English Bay Oil Spill Debrief and Tanker Scenario Planning Workshop

Oil Spill Debrief and Scenario Planning Workshop Summary

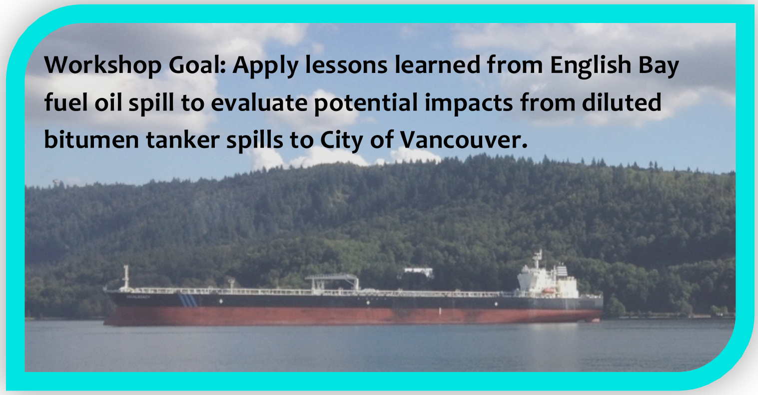
April 23-24, 2015 VanDusen Botanical Garden

Vancouver, British Columbia

Prepared for the City of Vancouver by:

Elise DeCola, Principal
Nuka Research and Planning Group, LLC
elise@nukaresearch.com

Executive Summary



This report summarizes the City of Vancouver *M/V Marathassa* (English Bay) Oil Spill Debrief and Scenario Planning Workshop that was held April 23-24, 2015. It describes the City of Vancouver's role in the incident, identifies lessons learned during the English Bay oil spill response, and considers how the City might be impacted by a larger scale oil spill from a diluted bitumen tanker.

City of Vancouver's Role in Oil Spill Response

Although the English Bay oil spill was a relatively small incident and the response was relatively short-lived (approximately 16 days of active Incident Command Post operations), The City of Vancouver allocated significant staff time and resources to manage the consequences of this incident. Preliminary estimates indicate that City personnel from at least 13 departments worked approximately 5,000 hours combined over the course of the active spill response to support the City of Vancouver Emergency Operations Centre (EOC), *M/V Marathassa* oil spill Incident Command Post (ICP), and field operations such as beach patrols, shoreline assessments, and crowd control.

The City filled a critical role in communicating with the public during the English Bay oil spill, allocating significant time and resources to creating clear, accurate public messages and disseminating them through a range of media. The City also provided mechanisms for concerned members of the public to register as volunteers and to report oiling observations. The City compiled statistics on the level of interest and engagement shown by the public through calls into the 3-1-1 call center, visits to the City's website, and activity on various social media outlets. Over 4,000 volunteers registered to assist with the spill response, and one of several websites established by the City had over 12,000 page visits over a three-week period.

Incident Debrief and Scenario Planning Workshop

The City began planning for a Tabletop Exercise that would allow senior staff to consider the implications of a major marine oil spill by participating in a simulated response to a hypothetical tanker spill. When the *M/V Marathassa* fuel oil spill occurred within weeks of the planned Tabletop Exercise, the City changed their approach to incorporate a debrief of the English Bay spill response with a facilitated discussion that considered how the City might need to scale up their recent experience in the face of a 16,000 m^3 diluted bitumen tanker spill. A series of Focus Group meetings led up to the Workshop and provided an opportunity for foundational discussions with senior managers from all departments that informed the Workshop format and scope.

The Incident Debrief and Scenario Planning Workshop was conducted over two half-day sessions, with 43 participants representing senior leadership from within City departments along with Vancouver Coastal Health. The English Bay oil spill debrief was conducted as a facilitated discussion where participants were prompted to consider: (1) specific actions that positively contributed to the outcomes of the response; (2) specific gaps observed during the *M/V Marathassa* oil spill response; and (3) the most critical outcomes for the City in dealing with future oil spills.

Actions that led to **positive outcomes** during the English Bay spill response included:

- The City's role in Unified Command provided necessary local knowledge and experience to inform decision-making.
- The City of Vancouver Emergency Operations Centre (EOC) was up and running within hours of notification, well ahead of the Incident Command Post, and provided a critical situation status and information role throughout the spill response.
- The City engaged almost immediately with other local partners and stakeholders, including surrounding municipalities, Vancouver Coastal Health, First Nations, and organizations like the Vancouver Aquarium.
- The City's information team was able to develop and disseminate information to the public and press much more quickly than the Unified Command information releases using a range of communication tools, such as social media, print media, signage, and messaging within the 3-1-1 call line.

Gaps in policies, plans, and resources noted during the English Bay spill response included:

- Delays in official notification to the City limited opportunities to take protective actions to minimize adverse impacts.
- Delays in the Responsible Party's acceptance of responsibility contributed to delays in ramping up the response and resulted in losses of knowledge and efficiency during the transfer of spill management authority from the federal government to the ship owner once they accepted responsibility for the spill.
- An uneven level of Incident Command System (ICS) proficiency among federal agencies and other partners in the ICP led to delays in producing Incident Action Plans, lack of consistency in incident documentation, outdated or incorrect information posted in ICP situation displays, incomplete staffing of all ICS functions, and a chaotic meeting environment.
- There were substantial gaps in the scope and quality of spill science that adversely impacted the rigor of environmental assessments and cleanup conducted during the response, resulting in problems with shoreline assessment mapping and

documentation, minimal environmental sampling and monitoring, and lack of protective booming.

- The spill response created a significant draw on City resources, including operational staff (particularly within Parks, because of the need for additional attention on beaches and parks), which would have been difficult to sustain.

The following were identified as **critical outcomes** for the City of Vancouver in managing oil spill response:

- Ensure City role and participation in Unified Command.
- Be prepared to manage convergent volunteers.
- Be prepared to collect the necessary information (samples, monitoring, etc.) to assess potential human health impacts and communicate those clearly to the public.

Impacts of a Diluted Bitumen Tanker Spill at First Narrows

Participants were presented with a credible worst case spill scenario, consistent with Trans Mountain Expansion project application materials, involving a collision at First Narrows that results in a 16,000 m^3 diluted bitumen spill, which would be over 5,000 times larger than the reported volume spilled by the *M/V Marathassa*. Information compiled by some of the City of Vancouver's experts during the Trans Mountain Expansion Project NEB hearing was discussed to help frame issues and assumptions for the diluted bitumen tanker scenario discussion.

Shoreline Impacts

It is assumed that a 16,000 m^3 diluted bitumen spill at First Narrows would result in significant and widespread impacts to the Burrard Inlet shoreline, based on the actual impacts of a smaller spill that occurred farther from shore (11,000 m^3 *Hebei Spirit* spill that occurred 8 km from shore and coated beaches in heavy oil) and the trajectory modeling performed by one of the City of Vancouver's experts (Genwest, 2015).

Workshop participants applied the following scenario planning assumptions about the spill trajectory:

- The oil will impact shoreline within hours
- Shoreline impacts will be widespread throughout Burrard Inlet
- Oil will come ashore in thick oil mats as well as discontinuous patches

Air Quality Impacts to Public Health and Safety

It is assumed that a 16,000 m^3 diluted bitumen spill at First Narrows would create a vapour cloud or plume that could pose significant risk to the health and safety of first responders and the public. The 2010 Kalamazoo River diluted bitumen pipeline spill resulted in close to 150 hospital visits for neurological, cardiovascular, dermal, ocular, renal, and respiratory problems. A diluted bitumen tanker spill in the Burrard Inlet could create air quality concerns for local residents because of the close proximity of the waterway to heavily populated areas.

Workshop participants applied the following scenario planning assumptions about air quality:

- The oil slick will create a vapour plume with benzene levels above the acute exposure limits
- The City will need to assess the situation to decide whether to evacuate, shelter-in-place, or issue other health and safety advisories to potentially affected residents
- The oil slick may create explosive or flammability risks
- Real-time data from air quality sensors may or may not be provided by the Responsible Party or response contractor; the City and other municipalities may need to conduct independent monitoring

Environmental Impacts

The hypothetical 16,000 m^3 diluted bitumen oil spill scenario would have significant adverse impacts to shoreline habitat, wildlife, and ecological health. It is assumed that a spill of this magnitude in the Burrard Inlet could result in major kills of sea- and shorebirds and marine mammals, and could have ecosystem-wide adverse effects. Sunken or submerged oil could present a source of re-oiling for years.

Workshop participants applied the following scenario planning assumptions about environmental impacts:

- There will be significant bird mortality
- There may be impacts to marine mammals
- The oil may potentially sink or submerge
- Shoreline re-oiling is possible
- Oil may linger on shorelines well past the end of active clean-up

Economic Impacts

The economic costs of oil spills to local municipalities are incurred over time, sometimes many years or decades, and can be difficult to compile. A study commissioned by the City of Vancouver identifies a range of cost categories where local governments may incur costs as the result of a major marine oil spill and estimates that the cumulative costs borne by a city after a major marine oil spill could be close to $1 billion (Stone, 2015).

Workshop participants applied the following scenario planning assumptions about economic impacts:

- Economic impacts will be widespread, will persist for an indeterminate length of time after the spill occurs, and will be challenging to measure.

Spill Response Limitations

On-water oil spill response is a logistically complex and often inefficient process. Even when everything goes well, the total amount of oil removed from the sea surface may be only a small percentage of the total volume spilled. There may be times when weather or environmental conditions prevent any response at all. Oil spills that occur during these gap periods would be left unmitigated for hours to days, depending on conditions.

Workshop participants applied the following scenario planning assumptions about spill response:

- Effective spill response will depend on speed of notification and deployment, weather and environmental conditions, and available equipment and responders
- It is impossible to fully contain and recover a 16,000 m^3 diluted bitumen oil spill, even under the best conditions
- Effective on-water cleanup may reduce the volume of oil that washes ashore, but there will be shoreline, wildlife, and environmental impacts regardless

Scenario Discussion and Key Issues

Once the scenario had been presented and discussed, the participants were divided into four groups and each assigned to a group to focus on specific discussion topics:

- Public health and safety
- Emergency management
- Public interface
- Consequence management

Each group was asked to consider how a large-scale tanker incident might impact the City, based on the *Marathassa* incident response, lessons from other major oil spills, and the assumptions about a major tanker spill scenario based on expert reports.

Public Health and Safety

Public health and safety is a cross-cutting issue that will impact all aspects of the City's involvement in a major oil tanker spill. The City's ability to protect first responders and the public from potential adverse health or safety impacts from a diluted bitumen spill will be the first concern throughout the spill response.

The scenario discussion identified a number of key concerns related to public health and safety:

- Understanding and evaluating the extent, movement, and duration of a toxic plume or vapour cloud from a major diluted bitumen tanker spill that occurs near City of Vancouver population centers.
- Understanding potential routes of exposure to first responders, City employees operating in the field, and local populations.

- Capability to implement air quality monitoring swiftly and in the highest risk areas immediately following a release.
- Access to the information about type of product released and plume location (toxicity and explosive risks) to support decision-making and emergency operations related to evacuation or shelter-in-place orders.
- Properly equipping first responders to protect them from potential adverse health effects.
- Detecting and remediating any cross-contamination that creates risk of secondary exposure to spilled oil in public buildings or transportation infrastructure.

Emergency Management

Scaling up from a fuel oil spill like the *Marathassa* incident to a major cargo spill from an oil tanker would create additional strain on the City's Emergency Management system.

The scenario discussion identified a number of key concerns related to emergency management during a major tanker spill:

- Drain on local emergency services to support emergency calls, traffic control, safety perimeters, and crowd control.
- Level 3 activation of Vancouver EOC would be unprecedented and require substantial resource tracking, management, and coordination for a prolonged period of time.
- Need to make quick emergency management decisions with incomplete information.
- Need for data to support closing and opening areas to public use.
- Human resource impacts to city personnel working on the oil spill (long hours, need for rest, burnout, critical incident stress).
- Continuity of operations impacts and potential need to suspend certain city services while resources are allocated to the spill response.

Public Interface

Local government is often the first point of contact for the concerned public during an oil spill, and the level of public interest and concern during the early days of the *M/V Marathassa* spill provided a small insight into how the public reacts when oil spills impact their home. A major diluted bitumen spill would present a public relations situation an order of magnitude more complex than the English Bay spill.

The scenario discussion identified a number of key concerns related to public interface during a major tanker spill:

- Need for clear and consistent information flow between the Incident Command Post and EOC, including regular status updates from the ICP regarding spill cleanup operations, response priorities, and other activities.

- Process for coordinating volunteer registration and overseeing volunteer response activities.

Consequence Management

The short- and long-term consequences of a major tanker spill to the City of Vancouver would be significant and far-reaching. During the *M/V Marathassa* oil spill, the City experienced a range of impacts associated with the spill response and also came to appreciate that there is significant uncertainty involved in anticipating long-term consequences.

The scenario discussion identified a number of key concerns related to consequences of major tanker spill:

- Planning for and addressing re-oiling events after active spill cleanup has ended.
- Ensuring that the City's priorities for protecting the environment and the public are incorporated into shoreline cleanup plans.
- Potential for lingering impacts to environment, wildlife, ecology, human use, economy, and quality of life.
- Coping with adverse impacts to sea and shorebirds and marine mammals that will propagate to other marine species and cause ecosystem-level effects.
- Managing community impacts and meeting the social service needs of impacted residents.
- Timeframe and documentation requirements for damage claims and potential for City damages to exceed liability limits.

Conclusions

The City recognizes that part of its duty of care to local residents involves preparing for marine oil spills, particularly as the risk of spills in the Burrard Inlet and English Bay may increase if the Trans Mountain Expansion project is approved. The English Bay spill response helped to clarify the City's understanding of how a marine oil spill response would proceed, in terms of the incident management, the response operations, and the effectiveness of the cleanup. Building from this experience, the City of Vancouver realizes that the impacts of a major diluted bitumen tanker spill at First Narrows would be catastrophic, even if the response proceeded with no complications or delays.

This scenario planning workshop helped the City to identify areas where the City can continue to focus its preparedness efforts in the event of future spills, and where more information or action is required from other agencies. But it also exposed a fundamental reality that a worst case tanker spill in the Burrard Inlet could not be fully mitigated, and that there would be significant adverse impacts to the local environment, public health, culture, , and economy.

Contents

1. Introduction

This report summarizes the proceedings of the City of Vancouver *M/V Marathassa* (English Bay) Oil Spill Debrief and Scenario Planning Workshop that was held April 23-24, 2015. It describes the City of Vancouver's role in the incident, identifies lessons learned during the English Bay oil spill response, and considers how the City might be impacted by a larger scale oil spill from a diluted bitumen tanker.

1.1 English Bay Oil Spill Initial Response

Photo: Darryl Dyck/Canadian Press (April 9, 2015)

On April 8, 2015, at approximately 5:00 pm local time, a recreational boater reported visible oil leaking from the starboard stern of the *M/V Marathassa*, a Panamax-sized bulk grain carrier at anchor in Vancouver's English Bay. The first vessel on-scene from Port Metro Vancouver arrived approximately one hour after the initial spill reports. Two hours later, the Canadian Coast Guard (CCG) directed Western Canada Marine Response Corporation (WCMRC) to respond to the spill. WCMRC crews were on-scene within about 90 minutes of the CCG call (approximately 9:30 pm).

According to initial reports, WCMRC advised that the *M/V Marathassa* was the source of the oil spill at around 4:00 am on April 9, and began booming the vessel 11 hours after the spill was first reported (*M/V Marathassa* denied responsibility until the evening of April 9). WCMRC informally notified the City of Vancouver at around 5:00 am, a full 12 hours after the spill was initially reported. WCMRC finished deploying containment boom around the leaking vessel just before 6:00 am on April 9. On-water skimming operations were conducted, although official documentation is vague regarding the volume of oil and oily water recovered during the first 36 hours of the spill. According to WCMRC, approximately 1000 L of oil was skimmed from the water during the first two days of the response.[1]

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[1] Another 400L is estimated to have been recovered from oiled boom and sorbent materials. Since the total volume of oil spilled is not known, it is impossible to estimate the percentage of spilled oil recovered, but the 80% recovery estimates widely reported in the media are inaccurate.

[2] Application materials describe the probability of a collision at First Narrows as increasing from 0.16%

Once notified, the City of Vancouver quickly responded by initiating a teleconference with the Corporate Management Team, activating the City Emergency Operations Centre (EOC), and dispatching City staff to the Port Metro Vancouver offices where an Incident Command Post (ICP) was eventually established. The City had a role in the Unified Command (UC), along with the CCG, Responsible Party (RP) representatives, WCMRC, the Province of BC, West and North Vancouver municipalities, and the Tsleil-Waututh and Squamish First Nations. The City also assigned support staff to the ICP to participate in the incident management process.

1.2 Role of the City of Vancouver in Oil Spill Response

Oil spill response is a multi-jurisdictional activity. The lead jurisdictional agencies during a marine oil spill represent the federal government and the province, but impacted municipalities and First Nations play an equally important role.

This workshop focused on the City of Vancouver's role in oil spill response generally, building on the experience during the English Bay spill. The City expects to engage in oil spill response for any spill that impacts or threatens to impact the city in three broad functional areas: Emergency Management, Incident Command, and Operations.

Emergency Management Core Functions

For any oil spill that impacts or threatens to impact the City of Vancouver, the City would activate the Emergency Operations Centre (EOC) to oversee the emergency management functions that the City would be responsible for assuming during any local emergency. Some of the activities at the EOC may overlap with or parallel the ICP, and coordination between the two groups is essential.

City Presence and Participation in Incident Command

The City has a role within Unified Command, which typically consists of local, provincial, and federal agencies, First Nations, as well as the Responsible Party. Unified Command activities occur at the Incident Command Post (ICP). Unified Command is responsible for directing the overall response to the incident and has primary responsibility for the containment and clean up of the oil spill. City representation on Unified Command ensures that the objectives and priorities of the City, including the protection of public health and safety, are incorporated into planning and response. The City provides representation to the Unified Command and support staff at the ICP to fill other roles in the spill response organization through the Incident Command System.

City Support and Operational Functions

The City has a duty of care to its citizens, and a responsibility to protect the public on land and within its jurisdictional boundaries. The primary response of the City will be land-based, although the City may serve in an enabling or supporting role to operations on the water. Through Unified Command, the City will provide input regarding the priorities of on-water response operations that will impact the response requirements and actions on land.

While some City staff, departments, and resources may be reassigned to support the Unified Command or EOC, there are other City Operations and Functions that will be expected to continue as normal during an oil spill, and others that will be required to expand or adapt to the changing spill response situation. These operations will be managed primarily through existing lines of authority within city departments, and may require a reallocation of resources or implementation of continuity plans.

1.3 City of Vancouver's Involvement in English Bay Spill Response

Scope of City's Involvement

The City's primary focus during the English Bay oil spill was to protect the health and well-being of its residents. City departments that were involved in managing the consequences of the English Bay oil spill to the city, its resources, and its residents included:

- **City Manager's Office** provided representation to the Unified Command.
- **Communications** developed public information messages, supported the ICP communications process, and disseminated information to the press and public through City website, social media, and news releases. The City website also gave the public an opportunity to provide feedback and to register as volunteers to support the spill response.
- **Digital Services** staffed the 3-1-1 reporting line that was used to compile public reports throughout the spill response, and became an important conduit for information to and from the concerned public.
- **Emergency Management** provided staff at the ICP and the EOC, and continues to provide staff to support the PMO.
- **Engineering** provided Sanitation trucks and services to assist with contaminated (oily) debris removal from city trash receptacles. They also printed signs to communicate beach closure and emergency information. Engineering staff supported wildlife response by installing fencing and signage to protect oiled birds in ponds at Vanier Park and Jericho.
- **Legal Services** provided support to the City's representation at Unified Command by advising on jurisdictional authorities and legal context for spill response, claims, and compensation.

- **Financial Services** oversaw the Finance and Logistics sections at the EOC, and continue to support by compiling information for cost recovery.
- **Board of Parks and Recreation** provided significant staff and management support to oversee volunteers, patrol beaches, set and tend public information signs, liaise with wildlife responders, participate in Shoreline Cleanup Assessment Technique (SCAT) surveys, and compile observations about shoreline oiling.
- **Police Department** provided security support to keep public away from active cleanup areas and closed beaches. VPD Marine Unit provided a vessel to support shoreline assessment in areas not accessible by land.
- **Real Estate and Facilities** provided personnel from Environmental Planning to participate in the Environmental Unit and SCAT surveys, and to contract water and sediment sampling for analysis by Vancouver Coastal Health.
- **Risk Management** provided staff to run the EOC and provided support to spill response functions like volunteer management.
- **Vancouver Coastal Health** (partner agency) provided public health officers to support Unified Command decision-making, provided technical experts to review sampling data, and participated in decisions about beach closures in the oil-impacted area.
- **Other EOC-trained staff** from across the City of Vancouver organization provided support as needed at the Emergency Operations Centre.

City of Vancouver Staff Time Allocated to the English Bay Oil Spill

The City of Vancouver simultaneously deployed staff to the Oil Spill ICP and manned the City of Vancouver EOC. The City EOC was activated from April 9 through April 17 (9 days), and the ICP was active from April 9 through April 24 (16 days). The City continues to participate in the project management office (PMO) that was created to manage the post-spill project phase (ongoing as of this report date). While the City is currently compiling a complete record of the level of effort City personnel contributed to the English Bay oil spill response, preliminary estimates indicate that City personnel in the EOC, ICP, and field together worked approximately 5,000 hours over the course of the active spill response (this does not include contractors).

City of Vancouver's Role in Communicating with Public

There was never an official website established by the Unified Command, the Responsible Party, or the federal government for this oil spill. Instead, the City of Vancouver became a primary information source for an interested public, allocating significant time and resources to creating clear, accurate public messages and disseminating them through a range of media. The City also provided mechanisms for concerned members of the public to register as volunteers and to report oiling observations.

The City compiled statistics on the level of interest and engagement shown by the public through calls into the 3-1-1 call center, visits to the City's website, and activity on various social media outlets. These statistics are summarized in the table below. (Sysomos, 2015a, b and c)

Public Interest and Social Interactions during English Bay Oil Spill

Public Attention to English Bay Oil Spill		
3-1-1 Call Line and City-sponsored websites with information about the English Bay oil spill	Public calls to 3-1-1 line (reports and enquiries) between April 9 and April 22, 2015:	278
	Volunteers that registered with City of Vancouver via City-hosted website or 3-1-1 calls over 5-day period (April 9-13, 2015):	4,043
	Number of page views for City of Vancouver volunteer cleanup website between April 9 and April 30, 2015:	12,776
	Number of page views for City of Vancouver "Fuel spill in English Bay" website between April 9 and April 30, 2015:	1,984
	Average length of time spent on City of Vancouver "Fuel oil in English Bay" website between April 9 and April 30, 2015:	3.7 minutes
Social media activity tracked	Estimated number of social media mentions for #vanfuelspill between April 9 and April 30, 2015:	31,026
	Estimated number of Twitter mentions of "oil spill" between April 9 and April 30, 2015:	50,901
	Estimated number of Twitter users to mention "oil spill" between April 9 and April 30, 2015:	26,442

1.4 Incident Debrief and Action Planning Workshop

On April 23-24, 2015, a facilitated workshop was conducted to provide an opportunity for City of Vancouver senior staff and managers to debrief from the *M/V Marathassa* oil spill response, to synthesize lessons learned about the impacts of marine oil spills to the City of Vancouver, and to extrapolate this experience to a potential worst case discharge from an oil tanker.

1.5 Information Sources for this Report

This report compiles information from multiple sources. Published references are listed in Section 8. Group discussion during the two days of the workshop is summarized in Sections 5 and 6. Additional information sources include:

- City of Vancouver Emergency Management staff provided information about the *M/V Marathassa* oil spill response based on personal records and observations and Unified Command documentation.
- City of Vancouver and Vancouver Coastal Health staff contributed information about the City's roles in an oil spill and anticipated impacts of a major tanker spill during Focus Group meetings that were conducted in advance of the workshop.
- Expert reports prepared for the City of Vancouver provided information about potential impacts of the hypothetical 16,000 m^3 diluted bitumen tanker spill; information from these reports is referenced to the source.

- The author participated in the *M/V Marathassa* spill response as a Unified Command technical advisor, reviewed all expert reports and external publications cited, and facilitated the Focus Group and workshop discussions summarized in this report.

1.6 Author Information

This report was prepared by Nuka Research and Planning Group, LLC under contract to the City of Vancouver. Nuka Research was retained as an expert in oil spill contingency planning and response to design and facilitate a marine oil spill tabletop exercise for senior City leadership.

Elise DeCola, the author of this report, is a founding Partner, Principal Consultant, and Operations Manager of Nuka Research and Planning Group, LLC (Nuka Research). Elise has been working as a policy analyst, contingency planner, and spill response technical advisor since 1996. She has developed oil spill contingency plans and emergency response plans for vessels, pipelines, oil storage facilities, and exploration and production operations. She has advised on oil spill response operations for local, state, and aboriginal groups, including recent experience as a Technical Advisor to Unified Command during the *M/V Marathassa* spill response in English Bay.

Elise was the Lead Facilitator for the City of Vancouver Oil Spill Debrief and Tanker Scenario Planning workshop. She organized and led the discussion during the two-day workshop as well as the Focus Group meetings and Corporate Management Team briefings that led up to the event. Elise has a broad range of experience organizing and facilitating workshops, field deployments, and emergency management exercises. She has facilitated a number of industry-led oil spill response exercises, including a multi-day Crisis Management Team exercise for a major U.S. oil company's corporate Safety, Health and Environment Group in preparation for the Y2K rollover. She has also conducted emergency management tabletop and field exercises for municipalities in Alaska ranging from large boroughs to small Alaska Native villages. She created a field exercise program in Massachusetts where local first responders implement geographic response plans to test strategies and improve readiness. She has also organized and facilitated workshops and workgroup meetings on topics ranging from oil spill tactics to meteorological observation systems to oil spill simulant and surrogate materials.

Ms. DeCola holds an MA in Marine Affairs from the University of Rhode Island and a BS in Environmental Science from the College of William and Mary in Virginia. Her curriculum vitae is included as an appendix to this report, and highlights some of her recent academic and technical peer-reviewed publications.

A certificate of expert's duty is included as Appendix E.

2. Purpose, Scope, and Format of English Bay Oil Spill Response Debrief and Tanker Scenario Planning Workshop

2.1 Workshop Goal

The goal of the *M/V Marathassa* Oil Spill Debrief and Action Planning Workshop was to evaluate the impacts of marine oil spills to the City of Vancouver by applying lessons learned from the spill in English Bay to broader oil spill risk scenarios.

2.2 Concept

Planning for the workshop was actually initiated before the English Bay oil spill occurred. The City of Vancouver originally planned to conduct a Tabletop Exercise to provide an opportunity for the City's Corporate Management Team (CMT) to evaluate the consequences of, and the City's preparedness for, a major marine oil spill.

As the City became engaged in the English Bay oil spill response, it became clear that a hypothetical scenario-driven exercise was no longer necessary to demonstrate how an oil spill would impact the city; however, because the English Bay spill was much smaller than a worst case tanker spill, there are elements of the City's response that were not exercised during the *M/V Marathassa* incident. The Tabletop Exercise was re-framed as an Incident Debrief and Tanker Scenario Planning Workshop, to provide an opportunity to review the lessons learned during the recent fuel oil spill response while also considering the consequences of a major tanker spill response to the City of Vancouver.

2.3 Pre-Workshop Activities

During the weeks prior to the April 23-24 workshop, a series of Focus Group meetings were conducted to orient participants to the purpose of the workshop, to initiate discussion about the scale-up tanker scenario, and to collect information from each department to inform the scenario discussion. A summary of these events is listed the Table below.

Pre-Workshop Activities

Pre-workshop Activity	Date (2015)	Summary	Participation
Executive Sponsors Committee Brief	April 7	Presentation to brief Executive Sponsors Committee on scope and format of Marine Oil Spill Tabletop Exercise and align objectives.	Executive Sponsors Committee
Marine Oil Spill Response Overview	April 9	Original intent was to provide "Oil Spill 101" contents – basics of Unified Command, spill response functions, and City role/priorities. Scope was expanded to include a briefing from COV EOC on evolving *M/V Marathassa* incident and general discussion of incident actions and priorities.	COV Corporate Management Team; EOC Staff
Focus Group Discussions	April 14, 15, 17	Smaller informal group meetings with senior staff to scope out roles and responsibilities and discuss ongoing response to English Bay spill and priorities for oil spill preparedness across all key functions and departments. A fourth session had been planned for April 10 but was cancelled because staff was occupied with *M/V Marathassa* response.	Senior staff

2.4 Workshop Schedule

The workshop was conducted as two half-day sessions. The schedule is summarized below.

DAY 1: *M/V Marathassa* Debrief

April 23: 1:00 to 5:00 pm

- Introductory Remarks
- Marathassa Incident Recap (Facts & Timeline)
- Round Table Discussion
- Synthesis of Key Lessons from *M/V Marathassa* Oil Spill Response
- Recap of Discussion

DAY 2: Tanker Scenario Planning

April 24: 8:30am to Noon

- Introductory Remarks
- Present Diluted Bitumen Tanker Scenario
- Break-out Group Discussion
- Report out on Action Planning Items
- Synthesis and Next Steps

2.5 Participation

Participants in the April 23-24 workshop included a Facilitation Team and Participants. The Facilitation Team was lead by a contracted facilitator (Nuka Research and Planning Group, LLC) with substantial support from City of Vancouver Emergency Management and Vancouver Services Review (VSR) staff. The 43 participants included CMT members and senior staff from the City of Vancouver (COV) and Vancouver Coastal Health.

Workshop participants and their roles and affiliations are listed in Appendix A.

3. M/V Marathassa Incident Debrief

Day 1 provided an opportunity for City of Vancouver CMT members and senior staff to share their experiences from the *M/V Marathassa* incident response through a facilitated discussion that focused on synthesizing key lessons that could be used to improve preparedness for future events.

Three prompts were provided to guide the roundtable discussion:

1. Identify **specific actions** that the City of Vancouver took during the English Bay spill response that positively contributed to the outcomes of the response.
2. Identify **specific gaps** (in information, policy, plans, resources) that you observed or experienced in the City of Vancouver's capability to respond to the English Bay oil spill.
3. Identify the **most critical outcomes** for the City of Vancouver in responding to any size or scale of oil spill.

3.1 Actions that Led to Positive Outcomes during the *M/V Marathassa* Incident

City Role In Unified Command and Incident Command Post Presence

Prior to the *M/V Marathassa* incident, it was unclear whether or not the City would be included as a partner in the Unified Command structure. As the *M/V Marathassa* response unfolded, a Unified Command was established to include municipal and First Nation interests along with responsible party, federal, and provincial representatives. The City's role in Unified Command was critical to the duty of care for citizens, because it facilitated a number of key processes, including:

- Quick compilation of local knowledge about the environment, resources-at-risk, and general logistics
- Synthesis of data on environmental, wildlife, and human health risks and vulnerabilities
- Proficiency in Incident Command System (ICS)

EOC Activation and Support for City Departments and Personnel

The City of Vancouver EOC was up and running within hours of the City's notification of the incident. By contrast, it took several days for an Incident Command Post (ICP) to be established and operational, and even then there were several key functions that were not filled. This quick activation of the EOC allowed the City to fill some initial gaps while the oil spill ICP took longer to ramp up. The City generated more frequent, detailed situation reports that provided a good communication tool for City leadership and external agencies.

Coordination with Key Partners and Stakeholders

The City engaged almost immediately with other local partners and stakeholders, including surrounding municipalities, Vancouver Coastal Health, First Nations, and organizations like the Vancouver Aquarium. Together, these groups initiated independent sampling programs to inform the evaluation of risk to the public and the marine environment.

City of Vancouver Public Information, Communications, and Messaging

The City has established mechanisms and processes for communicating information to the public, and these existing processes were applied to the spill response. The City's information team was able to develop and disseminate information to the public and press much more quickly than the Unified Command information releases, which often lagged by days. The City used a range of communication tools – from social media to print media to messaging within the 3-1-1 call line – to share information with a concerned public. The City created signs to communicate beach closures and restrictions.

4.2 Gaps in Policy, Plans, or Resources Observed during *M/V Marathassa* Incident

Delays in Incident Notification Process

The City of Vancouver received no notification of the English Bay spill from federal authorities. Instead, WCMRC provided a courtesy call to Emergency Management staff based on established working relationships. The value of the informal relationship was key, but the lack of formal notification resulted in a 12-hour delay in the City being able to plan, mitigate and respond to impacts from the spill. That delay meant that the window of opportunity for certain activities – i.e. protective booming ahead of shoreline impacts and collection of baseline samples ahead of the oil – was shortened or lost.

Delays in Responsible Party Acceptance of Responsibility

Most oil spill response plans presume that the polluter will notice the spill and notify the authorities right away. A recreational boater who noticed the slick originating from the *M/V Marathassa* first reported the English Bay oil spill. Aerial photographs showed a visible plume of oil trailing from the stern of the vessel, and media reports state that *Marathassa* crew members were observed to be cleaning up oil from around the ship using buckets shortly after the spill was reported. Yet, the vessel repeatedly denied responsibility for the spill. There was a delay in ramping up a response that was attributable at least in part to the fact that the responsible party initially denied any responsibility. There were delays in establishing an Incident Management Team. There were also losses of knowledge and efficiency in the transfer of spill management authority from the federal government back to the ship owner once they accepted responsibility for the spill.

Gaps in Incident Management Team and Incident Command System Implementation

The English Bay oil spill was only the third time that the CCG had implemented the Incident Command System (ICS) as a method for organizing and managing the spill response, and there were some challenges in its implementation. While the COV and Provincial staff assigned to the ICP had a common understanding of incident command based on the BC Emergency Response Management System (BCERMS) that is used for all hazards, there was a very uneven level of ICS proficiency among federal agencies and other partners in the ICP. This manifested in many ways, including delays in producing Incident Action Plans (IAP), lack of consistency in incident documentation, outdated or incorrect information posted in ICP situation displays, incomplete staffing of all ICS functions, and an often chaotic meeting environment. The City of Vancouver made a number of recommendations to the CCG and RP during the response to try to enhance the ICS implementation.

Gaps in Spill Science and Environmental Protection

The RP hired a single consulting firm to simultaneously serve as the RP's designate in the Unified Command and to conduct shoreline assessment. The City of Vancouver and other local stakeholders expressed concern about this relationship during the response, but it was permitted by the CCG. As a result, there were a number of issues where the City of Vancouver believes that a conflict of interest may have adversely impacted the rigor of environmental assessments and cleanup conducted during the response. Specific examples include:

- Shoreline Cleanup and Assessment Technique (SCAT) teams did not fully survey all areas of impacted or potentially impacted shoreline in the Burrard Inlet and English Bay.
- Shoreline assessment maps produced by the RP's contractor were incomplete and inaccurate.
- Insufficient environmental sampling and monitoring was conducted, and the RP's representative to Unified Command discouraged scientific sampling.
- No protective booming was ever deployed ahead of the oil slick.
- Cleaning the vessel so that it could be released back into commerce was a top priority of Unified Command, and the City along with other local stakeholders expressed concern that the commercial interests of the vessel owner were given priority over the public interest in cleaning and assessing shorelines.
- Shoreline assessment documentation did not follow industry best practices (e.g. consistent segment mapping; consistent signoff process for all segments).

Draw on City Resources

The spill response created a significant draw on City resources, including operational staff (particularly within Parks, because of the need for additional attention on beaches and parks). The City actively engaged in activities to protect the public and, in turn, improve the outcome of the response. These activities helped to mitigate the adverse impacts of the spill (keeping oily waste out of regular waste streams, keeping the public from handling oily waste without proper training and equipment, providing real-time reports from the field to UC via the EOC). This included:

- The City managed a convergent volunteer registration process through which 4,000 individuals volunteered to assist with the spill response. Although this volunteer force was not used during the response, the City developed a contingency plan for utilizing convergent volunteers. The city-run registration process provided a tool to collect information and an outlet for the concerned public to "do something."
- The City utilized existing trained and vetted volunteers through the Vancouver Volunteer Corps (VVC) to assist with beach patrols and disseminate information to the public. City staff were assigned to oversee the scheduling and management of volunteers.
- The City developed signs and assigned representatives (employees and volunteers) to communicate beach closure information to the public.
- The City provided Sanitation resources to manage initial disposal of oily waste during the initial days of the response, because convergent volunteers were placing oily waste in City trash receptacles.

4.4 Critical Outcomes

The following were identified as critical outcomes for the City of Vancouver in managing oil spill response:

- Ensure City role and participation in Unified Command.
- Be prepared to manage convergent volunteers.
- Be prepared to collect the necessary information (samples, monitoring, etc.) to assess potential human health impacts and communicate those clearly to the public.

5. Impacts of a Hypothetical 16,000 m^3 Diluted Bitumen Tanker Spill at First Narrows to the City of Vancouver

The workshop provided an opportunity for participants to apply the lessons learned by the City of Vancouver during the *Marathassa* incident to a hypothetical worst case discharge from a diluted bitumen tanker. Participants were presented with a spill scenario and provided with background information from City of Vancouver experts regarding the potential impacts of such a spill to the City.

5.1 Tanker Spill Scenario

Participants were presented with a hypothetical oil spill scenario that is consistent with a worst case discharge scenario as described in the Trans Mountain Expansion project application:[2]

> *At 07:00 on April 25, the laden oil tanker FSL Shanghai loses control of steering and collides with the M/V Utopha while transiting through the First Narrows. The collision causes the vessel to release 16,000 m^3 of Cold Lake Blend diluted bitumen into Burrard Inlet. It is a sunny spring Saturday with a number of events going on around the City.*

A spill of this size is over 5,000 times larger than the reported volume spilled by the *M/V Marathassa*, so the scope and scale of issues that the City would face would be more severe by an order of magnitude.

Information compiled by City of Vancouver experts during the Trans Mountain Expansion Project NEB hearing was discussed to help frame issues and assumptions for the diluted bitumen tanker scenario discussion.

5.2 Shoreline Impacts

The *Hebei Spirit* oil spill was briefly discussed to provide context for how a 16,000 m^3 spill might impact the shoreline of Burrard Inlet.

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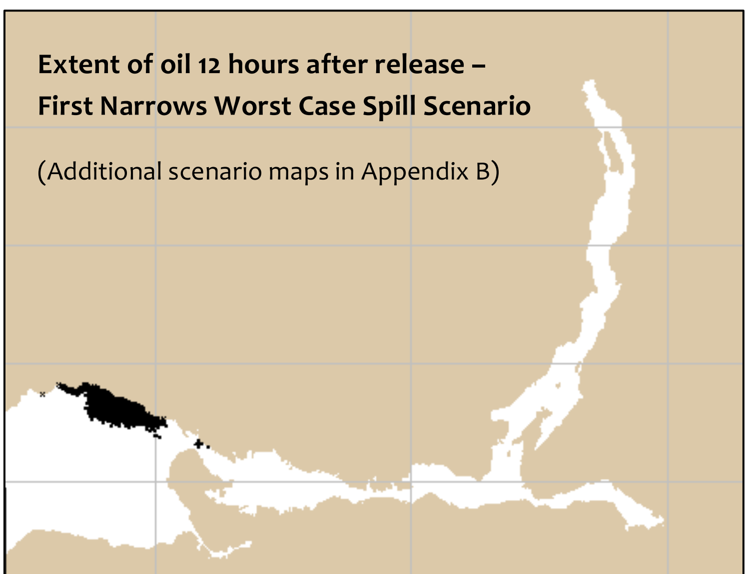
[2] Application materials describe the probability of a collision at First Narrows as increasing from 0.16% per year if the project is not approved (return rate of 597 years) to 1.14% per year in 2018 (return rate of 88 years) and 1.25% per year in 2028 (80-year return rate) if the project is approved (DNV, 2013).

Shoreline impacts from 11,000 m^3 *Hebei Spirit* oil spill. A worst case First Narrows spill would be larger and occur closer to shore.

The *Hebei Spirit* was a heavy oil spill that occurred 8km off the coast of Korea during 2007. The 11,000 m^3 spill was driven onto local beaches by wind and tide, and caused significant shoreline oiling and wildlife impacts. Oil persisted on the beaches for years (Yim et al., 2012). By comparison, a spill at the First Narrows would be much closer to shore; shoreline impacts could be expected soon after the release. Heavy oiling of the Burrard Inlet shoreline could take months to clean, and based on the experience during the *M/V Marathassa* spill, there would likely be a significant convergence of local residents trying to clean up the oil. The City of Vancouver could be faced with tens of thousands of volunteers and would require significant public safety resources to keep the public away from oiled beaches.

A series of trajectory maps were presented to illustrate the Burrard Inlet 16,000 m^3 diluted bitumen tanker scenario, showing potential shoreline impacts based on actual environmental conditions modeled for April 25, 2005. The maps were generated from a model that was developed by Genwest Systems, Inc. to support the City of Vancouver and other Interveners in the Trans Mountain Expansion Project NEB review (Genwest, 2015).



Extent of oil 12 hours after release – First Narrows Worst Case Spill Scenario

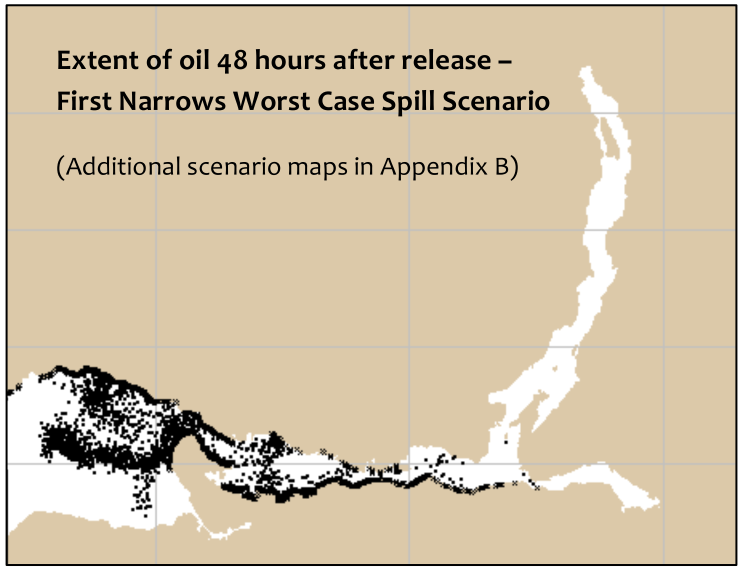
(Additional scenario maps in Appendix B)

The model shows that within

two hours of the spill, a thick on-water slick begins to spread and migrate. Six hours after the collision occurs, a 3.5 km slick of oil moves toward the West Vancouver shoreline between West Bay and Sandy Cove, and some of the oil reaches the rock and gravel shoreline.

Within 12 hours, more than 5 km of the West Vancouver shoreline, from John Lawson Park at Ambleside to Godman Creek at Sandy Cove, have been fouled. Over a quarter of the total spill volume has encountered shoreline at this point. Some of the oil may re-float, and the sediments that are attached to the sticky oil will contribute to potential sinking.

Stranded oil may persist on the shoreline for months to decades, depending on the shoreline type.

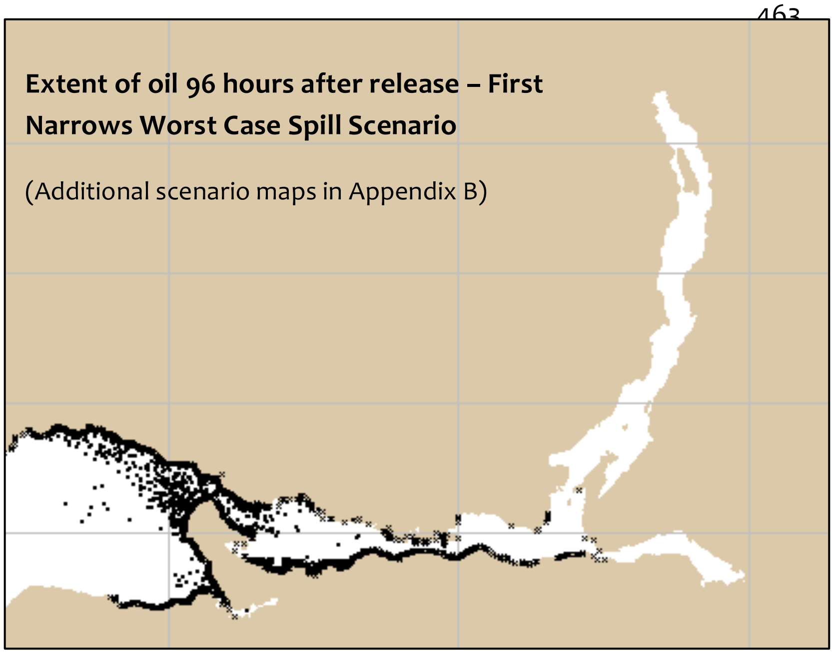


Extent of oil 48 hours after release – First Narrows Worst Case Spill Scenario

(Additional scenario maps in Appendix B)

Twenty-four hours after the two ships collide, oil has migrated with the incoming tide and impacted shoreline on the north side of Stanley Park. By the time 48 hours has elapsed, over 70% of the total spill volume has hit shorelines throughout the Burrard Inlet reaching back to Port Moody. Nearly the entire coastline of Stanley Park has been oiled.

Within 72 hours of the ship collision, oil has spread with the wind and tides to impact the South Shore including Sunset Beach and False Creek.



Extent of oil 96 hours after release – First Narrows Worst Case Spill Scenario

(Additional scenario maps in Appendix B)

By Hour 96, 83% of the spilled oil has reached the shoreline, with impacts extending form English Bay into Indian Arm. The window of opportunity for recovering oil on-water would have passed by this time, and response operations would turn to shoreline cleanup, which can be slow and arduous. Sometimes, cleanup techniques are so invasive that oil is left to naturally weather over time.

A spill of this magnitude has the potential to impact significant populations of birds, marine mammals, fish, and shoreline vegetation (discussed in Section 5.4).

Workshop participants applied the following scenario planning assumptions about the spill trajectory:

- The oil will impact shoreline within hours
- Shoreline impacts will be widespread throughout Burrard Inlet
- Oil will come ashore in thick oil mats as well as discontinuous patches

Appendix B contains maps produced for the City of Vancouver by Living Oceans, showing the extent of the spill at 2, 24, 48, and 72 hours overlaid with data about at-risk species and habitats.

5.3 Air Quality Impacts to Public Health and Safety

A diluted bitumen spill may also release a significant vapour cloud, creating responder and public safety concerns, as was experienced in Kalamazoo, Michigan following a diluted bitumen pipeline spill in 2010. That spill, which occurred in a rural area with a much smaller population base than the City of Vancouver, resulted in 147 health care visits by local residents and spill responders in the weeks following that spill. Clinical effects noted by medical treatment authorities included neurological, cardiovascular, dermal, ocular, renal, and respiratory problems. A survey of four exposed communities closest to the spill resulted in 97% to 100% of residents reporting noticing an odor for weeks following the spill. Local poison control and reporting procedures were critical to the State of Michigan's ability to manage human health exposures from the Kalamazoo River diluted bitumen spill. (Stanbury et al., 2010)

A major marine oil spill in the Burrard Inlet would create immediate air quality concerns for local residents. The City of Vancouver has a responsibility to protect residents by working with Vancouver Coastal Health to evaluate air quality data and inform the public of risks to public health and safety. In the event that a diluted bitumen spill presents an acute risk to human health or public safety, the City would be responsible to direct emergency safety measures such as evacuation or shelter-in-place.

As soon as oil spills from a tank or pipeline and begins to pool on a water surface (or on land), the oil undergoes a series of physical and chemical changes (Fingas, 2011). The lighter ends of the hydrocarbons tend to evaporate quickly, and as these chemical constituents move from a liquid to a gaseous phase, the vapours may present human health and safety risks related to chemical toxicity and explosive or flammability risks. Most of the documented research on oil vapour toxicity to humans has been done in the context of spill responders, since they are the individuals who typically come into closest contact with the oil (CDC, 2010). However, a major tanker spill in the Burrard Inlet could create air quality concerns for local residents because of the close proximity of the waterway to heavily populated areas.

A 2013 study by the US government found that, depending on the type and percentage of diluent mixed with the bitumen, low flash point and flammability may pose an explosive risk (Crosby et al., 2013). There has been no modeling completed to date to consider the potential explosive risk of a major diluted bitumen tanker spill at First Narrows, but this is also an issue of high concern to the City of Vancouver. Workshop participants noted that the gases associated with Cold Lake diluted bitumen would be heavier than air and therefore pose a potential explosive risk.

Workshop participants applied the following scenario planning assumptions about air quality:

- The oil slick will create a vapour plume with benzene levels above the acute exposure limits
- The City will need to assess the situation to decide whether to evacuate, shelter-in-place, or issue other health and safety advisories to potentially affected residents
- The oil slick may create explosive or flammability risks
- Real-time data from air quality sensors may or may not be provided by the Responsible Party or response contractor; the City and other municipalities may need to conduct independent monitoring

Material safety data sheets (MSDS) and chemical properties information for Cold Lake Blend diluted bitumen were distributed and are included in Appendix C. Workshop participants noted that Cold Lake Blend is only one of many diluted bitumen products that could be transported through the region; it will be very important for local first responders and health authorities to have immediate access to product information if a spill occurs in order to adequately address the potential air quality and explosive risks.

5.4 Environmental Impacts

The hypothetical 16,000 m^3 diluted bitumen oil spill scenario would have significant adverse impacts to shoreline habitat, wildlife, and ecological health. It is assumed that a spill of this magnitude in the Burrard Inlet could result in major kills of sea- and shorebirds and marine mammals, and could have ecosystem-wide adverse effects.

The trajectory modeling for a First Narrows spill shows that a 16,000 m^3 diluted bitumen release would impact shorelines throughout the Burrard Inlet and English Bay (Genwest, 2015). Direct oiling will adversely impact intertidal species and habitats. Different shoreline types would retain this oil to different degrees, with the potential for oil to linger on certain cobble shorelines for decades. Shoreline oil can re-mobilize and move, leading to re-oiling events that can persist long after the spill response is completed.

Diluted bitumen weathers into a heavy, viscous residue that can submerge or sink in some waters, particularly where salinity is low or suspended particulates are high. High wave energy and entrainment of shoreline sediments can also cause diluted bitumen to sink or submerge (King et al, 2014). Sunken or submerged oil is difficult to detect and recover, and may cause impacts to benthic or subtidal species and habitats. Unrecovered submerged oil can be another source of persistent re-oiling.

Workshop participants applied the following scenario planning assumptions about environmental impacts:

- There will be significant bird mortality
- There may be impacts to marine mammals
- The oil may potentially sink or submerge
- Shoreline re-oiling is possible
- Oil will linger on shorelines well past the end of active clean-up

5.5 Economic Impacts

The economic cost of oil spills to local governments is difficult to quantify for a number of reasons. Costs are incurred over time, sometimes many years or decades, and can be difficult to compile. Oil spill costs are often covered through legal pleas or court settlements with confidentiality attached. And some of the costs are simply difficult to measure. A study commissioned by the City of Vancouver identifies a range of cost categories where local governments may incur costs as the result of a major marine oil spill (Stone, 2015). These include the following, most of which the City of Vancouver also bore during the *M/V Marathassa* spill response.

- Cost of response activities
- Cost of providing space to stage response operations, provide housing for workers, provide office space, etc.
- Cost of evacuating public and sheltering evacuees
- Cost of increased first responder and emergency services
- Public health costs
- Costs of collecting, transporting, and disposing of waste generated by the response and recovery efforts
- Communications costs
- Volunteer management costs
- Cost of compiling data and research about damages
- Cost of recovery planning
- Interim financial relief and payout to impacted residents and services
- Cost of mitigation and preparedness for future response and recoveries
- Lost tax revenues
- Legal costs
- Permitting and regulatory oversight
- Lost use of public spaces
- Efforts to recover the City's brand image
- Opportunity costs of city staff time and resources allocated to the spill

The study estimates that the cumulative costs borne by a city after a major marine oil spill could be close to $1 billion (Stone, 2015).

Workshop participants applied the following scenario planning assumptions about economic impacts:

- Economic impacts will be widespread, will persist for an indeterminate length of time after the spill occurs, and will be challenging to measure.

5.6 Oil Spill Response Limitations

Most of the modeling for a diluted bitumen tanker spill at First Narrows considers how the unmitigated oil slick would move and weather. Under most circumstances, the Responsible Party and Canadian Coast Guard will engage an oil spill response contractor to attempt to contain and recover the oil slick before it reaches the shoreline. However, as shown in the trajectory maps in Section 5.2 and Appendix B of this report, a spill at First Narrows will hit the shoreline within hours, because of the close proximity of the spills site to the Burrard Inlet shore. Once the oil reaches the shoreline, it becomes unavailable for on-water recovery, and instead must be cleaned off the beach.

On-water mechanical recovery of oil using boom and skimmers is only effective when the vessels are able to target the thickest concentrations of oil and the equipment is able to safely operate. Conditions that preclude aerial surveillance or operation of mechanical recovery systems may cause response delays. Periods during which no response can be mounted because of weather or environmental conditions are sometimes referred to as a "response gap," and have been widely documented in a range of environments. When response gap conditions occur, no on-water recovery of oil is possible. (SL Ross, 2011; Nuka Research 2012; Nuka Research, 2014a; Nuka Research 2014b; DNV GL, 2014)

During those times when no gap exists, on-water recovery operations will be constrained by other realities. Mechanical removal of oil on water is a labour-intensive and often inefficient process. On-water recovery may remove only a portion of the total spill volume.

Workshop participants applied the following scenario planning assumptions about spill response:

- Effective spill response will depend on speed of notification and deployment, weather and environmental conditions, and available equipment and responders
- It is impossible to fully contain and recover a 16,000 m^3 diluted bitumen oil spill, even under the best conditions
- Effective on-water cleanup may reduce the volume of oil that washes ashore, but there will be shoreline, wildlife, and environmental impacts regardless

6. Diluted Bitumen Tanker Oil Spill Scenario Discussion

Once the scenario had been presented and discussed, the workshop participants were divided into four groups and each assigned to a group to focus on specific discussion topics:

- Public health and safety
- Emergency management
- Public interface
- Consequence management

Each group was asked to consider how a large-scale tanker incident might impact the City, based on the *Marathassa* incident response, lessons from other major oil spills (reviewed during Focus Group sessions) and the assumptions about a major tanker spill scenario based on expert reports (summarized in Section 5 of this report). This section synthesizes the discussion on these four topics.

6.1 Public Health and Safety

Public health and safety is a cross-cutting issue that will impact all aspects of the City's involvement in a major oil tanker spill.

A 16,000 m^3 diluted bitumen tanker spill in English Bay would have much more significant and widespread shoreline impacts than the *M/V Marathassa* incident. Rather than tarballs washing ashore, large volumes of oil could coat beaches. The numbers of volunteers eager to assist with the cleanup would likely be much higher than the 4,000 volunteers for the *Marathassa* spill, and the human health risks associated with untrained volunteers converging on the beaches to clean up oil would be much higher. In addition to shoreline and wildlife impacts, a major diluted bitumen tanker spill that creates large concentrations of pooled oil on land and water would generate concern about potential human health and public safety risks from vapours or explosions.

Air Quality

The health and safety issue of highest concern to the City during a diluted bitumen tanker spill is the potential for toxic vapours to impact local first responders and the public. The City's first concern would be to understand and evaluate the extent, movement, and duration of a toxic plume from a diluted bitumen release. The recent container fire at Port Metro Vancouver provided another real world reference point for the implications of toxic vapours or air quality impacts in heavily populated metropolitan areas.

In the event of a diluted bitumen tanker spill with a large on-water oil slick, the City and Vancouver Coastal Health would need first to understand the potential air quality impacts in the vicinity of the release. They would want to initiate air quality monitoring immediately, and would need information to support decisions about whether to direct the public to evacuate high risk areas, shelter-in-place, or take other precautionary measures. Given the delays in confirming the product spilled from the *Marathassa*, and the lack of emergency plans and notification protocols provided by Trans Mountain in response to multiple requests from Interveners, there are strong concerns that the City and VCH would not have access to information that they needed to inform public health and safety decision-making.

The City also has a duty of care to first responders, and would work with Vancouver Police and Fire to ensure that first responders had appropriate protective gear, including respirators if needed, before getting to close to the spilled product. Local first responders would also be concerned about explosive risks, particularly in areas where police or fire responders might approach the oil slick in vehicles or vessels that present a potential ignition source. Any health or safety constraints that limit first responders' access to areas within the City would also impact their capacity to initiate public safety operations such as establishing safety zones, evacuating at-risk populations, and deploying air quality monitoring equipment.

Evacuation and Sheltering

Air quality information would be used to drive decisions about whether to direct residents to evacuate certain areas or shelter-in-place (remain in their homes with windows closed and ventilation turned off). Evacuation orders would need to take into consideration routes of travel and location of Shelters. Any public safety messages regarding evacuation or shelter-in-place would need to be communicated to vulnerable populations, which include live-aboard vessel occupants, homeless, and residents of various care facilities.

The prospect of evacuating thousands of residents creates significant logistical and practical challenges that would be difficult to overcome. Travel routes can become quickly congested, busses may not operate in areas where vapours exceed safe exposure limits, and designated shelters must be set up to receive displaced residents. Local medical centers will need to be prepared for a potential influx of patients, and the City would work with medical centers to provide accurate information about the human health risks and symptoms of exposure to diluted bitumen vapours. For this reason, workshop participants agreed that in the case of a major tanker spill that created immediate potential human health risks at the scale of thousands or more residents, the only feasible option for the majority of the impacted public would be to shelter-in-place.

If the City decided to issue a shelter-in-place order, it would be critical to understand the potential duration of the risk. It may not be safe or practical to turn off ventilation systems for prolonged periods, particularly for large commercial buildings.

Water and Beach Users

A major oil spill to the Burrard Inlet would also impact the safety of the public across a range of water use activities – from beachgoers to swimmers to boaters. Accurate information about the extent of the oil and the potential for oil to sink or submerge would be important to advising the public. The City would work with Vancouver Coastal Health and Unified Command to consider all potential routes of exposure to the oil in the water column, including ingestion of tainted seafood and skin contact for swimmers, boaters, or beach users. The City would take responsibility to set out signage and broadcast public advisories about areas or activities to avoid.

Cross-Contamination

A major tanker spill in Burrard Inlet would create significant gross contamination of beaches, seawalls, and other coastal infrastructure. The potential for members of the public to knowingly or unknowingly pick up oil on shoes or clothing and transfer that oil to other places is another aspect of public safety that would fall to the City. The City would coordinate with the transit authority and with City facility managers to come up with a contingency to deal with cross-contamination of public transit infrastructure or public buildings.

6.2 Emergency Management

Scaling up from a fuel oil spill like the *Marathassa* incident to a major cargo spill from an oil tanker would create additional strain on the City's Emergency Management core processes. The City's Emergency Management system would be impacted in several ways by a major tanker spill that involved a longer clean-up period and more extensive environmental damages.

Emergency Services

City emergency services would be immediately impacted by a major tanker spill at First Narrows. These impacts would include the need for vehicle traffic control on the Lions Gate Bridge and adjoining roadways, along with the need to establish safety perimeters around oil-impacted areas to protect the public at large. The City would likely be faced with making critical emergency response decisions, including whether to direct residents to evacuate or shelter-in-place to avoid potentially harmful vapours from the oil slick. For many of these functions, the City would be forced to make quick decisions against sparse or incomplete information. Despite the City's best efforts to keep the public out of harm's way, it is likely that there would be a number of emergency services calls to assist people that are impacted by oil vapours.

Emergency Management

Given the scale of the response, the City of Vancouver EOC will be activated to a Level 3, with the Policy Group in the EOC. This would be the first time that the City of Vancouver EOC has ever activated above a Level 2, and would require additional resource tracking, management, and coordination.

Closing and Reopening Public Use Areas

Vancouver Public Health is responsible for determining when it is or is not safe for the public to access impacted areas, and the City would work closely with the health authority to make decisions about closures. The City had some experience with beach closures during the English Bay spill, and found that oiled beaches often attract the public, which could endanger their health and safety if they come into contact with the oil or harmful vapours . In the event of a major oil spill with widespread shoreline impacts, the City would be faced with closing large expanses of seawall, beach and park areas, and with limiting on-water recreation in impacted areas. The City would work with the Unified Command to identify appropriate measures to enforce these closures. The City would work with Vancouver

Coastal Health to make informed decisions about when it is safe for the public to begin using impacted public beaches, parks, seawall, and waterways.

Human Resources

A tanker spill would require more intense staff support – larger numbers of City staff assigned to both the EOC and ICP for a much longer duration of time, as well as field staff assigned for long periods of time to support response and recovery operations, provide information to the public, and manage the impacts of evacuation and shelter-in-place emergencies. During the English Bay oil spill, which was small in comparison to the tanker spill scenario, significant demands were placed on staff in the field, at the EOC, and at the ICP. Burnout became a concern, and the duration of that response was only a couple of weeks. Managing all aspects of the City's human resources – from assigning staff to various functions and shifts, to ensuring adequate rest and protecting emotional well-being – would be a real concern for a major, prolonged oil spill response.

Continuity of Operations

The scope and scale of a major tanker oil spill response would put major pressure on the ability to maintain City services, as well as the ability of First Responders to maintain a level of service to respond to other types of emergencies across the City. Coordinating the City's activities and prioritizing City operations – what will be done and what won't be done given limited capacity – will become a major strategic focus. Some departments may need to suspend non-essential services for a period of time. Additional staff may need to be hired or contracted in order to maintain services.

Decision-making in the Absence of Complete Information

While the City has the ability to develop plans and capabilities for emergency response and management, there will always be a need for situation-specific information that can only be gathered in the moment. Two recent experiences – the English Bay fuel oil spill and Port Fire – demonstrated that the information that is needed to make decisions is not always available in time for it to be useful. Critical ephemeral data or situation-specific information needed to support City decision-making includes:

- *Type of product spilled.* (In the case of a diluted bitumen spill, it would be important to know the type and formulation of the oil, because these products vary based on the parent bitumen and the type and quantity of diluent used.)
- *Estimated size of release.*
- *Material safety data sheets and chemical profiles of spilled oil.*
- *Air quality monitoring data, including both acute exposure levels for human toxicity and explosive/flammability risks.*
- *Fate and effect of the spilled product.* (Trajectory and plume models, fate and behavior, etc.)

6.3 Public Interface

The City's role as the first point of contact for the concerned public was emphasized during the *M/V Marathassa* oil spill. The level of public interest and concern during the early days of the spill provided a small insight into how the public reacts when oil spills impact their home. A major diluted bitumen spill would present a public relations situation an order of magnitude more complex than the English Bay spill.

Public Information

The City provided a critical communications and public information link throughout the *Marathassa* spill response. During the spill, the City of Vancouver's public information process occurred more quickly than news or information releases from the Unified Command. The City made every effort to proactively communicate factual information about the spill, but at times information about the status of the spill and response were difficult to obtain, even through the appropriate channels at the Incident Command Post. The City and other agencies requested a Joint Information Centre (JIC) be established, but this was never fully achieved.

In the event of a major marine tanker spill, all of the channels and modes of disseminating and collecting information from the public – such as 3-1-1 call centre, website, press releases, and social media outlets – would likely be implemented, but may require additional staffing and support resources. The duration of the communications and information cycle would also be much longer.

Volunteer Coordination

The number of volunteers that would emerge during a major tanker spill could be significantly higher than the 4,000 people that came forward during the *Marathassa* spill, and managing this high volume of people interested in helping with the spill response could create a major draw on city resources. Volunteers require coordination and oversight, and many of these functions would fall to City staff.

There are a number of legal and practical considerations in utilizing volunteers during oil spills. While these volunteers can fill important and necessary holes in the available labour force, they should not be involved in active oil spill cleanup or response functions unless appropriately trained and credentialed. Sorting out this information takes time and dedicated oversight. It is important to the City that the public is able to contribute to response and recovery of their community. Identifying appropriate avenues to safely engage volunteers is best practice in emergency response, and should be no different for oil spills.

6.4 Consequence Management

The short- and long-term consequences of a major tanker spill to the City of Vancouver would be significant and far-reaching. During the *M/V Marathassa* oil spill, the City experienced a range of impacts associated with the spill response and also came to appreciate that there is significant uncertainty involved in anticipating long-term consequences.

Shoreline Impacts

The City learned during the *M/V Marathassa* oil spill that shoreline cleanup operations do not continue indefinitely; cleanup endpoints are established and once a beach reaches those endpoints, no further efforts are made to clean the oil from the beach. For the English Bay spill, cleanup endpoints for high public use beaches required that residual oil on beaches was no longer tacky to the touch. For other shorelines along the Burrard Inlet, beach cleanup was considered to be complete once visible tar balls below a certain size (e.g. 3 cm) had been removed. In many locations, including parts of Stanley Park, segments of shoreline with visible "bathtub rings" of oil staining rocks and seawall were left to naturally degrade based on a net environmental benefit analysis (NEBA) process where the Unified Command determined that further efforts to clean the stain could cause more harm than good.

Based on this experience, the City of Vancouver recognizes that it will not be possible, after a major tanker spill, to fully clean every meter of impacted shoreline. There will be residual oil left on the shorelines of the Burrard Inlet, and this will be one aspect of the oil spill's lingering effects.

The consequences of residual or lingering oil along the Burrard Inlet coastline are difficult to measure. Any lingering oil that is biologically available can continue to harm wildlife. Lingering oil stains also create a perception of taint or pollution that may impact recreation, tourism, and quality of life for local residents.

Wildlife and Ecological Impacts

A major tanker spill in Burrard Inlet will have significant adverse impacts to sea and shorebirds and marine mammals that will propagate to other marine species and cause ecosystem-level effects. Shoreline habitat may be damaged or destroyed, and submerged or sunken oil may also impact benthic habitat and organisms. The implications of these wildlife and ecological impacts will be far-reaching and will be directly linked to socio-cultural and economic damages. All have the potential to impact the City of Vancouver and its residents.

Socio-Cultural Impacts

Local residents bear the brunt of the human impacts whenever an oil spill occurs. Local impacts may be immediate – disruptions to daily life, damage to public and private resources or infrastructure – or long-term. During the exercise, the City considered experience from past major oil spills like the *Exxon Valdez* spill in Alaska or the Deepwater Horizon well blowout in the Gulf of Mexico have shown that oil spills can have significant adverse community impacts. The City will deal with these impacts both directly and indirectly for years to decades after a major oil spill occurs.

Economic Impacts and Claims

Section 5.4 discusses the many ways in which oil spills can impact local economies. The English Bay spill response had definite economic impacts on the City of Vancouver, and the spill response lasted for only a couple of weeks. The City expended staff time and resources to support the response, and incurred costs by providing services such as waste removal, posting signs, and crowd control. The City lost revenue that would have been generated through ticketing, because enforcement staff were diverted to support the spill response.

The City is currently in the process of compiling cost data from the *M/V Marathassa* spill response as part of the cost recovery process. In the event of a major marine oil spill, the economic impacts would be much more significant. The City recognizes the importance of documenting all costs and their justification clearly. However, the City is concerned about liability limits in the event that a major spill resulted in significant damages that exceed the ship's insurance liability caps.

7. Conclusions

The City of Vancouver is acutely aware of the potential for a major marine oil spill to impact the City, its residents, services, and resources. The City recognizes that part of its duty of care to local residents involves preparing for marine oil spills, particularly as the risk of spills in the Burrard Inlet and English Bay may increase if the Trans Mountain Expansion Project is approved.

The City began planning for a Tabletop Exercise that would allow senior staff to consider the implications of a major marine oil spill by participating in a simulated response to a hypothetical tanker spill. When the *M/V Marathassa* fuel oil spill occurred within weeks of the planned Tabletop Exercise, the City changed their approach to incorporate a debrief of the English Bay spill response with a facilitated discussion that considered how the City might need to scale up their recent experience in the face of a 16,000 m^3 diluted bitumen tanker spill.

The English Bay spill response helped to clarify the City's understanding of how a marine oil spill response would proceed, in terms of the incident management, the response operations, and the effectiveness of the cleanup. The *M/V Marathassa* spill occurred while the ship was at anchor in English Bay, and yet there were still documented delays in notifying local officials, assigning responsibility to the shipowner, containing the source of the spill, and initiating oil recovery operations. The oil impacted shorelines throughout the Burrard Inlet and in English Bay.

Building from this experience, the City of Vancouver realizes that the impacts of a major diluted bitumen tanker spill at First Narrows would be catastrophic, even if the response proceeded with no complications or delays. This scenario planning workshop helped the City to identify areas where the City can continue to focus its preparedness efforts in the event of future spills. The exercise also exposed a fundamental reality that the consequences of a worst case tanker spill in the Burrard Inlet could not be fully mitigated, and that there would be significant adverse impacts to the local environment, culture, public health, and economy.

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Appendix A. Participant List

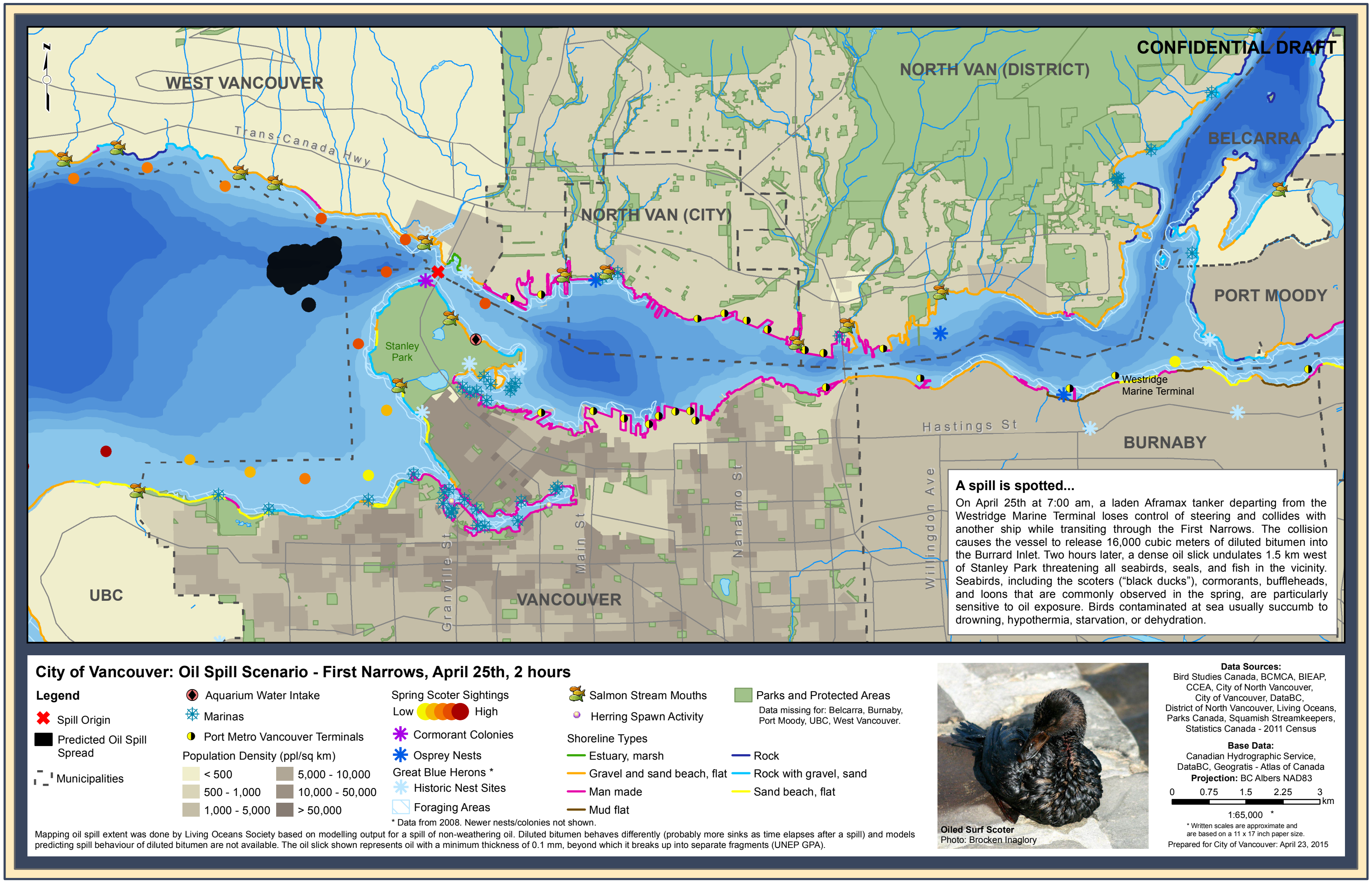
Workshop Participants

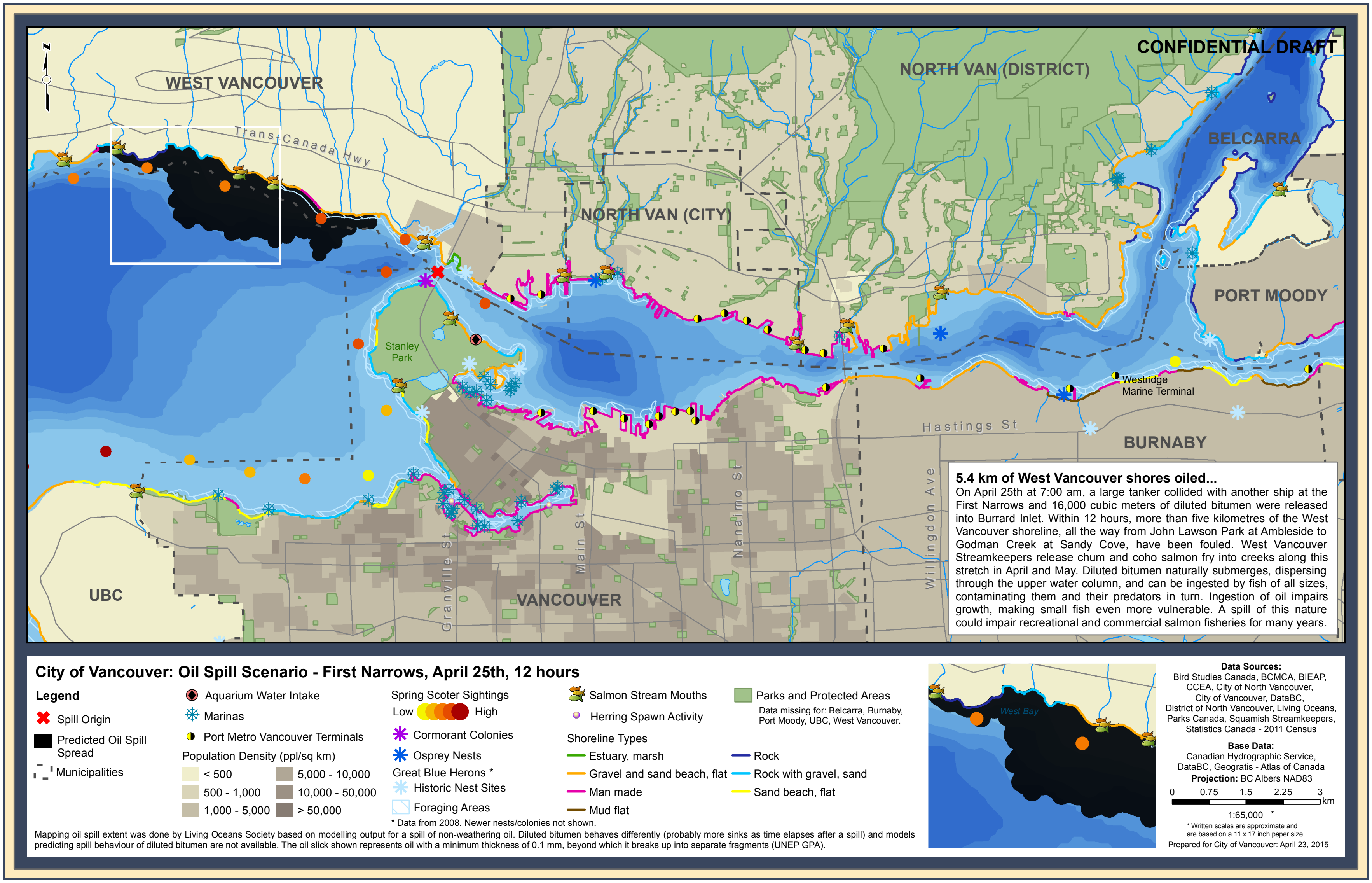
Participant	Title	Affiliation
Andrew Naklicki	Deputy General Manager, Human Resources	COV Human Resources
Andrew Ross	Manager, Organizational Safety	COV Organizational Safety
s. 15(1)(l)		
Bill Aujla	General Manager, Real Estate & Facilities Management	COV Real Estate & Facilities Management
Bill Harding*	Director of Parks	COV Park Board
Brian Crowe	Director Water. Sewers & District Energy	COV Engineering Services
Brian Jackson	General Manager, Planning & Development Services	COV Planning & Development Services
Carolina de Moura	Risk Manager	COV Risk Management
Dale Booth	Assistant Chief Operations	Vancouver Fire and Rescue - Emergency Services
Dan Wood	Assistant Chief	Vancouver Fire and Rescue - Emergency Services
Daniel Stevens*	Director of Emergency Management	COV Emergency Management
Darcy Wilson	Director, Digital & Contact Centre Services	COV 3-1-1 Contact Centre
Doug LePard	Deputy Chief Constable	Vancouver Police Department - Operations Division
Eric Smith	Director, Finance & Facilities Development	Vancouver Public Library
James Lu	Medical Health Officer	Vancouver Coastal Health
Jason High	Sergeant, Marine Unit	Vancouver Police Department, Marine Unit
Jason Twa	Assistant Director, General Litigation	COV Legal Services
Jennifer Mayberry*	Manager, Environmental Planning, Facilities Planning & Development	COV Real Estate & Facilities Management
Jerry Dobrovolny	Director of Transportation	COV Engineering Services
Jim DeHoop	Managing Director, Housing Delivery and Operations	COV Housing & Delivery Operations
John McKearney	Fire Chief	Vancouver Fire and Rescue
Katie McPherson*	Manager, Emergency Planning	COV Emergency Management
Kelly Oehlschlager	Assistant Director, Construction, Procurement & Technology	COV Legal Services
Malcolm Bromley	General Manager, Park Board	COV Park Board
Marvin Rogers	Director, Facilities Operations	COV Real Estate & Facilities Management

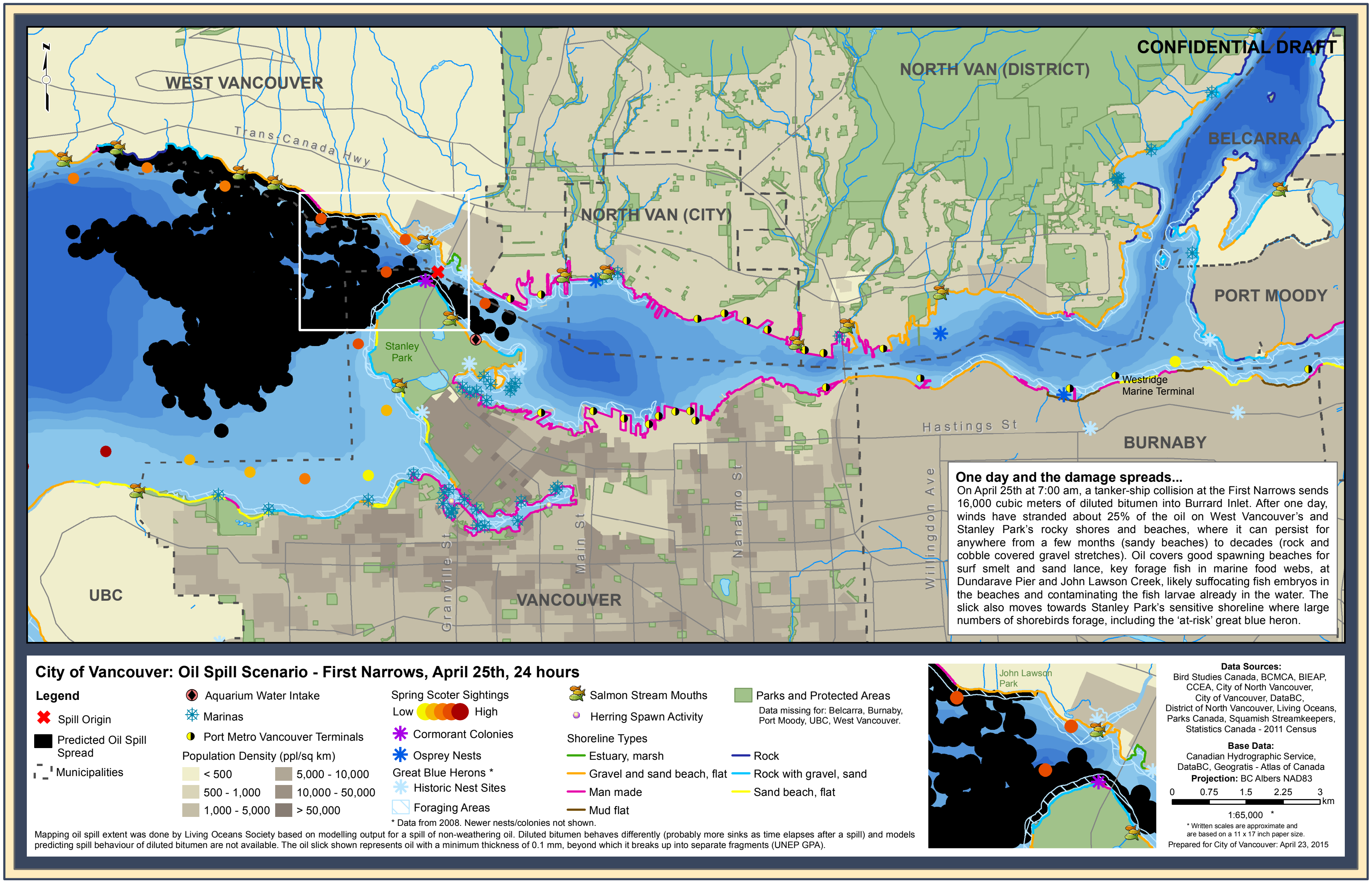
Participant	Title	Affiliation
Meena Dawar	Medical Health Officer	Vancouver Coastal Health
Mike Zupan	Manager Sanitation Services	COV Engineering Services
Mukhtar Latif	Chief Housing Officer	COV City Manager's Office
Pat Ryan	City Building Official	COV Planning & Development Services
Patrice Impey	General Manager Financial Services Group and CFO	COV Financial Services
Paul Mochrie	General Manager of Human Resource Services	COV Human Resources
Penny Ballem	City Manager	COV City Manager's Office
Randy Ash	Senior Environmental Health Officer	Vancouver Coastal Health
Rena Kendall-Craden*	Director, Corporate Communications	COV Corporate Communications
Richard Traier	311 Contact Centre Manager	COV Contact Centre
Robert Bartlett*	Chief Risk Officer	COV Risk Management
Sadhu Johnston	Deputy City Manager	COV City Manager's Office
Shelley Beaudet	Senior Environmental Health Officer	Vancouver Coastal Health
Susan Horne	Lawyer	COV Legal Services
Teresa Hartman	Acting General Manager, Community Services	COV Community Services
Tobin Postma	Communications Manager	COV Corporate Communications
Facilitation Team – Vancouver Services Review		
Chris Baas	Alex Everitt	Alanna MacLennan
Liz Jones	Krystie Babalos	
Facilitation Team – Nuka Research and Planning Group, LLC		
Elise DeCola		
**indicates participants who also assisted as Co-Facilitators or Break out Group leaders*		

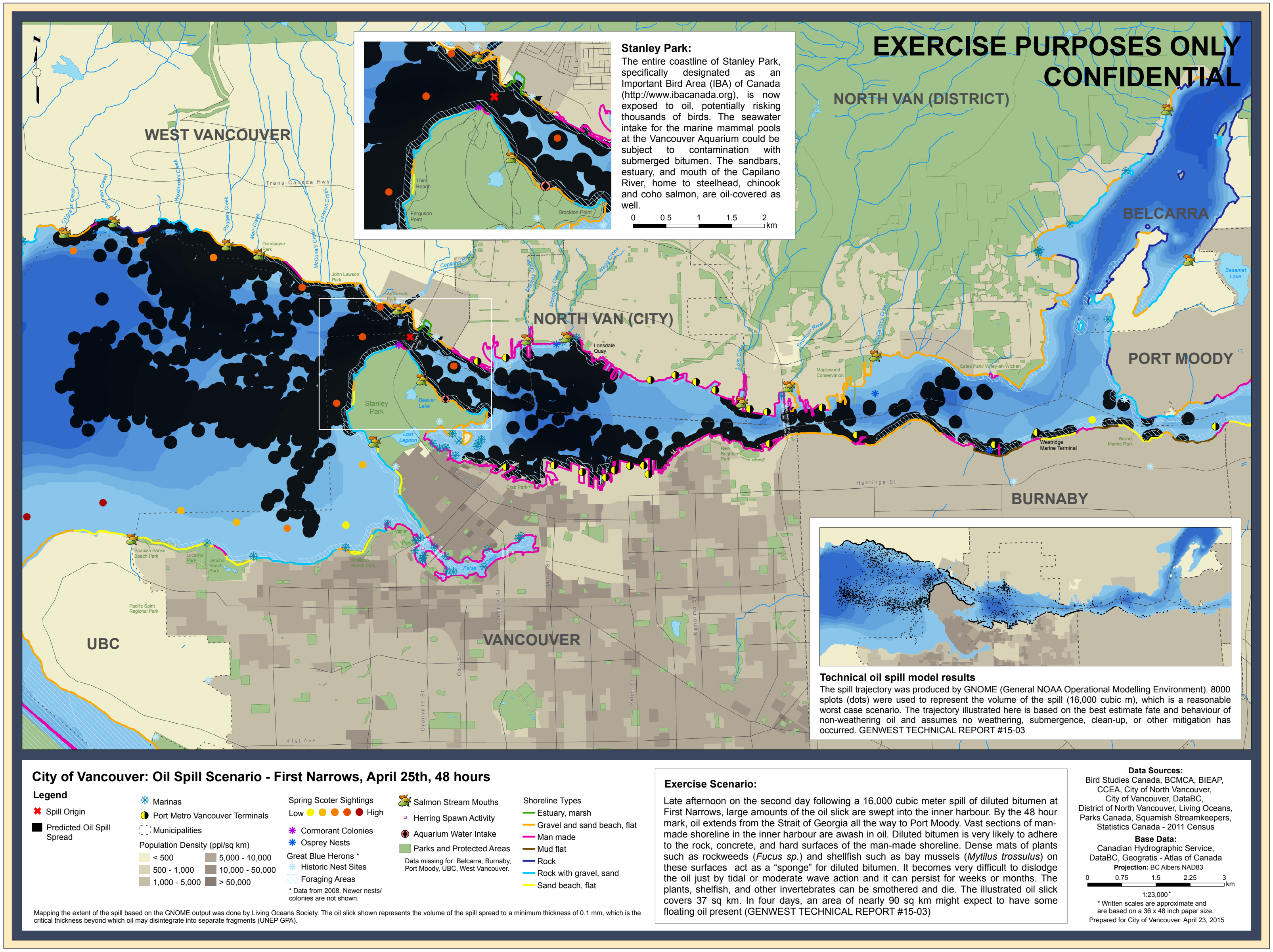
953

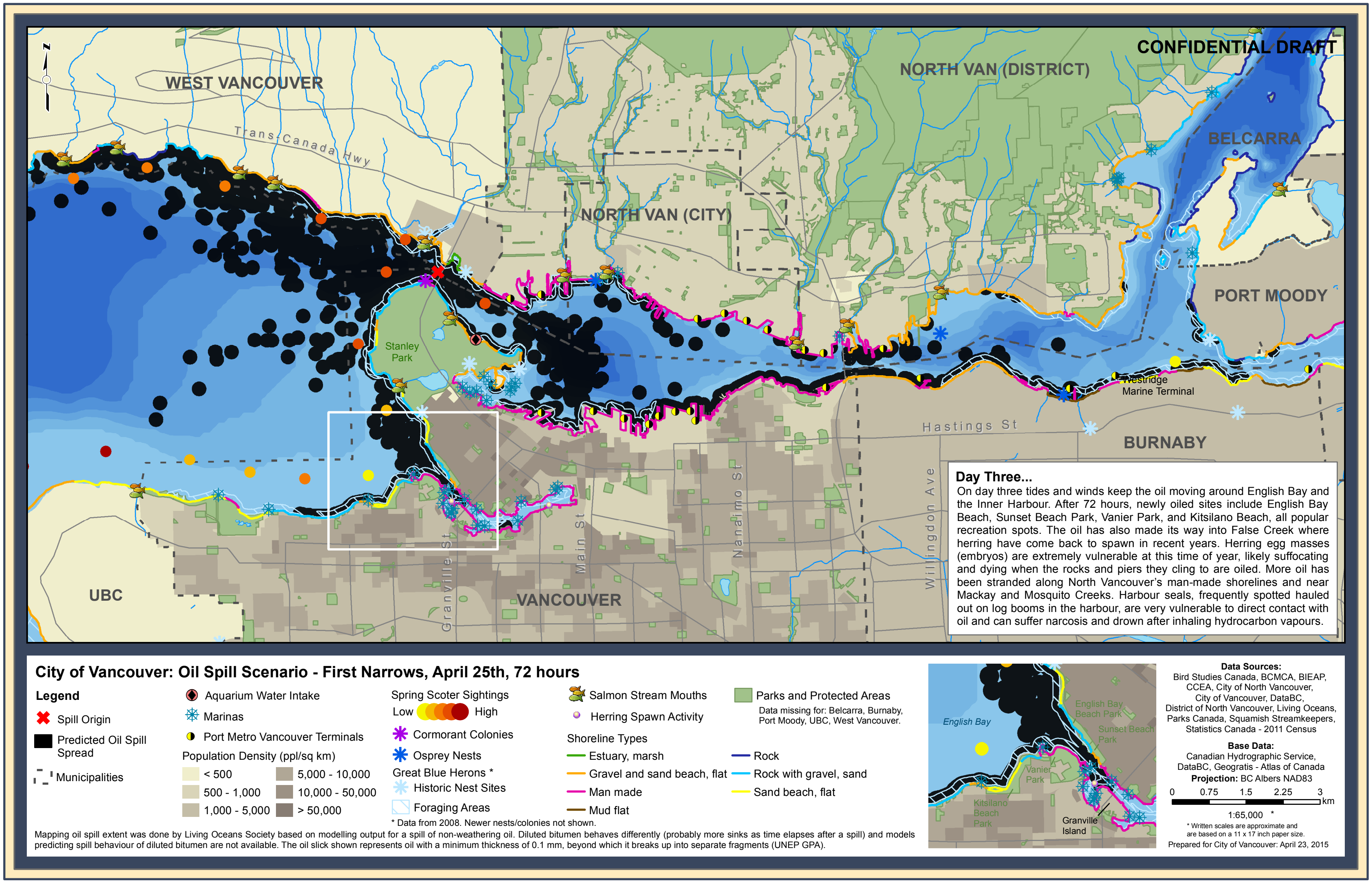
Appendix B. Scenario Maps




CONFIDENTIAL DRAFT
WEST VANCOUVER
NORTH VAN (DISTRICT)
NORTH VAN (CITY)
BELCARRA
PORT MOODY
BURNABY
VANCOUVER
UBC
Stanley Park
Trans-Canada Hwy
Hastings St
Granville St
Main St
Nanaimo St
Willingdon Ave
Westridge Marine Terminal
5.4 km of West Vancouver shores oiled...
On April 25th at 7:00 am, a large tanker collided with another ship at the First Narrows and 16,000 cubic meters of diluted bitumen were released into Burrard Inlet. Within 12 hours, more than five kilometres of the West Vancouver shoreline, all the way from John Lawson Park at Ambleside to Godman Creek at Sandy Cove, have been fouled. West Vancouver Streamkeepers release chum and coho salmon fry into creeks along this stretch in April and May. Diluted bitumen naturally submerges, dispersing through the upper water column, and can be ingested by fish of all sizes, contaminating them and their predators in turn. Ingestion of oil impairs growth, making small fish even more vulnerable. A spill of this nature could impair recreational and commercial salmon fisheries for many years.
City of Vancouver: Oil Spill Scenario - First Narrows, April 25th, 12 hours
Legend
Spill Origin
Predicted Oil Spill Spread
Municipalities
Aquarium Water Intake
Marinas
Port Metro Vancouver Terminals
Population Density (ppl/sq km)
< 500
500 - 1,000
1,000 - 5,000
5,000 - 10,000
10,000 - 50,000
> 50,000
Spring Scoter Sightings
Low
High
Cormorant Colonies
Osprey Nests
Great Blue Herons *
Historic Nest Sites
Foraging Areas
* Data from 2008. Newer nests/colonies not shown.
Salmon Stream Mouths
Herring Spawn Activity
Shoreline Types
Estuary, marsh
Gravel and sand beach, flat
Man made
Mud flat
Rock
Rock with gravel, sand
Sand beach, flat
Parks and Protected Areas
Data missing for: Belcarra, Burnaby, Port Moody, UBC, West Vancouver.
Mapping oil spill extent was done by Living Oceans Society based on modelling output for a spill of non-weathering oil. Diluted bitumen behaves differently (probably more sinks as time elapses after a spill) and models predicting spill behaviour of diluted bitumen are not available. The oil slick shown represents oil with a minimum thickness of 0.1 mm, beyond which it breaks up into separate fragments (UNEP GPA).
West Bay
Data Sources:
Bird Studies Canada, BCMCA, BIEAP, CCEA, City of North Vancouver, City of Vancouver, DataBC, District of North Vancouver, Living Oceans, Parks Canada, Squamish Streamkeepers, Statistics Canada - 2011 Census
Base Data:
Canadian Hydrographic Service, DataBC, Geogratis - Atlas of Canada
Projection: BC Albers NAD83
0 0.75 1.5 2.25 3 km
1:65,000 *
* Written scales are approximate and are based on a 11 x 17 inch paper size.
Prepared for City of Vancouver: April 23, 2015


CONFIDENTIAL DRAFT
WEST VANCOUVER
NORTH VAN (DISTRICT)
NORTH VAN (CITY)
BELCARRA
PORT MOODY
BURNABY
VANCOUVER
UBC
Stanley Park
Trans-Canada Hwy
Hastings St
Granville St
Main St
Nanaimo St
Willingdon Ave
Westridge Marine Terminal
One day and the damage spreads...
On April 25th at 7:00 am, a tanker-ship collision at the First Narrows sends 16,000 cubic meters of diluted bitumen into Burrard Inlet. After one day, winds have stranded about 25% of the oil on West Vancouver's and Stanley Park's rocky shores and beaches, where it can persist for anywhere from a few months (sandy beaches) to decades (rock and cobble covered gravel stretches). Oil covers good spawning beaches for surf smelt and sand lance, key forage fish in marine food webs, at Dundarave Pier and John Lawson Creek, likely suffocating fish embryos in the beaches and contaminating the fish larvae already in the water. The slick also moves towards Stanley Park's sensitive shoreline where large numbers of shorebirds forage, including the 'at-risk' great blue heron.
City of Vancouver: Oil Spill Scenario - First Narrows, April 25th, 24 hours
Legend
Spill Origin
Predicted Oil Spill Spread
Municipalities
Aquarium Water Intake
Marinas
Port Metro Vancouver Terminals
Population Density (ppl/sq km)
< 500
500 - 1,000
1,000 - 5,000
5,000 - 10,000
10,000 - 50,000
> 50,000
Spring Scoter Sightings
Low
High
Cormorant Colonies
Osprey Nests
Great Blue Herons *
Historic Nest Sites
Foraging Areas
* Data from 2008. Newer nests/colonies not shown.
Salmon Stream Mouths
Herring Spawn Activity
Shoreline Types
Estuary, marsh
Gravel and sand beach, flat
Man made
Mud flat
Rock
Rock with gravel, sand
Sand beach, flat
Parks and Protected Areas
Data missing for: Belcarra, Burnaby, Port Moody, UBC, West Vancouver.
John Lawson Park
Mapping oil spill extent was done by Living Oceans Society based on modelling output for a spill of non-weathering oil. Diluted bitumen behaves differently (probably more sinks as time elapses after a spill) and models predicting spill behaviour of diluted bitumen are not available. The oil slick shown represents oil with a minimum thickness of 0.1 mm, beyond which it breaks up into separate fragments (UNEP GPA).
Data Sources:
Bird Studies Canada, BCMCA, BIEAP, CCEA, City of North Vancouver, City of Vancouver, DataBC, District of North Vancouver, Living Oceans, Parks Canada, Squamish Streamkeepers, Statistics Canada - 2011 Census
Base Data:
Canadian Hydrographic Service, DataBC, Geogratis - Atlas of Canada
Projection: BC Albers NAD83
0 0.75 1.5 2.25 3 km
1:65,000 *
* Written scales are approximate and are based on a 11 x 17 inch paper size.
Prepared for City of Vancouver: April 23, 2015


EXERCISE PURPOSES ONLY
CONFIDENTIAL
WEST VANCOUVER
NORTH VAN (DISTRICT)
NORTH VAN (CITY)
BELCARRA
PORT MOODY
BURNABY
VANCOUVER
UBC
Stanley Park:
The entire coastline of Stanley Park, specifically designated as an Important Bird Area (IBA) of Canada (http://www.ibacanada.org), is now exposed to oil, potentially risking thousands of birds. The seawater intake for the marine mammal pools at the Vancouver Aquarium could be subject to contamination with submerged bitumen. The sandbars, estuary, and mouth of the Capilano River, home to steelhead, chinook and coho salmon, are oil-covered as well.
0 0.5 1 1.5 2 km
Technical oil spill model results
The spill trajectory was produced by GNOME (General NOAA Operational Modelling Environment). 8000 splots (dots) were used to represent the volume of the spill (16,000 cubic m), which is a reasonable worst case scenario. The trajectory illustrated here is based on the best estimate fate and behaviour of non-weathering oil and assumes no weathering, submergence, clean-up, or other mitigation has occurred. GENWEST TECHNICAL REPORT #15-03
City of Vancouver: Oil Spill Scenario - First Narrows, April 25th, 48 hours
Legend
Spill Origin
Predicted Oil Spill Spread
Marinas
Port Metro Vancouver Terminals
Municipalities
Population Density (ppl/sq km)
< 500
500 - 1,000
1,000 - 5,000
5,000 - 10,000
10,000 - 50,000
> 50,000
Spring Scoter Sightings
Low High
Cormorant Colonies
Osprey Nests
Great Blue Herons *
Historic Nest Sites
Foraging Areas
* Data from 2008. Newer nests/ colonies are not shown.
Salmon Stream Mouths
Herring Spawn Activity
Aquarium Water Intake
Parks and Protected Areas
Data missing for: Belcarra, Burnaby, Port Moody, UBC, West Vancouver.
Shoreline Types
Estuary, marsh
Gravel and sand beach, flat
Man made
Mud flat
Rock
Rock with gravel, sand
Sand beach, flat
Mapping the extent of the spill based on the GNOME output was done by Living Oceans Society. The oil slick shown represents the volume of the spill spread to a minimum thickness of 0.1 mm, which is the critical thickness beyond which oil may disintegrate into separate fragments (UNEP GPA).
Exercise Scenario:
Late afternoon on the second day following a 16,000 cubic meter spill of diluted bitumen at First Narrows, large amounts of the oil slick are swept into the inner harbour. By the 48 hour mark, oil extends from the Strait of Georgia all the way to Port Moody. Vast sections of man-made shoreline in the inner harbour are awash in oil. Diluted bitumen is very likely to adhere to the rock, concrete, and hard surfaces of the man-made shoreline. Dense mats of plants such as rockweeds (Fucus sp.) and shellfish such as bay mussels (Mytilus trossulus) on these surfaces act as a "sponge" for diluted bitumen. It becomes very difficult to dislodge the oil just by tidal or moderate wave action and it can persist for weeks or months. The plants, shelfish, and other invertebrates can be smothered and die. The illustrated oil slick covers 37 sq km. In four days, an area of nearly 90 sq km might expect to have some floating oil present (GENWEST TECHNICAL REPORT #15-03)
Data Sources:
Bird Studies Canada, BCMCA, BIEAP, CCEA, City of North Vancouver, City of Vancouver, DataBC, District of North Vancouver, Living Oceans, Parks Canada, Squamish Streamkeepers, Statistics Canada - 2011 Census
Base Data:
Canadian Hydrographic Service, DataBC, Geogratis - Atlas of Canada
Projection: BC Albers NAD83
0 0.75 1.5 2.25 3 km
1:23,000*
* Written scales are approximate and are based on a 36 x 48 inch paper size.
Prepared for City of Vancouver: April 23, 2015


CONFIDENTIAL DRAFT
WEST VANCOUVER
Trans-Canada Hwy
NORTH VAN (DISTRICT)
NORTH VAN (CITY)
BELCARRA
PORT MOODY
Stanley Park
Westridge Marine Terminal
Hastings St
BURNABY
Granville St
Main St
Nanaimo St
Willingdon Ave
UBC
VANCOUVER
Day Three...
On day three tides and winds keep the oil moving around English Bay and the Inner Harbour. After 72 hours, newly oiled sites include English Bay Beach, Sunset Beach Park, Vanier Park, and Kitsilano Beach, all popular recreation spots. The oil has also made its way into False Creek where herring have come back to spawn in recent years. Herring egg masses (embryos) are extremely vulnerable at this time of year, likely suffocating and dying when the rocks and piers they cling to are oiled. More oil has been stranded along North Vancouver's man-made shorelines and near Mackay and Mosquito Creeks. Harbour seals, frequently spotted hauled out on log booms in the harbour, are very vulnerable to direct contact with oil and can suffer narcosis and drown after inhaling hydrocarbon vapours.
City of Vancouver: Oil Spill Scenario - First Narrows, April 25th, 72 hours
Legend
Spill Origin
Predicted Oil Spill Spread
Municipalities
Aquarium Water Intake
Marinas
Port Metro Vancouver Terminals
Population Density (ppl/sq km)
< 500
500 - 1,000
1,000 - 5,000
5,000 - 10,000
10,000 - 50,000
> 50,000
Spring Scoter Sightings
Low
High
Cormorant Colonies
Osprey Nests
Great Blue Herons *
Historic Nest Sites
Foraging Areas
* Data from 2008. Newer nests/colonies not shown.
Salmon Stream Mouths
Herring Spawn Activity
Shoreline Types
Estuary, marsh
Gravel and sand beach, flat
Man made
Mud flat
Parks and Protected Areas
Data missing for: Belcarra, Burnaby, Port Moody, UBC, West Vancouver.
Rock
Rock with gravel, sand
Sand beach, flat
Mapping oil spill extent was done by Living Oceans Society based on modelling output for a spill of non-weathering oil. Diluted bitumen behaves differently (probably more sinks as time elapses after a spill) and models predicting spill behaviour of diluted bitumen are not available. The oil slick shown represents oil with a minimum thickness of 0.1 mm, beyond which it breaks up into separate fragments (UNEP GPA).
English Bay
English Bay Beach Park
Sunset Beach Park
Vanier Park
Kitsilano Beach Park
Granville Island
Data Sources:
Bird Studies Canada, BCMCA, BIEAP, CCEA, City of North Vancouver, City of Vancouver, DataBC, District of North Vancouver, Living Oceans, Parks Canada, Squamish Streamkeepers, Statistics Canada - 2011 Census
Base Data:
Canadian Hydrographic Service, DataBC, Geogratis - Atlas of Canada
Projection: BC Albers NAD83
0 0.75 1.5 2.25 3 km
1:65,000 *
* Written scales are approximate and are based on a 11 x 17 inch paper size.
Prepared for City of Vancouver: April 23, 2015

Appendix C. Diluted Bitumen Product Information

DILBIT

Attachment J. Wier IR 2.31

IMPERIAL OIL

DILBIT **MATERIAL SAFETY DATA SHEET**

Date Prepared: September 27,2002
Supersedes: September 20,1999
M.S.D.S Number: 11174
Reference: ERC

1. PRODUCT INFORMATION

NAME: DILBIT

SYNONYMS: 01.COLD LAKE BLEND
02.DILUTED BITUMEN
03.DILBIT COLD LAKE BLEND

DESCRIPTION AND APPLICATION:
A naturally occurring bitumen (high molecular weight hydrocarbon) blended with a diluent (Natural Gas Condensate or Diluent). Mixture is "sour" with approximately 3.5% sulphur by weight.

CAS# Not applicable

REGULATORY CLASSIFICATION:

WHMIS: Class B, Division 2: Flammable Liquids
Class D, Division 2, Subdivision A: Very Toxic Material

Canadian Environmental Protection Act (CEPA):
All components of this material are either on the Domestic Substances List (DSL) or exempt

TDG Information (Land Only)
TDG SHIPPING NAME: Petroluem Crude Oil

Primary TDG: 3 P.I.N.: UN1267
Secondary TDG: Packing Group: II
Tertiary TDG:
Marine Pollutant:

EMERGENCY TELEPHONE NUMBERS: Name of MFG/SUPPLIER:
IMPERIAL OIL
CRUDE OIL SUPPLY MKTG.

ADDRESS PHONE NUMBER:
Products Chemicals Div
Box 2480 Station M
Calgary, Alberta
T2P 3M9
(403) 237 - 3883

HEALTH: (519) 339 - 2145
TRANSPORTATION: (519) 339 - 2145

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2. REGULATED COMPONENTS

The following components are defined in accordance with subparagraph 13 (a). (I) to (IV) or paragraph 14(a) of the hazardous product act.

COMPONENT	%	CAS#
BITUMEN	40-70	8052-42-4
LIGHT NAPHTHA	15-40	v/v 64741-46-4
NATURAL GAS CONDENSATE	15-40	v/v 64741-47-5

---

3. TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE: Liquid
SPECIFIC GRAVITY: 0.9 to 1.2
ODOUR/APPEARANCE:
"Tarry" odour and associated smell of "rotten eggs" due to hydrogen sulphide presence; black liquid
ODOUR THRESHOLD: Not Available
VAPOR PRESSURE: 12 to 21 kPa @ 24 deg C
VAPOUR DENSITY: Not Available
EVAPORATION RATE: Not Available
BOILING POINT: 34 deg C
FREEZING/MELTING POINT: -35 deg C
VISCOSITY: 52 to 96 centistokes @ 38 deg C
PH: Not Applicable
SOLUBILITY: insoluble
CO-EFFICIENT OF
WATER/OIL DISTRIBUTION: Not Available

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DILBIT

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PERCENT VOLATILE: 10 - 30%
MOLECULAR FORMULA: Not Applicable
MOLECULAR WEIGHT: Not Applicable

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4. HEALTH HAZARD INFORMATION

NATURE OF HAZARD

INHALATION:
High vapour concentrations are irritating to the eyes, nose, throat and lungs; may cause headaches and dizziness; may be anesthetic and may cause other central nervous system effects, including death.
Hydrogen sulphide gas may be released. Hydrogen sulphide may cause irritation, breathing failure, coma and death, without necessarily any warning odour being sensed.
Avoid breathing vapours or mists.

EYE CONTACT:
Irritating, but will not injure eye tissue.
Hot splashes will cause eye burns and permanent eye damage.

SKIN CONTACT:
Low toxicity. Will enter the body through the skin and produce one or more toxic effects on the body.
Frequent or prolonged contact may irritate the skin and cause a skin rash (dermatitis).
Exposure to hot material may cause thermal burns.
Benzene may be absorbed through damaged skin and may cause blood or blood producing system disorder and/or damage.

INGESTION:
Low toxicity.

CHRONIC:
Contains polynuclear aromatic hydrocarbons (PNAs). Prolonged and/or repeated skin contact with certain PNAs has been shown to cause skin cancer. Prolonged and/or repeated exposures by inhalation of certain PNAs may also cause cancer of the lung and of other parts of the body.
Contains benzene. Human health studies (epidemiological) indicate that prolonged and/or repeated overexposures to benzene may cause damage to the blood producing system (particularly the bone marrow) and serious blood disorders including leukemia. Animal tests indicate that benzene does not cause malformations but may be toxic to the embryo/fetus. The relationship of the results to humans has not been established.
Studies indicate that benzene is a known human carcinogen.
Contains n-hexane. Prolonged and/or repeated exposures may cause damage to the peripheral nervous system (e.g. fingers, feet, arms etc.).

TOXICITY DATA:

Not available for product

OCCUPATIONAL EXPOSURE LIMITS

MANUFACTURER RECOMMENDS:
Although no specific hygiene standard exists, the workplace exposures to total particulates should be controlled well below a TWA value of 0.2 mg/m3 polynuclear aromatic hydrocarbon particulates measured as benzene solubles.
ACGIH RECOMMENDS:
For Hydrogen Sulphide, 10 ppm (14 mg/m3).
For Benzene, the ACGIH recommends a TLV of 0.5 ppm (1.6 mg/m3), and describes it as a confirmed human carcinogen.
For n-Hexane (skin), 50 ppm (176 mg/m3).

Local regulated limits may vary

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5. FIRST AID MEASURES

INHALATION:
In emergency situations use proper respiratory protection to immediately remove the affected victim from exposure.
Administer artificial respiration if breathing has stopped.
Keep at rest. Call for prompt medical attention.

EYE CONTACT:
Immediately flush eyes with large amounts of water for at least 15 minutes. Get prompt medical attention.

SKIN CONTACT:
Immediately flush with large amounts of water. Use soap if available. Remove contaminated clothing, including shoes, after flushing has begun.
Get prompt medical attention.
For hot material, immediately immerse in or flush affected area with large amounts of cold water to dissipate heat. Cover with

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clean cotton sheeting or gauze and get prompt medical attention. For hot material, no attempt should be made to remove material from skin or to remove contaminated clothing as the damaged flesh may easily be torn. Transport individual to a medical facility for treatment.

INGESTION:
If swallowed, DO NOT induce vomiting. Keep at rest. Get prompt medical attention.

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6. PREVENTIVE AND CORRECTIVE MEASURES

PERSONAL PROTECTION:
The selection of personal protective equipment varies, depending upon conditions of use.
Where skin and eye contact is unlikely, but may occur as a result of short and/or periodic exposures, wear long sleeves, chemical resistant gloves, chemical safety goggles, plus a face shield.
Where prolonged and/or repeated skin and eye contact is likely to occur, wear chemical resistant gloves, rubber boots, a chemical jacket, chemical safety goggles, and a face shield.
Where skin and eye contact with hot material is unlikely, but may occur as a result of short and/or periodic exposures, wear thermal resistant gloves, arm protection and a face shield.
Where concentrations in air may exceed the occupational exposure limits given in Section 4 and where engineering, work practices or other means of exposure reduction are not adequate, approved respirators may be necessary to prevent overexposure by inhalation.

ENGINEERING CONTROL:
The use of local exhaust ventilation is recommended to control emissions near the source. Laboratory samples should be handled in a fumehood. Provide mechanical ventilation of confined spaces. Use explosion-proof ventilation equipment.

HANDLING, STORAGE AND SHIPPING:
Keep containers closed. Handle and open containers with care. Store in a cool, well ventilated place away from incompatible materials.
Empty containers may contain product residue. Do not pressurize, cut, heat, or weld empty containers. Do not reuse empty containers without commercial cleaning or reconditioning.
Do not handle or store near an open flame, sources of heat, or sources of ignition.
Material will accumulate static charges which may cause a spark. Static charge build-up could become an ignition source. Use proper grounding and bonding procedures.

SPILL CONTROL AND DISPOSAL:
Consult an expert on disposal of recovered material. Ensure disposal is in compliance with government requirements and ensure conformity to local disposal regulations. Notify the appropriate authorities immediately. Take all additional action necessary to prevent and remedy the adverse effects of the spill.

LAND SPILLS:
Eliminate sources of ignition. Keep public away. Prevent additional discharge of material, if possible to do so without hazard.
Vapours or dust may be harmful or fatal. Warn occupants of downwind areas.
Prevent spills from entering sewers, watercourses or low areas.
Contain spilled liquid with sand or earth. Do not use combustible materials such as sawdust.
Recover by pumping (use an explosion proof motor or hand pump) or by using a suitable absorbent.

WATER SPILLS:
Keep public and other shipping traffic away. Prevent additional discharge of material, if possible to do so without hazard.
Eliminate all sources of ignition. Vapours or dust may be harmful or fatal. Warn occupants and shipping in downwind areas.
Remove from surface by skimming or with suitable absorbents.
If allowed by local authorities and environmental agencies, sinking and/or suitable dispersants may be used in unconfined waters.
Product will submerge after a few days of weathering.

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7. FIRE EXPLOSION HAZARD

Flashpoint and Method: < -18 deg C (CC)
Autoignition: Not Available
Flammable Limits (% volume): LEL: unknown UEL: unknown

GENERAL HAZARDS:
Extremely flammable; material will readily ignite at normal temperatures.
Flammable Liquid; may release vapours that form flammable

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mixtures at or above the flash point.
Decomposes; flammable/toxic gases will form at elevated temperatures (thermal decomposition).
Toxic gases will form upon combustion.

FIREFIGHTING:
Use water spray to cool fire exposed surfaces and to protect personnel. Shut off fuel to fire if possible to do so without hazard. If a leak or spill has not ignited use water spray to disperse the vapours.
Either allow fire to burn out under controlled conditions or extinguish with foam or dry chemical. Try to cover liquid spills with foam.
Respiratory and eye protection required for fire fighting personnel.
A self-contained breathing apparatus (SCBA) should be used for all indoor fires and any significant outdoor fires. For small outdoor fires, which may easily be extinguished with a portable fire extinguisher, use of an SCBA may not be required.

HAZARDOUS COMBUSTION PRODUCTS:

Oxides of carbon; hydrogen sulphide; oxides of sulphur

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8. REACTIVITY DATA

This material is stable.
Hazardous Polymerization will not occur.

INCOMPATIBLE MATERIALS AND CONDITIONS TO AVOID:
Heat; ignition sources; oxidizing agents

HAZARDOUS DECOMPOSITION:
Oxides of carbon; hydrogen sulphide

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9. NOTES

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Equipment handling hydrogen sulphide rich materials can accumulate black deposits of iron sulphide which, if dry, burn on exposure to air.
Hazardous concentrations of Hydrogen Sulphide (H_2S) gas may build-up in the vapour space of storage tanks or vessels.
Appropriate precautions must be taken when opening or entering vessels or other containers to avoid inhalation of H_2S.

SECTION(S) 1, 4, 9, HAVE BEEN CHANGED SINCE THE LAST REVISION TO MSDS

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10. PREPARATION

Prepared by: Imperial Oil Limited
Industrial Hygiene and Product Safety
(416) - 968 - 4940

Date Prepared: September 27,2002
Supersedes Date: September 20,1999

CAUTION:The information contained herein relates only to this product or material and may not be valid when used in combination with any other product or material or in any process. If the product is not to be used for a purpose o under conditions which are normal or reasonably foreseeable, this information cannot be relied upon as complete or applicable. For greater certainty, uses other than those described in section 1 must be reviewed with the supplier. The information contained herein is based on the information available at the indicated date of prepration. This MSDS is for the use of IMPERIAL OIL customer and their employees and agents. Further distribution of this MSDS is prohibited without the written consent by IMPERIAL OIL customers, suppliers or transporters.

FOR FURTHER INFORMATION CONTACT TEL. NO. (416) 968-4940, IMPERIAL OIL, INDUSTRIAL HYGIENE AND PRODUCT SAFETY

MSDS11174MC

 Oil Properties

Cold Lake Blend

Synonyms:
- Cold Lake Dilbit

- Cold Lake Blend consists of approximately 70% Cold Lake Bitumen and 30% condensate (see Cold Lake Diluent). Data from OGJ 99 were originally published in 1992 as part of a series entitled "Export Crudes for the '90s".

	Reference	ID

API Gravity

	Reference	ID
22.6	EETD	88
22.6	OGJ	92

Sulphur (weight %)

	Reference	ID
4.72	EETD	88
3.6	OGJ	92

Flash Point (°C)

	Reference	ID
<-35	EETD	88

Density (g/mL)

(°C)		Reference	ID
0	0.9273	EETD	88
15	0.9172	EETD	88
15	0.9177	OGJ	92

Pour Point (°C)

Environmental Technology Centre

		Reference	ID
	[illegible]	EETD	88
	-46	OGJ	92

Dynamic Viscosity (mPa·s or cP)

(°C)		Reference	ID
0	425	EETD	88
15	150	EETD	88

Kinematic Viscosity (mm²/s or cSt)

(°C)		Reference	ID
16	206	OGJ	92

Volatile Organic Compounds (ppm)

		Reference	ID
Benzene	1510	ESD	94
Toluene	3700	ESD	94
Ethylbenzene	290	ESD	94
Xylenes	3190	ESD	94
C3-benzenes	1810	ESD	94
Total BTEX	8700	ESD	94
Total VOCs	10500	ESD	94

Surface Tension (mN/m or dynes/cm)

(°C)		Reference	ID
0	29.2	EETD	88
15	27.1	EETD	88

Oil/Salt Water Interfacial Tension (mN/m or dynes/cm)

(°C)		Reference	ID
0	28.1	EETD	88
15	16.3	EETD	88

Oil/Fresh Water Interfacial Tension (mN/m or dynes/cm)

(°C)		Reference	ID
0	28.3	EETD	88
15	21.7	EETD	88

Boiling Point Distribution (weight %)

(°C)	Weight %	Reference	ID
40	7	ESD	94

60	7	ESD	94
80	11	ESD	94
100	13	ESD	94
120	15	ESD	94
140	17	ESD	94
160	18	ESD	94
180	19	ESD	94
200	20	ESD	94
250	23	ESD	94
300	28	ESD	94
350	34	ESD	94
400	41	ESD	94
450	48	ESD	94
500	54	ESD	94
550	62	ESD	94
600	69	ESD	94
650	76	ESD	94
700	82	ESD	94

Boiling Point Distribution (°C)

	Boiling Point °C	Reference	ID
10	77	ESD	94
15	116	ESD	94
20	207	ESD	94
25	271	ESD	94
30	315	ESD	94
35	356	ESD	94
40	396	ESD	94
45	432	ESD	94
50	469	ESD	94
55	504	ESD	94
60	539	ESD	94
65	574	ESD	94
70	610	ESD	94
75	646	ESD	94
80	687	ESD	94
85	727	ESD	94

Yield on Crude

(°C)			Reference	ID
C1-C5	Weight %	5	OGJ	92
20-175	Volume %	25	OGJ	92
175-295	Volume %	10	OGJ	92
295-343	Volume %	6	OGJ	92
343-565	Volume %	27	OGJ	92
565-816	Volume %	31	OGJ	92

Other Elements (weight %)

		Reference	ID
Nitrogen	0.38	OGJ	92

Aqueous Solubility (mg/L)

			Reference	ID
(°C)				
25	28.2	• (a)	EETD	88

Appendix D. Curriculum Vitae

Elise G. DeCola Curriculum Vitae

Elise G. DeCola
10 Samoset St., Plymouth, MA 02362
(508) 454-4009 * elise@nukaresearch.com

SUMMARY OF QUALIFICATIONS
Executive-level professional with deep expertise in marine environmental policy and resource management. Accomplished strategist and analyst with the ability to synthesize complex technical information to inform high-level policy.

EDUCATION AND CERTIFICATIONS
M.A., Marine Affairs, University of Rhode Island (1996)
Graduate Teaching and Research Assistant for Professor of Admiralty Law

B.S., Environmental Science, College of William and Mary (1992)

Incident Command System (ICS) 100-400; Hazwoper (24-hour); Coastal Oil Spill Response (NOAA); Shoreline Cleanup and Assessment Techniques (SCAT) Training; Oil Spill Response in Fast Water; Cold Water Oil Spill Response; Systematic Development of Informed Consent; FEMA Continuity of Operations (COOP) IS546 & IS547; Homeland Security Exercise and Evaluation Program (HSEEP) IS120, IS130, IS139; PADI Certified Divemaster

EXPERIENCE
Operations Manager, Nuka Research and Planning Group, LLC (2004 – Present) Co-founder and Operations Manager of environmental consulting firm specializing in oil spill prevention and response, risk and vulnerability assessment, all-hazards planning and mitigation, regulatory compliance, project management, marine transportation, and work group facilitation. Lead author for hundreds of technical studies, articles, and papers; serves as Principal Investigator for projects. A full list of project work is available upon request; selected projects include:

- *Oil Spill Contingency Plan development (pipeline, facility, vessel) (1996-present).* Developed oil spill contingency and emergency response plans for oil operations, including facilities, pipelines, exploration and production platforms, and vessels throughout US and in Australia and West Africa. Industry and government clients.
- *Expert witness, Northern Gateway Joint Review Panel (2011-2013).* Provided expert analysis and testimony to support First Nation Intervener review of Enbridge Northern Gateway pipeline Canadian National Energy Board Review.
- *British Columbia West Coast Spill Response Study (2013).* Researched and wrote three-volume study assessing state of oil spill preparedness and response planning in coastal British Columbia. Study included vessel traffic analysis for all Canadian Pacific waters and international best practices review to identify key elements of "world class" oil spill preparedness and response.
- *Geographic Response Plan Field Exercise Design and Facilitation (2009-present).* Developed and led multi-year project for Commonwealth of Massachusetts to systematically test protective coastal booming strategies across entire coastline.

- *Oil Simulants Project (2013-present).* U.S. federal government-sponsored project to convene and facilitate a high-level working group to develop consensus on the use of oil simulant and surrogate materials in U.S. waters, including best practices.

Research Editor, Cutter Environment/Aspen Publishers/Oil Spill Intelligence Report (1998 – 2002) Freelance writer and editor of environmental literature; developed technical reports for oil spill professionals on topics including oil spill contingency planning, dispersant use, in-situ burning, non-tank vessel spills, environmental risk management, and statistical analyses of annual oil spill data.

Project Manager, Technical Response Planning Corporation (1996 – 2003) Managed special projects for major oil companies. Developed, trained, and exercised a Y2K Crisis Management Team for Texaco's International Safety, Health and Environment Division, and developed an on-line training program and response manual for Conoco's North America Incident Support Team.

Owner, private consulting business (1996 – 2003) Owner and manager of a private consulting business providing clients with project management and general consulting in natural resource issues. The firm specialized in environmental compliance and emergency response planning.

Marine Environmental Policy Fellow, Rhode Island Senate Fiscal and Policy Office (1996) Researched and developed legislation to strengthen the state's requirements for oil-carrying vessels, and participated in U.S. Senate hearings on the Chaffee Amendments to the Oil Pollution Act of 1990.

Marine Policy Intern, Save the Bay (Narragansett Bay) (1996) Participated in an agency-industry cooperative Regional Risk Assessment Team to develop oil pollution prevention regulations for a special Regulated Navigation Area for New England waterways.

SELECTED PUBLICATIONS

A complete list of publications is available upon request.

DeCola, E.G., T. L. Robertson, J. Robida, B. House, and W.S. Pegau. *2014. Oil spill simulants workshop process and outcomes*. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 102-113.

Mattox, A., E.G. DeCola, and T. Robertson. 2014. *Estimating mechanical oil recovery with the response options calculator*. Presented at 2014 International Oil Spill Conference. Vol. 2014, No. 1, pp. 1759-1771.

Nuka Research and Planning Group, LLC. 2013. *West Coast spill response study, Volume 1: Assessment of British Columbia marine oil spill prevention and response regime*. Report to the British Columbia Ministry of Environment.

Nuka Research and Planning Group, LLC. 2010. *Alaska Risk Assessment of Oil and Gas Infrastructure: Summary of Phase 1 Alaska Risk Assessment Challenges and Accomplishments.* Report to Alaska Department of Environmental Conservation.

DeCola, E.G., M. Popovich, and J. Ball. 2009. *From Theory to Practice: Lessons Learned during the Geographic Response Plan Exercise in Rhode Island.* Proceedings of the 32nd Arctic and Marine

Oilspill Technical Seminar. Vancouver, British Columbia, Canada.

Nuka Research and Planning Group, LLC. 2009. *Evaluation of Marine Oil Spill Threat to Massachusetts Coastal Communities.* Report to Massachusetts Department of Environmental Protection.

Folley, G., L. Pearson, C. Crosby, E. DeCola, and T. Robertson. 2006. *The Alaska Commercial Fisheries Water Quality Sampling Methods and Procedures Manual.* Proceedings of the 29th Arctic and Marine Oilspill Technical Seminar. Vancouver, British Columbia, Canada.

DeCola, E.G. and S. Fletcher. 2006. *An Assessment of the Contribution of Human Factors to Marine Vessel Accidents and Oil Spills.* Report to Prince William Sound Regional Citizens' Advisory Council.

DeCola, E.G., Robertson, T.L., Robertson, R.R., and J. Banta. 2004. *Approach to Downstream Planning for Nearshore Response and Sensitive Areas Protection Outside Prince William Sound, Alaska.* Proceedings of the 27th Arctic and Marine Oil Pollution Technical Seminar. Edmonton, Alberta, Canada.

DeCola, E.G. 2003. *Dispersant Use in Oil Spill Response: A Worldwide Legislative and Practical Update.* Aspen Law and Business, New York, NY. 314 pp.Coil DA, Miller AD. Enhancement of enveloped virus entry by phosphatidylserine. J Virol. 2005 Sep;79(17):11496-500.

Nuka Research and Planning Group, LLC. 2006. Alaska Commercial Fisheries Water Quality Sampling Methods and Procedures Manual. Anchorage, Alaska: Alaska Department of Environmental Conservation. http://www.dec.state.ak.us/spar/perp/wq/wq_manual.htm

Nuka Research and Planning Group, LLC. 2006. *Oil Spill Response Mechanical Recovery Systems for Ice-Infested Waters: Technology Assessment for the Alaska Beaufort Sea*. Report to Alaska Department of Environmental Conservation.

DeCola, E. G. 2000. *Oil Spill Contingency Planning in the Twenty-First Century*. Cutter Information Corp., Arlington, MA.

Nixon, D., E. Golden, and L. Kane. 1999. *The legacy of the North Cape spill: a new legal environment for the tug and barge industry.* Ocean and Coastal Law (4)2:209-270.

RECOGNITION AND OTHER ACTIVITIES

First Place Planning Poster, International Oil Spill Conference (2011)
Peer Reviewer, International Oil Spill Conference (2011, 2014)
Platform Session Presenter, International Oil Spill Conference (1999, 2003, 2008, 2014)
Platform Session Presenter, Arctic Marine Oilspill Pollution Technical Seminar (2000, 2006, 2008, 2009, 2011)
Presenter, Coastal Zone Conference (1997, 2001)
Presenter, Massachusetts Soils Conference (2010)
Member, Environmental Business Council of New England
Member, Society for Women Environmental Professionals
Appointed Member, Plymouth Tidal Beaches Advisory Councill (2011-2014)

APPENDIX E. Certificate of Expert's Duty

I, Elise DeCola, of Plymouth, Massachusetts, USA have been engaged on behalf of the City of Vancouver to provide evidence in relation to Trans Mountain Pipeline ULC's Trans Mountain Expansion Project application currently before the National Energy Board.

In providing evidence in relation to the above-noted proceeding, I acknowledge that it is my duty to provide evidence as follows:

1. to provide evidence that is fair, objective, and non-partisan;

2. to provide evidence that is related only to matters within my area of expertise; and

3. to provide such additional assistance as the tribunal may reasonably require to determine a matter in issue.

I acknowledge that my duty is to assist the tribunal, not act as an advocate for any particular party. This duty to the tribunal prevails over any obligation I may owe any other party, including the party on whose behalf I am engaged.

Date: May 26, 2015 Signature: ____________________

Appendix F. Acronyms

BC	British Columbia
CCG	Canadian Coast Guard
CMT	Corporate Management Team
COV	City of Vancouver
EC	Environment Canada
EM	Emergency Management
EOC	Emergency Operations Centre
FTE	Full time equivalent
IAP	Incident Action Plan
ICP	Incident Command Post
ICS	Incident Command System
IFO	Intermediate Fuel Oil
MOE	Ministry of Environment
MSDS	Material Safety Data Sheets
NEB	National Energy Board
NEBA	Net environmental benefit analysis
PMO	Project Management Office
PMV	Port Metro Vancouver
RP	Responsible Party
SitReps	Situation Reports
SCAT	Shoreline Cleanup Assessment Technique
TC	Transport Canada
UC	Unified Command
VCH	Vancouver Coastal Health
VSR	Vancouver Services Review
WCMRC	Western Canada Marine Response Corporation