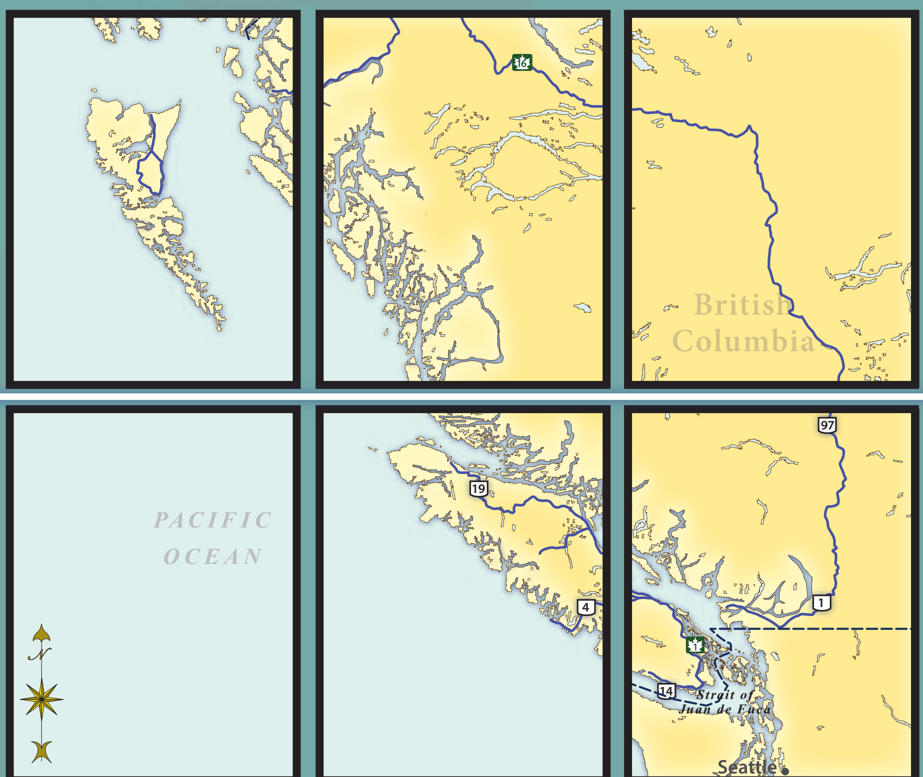
British Columbia Ministry of Environment

# WEST COAST
# Spill Response Study

## VOLUME 1: Assessment of British Columbia Marine Oil Spill Prevention & Response Regime

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*NOTE: The West Coast Spill Response Study is intended to provide a high level overview of key issues of interest to the BC Ministry of Environment. It was completed on a short timetable, with the first volume finished in March 2013 and Volumes 2 and 3 in July 2013, even as the context continued to evolve. Nuka Research appreciates the input provided by the Ministry and other agencies following a short review period. The incorporation of this input, all analysis, commentary, opinion, omissions, and/or errors, belong to Nuka Research as the author.*

# EXECUTIVE SUMMARY

As the volume of shipping on Canada's west coast has increased, and with several major marine transportation projects proposed for British Columbia's ports, the provincial government has a strong interest in understanding the risks associated with increased shipping and ensuring a world-class marine oil spill prevention, preparedness, and response regime is in place. The Ministry of Environment commissioned this report to provide an assessment of the current oil spill prevention and response regime on the west coast. The Government of BC has the opportunity now to seek consensus among the agencies, companies, and public interest organizations who have a stake in the safe operation of marine vessels in establishing exactly what "world class" looks like and identifying and pursuing the voluntary and/or legislated means of achieving it.

Canada's regulatory framework establishes *prevention* measures that are primarily overseen and implemented by the federal government and a spill *preparedness, response, and recovery* system that has the "polluter-pays principle" at its core. There is one industry-funded response organization based in British Columbia that implements marine oil spill response for western Canada. This organization, the Western Canada Marine Spill Corporation (WCMRC), has equipment based along the BC coast and is certified by Transport Canada as being able to respond to a 10,000t spill to marine waters.

Nuka Research ran a series of simulated oil spills to illustrate how much spilled oil could be collected using WCMRC's equipment resources and forces cascaded from nearby US states. These simulations considered some, though not all, of the real-world factors that will impact a spill response. Based on the results of these simulations and a high level review of existing laws and regulations, several areas warranting further consideration and possible enhancement are identified as important to the continued effort by agencies, companies, and public interest organizations to establish what a world-class system should look like for the west coast of Canada and how to get there. These include the response planning standard, general oversight, inter-agency coordination, the location of resources along BC's coastline, and planning assumptions and operational procedures such as a significant reliance on contractors and an assumed 24-hour operational period.

This is the first of three volumes, which together will form the substance of the West Coast Oil Spill Response Study. Volume 2 of this study will present a vessel traffic analysis that estimates current vessel traffic movements, including the quantity of petroleum products moved as cargo and bunker on marine vessels in BC. Volume 3 will consider the current system for prevention, preparedness, response, and recovery in BC in light of system components in other parts of Canada, the US, and Europe. There is no one system that all can agree to be the "best," and even if there were, it may not be suitable to BC's unique context in its entirety. However, Volume 3 will build on the information and analysis presented here to provide one perspective on what a world-class system might look like on Canada's west coast.

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# WEST COAST OIL SPILL RESPONSE STUDY, VOLUME 1:

## Assessment of British Columbia Marine Oil Spill Prevention and Response Regime

REPORT TO *British Columbia Ministry of Environment*

March 28, 2013

## 1. INTRODUCTION

This report was developed by Nuka Research and Planning Group, LLC (Nuka Research) for the British Columbia (BC) Ministry of Environment (Ministry). The Ministry commissioned this report to provide an assessment of the current oil spill prevention and response regime on the west coast.

### *1.1 Purpose and Scope*

As the volume of shipping on Canada's west coast has increased, and with several major marine transportation projects proposed for BC ports, the BC government has a strong interest in understanding the risks associated with increased shipping and ensuring a world-class marine oil spill prevention, preparedness, and response regime is in place. The Ministry commissioned Nuka Research to conduct a three-part study to inform their efforts:

- **Volume 1:** An assessment of the existing spill prevention and response regime in place for the west coast of Canada;
- **Volume 2:** A vessel traffic study that assesses the current and projected levels of shipping on the west coast of Canada; and
- **Volume 3:** A recommendation regarding the constituents of a world-class oil spill prevention, preparedness, and response system commensurate with present and future oil spill risks from marine vessels.

The three volumes together form the substance of the West Coast Spill Response Study. This report is Volume 1, providing a narrative assessment of the marine oil spill prevention and response regime in place in BC. The purpose of this study (Volume 1) is to provide the BC government with a baseline assessment of the existing marine oil spill prevention, preparedness, and response regime so that the government can build on the existing capacity to achieve their goal of a world-leading system. The results of this study will be weighed against the threat of spills from current and projected future shipping activities described in the vessel traffic study (Volume 2) and will form the basis of the recommendations for world-leading spill response presented in Volume 3.

This three-volume study builds on substantial previous work by the federal and provincial governments and other stakeholders to evaluate the marine spill response regime for the BC coast and identify gaps in the oil spill prevention, preparedness, and response capacity. This study aims to move the discussion forward by providing additional detail and analysis to inform future policy decisions.

### 1.2 Report Organization and Contents

Sections 2 through 5 describe the laws, regulations, programs, and plans that govern marine oil spill prevention, response, and preparedness in British Columbia. They tell us what is required in statute and regulation and what is in place (plans, equipment, vessels, personnel). Section 2 describes the regulatory framework for marine oil spill prevention, preparedness, response, and recovery. Section 3 highlights vessel-source spill prevention programs and systems. Section 4 describes the oil spill contingency plans that provide the framework for government and industry oil spill response management, and clean up. Section 5 summarizes the oil spill response capabilities in place for western Canada through spill response organizations and government agencies.

To provide the BC government with an illustration of how the current equipment and plans in place for the BC coast might perform during an oil spill, Section 6 contains a series of simulated oil spills to estimate response capacity. These spill simulations model how the response forces in place in BC and neighboring US jurisdictions might be applied to an on-water oil spill at two locations (one north and one south coast) and estimate the amount of oil that could be recovered during the first 120 hours of the response, given different parameters for oil type, season, and response force configurations. These simulations are presented to illustrate how some real-world factors influence the recovery of spilled oil in the marine environment.

Finally, Section 7 highlights some key issues that will be important to answer as all parties move forward in developing a “world-class” system to protect BC’s environment and communities from the damaging impacts of a major oil spill.

### 1.3 Limitations and Assumptions

This report was compiled on a very compressed timetable and against a backdrop of ongoing change.

Wherever possible, the authors sought out primary references for the information and data herein; however, our access to some information was limited. The report has been annotated to indicate areas where additional information would influence the analysis.

This report contains some ephemeral information that may become outdated. This is a typical limitation for a baseline study, and the report has been annotated to indicate information that may be subject to changes in the near future.

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# 2. REGULATORY FRAMEWORK

This section presents a high-level review of the statutory and regulatory framework governing marine oil spill prevention, preparedness, response and recovery as they apply to Canada's west coast.[1] The regulatory framework establishes the jurisdictional powers and authorities that relate to the existing spill prevention and response regime.

Canada's regulatory framework for marine oil spills rests primarily with federal laws and the agencies charged with their implementation. If a spill happens, federal laws also establish a response system based on the polluter-pays principle. At the provincial level, the Minister of Environment has the authority to require spill contingency plans from any potentially polluting operations in the province under the Environmental Management Act; in practice, however, marine activities fall under the purview of the federal government.

## 2.1 Maritime Safety and Spill Prevention

The Canada Shipping Act (most recently updated in 2001; this version should be considered to be referenced throughout this document)[2] and its implementing regulations establish requirements designed to prevent maritime accidents among both small and large vessels. Transport Canada oversees the implementation of most of these requirements. Many of these laws, especially those related to vessel design and operations, implement international agreements established by the International Maritime Organization (IMO).

### 2.1.1 Vessel Design and Construction Standards

The Canada Shipping Act governs many aspects of maritime operations, including spill prevention and response measures with which operators of certain vessels (based on size, cargo, and flag state) must comply when they are within Canada's Exclusive Economic Zone (EEZ).[3]

Oil tank vessels of 150 GT or more, and all other vessels of 400 GT or more that carry oil as fuel or cargo, must have a pollution prevention certificate to pass through Canadian waters.[4]

In most cases, spill prevention is akin to *accident* protection. The notable exception is the international requirement to have double hulls on certain vessels. This

[1] Different statutes and regulations may apply to marine spill prevention and response in other areas, such as the Arctic. These are not discussed in this report.

[2] S.C. 2001, c. 26

[3] Under the United Nations' Convention on the Law of the Sea (UNCLOS) Section 2 and the Canada Oceans Act, Canada's territorial waters extend to 12 nautical miles from the low-water line. Under Article 57 of UNCLOS, Canada's EEZ extends out another 200 nautical miles beyond the territorial waters.

[4] SOR/2012-69, Div. 1, Subdiv. 3.25

measure is specifically designed to prevent the spill of oil (or other cargo or substance) to water in the event of an accident that damages a ship's hull.

The tables below describe prevention measures that relate to the design and construction of the ship and those that relate to its safe navigation. Many of them are established in international law, but implemented for Canadian-flagged vessels or foreign vessels in Canadian waters through the Canada Shipping Act and its regulations.

***Table 2.1 Prevention requirements related to vessel design and construction***

| CATEGORY | REQUIREMENT | AUTHORITY |
|---|---|---|
| **Hull construction** | Oil tankers of 5,000 DWT or greater, and tankers carrying heavy grade oil[5] of 600 DWT or greater, must have double hulls. | International, adopted through Canadian standards.[6] |
| **Fuel tank protection** | All ships delivered on or after 1 August 2010 with an aggregate oil fuel capacity of $600m^3$ and above are required to have fuel tank protection designed to minimize outflow of oil from fuel tanks. The requirements include a protected location of the fuel tanks and performance standards for accidental oil fuel outflow. | International[7] |
| **Emergency towing arrangements** | Tankers of 20,000 DWT or greater must have an emergency towing arrangement at both ends that are strong enough to withstand the expected forces based on anticipated weather conditions and the size and weight of the ship.<br>Emergency towing *procedures* must be established for all ships. | International[8] |
| **Steering** | There are basic steering requirements for all ships, but notably tank vessels carrying 10,000t or more of oil or other chemical must have additional features such as an alarm to indicate steering failure and an indicator to show the rudder angle that is independent from the rudder.<br>Steering gear should also have auxiliary power and other redundant features. | Federal law[9]<br>International, implemented through Canadian regulation[10] |
| **Signaling devices** | Certain equipment, such as lights, radar, reflectors, and sound-signaling devices are mandated for use by all vessels. | International, implemented through Canadian regulation [11] |

[5] The regulation includes the following in its definition of "heavy grade oil": crude oils with a density greater than $900kg^3/m$ at 15 degrees C, fuel oils with a density greater than $900kg^3/m$ at 15 degrees C or kinematic viscosity at 50 degrees C higher than $180mm^2/s$; or bitumen, tar, and their emulsions.

[6] This is described in Transport Canada's Standards for the Double Hull Construction of Oil Tankers - TP 11710 E (2009) and required under international law under the International Convention on the Prevention of Pollution from Ships (MARPOL) 73/78 Annex I, Regulation 13G and Regulation 13H.

[7] Regulation 12A to MARPOL Annex I applies fuel tank protection requirements to all ships delivered on or after 1 August 2010 with an aggregate oil fuel capacity of $600m^3$ and above.

[8] International Convention on the Safety of Life at Sea (SOLAS) Annex II

[9] This is required under the Steering Appliances and Equipment Regulations of the Canada Shipping Act (SOR/83-810).

[10] Canada Shipping Act regulations at SOR/95-254, s. 10 in compliance with SOLAS

[11] Canada Shipping Act regulations (C.R.C, c, 1416) in compliance with the Convention on the International Regulations for Preventing Collisions at Sea, 1972

Safety inspections help to ensure that vessels are in compliance with all safety requirements. Some of these, such as the hull requirements, relate directly to spill prevention.[12] Inspections can also ensure compliance with navigational safety requirements.[13]

### 2.1.2 Navigational Safety

Key navigational safety regulations and policies relevant to spill prevention include marine pilotage, escort tugs for certain vessels, and vessel traffic management. These are discussed further in Section 3. There are many other navigational safety standards that contribute to safe navigation, such as crew training and watchstanding standards, that are not discussed here.

*Table 2.2 Prevention requirements related to safe navigation*

| CATEGORY | REQUIREMENT |
|---|---|
| **Vessel traffic management** | Vessels must have permission to enter designated zones and follow requirements for a heightened level of communication with marine traffic regulators while in them.[14] See Section 3.2. |
| **Escorts** | There are requirements in place for escorts in designated areas along the west coast; however, these are implemented through port and pilotage authorities, rather than through law or regulation See Section 3.4. |
| **Marine pilots** | Foreign vessels larger than 350 GT must have a local pilot within designated zones.[15] See Section 3.5. |

## 2.2 Spill Response

Canada's marine spill response preparedness is based primarily on the Canada Shipping Act, its implementing regulations, and associated guidelines. The overall framework for marine spill preparedness and response is that the "polluter pays" for basic preparedness: operators of certain vessels must pay fees to one of the regional response organizations certified by Transport Canada. If a spill occurs in western Canada's marine waters, the CCG will oversee the response implementation. If the source is unknown or the responsible party does not have a response organization in place (because they are not subject to the regulations), then the CCG will implement the response. Environment Canada and the BC Ministry of Environment, as the lead provincial agency, will provide input during a response.

[12] Canada Shipping Act, Part 1, Sec. 11(2)(b)

[13] Canada Shipping Act, Part 1, Sec. 11(2)(d)

[14] Canada Shipping Act, Part 4 Sec. 126(1) and SOR/89-98

[15] This requirement is found at C.R.C., c. 1270, Pacific Pilotage Regulations, under the Pilotage Act. These regulations exempt some vessels from this requirement: government vessels, ferries, and US government vessels smaller than 10,000 GT. The statute and regulations also establish a pilotage authority, which serves as a crown corporation and implements the pilot program throughout the country. In BC, the authority contracts with the BC Coast Pilots to implement the regulations. See: http://www.bccoastpilots.com.

The statute and regulations governing spill response preparedness define oil as "petroleum in any form, including crude oil, fuel oil, sludge, oil refuse, and refined products."[16] Therefore, spill preparedness requirements include spills from vessel cargo and also fuel oils.

### 2.2.1 Preparing for a Response

The Canada Shipping Act requires those operating vessels of 400 GT (or tank ships or barges of 150 GT)[17,18] to pay fees to response organizations that are able to respond to a spill that is *at least* the size of the vessel's cargo and fuel (up to 10,000 t[19]), and serves the areas where the vessel navigates.[20] The Act also requires certain vessels to have Shipboard Oil Pollution Emergency Plans (SOPEP).

Federal government agencies have also undertaken extensive planning for marine spill response. These are described further in Section 4. While there are mandates for agencies to be prepared for emergencies, there are not specific planning requirements in statute or regulation for government plans.

#### *RESPONSE ORGANIZATION PLANS*

Certified response organizations must submit plans to Transport Canada[21] that demonstrate their ability to respond to a certain sized spill and other requirements summarized in Table 2.3. The requirements are based on both regulation[22] under the Canada Shipping Act and Transport Canada's Response Organization Standards (TC, 1995). The certified response organization for western Canada is the Western Canada Marine Response Corporation (WCMRC). WCMRC's capabilities are discussed in Sections 4 and 5.

[16] Canada Shipping Act, Part 8, Sec. 165

[17] The covered vessels are included in regulation at SOR/2008-275(2). This regulation also excludes several categories of vessel from this requirement: foreign vessels that are transiting Canadian waters without stopping to engage in loading or unloading of oil; pleasure craft; and non-commercial government or naval vessels of Canada or another government. In addition, this requirement does not apply to vessels operating north of 60 degrees latitude [SOR/2008-275(4)]. Finally it also does not apply to vessels engaged in petroleum production or exploration [SOR/2008-275(2)(3)].

[18] Because of the definition of oil used in the applicable Part 8 of the Canada Shipping Act, a tank vessel carrying biofuels, food oils, condensate, or other substances that may be hazardous if spilled *but are not petroleum-based*, would not need to have a contract with a response organization for their cargo.

[19] Sec. 18 of SORS/95-405, "Response Organizations and Oil Handling Facilities Regulations."

[20] Part 8, Sec. 167

[21] Canada Shipping Act, Part 8, Sec. 169-171 and SOR-95-405, Sec. 7-9.

[22] SOR/1995-405

*Table 2.3 Transport Canada requirements for marine spill response organizations*

| CATEGORY | RESPONSE ORGANIZATION PLAN REQUIREMENT |
|---|---|
| **Spill size** | Equipment, procedures, and personnel sufficient to respond to up to 10,000t of spilled oil.[23] |
| **Response times** | First resources on scene by 6 – 18 hours, depending on location (or possibly longer, depending on travel time). See below. |
| **Storage** | Sufficient primary storage capacity to maintain recovery operations for 24 hours, and twice as much secondary storage capacity.[24] |
| **Shoreline clean-up** | 500m/day |
| **Duration of on-water recovery** | Up to 10 days from first deployment. |
| **Sensitive area protection** | Describe how they will protect and treat sensitive areas. |
| **Training and exercises** | A training and exercise program designed to test planning assumptions.<br>List personnel and their level of training. |
| **Wildlife** | Equipment that will be used to scare birds from oiled sites.<br>How they will support other efforts to rehabilitate wildlife. |
| **Plan updates** | Plans must be re-submitted annually, or when significant changes occur between annual plan submissions. |

On the west coast, the fastest response times are required for a spill within the "designated port" area immediate to the Port of Vancouver:[25] the first resources, enough to respond to 150t of spilled oil, must be deployed in 6 hours from notification[26] with the next set of resources (up to 1,000t total) by 12 hours. For a spill within the "primary response area" around Vancouver or the "enhanced response area" of the Juan de Fuca Strait (and including the designated port area), equipment capable of responding to up to 2,500t of spilled oil must be deployed on-scene by 18 hours and the maximum required equipment, up to 10,000t, by 72 hours.[27] For the rest of the coast, these latter response times of 18 and 72 hours apply, but with additional time allowed for travel from the designated areas in the south. These timelines and average speeds used to calculate the travel time assumptions are specified in the Standards. Travel times are assumed to be: 6 kts by sea, 65km/h by land, and 100 kts by air. (TC, 1995)

[23] The methodology used by Transport Canada to determine sufficiency of equipment, procedures and personnel is available from Transport Canada upon request.

[24] This can be modified if procedures and equipment for decanting the oil-water mixture are available and utilized, or if storage is available at the location.

[25] Vancouver is currently the only designated port in western Canada; however, it is possible that new ports could be designated, creating additional response requirements.

[26] These "150 tonne" resources cannot be moved from the designated port area of Vancouver without permission (SOR/95-405, s. 6).

[27] Equipment intended for use in the Vancouver Primary Response Area must be apportioned according to its suitability for the following environments: 40% onshore, 40% sheltered, and 20% unsheltered. For the Enhanced Response Area of the Juan de Fuca Strait, it must be 40% onshore, 20% sheltered, and 40% unsheltered. (TC, 1995)

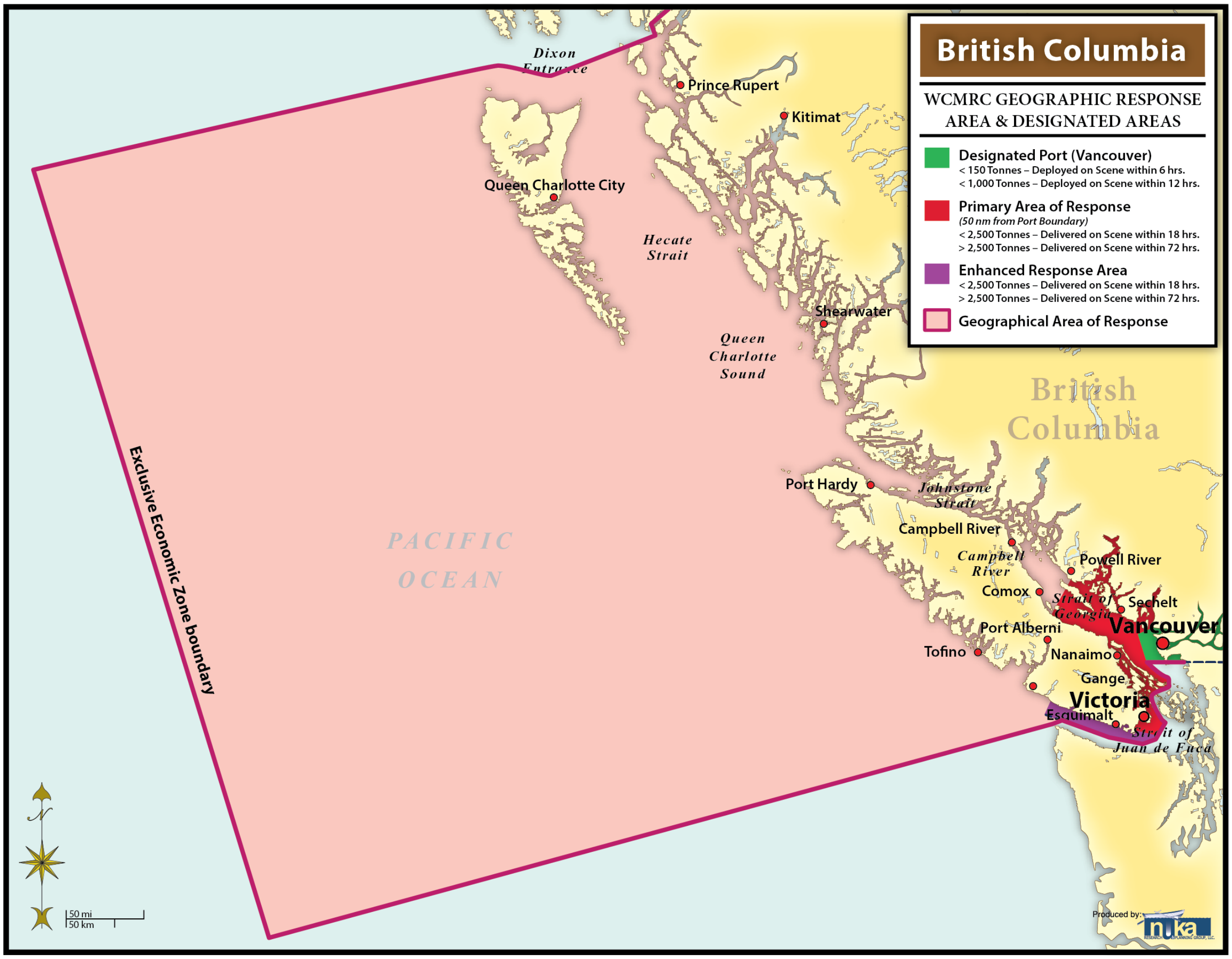

***Figure 2.1 Designated areas on the south coast of BC that determine regulatory requirements for response organization response time and WCMRC geographic response area***

#### *SHIPBOARD OIL POLLUTION EMERGENCY PLANS*

Oil tank vessels of 150 GT or greater and all other vessels of 400 GT or greater that carry oil as fuel or cargo must have a shipboard oil pollution emergency plan. The plan requirements are set out in MARPOL (Annex 1) and include describing the procedures and contacts that will be used to notify the appropriate government authority if a spill occurs and the procedures that will be undertaken by the crew to control the spill. All vessels flagged to countries that have ratified MARPOL must have these plans in place; for Canadian vessels, the requirements are codified in regulations under the Canada Shipping Act.[28] Transport Canada enforces this requirement.[29]

### 2.2.2 Implementing a Response

The CCG takes the lead in overseeing a response (if the responsible party can be identified and has a response organization), or implementing response

[28] SOR/2012-69, Div. 1, Subdiv. 3.27

[29] Canada Shipping Act, Part 9

activities (if the source of the spill is unknown or the responsible party does not have a response organization or is otherwise unwilling or unable to respond).

The Emergency Management Act[30] establishes roles and responsibilities for federal ministers related to emergency preparedness and response. Under this authority, Environment Canada provides input on environmental issues ranging from weather forecasts to potential resource impacts and coordinates multi-stakeholder Regional Environmental Emergencies Teams (REET) comprised of other agencies at the federal, provincial, or territorial level, industry, and other organizations (EC, 1999).[31]

The Migratory Birds Convention Act, Species at Risk Act, and Canada Wildlife Act generally give the Canadian Wildlife Service the responsibility for protecting certain species, but do not dictate specific requirements or planning standards for oil spill response.[32] The CWS does license responders who will be dealing with wildlife and it operates under the National Policy on Oiled Birds and Oiled Species at Risk (EC, 2000).

At the provincial level, the BC Ministry of Environment is the lead coordinating agency in the event of oil or other hazardous spills, per regulations under the province's Emergency Program Act.[33] The province will also regulate the management of oily waste under its Environmental Management Act regulations.[34]

## 2.3. Spill Liability and Recovery

### 2.3.1 Liability

Federal and provincial laws and regulations provide for the recovery of costs associated with the use of public resources (or private resources that are directed into use by a public agency) in responding to a spill. Again in keeping with the polluter-pays approach, as well as international conventions, as appropriate, the party responsible for the spill must pay for "reasonable" costs, according to the following:

- The federal Marine Liability Act[35] defines the responsible party's liability for a spill event based on the size of the vessel, regardless of whether the vessel operator is found to have been negligent. The current limit is approximately $137,973,797.[36] The Act also governs the

[30] S.C. 2007, c. 15

[31] Recent changes to the federal emergency management system include closing the regional Environment Canada center in BC, which had previously served a key role in coordinating the REET. The present status of the REET in BC is uncertain.

[32] As summarized in Table 4.2, there is work ongoing to update wildlife response plans and policies.

[33] BC Reg. 477/94

[34] BC Reg 63/2009

[35] S.C. 2001, c. 6, Sec. 51

[36] Section 51(4) sets the liability limits using an International Monetary Fund (IMF) unit that is not tied to one country's currency. The limits are different for vessels up to 5,000 tons and those that are larger, but there is an overall cap at 89,77,000 of the IMF's "Special

management of a Ship-source Oil Pollution Fund that was established based on a levy – last imposed in 1976 – on oil shipped as cargo to or from a Canadian port. As of March 31, 2012, the surplus in the fund was $395,748,612 (above the amount needed to meet the maximum potential claims for one spill) (Popp, 2012).

- Canada is party to international instruments, including the International Convention on Civil Liability for Oil Pollution Damage and the International Convention on Civil Liability for Bunker Oil Pollution Damage. If the vessel owner is unable to pay or costs exceed the limits, Canadian and international funds can provide $1.36 billion in total compensation (IOPC, 2013). The Government of Canada announced in March 2013 that it was going to review the liability and compensation regime for oil spills by Fall 2013. (TC, 2013a)

- At the provincial level, the Spill Cost Recovery Regulation lists costs incurred by the provincial government or its contractors that can be recovered under the Section 80 of the Environmental Management Act, ranging from food and accommodations or mileage reimbursement to clean-up certification, review of contingency plans, or research or analysis after the spill.[37] Provincial costs are subject to federal and international law.

Both federal and provincial mandates refer to "reasonable" costs, which can allow for some amount of subjectivity. Neither federal nor provincial law mandates that vessel owners provide funds to offset losses to individuals or communities resulting from long-term environmental damage.

### 2.3.2 Long-Term Recovery of Injured Resources

There is no process established in federal or provincial statute or regulation to dictate how long-term impacts to the environment or affected communities will be established or compensated. The BC government has legislated authority to restore injured habitat, but lacks a funding mechanism.[38]

Drawing Right units." The value of these units in specific currencies changes daily, so the maximum liability of a responsible party that spills oil to Canadian waters will vary.

[37] B.C. Reg. 321/2004

[38] SBC 2003, Chapter 53, Part 7, Div. 1, Sec. 80

# 3. PREVENTION PROGRAMS AND SYSTEMS

Prevention of oil spills from vessels is a key component to managing oil spill risks. There are a number of oil spill prevention programs and systems in place for vessels operating in western Canadian marine waters. Some are compelled by the regulatory requirements described in Section 2 of this report; others are government or industry-led initiatives. This section reviews key vessel-source spill prevention programs and systems.[39]

## *3.1 Vessel Standards, Inspections, and Port State Controls*

Section 2.1 summarizes the Canadian and international regulations that govern vessel construction, design, and operation.

Port State Control (PSC) is a Transport Canada ship inspection program that involves boarding and inspecting foreign vessels, including oil tankers, entering Canadian ports to ensure they comply with major international maritime conventions. Under the PSC program, all foreign tankers are required to be inspected on their first visit to Canada and every year thereafter. Port State Control inspectors examine the overall vessel condition, the working conditions of the crew, and key vessel safety systems, and equipment. Deficiencies are documented, and ships are detained when the condition of the ship or its crew presents unreasonable threat of harm to the marine environment. (TC, 2011)

In 2010, the most recent year for which PSC data has been published, 1,082 inspections were conducted nationwide, with deficiencies cited for 40% of ships inspected. Of the 443 ships cited for deficiencies, 20 were detained. Within the Pacific region, PSC inspections are carried out at Transport Canada centers in Vancouver, Victoria, Prince Rupert, and Nanaimo (See Figure 3.1). In 2010, a total of 468 PSC inspections were conducted in the Pacific region: 401 in Vancouver (the highest number for any Canadian port), 64 in Prince Rupert, one in Victoria, and two in Nanaimo. (TC, 2011) In March 2013, the Government of Canada committed to increasing the number of vessel inspections, to ensure that foreign tankers are inspected the first time they visit a Canadian port and annually thereafter (TC, 2013c).[40]

The Government has also proposed amendments to the Canada Shipping Act that will provide Transport Canada's marine safety inspectors with "tools to effectively ensure compliance" and new fines or penalties that they could impose (TC, 2013b).

[39] In addition to the measures described here, the Government of Canada has committed to defining Kitimat as a "public port" in its March 2013 announcement about its next steps to establishing a world-class prevention and response system (TC, 2013c).

[40] The focus of this commitment is on ensuring that oil tankers have double hulls; it is described as ensuring that Canada achieves its current stated policy, not an increase in the number of targeted inspections (TC, 2013c).

## 3.2 Vessel Traffic Management and Navigational Safety

Vessel traffic management and navigational safety programs and requirements may prevent oil spills by reducing the potential for collisions, allisions, or other navigational accidents. As described in Section 2.1, responsibility for navigational safety is largely allocated to Transport Canada and the CCG under the Canada Shipping Act. Several regulations under the CSA help ensure vessels navigate safely in Canadian waters. Vessels must have the appropriate navigation equipment, follow navigational rules and procedures, and have effective means of communication.

### 3.2.1 Vessel Traffic Management

The CCG operates the Marine Communications and Traffic Services (MCTS) program, which provides marine safety communications and co-ordination with rescue resources, vessel traffic services and waterway management, broadcast weather and safety information, and vessel planning support services (CCG, 2012b).

The MCTS operates the Vessel Traffic Services (VTS). There are five MCTS stations (Vancouver, Victoria, Comox, Prince Rupert, and Tofino) and three VTS zones (Vancouver, Prince Rupert, and Tofino). All vessels over 20m in length[41] operating in Canadian waters must receive VTS clearance before beginning a voyage or entering Canadian waters. VTS personnel operating from MCTS centers monitor the movement of vessels using VHF radio and direction finding equipment, tracking computers, and, in areas of high traffic density, surveillance radar. VTS provides a means of exchanging information between ships and a shore-based center to promote safer navigational decision-making and reduce potential accidents. (CCG, 2012b; BC, 2006)

In addition to the VTS, most large vessels operating in Canadian waters are also required to be fitted with an automatic identification system (AIS). AIS automatically provides information, including the ship's identity, type, position, course, speed, navigational status, and other safety-related information, to AIS-equipped shore stations, other ships and aircraft. These ships can also automatically receive such information from similarly fitted ships. MCTS centers use AIS to facilitate monitoring of marine traffic.

### 3.2.2 Tanker Exclusion Zones, Vessel Routing, and Geographic Restrictions

There are measures in place through various jurisdictions to provide additional navigational safety by excluding or controlling vessel traffic, particularly laden oil tankers, through specific waterways. Navigational restrictions like exclusion areas, preferred routes, and traffic separation help address safety and/or environmental concerns arising from vessel traffic. They can be useful where marine traffic density is high. Figure 3.1 shows the navigational

[41] VTS also includes ships engaged in towing or pushing any vessel or object of more than 20m (other than fishing gear) with a combined length of more than 45m.

restrictions[42] currently in place for oil tanker traffic in western Canada, which include:

- **Voluntary Tanker Exclusion Zone.** A voluntary Tanker Exclusion Zone has been established off the BC coast that applies to laden oil tankers in the Trans-Alaska Pipeline System service between Valdez, Alaska and Puget Sound, Washington. The zone, which keeps laden tanker traffic 50 nm offshore, does not apply to tankers travelling to or from BC ports. (TC, 2013)
- **Limitations to Tanker Movements in the West Coast Inside Passage.** Through a Transport Canada policy, tankers over 40,000 DWT are prevented from using the southern portion of the Inside Passage, specifically the Johnstone Strait and Discovery Passage. Instead, they are directed to the outside route for north/south transits. (TC, 2013)
- **Vancouver Second Narrows Movement Restricted Area.** The Vancouver Fraser Port Authority, in cooperation with the Pacific Pilotage Authority, has established the Second Narrows Movement Restricted Area (MRA) and associated transit procedures to enhance navigational safety through the second narrows. These include operational periods that restrict certain vessels to transits during slack tide, navigational channel clearances, speed restrictions, visibility limits, communications procedures, escort tugs (discussed in Section 3.3), pilotage (discussed in Section 3.5), traffic schemes, and other requirements. (Port Metro Vancouver, 2010)

The US Coast Guard has also placed restrictions on tank vessels operating in Puget Sound. Under US federal regulations, tankers over 125,000 deadweight tons that are bound for US ports may not operate in a specially regulated navigation area within Puget Sound (this area is not depicted in Figure 3.1).[43]

### 3.2.3 Aids to Navigation

Aids to Navigation are a basic, but important component of navigational safety and marine oil spill prevention. Aids to navigation are critical to safe vessel operations. Navigational aids designate channels, mark navigational hazards, and provide mariners with critical information for trip planning. The CCG's Aids to Navigation program provides both short-and long-range marine aids to navigation. Short-range aids include visual aids (fixed aids and buoys), sound aids (fog horns), and radar aids (reflectors and racons). The primary long-range marine aid is the Differential Global Positioning System (DGPS). The CCG has an estimated 1,764 Aids to Navigation marking potential hazards

[42] Other routing measures, such as traffic separation and recommended shipping routes, are not shown on this map but are shown on nautical charts.

[43] The regulated navigation are is defined as the waters of the United States east of a line extending from Discovery Island Light to New Dungeness Light and all points in the Puget Sound area north and south of these lights. 33 CFR 165.1303.

along BC's 27,000km of coastline.[44] The short- and long-range marine aids assist mariners to determine the position of their vessels, chart their course, and avoid dangerous waters. (CCG, 2011)

The CCG and the Canadian Hydrographic Service intend to expand navigational aids in western Canada, particularly along the north coast. They will conduct hydrographic surveys and will incorporate the aids to navigation information along with other safety information to generate improved navigational charts and other related safety products. The CCG and the Canadian Hydrographic Service will also develop options for enhancing Canada's current navigation system, potentially by leveraging advances in data collection and communications technologies such as real-time information and electronic charts. (TC, 2013c)

## 3.3 Escort and Rescue Tugs

The use of escort and rescue tugs for oil tankers in transit is a recognized spill prevention practice used in many jurisdictions.

### 3.3.1 Escort Tugs

Tug escort requirements currently exist for two geographic areas in southern BC (Figure 3.1). Escort tugs accompany vessels, typically laden oil tankers, through high-risk transit areas. Escort tugs assist with navigation and are available to immediately respond or assist in the event of an emergency.

In Haro Strait and Boundary Pass, all laden tankers of over 40,000 DWT must be escorted by an escort tug that meets minimum specifications established in a 2010 Notice to Industry. The tug is to be tethered for two miles of the transit, and is required to adhere to speed restrictions. (PPA, 2010)

The Vancouver Fraser Port Authority requires a minimum of two escort tugs to accompany laden tankers in excess of 40,000 DWT while transiting the First and Second Narrows, both inbound and outbound. The requirements specify minimum bollard pull, tug package configuration, and escort configuration. Three tugs are required for certain tankers based on their length overall plus breadth. (Port Metro Vancouver, 2010)

There are no escort tug systems currently in place in British Columbia waters north of the Vancouver area, and there are no federal or provincial statues or regulations that compel tanker escorts in BC waters.

[44] Information provided by CCG in comments on draft document (July 16, 2013).

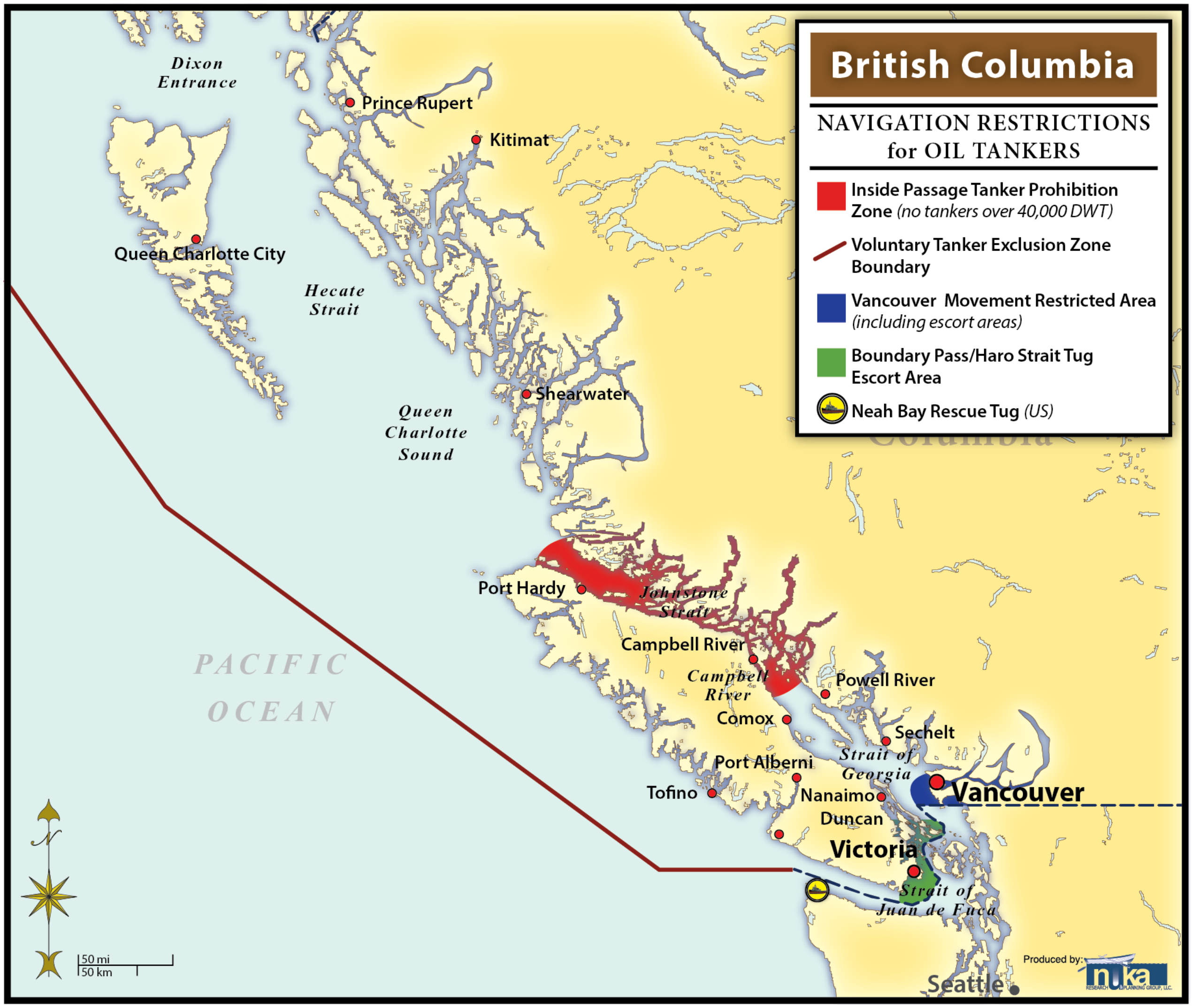


*Figure 3.1 Navigation restrictions currently in place for oil tankers in British Columbia*

### 3.3.2 Rescue Tugs

Unlike escort tugs, rescue tugs do not accompany vessels along transit routes, but are available to respond to a navigational emergency and potentially prevent or mitigate and accident or spill. There are no rescue tugs stationed in BC, but there is a rescue tug stationed just over the US border in Neah Bay, Washington (Figure 3.2) that could provide some emergency towing support to an incident in BC waters, if the State of Washington allows the tug to be released, though there is no specific mechanism designed to facilitate this.[45]

BC currently relies on a tug-of-opportunity system for rescue services. A tug-of-opportunity system provides a less costly but also less certain rescue tug response capacity by relying on nearby commercial tugs to provide rescue services, if needed. The Canadian and US vessel traffic services track tug

[45] The Neah Bay tug is funded by the US shipping industry under a 2009 mandate from the State of Washington (ESSB 5344). The Neah Bay tug has responded to requests for assistance in Canadian waters in the past (Washington Department of Ecology, 2013).

availability as part of the International Tug of Opportunity System (ITOS), which allows for a quick assessment of nearby tugs in the event of an emergency. There is no guarantee that appropriately sized or capable tugs-of-opportunity will be available or proximate to the vessel in need of assistance. If a tug-of-opportunity already has a vessel or barge in tow, there may be additional delays associated with safely releasing the primary tow so that the tug can respond to the emergency. Tugs-of-opportunity can be an effective prevention measure for certain types of accidents (i.e. drift groundings), but would not be as effective as an escort tug in preventing collisions or powered groundings. (USCG, 1999)

### 3.4 Marine Pilotage

Marine pilotage involves a mariner with extensive knowledge of a local waterway boarding a vessel to ensure it is safely navigated through the various passageways along the coast so there is no damage to the ship, its crew, or the marine environment. Every ship over 350 GT (excepting pleasure craft) and every pleasure craft over 500 GT is subject to compulsory pilotage in coastal areas within roughly two nautical miles of shore (see Figure 3.2). The Pacific Pilotage Authority (PPA) has oversight responsibility for pilotage requirements, and may waive compulsory pilotage under certain circumstances. The PPA oversees licensing of marine pilots based on regulatory standards. Pilots must have specific knowledge and training.

Two groups of marine pilots serve British Columbia: The BC Coast Pilots and the Fraser River Pilots. Marine pilots typically board a vessel at one of five pre-established Pilot Stations along the coastline. Vessel masters are required to provide pre-notification of their arrival to the pilotage authority in order to arrange for pilot boarding. Typically, a single pilot is dispatched, but two pilots are required for bridge watches in excess of eight hours or transits in excess of 105 consecutive nautical miles, or when the vessel master requests more than one pilot.

In March 2013, the Government of Canada committed to studying the existing pilotage programs around the country to consider the "legal and voluntary measures currently in place to safely guide vessels to their destination," (TC, 2013c).

Data from the PPA estimates their capacity to be approximately 11,000 trips per year. The BC Coast Pilots currently has 98 licensed pilots, with plans to bring five new pilots on in 2013. The PPA and BC Coast Pilots/Fraser River Pilots are aware of the potential implications of proposed expansions and new projects to increase the need for coastal pilots. (PPA, 2011)


*Figure 3.2 Marine pilotage areas in British Columbia*

## 3.5 Detecting and Deterring Illegal Releases of Oil to Water

Transport Canada operates the National Aerial Surveillance Program (NASP) to quickly detect spills to water and, in doing so, deter ship operators from illegal intentional releases (as well as providing an early notification of an accidental spill). NASP has three dedicated aircraft, including one based in Vancouver, BC. Transport Canada also works with Environment Canada on a Marine Aerial Reconnaissance Team (MART) and uses Environment Canada's Integrated Satellite Tracking of Pollution (ISTOP) program to monitor for marine pollution as well. (Transport Canada, 2009a) In background information provided with a March 2013 media release, the Government of Canada described proposed amendments to the Canada Shipping Act that would include, if enacted, provide long-term funding for NASP and enhanced surveillance in northern BC (TC, 2013c).

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# 4. MARINE OIL SPILL RESPONSE PLANNING

While the primary onus for spill response preparedness and implementation rests with industry and their contracted response organization, the federal and provincial governments have plans in place to implement their respective roles in a spill response. Canada and the US have also developed plans to coordinate spill response in border areas.

## 4.1 International Oil Spill Contingency Plans and Mutual Aid Agreements

The Government of Canada has developed joint planning and mutual aid agreements with its US counterparts, coordinated through each country's coast guard. The Government of BC also coordinates with the western US states through the Pacific States/BC Oil Spill Task Force, which has negotiated mutual aid agreements. [46]

### 4.1.1 Cross-border Contingency Plans

Canada and the US have established a contingency plan (with regional appendices) to guide the way the two countries will work together if a spill occurs in marine waters in border areas. On the west coast, the overarching plan and regional annexes for the San Juan Strait area (in the south) and Dixon Entrance (in the north) apply. The plans are summarized in Table 4.1.

*Table 4.1 International contingency plans related to marine oil spills*

| PLAN | SUMMARY |
|---|---|
| **Canada-United States (CANUS) Joint Marine Pollution Contingency Plan**<br><br>**(CCG and USCG, no date)[47]** | • Applies to Canadian and US waters.<br>• Establishes shared principle that response will rely to the extent possible on private sector resources supplemented by public resources.<br>• Establishes primary roles for CCG and US Coast Guard (USCG) in both planning and response (including as on-scene commanders of Joint Response Team, which will be selected to provide advisory support).<br>  - Describes how CCG and USCG will work together through the stages of response, including the resolution of issues.<br>  - Includes detailed contact information.<br>• Establishes expectations for exercises in geographic regions (to be described in the Annexes, but at least a table-top exercise every two years.)<br>• Countries will fund and document their activities – though if a country requests support, it will fund it. (Individual countries' own laws related to liability and compensation apply.)<br>• Establishes that lessons learned from exercises and actual responses will be incorporated into future plans, as appropriate. |

[46] The Pacific States/BC Oil Spill Task Force is a group of state and provincial agencies from California to Alaska (including Hawaii) that work together on regional spill prevention and response initiatives. These have included mutual aid agreements. More information is available at www.oilspilltaskforce.org.

[47] An updated plan was finalized in May 2013, but was not reviewed for the development of this March 2013 volume

| PLAN | SUMMARY |
|---|---|
| **Annex 5: Canada-United States Dixon Entrance - Geographical Annex (CANUSDIX), Draft**<br>**(CCG and USCG, 2008)** | • Describes notification procedures.<br>• Establishes shared goals for an effective and safe response.<br>• Describes procedures for moving equipment and personnel across the international border.<br>• Includes a communications plan, including VHF channels.<br>• References relevant documents or provides contacts related to environmentally sensitive areas, waste management, public information coordination, waste disposal, equipment inventories, and logistics.<br>• Commits to regular exercises. |
| **CANUSDIX Appendix: Guidelines for Resource Agency Input to Places of Refuge, Dispersant Use, and In-Situ Burning Decision-Making**<br>**(CCG and USCG, 2010a)** | • Developed by workgroup of resource agencies (led by Environment Canada and US Department of the Interior).<br>• Describes how resource agencies will work together to provide information to advise CCG and USCG, including checklists and considerations used to provide input on the decision to use dispersants or in-situ burning, or for selecting places of refuge.<br>• Includes agency contacts in both countries. |
| **CANUSDIX Appendix: Wildlife Response Guidelines**<br>**(CCG and USCG, 2010b)** | • Describes how resource agencies from both countries will work together to provide advice to the CCG and USCG, make decisions together related to wildlife impacts, and implement wildlife response.<br>• Focuses on migratory birds and sea otters, including checklist used when establishing capture programs.<br>• Describes oiled carcass recovery and entities and equipment available in the region for wildlife response activities (including bird deterrent and stabilization). |
| **Canada-US Joint Marine Pollution Contingency Plan, Annex 3: Pacific – Geographical Annex, Draft (CANUSPAC)**<br>**(CCG and USCG, 2012b)** | • Describes notification procedures.<br>• Establishes shared goals for an effective and safe response.<br>• Describes procedures for moving equipment and personnel across the international border.<br>• Includes a communications plan, including VHF channels.<br>• References relevant documents or provides contacts related to environmentally sensitive areas, waste management, public information coordination, waste disposal, equipment inventories, and logistics.<br>• Commits to regular exercises. |

### 4.1.2 Cross-border Mutual Aid Agreements between Governments

There are mutual aid agreements established between the government of BC with the western US states (Pacific States/British Columbia Oil Spill Task Force, 2011) and between the federal governments of Canada and the US through the Joint Contingency Plan. In amendments to the Canada Shipping Act recently proposed by the Government of Canada, responders from other countries would be granted the same immunity currently provided to individuals or organizations from Canada (TC, 2013a).

## 4.2 Federal Oil Spill Contingency Plans

At the federal level, Transport Canada is the lead department responsible for ensuring preparedness for marine oil spills, while the CCG is the lead when implementing or overseeing a response. The CCG has a national plan and regional supplements, including one for the Pacific Region. Transport Canada also has a national plan that focuses on the roles and responsibilities of federal agencies, the responsible party, and response organizations.

Under the Emergency Management Act of 2007, all agencies are required to be prepared for wide-ranging emergencies including oil spills.[48] For example, Environment Canada's Environmental Emergencies Program is designed to address a wide range of environmental emergencies, including marine oil spills.[49] Environment Canada's National Environmental Emergencies Contingency Plan (1999) describes how the agency will provide expertise related to meteorology, sensitive areas, spill modeling and trajectory analysis, and wildlife impacts and response. At the regional level, the Regional Environmental Emergency Teams (REET) are the focal point for gathering and delivering this information by incorporating the input of agencies at all levels of government (EC, 1999).

Table 4.2 summarizes federal government plans specific to marine oil spills that would be applicable to a marine oil spill on the west coast.

***Table 4.2 Federal contingency plans specific to marine oil spills***

| PLAN | SUMMARY |
|---|---|
| **Marine Spills Contingency Plan, National Chapter (CCG, 2011)** | • Lists marine incident reporting contact numbers for each region.<br>• Describes situations in which the Canadian Coast Guard will be the lead on-scene coordinator.<br>• Describes the incident response system and how different units work together in an actual response, as well as a basic level of coordination between headquarters and the regional branches in a spill response and developing related, national policies.<br>• Lists internal and external support agencies.<br>• References health and safety regulations.<br>• Specifies that CCG may contract private companies and response organizations.<br>• Lists courses available for response personnel (training is the responsibility of the regions.<br>• Commits that a CCG Environmental Response Duty Officer will be available in each region, 24/7.<br>• References a National Exercise Plan and National Training Plan. |

[48] S.C. 2007, c. 15

[49] In 2012, the BC center for Environmental Emergencies was closed, and the EC Environmental Emergencies Program was centralized to a single office in Montreal. The impact of this change on the REET is undetermined.

| PLAN | SUMMARY |
| --- | --- |
| **Pacific Regional Marine Spills Contingency Plan (CCG)** | • The CCG's National Chapter describes the contents of the regional chapters, though the Pacific Region Chapter was not available from CCG contacts to review. The chapter will be more regionally specific in its description of the strategies and resources that will be used, the location of CCG resources, exercise and training plans, and area-specific plans. (CCG, 2011) |
| **Marine Safety Management System: Environmental Prevention and Response National Preparedness Plan**<br>**(TC, 2010)** | • Describes the roles and responsibilities under Canada's oil spill response regime for Transport Canada, CCG, shippers, oil handling facilities, response organizations, and Environment Canada as codified in the Canada Shipping Act of 2001 and its regulations. |
| **National Places of Refuge Contingency Plan (TC, 2007)** | • Applies to all non-life threatening situations when a ship requests a place of refuge in Canadian waters.<br>• Lists information needed about the ship and its location, condition, and contact information.<br>• Describes Transport Canada's authority and the international guidelines related to potential places of refuge (PPOR).<br>• Lists criteria for selecting a PPOR to facilitate the comparison of different options (includes potential requirements, ability to navigate there safely, emergency response capabilities, conditions, etc.).<br>• Lists resources that may be impacted.<br>• Describes process for making decision about where to direct the vessel. |
| **Potential Places of Refuge Contingency Plan – Pacific Region**<br>**(TC, 2009b)** | • Applies to all non-life threatening situations when a ship requests a place of refuge in Canadian waters.<br>• Describes communications flow between Transport Canada and the CCG. (TC has authority to direct vessels per the Canadian Shipping Act.)<br>• Provides guidance information to be gotten from the vessel and the factors to take into account when directing its movements (daylight, other traffic, tide, problem vessel is experiencing, etc.).<br>• Includes checklists and contacts (with phone numbers). |
| **Canadian Wildlife Service (within Environment Canada)** | • Canadian Wildlife Service is currently working with Environment Canada's Environmental Emergency Program to update the oil spill contingency plan for the Pacific region (Personal communication from Erika Lok, CWS, March 20, 2013). In the interim, the National Policy on Oiled Birds and Oiled Species at Risk (EC, 2000) serves as a guide, though it is also being updated. |

### 4.3 BC Marine Oil Spill Contingency Plan

At the provincial level, the Ministry of Environment has a contingency plan specific to marine oil spills (summarized in Table 4.3). In parallel to the federal level, other agencies must have plans in place to respond to emergencies generally but no other agencies have contingency plans specific to marine oil spills. Local government emergency plans may also be activated if an oil spill occurs.

*Table 4.3 BC oil spill contingency plan*

| PLAN | SUMMARY |
|---|---|
| **BC Marine Oil Spill Pollution Plan (BC, 2007)[50]** | • Describes roles played by provincial agencies in an oil spill response, with the Ministry of Environment as the lead provincial agency.<br>• Describes the notification process and steps to establish an Incident Management Team (including contact information for both Canadian and US agencies and inter-agency teams) and/or Unified Command (with CCG and other federal agencies).<br>• Explains that provincial resources will be made available to support a response as needed.<br>• Establishes criteria for determining incident severity.<br>• Describes how the spill response will integrate with the BC Emergency Response Management System and the establishment of the Ministry's operational center.<br>• The Ministry may also support a response in US states under the States/BC Oil Spill Memorandum of Cooperation of 1989. |

## 4.4 Industry Oil Spill Contingency Plans

As noted in Section 2, the industry that is moving oil to or from Canadian ports has the primary responsibility to ensure marine oil spill response preparedness. Certain shippers are required to have a relationship with WCMRC and to have designated a primary contact. The WCMRC contingency plan, therefore, is a key document in determining what a response will look like in marine waters off the coast of BC.

### 4.4.1 WCMRC Oil Spill Contingency Plan

As described in Section 2, WCMRC must submit a plan to Transport Canada that demonstrates its ability to deploy a certain amount of equipment (up to enough to respond to a 10,000t spill) by a certain time (depending on location).[51] In addition, there are requirements to describe an exercise program, provide a certain amount of temporary storage, clean up 500m of shoreline per day, and complete on-water recovery within 10 days of deployment. Information about equipment inventories and locations is in Section 5.

WCMRC's geographic area of response extends the length of Canada's west coast and out to the EEZ. WCMRC has gone beyond the requirements of a response organization to develop eight reference and resource Area Plans, though these were not available for review. WCMRC's handbook says that these plans describe area sensitivities, Incident Command Post locations, staging areas, vessel launch locations, helispots, protection/treatment strategies, equipment resources, and logistical support services (WCMRC, 2012).

[50] The Ministry of Environment has noted that the 2007 plan is in need of updating.

[51] This plan was not available for review, but would no doubt significantly inform the analysis in the West Coast Spill Response Study. WCMRC staff indicated that the plan is currently under revision to reflect recent changes in the organization and the addition of new resources. This section summarizes information related to WCMRC's planning from its publicly available handbook (WCMRC, 2012).

WCMRC's handbook also describes the organization that it will use during a spill response: a Unified Command will be used to integrate the responsible party, lead agencies, and WCMRC (WCMRC, 2012).

WCMRC's handbook cites several areas in which its capabilities exceed the Transport Canada's standards for response organizations, including the ability to conduct three times the level of shoreline clean up and provide four times as much temporary storage. In addition, it states that WCMRC has twice as much containment boom and 10 times as much skimming capacity as required. (WCMRC, 2012).[52]

#### 4.4.2 Industry Mutual Aid Agreements

WCMRC also has mutual aid agreements in place with the Eastern Canada Response Corporation (ECRC), Southeast Alaska Petroleum Response Organization (SEAPRO) and Marine Spill Response Corporation (MSRC) to enhance its response capability (WCMRC, 2012).

#### 4.4.3 Shipboard Oil Pollution Emergency Plans (SOPEP)

Operators of covered vessels (oil tank vessels of 150 GT or greater and all other vessels of 400 GT or greater) must have a SOPEP on-board plan that describes the immediate actions that will be taken in the event of an accident or spill, including the contacts of the nearest coastal State. SOPEPs guide the actions that will be taken on board a ship to notify the appropriate authorities of a spill or potential spill and to do what they can to mitigate it. They do not describe how to mobilize a spill response.[53] These are the only plans that all large vessels in Canadian waters are required to have (Canadian vessels or vessels stopping at Canadian ports are required to have the relationship with a response organization that is described in Section 2). Transport Canada has oversight authority over SOPEPs.

### *4.5 Oil Spill Incident Management*

An important role of oil spill contingency plans is to establish the way that organizations and agencies will work together in the inevitable collaboration that is required for a successful response. WCMRC, BC, and US agencies and responders use the Incident Command System (ICS) approach, which has increasingly become standard practice within the industry. The CCG currently uses a different approach, called the Response Management System (RMS). There are differences ranging from terminology to the color vests worn by responders, but a key difference, which has been cited already by the Pacific States/BC Oil Spill Task Force (2011) and EnviroEmerg (2008), is that the RMS establishes designates the responsible party as the on-scene commander, while the ICS system uses a Unified Command. The Government of Canada's has recently indicated that the CCG will use the ICS approach (TC, 2013c). It

[52] There is no publicly available description of the methodology Transport Canada uses to determine WCRMC's ability to meet the 10,000t standard, though there are references to required exercises of both the 10,000t and 2,500t (Tier 3) response capability in WCRMC's handbook (WCMRC, 2012).

[53] SOPEP requirements were most recently updated by the Marine Environmental Protection Committee in MEPC 44/20, Annex 8.

is unknown to the authors whether these changes will include adoption of the Unified Command approach by the CCG, or the timetable for training personnel in the ICS approach.

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# 5. OIL SPILL RESPONSE EQUIPMENT AND INFRASTRUCTURE

This section describes the equipment and other infrastructure located in BC that is needed for a marine spill response.

## 5.1 Mechanical Spill Response Resource Inventories

WCMRC and CCG are the primary sources of spill response equipment in BC.

### 5.1.1 Government-Owned Response Equipment Inventory

The CCG maintains an inventory of spill response equipment for use in BC and other parts of the country. Figure 5.1 shows the location of CCG equipment depots based on published sources. For this analysis, the USCG provided information about two CCG spill response vessels that have been used in recent spill response exercises: the 83m CCGS Sir Wilfred and the 58m CCGS Bartlett, both homeported in Victoria (we did not have information about the vessels' skimming capacity, boom sweep, or personnel requirements).[54]

The Department of National Defence also maintains a limited amount of oil spill response equipment including two tugs, a Sea Truck workboat and a barge with side-sweep capabilities that includes a Current Buster system. This barge and related equipment is located in Nanaimo.[55]

The Western Response Resource List (WRRL)[56] is a database that includes equipment owned by 36 entities in the North Pacific region, including WCMRC, major US spill response organizations, oil companies, US federal agencies, and Washington and Oregon state agencies. Canadian government-owned spill response resources are not included in the west coast regional oil spill response equipment database per a policy decision not to make detailed inventory publicly available.

[54] Personal communication, Scott Knutson, USCG, March 2013.

[55] Personal communication, Scott Knutson, USCG, March 2013.

[56] www.wrrl.us


*Figure 5.1 Major oil spill response equipment depot locations in BC (based on WCMRC, 2008 and CCG, 2011)*

### 5.1.2 WCMRC Inventory

WCMRC's spill response equipment inventory is available through their website.[57] WCMRC equipment is also catalogued in the Western Response Resource List (WRRL),[58] which is utilized by Canadian and US spill planners and responders. Appendix A lists WCMRC's major equipment based on published "Port at a Glance" fact sheets, the WRRL, and information provided directly by WCMRC.[59] The locations of WCMRC storage depots are shown in Figure 5.1.[60] WCMRC

[57] http://www.wcmrc.com/?page_id=79

[58] www.wrrl.us

[59] WCRMC provides information about resources in different locations around the state in a set of fact sheets that is available here: http://www.wcmrc.com/?page_id=572. Nuka Research used these as the primary source of information about equipment resources, along with the WRRL. WCMRC also provided updated information about newly acquired resources a few days before this report was finalized. The inventory in Appendix A reflects that information through March 28, 2013. WCMRC continues to acquire new resources, and it is likely that this list will become outdated.

[60] Note that the Powell River depot is currently inactive.

equipment is intended for spills of petroleum oils only; they do not provide response to other types of hazardous materials spills or releases.

WCMRC has several oil spill response vessels (OSRV), which provide the core of most on-water response task forces (see discussion in Section 6.2.3). OSRVs provide an integrated vessel platform for oil containment and skimming, and typically have some on-board storage capacity. WCMRC currently has five dedicated OSRVs in inventory ranging from 8m to 22m. They are located in Vancouver (2), Burnaby, Esquimalt, and Prince Rupert. With one exception (the Burrard Cleaner No. 9, a 22.86m skimming vessel), the OSRVs are not ideal for open water use and are better suited for deployment in protected waters.

WCMRC has approximately 32,000m (105,000 ft) of boom in their inventory. Boom is typically categorized based on operating environment, which describes the maximum environmental conditions – primarily sea state – in which the boom can properly function (see discussion in Section 6.2.3). Most of the boom in WCMRC's inventory (nearly 80%) is protected water boom, which is rated to operate in wave heights up between 0.9 and 1.8m. Approximately 9% of the boom is open water rated, which can be used in offshore conditions, where wave heights reach or exceed 1.8m. Approximately 9% of the boom is calm water boom, which is smaller boom intended for sheltered harbor waters, where wave heights range from 0.3 to 0.9m. Finally, 2% of the boom is specially designed shore seal boom, which is meant for use in intertidal regions where the boom may be afloat at high tide but on the shore at low tide. Figure 5.2 summarizes the WCMRC boom inventory by boom size and storage location.

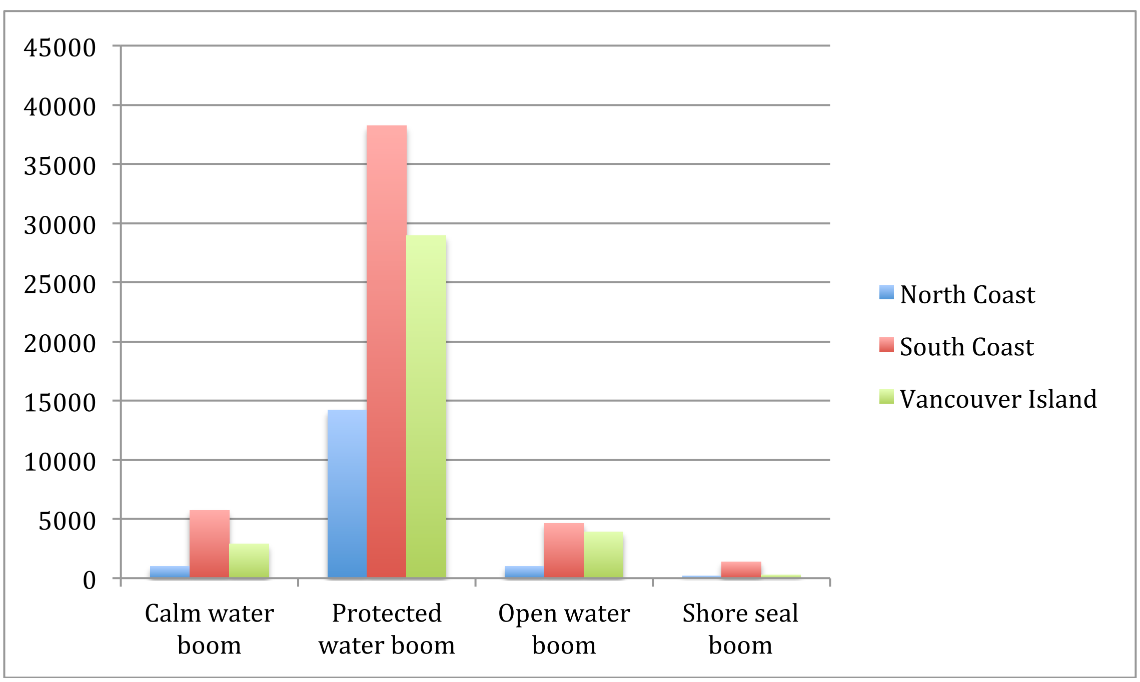


***Figure 5.2 WCMRC boom inventory (length in feet)***

WCMRC also has a significant portable skimmer inventory, with an estimated total skimming capacity of 280t/hr.[61] About half of this capacity (51%) is stored in equipment depots along the south coast. Approximately 26% is stored on Vancouver Island, with the remaining 23% in the north coast region. (WCRMC, 2012) Portable skimmers are relatively versatile, but are likely to be able to recover only a limited range of oil types and viscosities. Many portable skimmers can be incorporated into vessel skimming systems or used in shoreline recovery operations. Portable skimmers require additional support equipment including hydraulic power units, hoses (hydraulic, air, and discharge), control stands, adequate spare parts, and other ancillary equipment. Adequate temporary storage must also be available in order to utilize skimmers, and this can often be a more significant limiting factor on a response than the rate at which the skimmer encounters and recovers oil. Additional equipment necessary for on-water recovery includes outrigger systems as well as oil collection/concentration boom.

WCMRC's 2012 handbook estimates that they have approximately 11,700t of storage, which includes barges, bladders, integrated tank systems in oil spill response vessels, and floating tanks that can be used to store recovered oil and fluids.[62] An additional 4,400t of storage was recently added.[63] Most of the storage capacity (68%) is stored on the south coast. Approximately 2% is along the north coast, and 30% is on Vancouver Island.

WCMRC does not conduct salvage operations and does not have salvage equipment. Neither response organizations nor shippers are required to have salvage capacity or services in place in Canada.

## 5.2 Non-mechanical Response Inventories

WCMRC's equipment inventories do not list any non-mechanical response resources that would be used for in-situ burning or dispersants application, although there appears to be some fire boom available on one or more of their barges. The need for case-by-case approval for non-mechanical response methods may create a disincentive to stockpile the resources needed for dispersant application and in-situ burning.

## 5.3 Logistical and Operational Considerations

### 5.3.1 Mobilization and Deployment of Equipment

WCMRC and CCG spill response equipment is pre-positioned in areas along the BC coast, with the preponderance of equipment in the south coast/Vancouver Island area. WCMRC has three primary locations: Burnaby on the South Coast (the head office), Vancouver Island at Duncan, and in Prince

[61] The 2012 Operations Handbook cites 280t/hr as skimming capacity. The inventory included in Appendix A shows 80,425 gallons/hr skimming capacity. Depending upon the conversion factor applied, this equates to between 250-300t/hr. For the purpose of this study, recovery rates and storage volumes were converted to US measurements because the Response Options Calculator utilized in the Section 6 analysis does not support tonnes as a volumetric measurement.

[62] In the inventory of WCMRC response capacity included in Appendix A of this report, a lower total storage volume was calculated.

[63] Personal communications, Scott Wright, WCMRC, March 2013.

Rupert in the north. The CCG operates three large equipment depots at Vancouver, Victoria, and Prince Rupert (CCG, 2011).

In the event of a major marine oil spill, response resources would need to be mobilized and transported from equipment depots to staging areas near the spill location, and ultimately to the spill scene for deployment. This process requires transport overland, by air, or over water, depending upon the type of equipment, its origination point, and the location of the spill.

There are significant areas of the BC coastline that lack major transportation infrastructure. This may limit transportation options to marine travel, in many instances, which is typically the slowest mode of transport. In order to move spill response resources over land or by air, the equipment must be loaded onto trailers or aircraft. In most cases, airports must be capable of handling large cargo planes and must be connected to a port or boat ramp via roads to facilitate launching of vessels. The scenario analysis in Section 6 demonstrates how transportation and deployment times can impact on-water recovery.

#### 5.3.2 Personnel and Vessel Support

All the equipment in the world does not clean up spilled oil unless there are sufficient vessels and sufficient (and appropriately trained and certified) personnel to operate both vessels equipment. All of these resources must be on-scene quickly: the more time that is spent moving people or equipment from Washington, Oregon, Alaska, or eastern Canada, the less effective the response as the spill spreads, entrains, or sinks. In addition, 24-hour operations will require sufficient personnel to allow for the rotation of two or three people per position every 24 hours (representing 8- or 12-hour shifts). All of these people require food, shelter, and personal protective equipment (according to their role). A major response may require thousands of people.

WCMRC has approximately 27 full-time personnel (WCMRC, 2012). These personnel are supplemented by more than 100 fishing vessels and crew participating in the Fishers Oil Spill Emergency Team (FOSET),[64] and more than 20 contractor agreements and 30 advisory agreements in place. More than one hundred contractors are trained annually to supplement the efforts of WCMRC's full-time staff if needed (WCMRC, 2012).[65]

The FOSET fleet includes vessels 18 feet in length or greater with towing and lifting capability (WCMRC, 2012). Through WCMRC's mutual aid agreements with SEAPRO and MSRC (on the west coast of the US) and ECRC (in eastern

[64] Participation in FOSET is voluntary, and there are no contractual requirements that compel the vessels or their crew to be available for spill response.

[65] Response managers should be aware of the potential impacts of a major response operation on coastal communities. The personnel needed for a major response will impact the coastal communities where they are assigned to respond. The people living and working in the coastal communities may join the response effort, leaving their normal jobs unfilled. There will be an influx of people from outside of the region coming to these coastal communities hoping to find work in the response. This influx of people will add increased pressures to these coastal communities for housing, food, and other services.

Canada), WCMRC can supplement their own resources with an additional 22 skimming vessels, more than 500,000 feet of boom (including sweep systems), and additional portable skimmers and temporary oil storage devices.[66] WCMRC is also a member of the Global Response Network (GRN), though this does not necessarily mean that additional equipment will be available for a spill response.[67]

[66] Based on ECRC's on-line equipment lists (http://www.tc.gc.ca/eng/marinesafety/tp-tp14707-menu-1683.htm) and the WRRL (for SEAPRO and MSRC resources in the region).

[67] GRN does not provide direct access to its members' resources; these must be obtained through mutual aid agreements or other contractual arrangements between response organizations around the world. For more information, see: http://www.globalresponsenetwork.org.

# 6. RESPONSE CAPACITY ANALYSIS

Thus far, this report has catalogued the government regulations and requirements in place for marine oil spill response to describe the planning and resources in place for a major marine oil spill. WCMRC has resources in place that well exceed the national planning standards for marine response; their Operations Handbook indicates that their response capacity is more than twice the 10,000t requirement. In this section, Nuka Research analyzes the capacity of WCMRC's equipment resources (with cascading US resources as well) using a set of simulated scenarios and the information that was available from the WCMRC Handbook. CCG resources could further increase the amount of oil recovered.

## 6.1 Use of Simulated Scenarios to Estimate On-Water Spill Response Capacity

There are different ways to estimate how effective an oil spill response will be, though there is no one model or tool that is able to predict exactly how much oil could be recovered from any given spill due to the myriad factors involved. Factors that may impact total recovery include the behavior and movement of the spilled oil, environmental conditions, the time required to mobilize and transport equipment to the scene, and the ability of the spill response equipment to encounter the oil slick.

Nuka Research simulated a series of spills to illustrate how the spill response resources currently in place along the BC coast might be applied to the initial containment and recovery of a marine oil spill using existing response forces from WCRMC and neighboring jurisdictions. The simulations were run for the first 120 hours (five days)[68] of a spill at two locations: Dixon Entrance and the Strait of Juan de Fuca.

The purpose of this preliminary analysis is to illustrate general relationships among some of the parameters that will impact on-water marine oil spill recovery, such as oil type, season, spill location, day length, and response force capabilities. This response capacity analysis focuses only on on-water recovery, and does not factor in other spill response activities such as sensitive area protection, shoreline cleanup, or wildlife response. It is useful as a tool for estimating gross oil recovery, which will influence all other elements of the spill cleanup.

## 6.2 Response Options Calculator

To provide an illustration of the capability and limits of existing marine oil spill response resources in place in BC, the Response Options Calculator (ROC), a modeling tool created for the National Oceanic and Atmospheric

[68] A five-day spill duration was used because this is the limit of the modeling capability of the tool used (ROC). Canadian law sets a 10-day cleanup standard, as discussed in Section 2.

Administration (NOAA) was applied to hypothetical oil spills in two locations (NOAA, 2012). ROC simulates an idealized oil spill under simplified environmental conditions, providing a baseline for realistic oil recovery. The ROC model simulates oil weathering, spreading, and recovery by advancing skimming systems (mechanical recovery).[69] Spill behavior and weathering in ROC uses an established fate and effects model called ADIOS, combined with new algorithms for slick spreading (Genwest Systems Inc., 2012).

ROC does not include influences from tides, current, land, ice, debris, or complex weather conditions. Oil spread and spill response occur without any influence from land or shallow water. ROC assumes that the mass balance of oil on the water is always available for recovery, with no oil stranding on shorelines, and utilizes the average thickness of the total calculated slick to project recovery rate.[70] This analysis used ROC standard oil weathering. ROC weathering is not a comprehensive fate model, and does not account for such complex influences as water salinity, particulates, or the compositional complexity of oils like diluted bitumen. It does not account for possible oil submergence.[71]

### 6.2.1 General Assumptions

Modeling is necessarily dependent upon a series of assumptions. Basic assumptions applied to this analysis include: the operation of all equipment without malfunction or failure; the absence of spill-related mishaps or other accidents that could hinder the response; effective logistics, command, and communication; and effective reconnaissance and mapping of the spill.[72]

When applying the ROC simulation response capacity estimates to potential real-world spills, the estimated recovery capacities should be considered the best possible cases. Assumptions in this analysis are favorable towards effective spill response, creating a systematic positive bias.

### 6.2.2 Parameters Used in Simulations

A total of seven simulations were run: two for spills occurring in Dixon Entrance and five for spills occurring in the Strait of Juan de Fuca. All spills were the same volume (10,000t) and were modeled as instantaneous (vs. continual) releases, meaning the entire volume is spilled at one time. Each spill simulation was run for 120 hours (five days), which is the maximum length possible within the ROC model. Figure 6.1 shows the spill locations simulated.

[69] ROC can also be used to model non-mechanical response options such as dispersants or in-situ burning, but non-mechanical response was not included in this analysis.

[70] Detailed technical specifications on ROC and its underlying algorithms and function may be found in the technical documentation produced by Genwest Systems, Inc. and available online at www.genwest.com

[71] Recovery estimates in ROC assume that all non-evaporated, non-dispersed oil will remain floating throughout the simulated spills. In reality, the density curves for the diluted bitumen (SL Ross 2010a and 2010b) show the oils approaching neutral buoyancy as early as 24 hours into a response. Oil that becomes neutrally or negatively buoyant may submerge below the sea surface, making it difficult to track and rendering traditional skimming systems ineffective.

[72] Wherever possible, established models and assumptions are applied. Assumptions and models inherent to ROC are described in the ROC Technical Document (Genwest Systems Inc., 2012).


*Figure 6.1 Spill locations used in simulations*

Spills were modeled for the summer and winter solstices (longest and shortest day length). Average seawater temperatures and moderate wind speeds were used.[73] All but one of the simulations was run for Alaska North Slope (ANS) crude oil because it is currently moved through the Strait of Juan de Fuca and its behavior when spilled is well understood.[74] To compare recovery for crude oil to recovery for diluted bitumen, of interest due to several proposed pipeline projects, one of the Juan de Fuca spills was also run with McKay Heavy Bitumen diluted with Suncor Synthetic Light Oil (MKH).[75]

[73] Wind/sea state conditions were: Dixon Entrance Summer 15°C sea temp, 5 kt wind; Dixon Entrance Winter 6°C sea temp, 15 kt wind; Juan de Fuca Summer 12°C sea temp, 5 kt wind; Juan de Fuca Winter 7°C sea temp, 15 kt wind.

[74] Although crude oil is not moved through Dixon Entrance (Nuka Research, 2012a), it was modeled at this location to provide a baseline for comparing the relative impact of other variables to spill response at both locations.

[75] Because the ROC does not include any diluted bitumen products, MKH properties were taken from Northern Gateway project proposal documents (SL Ross, 2010a and b). It is the authors' opinion that the ROC model does not handle diluted bitumen as well as it does conventional crude oil.

Spills were modeled to include response forces both from within Canada and from nearby US ports,[76] with the exception of one spill which was modeled with Canadian forces only. The operational response period was set either for daylight-only or for 24-hour operations. Daylight-only operations were used as a baseline setting, since on-water operations are typically limited to daytime. However, because WCMRC spill response plans call for 24-hour response when possible, three scenarios were run for 24-hour recovery operations (two with crude oil and one with diluted bitumen).[77] Section 6.2.3 describes response force composition and operational assumptions.

Table 6.1 summarizes the parameters applied in each of the simulations.

***Table 6.1 Parameters for seven simulated spills***

| SCENARIO | LOCATION | SEASON | SPILL PRODUCT | OPERATIONAL PERIOD | RESPONSE FORCES |
|---|---|---|---|---|---|
| **Spill 1** | Dixon Entrance | Summer | Crude (ANS) | Daylight only (18 hrs) | Canada & US |
| **Spill 2** | Dixon Entrance | Winter | Crude (ANS) | Daylight only (8.5 hrs) | Canada & US |
| **Spill 3** | Juan de Fuca Strait | Summer | Crude (ANS) | Daylight only (17 hrs) | Canada & US |
| **Spill 4** | Juan de Fuca Strait | Summer | Crude (ANS) | 24 hours | Canada & US |
| **Spill 5** | Juan de Fuca Strait | Summer | Crude (ANS) | 24 hours | Canadian only |
| **Spill 6** | Juan de Fuca Strait | Summer | Diluted bitumen (MKH) | Daylight only (17 hrs) | Canada & US |
| **Spill 7** | Juan de Fuca Strait | Winter | Crude (ANS) | Daylight only (9.5 hrs) | Canada & US |

### 6.2.3 Response Force Composition

ROC requires detailed information about the spill response force being used in each simulation. For this analysis, task forces were assembled from WCMRC resource lists (WCMRC, 2012) and the WRRL based on the authors' best professional judgment, information in the WCMRC handbook, and information

[76] US response forces were included because the WCMRC contingency plan cites agreements with US and other international spill response organizations as potentially supplementing a west coast marine spill response. US forces are in closest proximity and therefore have the shortest deployment time. However, communications with the USCG reveal that there are unresolved issues associated with cross-boundary cascading of resources that may make invalidate assumption that US resources could be quickly cascaded across the border to support an on-water response in Canadian waters (Personal communication from Scott Knutson, USCG, March 18, 2013). If a spill threatens to impact US waters in a trans-boundary spill, there may be limits to the ability to release US resources across the border.

[77] Because the scenarios are using the WCMRC 24-hour operational period, we have allocated 2 hours per 24-hour period for "downtime." Downtime will be necessary for maintenance and repair of equipment, shift changes, and other activities. We took the 2 hours of downtime away from the night time operations, because these would be less efficient than daytime. Thus, the downtime has a lower impact on overall oil recovery.

in US spill response organization technical manuals (WSMC, 2011 and SEAPRO, 2013).[78] Although the CCG also has marine spill response resources, the authors were unable to get a listing of CCG spill response resources in western Canada, so CCG resources are not factored into this analysis.

Because the two spill locations are in international border regions, the analysis considered two tiers of response resources: the first from within Canada (WCMRC) and the second from US spill response organizations. For all spills except two in Juan de Fuca, spill response resources were assigned both from within Canada and from neighboring jurisdictions (US) with marine spill response equipment that could arrive on-scene within five days.[79]

Response forces differed for Dixon Entrance and Juan de Fuca. US forces were cascaded from Southeast Alaska to the Dixon Entrance spill, and from key locations in Washington and Oregon to the Juan de Fuca Strait spill. Southeast Alaska forces came from SEAPRO, the primary marine spill response organization in that region.[80] In Washington and Oregon, forces were selected that would reasonably respond to a spill near the mouth of the Strait of Juan de Fuca, according to published oil spill contingency plans (WSMC, 2011). This force represents the author's best estimate of substantial rapid response resources that could reasonably be mobilized within 12 hours for a spill in the selected area.[81]

Response forces were assembled with some consideration for the operating environment. All task force components are categorized based on their operating environment, using the classification system from the World Catalog of Oil Spill Response Products – Tenth Edition (Potter, 2013).[82] The three general operating environments typically used to describe marine waters for the purpose of spill response operations are:

[78] Note that the simulated response forces do not include the additional resources added to the WCMRC response inventory in March 2013, because this information was not available at the time the simulations were run. The March 2013 additions significantly increase on-water skimming capacity and temporary storage, and also added protected water boom. No major response vessels were added, and these would typically form the basis of offshore response task forces.

[79] Limited sets of cascading US forces were included. Because the ROC simulations were limited to 5 days, it was not practical to model the full extent of cascading US forces. However, for the purpose of this study, which was to focus on initial recovery of on-water oil, the earliest arriving resources would have the most critical impact. The forces included as cascading forces were those most proximate to the spill locations. They were given an extremely aggressive mobilization time to place them on scene very quickly, when they would have a high relative impact. Forces arriving at progressively later times would have a more incremental effect on on-water recovery, although they would likely play an important role in shoreline cleanup, which is beyond the scope of the ROC.

[80] In Southeast Alaska, only two suitable vessels were identified with the proximity to arrive on-scene within the initial 120 hours (SEAPRO, 2013).

[81] Oil spill response vessels were dispatched from locations as far as Astoria, Oregon. The authors applied their own best judgment in assigning out-of-region US forces to the response. In the event of an actual spill, decisions about resource mobilization across international borders would require coordination between US and Canadian officials, and would require release of resources by industry planholders and response organizations. In cases where a spill in boundary waters had the potential to migrate to US waters or shoreline, the US may not immediately release equipment.

[82] This also follows the American Society of Testing and Materials (ASTM)'s Standard Practice for Classifying Water Bodies for Spill Control Systems (ASTM, 2003).

- Open water - significant wave height at or above 1.8m;[83]
- Protected water - significant wave height between 0.9 – 1.8m;[84] and
- Calm water - significant wave height between 0.3 – 0.9m.

Appendix B shows the major Task Force components that were assigned for these scenarios. The tables list the appropriateness of each Task Force component for open water and protected water response. Many of the Task Forces rely on small to moderate-sized vessels that may not be capable of operating in heavy sea conditions. For the purpose of these scenarios, it is assumed that on-scene conditions are favorable for safe operations of all Canadian Task Forces.[85] However, in reality, environmental conditions at either spill site may preclude spill recovery operations during certain times of the year.[86]

#### 6.2.4 Operational Assumptions

All mobilization and deployment times assumed favorable conditions. Canadian forces were given a one-hour mobilization time. US forces were given a 12-hour mobilization time. All forces were given a one-hour on-scene setup time, which was added to their mobilization and transit time to determine when they commenced recovery operations. Travel times were calculated based on shortest lines-of-travel through navigable waters. Vessels speeds were drawn from specifications provided by the response organization.[87] Spill timing was set so that the first vessels arrived on-scene at the start of the first daylight working period, thereby maximizing oil recovery.

Estimated transit times and the assumptions used to develop them are described in Appendix B.

Numerical specifications were applied to the simulated response forces to establish how they would operate on-water. Assumptions (Table 6.2) were applied based on the authors' best professional judgment, manufacturer specifications, and experience with actual on-water oil spill recovery operations.

[83] WCMRC uses the term "unsheltered waters" for open water environment.

[84] WCMRC uses the term "protected waters" for nearshore and calm water environments.

[85] Task Forces cascaded in from US response organizations were selected based on their operating environment classification, as there are significantly more open water-capable resources in the US than in Canada. Only open water-capable US forces were deployed.

[86] This period of time is known as a "response gap" and could be estimated for various sites along the BC coast. An analysis of the response gap in Dixon Entrance found that on-scene conditions preclude on-water oil spill response 45% of the time on average, and up to 68% of the time during the fall/winter months (Nuka Research, 2012b).

[87] The minimum vessel speed permitted was 6 kts, which is the speed designated for calculating vessel response times (WCMRC, 2012 and TC, 1995). Vessels were permitted to travel faster than 6 kts, but not slower. It was assumed that all barges would have tugboats capable of moving them at 6 kts.

*Table 6.2 Summary of equipment and recovery specifications used in ROC simulations*

| FACTOR | VALUE USED |
|---|---|
| **Recovery Speed** | 1.2kph |
| **Decant Efficiency** | 80% |
| **Decant Pump Rate** | 50% of Skimmer Nameplate |
| **Swath Width** | 36.5m (all US forces and JDF TF2)<br>18.2m (all other Canadian TFs) |
| **Throughput Efficiency** | 75% daytime, 37% night[88] |
| **Offload Time** | 4 hours |
| **Discharge Pump Rate** | Sized to achieve 4 hour offload |
| **Transit to-and-from offloading** | 60 minutes, one way |
| **Recovery Efficiency** | Elastec X150 - 90%; Oleophilic Skimmers – 80%; Other Skimmers – 20% |
| **Mobilization** | Canadian Forces - 1 hour<br>US Forces – 12 hours |
| **Travel speed** | Strike team / system-based |
| **On-scene setup** | 1 hour (recovery); None (secondary storage) |

## 6.3 Outputs from ROC Simulations

The ROC outputs describe the volume of oil recovered by a response force at each location for each product type.

### 6.3.1 Summary of Recovery Estimates

Table 6.3 summarizes recovery system performance for the seven simulated oil spills. In six of the seven scenarios, more than 50% of the spill remains on the water at the end of the five-day simulation (Spill 4 had 49% of oil remaining on the water).

[88] Nightime throughput was reduced by 50% to reflect lower oil encounter rates at night, due to difficulty with tracking & surveillance in darkness. This adjustment was made according to the authors' best professional judgment.

*Table 6.3 Summary of gross oil recovery for all simulations based on ROC outputs for seven hypothetical spills at two locations at 24, 72, and 120 hours*

| SCENARIO | TOTAL OIL RECOVERED (TONNES) | | | MASS BALANCE AT 120 HRS (PERCENTAGE OF 10,000 TONNES SPILL) | | |
|---|---|---|---|---|---|---|
| | 24 hrs | 72 hrs | 120 hrs | Oil recovered (%) | Oil remaining on-water (%) | Oil dispersed & evaporated (%) |
| Spill 1[89] | 9 | 193 | 412 | 4% | 68% | 28% |
| Spill 2[90] | 2 | 102 | 247 | 3% | 71% | 26% |
| Spill 3[91] | 356 | 1440 | 1958 | 20% | 55% | 25% |
| Spill 4[92] | 356 | 1928 | 2549 | 25% | 49% | 26% |
| Spill 5[93] | 64 | 594 | 866 | 9% | 65% | 26% |
| Spill 6[94] | 370 | 2166 | 3099 | 31% | 56% | 13% |
| Spill 7[95] | 38 | 59 | 965 | 10% | 64% | 26% |

### 6.3.2 Detailed Outputs

Detailed ROC outputs are used to compare the spills.

Spill 4, represents the highest overall percentage recovery, and Spill 2, represents the lowest overall recovery. Spill 2 is a Dixon Entrance winter spill of ANS crude oil, where the response forces included both US and Canadian response resources. Only 3% of the 10,000t spill was recovered. Figure 6.2 shows the amount of oil that evaporates, is mechanically recovered, and remains on-water as a function of time. Evaporation peaks at hour 40 and then remains relatively constant. Recovery is negligible until about hour 41, which is due to the transit time for response resources and secondary storage. Although WCMRC's rapid response skimming vessel based at Prince Rupert arrives at the spill more quickly, it lacks sufficient internal storage for consistent recovery. A hypothesized barge[96] eventually arrives from Prince Rupert, enabling the Prince Rupert vessel to continue recovery, and cascading forces from SEAPRO and southern BC arrive, augmenting recovery capacity.

[89] Dixon Entrance, summer, crude oil, daylight only, Canada & US forces.

[90] Dixon Entrance, winter, crude oil, daylight only, Canada & US forces.

[91] Juan de Fuca, summer, crude oil, daylight only, Canada & US forces.

[92] Juan de Fuca, summer, crude oil, 24 hours, Canada & US forces.

[93] Juan de Fuca, summer, crude oil, 24 hours, Canada forces.

[94] Juan de Fuca, summer, diluted bitumen, daylight only, Canada & US forces.

[95] Juan de Fuca, winter, crude oil, daylight only, Canada & US forces.

[96] Nuka Research assumed the existence of such a barge, for this simulation, with a 1-hour mobilization time and 6-knot speed. Absent such a contract barge, recovery at Dixon Entrance spills would be lower.

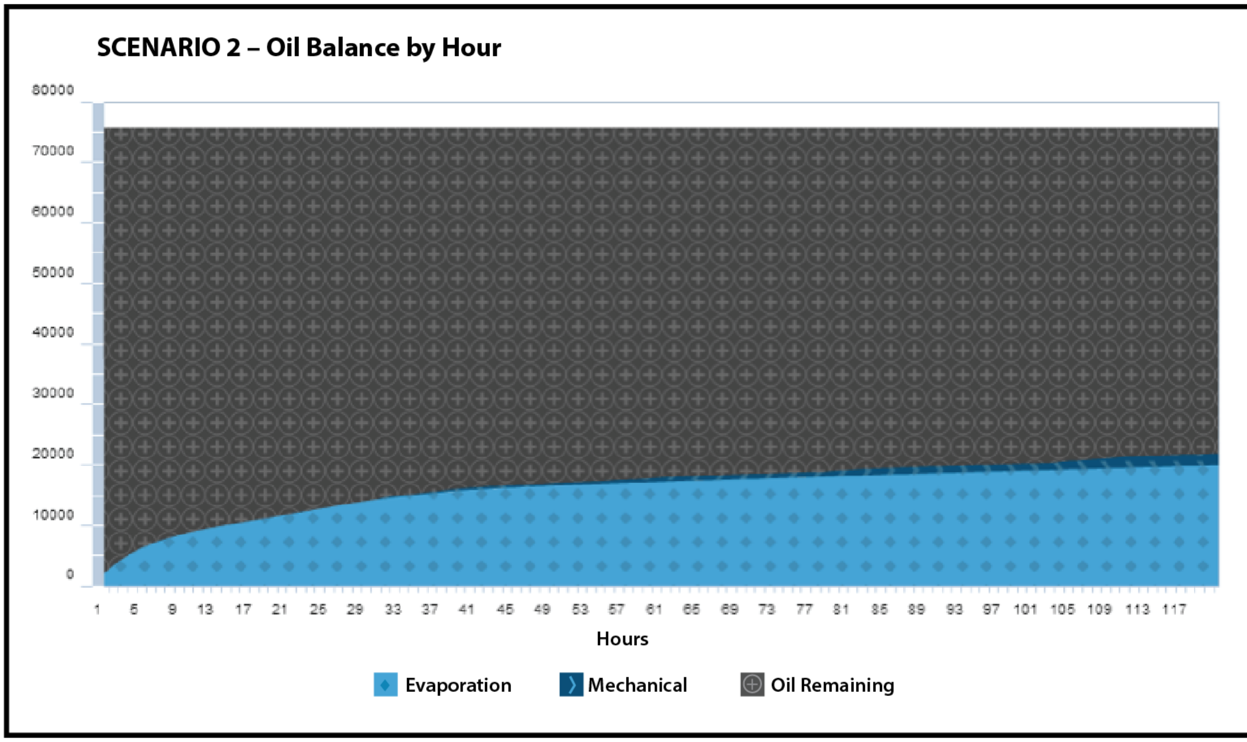


***Figure 6.2 Gross oil recovery for Spill 2 simulation by hour***

Figure 6.3 shows a pie chart of the mass balance of Spill 2 at hour 120, where 3% of the oil has been recovered, 26% evaporated, and 71% remains on the water.

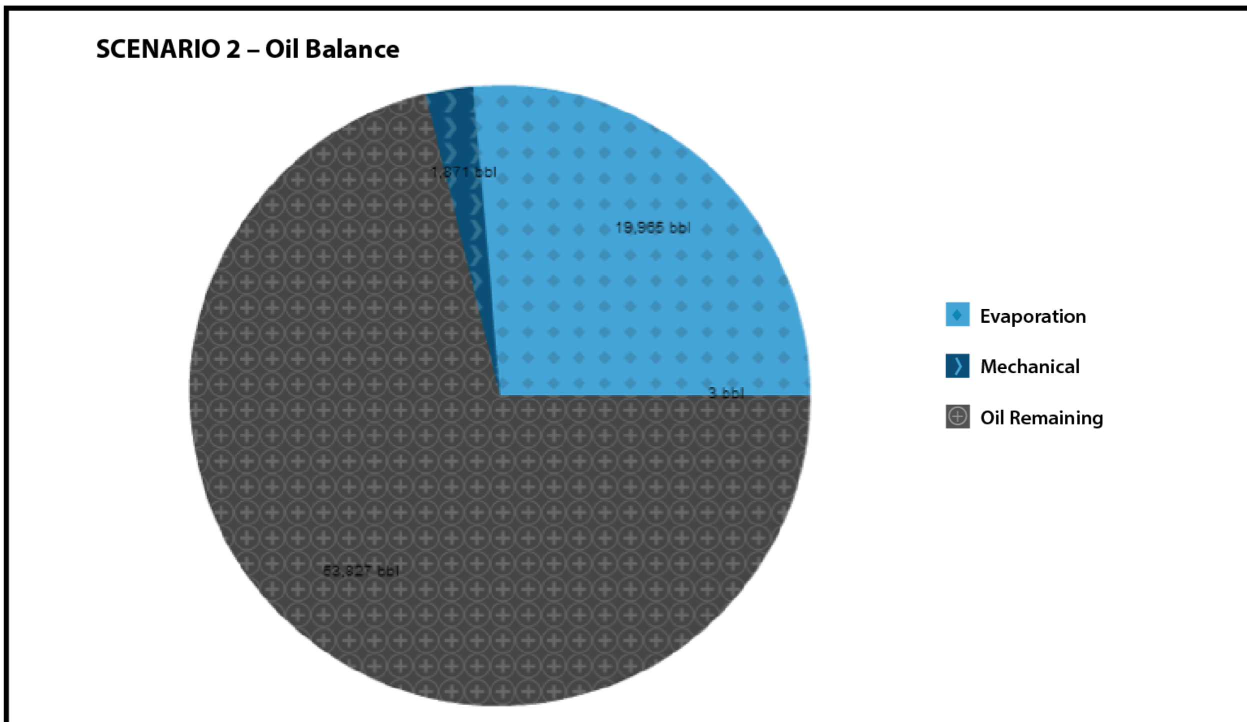


***Figure 6.3 Mass balance for Spill 2 simulation at hour 120***

By contrast, Spill 4, a summer Juan de Fuca crude oil spill with 24-hour operations by both Canadian and US forces, has the *highest* represented total oil recovery, with 25% of the spill recovered and 26% evaporated or dispersed by hour 120.

Figure 6.4 shows gross oil recovery by hour for Spill 4. Recovery begins around hour 6, because transit and deployment times for response resources are much shorter at this location. Figure 6.5 shows a pie chart of the mass balance for Spill 4.

Additional ROC outputs for Spill 4 demonstrate how oil characteristics change over time, and illustrate how rapidly oil composition can change during the first few days of a spill. Figures 6.6 shows the slick thickness curve. Slick thickness rapidly declines during the first 24 hours of the response, and then continues to decline more gradually. Slick thickness is a key determinant how much oil skimming equipment encounters, and therefore recovers. The ROC model presumes that all slicks encountered by the response forces will be of uniform thickness, and targets the average spill thickness. However, in reality, oil thickness will vary across geographic distance. As the spill progresses, it becomes increasingly difficult to encounter oil slicks that are thick enough to recover. The spreading spill means that aerial reconnaissance becomes even more important; however, the passage of time may also bring darkness or cloud cover.

Oil viscosity ("stickiness" of the oil, or its ability to flow) will also impact the effectiveness of on-water recovery. Figure 6.7 shows the oil viscosity curve for Spill 4. Oil viscosity has an impact on the effectiveness of skimming systems which is not accounted for in the ROC; the ROC presumes that the skimmers assigned to a spill continue to function as oil viscosity increases. Most skimmer heads reach their limits when oil exceeds a viscosity of 20,000 cST. Some skimmers are manufactured with high-viscosity skimmer heads that could be applied to the spill. The WCMRC inventory includes a number of skimmers that are appropriate for viscous oil skimming.

As an on-water spill weathers, the oil begins to emulsify, or incorporate water. The ROC estimates emulsion based on the parent oil properties. Figure 6.8 shows the emulsification curve for Spill 4. The higher emulsification of crude oil means that for every gallon of fluids recovered, in the model, up to 80% of it may be water.[97]

[97] The diluted bitumen emulsification curve is very steep, and by hour 24 the water content is approximately 50%, but the curve quickly levels out and by hour 30 it remains relatively stable at about 52%. The crude oil spill emulsifies more quickly, and continues to incorporate water until it maxes out at about 80% water, around hour 80.

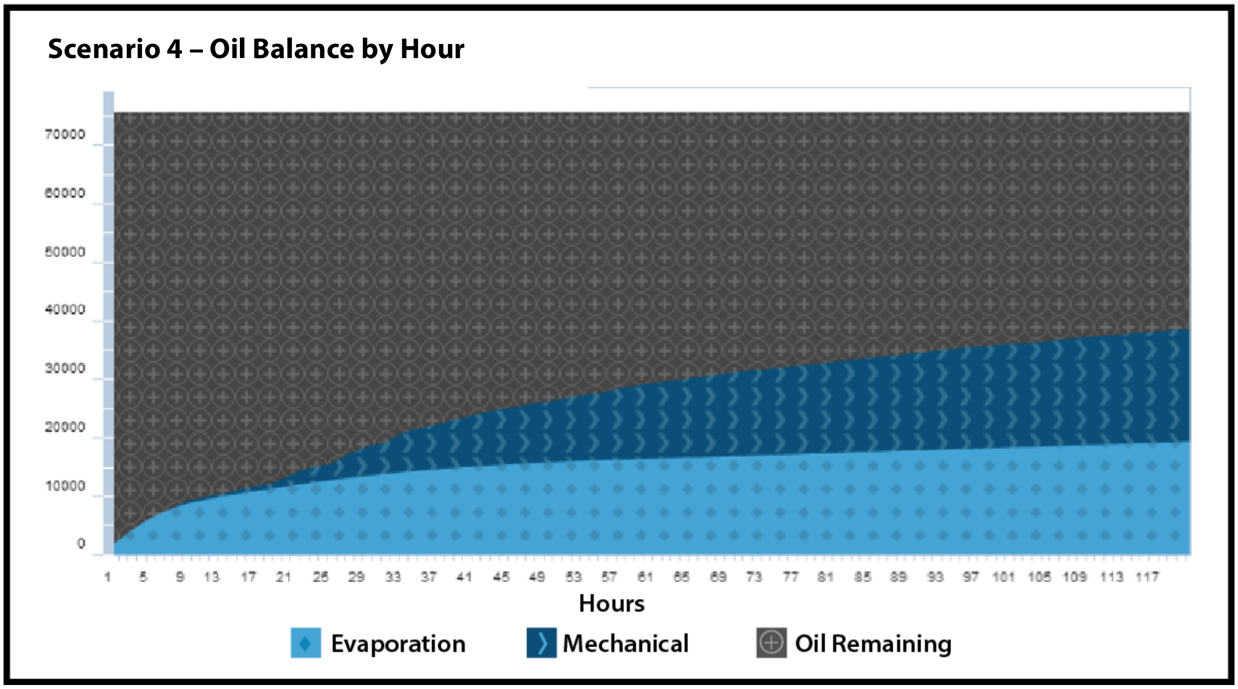


***Figure 6.4 Gross oil recovery for Spill 4 simulation by hour (up to 120 hours)***

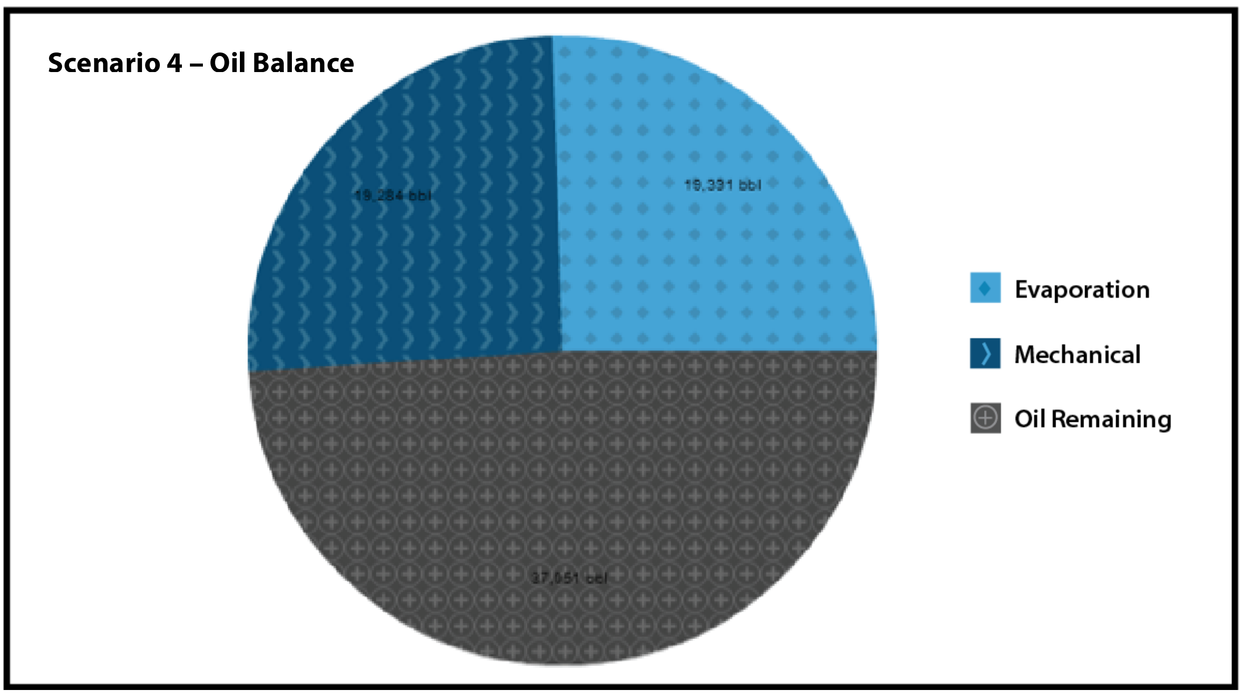


***Figure 6.5 Mass balance for Spill 4 simulation at hour 120***

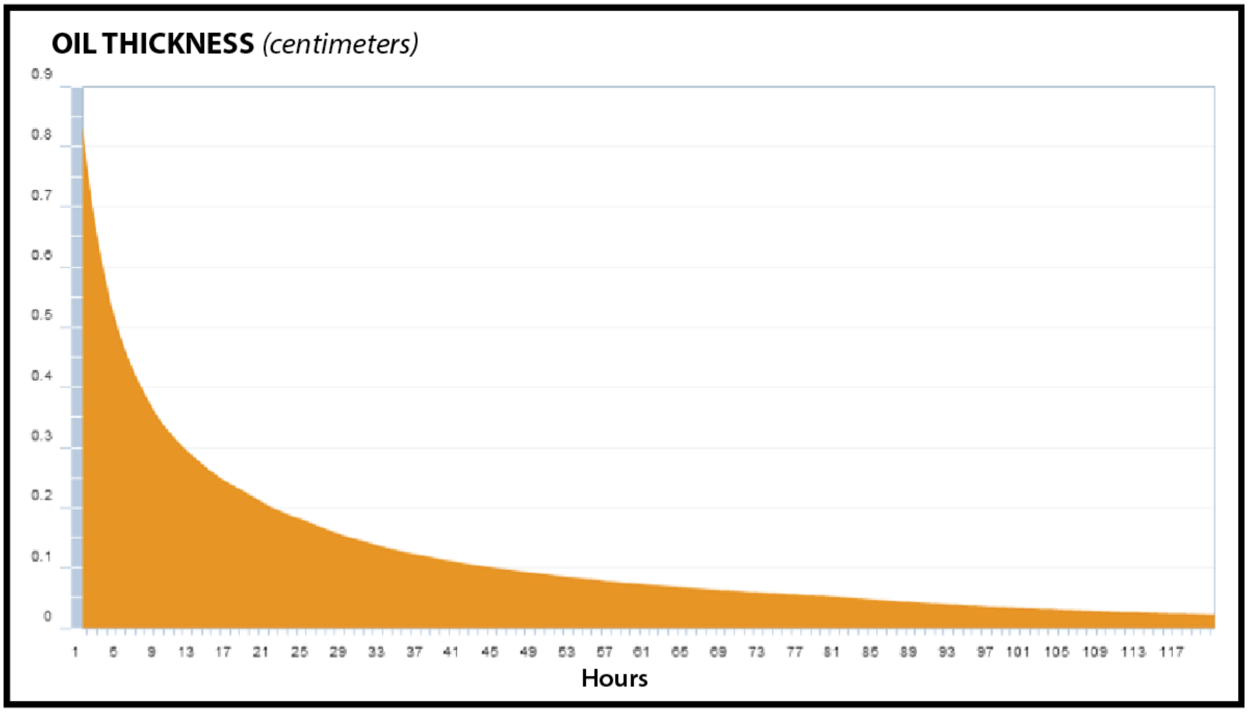


*Figure 6.6 Oil thickness curve for Spill 4 by hour*

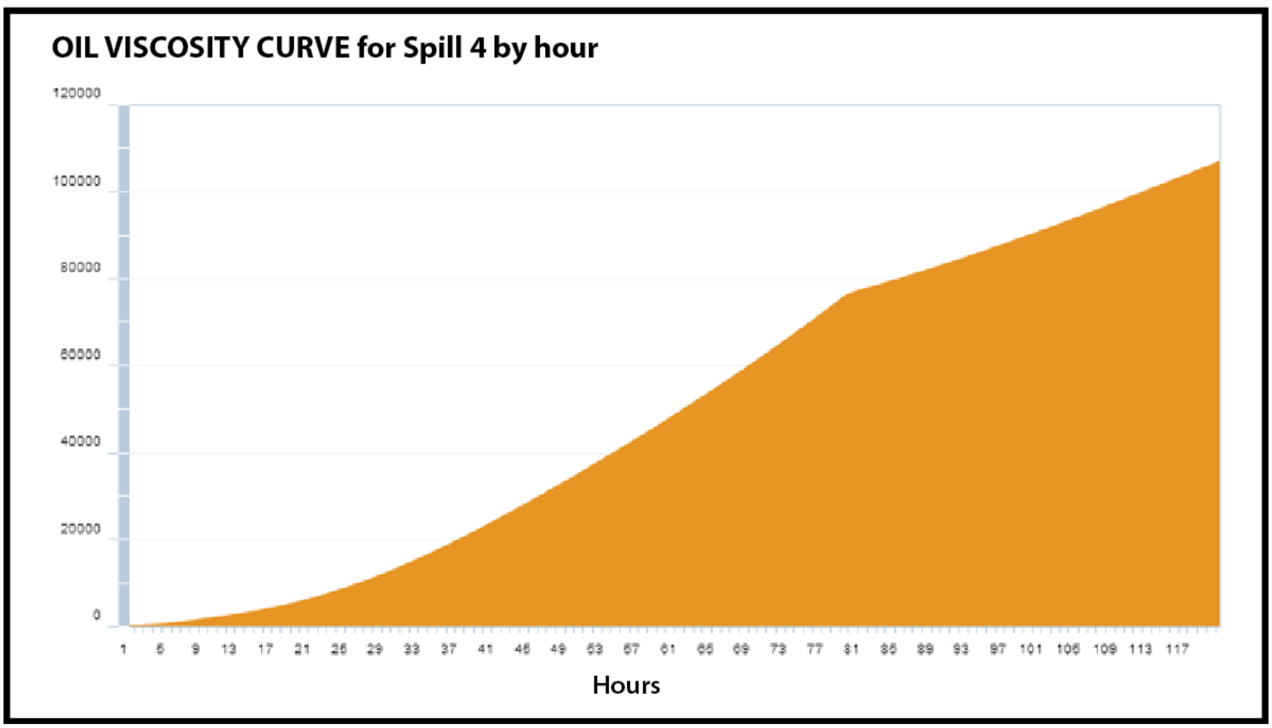


*Figure 6.7 Oil viscosity curve for Spill 4 by hour*

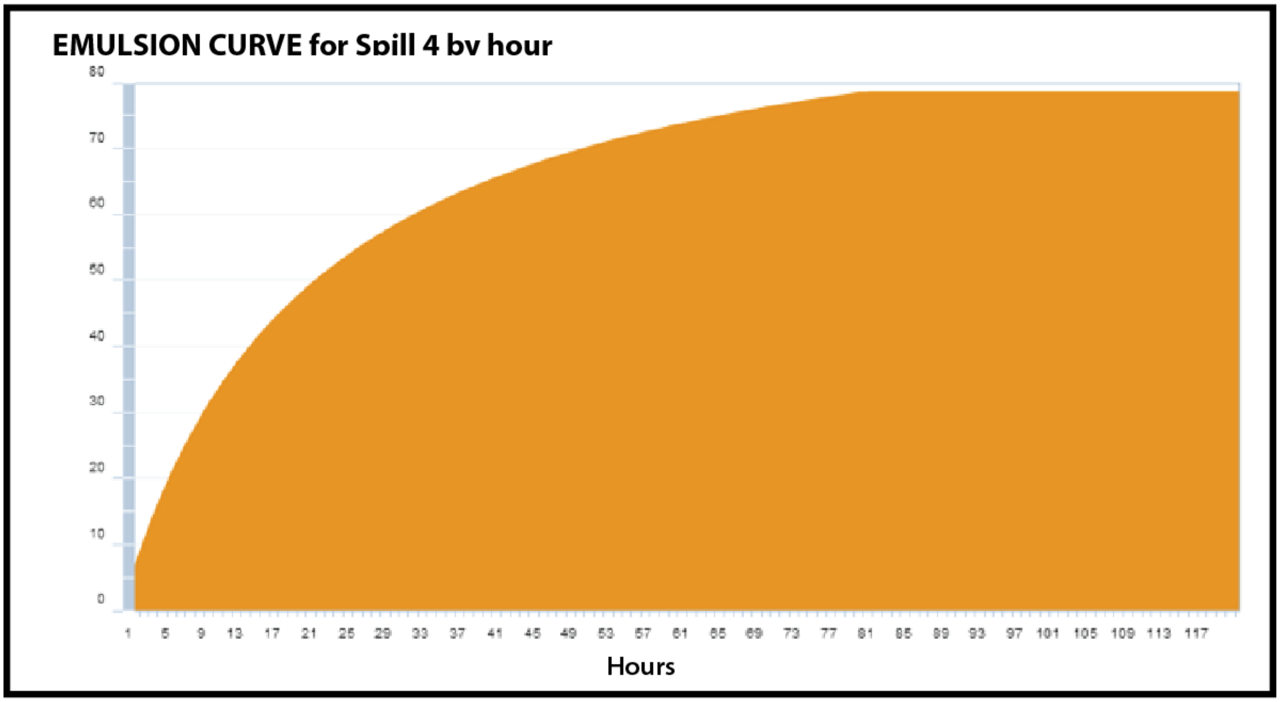


*Figure 6.8 Emulsion curve for Spill 4 by hour*

## 6.4 Factors Impacting Recovery Estimates

The seven simulated spill scenarios were presented to illustrate the complex interactions that contribute to the overall efficiency of an on-water response. The scenarios considered here represent a very small sample of all of the potential combinations of location, product type, season, operational parameters, and force composition that might occur. Many of the complex interactions that define response effectiveness are simplified for the purpose of modeling. Still, the exercise of simulating this small set of spills does provide some general insights into the relative influences of different factors to overall oil recovery during a marine oil spill.

### 6.4.1 Spill Location

Spill location has a major impact on oil recovery, due to the proximity of responding forces. Recovered oil estimates were higher across the board for the Juan de Fuca spill scenarios than for Dixon Entrance. This is due primarily to the significantly larger stockpile of resources available in the south coast region. Longer response times are required to mobilize resources from the south coast to the north coast region, and those delays lead to reduced overall recovery. An obvious remedy would be to increase the spill response resources stored in the north coast region.

While the spill simulations modeled two different locations, they did not fully incorporate the potential impacts of operating environment on spill response forces. Many of the Task Forces assigned to both spill locations would not be effective at the higher sea states that could occur at either Juan de Fuca or Dixon Entrance. A response gap analysis would provide additional information about the potential limits of weather and environmental factors to spill response at various sites along the BC coast.

#### 6.4.2 Oil Type and Properties

Oil type and properties have a substantial impact on recovery. Spills 3 and 6 had identical parameters (Juan de Fuca, summer, daylight, Canada and US forces) but Spill 3 was crude oil and Spill 6 was diluted bitumen. In this direct comparison, the ROC outputs showed higher recovery rates for the diluted bitumen spill than for crude oil. The detailed outputs showed lower rates of emulsification and spreading for diluted bitumen, which appear to have a positive influence on recovery estimates. ROC's weathering model (ADIOS) does not fully account for the behavior of different types of diluted bitumen, which are poorly studied and characterized. Additional information about diluted bitumen oil properties would be useful to future modeling efforts. Diluted bitumen is poorly understood. The oil properties for diluted bitumen were manually entered into the ROC, as it does not currently include diluted bitumen products in its database. The model does not account for potential oil sinking or submergence, nor does it factor in the reduced efficiency of skimmers as viscosity increases – yet, both of these are characteristics of diluted bitumen spills that could reduce recovery efficiency in a real world setting.

#### 6.4.3 Season

Not surprisingly, summer spill scenarios showed to have higher overall recovery than winter scenarios. This is due primarily to the longer daylight operational period during summer, as well as the lower wind speeds that were included in the model assumptions for a summer spill. The many interacting influences of on-scene conditions such as wind, waves, and visibility on overall response efficiency are not modeled in the ROC; however, on-scene weather has the potential to significantly impact recovery efficiency.

#### 6.4.4 Operational Period

The WCMRC Operations Handbook (2012) cites a 24-hour operational period for on-water response. Two simulations were run with a 24-hour operational period (Spills 4 and 5). Both spills were set in Juan de Fuca during summer; Spill 4 has Canadian and US forces, while Spill 5 has Canadian forces only. While Spill 4 has the highest overall total recovery (25%), Spill 5 has only 9% of the gross oil recovered at the end of 120 hours. This suggests that force composition played a more substantial role in overall recovery than operational period. Section 6.4.5 discusses force composition.

Spill 3 and 4 were identical, except that Spill 3 has daylight-only operations and Spill 4 has 24-hour operations. Spill 3 has 20% recovery, compared to 25% in Spill 4. While it is clear that 24-hour operations will enhance overall recovery rates, the difference was not as dramatic as the difference achieved through scaling up the force composition. From a logistical perspective, 24-hour operations can be challenging because they require sufficient staffing, additional safety precautions, and allowance for equipment downtime (no spill response systems can operate continuously without maintenance and repair).

Nighttime operations also require good spill tracking and surveillance, which can be challenging in darkness. While there has been a push to develop systems to support nighttime spill response operations in the wake of the Deepwater Horizon blowout (BSEE, 2012), there are no published reports documenting effective nighttime on-water spill response.[98]

While Spill 4 includes US response forces in 24-hour operations, it is unclear whether this would occur in practice. US contingency plans cite technologies for tracking oil during low visibility or darkness, but there are no explicit operational plans that suggest a 24-hour on-water response would be routinely applied (WSMC, 2011).

#### 6.4.5 Cascading Forces

The availability of resources to quickly respond to an on-water spill is critical to the overall recovery. Total recovery was highest for Juan de Fuca Strait spills where WCMRC response forces were supplemented with US forces. This was most notable in comparing Spills 4 and 5.[99]

#### 6.4.6 Duration of Scenarios

Response organization standards under the Canada Shipping Act require that planning be developed to sustain on-water recovery operations for 10 days from deployment; however, the ROC simulations shown here end at hour 120 (day five) because the model does not support longer simulations. Recovery operations would obviously continue beyond the fifth day, during an actual spill; however, response efficiency would diminish as the spill dispersed and the oil continued to weather.

### *6.5 Relevance of Simulations to Marine Spill Response Capacity*

The ROC simulations were run for illustrative purposes only. They are not meant to discredit the capacity of WCMRC, but to put into context the manner in which certain variables can impact on-water recovery operations. The scenarios show that at 10,000t response capacity does not necessarily equate to a guaranteed recovery of a 10,000t spill. They also show the importance of a systems-level analysis of spill response equipment.

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[98] For example, the Alaska Clean Seas Technical Manual (ACS, 2012) cites darkness as a limit to response operations.

[99] Moving response resources and personnel across the international border is challenged by border control requirements in both directions, but the CCG and USCG have sought to clarify and streamline the process to the greatest possible extent according to CANUSDIX exercise reports (Wagner, 2007; CCG and USCG, 2012a). In March 2013, the Government of Canada recommended change the Canada Shipping Act to grant the same immunity from liability to responders coming from the US that is currently afforded to Canadian responders (TC, 2013c). Release of equipment from the US is also limited by regulatory requirements on industry planholders to maintain a certain minimum capability.

The relationship between response planning standards and actual response capacity may be an area for the Government to explore as they consider changes to the Canada Shipping Act.

# 7. DISCUSSION

There have been numerous declarations made about the need for a "world-class" spill prevention and response system for the west coast of Canada, most recently from the Government of Canada (TC, 2013a). The Government of BC has the opportunity now to seek consensus among the agencies, companies, and public interest organizations who have a stake in the safe operation of marine vessels in establishing exactly what world-class looks like and identifying and pursuing the voluntary and/or legislated means of achieving it. The analysis in this report provides a snapshot of the existing baseline for spill prevention and response in western Canada.

In order to determine the steps needed to envision and establish a world-class system for oil spill prevention, preparedness, response, and recovery, a strong understanding of the strengths and weaknesses of the current system is needed. This report has identified several areas where current practices may need to be augmented or improved in order to achieve the best possible protection for BC's coastal resources, including:

- The 10,000t response planning standard as compared to potential worst-case spill of a ship's cargo and fuel oils;
- Transparency and diligence in government oversight to ensure a high state of readiness is sustained;
- Verifying planning assumptions and operating procedures such as the number and availability of contract personnel and vessels of opportunity, movement of equipment across the international border, and 24-hour operations;
- Inter-governmental coordination, including the response management structure used; and
- The location of equipment and other resources to ensure adequate preparation for spills anywhere along the coast, rather than highly concentrated in the far south only.

As the BC government moves forward with efforts to promote a world-class spill preparedness in western Canada, there are lessons to be taken from other jurisdictions. This report is the first in a three-volume study that will provide the BC government with a deeper understanding of how the present state of preparedness measures against the threat of oil spills from existing and future marine transportation.

Volume 2 of this study will present a vessel traffic study that estimates current vessel traffic movements, including the quantity of petroleum products moved as cargo and bunker on marine vessels in BC. This information is needed in order to understand the sizes, locations, and oil types of potential vessel spills, identify new or expanded prevention measures that may be warranted (especially as shipping to and from ports in the northern part of the coast increases), and ensure that the key parties that represent the potential "polluter" under the polluter-pays regime have adequate resources to clean up oil spills and restore impacted resources.

Volume 3 of this study will consider the current system for prevention, preparedness, response, and recovery in BC in light of system components in other regions. There is no one system that all can agree to be the "best," and even if there were, it may not be suitable to BC's unique context in its entirety. However, Volume 3 will build on the information and analysis presented here to provide one perspective on what a "world-class" system might look like in Canada's west coast, based on the present and potential future shipping levels identified in Volume 2. This will include considering prevention and safety measures, response planning, response resources, and recovery options.

Expanding or enhancing spill prevention and response capacity will, by necessity, be an iterative and deliberate process. Key organizations with roles in oil spill prevention and response are aware of the need to keep pace with western Canada's new shipping projects, and the vision of a "world-class" system has been embraced by both industry and government. The realization of this vision will require government and industry to continue to commit time, funding, and resources to enhance and improve the existing system. Subsequent volumes of this study will provide additional details to inform the BC government as they strive to ensure that environmental, economic and social values of BC are represented and protected.

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# Appendices

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# Appendix A.
## WCMRC Major Oil Spill Response Equipment Inventory

*Table A.1 WCMRC boom inventory*

| REGION | LOCATION | CALM WATER BOOM (UP TO 18") | PROTECTED WATER BOOM (19-36") | OPEN WATER BOOM (>36") | SHORE SEAL BOOM |
|---|---|---|---|---|---|
| | | TOTAL LENGTH OF BOOM IN FEET | | | |
| NORTH COAST | KITIMAT | 0 | 3001 | 0 | 200 |
| | MASSET | 0 | 1499 | 0 | 0 |
| | PRINCE RUPERT | 1,000 | 6,204 | 1,000 | 0 |
| | QUEEN CHARLOTTE CITY | 0 | 2,001 | 0 | 0 |
| | SHEARWATER | 0 | 1,499 | 0 | 0 |
| REGION TOTAL | | **1,000** | **14,204** | **1,000** | **200** |
| SOUTH COAST | BURNABY | 2,244 | 20,900 | 351 | 1,397 |
| | FRASER RIVER | 0 | 5,500 | 0 | 0 |
| | KELOWNA | 1,000 | 0 | 0 | 0 |
| | SECHELT | 0 | 2,000 | 0 | 0 |
| | VANCOUVER | 2,500 | 9,855 | 4,301 | 0 |
| REGION TOTAL | | **5,744** | **38,255** | **4,652** | **1,397** |
| VANCOUVER ISLAND | CAMPBELL RIVER | 1,499 | 1,000 | 1,000 | 0 |
| | DUNCAN | 1,000 | 6,046 | 0 | 203 |
| | HATCH POINT | 0 | 2,001 | 0 | 0 |
| | NANAIMO | 0 | 4,501 | 0 | 0 |
| | ESQUIMALT | 400 | 4,701 | 2,923 | 101 |
| | PORT ALBERNI | 0 | 5,301 | 0 | 0 |
| | PORT HARDY | 0 | 2,500 | 0 | 0 |
| | UCLUELET | 0 | 2,900 | 0 | 0 |
| REGION TOTAL | | **2,899** | **28,959** | **3,923** | **304** |
| GRAND TOTAL | | **8,643** | **67,214** | **9,575** | **1,901** |

*Table A.2 WMRC portable skimmer inventory*

| REGION | LOCATION | SKIMMER NAME | QUANTITY | DERATED CAPACITY (GAL/HR) | TOTAL (GAL) |
|---|---|---|---|---|---|
| NORTH COAST | **Kitimat** | RBS-05 | 1 | 635 | 635 |
| | **Prince Rupert** | T-18 Disc | 1 | 1144 | 1144 |
| | | GT-185 weir/brush | 1 | 2542 | 2542 |
| | | 1218/1 brush/disc/drum | 1 | 635 | 635 |
| | | Triton 35[100] | 3 | 2415 | 7245 |
| | | Lamor Minimax 12 | 1 | 1239 | 1239 |
| | | Lamor MM30 | 1 | 3368 | 3368 |
| | **Queen Charlotte City** | Triton 10 brush/disc/drum | 1 | 858 | 858 |
| | **Shearwater** | RBS-05 brush/disc/drum | 1 | 635 | 635 |
| **Total for North Coast** | | | | | **18301** |
| SOUTH COAST | **Burnaby** | RBS-05 (twin brush)[1] | 1 | 1271 | 1271 |
| | | Sala Roll Pump[1] | 1 | 1589 | 1589 |
| | | RBS-05 (twin brush) | 1 | 1271 | 1271 |
| | | T-18 disc | 2 | 1144 | 2288 |
| | | T-12 disc | 1 | 763 | 763 |
| | | JBF, DIP | 2 | 1906 | 3813 |
| | | GT-185 weir/brush | 1 | 2542 | 2542 |
| | | Triton 10 brush/disc/weir | 1 | 858 | 858 |
| | | RBS-01 brush/ disc/drum | 1 | 127 | 127 |
| | | Rope Mop (vertical) | 1 | 1144 | 1144 |
| | | Sala Roll Pump | 1 | 1589 | 1589 |
| | | 2ft Pedco weir (2 inch pump) | 2 | 2288 | 4576 |
| | | Slurp weir (2 inch pump) | 1 | 1335 | 1335 |
| | | Manta Ray (2 inch pump) | 1 | 1335 | 1335 |
| | | Triton 35 | 3 | 2415 | 7245 |
| | | Lamor Minimax 12 | 1 | 1239 | 1239 |
| | | Lamor MM30 | 1 | 3368 | 3368 |
| | **Fraser River** | T-18 disc | 1 | 1144 | 1144 |
| | **Kelowna** | 1218/1 brush/disc/drum | 1 | 1335 | 1335 |
| | | Skim Pack | 1 | 1335 | 1335 |
| | **Sechelt** | Triton 10 brush/disc/drum | 1 | 858 | 858 |
| **Total for South Coast** | | | | | **41025** |
| VANCOUVER ISLAND | **Campbell River** | T-18 | 1 | 1144 | 1144 |
| | **Duncan** | Triton 10 brush/disc/drum | 1 | 858 | 858 |
| | | RBS-05 | 1 | 635 | 635 |
| | | Triton 35 | 4 | 2415 | 9660 |

[100] Grey shading indicates resources that were newly added to the WCMRC resource inventory in March 2013.

| REGION | LOCATION | SKIMMER NAME | QUANTITY | DERATED CAPACITY (GAL/HR) | TOTAL (GAL) |
|---|---|---|---|---|---|
| | | Lamor Minimax 12 | 1 | 1239 | 1239 |
| | | Lamor MM30 | 1 | 3368 | 3368 |
| | **Hatch Point** | T-18 disc | 1 | 1144 | 1144 |
| | **Nanaimo** | T-18 disc | 1 | 1144 | 1144 |
| | **Port Alberni** | T-18 disc | 1 | 763 | 763 |
| | **Port Hardy** | T-12 disc | 1 | 1144 | 1144 |
| **Total for Vancouver Island** | | | | | **21099** |
| **Grand Total** | | | | | **80,425** |

[1] - *Dedicated Port Response Package – Must remain in Port of Vancouver*

***Table A.3 WCMRC temporary storage inventory***

| REGION | LOCATION | STORAGE TYPE | QUANTITY | PRIMARY (GALLONS) | SECONDARY (GALLONS) |
|---|---|---|---|---|---|
| **NORTH COAST** | **Kitimat** | Port-a-tank | 1 | 0 | 1335 |
| | | Floating Bladder | 1 | 0 | 1589 |
| | | Floating Collar | 1 | 0 | 1335 |
| | **Prince Rupert** | EAGLE BAY (Integral) | 1 | 2160[1] | 0 |
| | | Floating Bladder | 3 *(1589 ea)* | 0 | 4766 |
| | | Floating Bladder | 1 | 7944 | 0 |
| | | Floating Collar | 1 | 0 | 2161 |
| | | Port-a-tank | 1 | 0 | 1335 |
| | | Floating Bladder | 3 *(1320 ea)* | 0 | 3960 |
| | | Floating Bladder | 2 *(2640 ea)* | 0 | 5280 |
| | **Queen Charlotte City** | Floating Bladder | 1 | 0 | 1589 |
| | | Floating Collar | 1 | 0 | 2161 |
| | | Port-a-tank | 1 | 0 | 1335 |
| | **Shearwater** | Floating Bladder | 1 | 0 | 1589 |
| | | Floating Collar | 1 | 0 | 2161 |
| | | Port-a-tank | 1 | 0 | 1335 |
| **Total** | | | | **10104** | **31931** |
| **SOUTH COAST** | **Burnaby** | Floating Bladder | 2 *(1589 ea)* | 3178 | 0 |
| | | Floating Bladder | 2 *(6355 ea)* | 12710 | 0 |
| | | Floating Bladder | 1 | 7944 | 0 |
| | | Floating Collar | 1 | 0 | 667 |
| | | Floating Collar | 1 | 0 | 1335 |
| | | Floating Collar | 5 *(6673 ea)* | 0 | 33365 |
| | | Poly-Tank | 2 *(1589 ea)* | 3178 | 0 |
| | | Port-a-Tank | 1 | 0 | 1335 |
| | | Port-a-Tank | 1 | 0 | 2002 |

| REGION | LOCATION | STORAGE TYPE | QUANTITY | PRIMARY (GALLONS) | SECONDARY (GALLONS) |
|---|---|---|---|---|---|
| | | Port-a-Tank | 4 *(4004 ea)* | 0 | 16016 |
| | | Floating Bladder | 4 *(1320 ea)* | 0 | 5280 |
| | | Floating Bladder | 3 *(2640 ea)* | 0 | 7920 |
| | | BURRARD CLEANER NO. 3 (Integral) | 1 | 1175 | 0 |
| | **Fraser River** | Floating Bladder | 1 | 0 | 1335 |
| | | Floating Collar | 1 | 0 | 1335 |
| | | Port-a-Tank | 1 | 0 | 2002 |
| | **Kelowna** | Floating Bladder | 1 | 0 | 1335 |
| | | Floating Collar | 1 | 0 | 1335 |
| | | Port-a-Tank | 2 *(2669 ea)* | 0 | 5338 |
| | **Powell River** | Port-a-Tank | 1 | 0 | 2669 |
| | **Sechelt** | Floating Bladder | 1 | 0 | 1589 |
| | | Port-a-Tank | 1 | 0 | 1335 |
| | **Vancouver** | BURRARD CLEANER NO. 1 (Integral) | 1 | 4766[1] | 0 |
| | | BURRARD CLEANER NO. 2 (Integral) | 1 | 3813[1] | 0 |
| | | BURRARD CLEANER NO. 12 (Integral) | 1 | 0 | 5052 |
| | | BURRARD CLEANER NO. 17 (Integral) | 1 | 325068[1] | 0 |
| | | BURRARD CLEANER NO. 18 (Integral) | 1 | 1271038[1] | 0 |
| | | Floating Bladder | 1 | 0 | 1589 |
| | | Floating Bladder | 1 | 0 | 3178 |
| **Total** | | | | **1632870** | **96012** |
| **VANCOUVER ISLAND** | **Campbell River** | Floating Bladder | 1 | 0 | 1589 |
| | | Floating Collar | 2 *(2669 ea)* | 0 | 5338 |
| | | Port-a-Tank | 1 | 0 | 1335 |
| | **Duncan** | Floating Collar | 1 | 0 | 667 |
| | | Floating Collar | 2 *(1335 ea)* | 0 | 2670 |
| | | Port-a-Tank | 2 *(1335 ea)* | 0 | 2670 |
| | | Floating Bladder | 3 *(1320 ea)* | 0 | 3960 |
| | | Floating Bladder | 3 *(2640 ea)* | 0 | 7920 |
| | **Hatch Point** | Floating Bladder | 1 | 0 | 1652 |
| | | Floating Collar | 1 | 0 | 1335 |
| | | Port-a-Tank | 1 | 1335 | 0 |
| | **Nanaimo** | Floating Bladder | 1 | 0 | 1335 |
| | | Floating Bladder | 1 | 0 | 1589/5.0t |
| | | Floating Collar | 1 | 0 | 1335 |
| | | Port-a-Tank | 2 *(1335 ea)* | 0 | 2670 |

| REGION | LOCATION | STORAGE TYPE | QUANTITY | PRIMARY (GALLONS) | SECONDARY (GALLONS) |
|---|---|---|---|---|---|
| | **Esquimalt** | BURRARD CLEANER NO. 9 (Integral) | 1 | 25262[1] | 0 |
| | | BURRARD CLEANER NO. 10 (Integral) | 1 | 0 | 679370 |
| | | BURRARD CLEANER NO. 10 (Floating Bladder) | 1 | 7944[1] | 0 |
| | | BURRARD CLEANER NO. 10 (Floating Bladder) | 2 | 0 | 6355 |
| | | BURRARD CLEANER NO. 10 (Floating Collar) | 1 | 0 | 1335 |
| | **Port Alberni** | Floating Bladder | 2 (1588 ea) | 0 | 3177 |
| | | Floating Collar | 1 | 0 | 1335 |
| | | Port-a-Tank | 3 *(1335 ea)* | 0 | 4005 |
| | **Port Hardy** | Floating Bladder | 1 | 0 | 1588 |
| | | Floating Collar | 2 *(2670 ea)* | 0 | 5340 |
| | | Port-a-Tank | 1 | 0 | 1335 |
| **Total** | | | | **34541** | **739905** |
| **GRAND TOTAL** | | | | **1677515** | **867848** |

*[1] – Primary (Integral) oil storage capability for skimming vessels and barges are also listed in Table A.4 – WCMRC oil spill response vessels*

***Table A.4 WCMRC oil spill response vessels (OSRV)***

| REGION | LOCATION | VESSEL NAME | VESSEL TYPE | PERSONNEL REQUIREMENTS | EDRC (GAL) | TEMPORARY STORAGE CAPACITY (GAL)[101] |
|---|---|---|---|---|---|---|
| **North Coast** | **Prince Rupert** | M/V EAGLE BAY | 48 ft. Self-Propelled Vessel | 3 | 5211 | 2160 |
| **Region Total** | | | | | **5211** | **2160** |
| **South Coast** | **Burnaby** | Burrard Cleaner No. 3 | 30 ft. Self Propelled Vessel<br>Marco Filterbelt | 2 | 1906 | 1175 |
| | **Vancouver** | Burrard Cleaner No. 1 | Pushed Barge – 32 ft.<br>LORI 6 Brush | 3 | 7427 | 4766 |

[101] Primary (Integral) oil storage capability for skimming vessels and barges are also listed in Table A.3 – WCMRC temporary storage inventory.

| REGION | LOCATION | VESSEL NAME | VESSEL TYPE | PERSONNEL REQUIREMENTS | EDRC (GAL) | TEMPORARY STORAGE CAPACITY (GAL)[101] |
|---|---|---|---|---|---|---|
| | | Burrard Cleaner No. 2 | 50′ Self-Propelled Vessel | 3 | 2446 | 3813 |
| | | Burrard Cleaner No. 12 | Barge – 30 ft.<br>RBS-05D2 Brush/Disc/Drum | UNK | 1271 | 5052 |
| | | Burrard Cleaner No. 17 | Barge – 168 ft.<br>GT 185 w/ Helix Brush | UNK | 2542 | 325068 |
| | | BURRARD CLEANER NO. 18 | Barge – 248 ft.<br>Heavy Oil Skimmer | UNK | UNK | 1271038 |
| | | M/V M. J. GREEN | 50 ft. Self-Propelled Vessel | 3 | 10422 | 3177 |
| **Region Total** | | | | | **26014** | **1614089** |
| **Vancouver Island** | **Esquimalt** | Burrard Cleaner No. 9 | 75′ Self Propelled Vessel – Offshore | 4 | 3321 | 25262 |
| | | Burrard Cleaner No. 10 | 185′ Barge – Offshore<br>GT-185 weir/brush | UNK | 2542 | 679370 |
| **Region Total** | | | | | **5863** | **704632** |
| **Total** | | | | | **35182** | **2320881** |

# Appendix B.
## Task Force Configurations for Oil Spill Scenarios

*Table B.1 Task Force[102] Configurations for Juan de Fuca Spill – WCMRC Forces*

| BASE | OWNER | RESOURCE CATEGORY | ID | SPECIFICATIONS | STORAGE (TONNES) | EDRC* (TONNES/HR) | OPERATING ENV'T | NOTES |
|---|---|---|---|---|---|---|---|---|
| **TASK FORCE 1** | | | | | | | | |
| **VANCOUVER** | WCMRC | Skim Vsl | MJ GREEN | 45 ft/14m self propelled vessel | 6.8 | 32.8 | Protected water | *Derated capacity listed as per WCMRC |
| **SOUTH COAST** | WCMRC | Work Boat | BCO No. 13 | 18 ft/5.5m work boat (15 kts) | | | Protected water | Tow U or -U boom ahead of skimming vessel (150/300 ft) |
| | WCMRC | Work Boat | BCO No. 14 | 18 ft/5.5m work boat (15 kts) | | | Protected water | |
| | WCMRC | Work Boat | BCO No. 17 | 18 ft/5.5m work boat (15 kts) | | | Protected water | |
| **TASK FORCE 2** | | | | | | | | |
| **VANCOUVER ISLAND** | WCMRC | Skim Vsl | BCO No. 9 | 75 ft/23m self propelled vessel | 79.5 | 22 | Protected water/Open water | *Derated capacity listed as per WCMRC |
| **SOUTH COAST** | WCMRC | Work Boat | BCO No. 20 | 18 ft/5.5m work boat (25 kts) | | | Protected water | Tend collection boom (V-config) attached to skimming vessel (150/300 ft) |
| | WCMRC | Work Boat | BCO No. 25 | 18 ft/5.5m work boat (25 kts) | | | Protected water | |
| **TASK FORCE 3** | | | | | | | | |
| **VANCOUVER** | WCMRC | Skim Vsl | BCO No. 2 | 50 ft/15m self propelled vessel | 12.3 | 16.2 | Protected water | *Derated capacity listed as per WCMRC |
| **VANCOUVER ISLAND** | WCMRC | Work Boat | BCO No. 22 | 18 ft/5.5m work boat (25 kts) | | | Protected water | Tend collection boom (V-config) attached to skimming vessel (150/300 ft) |
| | WCMRC | Work Boat | BCO No. 23 | 16 ft/5m work boat (25 kts) | | | Protected water | |

[102] This table does not include a potential additional task force that would be comprised of the resources in the Port of Vancouver equipment package, because that dedicated equipment is required to remain within the port.

| BASE | OWNER | RESOURCE CATEGORY | ID | SPECIFICATIONS | STORAGE (TONNES) | EDRC* (TONNES/HR) | OPERATING ENV'T | NOTES |
|---|---|---|---|---|---|---|---|---|
| **TASK FORCE 4** | | | | | | | | |
| **VANCOUVER** | WCMRC | Skim Barge | BCO No. 12 | 30 ft/9m barge (requires tug or adequate tow vessel) | 15.9 | 2.0 | Protected water | *Derated capacity listed as per WCMRC |
| | FOSET | Work Boat | | | | | Protected water | Tow vessel plus work boat to tend boom in side-skimming configuration |
| | FOSET | Work Boat | | | | | Protected water | |
| **TASK FORCE 5**[103] | | | | | | | | |
| **VANCOUVER ISLAND** | WCMRC | Barge/ Skim | BCO No. 10 | 185 ft/56m tank barge (requires tug) | 250 0.2 | 8.0 | Protected water/Open water | *Derated capacity listed as per WCMRC |
| **TASK FORCE 6**[104] | | | | | | | | |
| **VANCOUVER** | WCMRC | Barge/ Skim | BCO No. 17 | 168 ft/51m tank barge (requires tug) | 102 3 | 8.0 | Protected water/Open water | *Derated capacity listed as per WCMRC |

[103] Note: TF 5 and TF 6 are large barges with significant primary oil storage. These barges can clearly serve as support and oil storage platforms, and while they have skimming capability as part of their on board package, it is not clear how or if WCMRC would deploy this asset for use as part of an on-water skimming task force. WCMRC's inventory does not indicate whether they have outrigger arms for use with oil collection boom, nor were we able to access any literature/manuals to indicate how they might incorporate work boats and boom in a enhanced booming configuration that would allow these barges to serve as primary oil recovery platforms. They were incorporated as task forces on the assumption that there are plans and equipment in place to support such use.

[104] See note for TF 5.

*Table B.2 Task Forces for Strait of Juan de Fuca Scenarios (US forces)*

| BASE | OWNER | RESOURCE CATEGORY | ID | SPECIFICATIONS | STORAGE | EDRC (GAL/T/HR) | OPERATING ENV'T | NOTES |
|---|---|---|---|---|---|---|---|---|
| **NEAH BAY, WA** | NRCES | Skim Vsl | OSRV CAPE FLATTERY | 110 ft/33.5m Self propelled vessel | 13440 42.3t | 1131* 3.5t | Protected water/Open water | * Foilex 150 Weir skimmer |
| **PORT ANGELES, WA** | MSRC | Work boat | OSRV PARK RESPONDER | 32 ft/10m Workboat | | | Protected water | |
| **NEAH BAY, WA** | MSRC | Skim Vsl | M/V ARCTIC TERN | 73 ft/22m self propelled vessel | 11592 36.5t | 6000 18.9t | Protected water/Open water | JBF Belt 5001 skimmer |
| **PORT ANGELES, WA** | MSRC | Skim Vsl | M/V SHEARWATER | 115 ft/35m self propelled vessel | 57246 180t | 12000 37.8t | Protected water/Open water | 2 JBF Belt 5001 skimmer |
| **ASTORIA, OR** | NRCES | Skim Vsl | M/V NRC QUEST | 159 ft/48.5m self propelled vessel | 36120 113.7t | 2520 7.9t | Protected water/Open water | Skimmer is Crucial Fuzzy Disc 13/30. |
| **PORT ANGELES, WA** | MSRC | Barge | KITTIWAKE | Offshore oil storage barge | | 982800 3091.3t | Protected water/Open water | |

*Table B.3 Task force elements for Dixon Entrance scenarios (WCMRC and US Forces)*

| BASE | OWNER | RESOURCE CATEGORY | ID | SPECIFICATIONS | STORAGE (TONNES) | EDRC* (TONNES/HR) | OPERATING ENV'T | NOTES |
|---|---|---|---|---|---|---|---|---|
| **TASK FORCE 1 – WCMRC** | | | | | | | | |
| **Prince Rupert** | WCMRC | Skim Vsl | M/V EAGLE BAY | 51 ft self propelled vessel (20 kts cruising speed) | 5211 | 2160 | Near/Open | *Derated capacity listed as per WCMRC |
| **TASK FORCE 2 – SEAPRO (US)** | | | | | | | | |
| **Ketchikan** | SEAPRO | Skim Vsl | RUDYERD BAY | 48 ft self propelled vessel (20 kts cruising speed) | 2310 | 4954 | Near/Open | EDRC as listed by SEAPRO |
| **TASK FORCE 3 – SEAPRO (US)** | | | | | | | | |
| **Juneau** | SEAPRO | Skim Vsl | NEKA BAY | 48 ft self propelled vessel (20 kts cruising speed) | 2310 | 3321 | Near/Open | EDRC as listed by SEAPRO |

***Table B.4. Transit distances and times for Task Forces to spill locations***[105]

| TASK FORCE (LOCATION) | TO JDF SPILL | | | TO DIX SPILL | | |
|---|---|---|---|---|---|---|
| | DISTANCE (KM) | SPEED | TRAVEL TIME (HRS) | DISTANCE (KM) | SPEED | TRAVEL TIME (HRS) |
| **JDF TF1 (Vancouver)** | 250 | 10 kts | 6 | 1000 | MJ Green | 56 |
| **JDF TF2 (Esquimalt)** | 110 | 6 kts | 22.5 | 1040 | #9 | 92 |
| **JDF TF3 (Vancouver)** | 250 | 6 kts | 22.5 | 250 | #2 | 92 |
| **JDF TF4 (Vancouver)** | 250 | 6 kts | 22.5 | 250 | #12 | 92 |
| **JDF TF5 (Vancouver)** | 250 | 26 kts | 5 | 250 | #10 | 23 |
| **JDF TF6 (Esquimalt)** | 110 | 6 kts | 22.5 | 1040 | #17 | 92 |
| **JDF US TF Cape Flattery (Neah Bay)** | 19 | 10 kts | 1 | | | |
| **JDF US TF Park Responder (Port Angeles)** | 110 | 12 kts | 5 | | | |
| **JDF US TF Arctic Tern (Neah Bay)** | 19 | 9 kts | 1 | | | |
| **JDF US TF Shearwater (Port Angeles)** | 110 | 10 kts | 6 | | Not deployed | |
| **JDF US TF Quest (Astoria, Oregon)** | Transit for TF Quest is derived from identified transit time to the Neah Bay Staging Area | | 17.5 | | | |
| **JDF US TF Kittiwake (Port Angeles)** | 110 | 6 kts | 10 | | | |
| **DE TF1 (Prince Rupert)** | 880 | 25 kts | 19 | 180 | 25 kts | 4 |
| **DE TF 2 Rudyerd Bay (Ketchikan)** | | | | 150 | 20 kts | 4 |
| **DE TF 3 Neka Bay (Juneau)** | | Not deployed | | 490 | 20 kts | 13 |
| **DE Secondary Storage Barge (Prince Rupert)** ***Hypothetical barge*** | | | | 180 | 6 kts | 30 |

[105] Task Force speeds are based on the cruising speed of the slowest vessel in the Task Force.

# Appendix C. Acronyms

| | |
|---|---|
| ADIOS | Automated Data Inquiry for Oil Spills |
| AIS | Automated identification system |
| ANS | Alaska North Slope |
| ASTM | American Society of Testing and Materials |
| BC | British Columbia |
| CANUS | Canada-United States |
| CANUSDIX | Canada-United States (Dixon Entrance area) |
| CANUSPAC | Canada-United States (south coast area) |
| CCG | Canadian Coast Guard |
| CCGS | Canadian Coast Guard Ship |
| DE | Dixon Entrance |
| DGPS | Differential Global Positioning System |
| EC | Environment Canada |
| ECRC | Eastern Canada Response Corporation |
| EEZ | Exclusive Economic Zone |
| FOSET | Fishermen Oil Spill Emergency Team |
| GRN | Global Response Network |
| ICS | Incident Command System |
| IMF | International Monetary Fund |
| IMO | International Maritime Organization |
| ISTOP | Integrated Satellite Tracking of Pollution |
| ITOS | International Tug of Opportunity System |
| JDF | Juan de Fuca |
| MARPOL | International Convention on the Prevention of Marine Pollution |
| MART | Marine Aerial Reconnaissance Team |
| MCTS | Marine Communications and Traffic Services |
| MKH | MacKay Heavy Bitumen |
| MRA | Movement Restricted Area |
| MSRC | Marine Spill Response Corporation |
| NASP | National Aerial Surveillance Program |
| NOAA | National Oceanic and Atmospheric Administration |
| PSC | Port State Control |
| PPA | Pacific Pilotage Authority |
| REET | Regional Environmental Emergencies Teams |
| RMS | Response Management System |
| ROC | Response Options Calculator |
| SEAPRO | Southeast Alaska Petroleum Response Organization |
| SOLAS | United Nations' Convention on the Safety of Life at Sea |
| SOPEP | Shipboard Oil Pollution Emergency Plan |
| TC | Transport Canada |
| TF | Task Force |
| UNCLOS | United Nations' Convention on the Law of the Sea |
| US | United States |
| USCG | United States' Coast Guard |
| WCMRC | Western Canada Marine Response Corporation |
| VHF | Very high frequency |
| VTS | Vessel Traffic Service |
| WRRL | Western Response Resource List |
| WSMC | Washington State Maritime Cooperative |

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# Appendix D. Authors

This report was researched and written by Nuka Research and Planning Group, LLC. Brief biographical sketches are provided for the authors.

### *Elise DeCola, Lead Author*

Elise DeCola is the operations manager of Nuka Research, and she was the lead author for this study. Her professional career began in legislative affairs in 1996, where her first assignment as a marine environmental policy fellow was to develop a state-level oil spill prevention and response law in the wake of a major New England fuel barge spill. She has since worked on oil spill policy research and contingency plan development and review in the US, Canada, and Europe. She regularly conducts field preparedness exercises for oil spill responders in the Northeast, and publishes regularly on the topic of oil spill preparedness. Ms. DeCola holds an M.A. in Marine Affairs from the University of Rhode Island and a B.S. in Environmental Science from the College of William and Mary in Virginia.

### *Sierra Fletcher, Contributing Author and Editor*

Sierra Fletcher is a Project Manager at Nuka Research and was a contributing author for this report. She has more than ten years of experience analyzing U.S. state, federal, and international policies on environmental issues including oil spill prevention and response and product stewardship. She contributes policy analysis, facilitation, and technical writing to Nuka Research's work on both the east and west coasts of North America. Ms. Fletcher has a M.A.L.D. in Environmental Policy from the Fletcher School of Law and Diplomacy at Tufts University and a B.A. from Yale University.

### *Mike Popovich, Oil Spill Response Equipment Expert*

Mike Popovich is a Project Manager with Nuka Research. He served for 26 years with the United States Coast Guard, both on active duty and as a civilian working in marine environmental response and investigation. Mr. Popovich has extensive experience overseeing responses to minor, medium, and major oil spills throughout the US. As an Environmental Equipment Specialist, he managed oil spill response equipment and trained Coast Guard personnel and vessel crewmembers on the proper use of oil recovery systems. He served for several months during the Macondo well blowout in 2010, first as part of the initial US Coast Guard on-water oil skimming operations and later in the Unified Command in New Orleans acquiring and allocating boom and skimmers for multiple Incident Command Posts throughout the theater of operations. In his role at Nuka Research, he manages an oil spill training and exercise program and contributes to oil spill planning projects in Alaska and New England.

### *Andrew Mattox, Analyst and Modeler*

Andrew Mattox is Nuka Research analyst, and he performed all Response Options Calculator (ROC) modeling and related analysis. Mr. Mattox has quantitative analysis experience in geological and earth sciences, environmental and weather data, and spill modeling. He served for six years as a wildland firefighter for the US Forest Service, where he acquired his training in operations and the Incident Command System, which is now applied to modeling oil spill responses. Mr. Mattox earned a BA in Geology from Carleton College and is currently an MBA candidate at the Bainbridge Graduate Institute.