Local Government Impacts of Oil Spills

A study of potential costs for the City of Vancouver

Prepared by:

Recovery and Relief Services, Inc.
Vancouver, BC

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Contents

1. Introduction of the Study and Methodology

1.1. What is your full name, position, area of expertise, and business address?

My name is Jeremy Thomas Stone and I am Executive Director of Recovery and Relief Services, Inc., a consultancy based in Vancouver, BC. My area of expertise relevant to this research is disaster recovery, particularly after oil spills. My business address is 71 W 17th Avenue, Vancouver, BC, V5Y 1Z5, Canada. I am the individual primarily responsible for this study. Additional research support for this study was provided by University of British Columbia researcher Lilia Yumagulova, and recent University of British Columbia graduate Sarah Thomas.

1.2. What is your educational and professional background?

Professionally, I have nearly 15 years' experience in economic development and economic recoveries after disasters. Besides working in various governmental and non-profit positions supporting economic development (e.g. United Nations, Peace Corps, Ecotrust Canada, etc.), I have also worked with several organizations that respond to natural and man-made disasters (e.g. the U.S. Economic Development Administration, Seedco Financial [now TruFund], J&M Global Solutions, etc.). My experience in this area includes project design, project management, and research for economic recovery. I have worked on numerous disaster recoveries including the World Trade Center recovery, Hurricane Katrina, the Deepwater Horizon oil spill, and most recently the 2013 Colorado floods. I have several published studies (both peer-reviewed and industry-based) on the impacts of oil spills on municipalities and the economy. My educational background includes a Bachelor of Arts in Anthropology from Reed College and a Master of Public Administration in International Economic Development from New York University. I am currently in my third year of a Doctoral degree in Community and Regional Planning from the University of British Columbia. My curriculum vita is provided in Appendix A of this study in support of these qualifications.

1.3. What are the questions or issues that you have been asked to address in your evidence?

A common principle in disaster management is the notion that all disasters are “local” (Dynes, 2002; Perry, 2003). Until external resources arrive, local jurisdictions confront disasters on their own, and long after recovery teams leave local communities live with the lasting effects of disasters. Consequently, the greatest exposure of oil spills is borne by the local jurisdiction. Despite the availability of compensation mechanisms, the most vulnerable populations to oil spills will generally be locally impacted communities, and the costs or impacts that are not compensated by national and international regimes will devolve to local governments, local businesses, and local individuals. Therefore, a thorough accounting of costs that local governments face is important to understand the exposure of impacted cities to potential oil spills, and the levels of compensation required for long-term recovery.

To this end, the City of Vancouver has requested that the following questions be answered:

- What are the typical costs that local governments are likely to incur in responding to, and recovering from, an oil spill?
- What hidden costs for local governments, if any, are associated with oil spills but are rarely compensated?

1.4. What is the methodology you used for your analysis?

Our approach to this study was to conduct a purely empirical analysis of known costs to local governments following oil spills, as well as compiling evidence of additional costs that are generally uncompensated or unmeasured. To do this, we analyzed data from 12 oil spills of various sizes, and from various contexts in North America, Europe, and Asia. Our focus was primarily on tanker spills, however we included other spill types when there was sufficient evidence of local government impacts, or it provided better evidence of costs in a Canadian context. An overview of the spills researched is detailed in Figure 1 below, and case studies of each spill are provided in Appendix B.

For these spills the research team reviewed dozens of academic, industry, and media reports to find evidence of costs incurred by municipalities and local governments for a variety of categories. This analysis built off of a previous literature review commissioned by the Vancouver Economic Commission that compiled years of research on ecological and economic effects of oil spills (Stone et al, 2013). Additionally, the team also engaged in primary research interviews

with local government leaders and oil spill experts in North America and Europe who were able to provide unpublished data concerning a broad range of expenses incurred after oil spills. However, not every governmental department had information to share, which is discussed further in Section 1.7 below. A list of documents reviewed for this study can be found in Appendix C, and a list of agencies and organizations that were contacted or interviewed can be found in Appendix D.

Figure 1: List of Spills Researched by Size

Name	Location	Year	Size (m3)	Total Known Cost
LA pipeline spill	Los Angeles, CA, USA	2014	160	N/A Ongoing
Cosco Busan	San Francisco, CA, USA	2007	188	$ 447,216,541
Burnaby Oil Spill	Burnaby, BC, Canada	2007	200	$ 16,863,271
Kirby 27706	Galveston, TX, USA	2014	546	N/A Ongoing
Mississippi River Spill	Louisiana, USA	2008	900	$ 100,000,000
Kalamazoo River Spill	Kalamazoo, MI, USA	2010	2,811	$ 1,326,754,386
Hebei Spirit	Yellow Sea, Korea	2007	11,000	$ 402,303,235
Exxon Valdez	Alaska, USA	1989	35,000	$ 4,723,461,125
Prestige	Galicia, Spain	2002	63,000	$ 5,799,653,620
Sea Empress	Pembrokeshire, UK	1996	72,000	$ 69,821,223
Amoco Cadiz	Brittany, France	1978	223,000	$ 834,927,134
Deepwater Horizon	Gulf of Mexico, USA	2010	627,000	$ 43,859,649,123

** All figures converted to 2014 Canadian Dollars*

Our methodology includes two further parameters that guide our analysis:

A. <u>We use specific historical costs rather than average per-unit studies of oil spill responses.</u>

Studies that focus on data near the means of risk are in direct contrast to modern disaster management methodologies that prepare for “low-chance, high-impact” events that present “urgent threats to societal core values and life-sustaining systems” (Comfort et al, 2010). From historical oil spill data, we know that the impacts from oil spills can cost much more than mean or median cost figures.

For example, typical average or median cost studies show global median clean-up costs to be from $10,467 USD/tonne to $15,900 USD/tonne, though the costs vary based on the country and the type of spill (Kontovas et al, 2010; Vanem et al, 2007). Individual spills, however, far exceed the median value. For example, the Exxon *Valdez* disaster, which happened in a comparable geography as Vancouver, cost $3.5 billion for clean-up costs

alone, or an average of approximately $83,000/tonne (McCammon, 2003, Fall et al, 2001). Similarly, the Enbridge pipeline spill in Kalamazoo, Michigan, which is one of the few recorded spills of bitumen cost $1.32 billion, or approximately $472,000/$m^3$ for the 2,811m^3 spill (Enbridge, 2013; Ellison, 2014)[1]. A comparatively small spill in the Mississippi River (approximately 900m^3) cost $68 million to clean up, or $75,555/tonne (Sayer, 2012). The cost of the Burnaby pipeline spill of 200m^3 (70,000 liters of which flowed into Burrard Inlet) was put at $15,000,000, which is approximately $75,000/$m^3$ (CBC, 2011; TransMountain, 2014).

For the purposes of preparing the financial or human capital resources needed for responding to an oil spill, only preparing to the median or the average falls far short of what may be necessary in a catastrophic spill situation. Therefore, this study uses both routine spills and outliers as a guide for plausible oil spill impacts.

B. <u>We use data that go beyond the historical or standard costs in the Canadian context.</u>

Studies that use oil spill cost figures for Canada are typically based on either historical models, or projections related to current standards set under national or international protocols (e.g. the 1992 Civil Liability Convention). However, these approaches are problematic for determining potential costs of oil spills in Vancouver for at least two reasons.

In terms of historical spills, there is very little data for cost analyses in Canada since there have been very few oil tanker spills here. In the past 20 years on the West Coast there have only been the relatively small *Queen of the North* (240m^3) and *Nestucca* spills (87m^3), while on the East Coast the majority of spills have been small spills from fishing vessels, or remote non-impacting spills like the *Arrow* spill of 1970 which spilled 10,000m^3 off of Nova Scotia (S.L. Ross, 2007; Transport Canada, 2014). These spills are either too small or too old to be illustrative of the expenses for catastrophic spills in Canada. To this extent, it is imperative to use comparable costs from other industrialized nations to understand what local governments may face for significant spills.

[1] The $1.32 billion figure includes some fines and other regulatory costs, thought the vast majority are clean up equipment and personnel, consulting fees, and professional costs related to the spill.

In addition, the current Canadian standards for oil spill response and recovery are insufficient for establishing the cost of a "world class system". Although the Government of Canada has established the need for a world class response system (Transport Canada, 2013), the current strategies and capacity have been found to be far below what is necessary (Office of the Auditor General of Canada, 2010; Nuka Research, 2013). Moreover, the 1992 Civil Liability Convention (CLC 1992), to which Canada is a signatory, is generally sub-standard to the US-equivalent Oil Pollution Act of 1990 (OPA 1990). Numerous studies have detailed the CLC 1992's inferior environmental protections, lower clean-up standards, and smaller compensation coverage than that of OPA 1990 (Mason, 2003; Kim, 2003; Jacobsson 2007; Kiran 2010; Schoenbaum, 2012). Thus, studies that claim Canada's cost of oil spill response is cheaper than the United States are not reporting cost-savings or economies of scale, but are instead describing the lower response and recovery standards that characterize the Canadian system. Accordingly, analyses that seek to establish the requirements for a world class system in the Vancouver region should rely on relevant empirical findings from best-in-class responses.

1.5. What are the summary of findings and conclusions for your analysis?

Local governments are on the front lines of oil spills, even though they are rarely highlighted in the oil spill response literature. Municipalities bear the physical scars of spills on the landscape, experience the core losses to their economies, and confront the long-term effects through costly and long-lasting recoveries. Although there is often a surge of recovery dollars following a spill, these rarely cover all of the individual costs across all categories.

Figure 2 below summarizes the quantitative findings of this study. A number of points are important to mention:

1) All figures are the uppermost data available found for each cost category. The cost category number refers to the section of the study in which the data can be found, and the spill source denotes from which oil spill the figure was derived.
2) The chart does not include most direct clean-up costs (e.g. oil containment and recovery of oil) as these costs are typically taken on by the responsible party. For a discussion of direct and indirect spill costs, please see Appendix E.

3) The chart does not include aggregate costs of Deepwater Horizon oil spill expenses since they represent multiple states. When Deepwater Horizon figures are used, they are only used from individual cities or states.
4) State- or province-level costs are occasionally included when the activities could likely be taken on by other local governments during oil spills. Since jurisdictional boundaries in other countries are not the same as in Canada, these costs are potentially ones that could devolve down to local governments.
5) Multiple cost categories had no quantitative data available, which is indicated by light-red shading. Please see Section 1.6(A) for further discussion of this issue.
6) All figures in this study are in 2014 Canadian dollars (See Appendix F for the conversion methodology).

Figure 2: Maximum Known Oil Spill Costs By Study Category

Cost Category	Upper Bound	Spill Source
2. Cost Categories: Response		
2.1. What is the cost of staging response activities?	$ 1,633,951	Cosco Busan
2.2. What types of space are required to stage the response, house workers, provide office space, etc?		
2.3. What is the scale of known evacuations for oil spills?		
2.4. What are the increased costs of fire, police and emergency services and other first responders?	$ 305,000	New Orleans, Deepwater Horizon
2.5. What are the public health costs?	$ 610,696	Kalamazoo
2.6. What are the costs of collecting, transporting, and disposing of waste generated by the response and recovery efforts?		
2.7. What type of communications effort is required and what are the costs (i.e. setting up IT, launching a website, etc.)?	$ 297,982	Cosco Busan
2.8. What are the costs for volunteer management?	$ 408,377	Cosco Busan
3. Cost Categories: Long-Term Recovery		
3.1. What are the costs of research and damage assessments?	$ 550,000,000	Exxon Valdez
3.2. What is the cost for recovery planning?		
3.3. What are the costs for developing technical assistance programs?	$ 190,000	New Orleans, Deepwater Horizon
3.4. What kind of interim financial relief and payouts are made by governments?		

3.5. What is the cost of mitigation and preparedness activities for future responses and recoveries?	$	10,200,000	Exxon Valdez
4. Cost Categories: Additional Costs and Losses			
4.1. What are the losses to various tax revenues?	$	164,000,000	Alabama, Deepwater Horizon
4.2. What are the legal costs during and following a response?	$	59,000,000	Prestige
4.3. What are the costs for permitting and regulatory oversight?			
4.4. What municipal spaces are generally lost due to an oil spill (e.g. waterfront, staging sites, etc.)			
4.5. What kinds of municipal staff are lost to the recovery industry?			
4.6. What are the costs for municipal brand recovery campaigns and similar civic events that reinvigorate the economy?	$	37,000,000	Prestige
4.7. What are the opportunity costs for local governments in dealing with oil spills			
Staff time:	$	196,000	Exxon Valdez
Routine Operations and Maintenance:			
Future Development:			

From the evidence summarized here, we can conclude that a catastrophic spill could present significant costs for local governments. The upper bound quantitative amounts in this study add up to close to $1 billion in costs incurred by the public sector following oil spills. Although these span different spills in different contexts, they suggest the level of expenses that local governments could potentially face in a catastrophic spill situation. The aggregate number would likely be much higher if monetary figures could be provided for the numerous cost categories that were identified in the course of this research, yet for which there was no available quantitative data (highlighted in light red in Figure 2 above). The characteristics of the oil spill area also play an important part in oil spill impacts, and spills that occur in-shore or adjacent to high population areas can be much more expensive to clean up (see Appendix E for more discussion on this point). A worst-case scenario oil spill in the Vancouver region could put immense fiscal pressure on the City of Vancouver and other local governments, especially in cases where non-compensable damages are high.

1.6. What are relevant qualifications of your analysis?

There are a number of issues that should be mentioned which impact our ability to provide definitive cost numbers for the analysis. These include the following:

A. More data is needed with regard to the impacts of oil spills on local governments. During our research we found that very little data is available concerning relevant oil spill impacts because there is poor tracking by local governments, a reluctance or inability to share data due to litigation, the length of time from relevant spills is too long to get appropriate data, or data is subsumed under categories that include other costs. Generally speaking, few municipal, regional, or state governments performed post-incident accounting studies. Typically the individual departments within a local government will bill the responsible party directly. While each department may track their own expenses, they do not necessarily submit these expenses to a central authority that tracks the total impact of the spill on that particular level of government. This is compounded by the fact that most oil spills are multi-jurisdictional hazards, which involve separate accounting departments that do not communicate with each other. Usually the only entity to have a total accounting of the various expenses is the responsible party itself, but these companies are not obliged to provide information publically, especially when they are involved in ongoing litigation.

   Another issue is that many cost categories are under-researched in both academic and industry circles (such as opportunity costs for local governments and the efficiency losses due to focusing on all-encompassing recoveries). Some losses or costs of oil spills for municipalities often come through the changing nature of city business after oil spills. The shift of attention and resources to the oil spill problem creates inefficiencies and opportunity costs that are not recoverable through compensation protocols, and the lost months and years of civic growth from an oil spill are impossible to grasp or adequately value.

   In order to address this issue of available data, there needs to be more of an emphasis on local governments as impacted parties in oil spills, and a greater focus on measuring hidden costs and damages. Many of the costs discussed here need detailed analyses beyond the scope of this study in order to fully appreciate the magnitude of costs for local governments after oil spills.

B. Costs for oil spills, especially in future oil spill events, are likely larger than costs described in this study. There are two issues that complicate the valuation of oil spill costs for local

governments. The first is that the costs of oil spills are continually increasing because affected communities are demanding stricter laws and greater investments into response and recovery (Wirtz et al, 2007). In fact, oil spill costs in the 2000s have been found to be hundreds of millions of dollars more expensive than in the 1960s and 1970s (Alló and Loureiro, 2013). In this sense, the data presented in this study is already likely below the cost requirements for future spills.

More importantly, the full breadth of oil spill costs are rarely compensated, and cannot always be measured adequately. The process for defining claims that are "admissible" to international compensation regimes is curtailed by the ability to measure impacts and prove causality, and is more of a process of negotiation with insurance companies, governments, and international bodies than a precise science (Mason, 2003; Liu and Wirtz, 2006; Schoenbaum, 2012). In addition to normally compensable claims, this study also attempts to capture the "hidden costs" that local governments may experience, for which there is either no supporting system of compensation, or no current tool for measurement. Not only are these costs experienced by governments in their response to oil spills, but as measurement tools and compensation regimes evolve, the public may find ways to add these costs to the category of "admissible" claims.

2. Cost Categories: Response

For the purposes of this study, we are using "response" to refer to both "emergency response" and "post-emergency response" of oil spills. This is inclusive of both the period during which oil is contained from a leaking vessel or other source, and the period of immediate clean-up of impacted areas (for a better understanding of these terms, please refer to Cheremisinoff and Davletshin, 2011: 280-282). It does not include long-term recovery costs (such as local economic support, etc., which are discussed in Section 3 below).

Within the response context, this section discusses costs that local governments may face in particular. While local governments are not typically involved in the direct work of removing oil from beaches, etc., (although see Purnell [1999] for examples of local government shoreline cleanup under the UK system), they often do take on a series of indirect costs that support those operations (see Appendix C for a discussion of different types of direct and indirect costs).

The following section of the study details costs that local governments incur while participating in a response to an oil spill. These do not include direct costs that are typically taken on the responsible party, as described in the methodology section above.

2.1. What is the cost of staging response activities?

"Staging" in a disaster management context refers to the resources and activities dedicated to the coordination of response activities, while "staging" in oil spill parlance refers to the storing of physical infrastructure for responding to the oil spill. For the purposes of this section, we use the word "staging" in the disaster management sense of the term, focusing specifically on coordination.

Following an oil spill, there is generally an incident command center or emergency operations center that centralizes response and recovery operations. However, depending on the jurisdiction and the type of spill, there may be several different offices managing different aspects of the response. In each of these situations, various back-office systems and staff support will be needed to manage activities, coordinate resources, track expenses, communicate with the public, and fill other necessary roles as they arise. These might include

full time staff, office space, back-office systems, media, legal, and other resources (Moore et al, 1998; Rodin et al., 1992; Palinkas et al., 1993).

As with other cost categories, it is difficult to detail these costs when they are often summarized within total response costs. However, the following are different examples of the types of costs that have been incurred by local governments during oil spills:

- *Kirby 27706*: Following a 530 tonne spill in the Houston Ship Channel, the Texas General Land Office got involved. They acted as the state agency supporting response and recovery activities that were being managed by the responsible party, Kirby Marine. This support role amounted to $461,620.89 of costs, which included personnel expenses and overtime, travel, equipment use, and indirect expenses and fringe (Texas GLO, personal communication). This did not include the expenses of other relevant agencies like the Galveston City Emergency Management Center, Galveston County Office of Emergency Management, and the Galveston Parks Board.

- *Cosco Busan*: Following a 188 tonne spill in the San Francisco Bay, the City and County of San Francisco deployed resources from multiple agencies over a ten day period. These agencies included the Mayor's Office, the Board of Supervisors, Port of San Francisco, San Francisco Fire Department, San Francisco Police Department, Department of Public Health, Public Utilities Commission, Recreation and Park Department, Department of Human Resources, General Services Agency, Mayor's Office of Neighborhood Services, Human Services Agency, Redevelopment Agency, Animal Care and Control, 311 Customer Service Center, Department of Building Inspection, Municipal Transportation Agency, the City Administrator's Office, the Controller's Office, and the City Attorney (CCSF After Action Report, 2010). In total, these costs (less legal and volunteer expenses) amounted to $1,633,951 (CCSF Audit Summary, 2008).

- Deepwater Horizon: Although the City of New Orleans experienced no oil inundation from the Deepwater Horizon oil spill, the City did have to react to the spill to ensure that the municipality was ready. The costs of the New Orleans Office of Homeland Security and Emergency Preparedness (NOHSEP) to respond to a disaster that did not directly impact their shores were $403,300 (USD 2010). This was solely for personnel direct costs and overtime over a three month period (City of New Orleans, personal communication).

2.2. What types of space are required to stage the response, house workers, provide office space, etc?

The space required for both implementing response operations and housing the incoming response workers is significant. Following the Kalamazoo oil spill, the Incident Command center was established and moved on three separate occasions. It started in the local Emergency Planning Center, but then moved to a local school so that they could use the gym space for meetings. Eventually this did not provide enough space, so they again moved to a vacant industrial site that they rented for that purpose. A couple of thousand people worked on site (City of Marshall, personal communication). Overall, 3,000 workers came to Kalamazoo (which only has a population of 7,000 people). All of the hotels in the region were occupied, and some workers were living in campgrounds, which lasted for the long-term duration of the clean-up. The EPA expected to stay for only 4 months, however they were still there 4 years later, and continued to occupy local spaces. During *Prestige*, most workers were in local government halls, municipal sports halls, and in other public buildings (Tucker and O'Brien, 2011). This issue was also present in the Exxon *Valdez* spill where small towns were inundated with response workers which severely strained local services (Rodin et al, 1992, p223).

2.3. What is the scale of known evacuations for oil spills?

Evacuations following tanker spills are rare, generally because they occur off-shore. Occasionally toxic fumes may pass onshore which require monitoring and possible evacuation, especially if the spill happens near a populated area. An example of this is the *Aegean Sea* incident in 1992 which was caused by a carrier that ran aground during heavy weather along the Galician coast of north-west Spain. The vessel broke in two, caught fire, and burned for several days, which resulted in a temporary mass evacuation due to dense clouds of black smoke that threatened the city of La Coruña (ITOPF, 2014). Additionally, urban oil spills have accounted for several evacuations including the Burnaby pipeline spill which resulted in the evacuation of 250 local residents, and the Los Angeles pipeline spill which prompted an evacuation of local businesses (CBC, 2011; Reuters, 2014). In the Burnaby spill, the city kept the residents for a number of hours and then Kinder Morgan offered them accommodations thereafter (City of Burnaby, personal communication). The Kalamazoo River spill also resulted in self-evacuation of nearby houses, and an extended area of recommended evacuation, covering 67 houses in

total (NTSB, 2012). However, due to ongoing litigation, costs for these evacuation orders were not available for this study.

2.4. What are the increased costs of fire, police and emergency services and other first responders?

First responders are necessary for a variety of functions in the wake of an oil spill. Police are required to seal off areas that are dangerous to the public while firefighters and EMTs may need to respond to those who have been affected by inhalation of fumes, or have been injured in clean-up procedures. Following the Exxon *Valdez* disaster, police dealt with exceptional increases in violence, drug abuse, and civil unrest (Palinkas et al, 1993). In the town of Valdez disturbance calls increased 124%, assaults increased 71%, and accident calls increased 166% (Rodin et al, 1992). Many of these incidents were linked to the influx of out-of-area workers who had descended on the town in the aftermath of the disaster (Rodin et al, 1992).

Some evidence from recent spills may suggest the low-end of costs for first responder support. The *Cosco Busan*, a relatively small spill of 188m^3 in San Francisco Bay in 2007, cost over $203,419 in emergency services alone (CCSF Audit Summary, 2008). Following the Deepwater Horizon spill in the Gulf, the City of New Orleans spent over $305,000 on police, fire, and security services even though the spill never reached the city's shores (City of New Orleans, personal communication). These costs were incurred over a three month period as the city prepared for a possible inundation of oil that never materialized.

Depending on the size of the spill and proximity to populated areas, the costs could be much higher than these amounts. Also, with significant volunteer mobilization and the influx of out-of-area workers, the costs to municipalities for emergency services can increase quite quickly (Tucker and O'Brien, 2011).

2.5. What are the public health costs?

Although personal health care costs are generally not an oil spill-related expense, there are some public health costs that are borne by governments. Examples of public health costs related to oil spills are as follows:

- *Cosco Busan*: The San Francisco Department of Public Health (DPH) costs amounted to $38,595 for spill response (CCSF Audit Report, 2008). From the outset of the incident, DPH coordinated with Unified Command to release a statement regarding the risks of oil exposure to the public. Public health precautionary measures were taken around the Bay with several beaches being closed and fishing and swimming being prohibited (CCSF After Action Report, 2008).

- Kalamazoo spill: In 2010, the Calhoun County Public Health Department (CCPHD) personnel provided over 3,500 direct hours of staff time in response to the incident. This resulted in expenditures totaling $502,000 for 2010 (CCPHD, 2014). CCPHD staff was involved with numerous aspects of the response including air and water monitoring, evacuations, and worker safety (Calhoun County, personal communication). Since July 2010 a total $610,696 was spent by CCPHD on staff expenses relating to the oil spill. Additionally, Michigan developed a public health surveillance system that included "health care provider reporting, community surveys, calls from the public to the Poison Control Center, and analysis of data" (Stanbury et al, 2010).

2.6. What are the costs of collecting, transporting, and disposing of waste generated by the response and recovery efforts?

Waste management consists of an assortment of activities that each bear short- and long-term costs. Absorbent boom, oiled sand, and other solid and liquid wastes must be collected and transported to incinerators, landfills, and storage facilities. Jurisdictions with waste-diversion laws require materials to be reused and recycled when possible, which requires transportation and technology available at relevant facilities. Following Deepwater Horizon, BP adhered to a similar law in Louisiana by incinerating waste and capturing the energy for transference to the power grid (Kubendran, 2011).

Figure 3 shows comparisons of waste generated by major oil spill events in comparison to the oil spilled (IPIECA, 2014). In extreme cases, the amount of wastes generated during an oil spill can range up to 40 times more than the actual oil lost from the ship. The Kalamazoo River bitumen spill released only 3,500m^3 of oil, but accounted for over 100,000m^3 of liquid and solid waste (IPIECA, 2014).

Following Exxon *Valdez*, collection of solid waste increased four to five times the normal volume of waste collection. Five to six years of landfill space was used in one summer, and 95,000 bags of oiled debris were removed from parkland on the Alaska Peninsula alone (Rodin et al, 1992; Fall et al, 2001). Following Deepwater Horizon, 92,000m^3 of solid waste was generated, which were distributed between multiple landfills around the Gulf Coast (Papp, 2011; Kubendran,

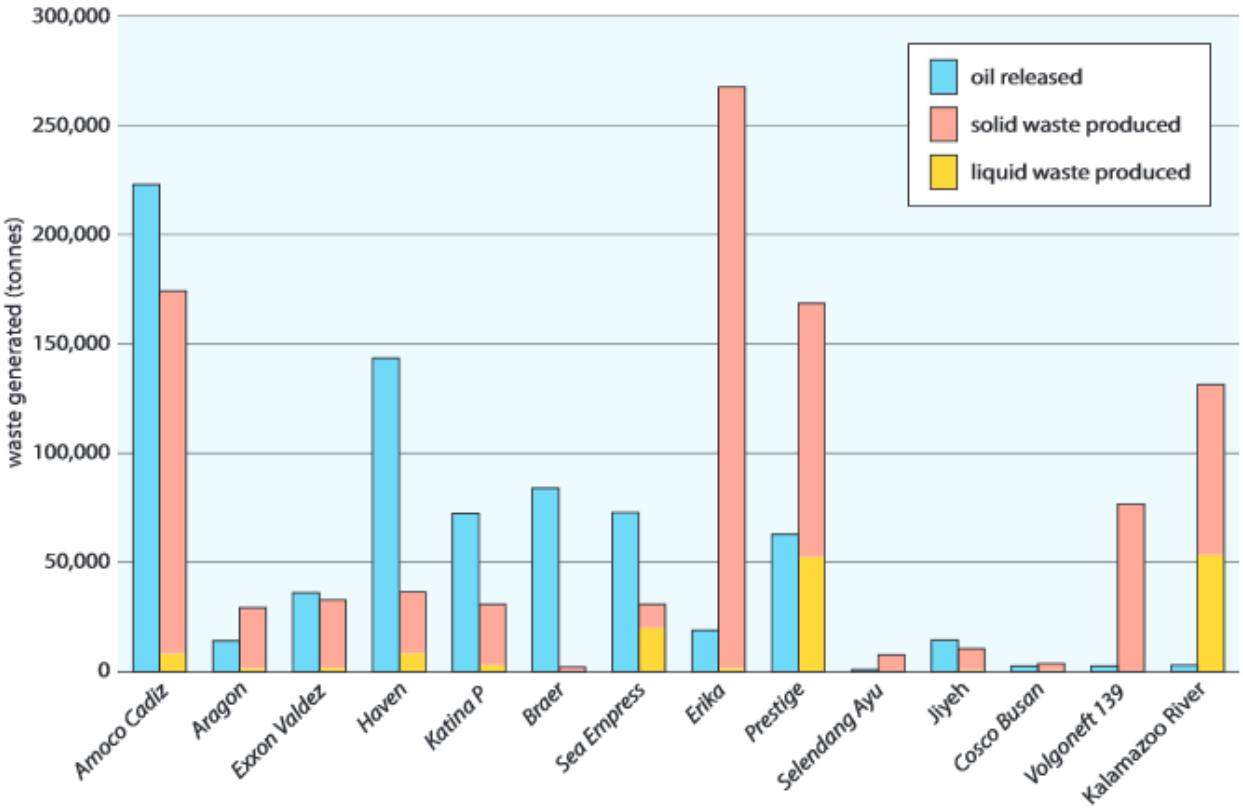

Figure 3: Comparison of quantities of oil released and waste produced for selected spills (IPIECA, 2014).

2011). Oily water and other forms of waste water must also either be processed to remove the toxic components, and/or delivered to liquid storage facilities for long-term storage. Again, following Deepwater Horizon 1.4 million barrels of liquid waste was generated and stored (Papp, 2011).Dead animals and fish also need to be removed. Following both the *Braer* and *Cadiz* spills, farmed fish had to be culled, transported, and disposed of in appropriate facilities (Goodlad, 1996; US Dept. of Commerce, 1983).

Waste management involves several intermediate steps before final disposal. Figure 4 shows a conceptual map of these steps (SLR, 2010). First, temporary storage sites must be developed directly adjacent to oiled areas. These allow for initial aggregation of waste for transport, and/or

allow for initial processing. Then, intermediate and long-term storage sites must be identified or developed in order for further aggregation, processing, or treatment to occur. Long-term storage sites may be used for final disposal, but in some cases these sites are only used for long-term treatment until the material is safe enough to dispose in other disposal areas. In addition to these types of sites, decontamination sites for treating waste management equipment and personnel may also be necessary (IPIECA, 2014). In all of these cases, the relevant sites must adhere to significant environmental protocols, which usually require lined separation from the environment, allow for groundwater and other testing, and include security parameters like fencing, etc. (SLR, 2010).

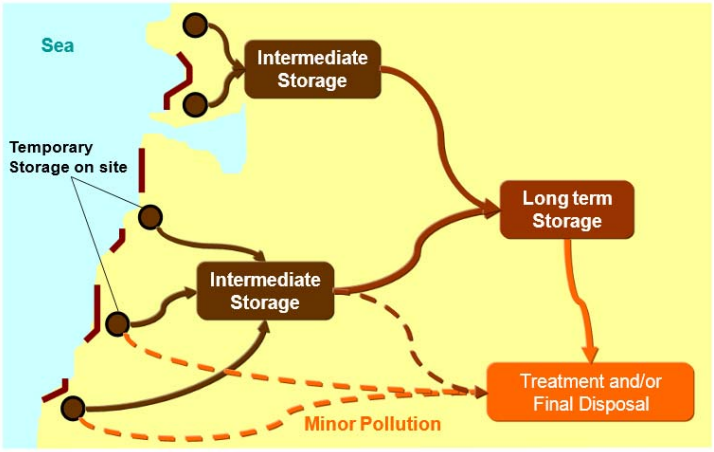

Figure 4: Waste management conceptual map (SLR, 2010).

Specific costs for waste disposal are generally added to other clean-up categories, and are consequently difficult to detail. Moreover, the long-term costs of developing new waste facilities after normal waste storage capacity have been maximized, are usually not captured by spill claims settlements. However, recent modeling of oil spill recovery in Scotland have shown disposal costs for a spill of up to 60,000m^3 to be up to approximately 68 million pounds ($107,000,000 CAD)(OPOL, 2012).

2.7. What type of communications effort is required and what are the costs (i.e. setting up IT, launching a website, etc.)?

One of the critical roles of disaster response is effective communication with the public. This can include various IT costs including a communications center and staff for researching and relating information to the public. During the *Cosco Busan* incident, the City and County of San Francisco Department of Emergency Management (CCSF DEM) provided communications equipment (cell phones, computers, printers, etc.) to the command post at the initial Fort Mason location, as well as a San Mateo mobile communications van which provided communications support for several days. However, this post was changed to one on Treasure Island, which needed to be renovated and fully outfitted with internet, fax machines, copiers, etc (CCSF After

Action Report, 2008). The Department of Public Works (DPW), and Department of Telecommunications and Information Services (DTIS) spent $155,038 and $142,943 respectively for these services (CCSF Audit Summary, 2008).

2.8. What are the costs for volunteer management?

Experience with previous oil spills has shown that large groups of volunteers may converge at a scene following highly publicized, widespread oil spills in coastal areas (Gass and Henry, 2005). Some examples include the estimated 1.82 million volunteers for the *Hebei Spirit* spill in 2007, which released 10,500m^3 of crude oil along the western coast of South Korea (Cheong, 2012). One million of these volunteers showed up during the first six weeks alone (Tucker and O'Brien, 2011). During the 1997 *Nakhodka* incident in Japan which released 6,200m^3 of fuel oil, approximately 500,000 volunteers actively participated in the response (Tucker and O'Brien, 2011). Similarly, an estimated 100,000 volunteers from across Europe traveled to Galicia for the *Prestige* oil spill in Spain. Most of the clean-up was done by volunteers who were not paid or compensated for the work that they did. An estimate of the contribution of these volunteers following *Prestige* was 325,345 labor days from November 2002 to July 2003, or $9.3 million based on the cost of labor in Spain in 2002 and 2003 (Xunta de Galicia, 2004 in Loureiro et al. 2006). Without volunteers, these would have been substantial additional costs for local jurisdictions.

Even though volunteers work without pay, they still create a series of costs for local governments in order to organize them and make them effective in the response. Some of the typical cost categories for volunteers include: reception and registration, training (both safety and work training), personal protective equipment (PPE - overalls, boots, gloves, masks etc), equipment and materials (spades, buckets, sorbents), accommodation, transport, and food/water and medical costs (Tucker and O'Brien, 2011). Estimates from the *Prestige* incident list costs per volunteer were up to $70/day for PPE and basic cleaning equipment (Gass and Henry, 2005; Tucker and O'Brien, 2011). Many volunteers were housed with willing local residents or in temporary accommodation set up in municipal sports halls and in other public buildings.

According to the City and County of San Francisco, the *Cosco Busan* response enlisted approximately 1,500 volunteers as Disaster Service Workers (DSWs). Volunteer costs detailed

by the City for the incident were $408,377 or $273 per volunteer (CCSF Audit, 2008). Although local regulations may have prohibited the use of volunteers, it quickly became apparent that volunteers were going to clean the beaches anyway, so a volunteer management plan had to be drafted and executed (CCSF After Action Report, 2008). This included the provision of training and other services that were paid for and provided by different agencies.

Among the most commonly cited concerns with regards to employing volunteers during oil spills are liability issues, the short term commitment by the majority of the volunteers, the uncertain effectiveness of their actions, excessive waste generation compared to professionals, inappropriate use of sorbents or non-selective removal of clean substrate from the shorelines, short–term use of costly protective equipment (such as boots etc), and secondary contamination throughout previously clean areas (Gass and Henry, 2005; Tucker and O'Brien, 2011). So in addition to the direct costs of managing volunteers, there are additional hidden costs which are difficult to calculate.

3. Cost Categories: Long-Term Recovery

Although the long-term "recovery" from an oil spill is generally discussed as a subsequent phase to the response, it usually begins at the same time as the response, and carries on long after the response completes. Recovery from an oil spill involves a number of activities including making an initial assessment of losses, planning out a viable strategy for addressing those losses, designing and implementing various programs to fulfill the strategy, and making the community more resilient in case of future disasters. The following sections detail a number of issues germane to the recovery following an oil spill.

3.1. What are the costs of research and damage assessments?

The long-term recovery from an oil spill requires the assessment of damages in order to prepare for response activities and litigation, as well as to perform ongoing monitoring and post disaster planning (Liu and Wirtz, 2006; US Department of Commerce, 1983). Natural resource assessments, economic analyses, and other damage assessments are usually necessary to this end.

Research costs tend to be high, especially for larger spills (Liu and Wirtz, 2006). Known research costs include the following:

- *Cadiz*: $14.3 million (US Department of Commerce, 1986)
- *Prestige*: $21.6 million (Liu and Wirtz, 2006)
- *Valdez*: $490 to $550 million (Liu and Wirtz, 2006)

Assessment costs can be significant following oil spills, and can add up especially when there is a need to monitor over a number of years. In the case of *Valdez* the passive use study alone cost $6 million (McCammon, 2003). After *Hebei-Spirit* the Ministry requested studies and ecological impact assessments (which continued on an annual basis) as well as initiating research into disaster prevention (Cheong, 2011). The *Cosco Busan* Shoreline Assessment and Natural Resource Damage Assessment resulted in an expense of $4,702,832 which included funds for restoration planning, administration and oversight (Steamship Mutual, 2011).

3.2. What is the cost for recovery planning?

In addition to the assessment phase, there is a phase of recovery planning and programming. Recovery planning usually involves a multi-stakeholder process that engages community members in designing their own recovery, and allocating resources to their needs. Recovery programming is the resulting series of activities that are used to implement the plan. The costs of recovery planning and programming are very difficult to assemble because they are rarely tracked in a systematic way.

Following *Valdez* a few municipal or regional planning processes were initiated to independently plan for the spill recovery. The Seward Multi-Agency Coordinating group was composed of the local city, the National Park Service, and other relevant entities, and it proceeded to plan for the local recovery and work with Exxon directly to allocate funds (Rodin et al, 1992). Similarly, the local residents of Kodiak collaborated with the Coast Guard and the Kodiak Island Borough to develop a local clean-up plan before Exxon officially arrived on site (Rodin et al, 1992). However, the costs for these planning processes have not been published.

3.3. What are the costs for developing technical assistance programs?

Recovering from oil spills is difficult for many individuals and business owners who have been impacted. Besides coping with the direct effects of the spill, they also have to deal with the procedures for applying for claims and getting their businesses or lives back on track. In many cases, oil spill victims have neither the expertise nor the capacity to engage in application processes, which usually requires technical assistance support from the public and non-profit sectors.

One of the largest technical assistance programs ever carried out after an oil spill occurred after Deepwater Horizon. Hundreds of thousands of claims were made, and although many of the claimants used private sector lawyers, many others used publicly-funded resources. In Louisiana little has been published about the technical assistance effort after Deepwater Horizon, but some evidence was made available by a local TA provider which can demonstrate what an effort like this would require.

In the first year after the spill began, 203,274 unique claimants made claims in Louisiana (NIMSAT, 2011). By June of 2012, this number had increased to 396,540 claimants (NIMSAT,

2012). During this time, the State of Louisiana issued fee-for-service contracts to qualified non-profits to operate claim centers for providing application technical assistance to claimants going through the process. These contracts were mostly issued by the Louisiana Oil Spill Coordinator's Office (LOSCO) and the Louisiana Department of Children and Family Services (DCFS), although complementary services were provided by the Louisiana Small Business Development Centers (LSBDC) to specifically support affected small businesses (CCC, personal communication). In the first year, seven organizations received fee-for-service contracts to provide these services to their constituencies in different areas of the State (EDS Associates, personal communication).

One organization, Coastal Communities Consulting, Inc. (CCC), a 501(c)(3) non-profit which serves primarily commercial fishermen in the Vietnamese-American community, worked with a small but important cross section of the population. The relevant figures associated with this work are shown in the Figure 5 below:

Figure 5: Coastal Communities Consulting Oil Spill TA Program, August 2010 - November 2011

Unique Clients	Clients Interactions	Total Hours	Total Billable
747	**4,996**	**4,058**	**$137,100**

In addition to the funds paying for the direct services, a local foundation also gave the non-profit $53,700 for capacity building and wrap-around services to be provided to the fishermen (including non-application-related business technical assistance, etc).

Several points are worth making. The first is that this is only a snapshot of the total expenses spent by the organization on application technical assistance. They are still involved in helping individuals and businesses apply for claims in 2014, although most of these services are now paid for by foundations. The second is that the almost 750 clients that they served represent only 0.01% of the total claimants in the State of Louisiana. When compared to the *Valdez* oil spill which had 32,000 claimants (O'Neill, 2010), this would still represent only 2.3% of all claimants. The final point is that this is only a fraction of the kinds of services the oil spill victims needed. Many of them also required personal financial counseling, career and housing counseling, etc. (CCC, personal communication). The approximately $191,000 listed above

suggests a more likely cost of millions of dollars when considered across the seven organizations and the number of years they have been engaged in this work. Similarly, it fails to capture the costs of the additional technical assistance services that have been provided to deal with the different needs beyond application assistance.

One final point to make is that of the 396,540 claims that had been filed in Louisiana by June of 2012, 110,656 claims (27.91%) were denied (NIMSAT, 2012). The "Retail, Sales, and Service" category had the largest class of denied claims with over 25% of its claims turned down. While some of these are likely mistaken or fraudulent claims that were submitted through the process, others may be issues of "pure economic loss" which are generally not possible to prove (or are even admissible in some compensation regimes) (Goldberg, 1994; Palmer, 2011). Individuals and businesses who cannot get benefits, or who are underpaid for their losses, may create a drag in the economy that will either require assistance in other forms, or will result in permanent losses of revenues and economic opportunities. These may result in further costs for local governments.

3.4. What kind of interim financial relief and payouts are made by governments?

Besides the formal claims made to the responsible parties following an oil spill, governments or other entities may provide short-term assistance in the form of grants, loans, or suspension of tax payments. They may also provide special assistance programs such as the "Emergency Food Relief Programs" established to provide wild foods to Alaska Native Communities following Exxon *Valdez* (Fall et al, 2001). This creates costs for both the direct expense of funds, and the indirect expense of administering the funding programs, which may also be managed by local governments. This assistance may or may not be reimbursed to governments during the claims process. Although there were numerous examples found for financial relief programs following oil spills (e.g. following *Prestige*, *Cadiz*, etc), it was unclear from the data what might be attributable to local governments.

3.5. What is the cost of mitigation and preparedness activities for future responses and recoveries?

Every oil spill reveals gaps in planning and preparedness which require mitigation for future spills. During the *Sea Empress* oil spill, it quickly became apparent that the emergency plan had

not been kept up to date and did not reflect the changes in waste regulation legislation that precluded the use of previously relied upon disposal outlets (Colcomb et al, 1997). During the *Cosco Busan* spill ineffective communication and information sharing prompted recommendations to actively engage in the San Francisco 2005 Area Contingency Plan (ACP) committee, and work to improve local government integration into Unified Command during oil spills (CCSF After Action Report, 2008). Similarly, in the Kalamazoo case, besides the operator error, insufficient public awareness and education allowed the release to continue for nearly 14 hours after the first notification of an odor to local emergency response agencies (NTSB, 2012). However, local oil spill recovery staff was not aware of any local-level investments into future planning to mitigate oil emergencies except for an emergency planning group discussion at the county level (City of Marshall, personal communication).

Additionally, the quality of the contingency planning and the management of response operations have been defined as a potentially crucial variable in determining the costs of the oil spill (Vanem et al 2007). The objective of oil spill contingency management is to minimize both the environmental impacts of areas most at risk and the total oil spill impacts (Liu and Wirtz, 2006). An independent organization that regularly reviews the quality of such plans and maintains public oversight has been suggested as an effective mechanism for combating complacency and fostering long-term partnerships for industry, government, and local communities in overseeing compliance (Section 5002 of OPA 90, "Terminal and Tanker Oversight and Monitoring).

In addition to these anecdotal reports, the following are examples of oil spill preparation and response systems that have been developed to increase capacity and planning:

- Washington State Department of Ecology Spill Prevention, Preparedness & Response Program: In the wake of the 1988 *Nestucca* fuel barge spill in Washington and the catastrophic 1989 Exxon *Valdez* tanker spill in Alaska, the Washington legislature created two dedicated accounts to fund the Department of Ecology's oil spill prevention, preparedness, and response activities. Today its core services include vessel and facilities inspections, plan review and approvals, contingency plan drills, natural resource damages assessment on spills to water, environmental restoration, and response to oil and hazardous materials spills delivered 24/7 from field offices.

According to the 2013-15 operating budget for the program, nearly $27.0 Million is assigned to the program. Out of this budget 17% ($4.68 million) is allocated for prevention (Washington Department of Ecology, 2014).

- The Prince William Sound Regional Citizens Advisory Councils (RCACs): After the 1989 Exxon *Valdez* oil spill in Alaska, two RCACs were established in Alaska by the U.S. Congress in order to promote partnership and cooperation among local citizens, industry and government, and to build trust and provide citizen oversight of environmental compliance by oil terminals and tankers. Congress identified complacency on the part of the oil industry and government regulators as a root cause of Exxon *Valdez*. The Prince William Sound RCAC was initially funded at $2 million a year and the funding is renegotiated every three years. Current funding is approximately $3.4 million a year. The original intent was to have 1/3 devoted to staff, 1/3 to administration, and 1/3 for research grants and contracts. Currently, due to inflation and increasing living costs, the personnel costs run about 55% of the total budget (PWRCAC, Personal Communication).

4. Cost Categories: Additional Costs and Losses

Outside of the response and recovery activities following an oil spill, there are other types of costs or losses that the public sector experiences. These are detailed below.

4.1. What are the losses to various tax revenues?

When economies, incomes, and real estate lose value, tax bases suffer. When revenues drop in impacted industries, buying power decreases throughout the economy, and jurisdictions with sales taxes experience reduced revenues (Moncrieff and Simpson, 1993). This is especially problematic after an oil spill because at the very time there is a greater need for public services to assist with the disaster, the volume of resources available to meet these needs decreases.

Although it is difficult to measure precisely which variables led to tax decreases in particular places, some jurisdictions have made very specific claims. By April 2011, BP had paid out $736 million in lost tax revenue claims to governments throughout Texas, Louisiana, Alabama, and Florida (GCCF, 2011). Additionally, the State of Alabama claimed tax losses from specific industries including tourism, retail, fishing, and real estate in two coastal counties. This was calculated at a loss of $164 million in taxes which resulted in a reduction of education spending of two full percentage points statewide (Leinwand, 2010; Addy and Ijaz, 2010). Likewise, five Florida cities claimed a combined $21 million of lost tax revenue related to lost tourism business (Tampa Bay Times, 2013; Dolac, 2013). Following a spill on the Mississippi River in 2008, the port was closed for six days, which likely led to significant tax and fee losses (Nossiter, 2008; Muskal, 2013).

4.2. What are the legal costs during and following a response?

Recovery from oil spills can cost millions of dollars in litigation and other legal services. However, due to the strict confidentiality that is held around legal expenses it is challenging to determine the total cost associated with litigation. The following are a few known examples of legal costs associated with oil spills.

- *Prestige*: The Spanish government was involved in litigation for over 11 years after the *Prestige* disaster, pursuing both criminal and civil penalties, as well as being sued

themselves. Criminal prosecution is rare under the CLC 1992 protocol (which most countries including Canada are signatories to), so this complicated the legal issues for Spain (Minder, 2012). The total cost of litigation was calculated at approximately $59 million over this period (Loureiro, personal communication).

- Exxon *Valdez*: Following the spill over 150 individual and class action lawsuits were filed against Exxon (Fall et al, 2001). On the government side, an initial cap of $20 million dollars in legal fees was set by the State of Alaska for litigation, but legal costs quickly started running $2 million per month, so $39 million was set aside (Hunt, 2010). Eventually, the costs were up to $47 million per year, far exceeding the initial estimates (Jenkins and Kastner, 2000).

- Amoco *Cadiz*: Not all legal costs have been recorded for this spill, although it is known that litigation for some towns in France cost $365,548 following the spill (US Department of Commerce, 1986, Grigalunas et al, 1986). It is expected that this is a gross underestimate of the total legal costs associated with the spill, especially because the legal costs nearly forced the plaintiffs in the case into bankruptcy several times, which eventually required them to be bailed out by the French government (Fourcade, 2011).

- *Cosco Busan*: Costs for the city attorney amounted to $406,728 following the spill, which does not include other litigation from separate parties (CCSF Audit Summary, 2008).

4.3. What are the costs for permitting and regulatory oversight?

Following the Exxon *Valdez* disaster some researchers found that issues like temporary structure permit requests, building code enforcement, land use permits, land leases, water demand, and other types of requirements put enormous pressure on local governments (Rodin et al., 1992). In fact, between 1988 and 1989 residential and commercial building permits issued in Valdez more than doubled, with the community development department being “inundated” with new business license applications, zoning requests, and other issues (Rodin et al., 1992). Interviews with the City of Marshall and the City of Battle Creek staff following the Kalamazoo spill suggested that there were significant costs in this category, but they could not provide the numbers (Personal communication).

Besides a few mentions, this is not an area that has been thoroughly researched elsewhere, and most of the related costs of managing these processes are most likely embedded within the operating budgets of the relevant departments. Despite the lack of examples, these are costs that should be highlighted when considering the impacts on local governments after oil spills.

4.4. What municipal spaces are generally lost due to an oil spill (e.g. waterfront, staging sites, etc.)

Marine and waterfront properties owned or used by municipalities may be damaged by direct oil contamination or while being used as staging or temporary disposal sites during the response. Although marine property losses have been recorded for various spills (*Cadiz*, *Hebei-Spirit*, etc.) there is little indication of what portion of these properties were owned by local governments (Grigalunas et al, 1986; Cheong, 2012). After *Valdez* local governments provided offices and other community facilities for response activities, but it is not clear how much this cost, or what alternate uses this took away from (Palinkas et al, 1993). After *Prestige*, $45.8 million was spent on “infrastructure”, although it is not clear how much of this was replacement or new build (Loureiro, personal communication).

4.5. What types of municipal staff are lost to the recovery industry?

A common occurrence after oil spills is a “brain drain” as qualified and knowledgeable employees of governments and businesses seek higher-paying opportunities in the spill response. This has been described several times in the Exxon *Valdez* response where many smaller towns and villages lost significant numbers of city employees and other staff. The village of Port Lions lost half of its city employees and almost its entire library staff to response activities (Rodin et al, 1992). This was also true for low-skilled occupations where staff were lost to response employment that paid high wages for unskilled workers (Palinkas et al, 1993). Survey results also showed a drop in formal volunteering, which was especially problematic for civic functions that depend on volunteer hours to enhance city budgets (Palinkas et al, 1993). However, in none of these cases were monetary losses established, and it may be difficult to assess how much time and expense was spent on finding and training new employees, or how new employees may have impacted the efficiency of government operations.

4.6. What are the costs for municipal brand recovery campaigns and similar civic events that reinvigorate the economy?

The image of a city can be tarnished by an oil spill when concerns are raised over the cleanliness of the city, the safety of seafood or local goods, and the quality of the water or other tourist amenities. In almost every case it is necessary for municipalities to launch brand recovery campaigns to reinvigorate their economies in the wake of such disasters. These campaigns range in scope but generally focus on announcing that the area is “back to normal”, and/or promoting the positive aspects of the municipality or region. Examples of brand recovery programs initiated by municipalities include the following:

- A campaign promoting water sports to rectify tourism losses following the *Sea Empress* spill (Moore et al, 1998)
- The hosting of beach volleyball competitions and festivals to attract new visitors after *Hebei-Spirit* (Cheong, 2012).
- Place-based promotional activities to prevent the erosion of France's "product image" after *Cadiz* (Grigalunas et al, 1986).
- The “Klean the Kazoo River Cleanup” event organized after the Kalamazoo oil spill by the Whitehouse Nature Center and Albion College Canoe and Kayak Club in partnership with municipalities. (City of Kalamazoo, personal communication).

Costs for campaigns like these typically run into the millions of dollars. Following the *Prestige* disaster, Spain launched the “Espana Verde” (Green Spain) campaign, which focused on municipal and regional brand revitalization. This campaign alone cost $37 million (Loureiro et al, 2005). After Deepwater Horizon, BP set aside $166 million for brand recovery and tourism campaigns throughout the Gulf Coast (Finn, 2012). Within this figure individual campaigns cost the city of Fort Meyers Florida $1.29 million, and the City of New Orleans $3.5 million, even though oil never reached the shores of either city (Finn, 2012, City of New Orleans, personal communication).

Within the Canadian context, brand recovery campaigns for various disasters besides oil spills have been initiated. Two notable examples include:

- Following the SARS epidemic in 2003, the City of Toronto spent $11.5 million on marketing efforts to draw tourists back to the city. These costs included concerts, media buys, branding campaigns, and festivals (Black, 2004).
- Following the Southern Alberta floods in 2013, the Calgary Business Recovery Task Force, an initiative led by the Calgary Chamber and Calgary Economic Development (CED), launched an eight-week "Rediscover Our City" marketing campaign which cost approximately $1 million (Legge, 2014). The initiative is directed at supporting and directing customer traffic to flood affected businesses.

4.7. What are the opportunity costs for local governments in dealing with oil spills?

The greatest gap in our understanding of oil spill impacts on municipal governments are the opportunity costs associated with focusing on the spill response and recovery. These activities may occupy city agendas and budgets for years after the spill response, and may create hidden costs and hardships for municipalities as they try to carry on daily work or execute long-term plans. A selection of common opportunity costs are listed below:

- Staff time: If staff are working on the oil spill, they are not working on the business of cities. Following *Valdez* the functioning of government in some places came to a "standstill", while others experienced reduced efficiency (Rodin et al, 1992). The City of Valdez spent 60 to 70% of their time immediately following the disaster on oil spill operations, which prompted reimbursements on a monthly basis from Exxon, and an additional $196,000 to pay for upfront costs (Rodin et al., 1992). The State of Florida was compensated for Fish and Wildlife staff who were busy doing spill response and could not do their regular job (Leinwand, 2010). Similarly, massive mobilizations of volunteers (1.8 million after *Hebei-Spirit*, etc.) channel civic resources away from activities that could benefit the municipality or region. Although it is relatively easy to calculate the value of labor put towards oil spill activities, it is much more difficult to determine the lost value of this labor for the city's other problems.

- Routine Operations and Maintenance: Similar to the staffing issue, when cities are focused on responding to an oil spill they are typically not engaged in the routine operations and maintenance that are usually performed. Following both the *Sea Empress* and *Valdez* spills maintenance on roads and buildings were either passed over or subcontracted to other

entities for a higher cost (Hill and Bryan, 1997; Rodin et al., 1992). In Port Lions, Alaska the building of a new community hall, replacement of water and sewer lines, and the repair of a city dock were all postponed (Rodin et al, 1992).

- Future Development: In addition to routine activities being disrupted, future developments like public transportation, waterfront developments, or new civic construction can be postponed or eliminated due to the focus on oil spill recovery. This can occur due to changing budget priorities, environmental conditions, or political attitudes. For example, even though the Pembrokeshire area was suffering 11.5% unemployment prior to the *Sea Empress* spill, the planned expansion of the local power station was rejected because of its reliance on imported bitumen. This was primarily due to a changing local perception about the heightened risk of oil spills (Edwards and White, 1999).

Appendix A: CV of Primary Researcher

JEREMY T. STONE

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Overview

- Extensive experience in community development, economic development, and disaster recovery.
- Primary areas of interest include economic development program design; disaster recovery planning; oil spills; Indigenous community planning; commercial fisheries management and policy; small business financing; innovation and sustainability within immigrant economies.
- Significant work in developing countries, First Nations communities, and immigrant communities.

Education

University of British Columbia - *School of Community and Regional Planning* **2012 - Present**
DOCTOR OF PHILOSOPHY Vancouver, BC

- Academic Focus – Economic development, community disaster recovery, social change.
- Dissertation – *Discursive Gentrification: Neighborhoods, Resistance, and the Urban Commons*

New York University - *Robert F. Wagner School of Public Service* **2004 - 2006**
MASTER OF PUBLIC ADMINISTRATION New York, NY

- Academic focus – International economic development, microfinance, and urbanization.
- Capstone – *Evaluation of Cambodia's Public Financial Management Reform Program: A Report Provided to the World Bank and the Royal Government of Cambodia.*

Reed College **1995 -1999**
BACHELOR OF ARTS – Anthropology Portland, OR

- Academic Focus – Cargo cults and the effect of religion on economic modernization in the South Pacific.
- Thesis – *The Fall of the Cassowary: Ethnicity, Morality, and Anthropological Understanding in West New Britain*

Consulting Experience

J&M Global Solutions **2014 - Present**
Disaster Recovery Consultant Alexandria, VA

- Provide project management and subject matter expertise for engagements involving disaster recovery, economic and community resiliency, governing for resilience, and evidence based decision-making.

Recovery and Relief Services **2010 - Present**
Founder and Executive Director Vancouver, BC

Founded consulting firm to provide research, program design, and planning services to organizations involved in disaster recovery and economic development. Sample engagements include:

- Greater New Orleans, Inc. – Analyzed the economic impact of the BP Oil spill on the commercial fishing industry of Southeast Louisiana; Also analyzed municipal procurement strategies following disasters.
- US Department of Commerce – Studied economic development challenges in Montauk, NY following the development of fishing quotas by the National Oceanic and Atmospheric Administration (NOAA).
- Haida First Nation – Developed a feasibility study of eco-tourism alternatives following the Haida's decision to buy out a bear-hunting license and end the bear hunts on Haida Gwaii.

- Vancouver Economic Commission – Studied the economic impacts of oil spills in the Burrard Inlet

Professional Experience

Ecotrust Canada **2008-2012**
Economic Development Project Manager Vancouver, BC

- Wrote business plans and feasibility studies for numerous Ecotrust programs including the ThisFish traceability system, the Terratruth decision support tool, the Cheakamus Community Forest carbon offset program, the Forest Stewardship Council certification program, and others.
- Provided community organizing and economic development support for initiatives across Ecotrust Canada's various disciplines including fisheries, forestry, green industries, etc.

Seedco Financial Services **2004, 2005-2008**
Senior Financial Services Officer New Orleans, LA

- Program design and management for disaster recovery programs following 9/11, Hurricane Katrina, and local NY emergencies (e.g. 2006 Queens blackout, etc).
- Developed a fisheries recovery program including financing and technical assistance for 4 parishes in SE Louisiana. Designed and funded a $1MM Fisheries Recovery Resource Center
- Managed a grant and loan program for the state, underwriting $15MM in grants, and $4MM in loans to businesses affected by Hurricane Katrina.

United States Peace Corps - Mongolia **2002 - 2003**
Community Economic Development Advisor Mongolia

- Advised Darkhan branch of the Mongolian Chamber of Commerce on capacity building, small business consulting, fundraising, and developing relationships with international aid and investment organizations.
- Completely overhauled the organization's operations through the production of a formal business plan as well as individual project plans for specific services.

Latino Economic Development Corporation **2001 - 2002**
Business Program Manager Washington, DC

- Managed 'Merchant Organizing' program focusing on capacity building, business technical assistance, and community advocacy for 4 business associations, on 3 commercial corridors, representing nearly 450 businesses.
- Managed 'Commercial Corridor Revitalization' program, which included working with city government officials to provide $300,000 in targeted assistance to business owners for façade renovations.

MarchFirst Consulting **1999 - 2001**
Business Development Consultant New York, NY

- New business development for Northeast Region of 10,000 employee firm.
- Primarily responsible for project planning for new business opportunities. Collaborated with department leaders and sales team to craft customized solutions for potential clients.
- Developed sales proposals and capabilities presentations, including strategic analyses, step-by-step project approaches, timelines, staffing plans, and cost estimates.

Founder and Board Experience

Coastal Communities Consulting **2009 - Present**
Co-Founder and President of the Board New Orleans, LA

- Established a 501(c)(3) non-profit organization to provide disaster recovery services and business technical assistance to commercial fishermen and rural entrepreneurs. Developed economic recovery programs for commercial fishermen following the BP oil spill.

Building Opportunities with Business **2013 - Present**
Treasurer, Board of Directors Vancouver, BC
- Support lending operations to small businesses in Vancouver's Downtown Eastside.

Short-Term Engagements

EMBERS Vancouver **2013**
Program Evaluation Advisor Vancouver, BC
- Evaluated the mission performance of EMBERS's staffing solutions program.

City of Vancouver – Downtown Eastside Planning Group **2013**
Economic Development Intern Vancouver, BC
- Studied issues affecting low-income-serving retail businesses in the Downtown Eastside.

Canadian Centre for Policy Alternatives **2013**
Climate Justice Intern Vancouver, BC
- Analyzed focus group data concerning economic and social service issues facing workers transitioning out of natural resource industries in British Columbia.

Seedco Financial **2010**
Oil Spill Program Manager New Orleans, LA
- Established emergency recovery center for businesses affected by the BP oil spill.

United Nations Development Programme (UNDP) **2005**
Microfinance Advisor New York, NY / Ulaanbaatar, Mongolia
- Expanded the "Enterprise Mongolia" program focusing on small business training and credit development in rural villages. Also developed programs promoting microfinance globally.

Research and Publications

Peer Reviewed Research
- Consequences of oil spills: A framework for scenario planning
  w/Stephanie Chang, et al. Ecology and Society (Special Issue) May 2014
- Ambiguity and Social Enterprise: The Impact of Definition Creep on Community Benefit and Engagement
  w/Wes Regan CCPA Publications Forthcoming

Industry Studies and Other Publications
- Post-Disaster Procurement and Economic Recovery: An Analysis of Regulations and Practice in Southeast Louisiana GNOinc.org Forthcoming
- Economic and Biophysical Impacts of Oil Tanker Spills Relevant to Vancouver, Canada
  w/Kyle Demes, et al. VancouverEconomic.com May 2013
- Retail Continuity in the Downtown Eastside: An Analysis of Present and Future Policies
  w/Daniel Iwama and Edmund Ma September 2013
- A Study of the Economic Impact of the Deepwater Horizon Oil Spill
  w/Innovative Emergency Management, Inc. October 2010
- Microfinance Plays Strong Role in Mongolia's Poverty Reduction Strategy
  w/Toshiya Nishigori Microfinance Matters, Issue 16 September 2005

Appendix B: Oil Spills Researched

The following are case studies for oil spills that formed the bulk of this study's analysis.

Amoco *Cadiz*: On March 16th, 1978, a steering gear failure resulted in the Amoco *Cadiz* tanker running aground off the coast of Brittany, France. 223,000m^3 of light crude oil and 4,000 m^3 of bunker fuel were released into the ocean in the weeks following the incident. The volume of contaminated fluid multiplied as oil mixed with the sea waters and eventually contaminated 320km of Brittany shoreline and resulted in the greatest loss of marine life recorded after a spill to that point. Millions of dead sea urchins and dead mollusks washed ashore and oyster cultivation was seriously affected. Rocky shores recovered relatively quickly, while the salt marshes took many years to recover (ITOPF, 2014a).

Burnaby Oil Spill: In July of 2007 a pipeline carrying crude oil was struck by an excavator working on a sewer line in Burnaby, BC, Canada. Lack of communication and pre-construction procedures were cited as factors contributing to the break. The pipeline released about 201m^3 of oil some of which flowed into the Burrard Inlet and some of which sprayed homes in the residential neighborhood. The incident caused environmental pollution in the area and lead to the evacuation of about 250 residents. Cost estimates for clean-up operations were about $17 million dollars (CBC, 2011).

Cosco Busan: On November 7, 2007, the freighter *Cosco Busan* struck the Bay Bridge under conditions of restricted visibility as it attempted to depart San Francisco Bay. As a result 53,569 gallons of oil flowed into the San Francisco Bay (according to US Coast Guard calculations). 89.66 miles of shoreline were polluted; although only 34.45 miles were polluted heavily or moderately. The spill precipitated widespread beach closures, fisheries closures (both commercial and recreational), and the cancellation of many activities on the Bay. A large-scale response ensued, with clean-up crews active for several weeks. The US Coast Guard officially declared the response to be complete on November 9, 2008, one year and two days after the spill. Some clean-up continued at several beaches into summer 2008, as they continued to have oiling episodes washed up by wave action. The overall costs of the incident as of 2011 were $222,300,000.

Deepwater Horizon: On April 20, 2010, the Mobile Offshore Drilling Unit Deepwater Horizon located off the Gulf of Mexico, USA, suffered a catastrophic blowout which caused the rig to sink and spew oil for nearly three months before being capped. It is estimated that 627,000m^3 of crude oil were spilt about a mile under the surface. Spill response was complicated given the severity of the spill, complexity of response, and potential impacts (Papp, R. J., 2011). Clean-up operations were still ongoing after a year and the event cost at least $44 billion dollars.

Exxon *Valdez*: On March 24th, 1989, the Exxon *Valdez* was grounded on a reef in Prince William Sound, Alaska, USA. Located in a pristine wilderness area, the collision resulted in 37,000m^3 of crude oil spilling into the Sound and spreading down the coast. Over 1,800km of shore line were affected and it is estimated that 1,000 sea otters and 35,000 birds died as a result. Particular efforts were made to protect fisheries but oil residues remained trapped in intertidal sediments at a few locations for years after. The spill resulted in one of the most expensive clean-up operations in North American history and costs were estimated to be above $4.7 billion (ITOPF, 2014b).

Hebei-Spirit: On December 7th, 2007, the 1993 tanker ship was anchored off Taean, South Korea, and was struck by a crane barge. The barge, having broken free from its tow in the bad weather, punctured three cargo tanks of the *Hebei Spirit*. 10,900m^3 of crude oils were released to the sea and proceeded to affect hundreds of kilometers of coast line around Korea. Clean up efforts went on for most of the year with significant involvement from local fishing vessels on top of the Korean organizational response. Fishing and seaweed cultivation facilities as well as tourism activities were affected. Claims up to about $3 billion were submitted though about two-thirds of them were rejected for various reasons including lack of documentation (ITOPF, 2014).

Kalamazoo River Spill: On Sunday, July 25, 2010, Enbridge's Line 6B ruptured in a wetland near Marshall, Michigan. The rupture occurred during the last stages of a planned shutdown and was not discovered or addressed for over 17 hours. During the time lapse, Enbridge twice pumped additional oil (81 percent of the total release) into Line 6B during two startups. The total release was estimated to be 843,444 gallons of crude oil. The oil saturated the surrounding wetlands and flowed into the Talmadge Creek and the Kalamazoo River. Local residents self-evacuated from their houses, with about 320 people reporting symptoms consistent with crude oil exposure. No fatalities were reported. According to the Enbridge Energy Partners' filing with the United States Securities and Exchange Commission in 2014, the cost of Kalamazoo clean-

up was $1.32 billion CAD, not including possible additional fines and penalties that might be imposed by US authorities in the future.

Kirby 27706: On March 22, 2014, about 546m^3 of fuel oil spilled into Galveston Bay near Texas City, Texas, USA. A ship collided with the oil tank-barge Kirby 27706 puncturing one of the tanks. The barge was moved aground relatively quickly and the remaining oil was removed from the vessel. The Houston Ship Channel and Intracoastal Waterway were initially closed to traffic and cleanup efforts are still ongoing (US Department of Commerce, 2014).

LA Pipeline Spill: On May 15, 2014 an above ground pipeline transporting oil from Bakersfield, CA to Texas ruptured in Los Angeles, CA, USA. Crude oil burst out of the pipe and spilled over a half-mile area which led to the evacuation of local businesses and sent two people to hospital. 160m^3 of oil spewed out onto the streets and the primary clean-up was expected to take about a week. Final costs and cleanup are still ongoing (Reuters, 2014).

Mississippi River Spill: On July 23, 2008, a tugboat pulling an oil-laden barge swung into the path of a large tanker near Louisiana, USA. The vessels collided splitting the barge in two and spilling 900$m^3$of heavy oil over the span of a couple days. Nearly 100 miles of waterways reaching out into the Gulf of Mexico were coated in thick black oil resulting in river closures estimated to cost $320 million per day. Clean up operations got underway and were estimated to be about $100 million but litigation around who is ultimately responsible for the disaster was still ongoing in 2012 (Nossiter, 2008, Sayre, 2012).

Prestige: On 13 November 2002, the *Prestige* oil tanker sprung a leak 30 miles west of Galicia, in northwest Spain. The 25-year-old single-hull ship was transporting 77,000$m^3$of heavy fuel oil from Lithuania to an undetermined destination (under a Bahamian flag, owned by a Greek shipping company and chartered by an Anglo–Swiss company). The tanker was towed, and having sailed for five days with a gash in its hull, it broke in two and sank 130 miles off the coast. The bulk of the 77,000$m^3$of heavy fuel spilled into the Atlantic Ocean and arrived on the coastline in three “black waves”, polluting approximately 1,000 km of shoreline in Galicia alone, resulting in losses to sea-based industries, tourism and environment. (Loureiro et al, 2005).

Sea Empress: On 15th February 1996, the Liberian registered single hull oil tanker carrying 130,000m^3 of crude oil from North Sea towards Texaco Refinery struck a rock at the entrance to

Milford Haven harbor in South Wales (United Kingdom). A total of 72,000m^3 of light crude oil and 450m^3 of heavy fuel oil was spilled. After seven days the *Sea Empress* was eventually brought under control and taken into dock at Milford Haven. As a result, 120 miles of Welsh coastline were contaminated and thousands of seabirds/wildfowl killed. Main shoreline clean-up activities completed in 6-9 months. Costs claimed for the clean-up were $18 million in this time (Purnell, 1999).

Appendix C: References

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Appendix D: Organizations and Agencies Contacted

The following are organizations and agencies that were contacted in the course of developing this study. Not all of those on this list were able to provide information for the study, but this, in itself, was considered an indication of what is available concerning municipal impacts of oil spills. The opinions expressed throughout the study are solely those of the authors, and are not intended to represent the opinions held by the organizations or agencies on this list.

Municipalities, municipal departments and local organizations	
City of Battle Creek, MI	City of Richmond, CA
City of Burnaby, BC	Los Angeles Emergency Management Department
City of Galveston Emergency Management Center	Plaquemines Parish Division of Administration
City of Marshall, MI	San Francisco Controller's office
City of New Orleans	San Francisco Department of Emergency
Regional and State Departments	
Calhoun County Health Department	Michigan Department of Environmental Quality
EPA Marshall Field Office	Pembrokeshire County Council
FEMA Region IX	Prince William Sound Regional Citizens' Advisory Council
Finance Department, Regional District of Central Kootenay (RDCK)	Slocan Valley Economic Development Commission
Fire and Rescue services, Regional District of Central Kootenay (RDCK)	TAMU - Natural Resources Center, Texas General Land Office - Oil Spill Division
Louisiana Oil Spill Coordinator's Office (LOSCO)	Texas General Land Office - Oil Spill Division
Louisiana Recovery Authority	The Regional Citizens Advisory Council of Prince William Sound
Federal Departments	
US Economic Development Administration	Environmental Protection Agency, Region 5
Academic Institutions	
Department of Ecology Spill Prevention, Preparedness & Response Program, Washington	Michigan State University
Faculty of Economy, University of Vigo	University of Kansas
Institute of Maritime Studies University of A Coruña	University of Santiago de Compostela
Other	
EnviroEmerg Consulting	International Tanker Owners Pollution Federation
Kirby Marine LLC	

Appendix E: Description of Direct and Indirect Oil Spill Costs

Oil spill response costs are composed of a variety of direct and indirect costs, and are subject to numerous variables that can increase or decrease the range of expenditures. Direct costs generally include the following (Fingas, 2013; US Department of Commerce, 1983):

- Oil containment and recovery – the use of booms, skimmers, pumps, and other methods to capture oil directly from the ship or while in the water;
- Oil treating or elimination – the use of dispersants, sinking agents, in-situ burning, or other techniques to keep the oil from reaching shore;
- Surface cleaning – the use of power-washers and manual retrieval methods to clean beaches, marshes, and other areas;
- Subsurface cleaning – soil and bioremediation or other techniques;
- Storage, separation, decontamination, transport, and disposal – the various post-collection processes for preparing oil (and mousse) for eventual disposal.

Indirect costs are those that support a clean-up operation. These can include (US Department of Commerce, 1983; Tucker and O'Brien, 2011):

- Readiness – Besides the investment into equipment like pumps skimmers and booms, the storage and maintenance of these items create costs even before the oil spill has happened.
- Administration – There are administrative costs in maintaining a spill response organization, and related training and planning, both before and during a spill.
- Coordination/Staging – Work areas are required for response personnel, including food stalls, personal cleaning equipment, accommodation, medical resources, etc. This involves not only developing temporary spaces, but also another layer of staffing and administration.
- Prevention – As with every disaster, lessons learned spawn a new understanding of vulnerability, which leads to new investments for infrastructure and response capacity.

Additionally there are various factors which drive clean-up costs including the type of oil, the location of the spill, the amount spilt and spill rate, the characteristics of the affected area (i.e. physical, biological, economic and political characteristics), weather and sea conditions, and time of year (White and Molloy (2003). A description of these factors is as follows:

- Type of oil: Depending on the type of oil (light crude, heavy crude, etc.) different oils will present different challenges and costs for clean-up (White and Molloy, 2003). For example, average clean-up costs for Marine Heavy Fuel Oil (MFO) spills have been found to be an average of 5 times more expensive than lighter oil product spills (Kontovas and Psaraftis, 2008).

- Amount spilled and rate of spillage: Various studies of oil spills have found that per unit costs of oil spills vary relative to the amount of oil spilled, with smaller spills costing more per tonne than larger spills (Monnier, 1994; Etkin, 2000; White and Molloy, 2003). This can be attributed to the relatively fixed costs of setting up the clean-up response, mobilizing the equipment and personnel, as well as bringing in the experts to evaluate the spill response and damages (Etkin, 2000). Similarly, the rate of spillage from tankers can impact costs especially when all of the spilled oil does not exit the ship at the same time. For example, the Betelgeuse, which sank in Ireland in 1979, continued to release oil over 21 months and required multiple subsequent clean-up efforts (White and Molloy, 2003).

- Characteristics of the affected area: The physical, biological, and economic characteristics of spill locations play an important role in determining the costs of the spill. For example, the amount of oil penetration along the coast depends on differences between rocky and sandy shorelines (Carls et al, 2001). Etkin (1998) and Kontovas and Psaraftis (2008) suggest that oil spills that occur in near shore locations or in ports are significantly more expensive to clean up than offshore spills, due to the higher probability for shoreline impact. Shoreline clean-up is considered to be one of the more expensive cleanup categories, with some data showing it to be 10 times more expensive that sea-based clean-up, and 100 times more expensive than pulling oil directly from the damaged ship (Nyman, 2009). The proximity to a major urban area and widespread visibility can influence the costs of an oil spill (Chang et al, 2014).

- Time of the year, weather, and sea conditions: Weather conditions and the seasonal temperature of the ocean can have a significant effect on the movement and weathering of oil, which will directly impact the amount and cost of clean-up required (Pearson et al., 1998; Alló and Loureiro, 2013). During the *Sea Empress* spill in Wales, high winds prevented at-sea recovery operations with only 3% of the spilled oil recovered, while in South Africa, shifting winds and sea currents after the sinking of the *Castillo de Bellver* resulted in the

majority of the 190,000m^3 of spilled oil moving away from shore (Moldan et al., 1985; Law and Kelly, 2004).

Appendix F: Currency Conversion Methodology

All of the costs in this report have been converted to 2014 Canadian dollars (CAD). Costs were converted to Canadian dollars using the appropriate exchange rate for the year in which the cost was originally quoted. A table of all exchange rates used is included in Table X below. For instance if the original value was identified as being in 1978 USD then the exchange rate of 0.877 would be applied to obtain 1978 CAD. The Canadian dollar equivalent was then adjusted for inflation using the Bank of Canada Inflation Calculator (http://www.bankofcanada.ca/rates/related/inflation-calculator/) to obtain 2014 figures.

Conversion	Year	Average Rate	Source
USD -> CAD	1978	0.877	data360.org
	1981	0.844	data360.org
	1989	0.847	data360.org
	1990	0.857	Canadianforex
	1991	0.873	Canadianforex
	1999	0.673	Canadianforex
	2000	0.674	Canadianforex
	2005	0.827	Canadianforex
	2007	0.935	Canadianforex
	2008	0.944	Canadianforex
	2009	0.88	Canadianforex
	2010	0.971	Canadianforex
	2011	1.011	Canadianforex
	2012	1	Canadianforex
	2013	0.971	Canadianforex
	2014	0.912	Canadianforex
EUR -> CAD	2003	0.637	freecurrencyexchange.com
	2004	0.619	x-rates.com
	2005	0.663	x-rates.com
	2010	0.732	x-rates.com

WON -> CAD	2008	1026	x-rates.com
Francs -> CAD	1978	4.18	Grigalunas et al, 1986
GBP -> CAD	1999	0.417	freecurrencyrates.com
	2012	0.633	freecurrencyrates.com

Sites Consulted:

Bank of Canada inflation calculator. Inflation Calculator [website]. Retrieved from http://www.bankofcanada.ca/rates/related/inflation-calculator/

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Appendix G: Certificate of Expert's Duty

I, Jeremy Stone, of Vancouver, British Columbia 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 5, 2015 Signature: