

SHIPPING ON THE BRITISH COLUMBIA COAST

Current Status,
Projected Trends, Potential
Casualties, and Our Ability to
Respond: A Briefing Report



Healthy Oceans, Healthy Communities.

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Contents

List of Acronyms	4	4.2 From Vessel Casualty	27
Living Oceans Society	5	5 Marine Vessel Casualty Risk and Emergency Response Preparedness	29
Acknowledgements	6	5.1 Marine Vessel Casualty Risk	29
Introduction	7	5.2 Canada’s Oil Spill Response Regime	30
1 Shipping on the B.C. Coast:		5.3 Limitations to Canada’s Oil Spill Preparedness and Response Regime	31
Current Status and Trends	9	5.4 Oil Spill Funding and Financial Vulnerability	34
1.1 Vessel Sectors and Vessel Types	9	6 Solutions and Policy Directions	37
1.2 Marine Traffic Activity	11	7 Maps	41
1.2.1 Trans-Alaska Pipeline System (TAPS) Oil Tankers	13	8 Glossary of Terms	47
1.3 Projected Trends	13	9 References	51
1.4 Case Study—Enbridge’s Northern Gateway Project	16	Appendix A: Marine Vessel Incidents and Casualties along the Pacific Coast	55
2 Shipping Legislation and Regulation	19	Appendix B: The World’s Largest Oil Spills and Global Oil Spill Trends	59
2.1 Legislation	19	Appendix C: Spill Cost Summary of Selected Oil Spill Incidents, 1984-2000	63
2.2 Regulatory Measures	20	Appendix D: Living Oceans Society’s Oil Spill Model	65
2.2 Double vs. Single Hulled Vessels	20		
2.3 Voluntary Tanker Exclusion Zone	20		
2.4 Accountability	21		
3 Types and Causes of Marine Vessel Casualties	23		
3.1 Types of Marine Vessel Casualties	23		
3.2 Causes of Marine Vessel Casualties	23		
4 Environmental Impacts	25		
4.1 From Normal Operations	25		

Figures, Tables, Maps

Tables

Table 1	Major Vessels that Frequent B.C.'s Coastal and Territorial Waters	9
Table 2	Oil Tanker Specifications.	11
Table 3	Annual Vessel Movements ⁴ by Vessel Type on the B.C. Coast from 1996/97 to 2003/04	11
Table 4	Traffic Patterns and Routes for Major Vessels in B.C. Waters	12
Table 5	Summary of Projected Major Vessel Traffic Volumes Based on West Coast Industrial Projects	15
Table 6	Weaknesses to Canada's Oil Spill Preparedness and Response Regime	32
Table A1	Twenty Years of Notable Major Marine Vessel Incidents along the Pacific West Coast	55
Table B1	World's Ten Largest Ship-Source Oil Spills since 1967	59
Table C1	Costs of Selected Oil Spills in the U.S., 1984-2000	63

Figures

Figure 1	Proposed Pipeline and Tanker Routes for Enbridge Northern Gateway Project	17
Figure 2	Causes of Oil Spills in Excess of 700 tonnes ²	24
Figure B1	Location of Major Oil Spills Since 1967	60
Figure B2	Annual Quantities of Oil Spilled Worldwide (From Spills Over 7 Tonnes) Including Major Accidents Between 1970-2009	61
Figure C1	Winter oil spill at Ness Rock, from Living Oceans Society's Oil Spill Model	65

Maps

Map 1	Vessel Traffic Density on the BC Coast	42
Map 2	Traffic Routes and Port Locations for Major Vessels in BC Waters	43
Map 3	Disabled Tankers Drift Rate vs. Voluntary Tanker Exclusion Zone	44
Map 4	Marine Vessel Incidents in Canada's Pacific Waters: January 1999 - July 2009	45

List of Acronyms

bb1 barrel	MoE Ministry of the Environment
B.C. British Columbia	NEB National Energy Board
bpd barrels per day	nm nautical mile
CCG Canadian Coast Guard	PNCIMA Pacific North Coast Integrated Management Area
CEAA Canadian Environmental Assessment Agency	RO Response Organization
DWT deadweight ton	RO-RO Roll-on/Roll-off vessel
FMO Federal Monitoring Officer	RP Responsible Party
GRP Geographic Response Plan	SDR Special Drawing Rights
GT Gross Tonnage	SOPF Ship-Source Oil Pollution Fund
HFO heavy fuel oil	TAPS Trans-Alaska Pipeline System
IMO International Maritime Organization	TBT tributyltin
km kilometre	TEZ Tanker Exclusion Zone
LNG liquid natural gas	TEU Twenty-foot Equivalent Unit
m³ cubic metres	ULCC Ultra Large Crude Carrier
MARPOL International Convention for the Prevention of Pollution from Ships	U.S. United States
	VLCC Very Large Crude Carrier



Healthy Oceans. Healthy Communities.

Living Oceans Society

Living Oceans Society is Canada's largest organization focusing exclusively on marine conservation issues. We are based in Sointula—a small fishing village on the Central Coast of British Columbia.

Living in a coastal community, we are reminded each day that our work is not just about

the fish—it's about the fish and the people. Living Oceans Society believes that people are part of the environment and that by protecting B.C.'s coastal ecosystem we can build sustainable communities today and for our children.

For information about Living Oceans Society please visit: www.livingoceans.org.

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Introduction

Transportation by water is an efficient and economical way to move goods and people. In general, vessels that travel through the coastal waters of British Columbia (B.C.) are well managed and the shipping system works well under Canada's Shipping Act and conventions of the International Maritime Organization (IMO). However, recent events on the B.C. coast, such as the Westwood Anette oil spill in Howe Sound, the sinking of the Queen of the North ferry, and the barge spill in Robson Bight, serve to remind us of the negative consequences of shipping.

As vessel traffic volumes increase, so does the potential for a shipping accident. Between 1999 and 2009 there were over 1,200 reported marine vessel incidents along the B.C. coast. Over the next 15 years, container ship volumes through coastal waters are predicted to increase by 300 percent. The number of bulk cargo vessels over that time will grow by 25 percent and cruise ship traffic is expected to increase by at least 20 percent. There are also several project proposals in place that would bring supertankers to the North and Central Coast for the first time. The preservation of the coast from shipping related accidents and oil spills is of utmost importance to coastal ecosystems and communities, as well as B.C.'s resource-dependent economy.

Numerous technical and operational weaknesses exist within Canada's and B.C.'s emergency preparedness and response strategy for marine vessel casualties, including oil spills. In the past, improvements to shipping practices, regulations and emergency response procedures have come in the wake of large scale environmental disasters, such as the 1989 Exxon Valdez oil spill in Alaska.

Living Oceans Society does not want to wait for an accident on the B.C. coast to occur before improvements are made to Canada's marine vessel casualty emergency response plan. It is imperative that government and stakeholders take actions now to:

-  Legislate a permanent ban on oil tanker traffic in Dixon Entrance, Hecate Strait and Queen Charlotte Sound;
-  Manage B.C.'s shipping industry with an ecosystem-based approach that ensures safe shipping practices, prioritizes the health of the ocean, and considers other sectors of economic activity; and
-  Improve Canada's and B.C.'s rescue and response capabilities for oil spills and other vessel casualties.

This briefing report was written with the intent to provide a summary of current and proposed shipping-related activities on the B.C. coast.

It aims to familiarize the reader with the impacts of shipping on the marine environment, as well as the risk and associated outcomes of major marine vessel casualties. The report also explores Canada's—and B.C.'s—emergency response preparedness for a major marine vessel casualty.

Through examination of the technical and institutional gaps in Canada's oil spill response regime, we have identified a number of possible solutions and policy directions to encourage the best possible shipping and emergency response practices for our coast.

1 Shipping on the B.C. Coast: Current Status and Trends

1.1

—○Vessel Sectors and Vessel Types

Canada's marine industry is comprised of domestic and international vessels. Domestic vessels are typically Canadian owned and operated ships such as ferries, fishing boats and barges. Alternately, international vessels are major sea-going ships chartered by companies that need

their services. These vessels are commonly referred to as "convention vessels" and include tankers, container, bulk carrier, general cargo and cruise ships (Reid, 2008). Specifications for various oil tanker classes are found in Table 2.

Table 1

—○Major Vessels that Frequent B.C.'s Coastal and Territorial Waters

—○Oil Tankers

Oil tankers are self-propelled tank vessels used for the transport of bulk crude oil and refined petroleum products. Tankers range in size from less than 50,000 deadweight tons (DWT) to 300,000 DWT or more. The largest of tankers ("supertankers") can transport between 2 and 3 million barrels [320,000 - 480,000 cubic metres(m³)] of oil as cargo. In addition to cargo, tankers carry fuel to power their own systems and engines. Known as bunker fuel, tankers carry between 2,000 and 8,000 m³ of fuel for this purpose. Because of their huge mass, tankers are very difficult to steer and stop. A loaded supertanker can take long as 15 minutes (and 3 km) to come to a full stop, and has a turning diameter of 2 km. The first tankers were generally single-hulled, but a global phasing out of single-hulled vessels was scheduled for 2010.

—○Chemical Tankers

Chemical tankers are designed to transport chemicals in bulk, in separated and protected compartments. Most modern chemical tankers are constructed with a double hull. The Port of Vancouver is the primary location for chemical tankers in B.C. to on- and off-load cargo. Globally, chemical tanker accidents are rare, with most incidents occurring at terminals.

—○Liquid Natural Gas (LNG) Tankers

Liquid Natural Gas (LNG) tankers are designed to transport liquid natural gas in bulk. Most LNG tankers are double hulled and have either spherical or box-shaped protrusions above deck. If LNG is released, it converts to a gaseous state and is highly explosive if ignited. At present time, no LNG tankers enter Canada's Pacific waters, but proposals for LNG terminals and gasification plants in northern and southern B.C. threaten to bring these tankers to the coast.

continued...

Major Vessels that Frequent B.C.'s Coastal and Territorial Waters (continued)

—○Bulk Carriers

Bulk carriers, or “bulkers,” carry cargo such as coal, grain, and cement in bulk and range from 10,000 to over 200,000 DWT. Bulk carriers are vulnerable to cargo shifting which can cause a ship to capsize. Bulk carriers carry a substantial amount of bunker fuel to operate their engines. The outer hull of bulk carriers typically serve as part of the vessel’s fuel tank, which can rupture in the event of a collision or grounding, releasing fuel into surrounding waters.¹

—○General Cargo Vessels

General cargo vessels, or “break-bulk” vessels, carry non-containerized or piece-handled cargo such as wood, construction materials and bagged products. General cargo vessels are smaller than bulk carriers and are approximately 50,000 DWT. Like bulk carriers, break-bulks carry a substantial amount of bunker fuel to operate their engines. Also similar to bulk carriers, the outer hulls of break-bulks serve as part of the fuel tank.¹

—○Container Vessels

Container vessels carry their load in truck or railcar-sized containers which can be loaded onto these vehicles at port for further land-based transport. Large container vessels can carry extremely heavy loads, as much as 300,000 DWT. Containers can capsize if loaded poorly. A loss of containers at sea poses a real threat to other vessels and can become a substantial source of marine pollution. Like bulk carriers and general cargo vessels, the outer hulls of container ships serve as part of the fuel tank which could rupture and release fuel in the event of collision or grounding.¹

—○Barges

Barges are not self-propelled but rather are pulled or pushed by tug or tow boats. In general, it is a

barge’s cargo that can pose an environmental risk as opposed to the barge itself. For instance, a large oil barge can carry up to 30,000 barrels (4,800 m³) of petroleum. Other dangerous goods such as paints, solvents, industrial chemicals, and biocides are also commonly transported on barges.

—○Ferries

Ferries are vessels that carry passengers and their vehicles. Ferries vary in size and design depending on the length of their route, water conditions and required capacity. Most ferries in B.C. are double-ended vessels and can shuttle between terminals without turning around. B.C. Ferries boasts three of the largest double-ended ferries in the world, known as “Super C-class” ferries.

—○Roll-on/Roll-off (RO-RO) Vessels

RO-RO vessels are designed to carry wheeled cargo such as cars, trucks and railcars. RO-RO vessels include ferries, barges, cruise and cargo ships. Large RO-RO vessels transit the outer coast of B.C. transporting vehicles from the southern U.S. to Alaska, and from Asian countries to North America via the Great Circle route.

—○Cruise Ships

Cruise ships are passenger vessels used for pleasure voyages. Typical cruise ships that traverse B.C.’s Inside Passage range from 50,000 – 90,000 Gross Tonnage (GT) and can carry between 700 to more than 3,000 passengers. Cruise ships carry substantial volumes of bunker fuel and thus pose an oil spill risk in the event of a vessel casualty. Other environmental concerns relate to discharges of a cruise ship’s waste streams which have the potential to threaten human health and damage aquatic life if not treated properly (Hall, 2008).

Source: Reid, 2008 (unless otherwise noted)

Table 2

—oOil Tanker Specifications

Tanker Class	Deadweight Tons (DWT)	Length (Meters)	Average Capacity (Barrels)
Oil barge	n/a	up to 112	10,000-65,000
Coastal/Handysize	up to 50,000	205	300,000 ²
Panamax	up to 80,000	230	500,000 ²
Aframax ³	80,000-120,000	245	700,000
Suezmax	120,000-200,000	285	1,000,000
Very Large Crude Carrier (VLCC)	200,000-300,000	350	2,000,000
Ultra Large Crude Carrier (ULCC)	300,000-550,000	415	3,000,000

Source: Reid, 2008; Island Tug & Barge Ltd. 2007

1.2

—oMarine Traffic Activity

Table 3 displays vessel movements by vessel type on the B.C. coast from 1996/7 to 2003/4. Map 1 illustrates vessel traffic densities on the B.C. coast in 2007. The greatest concentration of vessel traffic is in southern B.C. (MoE, 2006; Hall, 2008),

but proposed shipping and terminal expansions at the ports of Kitimat, Stewart and Prince Rupert are expected to substantially increase vessel traffic on the North and Central Coast (Section 2.3.1).

Table 3

—oAnnual Vessel Movements⁴ by Vessel Type on the B.C. Coast from 1996/97 to 2003/04

Vessel type	Vessel Description	Average Number of Vessel Movements/Year	Percent of Total
Passenger	Ferries and cruise ships	229,095	56
Tugs	Towing or propelling barges	117,319	29
Cargo	Bulk cargoes such as cars, grain, ore, etc.	29,253	7
Fishing	Catching, processing or transporting fish under the <i>Fisheries Act</i>	11,078	3
Tankers	Carrying liquid cargo (primarily oil)	2,739	<1
Chemical	Tankers carrying liquid chemicals, including petroleum and LNG	1,278	<1
Other	Vessels not categorized above	19,541	5
Total		410,303	100

Source: Ministry of Environment (2006)

Table 4 describes the main traffic patterns and routes for major vessels along coastal and territo-

rial waters. Map 2 illustrates these traffic routes as well as the locations of deep sea ports in B.C.

Table 4

—oTraffic Patterns and Routes for Major Vessels in B.C. Waters

Traffic Pattern/Route	Description
Port Access	There are four deep-sea port locations in B.C. connected to Canada's continental highways and railways: Lower Mainland ⁵ , Prince Rupert, Kitimat, and Stewart. The port system in B.C. handles 85 percent of the western provinces' marine exports of grain, coal, forest products, petroleum and petrochemicals. The Port of Vancouver is North America's largest port by tonnage (Government of B.C., 2005). In 2005, the Port of Vancouver, Fraser River Port (now amalgamated), and the Port of Prince Rupert account for more than 95 percent of the international trade moving through the B.C. port system (B.C. Government, 2005). Throughput of dry and liquid bulk, container shipments and cruise ship passengers at these ports are projected to increase.
Inside Passage	The Inside Passage route has almost constant vessel traffic. It is used primarily by Alaska-bound cruise ships, transit tankers, tugs, barges and fishing vessels. Vessel activity in the Inside Passage varies seasonally with 1,200-1,500 vessels using the passage each month in the summer and 800-1,000 vessels each month during winter. U.S. and Canadian commercial fishing boats are the most common small vessels and account for approximately 17 percent of traffic in the Inside Passage. Strong currents and narrow passages make these waters challenging for vessels to navigate and present close-quarter situations with other marine traffic (Reid, 2008). If Enbridge's Northern Gateway Project proceeds, at least 225 tankers will cross over the Inside Passage each year, carrying condensate and crude oil to and from the Port of Kitimat.
Great Circle	The "Great Circle" is the shortest distance between Asian Pacific Rim ports and the west coast of North America. It is the route travelled by many of the cargo vessels carrying commodities (oil, bulk goods, vehicles, general cargo) from North American to Asia, and Asian manufactured products to North America. The significance of vessel traffic in the Great Circle Route is that all ships in transit—whether from Alaska or Asia—sail near the west coast of Vancouver Island and Haida Gwaii, regardless of whether the vessel's destination port is in B.C. or Puget Sound.

Tanker Moratorium on the North and Central Coast

British Columbians have long been concerned about oil tanker traffic on the coast (Brander-Smith, 1990). According to federal government documents (Priddle *et al.*, 2004; Royal Society of Canada, 2003), a moratorium on crude oil tanker traffic in Hecate Strait, Dixon Entrance and Queen Charlotte Sound has existed since 1972. The moratorium was imposed by the federal Liberal government under Pierre Trudeau due to concerns over potential environmental impacts, and was later extended to include offshore oil and gas exploration and development on Canadian (offshore) lands. Public concern for the marine environment was further strengthened after witnessing the devastating and widespread effects of the 1988 Nestucca Barge spill in Gray's Harbour, Washington, and the *Exxon Valdez* oil spill a year

later in Prince William Sound, Alaska (Brander-Smith, 1990; Priddle *et al.*, 2004).

The North and Central Coast remained tanker-free until 2006 when the federal Conservative government permitted Canadian-chartered tankers to import condensate to the Methanex Marine Terminal in Kitimat via Douglas Channel and Caamano Sound (Reid, 2008). Ever since, the federal Conservative government has denied the existence of the moratorium on tanker traffic and



According to a 2010 poll, 80 percent of British Columbians support banning crude oil tankers in B.C.'s coastal waters, up from 72 percent in a similar 2008 poll (ForestEthics, 2010).

“If oil-tanker traffic is allowed off the coast, it becomes a statistical question of when, not if, an accident is going to occur.”

(David Anderson⁶, 1989)

has revoked the tanker moratorium statement from the Priddle (2004) report. This significant change in federal policy was made without consultation or input from coastal communities or First Nations governments along the tanker route and has been debated since.

Regardless of the existence of a federal tanker moratorium, a permanent, legislated tanker ban is needed in Dixon Entrance, Hecate Strait and Queen Charlotte Sound. According to a 2010 poll, 80 percent of British Columbians support a ban of crude oil tankers in B.C.'s coastal waters (ForestEthics, 2010). In March of 2010, the Coastal First Nations, an alliance of ten First Nations on the North and Central Coast of B.C. and Haida Gwaii, declared their opposition to tanker traffic stating:

“...in upholding our ancestral laws, rights and responsibilities, we declare that oil tankers carrying crude oil from the Alberta Tar Sands will not be allowed to transit our lands and waters.”

(Coastal First Nations, 2010b)

Southern Coast Oil Tankers

The Port of Metro Vancouver handles fuel oil and gasoline imports and exports through five terminals. In 2006, 1.7 million tonnes of gasoline and 1.4 million tonnes of fuel oil (mostly by barges) were shipped to and from points on Vancouver Island and in Washington State from the Port of Metro Vancouver. Kinder Morgan's Westridge Marine Terminal is the largest of the Vancouver terminals and has been in operation since 1957. Their operations are expanding: 34 crude oil tankers were loaded at the Westridge Marine Terminal in 2007 compared to 28 in 2006. Most crude oil shipments from the Kinder Morgan terminal are destined for California (Reid, 2008). However, the company has been “testing the logistics” of expanding the capacity of their pipeline and shipping Alberta oil to China (Statistics Canada, 2007).

1.2.1

Trans-Alaska Pipeline System (TAPS) Oil Tankers

U.S.-flagged and owned oil tankers transport crude oil from Valdez, Alaska along B.C.'s west coast to refineries in Puget Sound. This TAPS tanker traffic has resulted in an oil tanker traveling down B.C.'s coast every day since 1976. Today, TAPS tankers are built with dual systems: two engines, two screws, two rudders. The likelihood of both systems becoming disabled is remote (Reid, 2008).

1.3

—○Projected Trends

Among all of B.C.'s ports over the next 15 years, container ship volumes are expected to increase by 300 percent, bulk cargo shipments by 25 percent, and cruise ship traffic by 20 to 25 percent (Hall, 2008). Throughput of the Port of Vancouver is expected to grow 2.3 percent per year, from 73.57 million tonnes in 2004 to 106.4 million tonnes by 2020 (Government of British Columbia, 2005).

Projected Vessel Traffic Volumes from Proposed Pipeline and Terminal Expansion Projects

Several terminal expansion and pipeline development projects are proposed or underway along the B.C. coast that would increase shipping traffic, shipping-related impacts and the risk of marine vessel casualties on the coast (Reid, 2008; OSTF, 2002). At least four pipeline projects have been proposed for the North Coast alone which, if permitted, would bring more than 300 oil tankers to North and Central Coast waters every year (Reid, 2008). By far the largest pipeline proposal is Enbridge's Northern Gateway Project—described in greater detail in Section 1.4.

Most of these proposed developments are directly related to the current and forecasted expansion of the Alberta tar sands. Production of tar sands oil drives the development and expansion of pipelines that can transport oil and condensate between the tar sands and the ports of Kitimat and Vancouver (Reid, 2008). In turn, tankers would be required to ship condensate and oil to and from these ports.

Table 5 describes terminal expansion and pipeline development projects that are proposed or underway in B.C. The terminal expansion projects are part of the \$13 billion Asia-Pacific Gateway Project which aims to make intermodal container and bulk cargo management larger and more efficient (Reid, 2008).

“The north coast of B.C. is a well established commercial and recreational marine network of coastal and inland waterways. However, tankers transiting to and from Methanex's Kitimat Terminal will encounter locations where close-quarter situations with other marine traffic may occur including pilot boarding stations, narrow channels, channel beds, and areas where marine traffic crosses. In addition to marine vessel traffic, visiting tankers need to be aware of other regional activities that may present navigational hazards including military operations, exploratory work, seaplane activities, commercial fisheries, and environmentally and socio-economically sensitive shoreline features .

(Methanex Corporation, 2006)



At least four pipeline projects have been proposed for the North Coast alone. If permitted, these projects will bring more than 300 massive oil tankers to North and Central Coast waters every year.

Table 5 — Summary of Projected Major Vessel Traffic Volumes Based on West Coast Industrial Projects

Project	Vessel Type	Current Vessel Size	Current Traffic Volume	Potential Traffic Volume	Comments/Details of Project
Delta Container Terminal Expansion	Container	Current range of 1,600 to 6,300 TEU	3.1 vessels/day (1,131 vessels/year)	5.3 vessels/day (1,934 vessels/year)	New berth and second terminal to be in operation by 2021. Container vessels will also increase in size, up to 12,000 TEU.
Prince Rupert Container Terminal Expansion	Container	Up to 5,020 TEU	167,000 TEU total volume for 2007	Up to 2 million TEU annually by 2020	Individual container vessels will increase up to 12,000 TEU or greater.
Stewart Bulk Cargo and Container Terminal Expansion	Bulk	Unknown	30 vessels/year	100 vessels/year	Additional traffic volume will include container ships.
Kitimat General (Break-bulk) Terminal Project	General Cargo	n/a	n/a	n/a	Proposal in feasibility stage.
Kitimat LNG Terminal Project	LNG Tanker	n/a	n/a	70 to 90 LNG tankers /year	Size range from 160,000 to eventually 260,000 cubic meters LNG tankers.
Kitimat to Summit Lake LNG Pipeline Looping Project	LNG Tanker	n/a	n/a	Increase LNG tanker traffic	The pipeline project would significantly increase the capacity to overland transport LNG from the Kitimat LNG Terminal.
Texada LNG Terminal Project	LNG Tanker	n/a	n/a	36 LNG tankers /year	n/a
Kinder Morgan Canada's Pipeline System Expansion	Oil Tanker	65,000 to 85,000 DWT range	34 out-bound tankers for 2007	Up to one loaded tanker per day	Tanker size will increase to 100,000 DWT. Assumption is that all product will be transported by tanker; whereas, some may be transported overland.
EnCana/Methanex 's Condensate Tanker Imports	Oil Tanker	35,000 DWT	7 to 9 in-bound tankers/year	32 in-bound tankers/year	Condensate is currently transported overland by rail car (30-40 cars/day). Imports are limited by a shortage of temporary storage capacity at the terminal, which is in the process of being increased.
Pembina Pipeline Corporation's (Summit Lake) Condensate Pipeline Project	Oil Tanker	n/a	n/a	One in-bound tanker every 10 days (assuming an Aframax size)	Pipeline design capacity is 100,000 barrels per day (bpd). Could replace current condensates imports by EnCana being moved overland by railcar.
Enbridge Inc.'s Northern Gateway Pipelines Project - Condensate Import Pipeline	Oil Tanker	n/a	n/a	Average 71 tankers/year (Enbridge Northern Gateway Pipelines, 2010a).	Pipeline design capacity is 193,000 bpd (Enbridge Northern Gateway Pipelines, 2010a).
Enbridge Inc.'s Northern Gateway Pipelines Project - Crude Oil Export Pipeline	Oil Tanker	n/a	n/a	Average 149 tanker/year (Enbridge Northern Gateway Pipelines, 2010a).	Pipeline design capacity is 525,000 bpd of crude oil (Enbridge Northern Gateway Pipelines, 2010a).

Source: Reid, 2008 (unless otherwise noted)

1.4

—○ Case Study—

Enbridge's Northern Gateway Project

In May of 2010, Enbridge Northern Gateway Pipelines submitted a project application to the National Energy Board (NEB) and Canadian Environmental Assessment Agency (CEAA) in which it proposed to construct and operate two parallel 1,170 km oil pipelines between Kitimat, B.C. and Bruderheim, Alberta (Figure 1). The proposal includes the construction of a marine terminal at Kitimat, B.C. and associated tanker traffic. One pipeline would move 525,000 barrels of **crude oil** per day west to Kitimat, and the other would carry 193,000 barrels of **condensate** east to the tar sands (Enbridge Northern Gateway Pipelines, 2010a). If approved, an average of 220 supertankers will pass through the confined waterways of the Great Bear Rainforest on B.C.'s North and Central Coast each year, exporting oil

to Asian and southern U.S. markets and importing condensate to Alberta (Enbridge Northern Gateway Pipelines, 2010a).

The federal NEB/CEAA joint review of the project, led by a Panel of three government employees, is expected to be complete by the end of 2012. Numerous non-government organizations and First Nations were granted public participant funding to partake in and provide expert evidence to the review. If approved, the projected timeline for completion and operation is 2016.

Northern Gateway's emergency response strategy aims to "prevent accidents before they occur" (Enbridge Northern Gateway Pipelines, 2010b). The reality however, is that no amount of planning can fully eliminate the risk of an oil spill.

1 In 2006, the *International Maritime Organization* (under *MARPOL*), adopted a regulation requiring that all new ships with a bunker fuel capacity of 600 m³ or more must have their fuel tanks deeper inside their ship and behind two walls. The regulation also limits the capacity of each fuel tank to 2,500 m³. This regulation does not affect existing vessels (Reid, 2008).

2 The capacity of Coastal and Panamax tankers are approximations based on 40,000 and 70,000 DWT vessels respectively.

3 Aframax tankers are the most common tankers worldwide and are the type of tanker that currently exports oil from Kinder-Morgan

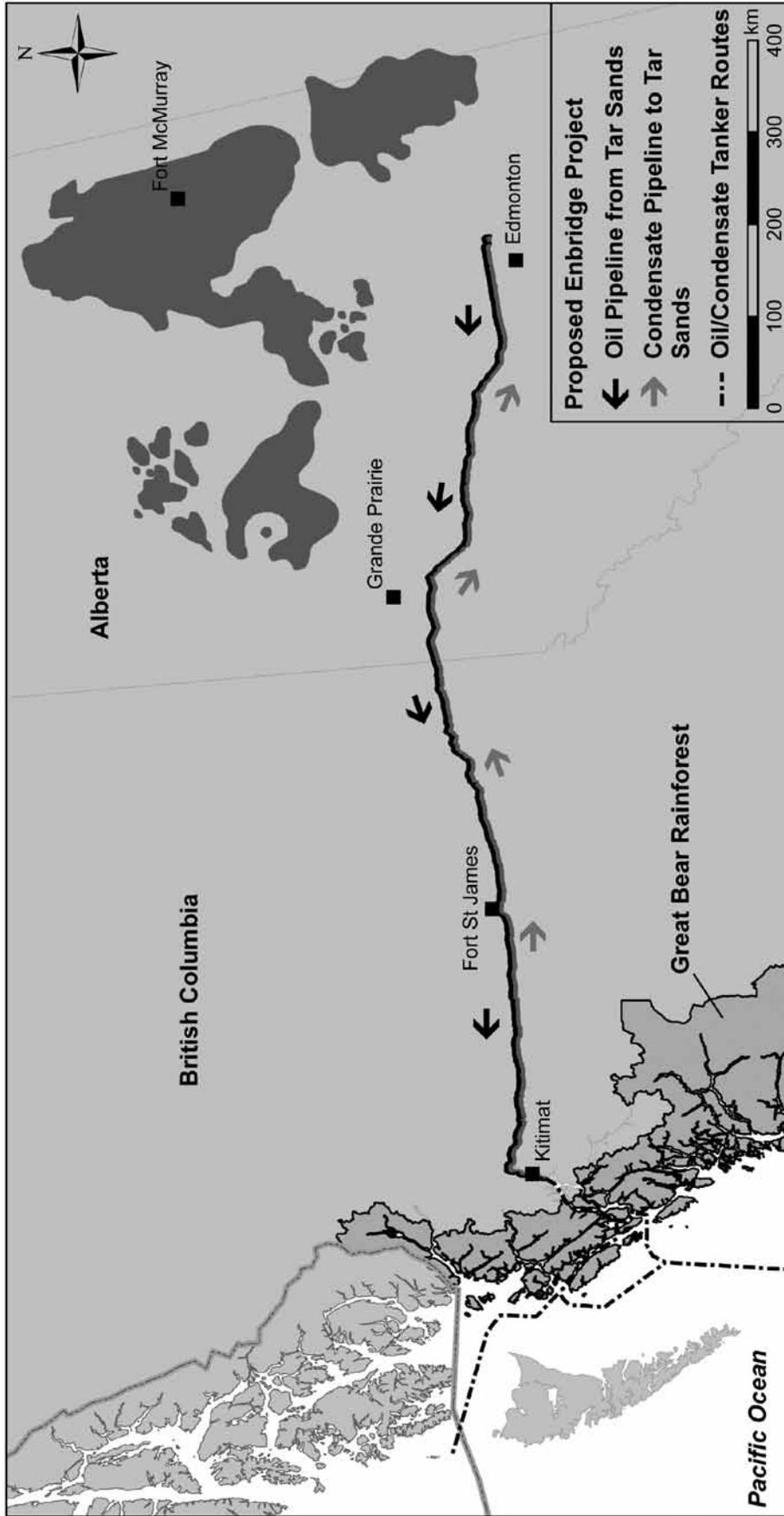
Canada's Westridge Marine Terminal in the Port of Vancouver (Reid, 2008).

4 Table describes average number of vessel movements per year and not number of actual vessels, in accordance with Transport Canada's method for counting vessels.

5 Lower Mainland ports include the Vancouver Port, Fraser River Port and the North Fraser Port. In 2008, these ports were amalgamated into Port Metro Vancouver (Port Metro Vancouver, 2008)

6 Former Minister of the Environment

Figure 1
Proposed Pipeline and Tanker Routes for Enbridge Northern Gateway Project



Data: Pipelines and tanker routes from Enbridge Northern Gateway Pipelines (2010c). Tar sands digitized by Global Forest Watch Canada from Canadian Centre for Energy Information (2008).

2 Shipping Legislation and Regulation

2.1

—o Legislation

The Government of Canada has jurisdiction over shipping in Canadian waters¹ and the Canadian Coast Guard is the lead federal agency² for maritime oil spills from vessels under the *Canada Shipping Act*. The B.C. provincial government has jurisdiction over the coastline and the B.C. Ministry of the Environment is the lead provincial agency for oil and hazardous material spills under the *Emergency Program Act*. The difficulties associated with this jurisdictional overlap is examined in Section 6.2.2.

A variety of legislation exists to govern shipping in B.C. and Canada:

- The *Canada Shipping Act (2001)*: is the principle legislation governing safety in marine transportation and recreational boating, as well as protection of the marine environment. It applies to Canadian vessels operating in all waters and to all vessels operating in Canadian waters. It promotes “the sustainable growth of the marine shipping industry without compromising safety (Reid, 2008).” It is administered by the Minister of Transport although some provisions are governed by the Minister of Fisheries and Oceans Canada. In 1993 the *Canada Shipping Act* was amended to
- require oil tankers and barges and oil handling facilities that receive shipments³ from these vessels to have an “arrangement” with a Transport Canada Response Organization (RO) to handle an oil spill for which they are responsible (Reid, 2008).
- The *Fisheries Act (1985)*: applies to shipping only insofar as the protection of fish and their habitat from pollution. It is administered by the Minister of Fisheries and Oceans Canada (Government of Canada, 1985).
- The *Marine Liability Act (2001)*: creates the legal liability on the ship owner for oil pollution damage and costs of reasonable measures⁴ undertaken. The Act also incorporates a number of international covenants into Canadian law (Reid, 2008).
- *International Maritime Organisation (IMO)*: was established in 1948 and is the United Nation’s specialized agency responsible for improving maritime safety and preventing pollution from ships (*IMO*, 2002). *IMO* conventions for ensuring crew and passenger safety, preventing accidents, and pollution, making arrangements for

compensation, and for the design and operation of major vessels come into effect when a majority of nations accede to them. Canada agreed to the conventions of the *IMO* under The *Canada Shipping Act (2001)*. The conventions do not address emergency preparedness however, which is left to the individual country (Reid, 2008).

● *The International Convention for the Prevention of Pollution from Ships (MARPOL)*: is intended to prevent ships from polluting the marine environment by operational or accidental causes. It covers pollution by oil, chemicals and harmful substances in packaged form, as well as sewage and garbage. As of December 2005, 136 countries (including Canada), representing 98 percent of the world's shipping tonnage, were party to *MARPOL*.

2.2

—○Regulatory Measures

2.2

Double vs. Single Hulled Vessels

Double-hulled vessels are often cited as an improvement over single-hulled vessels (OCIME, 2003). A double hull is essentially two skins of steel separated by a space about two metres wide which is used to hold ballast water when the vessel is without cargo (PWSRCAC, 2009). The theory is that if the outer hull is damaged, the cargo in the inner hull may still be protected (Reid, 2008). Double-hulled tankers offer the best protection when a collision or grounding occurs at slow speeds, but double hulls do present challenges as they are still a relatively new technology and are more susceptible to problems of poor maintenance and operation (OCIME, 2003). For instance, double hulls may result in increased corrosion between the hulls and a top heaviness that makes the vessel less stable in rough conditions.

In 1993, the *International Maritime Organization (IMO)* enacted a phase-out scheme for all single-hulled tankers by 2015, later accelerated to 2010 ((Reid, 2008). In addition, all tankers

operating in Canadian waters built or substantially modified after 1993 were to be double-hulled. The accelerated phase-out date put Canada at par with the U.S., which mandated all tankers calling at American ports be double-hulled by 2010, under the Federal Oil Pollution Act (OPA) of 1990 (Reid, 2008). Introduction of the OPA closely followed the *Exxon Valdez* spill in Prince William Sound in 1989. The *Exxon Valdez* was a single-hulled tanker.

2.3

—○Voluntary Tanker Exclusion Zone

The Voluntary Tanker Exclusion Zone (TEZ) (Map 3) has existed as an industry Code of Practice since the 1970s to discourage tankers carrying petroleum, liquid gas and vegetable oils from traveling too close to B.C.'s west coast (MacConnachie *et al.*, 2007). The TEZ was designed to reduce the risk of a disabled tanker drifting ashore before a salvage tug could reach it in difficult weather conditions (Reid, 2008).

Originally, the TEZ was aimed at TAPS tankers moving along the west coast of Haida Gwaii (Queen Charlotte Islands) and was unpopular among the tanker industry. In 1988, the U.S. and Canadian Coast Guards, along with the U.S. Chamber of Shipping, developed a TEZ that took into consideration:

- 1 The risk of a disabled tanker grounding on the B.C. coast;
- 2 The risk of west coast fishing vessels colliding with tankers;
- 3 The shipping industry's desire to keep the boundary close to shore for economic reasons; and
- 4 The position at the time of breakdown tankers were predicted to run aground before the arrival of a tug.

Critics point out that the economic interests of the shipping industry were too well accommodated in the development of the TEZ. It is deemed as an inadequate measure to protect the coast from potential tanker disasters because 1) it is voluntary, and 2) portions of the boundary fall substantially short of the distance required to

enable a rescue tug to arrive and secure a tow in severe weather conditions (OSPF, 2002). The nearest rescue tug is stationed 600 nm away, at Neah Bay in Washington State. Furthermore, oil barges and other non-oil carrying tankers (i.e. chemical tankers, bulk carriers, container vessels, etc.) do not need to travel outside the TEZ and often travel very close to shore (Reid, 2008). A drift analysis study which assessed the risk associated with disabled tankers and B.C. rescue tug capacity is described in Section 5.1.

2.4

—○Accountability

Internationally, the shipping industry is a complex structure of national and open registries. Some 29,000 vessels above 1,000 GT worldwide are engaged in seaborne trade and nearly half of these vessels are registered in the open registries of countries⁵ different from that of the ship owner (Reid, 2008). This practice can reduce operating costs and enables ship owners to avoid regulations in their own country (ITF 2010). The

term “flag of convenience” describes this business practice, the significance of which is that it raises the question of who is ultimately responsible, or accountable, for a vessel in the event of a casualty (Reid, 2008).

In Canada, accountability for a major spill is at “arms-length” ever since the *Exxon Valdez* spill in 1989. Oil companies will rarely put their corporate name on a vessel anymore because oil companies rarely own the vessels in which they transport their product. Instead oil companies charter vessels to do their shipping and it is the ship owner, not the product owner, that is the legally Responsible Party (RP) in the event of an oil spill or other marine casualty (Reid, 2008).

1 Canada’s Oceans Act defines “Canadian waters” as the area in between the low water line and 200 nautical miles (nm) out to sea.

2 Lead agency refers to the government department, ministry, or organization that has jurisdiction to manage an emergency.

3 The amendment only applied to tankers and barges carrying oil in excess of 150 tonnes, and to ships 400 tonnes or greater.

4 Reasonable measures and cost requirements are poorly defined (Reid, 2008).

5 Countries with open registries include Panama, Liberia, Cyprus, Bahamas, Bermuda and Vanuatu, as well as the international ship registries of Norway and Denmark (Reid, 2008).

3 Types and Causes of Marine Vessel Casualties

3.1.

—oTypes of Marine Vessel Casualties

A marine vessel casualty refers to an accident resulting in damage to a vessel such as grounding or sinking, collision or allision (Reid, 2008). However, a marine vessel incident refers to a vessel in distress (i.e. loss of engine power). Vessel incidents can lead to marine vessel casualties. On the B.C. coast between 1999 and 2009, over 1,200 vessel incidents were reported (Map 4).

Discharge of a Vessel's Cargo

Although we typically focus on the risk and potential impacts of a major tanker losing its cargo of oil, the loss of other cargos (i.e. containers and chemicals) can have substantial public safety and environmental consequences as well. Hundreds of floating containers from an overturned container ship pose a serious threat to vessels attempting to navigate through the flotsam. If containers are broken open at sea, or once they reach shore, the contents can become a substantial source of marine and coastal pollution (Reid, 2008). Of course, oil spills are also damaging events, the ecological impacts of which are described in Section 5.2

Release of Vessel's Bunker Fuel

An oft-overlooked aspect of marine vessel casualties is the potential release of a vessel's

bunker fuel which is carried by all vessels to operate their engines and ship systems. Most of the world's ocean-faring vessels use a heavy fuel oil (HFO) known as Bunker "C". The risk of a bunker fuel spill is greatest with general cargo ships, bulk carriers and container vessels since the outer hulls of these ships serve as part of the fuel tank and can rupture in the event of a collision or grounding. The bunker fuel capacity of major marine vessels is considerable. Bulk carriers hold as much as 4,000 m³ of HFO and 300 m³ of diesel oil. An even greater threat comes from large oil tankers and container vessels which carry as much as 7,500 m³ of HFO and 400 m³ of diesel as bunker fuel (Reid, 2008).

Ship Wreck

A ship wreck due to grounding or sinking poses the economic dilemma of whether to salvage the vessel or leave it as a wreck. A ship wreck that is not removed can be a public safety issue, a blight on the landscape, a navigational risk, and a source of chronic pollution as the vessel degrades over time (Reid, 2008).

3.2

—oCauses of Marine Vessel Casualties

Most vessel accidents are a result of a combination of factors, all which contribute in varying degrees to the final outcome. According to marine

statistics compiled by the Transportation Safety Board of Canada between 2002 and 2006, the most common cause of shipping accidents involving Canadian commercial vessels were groundings, strikings (not including collisions) and fires or explosions (TSB, 2007). These data reflect those collected by the International Tanker Owners Pollution Federation (ITOPF) which has maintained a database of accidental oil spills from tankers, combined carriers and barges since 1970.

The ITOPF classifies spills as either “operational” or “accidental” (ITOPF, 2010). ITOPF data indicates that most spills from tankers result from routine operations (i.e. operational), such as loading, discharging, and bunkering in ports or at oil terminals (ITOPF, 2010). Most operational spills are small, 90 percent of which have resulted in less than 7 tonnes of oil being spilled. On the other hand, accidental spills, such as those resulting from vessel collisions or groundings, typically result in much larger spills. Eighty-four percent of accidental spills have resulted in oil spills in excess of 700 tonnes (ITOPF, 2010). Figure 2 provides a breakdown of the causes of oil spills that resulted in quantities of oil in excess of 700 tonnes being released.



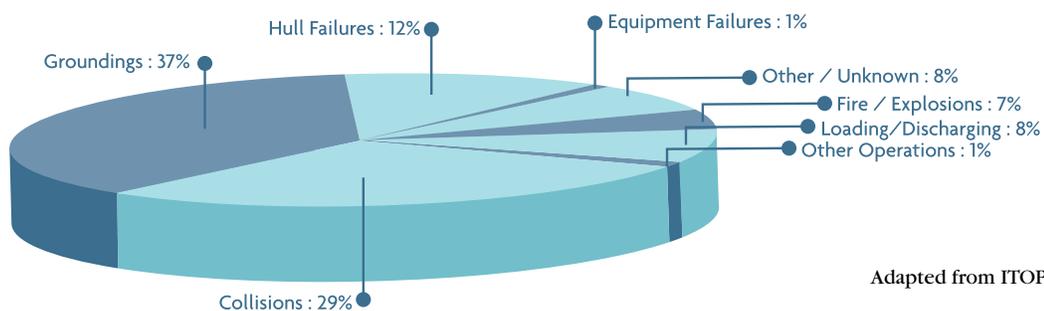
Human factors are cited as the underlying cause of 75-80 percent of oil spills and marine accidents. (DeCola & Fletcher, 2006)

The Role of Human Error in Marine Vessel Casualties

Conservative estimates suggest that human factors—either individual errors or organizational failures—are the “real” or underlying cause behind as much as 75-80% of oil spills and marine accidents (DeCola & Fletcher, 2006; Brander-Smith, 1990). Although we may identify the causes of oil spills and accidents according to a type of incident (e.g. groundings, collisions, fires, etc.), the root cause can likely be traced back to a chain of events involving human performance breakdowns, resulting in poor choices and decisions. The significance of this information should not be overlooked. Human and organizational errors will continue to occur despite improvements to oil spill prevention technologies, tanker design and regulatory oversight (DeCola & Fletcher, 2006). Proposed terminal expansion and pipeline development projects on the B.C. coast are not exempt from the reality of human nature.

Figure 2

— Causes of Oil Spills in Excess of 700 tonnes²



Adapted from ITOPF (2010)

¹ In 2006, the *International Maritime Organization* (under *MARPOL*), adopted a regulation requiring that all new ships with a bunker fuel capacity of 600m³ or more must have their fuel tanks deeper inside their ship and behind two walls. The regulation also

limits the capacity of each fuel tank to 2,500m³. This regulation does not affect existing vessels (Reid, 2008).

² Includes operational and accidental oil spills (ITOPF, 2010).

4 Environmental Impacts

4.1.

—o From Normal Operations

A catastrophic oil spill may be the first thing that comes to mind with respect to the potential impacts of shipping. However, a number of other sources of pollution and environmental disturbance exist in the realm of vessel and shipping activities. These impacts range from chronic oil pollution from oily wastewater discharges, to the introduction of invasive species and anthropogenic noise pollution. The following section outlines several shipping-related sources of marine pollution and disturbance, and some of the resulting ecological impacts.

Water Pollution

Chronic oil pollution from marine traffic (as opposed to acute oil spills) contributes more oil to the marine environment than do acute spills¹ (Haggerty *et al.*, 2003). Worldwide, operational discharge from ships is estimated to amount to 198,000 tonnes each year² (GESAMP, 2007). Chronic oil pollution most frequently occurs during cargo transfers at ports where vessels discharge oily bilge and waste water (Haggerty *et al.*, 2003), but also on offshore shipping routes through engine, tank and shipboard machinery washings (Van Hinte, 2005; Haggerty *et al.*, 2003). Chronic oil pollution has persistent, cumulative impacts on marine plants and animals (MoE, 2006;

Hall, 2008) and can be as toxic to marine life as an oil spill (Johannessen, *et al.*, 2007).

Anti-fouling paints, used as a biocide on vessel hulls since the 1970s, commonly contain a compound called tributyltin (TBT)³ (Haggerty *et al.*, 2003), which has been described as “the most toxic substance ever deliberately introduced into natural waters” (Stewart & Thompson, 1994). Benthic sediment cores approximately 25 kilometres offshore from Vancouver harbour have shown traces of TBT (Stewart & Thompson, 1994). Wood preservatives, often applied to pilings, piers and docks, also have toxic effects when released into the marine environment (Molnar & Koshure, 2009).

Debris disposal by ships pose serious risks to marine organisms (Molnar & Koshure, 2009; Hall, 2008) if they become entangled in debris or mistake the marine debris for prey (BCCSN, 2010). Common types of debris such as glass, metals, paper, food wastes, wood, rubber and packaging materials can be discharged overboard at prescribed



As many marine birds are killed as a result of chronic oiling as from catastrophic oil spills (Johannessen, *et al.*, 2007).

distances from shore under various international marine conventions (Van Hinte, 2005). The release of sewage and grey water from ships into the marine environment is of great concern due to concentrations of pharmaceuticals, coliform bacteria, personal care products, oils and greases, and nutrients found in human waste and in grey water from sinks, showers and galleys (Johannessen *et al.*, 2007). The release of sewage and grey water is of particular concern with respect to cruise ships. It is estimated that a cruise ship carrying 3,000 people for one week can produce 3.8 million litres of waste water and 800,000 litres of sewage (Hall, 2008).

Air Pollution

International shipping is becoming an increasingly significant source of air pollution and greenhouse gas emissions. By 2010, marine vessels are predicted to exceed on-road motor vehicles as a source of smog-forming air pollutants in Metro Vancouver (MoE, 2006; Van Hinte, 2005). Key compounds emitted by ocean-going vessels include carbon dioxide, nitrogen oxides, sulphur oxides, carbon monoxide, volatile organic compounds, black carbon and particulate matter. These compounds have been linked to a variety of public health concerns and ecosystem impacts, as well as global warming and ocean acidification. At present, no mandatory measures to regulate and reduce emissions of greenhouse gases from international shipping sources exist (Maritime Environment Protection Committee, 2010). Without action, carbon dioxide emissions from shipping could rise as much as 75 percent in the next 15-20 years (Vidal, 2007).

Noise Pollution

Ambient noise levels in the ocean are thought to be at least ten times higher today than they were a few decades ago (Hildebrand, 2003). Loud sounds can interfere with marine mammals dependent on the physics of underwater sound for communication, reproduction, navigation, and locating food (Molnar & Koshure, 2009). Noise pollution from engine propellers, seismic surveys and navy sonar produce sound levels that are above the pain threshold for killer whales (Molnar



Southern coastal B.C. is critical habitat for Southern Resident killer whales which are listed as “Endangered” by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC, 2009). There is concern that noise from heavy marine traffic in the Georgia and Juan de Fuca straits (Map 2) may be interfering with the whales’ ability to locate prey and communicate with each other, although this has yet to be assessed (DFO, 2005).

& Koshure, 2009) and is cited as a conservation concern for threatened Northern Resident and endangered Southern Resident killer whales (Joyce, *et al.*, 2005).

Invasive Species

More than 3,000 species of animals and plants are estimated to be transported around the world daily in ballast water (MoE, 2006). When ballast water is discharged, alien species may become introduced to a new area. Alien species are considered invasive if their introduction causes harm to the environment, the economy or human health (Transport Canada, 2010). A recent analysis of high density shipping areas in B.C. identified the Strait of Georgia, Johnstone Strait and parts of the Inside Passage along the B.C. Central Coast as areas at the highest risk for significant invasive species introductions (Herborg *et al.*, 2008).



The European green crab was introduced to San Francisco Bay through ballast water and is currently migrating up the west coast, threatening indigenous crab populations (Van Hinte, 2005).

Ship strikes

“Ship strike” is the term used when a ship hits a whale or other marine mammal. Ship strikes can pose substantial conservation issues for small populations or endangered species (Laist et al., 2001). Fortunately, ship collisions with whales on the B.C. coast are rare, but increased marine traffic in shipping lanes that cross whale migration and feeding areas increases the risk of collisions (Environment Canada, 2004). In the narrow passageways of B.C.’s North and Central Coast, where whales and high vessel traffic densities are found, researchers have demonstrated an elevated ship strike risk for humpback, fin and killer whales (Williams & O’Hara, 2009).

For a more thorough assessment of the impacts of shipping download: “Cleaning Up Our Ocean: A report on ocean pollution from shipping-related sources in the Pacific North Coast Integrated Management Area (Pncima) on the British Columbia Coast” from www.livingoceans.org/initiatives/ocean-planning/reports-publications.

4.2

—o From Vessel Casualty

Oil Spills

When oil is released in a spill, it is acted upon by physical, chemical and biological “weathering” processes. If released at the ocean’s surface, oil rapidly spreads into slicks and moves along with the prevailing water flow and wind direction. When spills occur beneath the surface of the ocean, the oil spreads through the water column and drifts with currents (Patin, 1999). In both instances, spilled oil can dissolve, evaporate, emulsify, and disperse within the water column, aggregate into lumps or tar balls, oxidise or enter the sediment. Waves and currents will eventually bring spilled oil to near shore areas (U.S. NOAA, 1997), and substantial portions of oil spills typically reach shorelines before they are completely weathered at sea (Patin, 1999).

Oil spills can have immediate and harmful impacts on marine organisms. Specific ecological impacts of oil spills are difficult to predict as



An oil spill of 36,500-365,000 barrels can spread to cover an area of 50,000 km² (Patin, 1999).



The *Exxon Valdez* oil spill in 1989 was estimated to have resulted in the death of 2,800 sea otters, 250,000 birds, 1.9 million salmon, and 12.9 billion herring (Brown *et al.*, 1996; Geiger *et al.*, 1996; Piatt & Ford, 1996).

they are unique to the nature and size of the spill (Birtwell & McAllister, 2002; Patin, 1999; GESAMP, 1993), the surrounding environment (Birtwell & McAllister, 2002; Strong et al., 2002; Wells et al., 1995), and biological characteristics of impacted organisms. For instance, animals that live at the ocean’s surface, in inter-tidal zones, in estuaries and in other coastal habitats are impacted most severely by oil spills (Strong et al., 2002; GESAMP, 1993). Immediate effects on marine life may be compounded by linkages of organisms within food webs (Birtwell & McAsllister, 2002).

The duration of environmental impacts from oil spills varies according to species and the degree to which oil is retained in shoreline sediments. Oil can persist for longer periods on beaches composed of coarse materials such as gravel and cobbles (U.S. NOAA, 1997; GESAMP, 1993). A 2003 study in Prince William Sound indicated that oil remained in shoreline sediments and a number of species were still exhibiting signs of oil pollution 14 years after the *Exxon Valdez* spill (Peterson, *et al.*, 2003). Impacts on the natural environment from an oil spill could have far reaching socio-economic and cultural effects by negatively impacting commercial, recreational or subsistence fisheries, and marine recreation and tourism industries.

FACT

The length of time an animal is in oil is a more important determinant of survivability than the amount of oil it has been exposed to. A highly oiled bird that has been captured and appropriately cared for within a few hours has a greater chance of survival—and less suffering—than a lightly oiled one left in the wild for days (Reid, 2008).

1 *Chronic* oil pollution refers to operational discharge of oil from ships into the marine environment. In contrast, *acute* oil pollution results from accidental oil spills (Molnar & Koshure, 2009).

2 Includes operational discharges of fuel oil, bilge oil and oily ballast water (GESAMP, 2007).

3 The use of TBT compounds in antifouling paints in Canada was prohibited in 2002 (Health Canada, 2002).

5 Marine Vessel Casualty Risk and Emergency Response Preparedness

5.1

—o Marine Vessel Casualty Risk

In 1990 a federal public review on tanker safety in Canadian waters determined that—based on the current levels of tanker traffic—Canada could expect 100 small, ten moderate and at least one major oil spill every year. A catastrophic¹ spill—for which Canada was considered “wholly unprepared”—could be expected once every 15 years (Brander-Smith, 1990). Twenty years later, Canada’s Commissioner of the Environment and Sustainable Development determined that Canada’s plan for oil spill preparedness and response still does not adequately establish national preparedness capacity (CESD, 2010). In addition, the 2010 Commissioner’s report noted the lack of any preparedness and response regime for ship-source chemical spills (CESD, 2010).

Risk analyses indicate that the risk of vessel collisions increases with traffic density (OSTF, 2002). Expected increases in tanker and other vessel traffic on the B.C. coast will thus increase the risk to sensitive coastal resources from oil or other hazardous cargo spills caused by collisions or groundings.

Drift Analysis Study

In 2002, the Pacific States/B.C. Oil Spill Task Force undertook a study to determine the relative risk of marine casualties from California to

“The unfortunate fact remains that, given the high marine traffic and topography of our coastline, it simply is not possible to completely prevent spills from happening in the first place. Narrow passages, underwater obstacles and a rocky ocean floor are only a few of the distinctive natural traits of our coastal waters”

(Penner, 2008).

Alaska. The study evaluated how fast disabled tanker and non-tanker vessels would drift ashore in various weather conditions (drift rate), and the time required for a rescue tug to arrive on scene and secure a tow.

The study articulated the fact that B.C. has no dedicated rescue tug along the coast, instead operating on the *hope* that a commercial tug will be in the locale of a stricken vessel to provide emergency services. These “tugs-of-opportunity” are typically stationed in the Vancouver area when not engaged in their commercial work. The closest dedicated rescue tug is in Washington State, at Neah Bay (OSTF, 2002).



According to a drift analysis study, a vessel adrift off Haida Gwaii in severe weather would have to be 216 nautical miles (nm) offshore to ensure its rescue before drifting aground. The current Tanker Exclusion Zone falls far short of this requirement (OSTF, 2002).

Major non-tanker vessels were indicated to pose a high risk for potential grounding because they commonly travel close to shore and only have one engine system. In average weather conditions, oil tankers that stay behind the voluntary TEZ pose low risk of grounding. In severe weather conditions however, a stricken vessel would have to be 50 nm off-shore of Vancouver Island, or 216 nm off of Haida Gwaii (Queen Charlotte Island) in order for a rescue tug to have sufficient time to be dispatched, arrive on scene and secure a tow before the vessel drifted ashore and grounded (OSPF, 2002). Off of Haida Gwaii, this “worse case” drift is beyond Canada’s voluntary TEZ (Map 3). A mitigating factor today is that most of the U.S. TAPS tankers from Alaska have dual engine systems and the likelihood of both becoming disabled is remote. However, other oil tankers that are chartered by U.S. or Canadian companies have only one engine system and therefore do not have this risk reduction feature.

5.2

—oCanada’s Oil Spill Response Regime

A mechanism for emergency preparedness and response became enshrined in the *Canada Shipping Act* in 1995 as a result of the 1988 *Nestucca* tug and barge collision, the 1989 *Exxon Valdez* oil tanker grounding and a number of public and private studies that indicated Canada’s ability to respond to an oil spill was deficient. The regulation that followed these events was the *Response Organizations and Oil Handling Facilities Regulations*, regulated by Transport Canada. Since the regulation was essentially in response to two oil spill incidents, government and industry negotiated legislation which focused only

on the oil spill component of an accident—not on the casualty itself (e.g. vessel salvage, rescue tug role, non-oil marine pollutants, etc.). Examination of Canada’s current legislative framework for oil spill preparedness and response reveals numerous institutional and technical gaps for both oil spills and other vessel casualties not involving spilled oil (Reid, 2008).

Response Organizations

The 1993 *Response Organizations and Oil Handling Facilities Regulation* established an entity called a Response Organization (RO) with which ship owners and oil handling facilities² must make pre-arrangements to handle an oil spill for which they are responsible (Reid, 2008). ROs must be federally certified and are not-for-profit organizations. To be certified, ROs must meet the “Response Organization Standards” defined by Transport Canada (1995). In B.C., the RO is Burrard Clean, a division of Western Canada Marine Response Corporation. ROs operate by collecting fees from ship owners—the “responsible party” (RP) in the event of an oil spill—with which they purchase response equipment (booms, skimmers, vessels, etc.), hire staff and undertake response planning (Reid, 2008). The fees are a legal requirement but do not pay for the actual response operations.

However, in the event of an oil spill, ship owners are not actually mandated to hire and mobilize the RO and consequently may take on the task themselves. Furthermore, when ROs are employed, their services are limited to on-water response and shoreline cleanup for up to 10,000 tonnes of oil (Reid 2008). There can also be a critical delay between the time an RO is dispatched and the beginning of cleanup efforts. Finally, since oil spill response preparedness is the only potential shipping consequence mandated to be funded by the shipping industry, ROs are not required to attend a vessel casualty that does not involve an oil spill or the threat of an oil spill. In these instances, emergency response becomes the responsibility of the RP (ship owner or relevant representative) or the government, if the RP is unwilling or unable to respond.

An RO is mandated to plan and prepare to:

- deploy response equipment within 6 - 72 hours after notification⁴
- remove oil from water within 10 days, once operational
- treat a minimum of 500 metres of oiled shores per day
- hold oily wastes for 24 hours

An RO is not required to undertake any of the following consequences of a vessel incident or casualty:

- salvage (emergency repair)
- firefighting
- lightering (removal of cargo and fuels)
- clean-up of non-oil pollutants such as hazardous materials, containers or bulk goods
- respond to oils⁵ not stipulated under the *Canada Shipping Act* (e.g. bio-fuels, condensates, canola)

Government's Role

In the event of a vessel casualty on the B.C. coast, the lead federal agency is the Canadian Coast Guard (CCG) and the lead provincial agency is the B.C. Ministry of Environment (MoE). There is an identified lack of harmonization between these jurisdictions pertaining to vessel casualties (including oil spills) rooted in each organization's incident management paradigms. Whereas the province uses an international standard of incident management (the "Incident Command System"), the CCG has adopted an incident management regime that is foreign to industry and provincial response teams.

A keystone component of the CCG's emergency response mechanism is the concept of "one lead agency", and by definition (but not legislation), this precludes provincial, local and First Nations governments from contributing harmoniously to CCG's response capacity. In the event of

a spill the CCG largely assumes a "monitoring" role over the RP's response efforts through a team of Federal Monitoring Officers (FMOs). Public perception may be that CCG skimmers, booms, field staff, etc. would automatically be employed to assist with clean-up, but this is not what was "brokered with industry" when Canada's spill response regime was established. Under the polluter-pay principle, any federal government equipment employed will be subject to cost recovery from the RP.

Alternately, the provincial emergency response approach is to establish Unified Command with the RP and local and First Nations governments in the event of a spill. This "joining of forces" theoretically means that all departments, agencies and industries with a functional, jurisdictional or legal responsibility can contribute to the response strategy, operations and use of resources.

If and when the RP legally relinquishes responsibility to the federal government via a "transfer-of-command" (Section 6.4.2), provincial, First Nations and local government responders are re-directed to work under the federal government as part of the CCG's Regional Environment Emergency Team. Noteworthy however, is that the political and operational "dynamics" of a transfer-of-command situation have yet to be tested in B.C. (Reid, 2008).

5.3

—○ Limitations to Canada's Oil Spill Preparedness and Response Regime

Oil spills are the only potential shipping consequence mandated to be funded by the shipping industry (Reid, 2008). Canada has no legislated capacity to respond to vessel incidents or casualties that do not involve spilled oil or the threat of spilled oil. Furthermore, even within Canada's oil spill preparedness and response regime there is substantial room for improvement. Table 6 describes a number of identified weaknesses of Canada's oil spill preparedness and response regime based on an analysis commissioned by Living Oceans Society in 2008 (Reid, 2008). These limitations are categorized as follows:

- Limitations regarding preparedness and response for oil spills

Table 6

Weaknesses to Canada's Oil Spill Preparedness and Response Regime

Limitations regarding preparedness and response for oil spills

Oiled wildlife response

Current RO regime only includes hazing (i.e., scaring away) birds to prevent them from landing on oiled waters or shores. Historically, wildlife response in B.C. has been performed free of charge by volunteer animal welfare organizations. Though dedicated and hardworking, these people lack the emergency management skills and resources (time, staff, equipment, etc.) to fully commit to the response effort.

Managing an oil spill workforce

ROs are required to clean a minimum of 500 metres of shoreline per day in the event of an oil spill reaching the beach. This rate of shoreline cleanup would not necessarily require a large workforce. Furthermore, oil spill response exercises have not focused on shoreline cleanup. As a result, Canada does not have a trained or prepared workforce to deal with shoreline cleanup, nor have we developed the capacity to manage a large oil spill work force.

Oily waste disposal

Once oily wastes are removed from the shore or water, ROs are only required to have custody of the wastes for up to 24 hours in a primary location and 48 hours worth of collected oily wastes in a secondary location. After this time, the RP or government (usually the province) must find additional storage capacity and decide on a final disposal location. B.C. has developed no meaningful solution for this as there are very few options for handling large amounts of oily waste in an emergency. In the absence of an oily waste disposal plan, the application of waste-minimizing response strategies such as in situ burning and dispersant use become very important.

In-situ oil burning and dispersant use

In situ burning and application of dispersants can increase the amount of on-water oil recovery that is achievable with only booms and skimmers. Canada is one of the few nations that does not use these waste-minimizing response strategies. Known environmental impacts of in situ burning and dispersant use should be balanced with the knowledge that they can minimize shoreline cleanup, oily waste generation, impacts to wildlife, and workforce health. No guidelines exist

for these methods to be in the “tool box” of potential response measures.

Response to oil spills not defined by Canada Shipping Act

ROs are only required to plan, prepare and respond to spills of oil types that are defined in the *Canada Shipping Act*, including crude oil, fuel oil, sludge, oil refuse and refined oil products. Therefore, ROs are not required to respond to spills of condensates, bio-fuels or other oils (e.g. canola). No preparedness and response measures exist for these types of oil spills.

Financial assurance for ROs

The ability of an RO to perform their services is dependent on payment from the RP. An RO can bill the RP on a daily basis and cease to provide services if payments are not made. Legally, it is difficult to gain “financial assurance” from the RP and if an RO is not properly compensated, they have no legal recourse. In addition, RO fees are insufficient to effectively plan, procure equipment and staff their operations, and do not reflect their client's risk to the environment and potential consequences of a spill (i.e. fees are not “risk-based”).

Limitations regarding preparedness and response for incidents and vessel casualties not involving spilled oils

Tug rescue of a disabled vessel

B.C. has no dedicated rescue tug. Instead, the province relies on a “tug of opportunity” system based on the assumption that a tug will be close enough to reach and snag a vessel in distress (e.g. loss of propulsion or steering) before it drifts to shore and grounds. This tug of opportunity system is deficient in several ways, not the least of which is that a tug may simply not be close enough to reach a stricken vessel in time. Tugs are typically stationed near Vancouver when not engaged in commercial work. Furthermore, B.C. has only a few tugs large enough to handle a severe weather rescue and crew training, skills and equipment are lacking. The closest dedicated rescue tug is stationed at Neah Bay, Washington.

Tug escort of vessels

A laden crude oil tanker under 40,000 DWT leaving the Port of Vancouver is required to be escorted by a tug. Tankers larger than 40,000 DWT require the escort of two tugs. However, guidelines for oil tanker escort are

potentially outdated and may not reflect “best practices.” This need is particularly pressing due to the expected increase in vessel traffic expectations for southern B.C. waters. Haro Strait is recognized as a high navigational risk area due to its narrow confines, strong currents and existing high vessel traffic volumes.

Salvage operations

Salvage operations are not part of Canada’s oil spill response regime and B.C. essentially has no salvage operations capacity. This is partly a result of the relative lack of marine vessel casualties in recent years and thus a reduced need for the salvage industry.

Place of refuge decision-making

The decision to allow a place of refuge to be sought, and the determination of its location is critical since it can impact the adjacent coastal community’s welfare, the environment and the potential response cost. Challenges to making this decision include: a lack of a mechanism to notify relevant coastal communities/First Nations, lack of understanding by coastal communities/First Nations, and lack of plans to document anchorage suitability and environmental suitability for possible places of refuge.

—o Limitations regarding preparedness and response for both oil spills and incidents and vessel casualties not involving spilled oil

Financial risk and vulnerability to government

The RP is financially responsible for an oil spill or other vessel casualty under the “polluter-pay” principle (Section 5.4) of Canada’s oil spill response regime until costs reach a legally-defined limit called the “limit of financial responsibility.” Financial risk refers to the RP defaulting on their financial commitments or exceeding their limit of financial responsibility. Once the limit is reached, responsibility for oil spill cleanup and compensation efforts is transferred to the government (federal and provincial). This threat of financial vulnerability to the government (and thus tax-payers) is real.

Divergent response paradigms between levels of government

The CCG and the B.C. MoE may each have jurisdictional responsibilities for marine vessel casualties, but they take opposite approaches to the challenges associated with cross jurisdictional emergency

response. The MoE’s emergency response strategy involves collaboration between provincial agencies, First Nations, and local government. The CCG’s emergency response system is based on a “one lead agency” approach, and has no strategic placement for provincial, local or First Nations government once the RP has reached their limit of financial responsibility and has transferred responsibility to the federal government.

Natural resource damage assessment policy and process

The federal and provincial government each have an account⁸ into which they can receive compensation “awards” from the RP for marine accidents and oil spills which can be used to rehabilitate the damaged environment. It is unlikely however that the RP will have any money left over for natural resource damage compensation after they have paid for response management, impact mitigation, legal fees, penalties and public/private damage compensation. Current policies impede governments from making claims for natural resource damages, and claims that are funded through the IMO’s International Oil Pollution Compensation Funds (Section 5.4) do not include “claims for damage to the ecosystem” (IOPCF, 2010). Finally, neither Canada nor B.C. has a process by which they can assign a monetary value to the damaged resource.

Building emergency response preparedness capacity

A lack of money, organization, communication, people and equipment has led to fundamental gaps and weaknesses in Canada’s and B.C.’s capacity to build emergency response preparedness. Few people in government are actually engaged in emergency planning and Canada lacks an effective mechanism to provide public oversight of emergency preparedness. Little to no community outreach has been undertaken to foster emergency preparedness and Canada’s oil spill Response Organization regime is vastly under-funded.

Geographic Response Plans to guide local preparedness

Geographic Response Plans (GRPs) for major vessel casualty response have not been developed for Canada, nor is there a framework in B.C. to guide what a GRP should contain. GRPs can be essential guides to protecting natural and cultural resources during emergency response procedures and can expedite place of refuge decision-making. Without a GRP, responders are far less equipped to effectively and quickly engage in response strategies.

Source: Reid, 2008 (unless otherwise noted)

- Limitations regarding preparedness and response for non-oil spill incidents and vessel casualties
- Limitations regarding preparedness and response for both oil spills and non-oil spill incidents and vessel casualties

5.4

—● Oil Spill Funding and Financial Vulnerability

Oil spills are expensive⁶. Depending on their size and location, they can be multi-million dollar-a-day events⁷ (OSTF, 2002). The following section outlines the mechanisms by which oil spill response activities are paid for, the gaps that remain in our ability to pay for an oil spill and the extent to which governments are financially vulnerable in the event of a major oil spill.

○ 36 Polluter Pay Principle

According to the *Marine Liability Act*, ship owners are responsible for pollution damages, clean-up costs and reinstatement measures from oil spills, based on the “polluter pay principle” (CCG, 2009). This principle is manifested in the shipping industry’s requirement to pay membership fees to a RO, but also through various funding arrangements (i.e. insurance) that ship owners are required to have (Section 6.4.4). However, the *Marine Liability Act* also establishes a financial limit to this liability, as described below.

Limit of Financial Responsibility

The *Marine Liability Act* establishes a limit to a ship owner’s financial responsibility for any single oil pollution occurrence. The limit of financial responsibility applies to all types of seagoing (convention) vessels⁹ and is determined according to the tonnage of a ship and the International Monetary Fund’s “Special Drawing Right” (SDR) calculations based on a country’s currency¹⁰. Once a ship owner reaches their limit of financial liability, they are no longer considered the Responsible Party and can legally relinquish responsibility to the government through a “transfer-of-command”. In some situations, this transfer can happen a lot sooner than government or the public would expect, and very possibly before there is closure to

the incident. To be entitled to the limit of financial responsibility, ship owners must have an arrangement with a *Protection and Indemnity Club*.

Financial Risk and Financial Vulnerability

Financial risk pertains to a Responsible Party (i.e., ship owner) defaulting on response commitments or exceeding their limit of financial responsibility for a vessel casualty. Both outcomes result in the Responsible Party transferring the responsibility for vessel casualty response on to government. Financial vulnerability refers to the financial, operational, and political consequences that can result from a transfer-of-command (Reid, 2008).

Funding Regimes

Major marine vessels carry insurances for potential financial risk from the damage or total loss of their vessel and its cargo and the costs of emergency salvage. In the event of marine pollution, the insurances can cover response, remediation and damage compensations. Lastly, insurances can cover their legal fees and penalties. These insurances are for the benefit of the shipping company.

As general practice, the international shipping industry “pools” its risk by collectively subscribing and paying into different types of insurance regimes. The most common being the Protection and Indemnity insurance required for all vessels over 300 GT. Depending on a vessel’s cargo, additional levels of insurances are required.

The following examines the four tiers of funding and compensation for vessels that carry petroleum products in bulk (tankers and barges) in Canadian waters.

Tier 1

Civil Liability Convention and Protection & Indemnity Clubs

The *1992 Civil Liability Convention* (1992 CLC) governs the liability of ship owners for pollution damage by laying down the principle of strict liability and creating a system of compulsory liability insurance (Secretariat of the International Oil Pollution

Compensation Funds, 2010). Ship owners are generally allowed to limit their financial liability depending on the tonnage of their ship. For a ship 140,000 tonnes and above, the limit is 89,770,000 SDR (approximately \$140CAD in July 2010). This is paid by the ship's insurer, usually a Protection & Indemnity Club (P&I Club).

The P&I Club insurance serves to pay for spill response, damage compensation, salvage removal, and any relevant penalties in the case of an oil spill, but also covers a wider range of vessel incidents including a spill involving condensate. Problematically, the RP may hold a portion of this money aside for damage compensation and penalty fines thereby reducing the amount of money available for spill response and cleanup. This could potentially increase the costs transferred to the government in the event of a transfer of command (Reid, 2008).

Tier 2

International Oil Pollution Compensation Fund, 1992

If the amount available from Tier 1 insurance does not cover all admissible claims, further compensation is available from the *International Oil Pollution Compensation Fund 1992 (1992 Fund)* of the IMO. The maximum amount payable by the *1992 Fund* for one incident is 203 million SDR (approximately \$317 in July 2010) (SIOPCF, 2010), inclusive of the sum paid by Tier 1 insurance.

The *1992 Fund* only applies to oil pollution damage resulting from spills of persistent oil from tankers (SIOPCF, 2010). If the cargo is considered "non-persistent" in the environment (e.g. condensate), then the limit of financial responsibility is the maximum amount paid by Tier 1 insurance. The *1992 Fund* does not provide money for other consequences of an oil spill (e.g. vessel salvage, cargo removal, lightering) unless these actions can be specifically linked to mitigating or preventing further oil pollution. If a ship owner has exceeded their limit of financial responsibility, this could mean that financial responsibility for these "other" consequences

are borne by the government through transfer of command (Reid, 2008).

Tier 3

International Oil Pollution Compensation Supplementary Fund

In January 2010, Canada adopted the *2003 Protocol* to the *1992 Fund Convention* providing another tier of funding for damages resulting from the spill of persistent oil from tankers. This is known as the *International Oil Pollution Compensation Supplementary Fund (Supplementary Fund)*. Membership to the *Supplementary Fund* is optional and is only open to nations party to the *1992 Fund*. The maximum amount payable for one incident is 750 million SDR (approximately \$1.18 billion CAD in July 2010) including the amounts available from Tier 1 and 2 (SIOPCF, 2010).

International Convention on Civil Liability for Bunker Oil Pollution Damage

Canada adopted the *International Convention on Civil Liability for Bunker Oil Pollution Damage* in 2009¹¹. The convention was created to ensure that adequate, prompt and effective compensation is available to persons who suffer damage caused by spills of oil, when carried as fuel in ships' bunkers (IMO, 2008). The convention requires vessels over 1,000 tonnes to maintain insurance or other financial guarantees to cover the liability of the registered owner for pollution damages.

Tier 4

Ship-Source Oil Pollution Fund:

When an RP's financial limit of responsibility is reached, Canada can access a domestic fund called the *Ship-Source Oil Pollution Fund (SOPF)*. It was established by amending the former *Canadian Shipping Act* and is governed by the *Marine Liability Act* (OASOPF, 2010). During the 2009-2010 fiscal year the maximum liability of the *SOPF* was approximately \$155 million CAD for one oil spill (OASOPF, 2010). The amount is indexed annually and is exclusive of Tiers 1 through 3.

The *SOPF* covers claims regarding oil spills from all classes of ships. It is not limited to spills from sea-going tankers or persistent oil, unlike the *1992 Fund* (OASOPF, 2010).

Summary of Oil Spill Funding Status

In summary, the maximum amount of money available to deal with a worse-case scenario oil spill in Canadian waters is approximately \$1.33 billion CAD. Unfortunately, this may be inadequate to properly address the environmental and social impacts of an oil spill and to limit the extent to which government is financially

vulnerable. An RP may hold a substantial portion of insurance funds aside to pay for legal fees, penalties, and private damage compensations, thus reducing the amount of money actually allocated to impact mitigation and natural resource damage compensation. Furthermore, the maximum level of funding available for a spill is dependent on the size of the vessel involved and the type of pollutant spilled. A tanker carrying condensate would not for instance be eligible for funding arrangements with the IMO's 1992 Fund. Similarly, a small tanker spilling crude oil would be eligible for less than the maximum amount of funds.

- 1 The Brander-Smith report defined a "catastrophic spill" as over 10,000 tonnes of oil (1990).]
- 2 The Shipping Act was amended to protect all navigable waters by placing requirements on tankers and barges carrying oil in bulk of 150 tonnes or greater, on ships 400 tonnes or greater and on oil-handing facilities that receive deliveries from the aforementioned vessels (Reid, 2008).
- 3 The *Exxon Valdez* spill was 37,000 tonnes.
- 4 Response deployment time varies according to the quantity of oil spilled and location of spill (Reid, 2008).
- 5 The CSA 2001 defines "oil" as petroleum in any form, including crude oil, fuel oil, sludge, oil refuse, and refined products (Reid, 2008).
- 6 In the event of a vessel casualty a ship owner may need to pay for: legal fees, penalties, response management (both government and RO participation), impact mitigation (booming, skimming, oily waste management, salvage, etc.), impact assessments, monitoring,

private/public damage compensation and natural resource damage assessment compensation (Reid, 2008).

- 7 A spill cost summary on selected U.S. incidents from 1984-2000 indicates the average cost of an oil spill was \$914 million (in 1997 U.S. \$ equivalents). The *Exxon Valdez's* total spill cost was over \$12 billion (OSTF, 2002).
- 8 Environment Canada has established the Environmental Damage Fund and B.C. has established the Habitat Conservation Trust Foundation.
- 9 Container, general cargo, RO-RO, ferry, and bulk carrier vessels, tankers carrying LNG or chemicals, and oil tankers since they carry persistent heavy grade oil to operate their engines.
- 10 Special Drawing Rights are defined by the International Monetary Fund. Value of SDR on July 23, 2010 was approximately \$1.56 CAD.
- 11 As enacted by amendments to the *Marine Liability Act* (Bill C-7) which came into force in January of 2010.

6 Solutions and Policy Directions

Achieving greater protection from existing and potential impacts of shipping on the B.C. Coast involves a combination of removing risks, controlling risks, and mitigating the consequences of accidents. Canada and B.C. could achieve greater protection from shipping-related impacts with the following actions:

Remove the Risks

Legislate a permanent ban on oil tanker traffic in Dixon Entrance, Hecate Strait, and Queen Charlotte Sound.

Control the Risks

Manage B.C.'s shipping industry with an ecosystem-based approach that prioritizes the health of the ocean, ensures safe shipping practices, and considers other sectors of economic activity.

Mitigate the Consequences

Improve Canada's and B.C.'s rescue and response capabilities for oil spills and other vessel casualties.

Removing the risks would mean a ban on shipping however this is not reasonable, advisable or possible. Nevertheless, there are places, and there are types of shipping activities, which if brought together impose the likelihood of catastrophic harm to the B.C. coast. In these places,

there is no level of acceptable risk. Living Oceans Society advocates for a permanent ban of bulk oil tanker traffic on the North and Central coast of B.C. The following are related policy recommendations:

- a The Canadian government should legislate a permanent ban on crude oil tankers in Dixon Entrance, Hecate Strait and Queen Charlotte Sound.
- b The B.C. government should support and advocate for federal legislation that permanently bans crude oil tankers in Dixon Entrance, Hecate Strait and Queen Charlotte Sound.
- c The Canadian and B.C. governments should prohibit port expansions and pipeline development projects that would result in increased tanker traffic in sensitive marine areas.

Controlling the risks associated with shipping on our coast requires stronger regulation. Risk of harm to the ocean and coastal economies must be minimized. This entails a strong and comprehensive regulatory regime, legal and protocol co-ordination between jurisdictions, adequately funded and trained oversight, and the highest standards in all respects. Living Oceans Society believes

that this will be best achieved through processes such as Marine Planning Partnership (MaPP) for the North Pacific Coast and the Pacific North Coast Integrated Management Area (PNCIMA) planning process, which are currently underway on the coast to ensure that coastal activities operate within the conservation and economic objectives of the region¹. The following are related policy recommendations:

- a Transport Canada should consider a dedicated rescue tug for the North and Central Coast of B.C. In addition, a revision of Canadian tug escort standard is needed to reflect worldwide best practices for tug escorts of laden tankers.
- b Transport Canada should undertake an oil tanker drift and rescue tug analysis to re-evaluate the efficacy of the Tanker Exclusion Zone (TEZ) and implement a tracking system that goes beyond the voluntary measures of the TEZ.
- c Transport Canada and the shipping industry should develop vessel salvage capability for the coast and ensure integration with other response mechanisms (e.g. tug rescue, fire fighting, and spill response).
- d Transport Canada should develop a protocol for place-of-refuge decision-making. Special attention should be given to identify local community representatives that have the mandate, authority and expertise to facilitate a decision.

Mitigating the consequences of accidents, when they do occur, involves responding effectively to casualties. Accidents will happen, despite bans and regulations. When a ship is in distress, an appropriate and planned response must be mobilized quickly to minimize or prevent loss of life, load, fuel and vessel and to minimize associated environmental impacts. Living Oceans Society believes that vast improvements are needed in Canada's emergency response preparedness and oil spill response regime. The following are related policy recommendations:

- a Canada's Response Organizations and Oil Handling Facilities Regulation should

expand their wildlife response capability and capacity to include hazing, capture, assessment, rehabilitation and release of oiled birds and mammals.

- b Canada's Response Organizations and Oil Handling Facilities Regulation should focus on oil spill workforce capacity, not on the minimum length of shoreline treated per day.
- c Canada's Response Organizations and Oil Handling Facilities Regulation should not be based on a time frame for holding temporary oily wastes, but specify holding capacities.
- d Canada's Response Organizations and Oil Handling Facilities Regulation should require ROs to have the latest cleanup technologies, including a variety of options to augment mechanical-based response (e.g. in-situ burning and dispersant use).
- e Canada's Response Organizations and Oil Handling Facilities Regulation should broaden the definition of "oil" to include other types that pose an environmental risk if spilled. Certain products should be explicitly referenced (e.g. condensates, bio-fuels, canola oil).
- f The Response Organizations and Oil Handling Facilities Regulation should provide financial assurances to ROs and other contractors should they incur a financial loss due to a client not fully paying for emergency services provided.
- g The Marine Liability Act should be amended to establish unlimited financial liability for owners, ship masters, and/or contractors of ships to insure all clean up costs, recovery costs, economic impacts and non-economic impacts to the ecosystem will be recovered.
- h Transport Canada should address the financial vulnerabilities associated with both the international Supplementary Fund (Tier 3) and the National Ship-Source Oil Pollution Fund (Tier 4) including re-instatement of a levy of 44.85 cents per metric tonne of "contributing oil" imported or shipped

from a place in Canada in bulk or as cargo on a ship.

- i An understanding between lead federal and provincial agencies (CCG and MoE respectively) needs to be reached regarding associated responsibilities in the event of oil spills and other marine vessel casualties. The divergent response paradigms that currently exist do not serve the interests of any parties wishing to seek an integrated response to a marine vessel casualty.
- i Environment Canada and the B.C. MoE should prepare a natural resource damage assessment harmonization agreement that

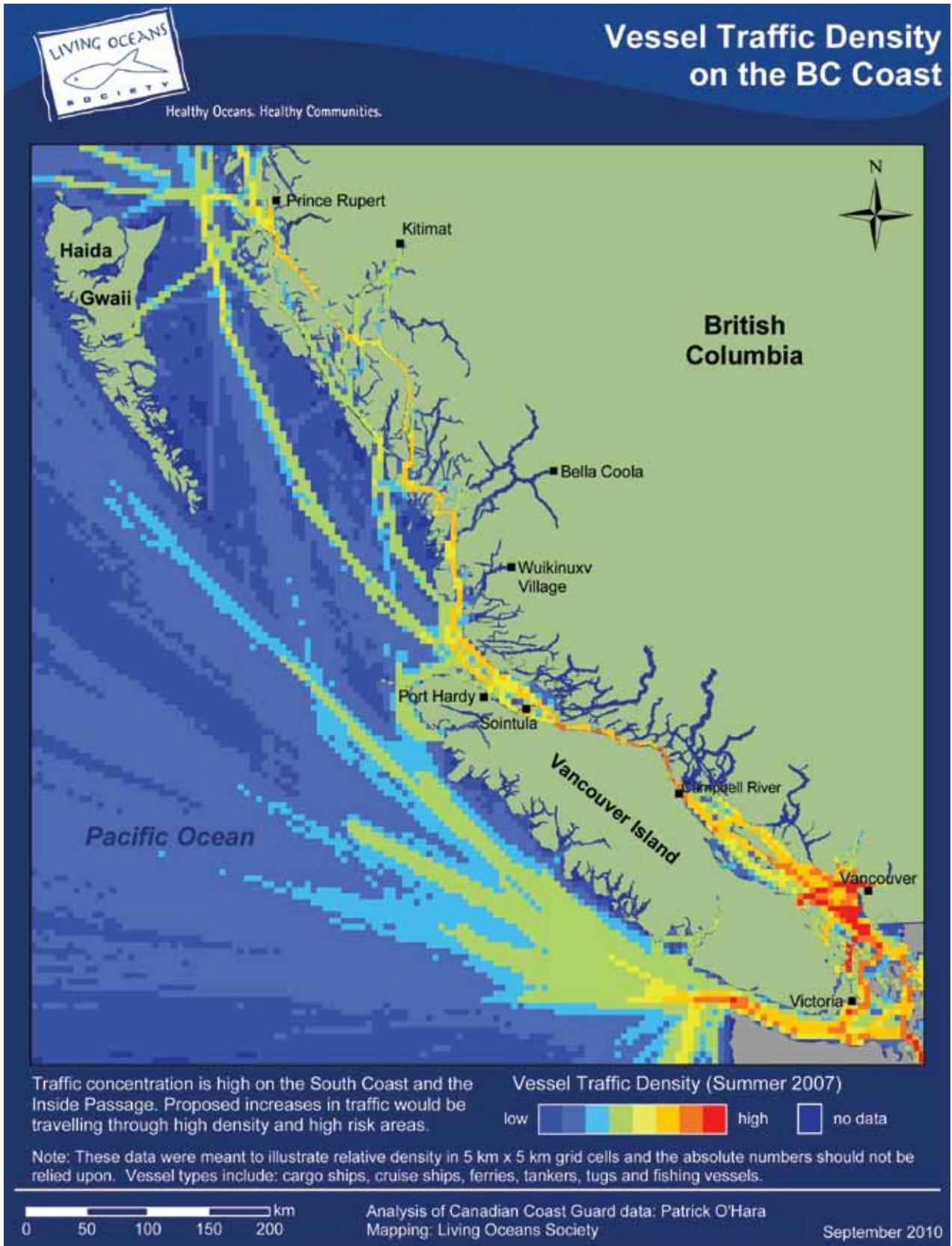
is inclusive of each other as well as First Nations and local governments.

- k Governments and the shipping industry should establish an industry funded citizen's oversight committee with a mandate of reviewing and making recommendations on the effectiveness of shipping practices and emergency response capabilities.
- l Transport Canada, B.C. government and the shipping industry should develop Geographic Response Plans to help ensure effective response capacity to worst case casualty scenarios. Local knowledge of coastal communities' and First Nations' should inform this process.

1 For more information on "Marine Planning Partnership for the North Pacific Coast" (MaPP) go to www.MaPPOcean.org or for the

"Pacific North Coast Integrated Management Area" (PNCIMA) go to www.pncima.org

7 Maps



Map 1

—○Vessel Traffic Density on the BC Coast



Traffic Routes and Port Locations for Major Vessels in BC Waters



There are 3 main traffic routes for major vessels along coastal and territorial waters: Port Access, Inside Passage, and the Great Circle shipping route. Four deep-sea port locations (Metro Vancouver, Prince Rupert, Kitimat and Stewart) connect vessels to Canada's highways and railways. The Strait of Georgia, Haro Strait, and Juan de Fuca Strait have the highest port access volumes as they provide access and egress to all major ports in the Lower Mainland and US Puget Sound (Reid, 2008).

- Deep-sea Ports
- Vessel Routes**
- Inside Passage
- Great Circle Route

Reid, S. Major Marine Vessel Casualty Response Preparedness in BC. Cowichan Bay. EnviroEmerg Consulting Services, 2008.

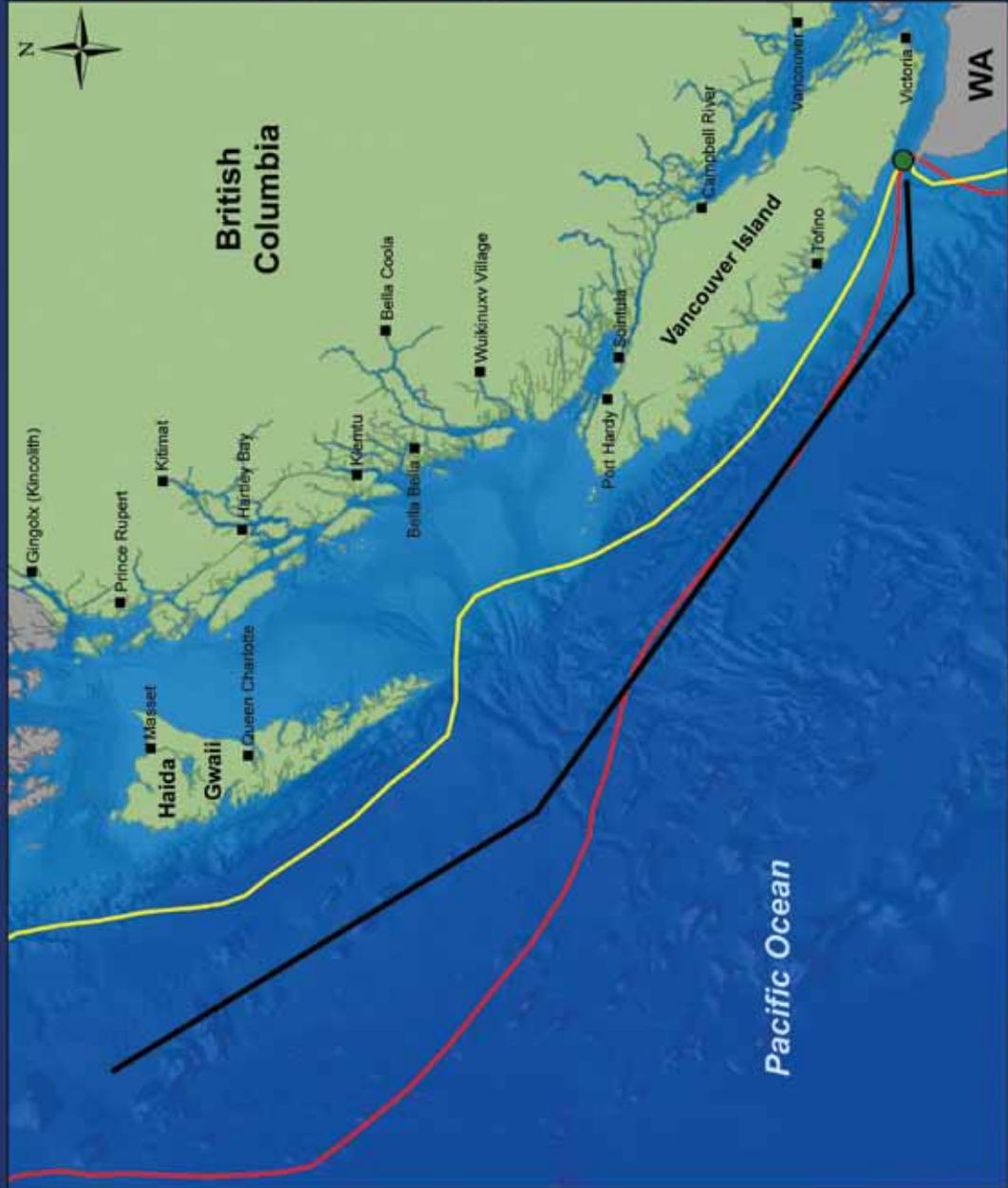


Data digitized from: Ports - www.lbc.leg.bc.ca/public/pubdocs/bcdocs/375137/sbed_mar_18_05.pdf, Inside Passage - Transport Canada map, Great Circle Route - map in The Economist, Jan. 2007. Mapping: Living Oceans Society

September 2010

Map 2
 —○— Traffic Routes and Port Locations for Major Vessls in BC Waters

Disabled Tanker Drift Rate vs. Voluntary Tanker Exclusion Zone



Drift Rate Analysis

-  Average Weather Case
-  Worst Weather Case
-  Available Rescuer Tug

Voluntary Tanker Exclusion Zone Boundary

The red and yellow lines indicate the distance a disabled tanker must be from shore in order to be rescued by an available tug before hitting land in different weather conditions. Tankers outside these lines are likely to be rescued before drifting to shore. The black line indicates the Voluntary Exclusion Zone which was put in place to keep Alaskan tankers from getting too close to shore and into a dangerous situation if they lost power. It is interesting to note that the Exclusion Zone, as presently designed, would not protect Haida Gwaii from a drifting tanker in severe weather conditions. As of 2008, approximately one Alaskan tanker travels along the west coast per day.

Exclusion Zone: BC Ministry of Energy, Mines and Petroleum Resources; Drift lines digitized by Living Oceans Society from the West Coast Offshore Vessel Traffic Risk Management Project Final Report 7/2002
 Bathymetry: DFO
 Mapping: Living Oceans Society



February 2010

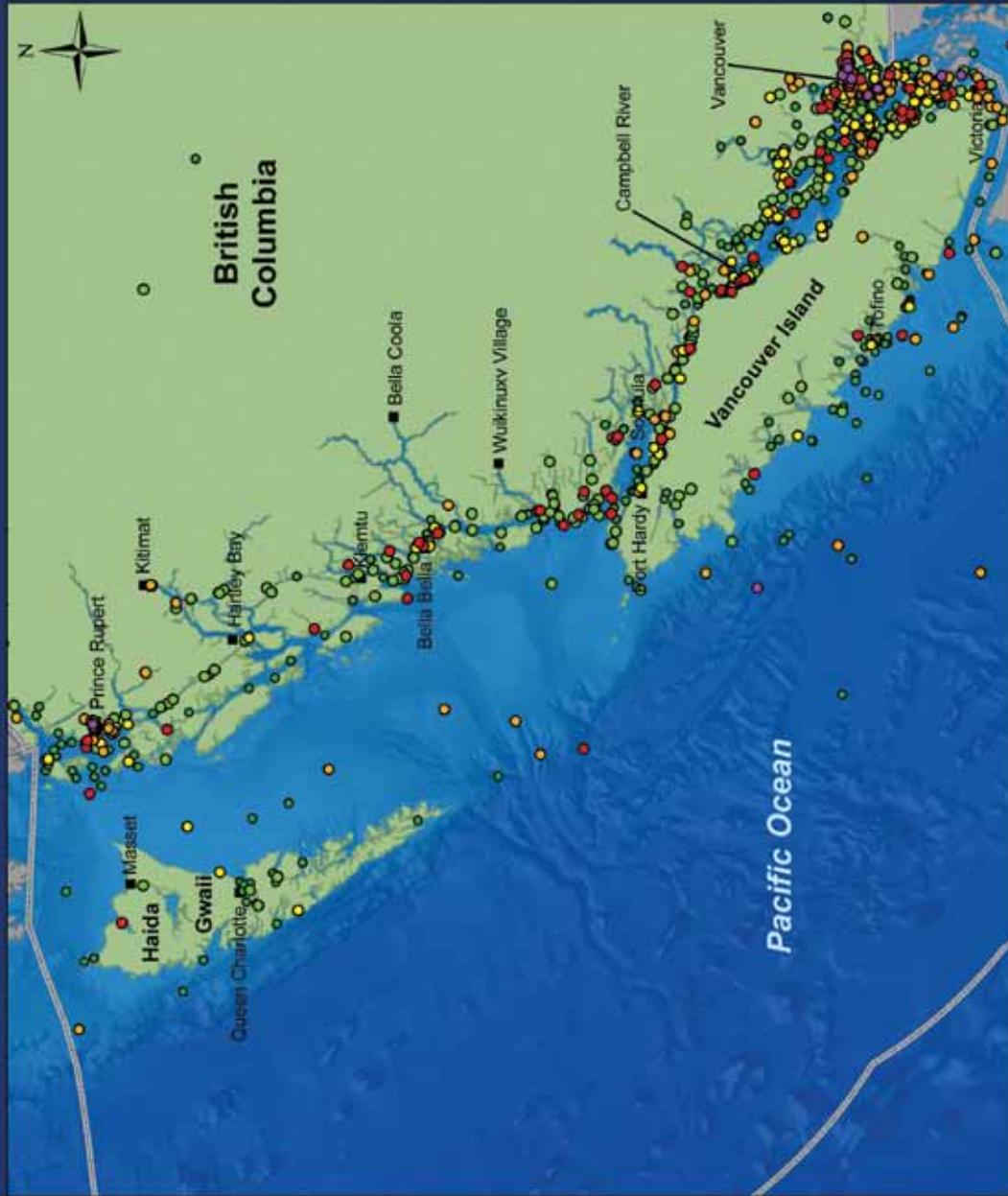
Map 3

—○ Disabled Tankers Drift Rate vs. Voluntary Tanker Exclusion Zone

Marine Vessel Incidents in Canada's Pacific Waters January 1999 - July 2009



Healthy Oceans. Healthy Communities.



Vessel Types (# of Incidents)

- Barges (86)
- General Cargo / Container and Bulk Carriers (164)
- Ferries (292)
- Tankers (12)
- Tugs (338)
- Other Vessel Types (383)

Between Jan. 1999 and July 2009, there were 1,275 reported incidents with commercial vessels (excluding fishing vessels) along the BC coast.

Primary Incident Types

- Capsizing (36)
- Collision (30)
- Fire/Explosion (80)
- Flooding (44)
- Grounding (123)
- Propeller/Rudder/Structural Damage (18)
- Sinking (41)
- Striking (158)
- Other (745)

Data: Incidents - Transportation Safety Board - Note that foreign, freshwater and 'person falling overboard' incidents were excluded. Also note that spatial inaccuracies in the data have not been rectified. International Boundary - Natural Resources Canada; Bathymetry - Fisheries and Oceans Canada
Mapping: Living Oceans Society



October 2009

Map 4

—○ Marine Vessel Incidents in Canada's Pacific Waters: January 1999 - July 2009

8 Glossary of Terms

Ballast: any solid or liquid brought onboard a vessel to regulate the stability or to maintain stress loads within acceptable limits. Seawater is the present ballast of choice. Ballast may be taken on board to keep a ship deep enough in the water to ensure efficient propeller and rudder operation, and to avoid the bow emerging from the water, especially in heavy seas (Transport Canada, 2010).

Barrels per day (bpd): standard throughput capacity measure for oil and petroleum liquids pipelines and oil production.

Bunker Fuel: a general term referring to fuel burned in ships for propulsion. It largely consists of residual fuel, which is one of the products of crude oil refining. Residual fuel oils are the heavier oils that remain after the lighter fractions (i.e. gasoline) have been distilled away in the refining process. Residual fuel is inexpensive compared to other crude oil-derived products and contains high levels of sulfur, nitrogen, polycyclic aromatic hydrocarbons, and metals (Denton, 2004). Emissions from combustion carry a number of toxic and air polluting substances.

Bunker C: a common type of bunker fuel (Denton, 2004).

Compensation: the transfer of funds from the proponent or developer of a project causing

an adverse impact to those people or agencies which bear the impact. The payment enables those impacted to pursue measures to redress any remaining resource losses (Reid, 2008).

Condensates: are liquid hydrocarbon mixtures recovered from natural gas reservoirs. They are volatile, potentially explosive, and are so toxic that they can kill marine life on contact. Condensates are used to thin bitumen from Alberta tar sands oil so it will flow in a pipeline. Condensates are not defined as “oil” under the *Canada Shipping Act* and Response Organizations are therefore not equipped or required to respond to a spill involving condensates. Condensate spills are also eligible for substantially less oil spill funding than a tanker spill of the same size carrying crude oil (Reid, 2008).

Crude Oil: are the remains of animals and plants that have been covered by layers of sand and silt for hundreds of millions of years. Heat and pressure from the layers turned the remains into crude oil. After crude oil is removed from the ground it is separated into useable petroleum products (e.g. gasoline, diesel, jet fuel, heavy grade oil, heating oil, liquefied petroleum gases) at a refinery. Crude oil is measured in barrels (Energy Information Administration, 2010). 1 barrel = 42 U.S. gallons = 0.16m³ (Reid, 2008).

Deadweight ton (DWT): is a unit of measure for a vessel's cargo-carrying capacity. 1 DWT is 2,240 pounds. This unit of measure is generally used for bulk carriers, tankers and barges, since most of the volume of their hulls are used for cargo (Reid, 2008). The Westridge Marine Terminal in the Port of Vancouver can facilitate oil tankers up to 100,000 DWT. The *Exxon Valdez* was 215,000 DWT.

Geographic Response Plan: site-specific oil response plan

Gross Tonnage (GT): is a unit of measure for a vessel's cargo carrying capacity. 1 GT is 100 cubic feet (roughly 2.83 cubic meters). This unit of measure is generally used for ships with little cargo capacity, such as cruise ships and ferries (Reid, 2008). A typical Alaskan cruise ship, which can carry between 700 and 3,000 passengers, ranges from 50,000 GT to 93,500 GT.

Incident Command System: a set of personnel, policies, procedures, facilities, and equipment integrated into a common organizational structure designed to improve emergency response operations of all types and complexities (Irwin, 1989).

International Maritime Organization (IMO): was established in 1948 and is the United Nation's specialized agency responsible for improving maritime safety and preventing pollution from ships (IMO, 2002). IMO conventions for ensuring crew and passenger safety, preventing accidents, pollution, and making arrangements for compensation, and for the design and operation of major vessels come into effect when a majority of nations accede to them (such as Canada under the *Canada Shipping Act*). However, the design, arrangement and level of emergency preparedness for a vessel casualty is left to the individual country to determine (Reid, 2008).

Major Marine Vessel: includes oil tankers and barges of 150 GT and above, and any other vessel over 400 GT (Reid, 2008).

Marine Vessel Casualty: refers to an accident resulting in damage to the vessel such as a grounding, sinking or collision. The results of

a marine vessel casualty can be cargo loss or spill, ship wreck or other consequence resulting in environmental damage (Reid, 2008).

Mitigation: an aspect of the management of impacts whereby a developer/proponent of a project takes measures in the planning, design, construction, operation (etc.) of a project with the objective of preventing, reducing or offsetting adverse environmental or social impacts (Reid, 2008).

Nautical Mile: 1.852 kilometres, 1.1508 miles, 1/21,600 of the circumference of the Earth at the equator.

Persistent Oil: the IMO categorizes oil as either persistent or non-persistent according to the likelihood of the material dissipating naturally at sea and whether cleanup would be required in the event of a spill. The boundary is somewhat arbitrary given the continuum of oil types with varying degrees of persistence. Non-persistent oils are defined as those of a "volatile" nature, composed of lighter hydrocarbon fractions, which tend to dissipate rapidly through evaporation. Persistent oils generally contain a considerable portion of heavy hydrocarbon fractions (Reid, 2008). The significance of the distinction between persistent and non-persistent oils is that only persistent oils are eligible for International Oil Pollution Compensation Funds and Civil Liability Convention Funds in the event of a spill. Condensates are considered non-persistent oil, but crude oil, fuel oil, and lubricating oil are considered persistent (Reid, 2008).

Place of Refuge: is where a ship in need of assistance (due to loss of propulsion or steering, actual or imminent hull breach, or fire) can take action to stabilize its condition, reduce the hazards to navigation, protect human life and the environment (Transport Canada, 2007b).

Port Metro Vancouver: includes the Fraser River Port Authority, the North Fraser Port Authority, and the Vancouver Port Authority.

Salvage: the act of a vessel providing assistance to a disabled ship to proactively prevent sinking or release of polluting substances (oil, cargo, containers). If the vessel has sunk, salvage op-

erations can include ship recovery and/or removal of fuel oils (Reid, 2008).

TEU (Twenty-foot Equivalent Unit): is the standard unit for describing the capacity of container ships and container terminals. One twenty foot long inter-modal container is 1 TEU (OECD, 2002).

Vessel Incident: refers to a vessel in distress (i.e. loss of engine power) but not *necessarily* resulting in a marine vessel casualty. Vessel incidents can lead to marine vessel casualties (i.e. a container vessel loses engine power,

drifts, grounds, and ruptures its fuel tank, resulting in a spill of fuel or oil.

Vessel Movement: A measurement of marine traffic density. It is defined as a vessel entering, exiting, or travelling through a Vessel Traffic Service (VTS) Zone.

Vessel Traffic Services (VTS) Zones: are operated by the Canadian Coast Guard (CCG) to “make voyages safer and to protect the environment.” VTS provides a means of exchanging information between ships and a shore-based centre. CCG operates three VTS Zones; Vancouver, Tofino and Prince Rupert (CCG, 2008).

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Appendix A

Marine Vessel Incidents and Casualties along the Pacific Coast

The west coast has not experienced a major oil spill since the *Nestucca* barge oil spill in 1988 and the *Exxon Valdez* oil spill in 1989. However, there were over 1,200 reported marine vessel incidents along the B.C. coast between 1999 and 2009¹ (Map 4). Table A1 describes notable major vessel incidents along the Canada's west coast between 1988 and 2009. Two hypothetical vessel casualties are also included. The first scenario is representative of the type of tanker (Very Large Crude

Carrier) that would service the Enbridge Northern Gateway marine terminal in Kitimat (Section 1.4). The second hypothetical scenario illustrates the potential oil spill volume of an Aframax tanker, which currently exports oil from Kinder-Morgan Canada's Westridge Marine Terminal in the Port of Vancouver. Aframax tankers are the most common tankers worldwide (Reid, 2008).

Table A1

Twenty Years of Notable Major Marine Vessel Incidents along the Pacific West Coast

Nestucca (Barge)

The tug *Ocean Services* rammed and holed its tow — the oil barge *Nestucca* — 3 km off of Gray's Harbour, Washington. Spilled oil drifted all along the west coast of Vancouver Island, from near Victoria in the southeast to near Cape Scott in the north. As many as 56,000 seabirds were killed. Many shores were oiled.

LOCATION Gray's Harbor, Washington

DATE Dec 23 1988

OIL TYPE Bunker C

POTENTIAL SPILL SIZE (BARRELS) Unknown

ACTUAL SPILL SIZE (BARRELS) 5,500

Exxon Valdez

The oil tanker *Exxon Valdez* grounded on Bligh Reef in Prince William Sound, Alaska. The spill eventually covered 28,000 km² of ocean and 1,900 km of shoreline.

LOCATION Prince William Sound, Alaska

DATE Mar 24 1989

OIL TYPE Crude oil

POTENTIAL SPILL SIZE (BARRELS) 1,261,400

ACTUAL SPILL SIZE (BARRELS) 284,000

Kuroshima

A reefer seafood ship — *Kuroshima* — drifted aground in storm conditions while anchored in Summer Bay on the Aleutian Island of Unalaska, Alaska. The vessel spilled 28 barrels of Bunker C oil in this accident, contaminating about 10 km of shoreline.

LOCATION	Unalaska, Alaska
DATE	Nov 27 1997
OIL TYPE	Bunker C
POTENTIAL SPILL SIZE (BARRELS)	5700
ACTUAL SPILL SIZE (BARRELS)	28
OIL TYPE	Lube Oil
POTENTIAL SPILL SIZE (BARRELS)	680
ACTUAL SPILL SIZE (BARRELS)	0

Hanjin Elizabeth

The container vessel *Hanjin Elizabeth* began drifting about 80 nautical miles from Brooks Peninsula on Vancouver Island towards the Cape Scott Islands. A tow was briefly attached before breaking. The short stabilization of the vessel enabled enough time for ship crew to safely fix and restore engine function.

LOCATION	Brooks Peninsula, B.C.
DATE	Feb 11 1998
OIL TYPE	Bunker C
POTENTIAL SPILL SIZE (BARRELS)	19,585
ACTUAL SPILL SIZE (BARRELS)	None

New Carissa

The bulk carrier *New Carissa* — on its way to Coos Bay, Oregon — lost anchor during storm conditions and grounded outside of Coos Harbor. It spilled 2,005 barrels when it broke in half. Wreck removal became the major cost of the incident.

LOCATION	Coos Bay, Oregon
DATE	Feb 4 1999
OIL TYPE	Bunker C
POTENTIAL SPILL SIZE (BARRELS)	11,429
ACTUAL SPILL SIZE (BARRELS)	2,005

*Queen of Surrey*²

En route from Horseshoe Bay to Langdale, B.C., the *Queen of Surrey* RO-RO ferry suffered a diesel oil fire on its No. 2 main engine. The fire was extinguished and the ferry was towed to Langdale. There were no fatalities.

LOCATION	Horseshoe Bay, B.C.
DATE	May 12 2003
OIL TYPE	n/a
POTENTIAL SPILL SIZE (BARRELS)	Unknown
ACTUAL SPILL SIZE (BARRELS)	0

Selendang Ayu

The Malaysian freighter *Selendang Ayu* went aground and broke in half in Skan Bay off of Unalaska Island in the Aleutian chain.

LOCATION	Unalaska Island, Alaska
DATE	Dec 8 2004
OIL TYPE	Fuel oil
POTENTIAL SPILL SIZE (BARRELS)	Unknown
ACTUAL SPILL SIZE (BARRELS)	7,670

Queen of Oak Bay

The *Queen of Oak Bay* lost power four minutes before it was to dock at the Horseshoe Bay terminal in West Vancouver, B.C. The vessel became adrift and unable to change speed, but was able to steer. It slowly ran into the nearby marina. It destroyed or damaged 28 pleasure craft and subsequently went aground a short distance from the shore. No casualties or injuries were reported and no oil spilled from the ferry.

LOCATION	Horseshoe Bay, B.C.
DATE	Jun 30 2005
OIL TYPE	Diesel
POTENTIAL SPILL SIZE (BARRELS)	Unknown
ACTUAL SPILL SIZE (BARRELS)	0

Queen of the North

The *Queen of the North* ferry sank after running aground on Gil Island in Wright Sound, 135 km south of Prince Rupert, B.C. The vessel was a RO-RO ferry operated by BC Ferries that travelled the Inside Passage. Two passengers died. In addition to fuel, the ferry was also carrying sixteen vehicles. The grounding and sinking created an oil slick that spread throughout the sound. The marine diesel oil quickly evaporated in the choppy seas and warm weather.

LOCATION	Wright Sound, B.C.
DATE	Mar 22 2006
OIL TYPE	Diesel
POTENTIAL SPILL SIZE (BARRELS)	1384
ACTUAL SPILL SIZE (BARRELS)	Unknown
OIL TYPE	Lube oil
POTENTIAL SPILL SIZE (BARRELS)	14
ACTUAL SPILL SIZE (BARRELS)	Unknown

Andre

The MV *Andre*, a Hong Kong-registered bulk carrier, spilled over 7,500 litres [approximately 47 barrels (bbl)] of oil into Vancouver Harbour while the vessel was bunkering fuel oil at anchorage in the Port of Vancouver (Transport Canada, 2007a).

LOCATION	Vancouver Harbour, B.C.
DATE	Jul 4 2006
OIL TYPE	Bunker C
POTENTIAL SPILL SIZE (BARRELS)	Unknown
ACTUAL SPILL SIZE (BARRELS)	47

Westwood Anette

The general cargo *Westwood Anette* punctured its “day-tank,” (fuel tank) despite a two-tug escort when it was blown into pylons during high winds. It spilled 243 barrels of Bunker C fuel oil into Howe Sound and the adjacent Squamish Estuary in B.C.

LOCATION	Squamish, B.C.
DATE	Aug 5 2006
OIL TYPE	Bunker C
POTENTIAL SPILL SIZE (BARRELS)	Unknown
ACTUAL SPILL SIZE (BARRELS)	243

Ted Leroy Trucking (barge)

During passage through the Michael Biggs Ecological Reserve, a Ted Leroy Trucking barge listed and 11 pieces of heavy equipment carrying 20,000 litres (approximately 126 bbl) of fuel and oil slipped off into the waters home to the B.C. Northern Resident orcas (Living Oceans, 2010c).

LOCATION Robson Bight, B.C.

DATE Aug 20 2007

OIL TYPE Diesel

POTENTIAL SPILL SIZE (BARRELS) 126

ACTUAL SPILL SIZE (BARRELS) Unknown

Sea Voyager

The 40 meter, U.S. owned tugboat the Sea Voyager beached only a couple meters from a fully functioning navigational light on calm seas just south of Bella Bella, B.C. while en route from Seattle to Alaska (Montgomery, 2007). It was carrying 56,000 litres of diesel, 6,800 litres of lube oil and more than 1,200 litres of hydraulic oil (approximately 403 bbl total). The amount of the leak is believed to be about 49,000 litres.

LOCATION Bella Bella, B.C.

DATE Mar 2 2008

OIL TYPE Diesel Lube Oil

POTENTIAL SPILL SIZE (BARRELS) 403

ACTUAL SPILL SIZE (BARRELS) ~308

Petersfield

Shortly after leaving the Port of Kitimat, the cargo vessel *Petersfield* suffered steering failure and struck the shore in Douglas Channel. Significant damage occurred to the ship but no one was hurt and no oil or cargo was spilled.

LOCATION Douglas Channel, B.C.

DATE Sept 25 2009

OIL TYPE Bunker C

POTENTIAL SPILL SIZE (BARRELS) 10,000³

ACTUAL SPILL SIZE (BARRELS) 0

HYPOTHETICAL EXAMPLES

VLCC

50 of the 220 tankers visiting the proposed Enbridge marine terminal in Kitimat, B.C. will be VLCC class (Enbridge Northern Gateway Pipelines, 2010a). They will ply the waters adjacent to the Great Bear Rainforest and past Gil Island where the *Queen of the North* sank in 2006.

LOCATION Douglas Channel, B.C.

DATE TBA

OIL TYPE Heavy crude oil

POTENTIAL SPILL SIZE (BARRELS) 2,300,000

ACTUAL SPILL SIZE (BARRELS) TBA

Aframax

Aframax tankers currently export oil from Kinder-Morgan Canada's Westridge Marine Terminal in the Port of Vancouver.

LOCATION Haro Strait, B.C.

DATE TBA

OIL TYPE Heavy crude oil

POTENTIAL SPILL SIZE (BARRELS) 700,000

ACTUAL SPILL SIZE (BARRELS) TBA

Source: Reid, 2008 (unless otherwise noted)

1 Excluding fishing vessels.

2 Transportation Safety Board report # 396048 "Queen of Surrey"
http://www.tsb.gc.ca/en/reports/marine/2003/m03W0073/m03w0073_sec1.asp.

3 Estimate based on vessel size.

Appendix B

The World's Largest Oil Spills and Global Oil Spill Trends

On March 24, 1989, the oil tanker *Exxon Valdez* grounded on Bligh Reef in Prince William Sound, Alaska. The tanker carried 53 million gallons (1.2 million barrels) of Prudhoe Bay crude oil, 11 million gallons (257,000 barrels) of which spilled into the sea. The oil slick resulting from the spill eventually covered 28,000 km² of ocean

and 1,900 km of shoreline. Incredibly, the *Exxon Valdez* was not even in the world's top 30 largest ship-source oil spills, and yet Alaskan coastal communities are still witnessing impacts over 20 years later. Table B1 identifies the world's 10 largest oil spills from tankers since 1979. The *Exxon Valdez* spill is shown for comparison.

Table B1

—o World's Ten Largest Ship-Source Oil Spills since 1967

Rank	Spill Name	Location	Year	Crude Oil Spilled	
				(Tonnes)	(Barrels)
1	Atlantic Empress	Trinidad and Tobago	1979	287,000	2,201,000
2	ABT Summer	Angola	1991	260,000	1,994,000
3	Castillo de Bellver	South Africa	1983	252,000	1,933,000
4	Amoco Cadiz	France	1978	223,000	1,710,000
5	Haven	Italy	1991	144,000	1,104,000
6	Odyssey	Nova Scotia	1988	132,000	1,012,000
7	Torrey Canyon	UK	1967	119,000	912,000
8	Sea Star	Gulf of Oman	1972	115,000	882,000
9	Irenes Serenade	Greece	1980	100,000	767,000
10	Urquiola	Spain	1976	100,000	767,000
35	Exxon Valdez	Alaska	1989	37,000	257,000

Source: ITOPE, 2010

Figure B1

—o— Location of Major Oil Spills Since 1967



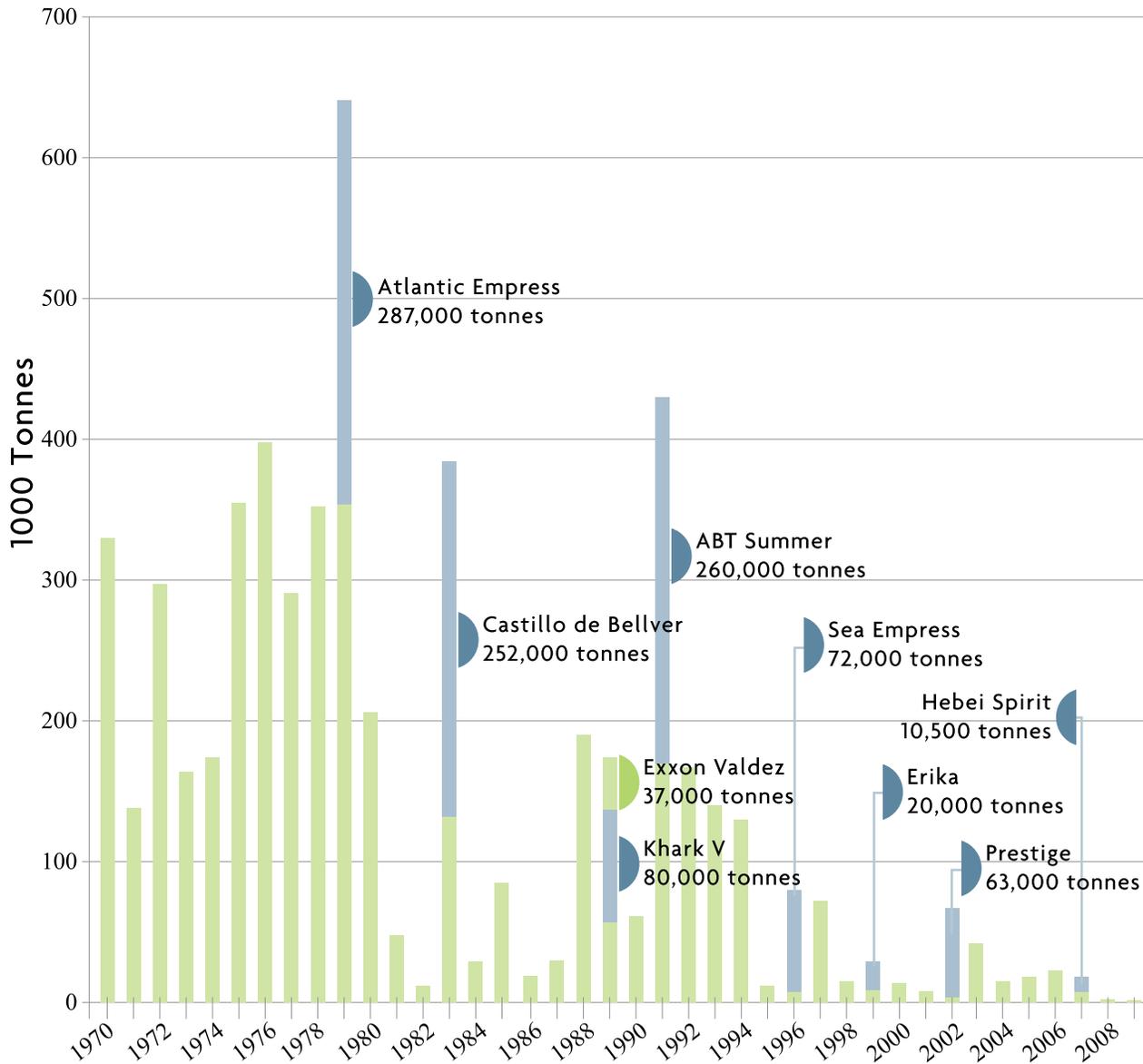
Source: ITOPE, 2010

Approximately 5.65 million tonnes of oil were spilled globally as a result of tanker accidents from 1970 to 2009 (IOTPE, 2010). In general, the number of spills over seven tonnes have decreased since 1970, along with annual overall quantities of spilled oil (Figure B2). However, it only takes a single major oil spill to cause vast devastation

of the marine and coastal environment. Figure B2 illustrates that a large portion of total oil spilled since 1970 was a result of only a few major accidents. For instance, in 1979 over 600,000 tonnes of oil was spilled globally, with the Atlantic Empress accounting for nearly half of this total.

Figure B2

Annual Quantities of Oil Spilled Worldwide (From Spills Over 7 Tonnes) Including Major Accidents Between 1970-2009



Source: ITOPE, 2010

Appendix C

Spill Cost Summary of Selected Oil Spill Incidents, 1984-2000

The cost of oil spills varies considerably depending on a variety of factors including: the type of oil, amount spilled, spill rate, location of the spill, etc. Response can be challenging and conditions unfavourable. In addition to response and cleanup costs, there are often fines or compensation that must be paid. One aspect is certain though: they are always expensive.

Table C1

Costs of Selected Oil Spills in the U.S., 1984-2000

Vessel/Facility Name	Vessel Type	Oil Type	Date	Location	Total Spill Volume (gal)	Total Spill Cost (millions)
Arco Anchorage	Tanker	Crude	Dec 31, 1985	Washington	189,000	\$27.2
Apex Houston	Barge	Crude	Jan 28, 1986	California	25,000	\$12.11
Glacier Bay	Tanker	Crude	Jul 2, 1987	Alaska	60,000	\$89.18
Nestucca	Barge	Fuel Oil	Dec 23, 1988	Washington	231,000	\$27.68
Exxon Valdez	Tanker	Crude	Mar 24, 1989	Alaska	11,000,000	\$12262.95
American Trader	Tanker	Crude	Feb 7, 1990	California	417,000	\$59.52
Sammi Superstars/Maui	Freighter	Fuel Oil	Jan 8, 1991	California	32,064	\$20.0
Texaco Anacortes	Refinery	Crude	Feb 22, 1991	Washington	27,300	\$11.0
Tenyo Maru	Fishing Vessel	Fuel Oil, Diesel	Jul 22, 1991	Washington /BC	173,000	\$28.33
Union Oil	Pipeline	Crude	Aug 3, 1992	California.	14,700	\$16.7
Morris J.	Barge	Fuel Oil	Jan 7, 1994	Puerto Rico	789,000	\$182.14
Kuroshima	Freighter	Fuel Oil	Nov 26, 1997	Alaska	47,000	\$11.5
Command	Tanker	Fuel Oil	Sep 28, 1998	California	51,450	\$9.4
New Carissa	Feighter	Fuel Oil	Feb 4, 1999	Oregon	70,000	\$36.5
U.S. Averages					822,370	\$914.0

Source: OSTF, 2002

Appendix D

Living Oceans Society's Oil Spill Model

When assessing the feasibility of a project, associated risks and potential impacts of a worst case scenario need to be accounted for. In 2008 Living Oceans Society commissioned the development of a computer generated oil spill model to examine the possible consequences of oil spills on

the North and Central Coast of B.C. Development was based on sound ecological and oceanographic science and the best technical tools available.

To see an animated version of the oil spill model visit: <http://www.livingoceans.org/initiatives/tankers/oil-spill-model>

Figure C1

—o Winter oil spill at Ness Rock, from Living Oceans Society's Oil Spill Model



