harbour	47	42.8	53	57.6	Atlantic Cod
Merasheen Mussel Farms Inc. *	Barren Island	47	31.2	54	6.36	Blue Mussels
Merasheen Mussel Farms Inc. *	Jean de Gaunt Island	47	32.9	54	13.09	Blue Mussels
Merasheen Mussel Farms Inc. *	Presque Harbour	47	24.8	54	29.7	Blue Mussels
Merasheen Mussel Farms Inc. *	Rose au Rue	47	30.1	54	10.86	Blue Mussels
Merasheen Mussel Farms Inc. *	Dog Harbour	47	34.7	54	8.6	Blue Mussels
Moulton, Clayton	Flat Island Harbour	47	16.12	54	55.15	Atlantic Cod
Norman, Bernard	Jerseyman Island	47	20.09	54	53.24	Atlantic Cod
Pevie, Joseph and Pearson, Christopher	Woody Island	47	22.38	54	42.34	Atlantic Cod
Pomeroy, Donald A. & Barry, John Jr.	Petite Forte Harbour	47	24.06	54	39.49	Atlantic Cod
Pomeroy, Donald A. & Barry, John Jr.	Gaultoin's Cove (near Great Paradise)	47	20.9	54	35.4	Atlantic Cod
Sapphire Sea Farms Ltd.	Dunville	47	15.9	53	55.11	Atlantic Cod
Warren, Christopher J.	Big South West Cove, Merasheen	47	34.43	54	10.35	Blue Mussels
Warren, Christopher J.	Merasheen Island	47	36.22	54	9.85	Blue Mussels

Source: DFA, Newfoundland and Labrador (T. Budgell, DFA Grand Falls, August 2006)
* DFA indicates that applications for these operations are still under review/licence not yet approved

In addition to the above, information available from DFA indicates that, during the past decade or so, aquacultural activities have been approved, developed or proposed at additional sites within Placentia Bay. However, the department currently considers all of these sites as "inactive" and "abandoned"; these files are now closed, and the sites have reverted to the Crown. In future, however, some of these sites may be re-activated, and thus it may be useful to list these locations, if only to indicate the potential for a more widespread development of the area's aquaculture sector in future. Table 6 indicates the location and species of these previously licenced, or proposed, aquaculture sites.

Table 6. Other "Potential" Placentia Bay Aquaculture Sites (ca. 1997-2005)

Site Location	Species	Previous Status (if known)
Bar Haven	Blue Mussels	Developmental
Bar Haven (north of Haddock Head)	Blue Mussels	Commercial
Gulch Head	Blue Mussels	Unknown
Bar Haven	Blue Mussels	Commercial
Cooper Island	Sea Urchins	Developmental
Fox Cove	Atlantic Cod	unknown
Jigging Cove (near Monkstown)	Atlantic Cod	unknown
Southern Harbour	Atlantic Cod	Developmental
Monkstown	Atlantic Cod	Developmental
Spanish Room Point	Atlantic Cod	unknown
Cross Island	Blue Mussels	Developmental
Petite Forte Harbour	Atlantic Cod	unknown
Petite Forte Harbour	Atlantic Cod	unknown
Muddy Hole, Sound Island	Atlantic Cod	Developmental
Jerseyman Island	Steelhead Trout	Research
West of Chambers Island	Atlantic Cod	unknown
North of Little Chambers Island	Atlantic Cod	unknown
Southwest of Isle Valen	Atlantic Cod	unknown
South of Isle Valen	Atlantic Cod	unknown
North of Little Isle Valen	Atlantic Cod	unknown

Site Location	Species	Previous Status (if known)
Southwest of Chambers Island	Atlantic Cod	unknown
Northeast Nonsuch Arm	Atlantic salmon	unknown
Boat Harbour	Atlantic Salmon	unknown

Source: DFA licence files (2003/2004); AquaGIS.com data; and Todd Budgell, pers comm., August 2006

Annex 1. Agencies and Persons Consulted

Department of Fisheries and Aquaculture (2004* and 2006 Consultations)

Mike Warren, Executive Director, Policy and Planning

Todd Budgell, Manager of Aquaculture Licencing and Inspections

Shawn Robinson*, Director of Aquaculture

Brent Tompkins*, Aquaculture Development Officer

Elizabeth Barlow*, Salmonid Aquaculturalist

Steve Moyse*, Aquaculture Planning Analyst

Paul James*, Aquaculture Development Officer

Annex 2. References and Information Sources

Burke Consulting. 2000. Strategic Plan: Newfoundland and Labrador Aquaculture. Prepared in collaboration with Resource Development Associates.

Canning and Pitt Associates. 2005. Placentia Bay Project Benefits Study: Marine Institute Canadian Centre for Marine Communications.

Canning and Pitt Associates. 2004. Placentia Bay Commercial Fisheries 1996-2003: Newfoundland Transshipment Limited.

Canning & Pitt Associates. 1997. Whiffen Head and Placentia Bay: Commercial Fisheries Environment, in TERMPOL Review Process for Newfoundland Transshipment Limited.

Canning & Pitt Associates. 1996. Newfoundland Transshipment Terminal Environmental Assessment: Section 4.8 Commercial Fisheries.

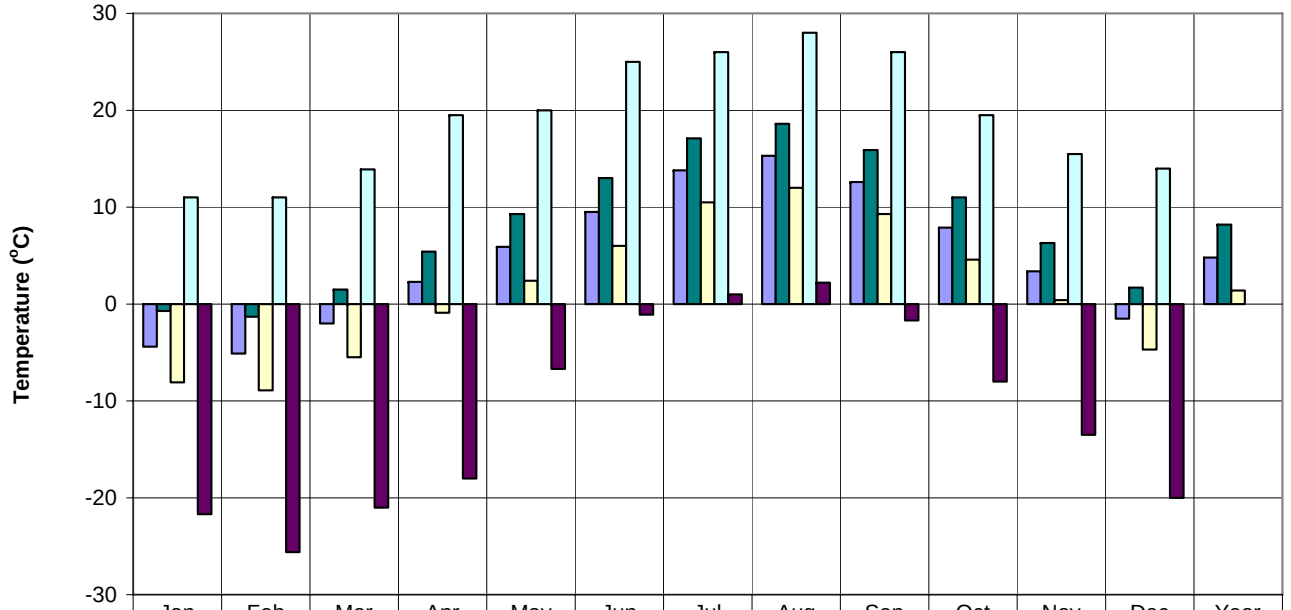
Department of Fisheries and Aquaculture Newfoundland and Labrador (DFA). 2004. Aquaculture Geographic Information System, www.AquaGIS.com

DFO. Catch and Effort Data,1980 - 2006

Appendix 'D'
Climatology Summaries

Station Active From 1971-1994

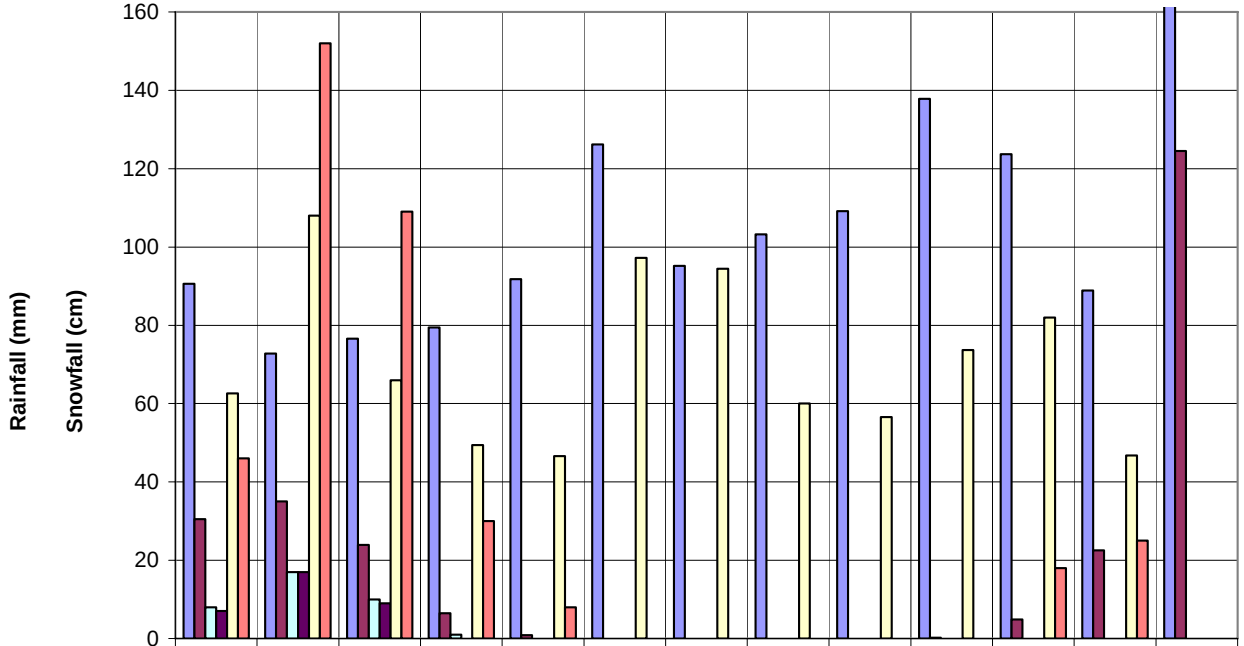
Air Temperature
Arnolds Cove



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Daily Average (°C)	-4.4	-5.1	-2	2.3	5.9	9.5	13.8	15.3	12.6	7.9	3.4	-1.5	4.8
Daily Maximum (°C)	-0.7	-1.3	1.5	5.4	9.3	13	17.1	18.6	15.9	11	6.3	1.7	8.2
Daily Minimum (°C)	-8.1	-8.9	-5.5	-0.9	2.4	6	10.5	12	9.3	4.6	0.4	-4.7	1.4
Extreme Maximum (°C)	11	11	13.9	19.5	20	25	26	28	26	19.5	15.5	14	
Extreme Minimum (°C)	-21.7	-25.6	-21	-18	-6.7	-1.1	1	2.2	-1.7	-8	-13.5	-20	

Station Active From 1971-1994

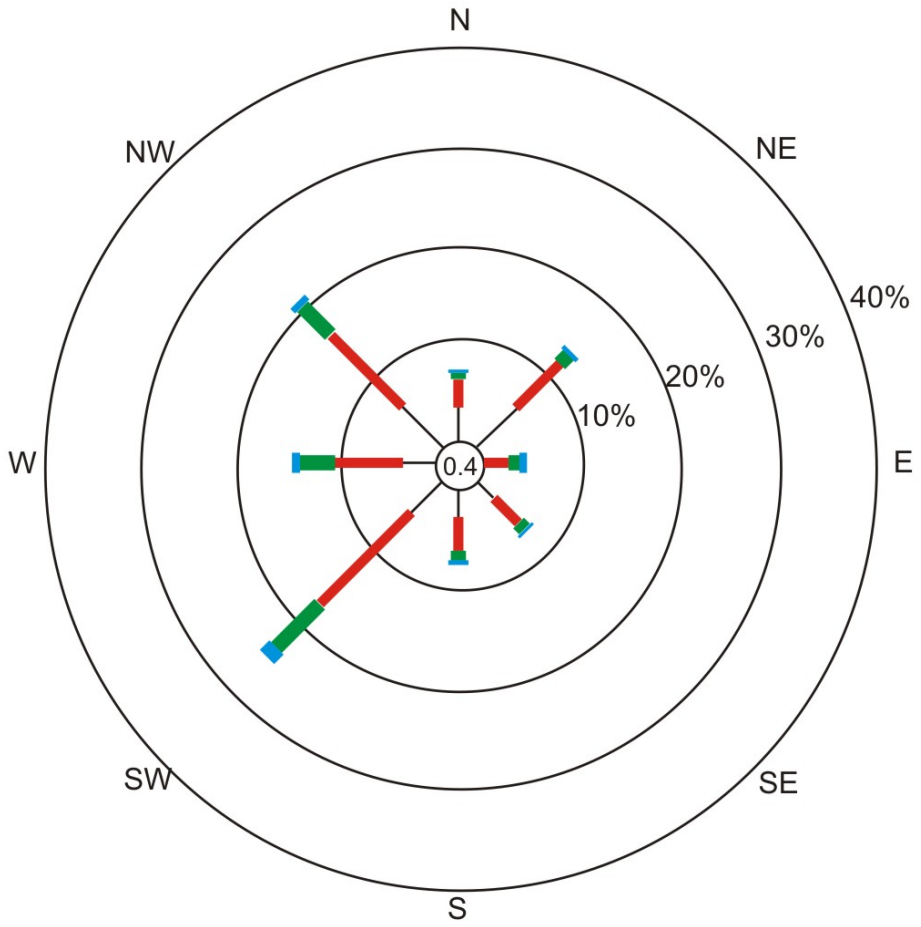
Precipitation
Arnolds Cove



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average Rainfall (mm)	90.6	72.8	76.6	79.4	91.8	126.2	95.2	103.2	109.2	137.8	123.7	88.9	1195.5
Average Snowfall (cm)	30.5	35	23.9	6.5	0.9	0	0	0	0	0.2	4.9	22.5	124.5
Average Snow Depth (cm)	8	17	10	1	0	0	0	0	0	0	0		
Median Snow Depth (cm)	7	17	9	0	0	0	0	0	0	0	0		
Extreme Daily Precipitation (mm)	62.6	108	66	49.4	46.6	97.2	94.4	60	56.6	73.7	82	46.8	
Extreme Snow Depth (cm)	46	152	109	30	8	0	0	0	0	0	18	25	

Site: Arnold's Cove, 1971 - 1993 (MSC measured)
Sampling Interval (DT): 1 hour
Observation Period: January

Prepared by amec
September 7, 2006



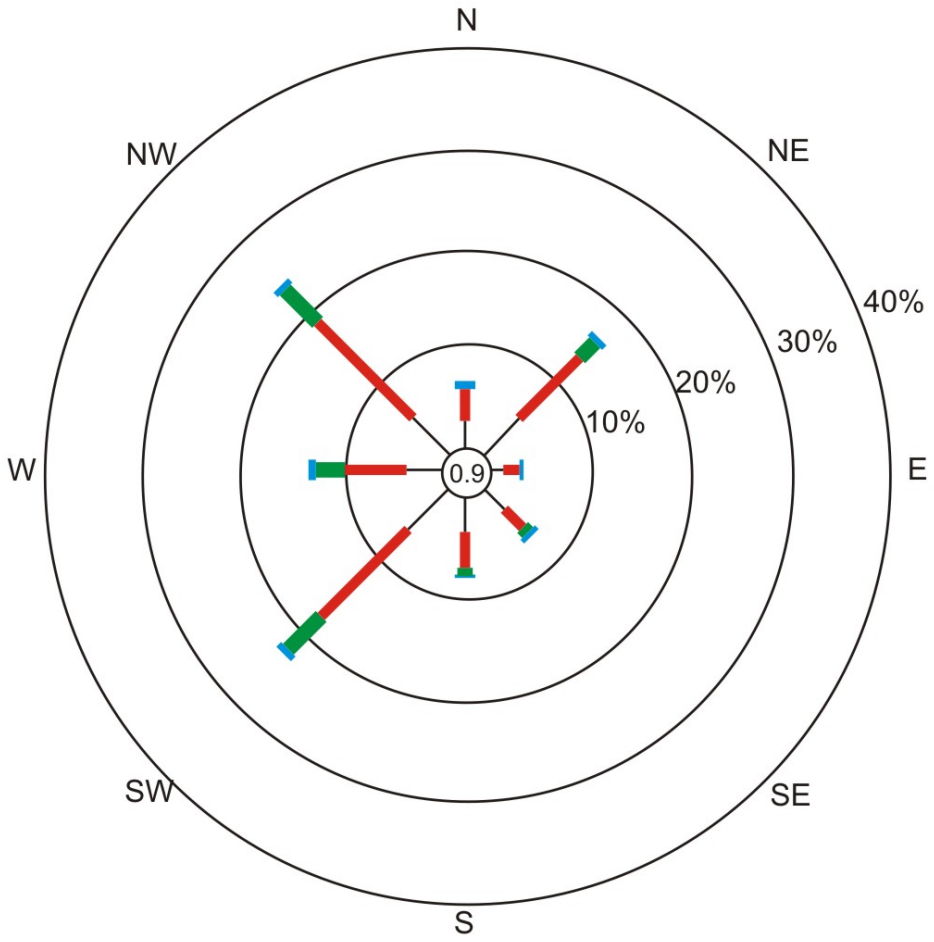
Graph Binning: 18 km/h (5 m/s)

Direction (from)	# of Obs.	% TOTAL
NE	1774	13.6
E	555	4.3
SE	868	6.7
S	919	7.1
SW	3240	24.9
W	1921	14.8
NW	2763	21.2
N	931	7.1
Calm	50	.4
Missing	3347	20.4

Total # of Obs. = 13021

Site: Arnold's Cove, 1971 - 1993 (MSC measured)
Sampling Interval (DT): 1 hour
Observation Period: February

Prepared by amec
September 7, 2006



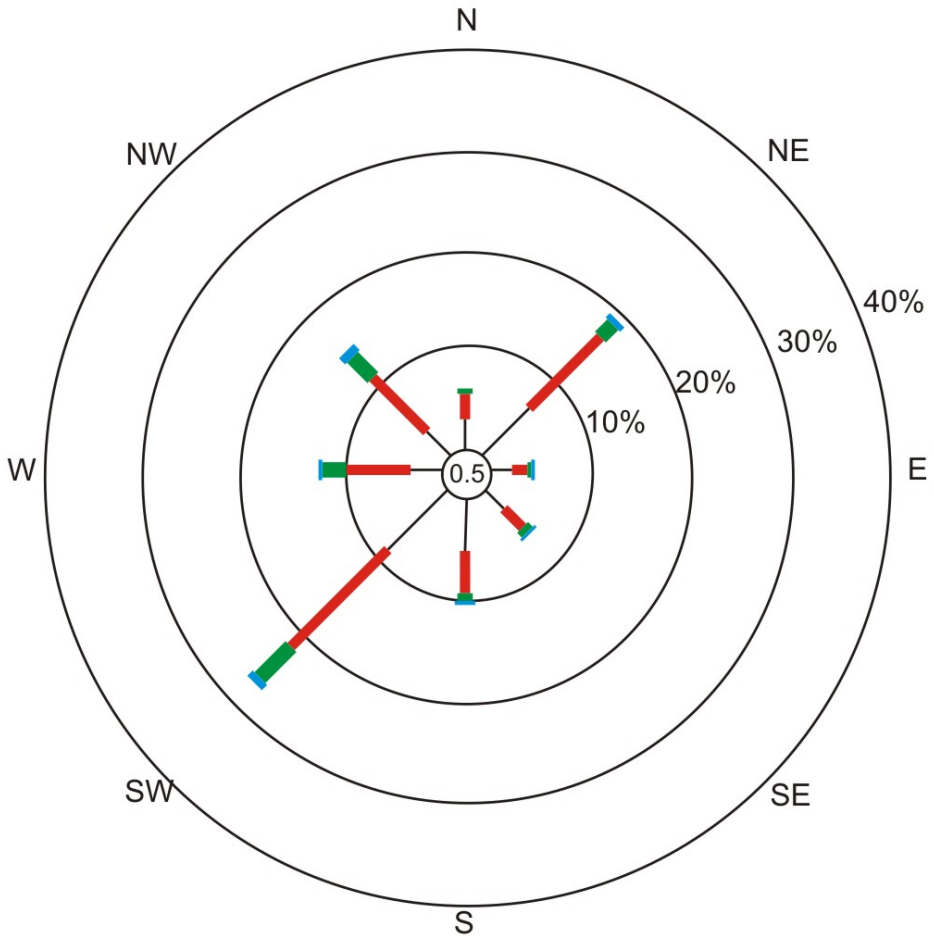
Graph Binning: 18 km/h (5 m/s)

Direction (from)	# of Obs.	% TOTAL
NE	1954	16.8
E	410	3.5
SE	743	6.4
S	874	7.5
SW	2606	22.3
W	1479	12.7
NW	2731	23.4
N	763	6.5
Calm	100	.9
Missing	3268	21.9

Total # of Obs. = 11660

Site: Arnold's Cove, 1971 - 1993 (MSC measured)
Sampling Interval (DT): 1 hour
Observation Period: March

Prepared by amec
September 7, 2006



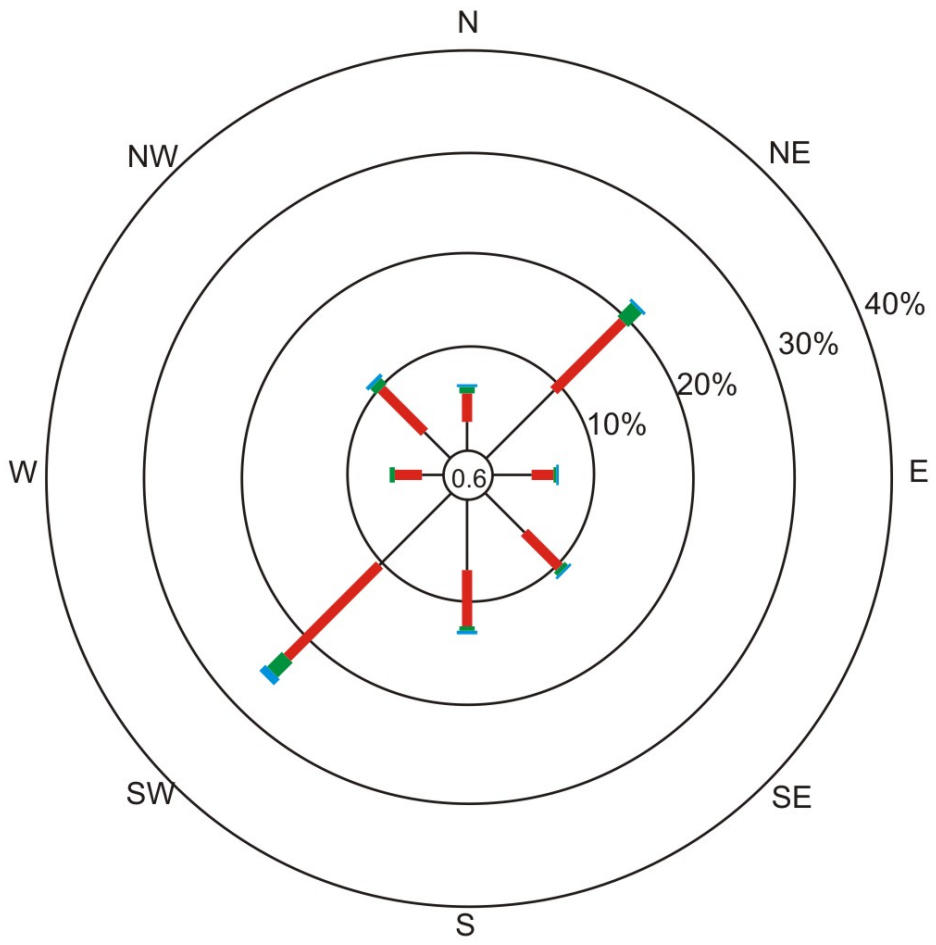
Graph Binning: 18 km/h (5 m/s)

Direction (from)	# of Obs.	% TOTAL
NE	2775	19.2
E	638	4.4
SE	928	6.4
S	1514	10.5
SW	3893	26.9
W	1740	12.0
NW	2051	14.2
N	850	5.9
Calm	79	.5
Missing	1900	11.6

Total # of Obs. = 14468

Site: Arnold's Cove, 1971 - 1993 (MSC measured)
Sampling Interval (DT): 1 hour
Observation Period: April

Prepared by amec
September 7, 2006



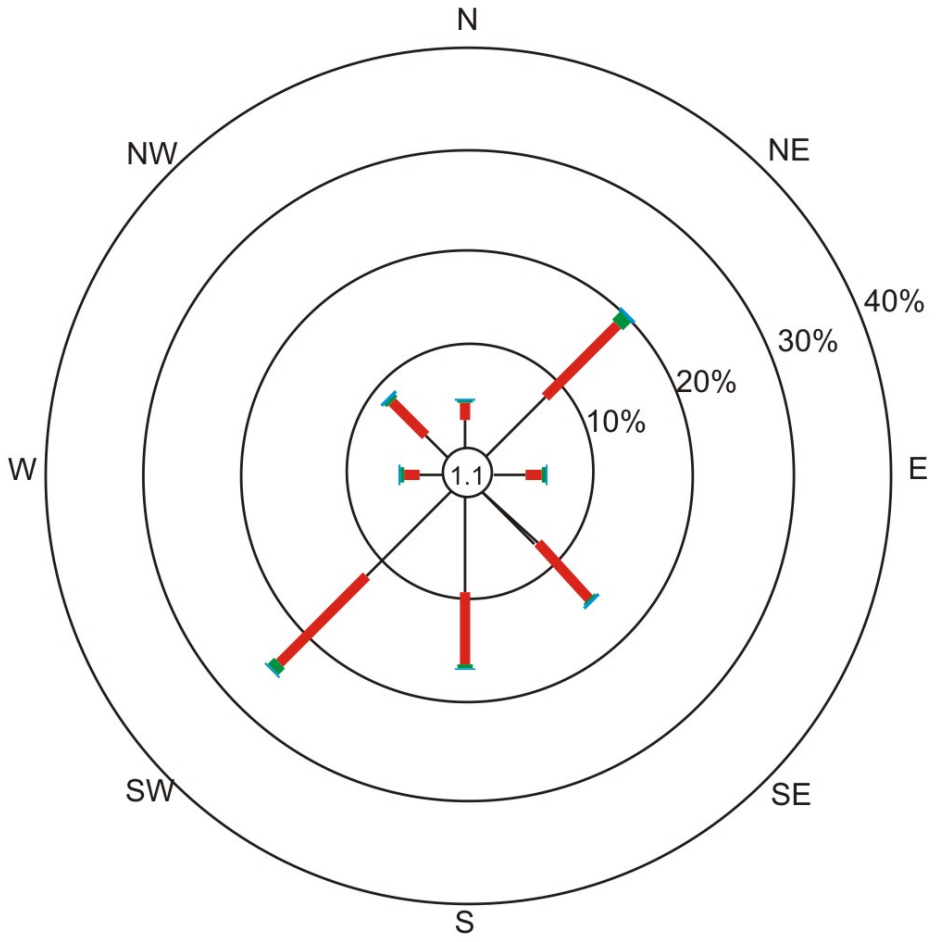
Graph Binning: 18 km/h (5 m/s)

Direction (from)	# of Obs.	% TOTAL
NE	2932	20.8
E	839	6.0
SE	1524	10.8
S	1867	13.3
SW	3661	26.0
W	802	5.7
NW	1516	10.8
N	861	6.1
Calm	84	.6
Missing	1754	11.1

Total # of Obs. = 14086

Site: Arnold's Cove, 1971 - 1993 (MSC measured)
Sampling Interval (DT): 1 hour
Observation Period: May

Prepared by amec
September 7, 2006



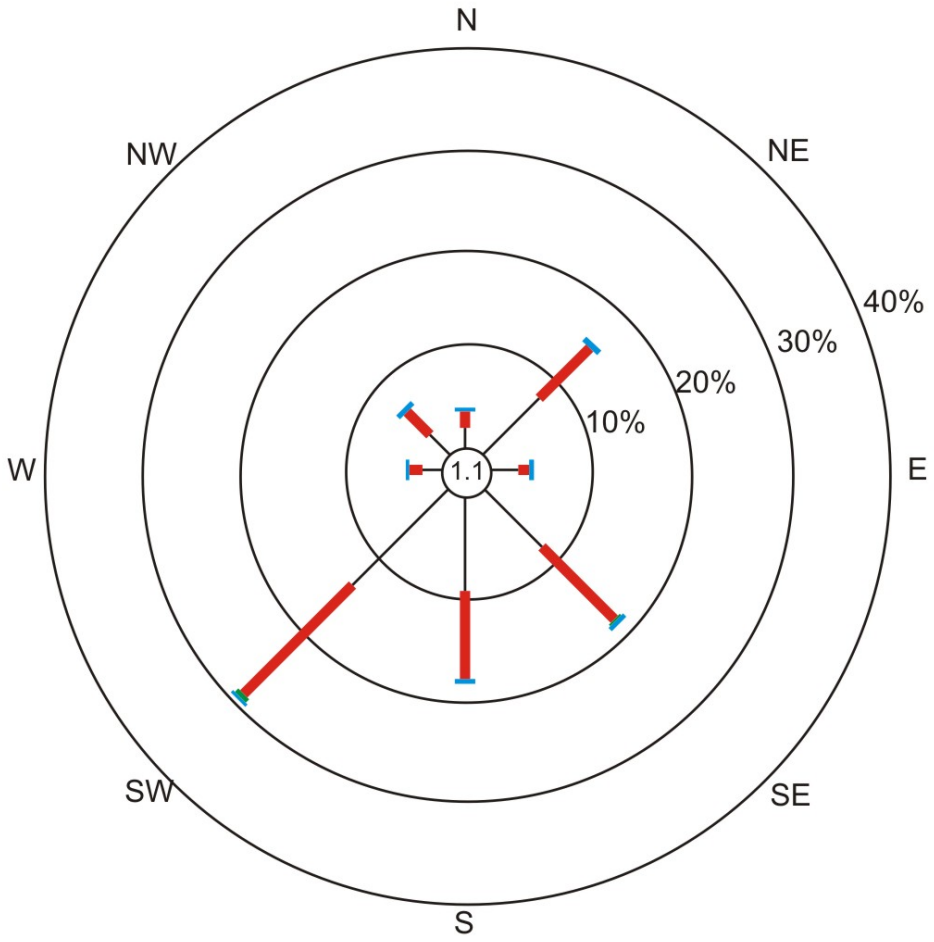
Graph Binning: 18 km/h (5 m/s)

Direction (from)	# of Obs.	% TOTAL
NE	2713	19.6
E	732	5.3
SE	2102	15.2
S	2329	16.8
SW	3471	25.0
W	592	4.3
NW	1150	8.3
N	621	4.5
Calm	147	1.1
Missing	2511	15.3

Total # of Obs. = 13857

Site: Arnold's Cove, 1971 - 1993 (MSC measured)
Sampling Interval (DT): 1 hour
Observation Period: June

Prepared by amec
September 7, 2006



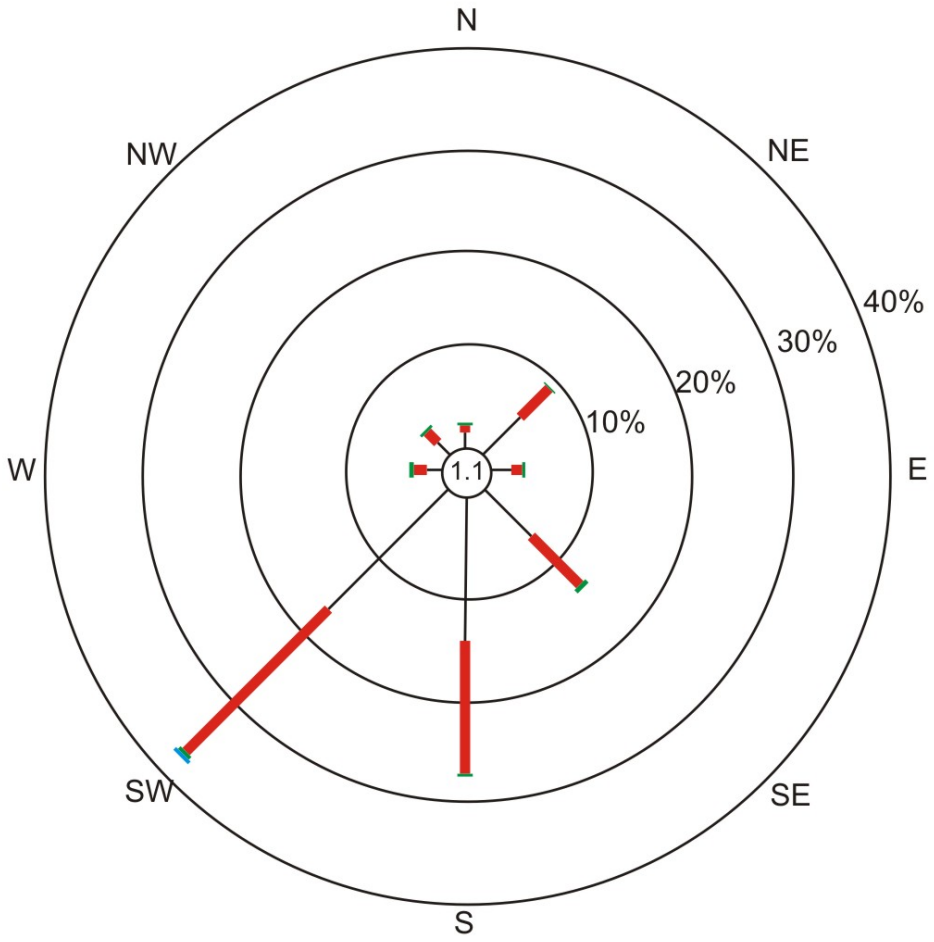
Graph Binning: 18 km/h (5 m/s)

Direction (from)	# of Obs.	% TOTAL
NE	2098	15.5
E	565	4.2
SE	2562	18.9
S	2470	18.3
SW	3932	29.1
W	443	3.3
NW	817	6.0
N	488	3.6
Calm	149	1.1
Missing	2316	14.6

Total # of Obs. = 1352

Site: Arnold's Cove, 1971 - 1993 (MSC measured)
Sampling Interval (DT): 1 hour
Observation Period: July

Prepared by amec
September 7, 2006



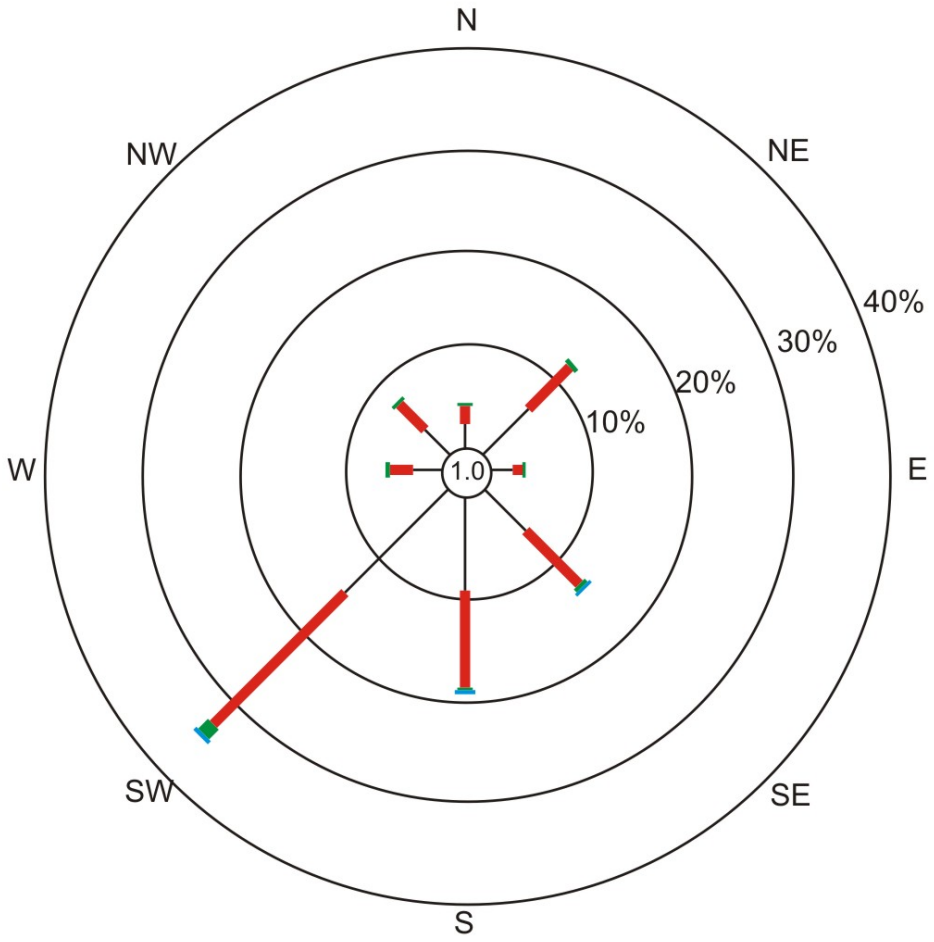
Graph Binning: 18 km/h (5 m/s)

Direction (from)	# of Obs.	% TOTAL
NE	1235	9.3
E	439	3.3
SE	1753	13.2
S	3625	27.2
SW	4981	37.4
W	405	3.0
NW	439	3.3
N	306	2.3
Calm	147	1.1
Missing	3062	18.7

Total # of Obs. = 13330

Site: Arnold's Cove, 1971 - 1993 (MSC measured)
Sampling Interval (DT): 1 hour
Observation Period: August

Prepared by amec
September 7, 2006



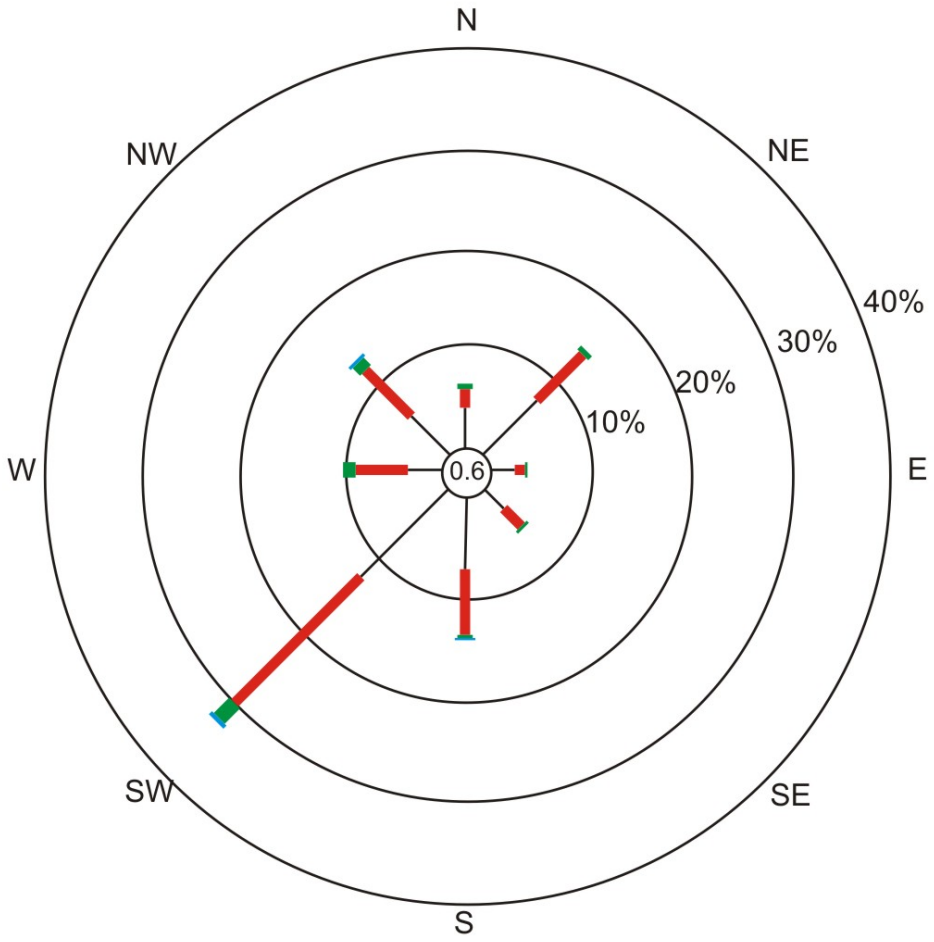
Graph Binning: 18 km/h (5 m/s)

Direction (from)	# of Obs.	% TOTAL
NE	1596	12.4
E	448	3.5
SE	1770	13.7
S	2441	18.9
SW	4398	34.1
W	696	5.4
NW	902	7.0
N	517	4.0
Calm	133	1.0
Missing	3467	21.2

Total # of Obs. = 12901

Site: Arnold's Cove, 1971 - 1993 (MSC measured)
Sampling Interval (DT): 1 hour
Observation Period: September

Prepared by amec
September 7, 2006



Graph Binning: 18 km/h (5 m/s)

Direction (from)	# of Obs.	% TOTAL
NE	1772	14.4
E	435	3.5
SE	673	5.5
S	1768	14.4
SW	4027	32.7
W	1226	10.0
NW	1593	13.0
N	731	5.9
Calm	75	.6
Missing	3540	22.3

Total # of Obs. = 12300

Site: Arnold's Cove, 1971 - 1993 (MSC measured)
Sampling Interval (DT): 1 hour
Observation Period: October

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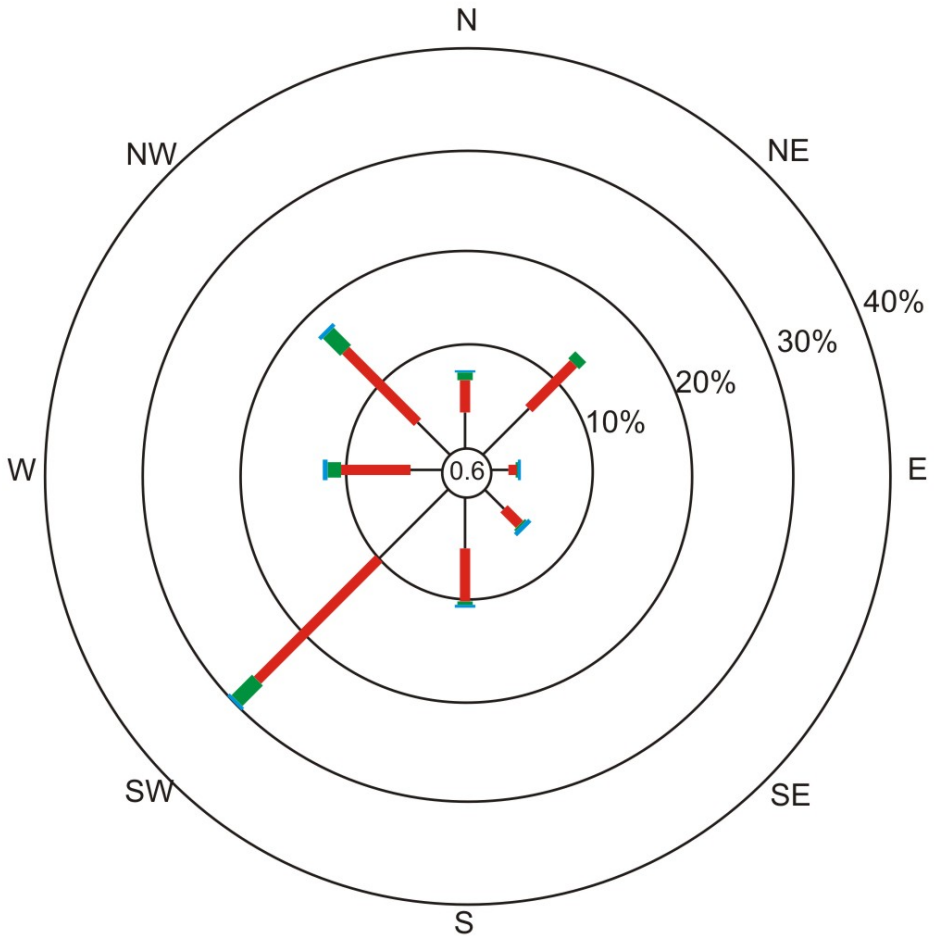


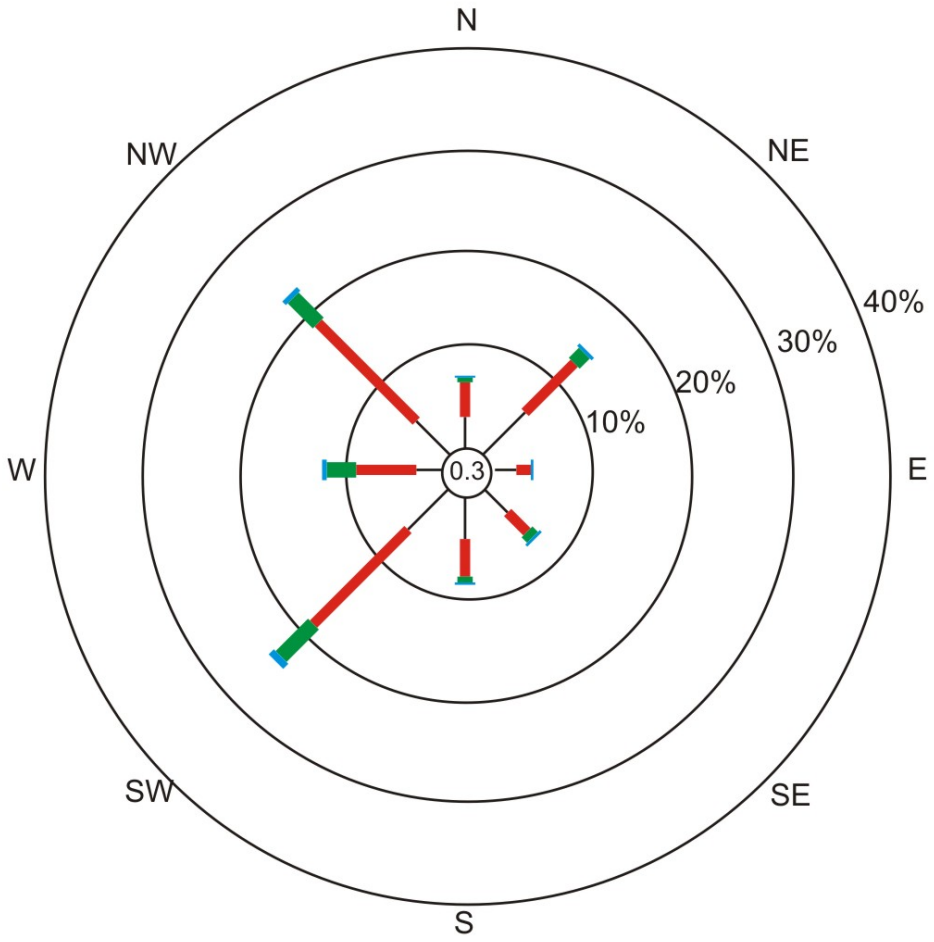
Graph Binning: 18 km/h (5 m/s)

Direction (from)	# of Obs.	% TOTAL
NE	1713	13.8
E	358	2.9
SE	699	5.6
S	1342	10.8
SW	3727	30.1
W	1449	11.7
NW	2122	17.0
N	911	7.3
Calm	75	.6
Missing	3972	24.3

Total # of Obs. = 12396

Site: Arnold's Cove, 1971 - 1993 (MSC measured)
Sampling Interval (DT): 1 hour
Observation Period: November

Prepared by amec
September 7, 2006



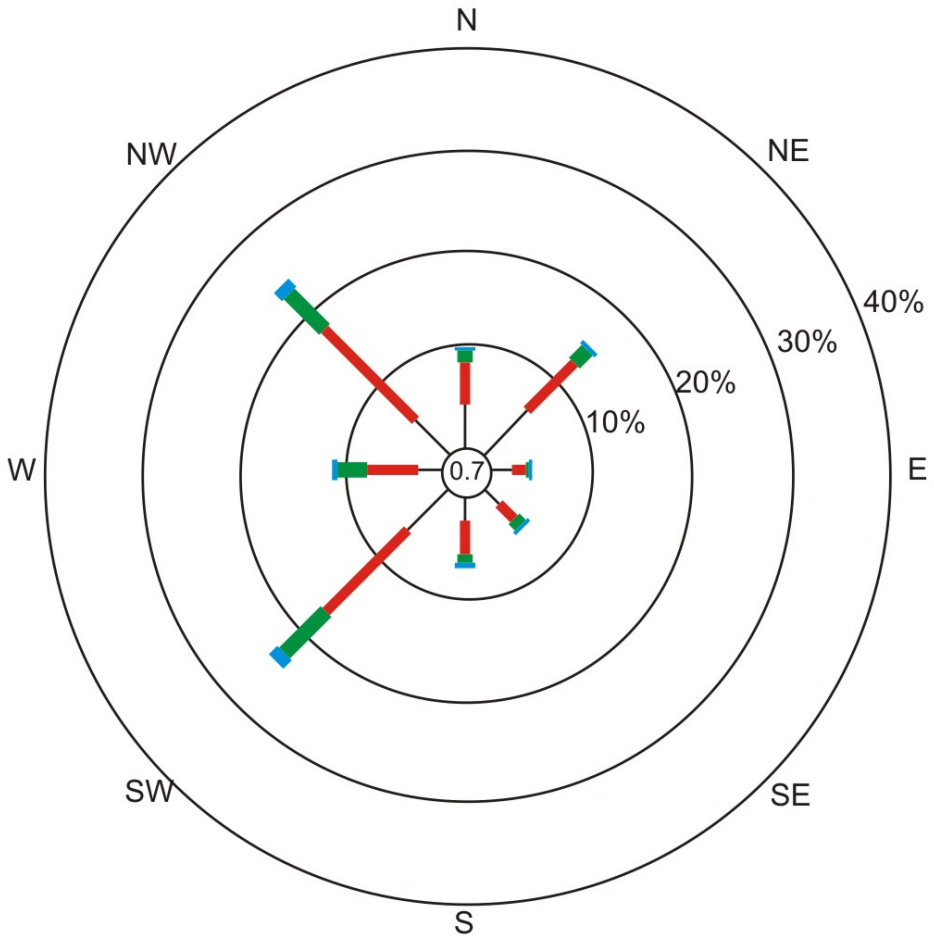
Graph Binning: 18 km/h (5 m/s)

Direction (from)	# of Obs.	% TOTAL
NE	1839	14.3
E	494	3.8
SE	840	6.5
S	1112	8.6
SW	3150	24.4
W	1570	12.2
NW	2948	22.8
N	911	7.1
Calm	39	.3
Missing	2937	18.5

Total # of Obs. = 12903

Site: Arnold's Cove, 1971 - 1993 (MSC measured)
Sampling Interval (DT): 1 hour
Observation Period: December

Prepared by amec
September 7, 2006



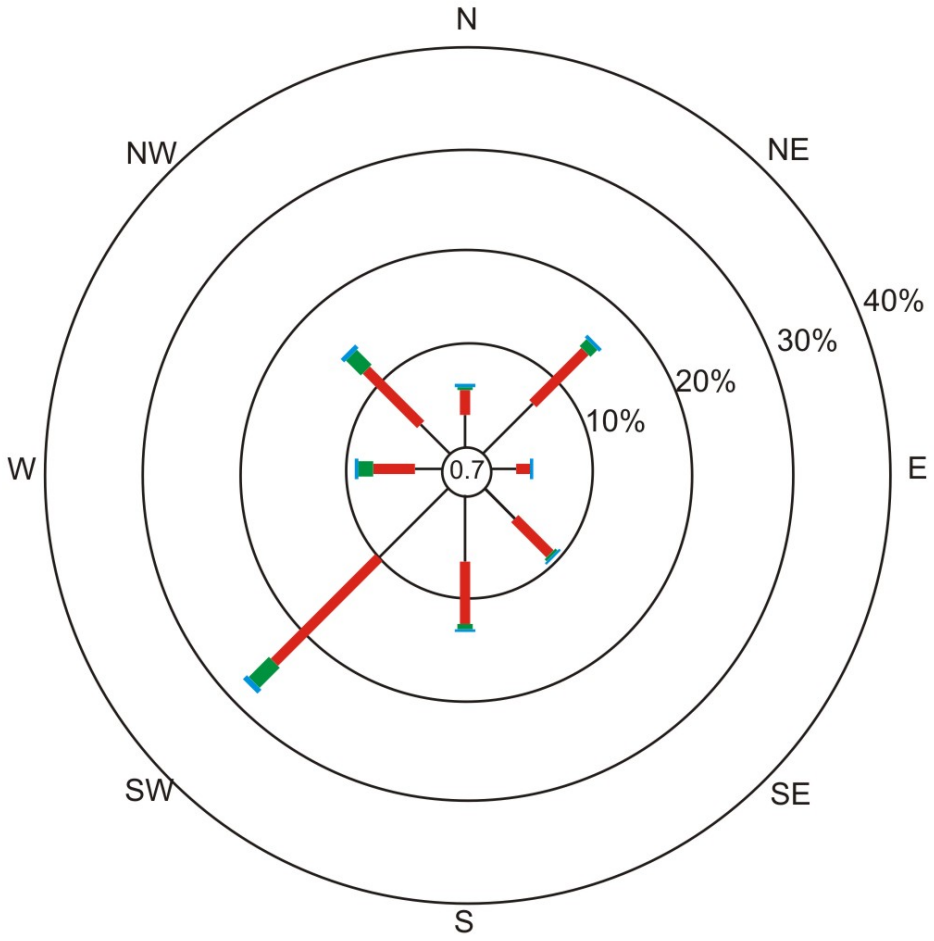
Graph Binning: 18 km/h (5 m/s)

Direction (from)	# of Obs.	% TOTAL
NE	1905	14.7
E	500	3.9
SE	685	5.3
S	878	6.8
SW	3133	24.2
W	1443	11.2
NW	3051	23.6
N	1253	9.7
Calm	93	.7
Missing	3427	20.9

Total # of Obs. = 12941

Site: Arnold's Cove, 1971 - 1993 (MSC measured)
Sampling Interval (DT): 1 hour
Observation Period: July 1, 1971 to July 1, 1993

Prepared by amec
September 7, 2006



Graph Binning: 18 km/h (5 m/s)

Direction (from)	# of Obs.	% TOTAL
NE	24306	15.4
E	6413	4.1
SE	15147	9.6
S	21139	13.4
SW	44219	28.1
W	13766	8.7
NW	22083	14.0
N	9143	5.8
Calm	1171	.7
Missing	35501	18.4

Total # of Obs. = 157387

Waves

Wave roses are based on AES40 node 5616 at coordinates Lat 46.875N, Long 55.0W. Directional statistics on wave climate were calculated using wind data from AES40, a 49-year hindcast of 6 hourly data provided by Meteorological Services Canada (AES, 1999, Swail et al., 2000). The grid point used was 5616 (46.875N, 55.0W.), which lies in the mouth of Placentia Bay, Newfoundland and Labrador.

Predominate wave direction (based on yearly analysis) is from south and southwest. Maximum wave heights in these directions are 6m. As with the wind regime the majority of the winds are from the southwest and south annually with the greatest magnitude winds occurring in winter. The wave roses confirm this with the majority of the waves coming from the southwest and south with the largest magnitude waves occurring in the winter months.

Maximum wave directions heights are 6m, which occur during winter months (Nov-March). Wave directions for all months come from the south-southwest direction. During summer months (Jun, July, Aug), maximum wave heights are on the order of 3m.

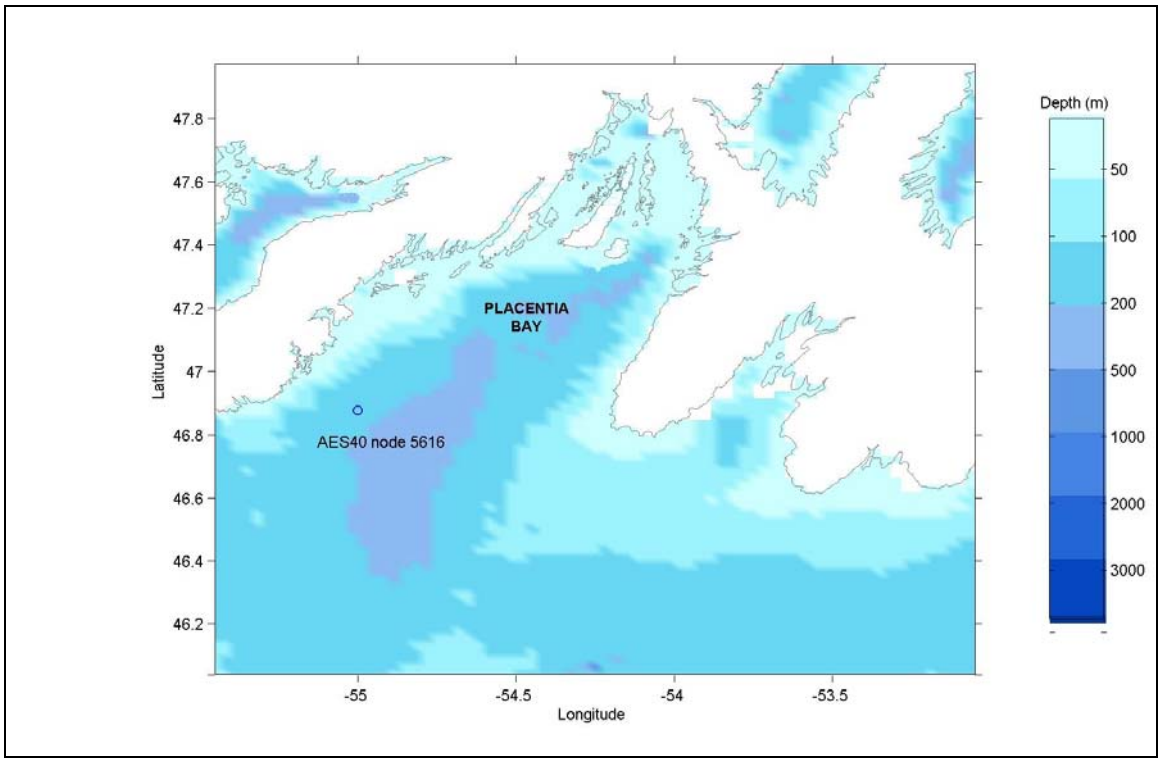


Figure 1, AES40 Grid Point Location.

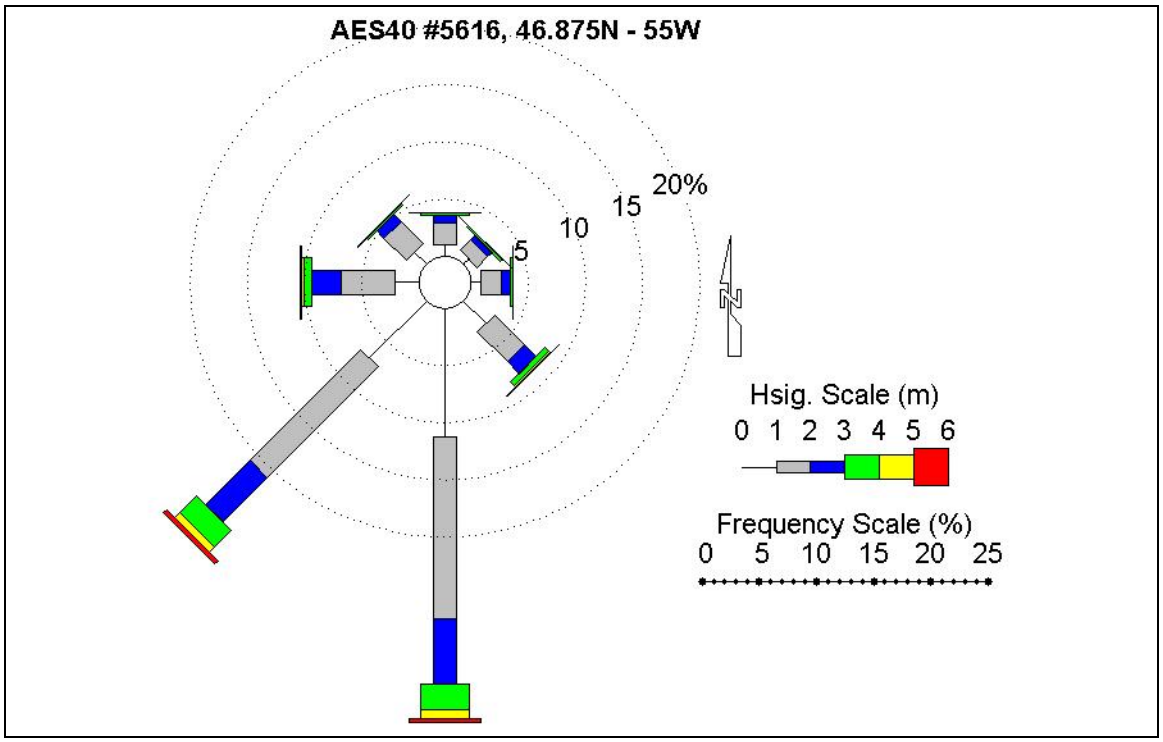


Figure 2, AES 40 Annual Wave Rose.

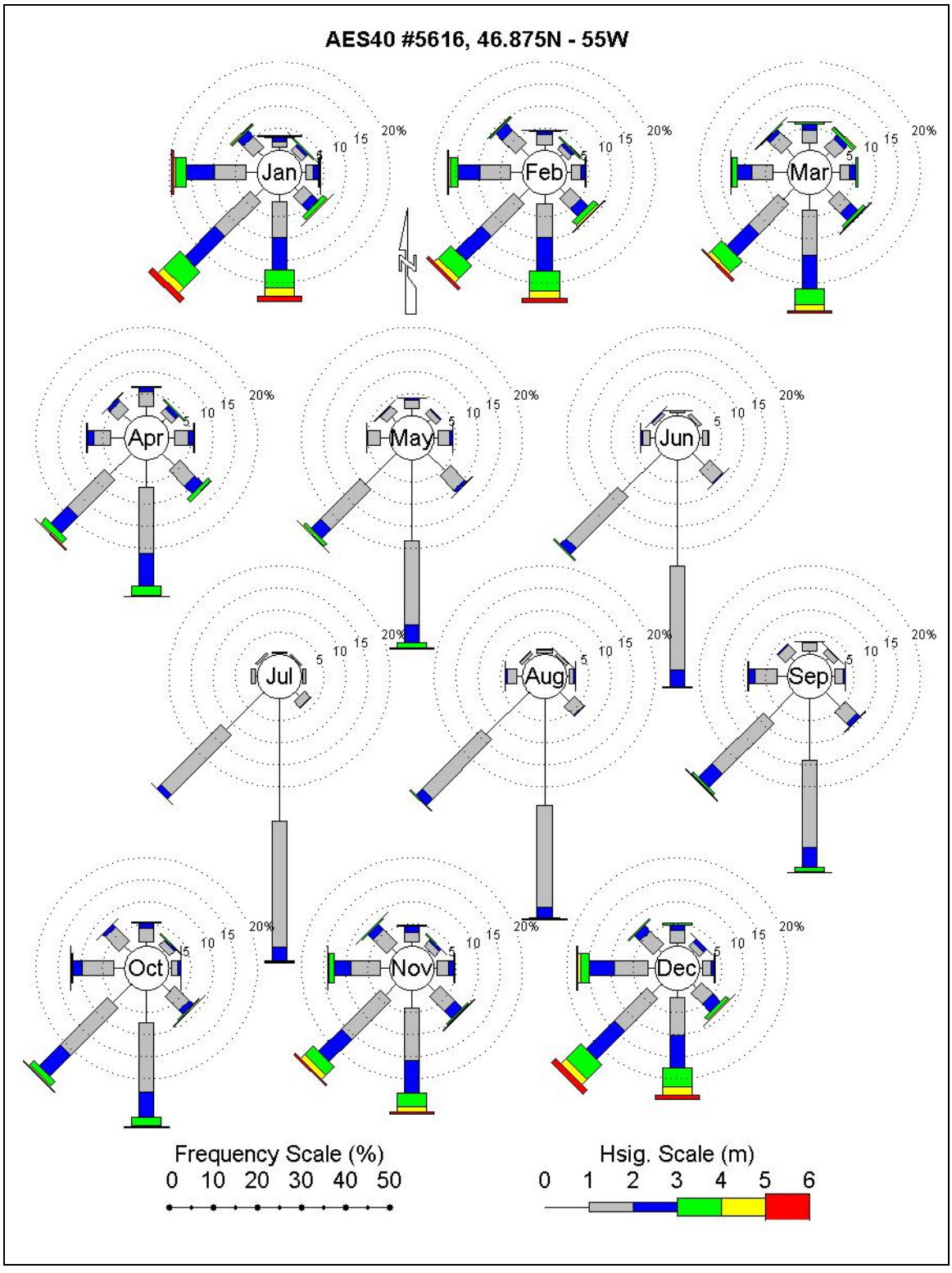


Figure 3, AES 40, Monthly Wave Roses.