



**A CONDENSED POLICY TIMELINE FOR THE**

# Burnaby Mountain Tank Farm

Emergency Management and Response Plans

**TERRY BEECH**

BURNABY NORTH - SEYMOUR

This is an internal document that has been made public  
in advance of the UniverCity Community Association's  
Town Hall on Safety, March 7, 2019.



Dear Friends, Neighbours, and Residents of Burnaby Mountain,

I want to thank all members of our community for their continued engagement regarding safety and security issues with regards to Burnaby Mountain and the Tank Farm in particular. Your voices and concerns over the last three years have allowed me to be a more effective Member of Parliament and ensure that your voices are heard strongly in Ottawa.

After meeting with representatives of your community in October, where the idea of a town hall was initially raised, I set out to formalize our own internal working documents that we have utilized to track the various viewpoints of a number of stakeholders in the Burnaby Mountain Community.

In the interest of openness and transparency, and to ensure residents are armed with the most recent and up to date information, I am making these documents public. The document entitled "Burnaby Mountain Tank Farm: Emergency Management and Response Plans," provides an up to date timeline of issues ranging from 2011 to present, and a collection of relevant documents with regards to emergency response planning and safety concerns. This document is published in addition to my previous work on the Trans Mountain Pipeline, Climate Change, the Trans Mountain hearings, and the Detailed Route Hearings. All of this information is available on my website at [TerryBeechMP.ca](http://TerryBeechMP.ca).

It is my hope that this information empowers our community to continue its advocacy for a safe and prosperous Burnaby Mountain Community.

Sincerely,

**Terry Beech**

A handwritten signature in black ink, appearing to read "Terry", written in a cursive style.

# OVERVIEW

Since 1953, the Canadian division of Kinder Morgan Energy Partner has operated the Trans Mountain Pipeline between Edmonton, AB and Burnaby, BC. The Trans Mountain Expansion Project hopes to expand the current 1,150 km crude and refined oil pipeline by twinning the pipeline with 987 km of new buried pipeline, creating new and modified facilities including pump stations and tanks, and constructing additional tanker loading facilities. If the Trans Mountain Expansion Project is approved, it would transport approximately 890,000 barrels per day compared to its current capacity of 300,000 barrels.

Local residents, Indigenous communities, and both municipal and provincial governments along the Trans Mountain Expansion Project route have protested the project and the National Energy Board review process. Legal challenges have effectively halted any new construction related to the Trans Mountain Expansion Project.

On April 8, 2018 Kinder Morgan Canada suspended all non-essential activities related to the pipeline because the political climate and legal challenges heightened uncertainty. On May 29, 2018 the federal government announced its intent to purchase the pipeline from Kinder Morgan for \$4.5 billion. On August 30, 2018 Kinder Morgan Canada's shareholders voted to approve the sale.

That same day, the Federal Court of Appeal overturned the National Energy Board's approval of the Trans Mountain Expansion Project. The Court concluded that the government's "duty to consult [Indigenous communities] was not adequately discharged" and the National Energy Board's environmental assessment did not properly consider the impact increased tanker traffic would have on endangered killer whales in the Salish Sea. On February 22, 2019 the National Energy Board responded to the Court's decision with a reconsideration report which again recommended the Governor-in-Council approve the Trans Mountain Expansion Project.

The Governor-in-Council now has 90 days to review the National Energy Board's recommendation. If they decide to approve the expansion, a Certificate of Public Convenience and Necessity by Order-in-Council (i.e. Cabinet recommendation) will be issued and the project will proceed.

While the Trans Mountain Expansion Project has many components, Burnaby Mountain constituents are worried about the addition of 14 storage tanks to the Burnaby Terminal's existing 12 storage tanks on the north and east sides of the site (near Simon Fraser University). If approved, these new storage tanks will increase storage capacity by 620,000 m<sup>3</sup> or 230%. Risks include "an accident or malfunction, such as a fire or spill, leading to a hazardous exposure, isolation, and/or evacuation of the SFU population." (*"Trans Mountain Expansion Project - Review of Human Health Risk Assessments, Evidence Report,"* (May 21, 2015), Pottinger Gaherty Environmental Consultants Ltd.) In particular, disagreements between Trans Mountain and the City of Burnaby over adequate emergency management and response planning has exacerbated our constituents' concerns.

The purpose of this document is to outline the discussion surrounding emergency management planning for the Burnaby Terminal. This document includes a timeline of events about the Burnaby Terminal's current and proposed Emergency Response Plans.

# TIMELINE OF EVENTS

<b>Mar 15, 2011</b>	Doug McCutcheon and Associates Consulting submit their commissioned risk assessment report to the NEB about the the existing Burnaby Terminal facility.
<b>May 23, 2013</b>	Trans Mountain files a project description for the TMEP.
<b>Oct 1, 2013</b>	Doug McCutcheon and Associates Consulting submit their commissioned risk assessment report to the NEB about the TMEP. (54 pages)*
<b>Jun 18, 2014</b>	Burnaby Fire Department and Kinder Morgan meet to discuss the Burnaby Terminal's existing fire protection capabilities. (7 pages)
<b>Oct 17, 2014</b>	KMC submits an explanation to the NEB about why they cannot make parts of their Emergency Management Program Documents public. (5 pages)
<b>May 1, 2015</b>	Burnaby Fire Department submits their evidentiary paper about the fire and safety risks, hazard events and consequences associated with the TMEP. (96 pages)*
<b>May 21, 2015</b>	<p>Pottinger Gaherty Environmental Consultants Ltd. ("PGL") submits their commissioned evidence report to SFU about the HHRA associated with the TMEP. (8 pages)</p> <p>David Etkin, Kaz Higuchi, Sarah Thompson (York University) and Markus Dann (University of Calgary) submit their commissioned gap analysis report to SFU about the hazards of the TMEP to SFU, especially with respect to Trans Mountain's ERP. (67 pages)</p>
<b>May 22, 2015</b>	Dr. Ivan Vince submits his commissioned report to the City of Burnaby about the potential off-site risks of the TMEP. (29 pages)
<b>Aug 20, 2015</b>	<p>Trans Mountain responds to the Burnaby Fire Department's evidentiary paper about the fire and safety risks, hazard and events and consequences associated with the TMEP. (70 pages)*</p> <p>Trans Mountain responds to the Etkin et al.'s gap analysis report to SFU about the hazards of the TMEP to SFU, especially with respect to Trans Mountain's ERP. (28 pages)</p>
<b>Jan 12, 2016</b>	City of Burnaby submits their final written arguments against the TMEP.
<b>May 19, 2016</b>	The NEB publishes their report recommending the TMEP be approved.
<b>Aug 17, 2016</b>	Mark W. LaLonde, SFU's Chief Safety Officer, presents to the Trans Mountain Ministerial Panel about SFU's concerns with the TMEP. (3 pages)

(\*indicates only the executive summary or relevant pages are included)

<b>Nov 25, 2016</b>	Andrew Petter, SFU President, writes a letter to then Minister of Natural Resources, the Hon. Jim Carr, expressing concerns with the TMEP. Attached to his letter is PGL's commissioned report for SFU entitled "Trans Mountain Expansion Project (TMEP): Evaluation of Risks to SFU." (14 pages)
<b>Nov 29, 2016</b>	GIC issues the OIC accepting the NEB recommendation that the TMEP be approved, directing the NEB to issue a CPCN to Trans Mountain.
<b>Dec 21, 2016</b>	Trans Mountain completes a report for the TMEP entitled "Burnaby Terminal Fire Protection Philosophy."
<b>Mar 1, 2017</b>	<p>As part of the NEB's Condition 22, KMC files an updated risk assessment (Appendix B1) for its Burnaby Terminal. (14 pages)</p> <p>As part of the NEB's Condition 24, Trans Mountain files an updated summary report (Appendix B1) for its Burnaby Terminal Second Containmentment. (14 pages)</p> <p>As part of the NEB's Condition 24, Trans Mountain files an updated final design (Appendix B2), for its Burnaby Terminal Second Containmentment. (169 pages)*</p>
<b>Jul 14, 2017</b>	Kinder Morgan responds to the City of Burnaby's letter of comment with concerns about Conditions 22 and 24, filed June 30, 2017. (20 pages)
<b>May 3, 2018</b>	City of Burnaby submits their comments on Trans Mountain's response to the NEB's Information Requests Nos. 1, 2, and 3 on the Burnaby Terminal Variance. (10 pages)
<b>Aug 30, 2018</b>	The Federal Court of Appeal releases its decision in Tsleil-Waututh v. Canada (Attorney General), quashing the CPCN.
<b>Oct 2, 2018</b>	The Concerned Residents of Burnaby Mountain submits a group application to participate as an intervenor for the reconsideration of the TMEP. (4 pages)
<b>Oct 3, 2018</b>	City of Burnaby submits a letter of comment for the reconsideration of the TMEP focused primarily on marine shipping. (4 pages)
<b>Nov 20, 2018</b>	Simon Fraser Student Society submits a letter of comment for the reconsideration of the TMEP. (4 pages)
<b>Feb 22, 2019</b>	The NEB publishes their reconsideration report of the TMEP.

(\*i indicates only the executive summary or relevant pages are included)

# | EMERGENCY RESPONSE PLANS

Trans Mountain's "Emergency Response Plans: Terminals and Tank Farms" document is available on their website and was last revised in October 2018. Site-specific section for the Burnaby Terminal includes (see Annex A for more details):

**6.3** Fire Hazards

**7.4** Burnaby Terminal

**9.5.7** Mobile Fire Equipment List

**16.0** Regulatory Background

# | LIST OF ACRONYMS

**CPNC** Certificate of Public Convenience and Necessity

**CRBM** Concerned Residents of Burnaby Mountain

**EMP** Emergency Management Plan

**ERP** Emergency Response Plan

**GIC** Governor-in-Council

**HHRA** Human Health Risk Assessments

**KMC** Kinder Morgan Canada

**NEB** National Energy Board

**OIC** Order-in-Council

**SFU** Simon Fraser University

**TMEP** Trans Mountain Expansion Project

**TMX** Trans Mountain Expansion Project

**UCA** UniverCity Community Association

# | LIST OF ANNEXES

Annex A – Trans Mountain Emergency Response Plan sections that apply to the Burnaby Terminal.

### 6.2.3 Summer Response Considerations

During the summer months personnel must be aware of the impact that heat and/or humidity will have on overall health. Summer related hazards that should be considered as part of the Health and Safety Plan include;

- **Heat Exhaustion** - a condition that occurs when the body is overheated and dehydrated. Symptoms associated with this illness may include heavy sweating , dizziness and fainting
- **Heat Stroke** – occurs when the body is overheated, at or above 104 F (40 C), due to prolonged heat exposure. Is considered a medical emergency requiring immediate treatment in order to prevent permanent physical damage
- **Biological hazards** – a review of potentially hazardous wildlife (insects, mammals) and plants (poisonous weeds) should be completed with responders as part of the pre-job Tailgate Meeting
- Shaded areas with adequate rehab supplies, including water, should be established on-site in order to provide responders with an area to rest and recover during break periods

### 6.3 Fire Hazards

Fire Hazards, other than wildfire, which could impact Trans Mountain operations can be grouped into three main categories;

- Terminal and Tank Farm fires
- Pump Station fires
- Pipeline Right-of-Way fires

In general there are three classes of fire that Trans Mountain responders should be familiar with .These classifications stem from the type of fuel that ignited and maintains the fire. The following descriptions provide a brief overview of these classes.

- **Class A Fires** - Consist of ordinary combustibles such as wood, paper, trash or anything else that leaves an ash. Water works best to extinguish a Class A fire.
- **Class B Fires** - Are fueled by flammable or combustible liquids, which include oil, gasoline, and other similar materials. Class B fires often spread rapidly and, unless properly secured, can re-flash after the flames are extinguished. Smothering effects which deplete the oxygen supply work best to extinguish Class B fires.
- **Class C Fires** - Energized electrical fires are known as Class C fires. Always de-energize the circuit then use a non-conductive extinguishing agent, such as Carbon dioxide. They can be caused by a spark, power surge or short circuit and typically occur in locations that are difficult to reach and see.

In the event of a fire originating from a Trans Mountain facility priority must be given to life safety. Notification and evacuation of the hazard area are the primary means of initial response. Once personnel are accounted for the On-Scene Commander may determine response options including offensive, defensive or non-intervention strategies.

### 6.3.1 Terminal/Tank Farm Fires

Strategies and tactics to be utilized when responding to a Terminal and/or Tank Farm fire are specifically outlined in their corresponding facility **Fire Pre-Plan**. Fire Pre-Plans provide initial responders with immediate response options including defensive and offensive fire fighting tactics. The plans incorporate fire calculations for necessary amounts of water, foam concentrate and pumping capacities needed to extinguish rim seal, full surface and containment bay fires. They also include strategies for the extinguishment of three dimensional fires that may occur at valve and/or manifold locations.

In addition to Fire-Pre Plans all Terminals and Tank Farms have Fire Safety Plans which provide information regarding building evacuation procedures, evacuation routes, on-site fire equipment and fire prevention practices. For additional information refer to the specific facility Fire Safety Plan.

### 6.3.2 Pump Station Fires

Pump Station fires may originate from a variety of ignition sources including faulty electrical wiring, overheated materials such as flammable liquids, and lightening.

Prevention is the best method for avoiding pump station fires. Prevention activities can include;

- monitoring the accumulation of flammable and combustible waste and residues that contribute to fires
- ensuring that general equipment maintenance procedures are followed
- all flammable liquids are stored properly
- proper hot work permitting is issued
- appropriate level of fire detection and extinguishment systems and resources are available on-site (i.e. fire extinguishers)

#### 6.3.2.1 Pump Station Fire Response Checklist

- Once fire is confirmed sound fire alarm to alert all on-site staff and contractors
- Following designated evacuation routes as outlined in the facility *Fire Safety Plan* and proceed to the designated muster station. Conduct head count.
- Call 911 or the local fire department
- Notify the Edmonton Control Centre in order to issue ERL (+).
- Shutoff or isolate fuel sources feeding the fire if this can be done safely
- Provide first aid to any personnel who may be injured or require assistance
- For small fires consider an offensive attack utilizing handheld fire extinguishers (ABC and/or CO<sub>2</sub>) and wheeled dry chemical extinguishers
- If the fire grows in size or if extinguishment cannot be safely achieved utilize and defensive strategy and retreat from the area
- Coordinate response with local fire
- Monitor weather conditions, including wind direction, as excessive smoke may impact members of the public



### 6.3.3 Right-of-Way Pipeline Fires

Right-of-way fires typically originate from failed piping/flanged connections causing a release of product into the ground with possible surface pooling. In order for a right-of way- fire to occur the released products vapours must reach a source of ignition, such as from equipment, machinery and/or vehicles near right-of-way.

Prevention is the best method for avoiding right-of-way fires. Prevention activities include;

- 24/7 monitoring of pipeline operations via SCADA system
- Aerial patrols of right of way looking for signs of
  - Vehicles/machinery on right of way
  - Discolored vegetation
  - melted snow
- Local visual inspections from operators
- In depth maintenance/integrity program

#### 6.3.3.1 Right-of-Way Pipeline Fire Response Checklist

- Once fire is confirmed muster any personnel in area upwind of incident
- Call 911 or local Fire Department
- Notify control center in order to issue ERL (+)
- Shut off or isolate fuel source feeding fire if this can be done safely
- Refer to the *Right-of-Way Fire Emergency Response Plan Supplement* for a list of strategies and tactics
- For small fires consider an offensive attack utilizing handheld fire extinguishers (ABC)
- If fire grows in size or if extinguishment cannot be safely achieved utilize a defensive strategy and retreat from area
- If fire impacts adjacent wildland, follow the *Wildfire Plan* and ensure the appropriate Provincial Wildfire Agency is notified
- Coordinate response with local Fire Department
- Monitor weather conditions, including wind direction, as excessive smoke may impact members of the public

### 6.3.4 Vehicle Fires

Most vehicle fires are a result of malfunctioning electrical components, fuel lines or a fuel pipe splitting. In the case that Trans Mountain personnel are in a vehicle and begin to see smoke or smell burning material they should safely pull over and shut off the vehicle. Shutting off the engine will stop the flow of fuel and may prevent a full-blown fire. It is critical for the driver and other personnel to ensure they immediately exit the vehicle, and if safe, move off the road in order to reduce the likelihood of secondary accidents.

- For small fires only (passenger section, electrical fault, fires contained to contents of cargo space or trunk) use a vehicle ABC type fire extinguisher, if it is safe to do so.
- For large fires or fires involving fuel or storage tanks on the vehicle, evacuate the area by at least 25 metres and call for assistance from emergency responders. Once in a safe area you should stand by, assess the situation, and wait for assistance from emergency responders.

#### 6.3.4.1 Vehicle Fire Response Checklist

- If smoke or flames are detected from an operating vehicle, safely pull to the side of the road and exit the vehicle.
- Move away from the vehicle and call 911 for any large or out of control fire
- If the fire is small in size attempt extinguishment with vehicle fire extinguisher if it is safe to do so
- Notify your supervisor and the Edmonton Control Centre

## 7.4 Burnaby Terminal

The Burnaby Terminal is located within the City of Burnaby. The terminal is located on Shellmont Street. The surrounding land use is industrial operations, residential developments, recreational facilities and parks, and Simon Fraser University to the northeast of the site.

Total area occupied by the Terminal and Division Office is 76.3 hectares (188.6 acres). The area within the security fencing is 70.5 hectares (174.1 acres). During normal working hours, controlled access to the Terminal is through the Main Gate past the Gate Keeper (Security Guard). The Terminal Operating Technicians may also control the Main Gate remotely from the Control Room with an intercom and security camera.

Burnaby terminal includes four 12,650 m<sup>3</sup> (80,000 bbls) tanks (Tanks 71, 72, 73 & 74), six 23,850 m<sup>3</sup> (150,000 bbls) tanks (Tanks 81, 82, 83, 84, 85 & 86), three 24,963 m<sup>3</sup> (157,000 bbls) tanks (Tanks 87, 88 & 90), and two additional tanks (Tank 99), with a capacity of 1,081 m<sup>3</sup> (6,800 bbls), all of which is surrounded by Shellmont Street, Greystone Street/Arden Avenue, Burnaby Mountain Parkway, and the Gagliardi Way roads.

The site slopes steeply from north to south in a series of steps or tiers. The Upper Firewater Levy and Fire Pump House are at the highest elevation with the Tank Farm in two tiers just below. Tank elevations range generally between 150 on the Lower Road to 175 meters on the Upper Road. Tank Manifold, Booster Pumps, Mainline Receiving Barrel, Crude and Products Prover loops and the Control Building complex are all located at the same level. The Station is controlled by the Control Centre in Edmonton (Trans Mountain CCO).

All tanks have fire suppression systems installed in addition to on-site fire suppression equipment including a foam trailer and hoses. The fire fighting tactics can be found in the "Fire Pre-Plan" for each area of the terminal.

The tank spacing has been considered when designing the "Fire Pre-Plan" and fire suppression systems, including the escape routes and personnel safety at Sumas Tank Farm the detailed fire plan information can be found in the "Fire Pre-Plan" and/or the "Fire Safety Plan"

### 7.4.1 Mutual Aid

Trans Mountain belongs to the Burrard Industrial Mutual Assistance Group (BIMAG). The agreement is amongst industrial operators in the Burrard inlet area which includes Shell (Burmound and Shellburn facility), IOR (IOCO and Lougheed facility) and Suncor.

### 7.4.2 Air monitoring

Burnaby Terminal has fixed gas detection located within the manifold building, including personal air monitors which can be used in the short term to determine air quality. Offsite, outside contractors will be used to assist with downwind monitoring.

Real-time continuous ambient fence line monitors measure Hydrogen Sulfide (H<sub>2</sub>S), Volatile Organic Compounds (VOCs), Sulfur Dioxide (SO<sub>2</sub>) and weather parameters such as wind speed, wind direction, temperature and humidity. The Système Automatisé de Monitoring (SAM) unit (translated in English as Automated Monitoring System) is installed in the North West corner of the Burnaby Terminal. All data, real time and historic, can be viewed and downloaded from a secured website. The monitoring system has an integrated alarm system to send out email notifications to designated individuals should any applicable provincial regulatory ambient air quality objectives be reached.

In the event of an emergency, the Air Monitoring Plan will be activated in conjunction with this Plan. After the initial assessment has been conducted an incident specific air monitoring plan will be developed to support the Incident Action Plan.

### **7.4.3 Site Plans**

There are a number of Site Plans for Burnaby Terminal which outlines the individual buildings and tank farm areas with respect to mustering locations and fire escape routes. Please refer to the "Fire Safety Plan" for detailed drawings of each of the buildings.

### **7.4.4 Site Drainage**

Burnaby Terminal has been designed to ensure any leaked product and/or surface water does not leave the terminal property until it is safe to be released. Each of the Burnaby tanks has been designed with individual containment berms. The spill of any of the tanks will fill the dike surface area which is capable of containing the full tank volume.

Surface run-off at the Terminal is collected in the Containment Pond (Lower Levy) adjacent to the Division Office. Here the pond is monitored for the presence of hydrocarbons before discharge from the site. Eagle Creek also traverses the site from north to south. Through the main portion of the Terminal, the creek flow is routed through a buried pipeline to prevent any possibility of contamination. Water from the tank bays is channeled to two Oil Water Separators (East & West) which are monitored by instrumentation capable of detecting hydrocarbons. Clean water continues to the Containment Pond while any detected oil from the West Separator is sent to Tank 99. Detecting hydrocarbon in the East Separator will cause the valve on the inlet from the tank bays to automatically close.

The Containment Pond located in the lower south west corner of the Terminal collects surface run-off from the Terminal site and discharge from the East and West Oil Water Separators. The down slope sides of the pond are an earth-fill dam. A concrete swale system along the south boundary of the Terminal also channels run-off into the pond.

Discharge from the Containment Pond is regulated by an adjustable Outer Ring on the Stand Pipe in the pond, and operates like a weir system taking the water from the lower portion of the water column. A valve on the line leading from the stand pipe may be used to shut off discharge from the pond before it reaches a public water course (Eagle Creek) at the edge of the Trans Mountain property. Flow eventually enters Burnaby Lake. The water is tested on a regular basis to ensure there is no hydrocarbon being released to Eagle Creek and ultimately Burnaby Lake.

### 7.4.5 Initial Public Safety Action Zone – Burnaby Terminal

The following initial distances will be used as a starting point and to help determine when or if public safety measures are required for vapour/radiant heat effects from an incident at the Burnaby Terminal. At a minimum evacuation of all members of the public and non-essential personnel within impacted area is recommended for any fire on site until the exact location and impacts of a fire are identified.

Incident Description	Hazard	Zone	Initial Public Safety Measure
<b>Spill, no fire</b>	Vapour	300m	Shelter-in-Place
<b>3-D Fire<sup>10</sup>/ Rim seal fire</b>	Heat & Smoke	184m	Evacuate
<b>Full surface fire/ Boilover</b>	Boil-over	10x diameter of affected tank	Evacuate
<b>Containment bay fire/ Spill with fire</b>	Heat & Smoke	0m - 184m if fire < 1,640 m <sup>2</sup>	Evacuate <i>(because of heat)</i>
		0m - 532m if fire > 1,640 m <sup>2</sup>	Evacuate <i>(because of heat)</i>

Once immediate public safety measures have been completed and the Incident Command Post has been established, further evacuation planning can take place under the jurisdiction of the Local Authority.

Trans Mountain will assist the Local Authority to the extent possible for all evacuations. This assistance may include the sharing of personnel, resources, information, and the preparation of an incident specific evacuation plan.

<sup>10</sup> A three-dimensional fire is a liquid-fuel fire in which the fuel is being discharged from an elevated or pressurized source, creating a pool of fuel on a lower surface.

### 7.4.6 Initial Public Safety Action – Map

The following map depicts the Initial Public Safety Action Zone for the credible worst case scenario. At the time of an incident the incident location and public safety zone will be identified by the Incident Comander and the Local Authority.





**9.5.6 Mobile Spill Equipment List**

Trans Mountain Location*	Boat	Boom Trailer	Decon Trailer	OSCAR Trailer	Rapid Response Trailer	Wildlife Response Trailer	Wildfire Trailer	Submerged Oil Trailer	Land/Creek Trailer	Winter Response Trailer
Gainford Station	X	X		X						X
Edson Station			X							
Jasper Station	X	X		X		X	X			X
Rearguard Station			X	X						
Blue River Station	X	X		X			X			X
Blackpool Station			X							
Kamloops Terminal	X	X		X		X	X	X		X
Kingsvale Station		X	X							
Hope Station	X				X		X			
Sumas Station		X	X			X			X	
Burnaby Terminal	X			X						
Westridge Marine Terminal	X									
Laurel Station	X			X						
Burlington Station				X						

\*Equipment is subject to movement based on risk

**9.5.7 Mobile Fire Equipment List**

Trans Mountain Location	Fire Foam Trailer	Fire Hose Trailer	Fire Truck	Foam Bladder Trailer	Foam Cannon	Portable Fire Pump
Edmonton Terminal	X	X		X	X	
Gainford Station						
Edson Station						
Kamloops Terminal			X			
Sumas Station						
Sumas Tank Farm						X
Burnaby Terminal		X			X	X
Westridge Marine Terminal				X		



## 16.0 REGULATORY BACKGROUND

### 16.1 Federal

Agency	Responsible For Contact	Reporting Requirements	Comments
<b>NEB/CTSB Single Window Occurrence Reporting</b>	EH&S department	Effective September 01, 1999 the NEB & CTSB have a single window incident reporting hot line Reporting to this one number satisfies the requirement to advise both these Boards. Note: The same information as that detailed in the NEB & CTSB sections below is required.	The single window initiative does not detract from the substantive reporting obligations set out in section 52 of the OPR-99. The information required by the NEB under section 52 of the OPR 1999 must now be sent to the CTSB in accordance with the time frames established by the NEB under the OPR-99 and the OPR-99 Guidance Notes.
<b>National Energy Board</b>  Report to NEB through Canadian Transportation Safety Board	EH&S Department	All "Significant Incidents" must be immediately reported to the CTSB reporting line via the Reporting Hotline telephone number (1-819) 997-7887). A Significant Incident may be defined as; <i>(1) fatality; (2) missing person (as reportable pursuant to the Canadian Oil &amp; Gas Drilling &amp; Production Regulations (DPR) under the Canadian Oil &amp; Gas Operations Act (COGOA) or the Oil &amp; Gas Operations Act (OGO); (3) a serious injury (as defined in OPR or TSB regulations); (4) a fire or explosion that causes a pipeline or facility to be inoperative; (5) a LVP hydrocarbon release in excess of 1.5 m3 that leaves company property or right of way; (6) a rupture (defined as an instantaneous release that immediately impairs the operation of a pipeline segment such that pressure of the segment cannot be maintained; (7) a toxic plume as defined in CSA Z662</i>  Other events that do not meet the NEB/CTSB "Significant Event" criteria but are still deemed reportable (see below) , must be reported via the NEB's Online Event Reporting System (OERS) ( <a href="https://apps.neb-one.gc.ca/ers">https://apps.neb-one.gc.ca/ers</a> ) within 24 hours of occurrence or discovery include;	Typically within 1 hour, a company should communicate all available factual information to the CTSB. The preliminary incident report should: (a) describe the incident, including the events leading up to and following the incident; (b) list all relevant agencies contacted and persons affected by the incident; (c) summarize any losses or impacts to people (e.g., injury, fatalities), environment (e.g., terrain, habitats, animals), production (e.g., interruption or reduction in service), and property; (d) identify any unsafe acts or conditions contributing to or causing the incident; (e) provide details on any emergency response; and (f) state any corrective actions taken or planned to be taken to minimize the effects of the incident.  A detailed incident report should correct any information provided in the preliminary incident report and/or provide additional information. The detailed incident report should (a) provide any details regarding the failure mechanism and detailed analysis of the failed component (if necessary); (b) identify the underlying causes and contributing factors of the incident; (c) update the progress of any corrective actions taken or planned to be taken to minimize the effects of the incident; and

Agency	Responsible For Contact	Reporting Requirements	Comments
		<p><i>(1) incidents as defined under the OPR, PPR, and DPR/Oil &amp; Gas Drilling Regulations; (2) unauthorized activities under the NEB Pipeline Crossing Regulations Part II; (3) emergency burning or flaring under PPR; (4) hazard identification under the PPR; (5) suspension of operations under the PPR; (6) near-misses under the DRP; (7) serious accidents or incidents under the Canadian Oil &amp; Gas Geophysical Operations Regulations/Oil &amp; Gas Geophysical Operations Regulations; (8) emergencies or accidents under the Canadian Oil &amp; Gas Installations Regulation/Oil &amp; Gas Installations Regulation; and (9) accidents, illness, and incidents under the Canadian Oil &amp; Gas Diving Regulations/Oil &amp; Gas Diving Regulations</i></p>	<p>(d) state any actions taken or planned to be taken to prevent a similar incident.</p> <p>If the OERS is not available, all pipeline occurrences must be reported by telephone to the CTSB</p> <p>NEB Incident Line 403-807-9473</p>
<b>Canadian Transportation Safety Board</b>	EH&S Department	<p>Verbal notification of "significant pipeline occurrences" to the CTSB must be made immediately. Such occurrences include; <i>(1) loss of human life; (2) a serious injury (defined in the Onshore Pipeline Regulations or the Transportation Safety Board Regulations); (3) a fire or explosion that causes a pipeline or facility to be inoperative; (4) a low vapour pressure hydrocarbon release in excess of 1.5 m<sup>3</sup> that leaves company property or the right-of-way; (5) a rupture (an instantaneous release that immediately impairs the operation of a pipeline such that pressure cannot be maintained); or (6) a toxic plume (defined in Canadian Standards Association Standard Z662).</i></p>	<p>The report must contain the following information:</p> <p>(a) the name of the operator; (b) the date and time of the occurrence; (c) the unique identifier of the pipeline or portion of pipeline, such as its name or number; (d) the specific pipeline components that malfunctioned or failed; (e) the location of the occurrence by reference to a specific designation point such as the operator's facility or the pipeline's kilometre post location; (f) the closest city, town or village to the occurrence site; (g) the number of persons who were killed or sustained serious injuries as a result of the occurrence; (h) a list of any commodity contained in or released from the pipeline and an estimate of the volume of commodity released and recovered; (i) the actual or anticipated duration of any interruption of the operation of the pipeline or a portion of the pipeline; (j) a description of the occurrence, the events leading up to it and the extent of any damage, including the consequences on the pipeline or portion of the pipeline and on any</p>

Agency	Responsible For Contact	Reporting Requirements	Comments
			other property and the environment; (k) a description of any action taken or planned to address the consequences of the occurrence; (l) a description of any action taken or planned to protect persons, property and the environment, including any evacuation as a result of the occurrence; (m) the name and title of the person making the report and the phone number and address at which they can be reached; and; (n) any information specific to the occurrence that the Board requires
<b>Canadian Transportation Safety Board, Continued</b>	EH&S Department	Other pipeline occurrences that must be submitted into the Online Event Reporting System (OERS) include <i>(1) a person is killed or sustains a serious injury; (2) the safe operation of the pipeline is affected by;</i> <i>a) damage sustained when another object came into contact with it, or</i> <i>b) fire or explosion or an ignition that is not associated with normal pipeline operations; (3) an event or an operational malfunction results in;</i> <i>a) an unintended or uncontrolled release of gas,</i> <i>b) an unintended or uncontrolled release of HVP hydrocarbons,</i> <i>c) an unintended or uncontained release of LVP hydrocarbons in excess of 1.5 m3, or</i> <i>d) an unintended or uncontrolled release of a commodity other than gas, HVP hydrocarbons or LVP hydrocarbons;</i> <i>(4) there is a release of a commodity from the line pipe body; (5) the pipeline is operated beyond design limits or any operating restrictions imposed by the National Energy Board; (6) the pipeline restricts the safety operation of any mode of transportation; (7) an unauthorized third party activity within the safety zone poses a threat to the safe operation of the pipeline; (8) a geotechnical,</i>	The Online Event Reporting System (OERS) automates the single-window pipeline occurrence notification process that was established by the CTSB and the National Energy Board (NEB) in 1999.  Starting 1 January 2015, the OERS must be used to report all pipeline occurrences.  Except for significant occurrences as listed in the previous section, telephone notification will no longer be required.  If the OERS is not available, all pipeline occurrences must be reported by telephone to the CTSB  Information must be entered in the OERS even if the occurrence has been reported by telephone.  Incident Line 819-997-7887, Fax 819-953-7876, email <a href="mailto:pipelinenotifications@tsb.gc.ca">pipelinenotifications@tsb.gc.ca</a>

Agency	Responsible For Contact	Reporting Requirements	Comments
		<p><i>hydraulic or environmental activity poses a threat to the safe operation of the pipeline; (9) the operation of a portion of the pipeline is interrupted as a result of a situation or condition that poses a threat to any person, property or the environment; or (10) an unintended fire or explosion has occurred that poses a threat to any person, property or the environment.</i></p>	
<p><b>Environment Canada</b></p> <p><b>For Environmental Emergencies pertaining to Gasoline</b></p>	<p>EH&amp;S Department</p>	<p>Under requirements of the Environmental Emergency Regulations, notification of an environmental emergency is required for all substances which are accidentally released in quantities which exceed the criteria specified by Environment Canada in the regulations.</p> <p>At least 200 litres of Gasoline.</p> <p>Alberta Alberta Ministry of Environment Telephone: 780-422-4505 or 1-800-222-6514i</p> <p>British Columbia Emergency Management British Columbia Ministry of Justice Telephone: 1-800-663-3456</p>	<p>The verbal report should include the following information as it is known at the time of the report: (a) the reporting person's name and telephone number at which the person can be immediately contacted (b) the name of the person who owns or has charge, management or control of the substance immediately before the environmental emergency (c) the date and time of the release (d) the location of the release (e) the name/ UN number of the substance (f) the estimated quantity (g) the means of containment (from which the substance was released) and a description of its condition (h) the number of deaths and injuries resulting (i) the surrounding area affected and potential impact of the release (j) a brief description of the circumstances leading to the release (k) the cause of the release (if known) (l) details of the actions taken or further actions contemplated (m) names of the agencies notified or on-scene (n) other pertinent information.</p> <p>Under requirements of the E2 Regulation a written report should be made within 30 days.</p>
<p><b>Environment Canada (EC)</b></p>	<p>Liaison Officer</p>	<p><i>For spills or deleterious substances (i.e. silt) of any size that enter (or may enter) waters frequented by fish (includes creeks, ditches, fresh water streams, tidal and marine waters)</i> EC should be notified.</p>	<p>Provides advice to federal and provincial agencies for spill response and protection of sensitive habitat. EC administers Section 36(3) (pollution provisions) of the Fisheries Act. EC will notify EMBC, Canadian Coast Guard, other affected federal agencies and BC Ministry of Environment.</p>

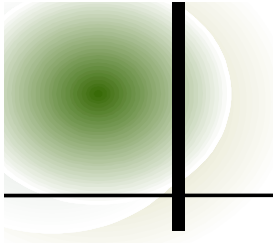
Agency	Responsible For Contact	Reporting Requirements	Comments
Transport Canada	Liaison Officer	For spills involving transportation of dangerous goods (other than in the pipeline eg. tanker truck). Transport of Dangerous Goods Regulation.	Call local police or CANUTEC.  For CANUTEC, Tel: (collect) 0-613-996-6666+

## 16.2 Provincial – Alberta

Agency	Responsible For Contact	Reporting Requirements	Comments
Alberta Environment & Alberta Energy Regulator	Liaison Officer	Spills on the pipeline right-of-way or lands not owned by the Company may be reportable to AER. Generally, spills of refined products in excess of 200 litres and unrefined products in excess of 2m <sup>3</sup> , and which have or may have an adverse effect on the environment are reportable. Note: Contact Law Department before notification for spills on company owned land or for clarification of "reportable" thresholds. Environmental Protection and Enhancement Act (ss. 99 and 100), Release Reporting Regulation; Oil and Gas Conservation Act and Regulations.	Notifications for all environmental emergencies, including spills, can be made by one call to the Alberta Energy & Environment 24 Hour Response Line (1-800-222-6514).
Alberta Environment & Sustainable Resource Development	Liaison Officer	In certain areas and at certain times of the year, a fire caused by a leak from the pipeline or by construction or maintenance activities which the Company is unable to extinguish must be reported to a forest officer, the municipality, or the RCMP. Alberta Forest and Prairie Protection Act.	Wildfires should be reported through the 24 hour Wildfire Reporting Line at Toll Free: 310-FIRE (3473)

**16.3 Provincial – British Columbia**

Agency	Responsible For Contact	Reporting Requirements	Comments
<b>BC Emergency Management</b>	Liaison Officer	<p><i>For spills equal or greater than 100 litres (0.1 m<sup>3</sup>) of petroleum (does not apply to NEB regulated facilities).</i> (1-800-663-3456) Spill Reporting Regulation, Waste Management Act (Aug/ 1990).</p>	EMBC will notify other agencies including: BC Ministry of Environment, Lands & Parks, Environment Canada, Canadian Coast Guard and affected municipal governments.
<b>Ministry of Forests</b>	Liaison Officer	<p><i>In the event of fire associated with pipeline maintenance work or a leak.</i></p> <p>Forest Fire Practices Code (Bill 40, Section 86, 88- duty to report and control fires). Fire Prevention and Suppression Regulation.</p>	
<b>British Columbia Ministry of Environment &amp; Climate Change Strategy (BC MoE) 800-663-3456</b>	Liaison Officer	<p><i>Responsible for the effective protection, management and conservation of B.C.'s water, land, air and living resources.</i> <i>The 24-hour, toll free number connects with the Emergency Coordination Centre (part of Emergency Management BC).</i></p>	EMBC will advise BC MoE of reportable spills. BC MoE provides advice on response and protective measures to minimize the environmental impacts of spills. Approvals for waste storage, treatment and disposal should be coordinated through this agency.
<b>BC Environment Assessment Office (BC EAO) 800-663-3456</b>	Liaison Officer	<p><i>In the event that a spill originating from the Trans Mountain Expansion Project is confirmed to contaminate drinking water, the company must notify BC EAO and MOE within the following time periods:</i></p> <p><i>As soon as practicable;</i></p> <ul style="list-style-type: none"> <li>• <i>Within 72 hours,</i></li> <li>• <i>whichever is less.</i></li> </ul> <p><i>The 24-hour, toll free number connects with the Emergency Coordination Centre (part of Emergency Management BC).</i></p>	EMBC will advise BC EAO of reportable spills.



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# Kinder Morgan Canada

## Trans Mountain Pipeline ULC

### “Trans Mountain Expansion Project” *Burnaby Terminal Portion*

## Risk Assessment

## Final Report

October 1<sup>st</sup>, 2013

Prepared By:

**Doug McCutcheon and Associates, Consulting**

A Division of “Human Factors Impact Ltd.”



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**EXECUTIVE SUMMARY:**

The risk analysis (*March 15, 2011 by Doug McCutcheon and Associates Consulting*) of the existing Trans Mountain Pipeline Burnaby site shows the risk to be within the acceptable criteria as recommended by the MIACC "Risk Based Land Use Planning" guideline. The proposed expansion to 26 tanks also is within the MIACC acceptable risk criteria.

The new proposed 14 tank addition including the replacement of one existing tank will see a combination of external floating roof design, fixed roof and possibly geodesic domes. Each of the new tanks are to be fitted with foam addition capability to the internal roof and floating roofs, which will act to provide emergency response needs to a major tank fire incident. There is very little water in the crude streams that are shipped to the site and any water collection within the tanks will be managed through the high product turnover rate thereby reducing the probability of a boil-over scenario. Should such a scenario develop ample time will be available for emergency procedures to implement appropriate action. However, the boil over scenario needs to be referenced in the emergency plan for the site.

Each of the individual tanks are located within their own dyked area some will be sufficient to contain a spill of the entire tank contents while others located in the north area of the site will overflow to an internal remote impoundment area. Because all of the crude oil streams and other products can be considered as flammable liquids the need for prevention of releases and ignition sources is required. This hazard and risk analysis is specific to the fire related to a major tank spill and the radiant heat effect of the flames. Included are the analysis of the smoke plume from the fire and a consideration of the Sulphur component in the oil, which has been recognized as a health concern.

An oil fire scenario is dependent on the surface area exposed to air. To determine the extent of this area a calculation was completed to represent what such a spill might look like for each of the newly proposed tanks and the remote north impound area. The tank farm design is to the National Fire Code of Canada requirements.

Using two tools to characterize the fire scenario with accepted criteria it shows an immediate radius of 86 and up to 224 meters will see a direct impact from such a major fire. This distance will reach some areas outside the property line and will need to be included in emergency planning. Another tool was used to calculate the downwind travel distance for a smoke cloud. In most cases the cloud of smoke from a fire will not be a health concern for people exposed downwind. It will be more of a nuisance concern. However as there is a possibility some of the oil will contain small amounts of Sulphur which will be converted to Sulphur Dioxide (SO<sub>2</sub>) in a fire, the analysis shows a potential health concern could be felt up to 5.2Km downwind. Care to ensure involvement in community communications and needs is apparent here. This issue is typical of other tank farm operations as is shown later with reference to the Buncefield UK incident.

The overall risk of  $1 \times 10^{-5}$  for the site is well within the acceptable level of risk criteria as set out by MIACC.

The main concern is a major tank leak and probability data shows this is potentially possible. Good management practices around operations, inspection and maintenance are required to maintain the risk no higher than  $1.0 \times 10^{-5}$ . In order to ensure the possibility remains low special design and operational features are included. These components should serve to maintain the risk within the acceptable criteria for MIACC.



Doug McCutcheon, P.Eng.

Subject: Trans Mountain Tank Farm

Tactical Risk Analysis

2015 May 01.....Appendix H - 1

## Appendix H Trans Mountain Tank Farm Fire Protection Meeting 2017.05.30



Fire Department  
Administration Division

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### INTER-OFFICE MEMORANDUM

TO: BURNABY FIRE DEPARTMENT  
RECORDS

DATE: 2014 June 18

FROM: CHRIS BOWCOCK  
DEPUTY FIRE CHIEF

SUBJECT: **MEETING MINUTES - 2014.05.30**  
**KINDER MORGAN TRANS MOUNTAIN TANK FARM**  
**CURRENT FACILITY FIRE PROTECTION**

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Date: May 30, 2014  
0800 - 0930

Location: Office of the Fire Chief  
Burnaby Fire Department  
Fire Station #1 – Administration  
4867 Sperling Avenue  
Burnaby, BC

Attendees: Doug McDonald Fire Chief – Burnaby Fire Department  
Chris Bowcock Deputy Fire Chief – Burnaby Fire Department  
Rob Hadden Director, Western Region – Kinder Morgan Canada  
Troy Edwards Fire Protection Specialist – Kinder Morgan Contractor  
Kelly Malinoski ER & Security Advisor – Kinder Morgan Canada

1. Meeting commenced with Doug McDonald thanking Kinder Morgan representatives for coming and stated that as agreed upon at the acceptance of the meeting invitation, the scope of the discussion was to focus on the status of current Trans Mountain Tank Farm (TMTF) Fire Protection only in an effort to respect the regulatory application-review process being under taken by the National Energy Board with respect to the Kinder Morgan Trans Mountain Expansion Project.
2. Doug McDonald re-stated the original premise proposed by Kinder Morgan of the meeting as an informal discussion.

*No agenda was presented and no discussion or agreement was made as to the taking of formal meeting minutes or by whom formal meeting minutes would be taken.*

3. It was agreed upon that that the Burnaby Fire Department needs to understand the current status of the TMTF fire protection capability and emergency preparedness. It was agreed upon that the Kinder Morgan needs to understand what the Burnaby Fire Department requires of the TMTF fire protection capability and emergency preparedness.
4. Rob Hadden stated that he agrees that the fire/safety risks of a sulfur based gas release, toxic smoke discharge and tank fire boilover are valid event potentials.
5. Doug McDonald described the current level of service provided by the Burnaby Fire Department with specific respect to hydrocarbon facility emergency response. Doug

McDonald identified that the level of service currently provided by the Burnaby Fire Department has not changed in premise in greater than 30 years. The Burnaby Fire Department's expectation has always been consistent with the hydrocarbon facilities located in Burnaby, in that the hydrocarbon company would provide a Fire Brigade and we would support when our resources are available, with the secondary operations of water supply and exposure protection under the direction and expertise of their staff. Specifically, the Burnaby Fire Department's priority is to ensure and actively protect public safety, and as personnel and equipment are available, to secondarily provide non-technical hydrocarbon firefighting operations if possible to support the hydrocarbon facility's role as the primary emergency responder within the facility fenceline.

6. Chris Bowcock stated that the Burnaby Fire Department will respond to TMTF emergency events as the primary responder to conduct operations to rescue endangered facility staff and for facility structural firefighting operations within the buildings of the TMTF facility. The Burnaby Fire Department may if available provide secondary water supply operations such as relay pumping or secondary discharge of cooling water streams from safe operating positions to support the TMTF facility as it conducts primary fire attack operations.
7. Troy Edwards asked Chris Bowcock directly how the Burnaby Fire Department would operate at a hypothetical highway gasoline transport truck fire.
8. Chris Bowcock responded by stating that the Burnaby Fire Department would respond to protect the public from the event hazard, to isolate evacuate and restrict access to the hazard area and to provide exterior water streams to contain the fire event in order to prevent fire extension. Chris Bowcock stated that in this hypothetical event the shipper is responsible for the primary technical emergency response to events created by transport of their dangerous goods.
9. Chris Bowcock stated that this level of service provided by the Burnaby Fire Department in the hypothetical highway gasoline transport truck fire is consistent with a hypothetical event occurring from the release of chlorine gas from a rail tanker. The Burnaby Fire Department would respond to protect the public from the event hazard, to isolate, evacuate and restrict access to the hazard area. Chris Bowcock stated that in this hypothetical event the shipper, in this case the chlorine gas manufacturer is responsible for the primary technical emergency response to the event, through its industry response team, for the capping or release control of the rail car. In this case the Burnaby Fire Department would support the industrial responder with secondary Hazardous Material Team operations.
10. Chris Bowcock stated that the Burnaby Fire Department takes the role as the primary response agency for structural firefighting in the City of Burnaby. Chris Bowcock stated

that the industrial hydrocarbon company in the City of Burnaby is responsible to provide the primary technical hydrocarbon industrial fire operations.

11. Doug McDonald stated that the Burnaby Fire Department has received hazardous materials awareness level training from specific chemical industrial response teams. Doug McDonald stated that the training Kinder Morgan provided the Burnaby Fire Department with regards to Tank Fire theory and site tours was characterized and agreed upon as awareness level training at the agreement to participate.
12. Troy Edwards stated that if the Burnaby Fire Department entered into a Mutual Aid agreement with the TMTF, the fire protection resources of the Trans Mountain Tank Farm could be made available to the Burnaby Fire Department for incident such as the hypothetical highway gasoline transport truck fire described earlier.
13. Doug McDonald stated that the Burnaby Fire Department is currently entered into a mutual aid agreement with the other regional fire departments. Doug McDonald stated that Burnaby Fire Department has often responded on a mutual basis with smaller departments, but often these smaller departments are incapable of reciprocating the service.
14. Doug McDonald also stated that he would speak with senior City Managers about the Fire Department entering into a memorandum of understanding regarding roles & responsibilities at Kinder Morgan sites for current operations only.
15. Troy Edwards provided a summary of the improvements made to the TMTF fire protection capability over the last 9 years, and stated clearly that these improvements are independent of the expansion and are intended to be replaced if there is an expansion.
16. Troy Edwards identified the current TMTF fire protection resources as including:
  - Foam Trailer 500 usgal Fluoroprotein
  - Electric Fire Pump 1000 usgpm
  - Diesel Fire Pump 1000 usgpm
  - Fire Water Reservoir with sufficient water volume to provide a 65 minute full surface fire attack on largest tank
17. Troy Edwards identified the coming TMTF fire protection resource end of August 2014 as including:
  - Water Pump 4000 usgpm

- Foam System with an around the pump foam proportioning to supply Fire Water Main with Foam Solution for facility distribution
  - Foam Concentrate Tank 10,000 usgal AFFF
  - Mobile Trailered Foam Monitor capable discharging Foam Solution at 6000 usgpm
18. Troy Edwards stated that the TMTF fire protection system has been re-designed, upgraded and includes UV/IR detection.
19. Chris Bowcock asked if the TMTF possesses the equipment and trained personnel resources to extinguish a full surface tank fire at the largest tank on the TMTF facility.
20. Troy Edwards stated that the TMTF has no personnel trained operate the mobile fire protection equipment to execute the extinguishment of a TMTF full surface tank fire. Troy Edwards stated that the TMTF has equipment on-site to ensure a timely response to a full surface tank fire.
21. Chris Bowcock asked if the TMTF possesses the equipment and trained personnel resources to extinguish a rim seal fire.
22. Troy Edwards stated yes, but with a significant delay on night shift.
23. Chris Bowcock asked if the TMTF possesses the equipment and trained personnel resources to extinguish or suppress a dike spill/fire.
24. Troy Edwards stated that the TMTF would be unable to extinguish or suppress a dike spill/fire during night shift.
25. Chris Bowcock inquired about the status of the Lower Burrard Mutual Aid Group.
26. Kelly Malinoski stated that the mutual aid agreement is not intact. Kelly Malinoski stated that Kinder Morgan has attempted several times to reform the mutual group but currently without success.
27. Troy Edwards stated that Kamloops Fire Department and Kinder Morgan have an intact mutual aid agreement.

28. Chris Bowcock asked how Kinder Morgan would characterize their current relationship with the Strathcona County Fire Department.
29. Troy Edwards stated that they have a very good mutual working relationship with the Strathcona County Fire Department.
30. Troy Edwards offered additional training to the Burnaby Fire Department that could be provided on a flexible format.
31. Chris Bowcock stated that training in the Burnaby Fire Department is schedule one (1) year in advance, and that the scheduling of this training could not take place immediately and much management and schedule modification would be required to allocate the time necessary.
32. Chris Bowcock asked if the TMTF had an Emergency Response Plan.
33. Kelly Malinoski stated that that there is not an Emergency Response Plan specific for the TMTF, but a general Emergency Response Plan applicable for all Kinder Morgan facilities along and including the current pipeline.
34. Chris Bowcock stated that in the Kinder Morgan Emergency Response Plan the section on the TMTF was not provided to the Burnaby Fire Department when requested September 2013, based on a security premise.
35. Chris Bowcock asked if the TMTF had specific tank and spill fire protocols for the TMTF.
36. Kelly Malinoski stated that an Emergency Response Plan for the TMTF was being developed.
37. Tory Edwards stated that tank farm fire protocols will be developed in the future, and Kinder Morgan would appreciate any input as to format the Burnaby Fire Department could provide.



*Subject: Trans Mountain Tank Farm*

*Tactical Risk Analysis*

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38. Kelly Malinoski identified and presented the opportunity for the Burnaby Fire Department to attend the coming Kinder Morgan Westridge facility Boom Deployment exercise on June 24, 2014 from 0900 to 1200. Kelly Malinoski stated that the invitation has also been extended to Transport Canada, Port of Metro Vancouver and the Burnaby RCMP.

Chris Bowcock  
Deputy Fire Chief

:cb

## **Attachment 1 Emergency Management Plan Documents Trans Mountain Pipeline System**

### **Emergency Management Program Documents**

The Emergency Management Program (EMP) is made up of a number of elements used to guide Kinder Morgan Canada Inc.'s (KMC) emergency planning and response to specific incidents. In addition to the primary elements described in this Attachment including the Incident Command System (ICS) Guide, Emergency Response Plans (ERPs), Control Point Manual, Field Guide and Fire Plans, the program relies upon and is part of the fabric of KMC's overall management system for pipeline operations. As such the EMP relies upon standards, procedures for safe operation as well as the training and experience of KMC employees and contractors.

Since it is not possible to foresee all outcomes of an incident, the EMP does not attempt to address detailed or specific outcomes of an incident. Instead the EMP is founded upon the Incident Command System (ICS), which is a proven and robust means to efficiently organize and coordinate the response efforts including the deployment and acquisition of resources. The program is also focused on the actions to respond to incidents regardless of their cause with a focus on oil spills hazards. The documents are not intended to prescribe response actions, but to provide pre-defined guidance to augment the expertise of KMC employees and others in responding to the dynamic needs of an incident.

KMC notes the EMP documents were not written to facilitate a public review and are first and foremost a working tool to be used in the event of an emergency, by Emergency Response professionals and are, therefore, worded as such. They were developed as part of an overall program to meet the National Energy Board's (NEB) requirements in the *National Energy Board Onshore Pipeline Regulations*, sections 32 to 35. These documents are one tool used to train and guide KMC staff, emergency response organizations, and other relevant authorities as part of KMC's Emergency Preparedness and Response Exercise and Training Program.

### **Emergency Management Program Review and Communication**

The EMP documents are reviewed and revised annually, they are living documents and subject to updates outside the annual update schedule to incorporate ongoing changes in operations, changes in response readiness, or when feedback is received, which would contribute to a stronger emergency management document.

As part of this process Trans Mountain provides copies of the ERPs to municipalities and other agencies as listed in the Distribution section of each document. Due to differences in the timing of publishing and distribution of the documents, the distribution table in the current version is not up to date. Versions provided to outside agencies typically have some sensitive information redacted. Regardless of whether they receive copies of the ERPs, outside agencies are invited to participate in KMC's response training and exercises of which the ERPs are a central focus.

### **Confidentiality of the Emergency Management Program**

Not all of the EMP documents have been provided as part of this filing and some parts of those that have, have been redacted. The rationale for withholding (redacting in full) or redacting portions of the documents is based on the following criteria:

- **Personal:** The information contains personal contact information for employees or other individuals who may be called upon to respond to an emergency.

- **Commercial:** The information contains the contact information for contractors, consultants and/or businesses that may be called upon for services during an emergency.
- **Security:** The information has been deemed to be security sensitive, which if released could impact the security and/or safety of the facility, employees, contractors, the environment and or the public. Since KMC is part of the nation's Critical Infrastructure, it is not appropriate to file security sensitive information about facility operations and countermeasures.

Each of the documents in the EMP is discussed in the following paragraphs, along with a description and information related to the filing of the document.

#### **Incident Command System (ICS) Guide (July 2013) - Attachment 2.1**

KMC's ICS Guide (July 2013) is provided without redaction. This guide describes the ICS system including individual roles and the overall process and is used as a tool to assist the response teams in fulfilling their roles and responsibilities during an emergency. It is not meant to be an exhaustive list of duties; however it is meant to ensure all variables are considered during a response. This guide has been customized to KMC's program needs. The guide is part of a regular review process, to ensure it is current and continuously improved. The ICS Guide is used extensively at exercises and tested on a regular basis.

#### **Emergency Response Plans (ERPs) – Attachments 2.2, 2.3 and 2.4**

The ERP is the primary document used to describe how KMC responds to an incident. KMC maintains three separate ERP's (Westridge Marine Terminal ERP, Trans Mountain Pipeline ERP, Terminal and Tank Farms ERP) for operations associated with the existing Trans Mountain Pipeline. The ERP's contain information that describes the response structure, safety, incident assessment, protection and recovery tactics, and notification contacts, and requirements.

Some information in the ERPs has been redacted. The following tables provide an explanation of what has been redacted and the reason for the redactions.

**Table 1 Westridge Marine Terminal Emergency Response Plan (ERP) (Publish Date: July 2014) list of redactions (Attachment 2.2)**

<b>Section</b>	<b>Reason</b>
Preface/Distribution List	Personal
2.6 Kinder Morgan Contacts	Personal
2.7 Emergency Response Line Contacts	Personal
2.8 Facility Contact Numbers	Security
2.10 External Notification Chart	Commercial
2.11 Reporting Requirements	Commercial
2.14 Support Services	Commercial
2.14.1 Primary Response Contractors	Commercial
2.14.2 Industrial Fire Fighting and Air Monitoring	Commercial
2.14.3 Support Services	Commercial
2.15 Oil Company Contacts	Commercial

Section	Reason
2.16 Mutual Aid	Commercial
6.7 Bomb Threat Checklist	Commercial
6.8 Breach of Security Checklist	Security
7.0 Site Information	Security
7.1 Marine Berth	Security
7.2 Staffing	Security
7.4.1 Remote Emergency Shut Down	Security
7.4.4 Halting of Operations	Security

**Table 2 Trans Mountain Pipeline ERP (Publish Date: July 2014) list of redactions (Attachment 2.3)**

Section	Reason
Preface/Distribution List	Personal
2.6 Kinder Morgan Contacts	Personal
2.7 Emergency Response Line Contacts	Personal
2.8 Facility Contact Numbers	Security
2.10 External Notification Chart	Commercial
2.11 Reporting Requirements	Commercial
2.14 Support Services	Commercial
2.14.1 Primary Response Contractors	Commercial
2.14.2 Industrial Fire Fighting and Air Monitoring	Commercial
2.14.3 Support Services - Stony Plain District	Commercial
2.14.4 Support Services - Jasper District	Commercial
2.14.5 Support Services – North Thompson District	Commercial
2.14.6 Support Services - Kamloops District	Commercial
2.14.7 Support Services - Sumas District	Commercial
2.15 Mutual Aid	Security
6.8 Bomb Threat Checklist	Security
6.9 Breach of Security Checklist	Security
7.3 Line Section Descriptions	Security
7.5 Valve Locations and Access	Security

**Table 3 Terminals and Tank Farms ERP (Publish Date: July 2014) list of redactions (Attachment 2.4)**

Section	Reason
Preface/Distribution List	Personal
2.6 Kinder Morgan Contacts	Personal
2.7 Emergency Response Line Contacts	Personal
2.8.2 External Notification Chart	Commercial
2.8.3 Reporting Requirements	Commercial
2.9.4 Industry Contacts - Edmonton Contacts	Commercial
2.9.5 Industry Contacts - Kamloops Contacts	Commercial
2.10 Support Services	Commercial
2.10.1 Primary Response Contractors	Commercial
2.10.2 Industrial Fire Fighting and Air Monitoring	Commercial
2.11 Incident Command Post Locations	Commercial
2.11.1 Edmonton Terminal	Commercial
2.11.2 Kamloops Terminal	Commercial
2.11.3 Sumas Terminal	Commercial
2.11.4 Burnaby Terminal	Commercial
2.12 Additional Resource Suppliers	Commercial
2.12.1 Edmonton Terminal	Commercial
2.12.2 Kamloops Terminal	Commercial
2.12.3 Sumas Terminal	Commercial
2.12.4 Burnaby Terminal	Commercial
2.13 Mutual Aid Agreements	Security
6.8 Bomb Threat Checklist	Security
6.9 Breach of Security Checklist	Security
7.1 Edmonton Terminal	Security
7.1.4 Site Drainage	Security
7.1.6 Evacuation Zone Map	Security
7.1.7 Edmonton Terminal Map	Security
7.2 Kamloops Terminal	Security
7.2.4 Site Drainage	Security
7.2.6 Evacuation Zone Map	Security
7.2.7 Kamloops Terminal Map	Security
7.3 Sumas Tank Farm	Security
7.3.4 Site Drainage	Security

Section	Reason
7.3.6 Evacuation Zone Map	Security
7.3.7 Sumas Terminal Map	Security
7.4 Burnaby Terminal	Security
7.4.3 Site Drainage	Security
7.4.5 Evacuation Zone Map	Security
7.4.6 Burnaby Terminal Map	Security

### Trans Mountain Pipeline Control Points Manual, Field Guide and Fire Safety Plans

As noted in the cover letter to this submission, Trans Mountain does not seek to file the *Trans Mountain Pipeline Control Points Manual*, the *Trans Mountain Field Guide*, or the *Fire Safety Plans* and the *Fire Pre-Plans* identified in the ERPs, as the information in these documents is security sensitive. The following is a brief description of the manuals that are not being filed:

#### Control Point Manual

The Control Point Manual contains specific information on the expected points of response, and additional confidential information such as property owner contact details and access directions. The control point sheets give company personnel a starting point for response and often outline a basic response tactic. The manual contains approximately 420 pages of site descriptions.

#### Trans Mountain Field Guide

The Field Guide Manual contains detailed drawings of facilities, building and on-site control systems as well as directions to various pipeline access points. The purpose of the Field Guide is to give first responders strategies to assist during the response to an incident. The Field Guide is approximately 180 pages in total; however Sections 1, 3, 4, 5 and 6 contain the same un-redacted information provided in the ERPs in this filing.

#### Fire Safety Plans

Fire Safety Plans contain detailed drawings of company buildings and control systems, along with initial response actions during emergencies and evacuations. The fire safety plan collection for the entire Trans Mountain system is approximately 613 pages in length. This larger plan is broken down for each individual facility and building in the pipeline system and organized by facility. The program also includes Fire Pre-Plans for all company tank farms and/or terminals. The pre-plans highlight each tank and surrounding piping, the fire systems, and provide tactical information for fighting storage tank fires, as well as adjacent tank cooling. The length of these documents reflects the complexity of the facility for which they are written, for example the documents for Edmonton Terminal are kept in 3 separate 3" binders, whereas the Burnaby Terminal, which is a much smaller facility, is contained within one 3" binder.



Fire Department

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**SUBJECT: TRANS MOUNTAIN TANK FARM  
TACTICAL RISK ANALYSIS**

**DATE: 2015 May 01**

Chris Bowcock  
Deputy Fire Chief

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In light of the Trans Mountain Expansion Project (TMEP) proposal by Kinder Morgan Canada (KMC) at the Trans Mountain Tank Farm (TMTF) facility, this evidentiary paper has been to analyze the fire and safety risks, hazard events and consequences associated with the project.

Each of the risks outlined have been validated as legitimate, based upon actual occurrence within the hydrocarbon industry in North America within the past decade, with the specific event occurrences being referenced. The hazard events and consequences are identified industry standard considerations with regard to emergency management of crude oil storage facilities.

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## Executive Summary

On 16 December 2013, Kinder Morgan submitted an application to the National Energy Board (NEB) for the expansion of the Trans Mountain Pipeline system, which includes the expansion of the Burnaby Mountain Terminal from 13 storage tanks to 26. The findings of the fire safety and risk analysis within this paper raise concerns over KMC selection of the Burnaby Mountain Terminal for the densification of storage tank use. Based on the findings of the analysis, the Burnaby Mountain Terminal is not the appropriate location for the expansion of the Burnaby Mountain Terminal as it poses significant constraints from an emergency/fire response perspective, including but not limited to safety of firefighters and effectiveness to combat fire; containment and extinguishment of fire/spill/release; evacuation of employees within the Burnaby Mountain Terminal facility; evacuation of adjacent neighbourhoods, as well as broader areas impacted by release of sulfur based gases and toxic smoke plumes; and, protection of adjacent properties, including conservation lands.

Additionally, the TMEP lacks appropriate consideration for original facility fire protection premises and industry best practices in petroleum storage and fire protection, as the proposal only seeks to comply with minimum federal and provincial code requirements.

This paper has analyzed and identified the impacts of the TMEP with regard to the *reduction in countermeasures* and resulting facility susceptibility to *consequences* resulting from *hazard event* occurrence.

## Countermeasures

The increased consequences arising from risk occurrence is a direct result of the facility configuration changes and additional storage tank locations which reduce the positive impact of the previously engineered fire and safety protection countermeasures. The Countermeasures which will be marginalized by the TMEP, include:

- **Tank Spacing**
  - A 33% reduction in the overall facility Tank Spacing
  - A 45% reduction in the proposed Tank Spacing versus existing Tank Spacing premise
- **Application Positions**
  - A 70% increase in the number of Storage Tanks that do not provide safe deployment positions for fire operations in all potential wind conditions.
  - 100% of the proposed Storage Tanks do not provide safe deployment positions for fire operations in all wind conditions.
- **Distance to Fenceline**
  - A 30% reduction in the facility average Tank to Fenceline Distance
  - A 61% reduction in the average proposed Tank to Fenceline Distance

## Hazard Events

The TMEP degrades the original fire protection premise of the facility and increases the likelihood of spill or fire extension exposing the community to the following hazard events.

- **Regional Seismic Event**  
The consequences of a seismic event occurrence are increased due to the location of the facility elevated immediately above residential communities and sensitive environmental areas, watercourses and eco-systems in close proximity, in the outfall downhill direction.
- **Flammable Gas Outfall**  
The lighter components of the crude oil when released form flammable outfalls with low ignition points and the significant potential to propagate explosion and fire events.
- **Release of Sulphur based Gases**  
The loss of containment of crude oil products presents the potential for poisonous Hydrogen Sulfide and Sulphur Dioxide release.
- **Watercourse Outfall of Liquid Crude Oil Release**  
The release of Crude Oil to areas outside of lined secondary containment diking creates the potential of a crude oil introduction into watercourses exiting the TMTF facility.
- **Tank Fire Burnout**  
The operations associated with protection of adjacent tanks and the Burnaby Mountain Conservation Area, as well as evacuating persons potentially impacted by a 4 day tank fire event from a facility with such tight proximity to high density residential communities would require an emergency activation of provincial scale.
- **Tank Fire Boilover**  
The potential for Boilover exists in any wide boiling range hydrocarbon, such as a crude oil storage tank full surface fire. For a proposed 200' storage tank, a Boilover event can discharge heated and molten crude oil outwards to 2,000', resulting in large area life hazard and the potential for propagation of additional storage tank fires.

## Consequences

The Trans Mountain Expansion Project (TMEP) will create elevated risk and consequences of risk occurrence to the community by increasing the number and size of hydrocarbon storage tanks within an already geographically challenged facility. Hydrocarbon storage tanks on Burnaby Mountain present several public safety risks, which include increased potential for, include:

- **Flammable Gas Outfall against the Fenceline**  
The potential for flammable gas ignition outside the fenceline is based upon the use of the land areas in proximity to the fenceline. The highly populated areas around the TMEP present a high likelihood of ignition.
- **Release of Sulphur Based Gases against the Fenceline**  
Highly toxic Hydrogen Sulfide (H<sub>2</sub>S) will very quickly, upon facility release, expose residential areas to conditions that are immediately dangerous to life. Smoke outfalls from fire event may contain Sulphur Dioxide (SO<sub>2</sub>), in which KMC analysis shows a potential health concern could be felt up to 5.2 km. downwind.
- **Release of Toxic Smoke Plumes against the Fenceline**  
The potential health impacts of exposure to by-products from crude oil combustion are most notably likely to harm those with pre-existing chronic respiratory conditions, increase rates of asthma and cardiovascular illness, with potentially undetermined effects on longer term illness accumulations such as cancer.
- **Heat Discharge against the Fenceline**  
The TMEP reduces the Heat Source distance to Wildland Impact and potential Wildfire exposure of the Burnaby Mountain Conservation Area by 66%.  
The existing TMTF is designed with a set back or buffer distance of not less than 200' from the fenceline.

## Conclusions

The TMEP will increase the impacts associated with the risks of crude oil loss of containment or fire across all potential event types due to the increased proximity to residential population densities, highly susceptible conservation forest areas and downhill or downwind sensitivities. The event elapse time prior to life and environmental impact will be significantly reduced by the TMEP, as has many of the engineered in facility configuration countermeasures responsible for the minimization of event growth and corresponding impact escalation have been greatly reduced from original facility premises which fundamentally adhered to the intent of best practices, to the reduced performance of minimum code requirements.

The existing high consequence event potential of a regional seismic event will tax the TMTF facility as the tertiary containment system has not been proposed to be upgraded nor will the secondary containment provisions of existing storage tanks, creating a potential release of 40% of the volumetric crude oil from the facility or up to 2.24 Million Barrels of crude oil. The impact of this loss is not increased by frequency of event occurrence, but by the TMEP not incorporating site wide upgrades to maintain the countermeasure premises currently in place.

Fires occurring in this tank farm will have a potential to be severe in magnitude. Inherent in the layout of this tank farm is the potential of a fire event occurring in such close proximity to adjacent tanks, that subsequent ignition of additional storage tanks is a dangerous reality. A significant emergency management concern in a facility of this type is the escalation from a single tank fire to a multiple tank fire event. The resource requirements and the excessive complexity and risk to emergency responders, typically prevents the safe firefighting of a multiple tank fire event. The TMEP proposal includes the mass densification of the facility, adding many more and many larger product storage tanks. The addition of storage tanks decreases the distance between each tank. The distance between storage tanks is a key design and engineering feature provided to allow firefighters to effectively isolate an active tank fire, preventing a multiple tank fire event. The TMEP proposal effectively increases the risk associated with a multiple tank fire event due to the reduction in storage tank spacing.

The TMEP proposes the increasing of the tank farm storage tank density, by decreasing engineered tank isolation distances, which in turn increases the potential for fire event escalation through extension, in a facility that has reduced its internal fire protection capability without approval. Notable by its absence from the TMEP application to the NEB is a detailed analysis of the effect of the tank spacing reduction on the requirements of mobile and fixed fire protection countermeasures, and the subsequent changes to the fire protection premises currently utilized. Weaknesses in the design of a facility can create fire event situations that cannot be safely or effectively mitigated without allowing a storage tank or several tanks to burnout.

The TMTF was originally approved based on the provision of a 2 tank diameter spacing. In subsequent years the addition of Tank 88 marginally reduced the overall facility tank spacing to 1.86 tank diameters (average), but maintained the original premise of tank spacing to provide tank isolation and reduce escalation and extension potentials. The TMEP massively deviates from the original safety premise and approval basis of providing storage tank isolation for proposed tanks at a proximity distance of 0.5 tank diameters.

The addition of storage tanks into the existing TMTF changes the risk control premises with regard to storage tank isolation by facility design. In order to achieve the desired storage tank volume, KMC is proposing a significant replacement of designed isolation of each storage tank. In essence, the TMEP shifts the control of hazard from an engineered approach of tank isolation, to an emergency response approach. As the authority having jurisdiction for fire protection approval within the City of Burnaby, the Burnaby Fire Department has recently been advised by KMC on May 30, 2014, that the facility no longer has the emergency response ability to extinguish fire events with internal facility resources, and that additional hydrocarbon specialized firefighting resources from regional facilities are no longer available.

To complicate the emergency control activities, because of the tighter tank spacing, many heat exposure cooling operations are not possible due to insufficient firefighting deployment positions. The TMEP proposed to group many tanks with common diking separated only by small intermediate dike segregation. These larger dikes areas reduce the available access and deployment roadway positions to facilitate safe, efficient and effective firefighting stream applications.

The decreased tank spacing within the tank farm has additional significant consequences. Many of the potential tank fire scenarios within the Trans Mountain Tank Farm facility would be inextinguishable due to lack of safe firefighting positions. The general configuration proposed by Kinder Morgan provides insufficient safe access routes and operating positions from which firefighters could apply protective streams to isolate or extinguish fire events. The elevation changes within the Trans Mountain Tank Farm do not provide multiple firefighting positions or consideration for approach elevations to enable safe and effective operations for all potential wind directions. In order to extinguish a tank fire within the Tran Mountain Tank Farm emergency responders could be forced to significantly risk their personal safety in order to overcome the design inadequacies of the facility. Specifically, the configuration of the tank farm on a hillside in such a tight footprint would require firefighting personnel to operate in elevated positions above the tank, exposing them to potentially excessive heat and smoke outfalls. In these instances emergency responders would likely be forced to allow the tank fire to burn out while adjacent tanks are protected.

The TMEP presents a significantly larger fire control risk within the TMTF. The identified increase in events with potential to escalate and extend to adjacent storage tank exposures due to insufficient firefighting deployment positions increases the likelihood of a multiple tank fire (including the potential of having to allow one or several storage tanks to burnout over 2-4 days), toxic smoke plume discharge (including long term chemical exposure to adjacent communities), and heat discharge to areas outside the facility (including high probability of fire extension to the forest areas of the Burnaby Mountain Conservation Area. The risk of community impacts outside of the facility from a TMTF fire event are increased by 70%.

The reality of employing a Burnout tactic for a Tank Fire event within the proposed TMEP configuration is that success associated with preventing fire extension throughout the TMTF and the adjacent community would by no means be assured. Significant potential exists that due to the proposed configuration, density, complexity and proximity to the community impacts and fire spread potentials that would create scenarios where fire containment is not possible.

The cost of this risk potential assumed by the community is not in line with the safety and risk management premises initially utilized for original facility approval by the City of Burnaby. The specific driver of the increased risk is the reduction in the effective of the facility design to limit fire event growth and restrict hazardous impacts to an immediately controllable area of impact during a short emergency response timeframe. It is critical for public safety that design configuration utilized support the protection of life, the environment and property. The TMEP does not provide the basic engineered safety provisions standard in high-impact potential facility design.

The potential for Boilover exists in any wide boiling range hydrocarbon, such as crude oil. For a proposed 200' storage tank, a Boilover event can discharge heated and molten crude oil outwards to 2,000'. A Boilover event occurring from a Tank Fire in the TMTF, the high hazard expected to receive the discharged heated and molten crude oil would encompass the entire TMTF, the Shellmont Tank Farm, the Forest Grove, Meadowood, and Sperling-Duthie Communities, closing Gaglardi Way and the Burnaby Mountain Parkway. It is anticipated that the consequences of Boilover exposure within the areas identified would include human injuries to emergency responders and unevaluated civilians, mass tree top based wildland fire initiation, structural fire initiation to many residential buildings, potential tank fire initiation within the TMTF and the Shellmont Tank Farm and significant isolation of the SFU and UniverCity communities.

The TMEP proposes a reduction in the tank to fenceline spacing of 30% on a facility wide comparison, and utilizes a new tank positioning premise which reduces the tank to fenceline distance by 61%. The decreased tank to fenceline distance and consequential impact potentials to the community presents the higher requirement and increased priority of evacuation operations conducted simultaneously with fire control activities. This response requirement significantly increases the emergency response resource requirements associated with identifiable emergency event potentials.

The TMEP significantly increases the urgency and expedience required to prevent community life and environmental impact outside the facility fenceline in the event of a product release or storage tank fire. The positioning of storage tanks in such close proximity creates a greater potential for citizen exposure within the adjacent communities to the hazardous effects of flammable gas outfalls and sulphur based gases. Additionally, the close proximity of storage tanks to the fenceline dramatically increases the risk of wildland fire to the Burnaby Mountain Conservation Area.

The process undertaken by KMC to seek expansion approval requires that the company, through its federal, provincial and municipal applications, accurately describes the project and its resultant operations within the proposed site. As such, the onus is on the applicant to document and commit to a project that meets the needs of the stakeholders impacted by the project and the authorities having jurisdiction.

What may not be noted by KMC is the aspect of regulatory compliance to City of Burnaby Bylaws, specifically the requirement for Emergency Response Plans and Fire Protection provision that the adequacy of which is determined, solely by the Fire Chief.

With this in mind, the Burnaby Fire Department is resolute in asking increasingly more detailed questions in order to address the increase in risk the TMEP will pose and the operation impacts the project will have on the Burnaby Fire Department and the community for which they advocate.

KMC has undertaken as part of their submission a Qualitative Risk Assessment on Facility Hazards. It is important to note in *section 3.2 Facilities* the KMC states that “*For each valid and independent consequence reduction measure the consequence level will be reduced by one.*” Presumably KMC intends to self-determine acceptable consequences, degrees of consequence reduction and levels of acceptable risk.

Following the NEB Intervener Round 1 Information Request process, in which details around the risk to safety created by the TMEP, KMC failed to answer any of the questions asked by the City of Burnaby and subsequently responded to the City of Burnaby by stating that “There is no further response required”.

No statement intent re approval of the Burnaby Fire Chief in accordance with City Bylaw NO.11860 is apparent within the submission. The point here is KMC has not provided sufficient detail for the Fire Chief to be apprised of the TMEP Facility Hazards or to comment on or approve of the adequacy of the consequence reduction measures. The key concept is that the Qualitative Risk Assessment team does not determine the adequacy of the consequence reduction measures; the Burnaby Fire Department Fire Chief has the responsibility and duty to do so.



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Attention: Terry Waterhouse & Laura Barnette

**RE: TRANS MOUNTAIN EXPANSION PROJECT – REVIEW OF HUMAN HEALTH RISK ASSESSMENTS, EVIDENCE REPORT**

Pottinger Gaherty Environmental Consultants Ltd. (PGL) is pleased to provide this evidence report of our opinion of the human health risk assessment work completed for the proposed Trans Mountain Expansion Project (TMEP) by Trans Mountain Pipeline ULC (Trans Mountain).

We reviewed the responses to Simon Fraser University's (SFU) Information Requests No. 2 related to emergency response and preparedness, portions of Volume 5 and 8 of the TMEP Application, human health risk assessments (Intrinsic, 2013a, 2013b, 2014a, 2014b, 2014c), and the facility risk assessment (Doug McCutcheon and Associates, Consulting, 2013) to identify possible gaps or deficiencies. The following is a fact-based evidence report for consideration by the National Energy Board (NEB) that focuses on the adequacy of the Human Health Risk Assessment (HHRA) in relation to the community at SFU.

This evidence report is presented with the following sections:

- Background – a brief background to the proposed Trans Mountain project with a focus on the components on Burnaby Mountain;
- HHRA Methodology – description of typical HHRA framework;
- HHRA in Context of Environmental Assessments – discusses the role of HHRAs in the context of environmental assessments;
- How Trans Mountain Assessed Human Health Impacts – summary of the work completed by Trans Mountain to assess human health impacts; and
- Gaps and Conclusions.

Based on our review, the HHRAs completed for the TMEP have not addressed:

- Risks from exposure to fire-related emissions (e.g., smoke and SO<sub>2</sub>), from an accident and/or malfunction, to human receptors at SFU;
- The risks from exposure from the potential release of products that might be transported or stored other than the Cold Lake Winter Blend; and
- The risks to human receptors under high intensity exposure scenarios.



This means that the risk characterization and conclusions in the HHRA's completed for the TMEP may not capture the potential exposure scenarios needed to appropriately inform an NEB decision. The NEB risks approving a project that has not fully considered the health risks associated with a realistic emergency situation, thereby possibly lacking in appropriate response plans and exposure of the SFU community to unknown health risks.

## 1.0 BACKGROUND

Trans Mountain is proposing to expand its pipeline system, between Edmonton to Burnaby. The system transports crude oil and refined products between the two locations. The proposed expansion involves the following:

- Completion of the twinning of the pipeline in Alberta and BC with 987km of new buried pipeline;
- New and modified facilities, including pump stations and tanks; and
- Additional tanker loading facilities at the Westridge Marine Terminal, Burnaby, BC.

For Burnaby Mountain, this means an additional 14 storage tanks and new pipelines to the Burnaby Terminal, and new pipelines between the Burnaby and Westridge Marine Terminals. The additional storage tanks, which will increase storage capacity by 620,000m<sup>3</sup> (230% of existing capacity), are proposed on the north and east sides of the site (near SFU).

The area between SFU and the Burnaby Terminal is predominately forest, with the only two access routes to the campus. SFU is concerned about the potential effects of an accident or malfunction, such as a fire or spill, leading to hazardous exposure, isolation, and/or evacuation of the SFU population.

## 2.0 HHRA METHODOLOGY

Risk assessment is a tool used to evaluate and estimate the severity of existing and potential future impacts from exposure to substances to an individual. It involves the collection, analysis and interpretation of environmental data and the comparison to toxicological values based on specific target organs. The outcome is a calculated level of risk which is deemed as acceptable or unacceptable, based on regulatory or societal values.

There are three prerequisites for a risk to exist:

- A substance must be present at hazardous levels;
- A receptor must be present; and
- An exposure pathway must exist between a receptor and a substance.

In general, HHRA methodology is based on methods developed for human exposure to environmental contaminants. The framework for HHRA is based on the following:

- Scoping/problem formulation – Scoping and problem formulation is the first and the most critical step when conducting an HHRA. This step establishes the spatial and temporal boundaries, and identifies substances that may have adverse effects to potential human receptors via credible exposure pathways (contaminants of concern);
- Exposure assessment – The exposure assessment is a quantitative process to estimate the dose or level of exposure experienced by human receptors. This often includes exposure, fate and transport modelling;
- Toxicity/Hazard assessment – This involves describing the acute and chronic effects of substances, mode of action, and selection of acceptable exposure limits for each substance. These limits are typically available from regulatory agencies (e.g., Health Canada, US

Environmental Protection Agency, World Health Organization), and when not available, they can be developed from published toxicological studies;

- Risk characterization – Risk characterization involves comparing the exposure estimated to the acceptable exposure limit to yield a risk estimate. The risk estimate is compared to risk levels typically set by regulatory agencies; and
- Uncertainty – Describes the uncertainties that could contribute to variability in the risk characterization, the potential changes, and the level of confidence in the current outcome.

This approach is described in detail in AB HPB (2011), BC MOE (2012), HC (2012), and US EPA (1989).

### 3.0 HHRA IN CONTEXT OF ENVIRONMENTAL ASSESSMENTS

Environmental assessment (EA) involves the assessment of potential (and cumulative) effects for all phases of a proposed project (i.e., construction, operation, decommissioning/abandonment), including accidents and malfunctions (i.e., unplanned events). Although accidents and malfunctions may have a low likelihood of occurrence, there is a potential for significant risks if there are severe consequences and because of their unplanned nature. To examine the human health component in the environmental assessment, HHRAs can be used to assess the potential risks to people from exposure during all project phases.

In the context of EA, HHRAs are a tool to help decision-makers make effective and prioritized decisions that have the greatest potential to protect human health. They are intended to be a transparent tool, to guide risk management decisions. They can be used to understand the potential risks to human health and to design mitigation measures to address unacceptably high risks, such as emergency response plans.

This information is required to be considered by the NEB as per the NEB Filing Requirements under Human Health (NEB, 2014):

*“Where it is reasonable to assume there could be a potentially high or significant risk to human health from the project, provide a human health risk assessment.”*

Additionally, the guidance in the NEB Filing Manual for this requirement includes (NEB, 2014):

*“As the definition of human health includes consideration of mental and social well-being, applicants must also consider any adverse emotional or social stressors potentially resulting from the project, including:*

- *concern for public safety from construction or operations-related accidents or malfunctions; or*
- *disruption of normal, daily living activities.”*

The decision makers for this project are tasked with answering a multitude of questions, including:

***Do we understand the risks posed by accidents to the health of local communities, and is the project appropriately planned and prepared to prevent significant consequences?***

### 4.0 HOW TRANS MOUNTAIN ASSESSED HUMAN HEALTH IMPACTS

For the proposed project, Trans Mountain assessed the potential for adverse environmental effects as part of their application to the NEB. Environmental effects, including those caused by accidents and malfunctions were considered. For human health, these effects were considered in several risk assessments.

#### 4.1 HHRA

HHRA were completed for the pipeline and related facilities (Intrinsic, 2013a, 2014a), the Westridge Terminal facilities (Intrinsic, 2014c), and the marine transportation (Intrinsic, 2013b, 2014b). In general, these reports followed typical HHRA methods from Health Canada (HC, 2010) and risk characterization was completed using toxicological data. These reports helped to identify the need for planning and preparedness around emergency and spill response.

In brief, the HHRA are summarized below:

- Pipeline and facilities – This HHRA considered the risks from a pipeline spill of Cold Lake Winter Blend (considered to be representative of the oil spilled) in an urban area. Two spill volumes were considered: 1,558m<sup>3</sup> for a credible worst-case spill and 1,012m<sup>3</sup> for a smaller spill. Spills were assumed to occur in a populated resulting in inhalation exposure to volatilized components of the released product. Receptors were considered to be the general public and emergency responders. Exposure was assumed to occur during the early stages of the spill, prior to implementation of emergency and spill response measures;
- Westridge Terminal – This HHRA considered the risks from the uncontrolled release of vapour and other emissions from the TMEP to residents (including aboriginal peoples, and urban dwellers) and area users (people who might use the area for recreation or other purposes). The main exposure pathway considered was inhalation; other pathways assessed included incidental ingestion, dermal contact, uptake through the food chain (i.e., consumption of impacted harvested foodstuffs). The local study area was assumed to be 5km, and included the entirety of SFU and Burnaby Mountain; and
- Marine Transportation – The marine HHRA evaluates the potential risks from exposure to chemical emissions due to Project-related marine traffic. Receptors considered were residents and/or area users within 5km of shipping lanes. Because the release mechanism was through emissions, the exposure pathways were the same as for the Westridge Terminal.

#### 4.2 Risk Assessment – Burnaby Terminal Portion

Another risk assessment was completed for the Burnaby Terminal (Doug McCutcheon and Associates, Consulting, 2013). This risk assessment was based on the guidance provided by the Major Industrial Accidents Council of Canada (MIACC, 1994 and 1995). This type of risk assessment is conducted to demonstrate the level of risk to public safety associated with major projects and modifications to an existing facility.

The risk assessment evaluated the effects and consequences of a fire scenario from three accident scenarios. The three scenarios considered were:

- Tank fire caused by a major oil tank release;
- Toxic cloud release from a fire (includes smoke and SO<sub>2</sub>); and
- Boil-over (specific type of fire scenario).

Two effects, radiant heat and smoke were considered most significant. The potential extent of impact was estimated for radiant heat, the smoke plume, and sulphur (SO<sub>2</sub>). The immediate impact of radiant heat from fire at the facility is estimated to be up to 224m from the dike walls. The modelled concentrations for smoke and SO<sub>2</sub> were compared to Emergency Response Planning Guidelines and Immediately Dangerous to Life and Health levels. Smoke is estimated to drift down gradient up to 43km. SO<sub>2</sub> is modelled to extend as far as 5.2km. The SFU campus is less than 1km to the northeast from the Burnaby Terminal component of the TMEP.

## 5.0 GAPS AND CONSEQUENCES

When reviewed for completeness and consistency with typical guidance for conducting HHRAs, several gaps appear in the HHRAs provided for the TMEP. These gaps may limit the ability of the NEB to understand the magnitude of the risks, and suitability of the emergency management plans. The specific gaps identified are discussed below.

- Absence of fire scenario in the HHRAs – The HHRAs completed by Trans Mountain considered health effects to vapour from spills and leaks (along the pipeline or at the terminal), and emissions (from operational activities) related to the TMEP. Although there is a detailed discussion of a fire scenario for the risk assessment completed at the Burnaby Terminal (see Section 4.2 of this report), there is no linkage to the potential risks in any of the HHRAs.
  - There is a requirement, in the EA process, that proponents assess the potential impacts from accidents and malfunctions such as a fire. The risks from the potential effects of fire-related emissions have not been considered in the HHRAs, following Health Canada methods. Emissions from fire events in general are well documented (Duran, 2014; Morandi et al., 2009; USDA, 1997). These emissions include soot and particulate matter, SO<sub>2</sub>, carbon monoxide, sulphur and nitrogen oxides, volatile organic compounds such as benzene, and semi-volatile compounds such as polycyclic aromatic hydrocarbons (US EPA, 2002). Smoke and emissions from fires are known to adversely impact human health at SFU. This means that the probability (and magnitude) of an unacceptable risk was not determined for the various potential receptors at SFU.
  - The risk assessment for the Burnaby Terminal was completed using guidance from MIACC (1994, 1995). These types of risk assessments are used for risk reduction at industrial facilities and emergency response planning. The Burnaby Terminal risk assessment is not consistent with the framework, methods and rigour of typical HHRAs (AB HPB, 2011; BC MOE, 2012; HC, 2012; US EPA, 1989). It is not a surrogate for an HHRAs and does not assess the risk (or significance of accidental effects) to the air quality and health of the SFU population. It is of note that this risk assessment did not evaluate the potential risk related to the spread of a fire to the surrounding forested area. This would lead to potentially greater exposure and risk to SFU from the smoke and emissions, and potential isolation of the campus by blockage of egress routes.
- Rationale for spill volume – The HHRAs provide a brief explanation for the use of the two different sized spills. There is no technical information or rationale provided to justify the use of either of these two volumes. There have been larger spills reported by Trans Mountain (1587m<sup>3</sup> spilled in 1985) and others (Enbridge spilled 3,800m<sup>3</sup> in 2001)<sup>1</sup>.
- Limited contaminants of concern in HHRAs - Cold Lake Winter Blend was assumed to be representative of the product released in an accident/malfunction. Kinder Morgan's website suggests crude oil, semi-refined and refined products will potentially be transported or stored along the TMEP. It is unknown if other products transported or stored are similar in chemistry, toxicology, and environmental behaviour if accidentally released. Emissions (i.e., vapour and fire-related) will depend on the grade and composition of the product and may vary significantly from Cold Lake Winter Blend. Because the emissions are potentially quite different depending on the product(s) released, the substances considered as potential health hazards (i.e., contaminants of concern) in the current risk assessments may be too limited (i.e., there may be other substances that should be considered contaminants of concern). As a result, the total risk may be underestimated and HHRAs conclusions could change significantly depending on the products released.
- Incomplete receptor characterization – The general public, early responders, residents, and area users were considered to be receptors (in some combination) in the various HHRAs for

<sup>1</sup> The Trans Mountain spill is reported on their website (<http://www.transmountain.com/uploads/pages/1422040950-Dec-2014-Spill-Chart-for-posting-FINAL.pdf>) and the Enbridge spill in a CBC compilation of NEB incidents since 2000 ([http://www.cbc.ca/news2/interactives/pipeline-incidents/data/pipeline\\_incidents\\_neb\\_2000\\_2012.csv](http://www.cbc.ca/news2/interactives/pipeline-incidents/data/pipeline_incidents_neb_2000_2012.csv)).

the Project. Specific receptors in high intensity exposure scenarios (i.e., higher inhalation rates than general public), such as for construction workers, athletes, and people engaged in recreational activities (all frequently present at SFU), were not considered. Health Canada (2010) indicates it is advisable to include "a description of all potential exposure pathways and potential human receptors (including sensitive receptors)" and "exposure pathways and human receptors screened out be accompanied by a rationale as to why they would not be a potential concern." In the absence of an assessment identifying all potential receptors and exposure pathways and why they may or may not be necessary, it is unknown if these or other receptors at SFU should be considered in the HHRA.

- As a result of the above gaps, the adequacy of proposed emergency planning to mitigate, or avoid, significant effects to human health at SFU is unknown (Etkin et al., 2015).

In conclusion, the TMEP Application does not sufficiently inform SFU of the potential risks to which they may be exposed or to comprehensively understand the human health risks to their populations. Without filling the information gaps identified herein, it is difficult to determine whether or not there are serious health risks that need specific attention in the emergency plans of SFU and TMEP.

## 6.0 STANDARD LIMITATIONS

PGL prepared this letter report for our client and its agents exclusively. PGL accepts no responsibility for any damages that may be suffered by third parties as a result of decisions or actions based on this letter report.

PGL relied on the listed documents for site information to prepare this opinion and as such, the limitations of our review are at least as great as those documents.

The findings and conclusions are site-specific and were developed in a manner consistent with that level of care and skill normally exercised by environmental professionals currently practising under similar conditions in the area. Changing assessment techniques, regulations, and site conditions means that environmental investigations and their conclusions can quickly become dated, so this report is for use now. The report should not be used after that without PGL review/approval.

The project has been conducted according to our instructions and work program. Additional conditions, and limitations on our liability are set forth in our work program/contract. No warranty, expressed or implied, is made.

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## 8.0 CLOSING

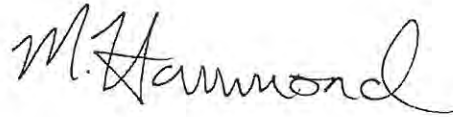
We trust that this meets your needs. If you have any questions or require clarification, please contact Mike Shum or Matt Hammond at 604-895-7656 and 604-895-7644, respectively.

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# Hazards to Simon Fraser University Associated with the Trans Mountain Expansion Project: A Gap Analysis

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## 1 Executive Summary

- (1) The proposed expansion of the Kinder Morgan pipeline and tank farms in the Burnaby area create increased risk for Simon Fraser University (SFU). In part this is because more product will be flowing through the pipelines and stored at the Burnaby Tank Farm, but it is also because previous levels of safety will be decreased by densification of the tank farm, tanks being positioned closer to fences and roads, and the reduced ability of the Burnaby Fire Department to effectively respond to an accident. Pipelines and tank farms have a history of accidents, and though they are rare at any one location they occur often enough to require planning. In particular, the largest historical accidents comprise a significant proportion of total impacts, and therefore worst case scenario planning is needed in such circumstances. The “credible worst case” scenarios used by Trans Mountain in their risk analysis need to be carefully scrutinized, to ensure that they adequately inform SFU emergency planning.
- (2) The risks associated with the pipeline and tank farms, as they might impact SFU, need to be more comprehensively analyzed and documented than has thus far been done, and SFU should develop their emergency plans to reflect these new risks. This will involve the development of more realistic accident scenarios, hazard zone mapping, and detailed meteorological modelling. Local effects can be very important, and mesoscale modelling is required to adequately analyze potential impacts on SFU from an accident.
- (3) Of particular importance is the proximity of the Burnaby Tank Farm to SFU. Worst case scenarios of fires or explosions, and exposure to resulting plumes, have the potential to impact, or even envelop the university, and block access to and from SFU, thus making an evacuation difficult or impossible.
- (4) An air quality dispersion modelling approach is generally used to assess compliance of emissions with air quality regulations and standards, as has Trans Mountain used the CALPUFF dispersion modelling system. The dispersion modelling system is composed of 3 components: CALMET (meteorological driver), CALPUFF (chemical dispersion) and CALPOST (post-processing of CALPUFF output). The CALPUFF modelling system has gained a regulatory approval by the US Environment Protection Agency (EPA), to be used as a tool to meet emission compliance and for assessing air quality from those emissions. The CALPUFF system has been used extensively worldwide as one of the better models for a non-steady state emission situation. However, it has a number of tuning parameters that need to be adjusted and checked for validity. Based on the published reports from the National Energy Board hearing, there is no evidence to show that Trans Mountain has been sufficiently diligent in applying the model to address the case of a catastrophic release of a toxic buoyant material.
- (5) Embedded in the report are 23 recommendations that represent best practise within the risk assessment and modelling community, and will provide SFU with an increased understanding of the risks they are exposed to as a result of the Trans Mountain expansion of pipelines and tank farms, and what gaps need to be addressed.

## 2 Introduction

- (6) The authors of this report have been retained by Simon Fraser University (SFU) to evaluate: (a) Trans Mountain emergency planning, and (b) specific aspects of the risk assessment methodology related to air dispersion modelling used by Trans Mountain Pipeline ULC (TM), in support of TM's application to the National Energy Board for a certificate of public convenience and necessity in respect of the Trans Mountain Expansion Project (TMEP).
- (7) Trans Mountain has applied to the National Energy Board for authorization to expand the capacity of its 1,150-km oil pipeline and tank farms running from Edmonton, Alberta to Burnaby, BC. This would increase the capacity of the system to about 890,000 barrels/day from the current 300,000. As part of the TMEP, new tanks would be added to the Burnaby Tank Farm and Westridge Terminal, and new pipelines would connect the Burnaby and the Westridge Marine Terminals (Figures 2.1a&b), both located in Burnaby, BC. Trans Mountain proposes three alternative routes to convey the pipelines<sup>1</sup>:
- A 2180 m long horizontal directional drilled installation (HDD) from the Burnaby Storage Terminal to the Kask Brothers facility, and a 435 m long HDD connecting the Kask Brothers and Westridge Marine Terminal facilities.
  - A 2680 m long tunnel connecting the Burnaby Storage and Westridge Marine terminals.
  - A 3625 m long conventionally trenched pipeline, mainly following existing streets in Burnaby.
- (8) This expansion, including more tanks and pipelines going into the Burnaby Tank Farm and Westridge Terminal, would result in changes to hazards that SFU is exposed to from accidents related to pipelines and storage tanks. Because SFU is at a higher elevation than the pipeline or tank farms they would not be directly affected by the spill of product flowing through the pipes or stored in tanks, which would flow downhill and/or be absorbed into the ground. However, accidents have the potential to affect SFU because of fire or explosions, or by airborne contaminants that could be carried to SFU within the boundary level wind field.
- (9) In order for SFU to properly develop emergency plans they require an accurate assessment of how their risks would change as a result of this development. As part of their application TM has provided a risk analysis and a description of their emergency planning system. This report will examine their emergency planning and air dispersion modelling, as it relates to the needs of SFU.

Figure 2.1a: SFU and the proposed pipeline route<sup>2</sup>



Figure 2.1b: SFU and the proposed pipeline route<sup>3</sup>



Figure 2.1c: Proposed Burnaby Terminal Expansion. Note that the proposed tanks (green) are closer to roads and also closer to each other than the existing tanks. These two factors increase the threat level, and make response by the Burnaby Fire Department much more difficult<sup>45</sup>.



### 3 Statement of Work

- (10) SFU has contracted with the authors to provide the following:
- a) A critical analysis of the currently available Trans Mountain emergency planning documents and the resulting implications for SFU.
    - i. Section 8 of this report will analyze the Trans Mountain emergency planning system, primarily through comparison to the National Energy Board Onshore Pipeline Regulations - SOR/99-294 and the Emergency Management Regulation (EMR), B.C. Reg. 204/2013 of the B.C. Oil and Gas Activities Act (OGAA). The former is the primary enforcement mechanism for inter-provincial pipeline operations in Canada, and the latter governs the Oil and Gas industry in B.C. Together, they outline a minimum standard for compliance for activities of the TM project and Kinder Morgan. Additional standards will also be utilised to assess the emergency plan documents provided in support of the TM expansion project, including the CSA Z1600 (Emergency Management and Business Continuity Programs) which is strongly supported by the National Energy

- Board (NEB), as well as emergency management theory and best practices. Any gaps in the aforementioned documents will be flagged and the implications for SFU identified.
- ii. Additionally, the capacity of TM to perform EM functions listed in their planning documents will be considered, including any past events that required emergency response. It must be noted that complete TM planning documents are not available since they are, in part, redacted, and finalized plans will not be available until shortly before final construction.
- b) An evaluation of air dispersion modelling within the TM risk analysis. An accident at the Burnaby or Westridge tank farms, or the pipeline, could result in a toxic plume affecting SFU.
- i. Section 11 will overview the applicability of the CALPUFF model used by TM for air dispersion modelling (both in terms of the model itself, and the conditions under which it was run), and the scenarios run by TM in terms of their usefulness to SFU.
  - ii. Evaluating the threat from airborne contaminants requires more than just air dispersion modelling, and requires the following assessments: (a) the probability of an accident resulting in explosion, fire or the release of toxic gaseous compounds from the pipeline or tank farms, and (b) estimates of worst case scenarios, including the kind and amount of product released, and over what time frames. It is beyond our scope of work to review probability calculations, but we will consider worst case scenarios and model suitability.

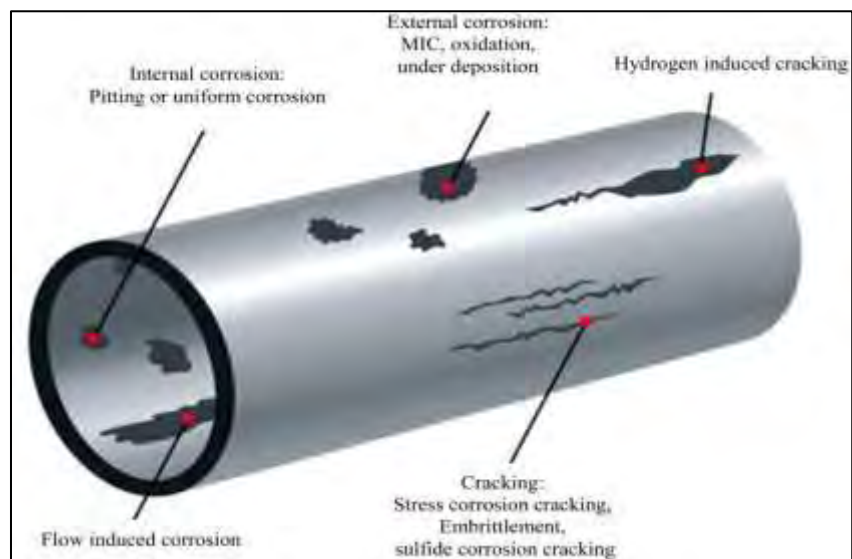
## 4 Context

### 4.1 Overview of risks associated with pipelines

- (11) **Hazards:** There are a variety of hazards that can result in spills or leaks from pipelines as a result of cracking, fractures or corrosion (Figure 4.1). In general the causes can be divided into the categories of natural, technological, and human caused. Natural causes include earthquakes and landslides, technological causes include corrosion and equipment failure, and human causes include incorrect operation and construction errors.
- (12) Data collected over the past decades can be used to generate the probability of incidents. The following baseline incident frequencies (Table 4.1) were generated from the U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration (PHMSA) incident database and are expressed as per mile of pipeline per year<sup>6</sup> (i.e., /mile-year).

Table 4.1: Frequencies of Technological Accidents<sup>7</sup>

Table A-2 Baseline Incident Frequencies Threat Name	Incident Frequency/mile-yr	Occurrence Interval (years)
Corrosion	2.90E-04	3,400
Excavation damage	1.22E-04	8,200
Materials and Construction	3.00E-04	3,300
Hydraulic Event	1.47E-04	6,800
Ground movement	1.23E-05	81,500
Washout and flooding	1.14E-05	87,800

Figure 4.1: Technological Causes of Pipeline spills<sup>8</sup>

(13) **Factors Affecting Failure:** A number of factors affect the probability of a pipeline failure as shown in Figures 4.2, (Source: European Gas Pipeline Incident Data Group<sup>9</sup>). Beyond a pipeline age of about 20 years, failures increase rapidly. Other factors of importance are the diameter and wall thickness of the pipeline, pressure and temperature, product type, standard operating procedures and personnel training.

- a) Age of Pipeline: Failures increase with age after about 20 years.
- b) Pipeline Diameter: Failures decrease as diameter increases. Diameters over 43 cm are much safer.
- c) Wall Thickness: Failures decrease as wall thickness increases. Thicknesses over 1.0 cm are significantly safer.
- d) Pressure & Temperature: Failures increase as pressure<sup>10</sup> and temperature<sup>11</sup> increase.
- e) Product Type: Hazardous liquid transportation has the highest probability of failure.

Figure 4.2a: Effect of Age on Failure<sup>12</sup>

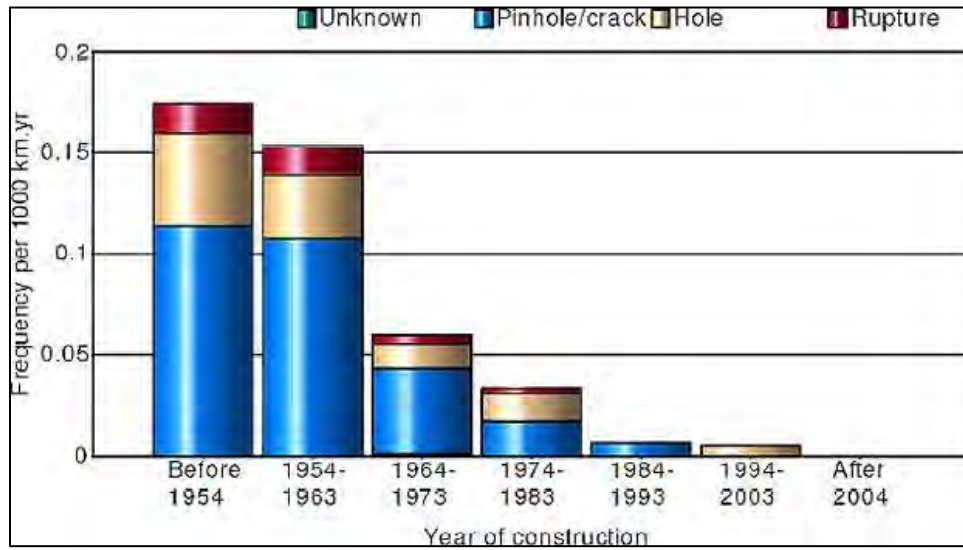


Figure 4.2b: Effect of Pipe Diameter on Failure<sup>13</sup>

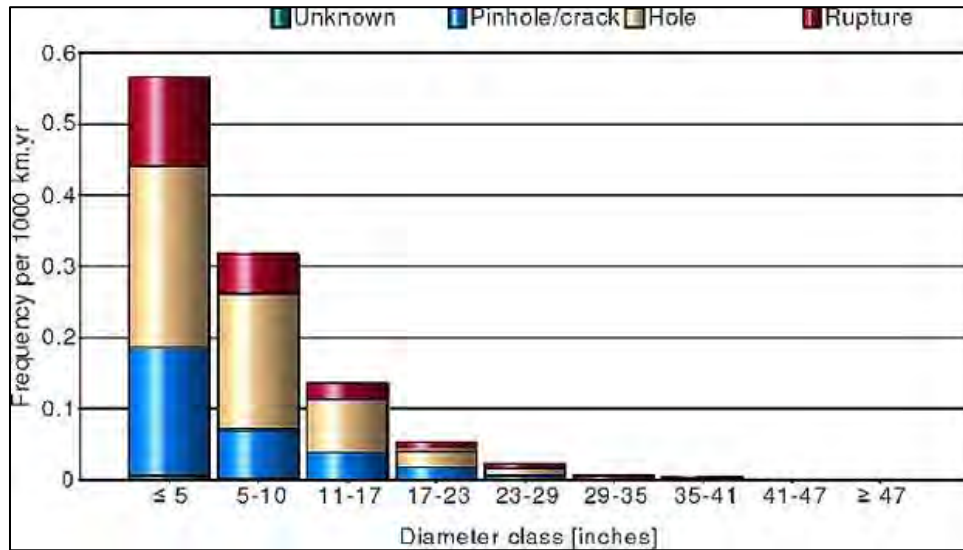




Figure 4.2c: Effect of Pipe Wall Thickness on Failure<sup>14</sup>

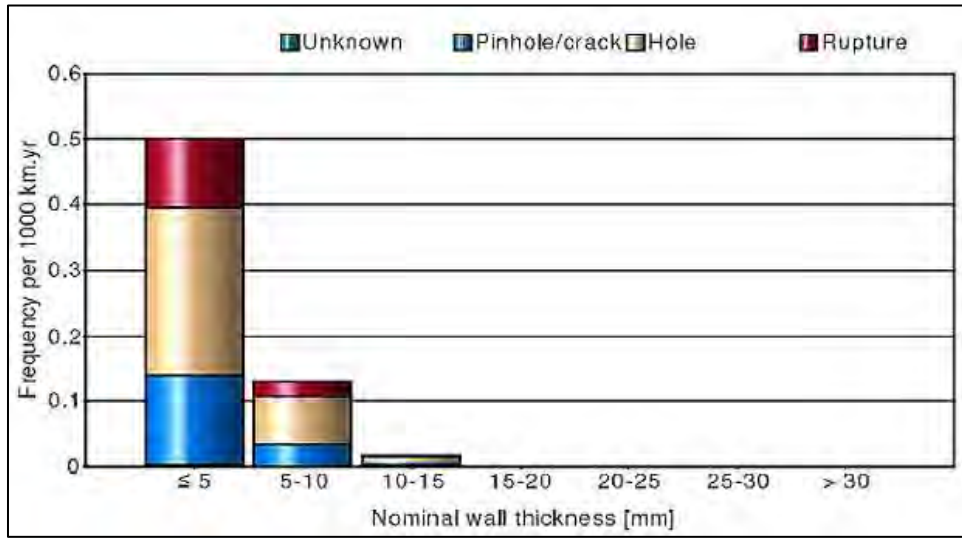


Figure 4.2d: Relationships between failure probability ( $P_f$ ) and fluid pressure ( $P_a$ ) for varying exposure periods ( $T$ )<sup>15</sup>

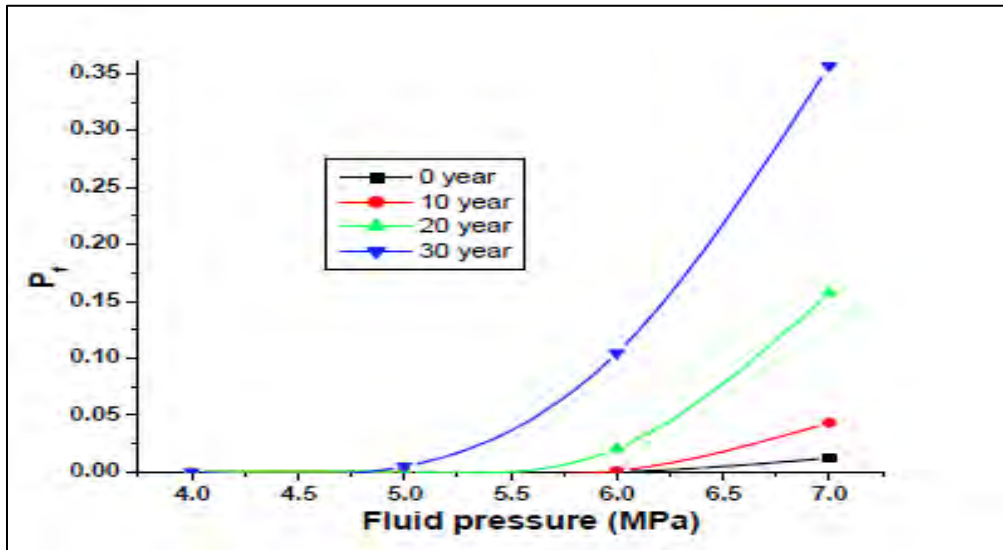


Figure 4.2e: Bar chart of % weight loss against exposure time at various temperatures. Higher temperatures result in greater rates of external corrosion<sup>1617</sup>.

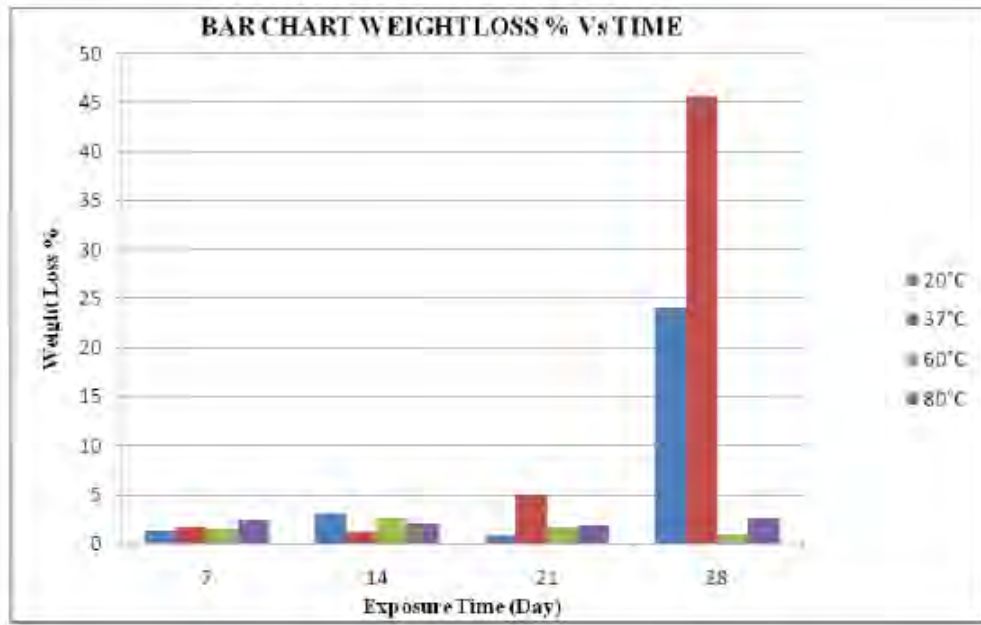


Figure 4.2f: Probability of Failure According to Product<sup>18</sup>



## 4.2 History of pipeline accidents

- (14) **U.S. Data:** The U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration<sup>19</sup> (PHMSA) keep a database of all pipeline incidents reported in the U.S. beyond a certain threshold. Significant incidents need to satisfy one or more of the following criteria:
- a) a fatality or injury requiring in-patient hospitalization;
  - b) \$50,000 or more in total costs, measured in 1984 dollars;
  - c) highly volatile liquid releases of 5 barrels or more, or other liquid releases of 50 barrels or more;
  - d) liquid releases resulting in an unintentional fire or explosion.
- (15) PHMSA data from 1993-2012, of both onshore and offshore pipelines carrying hazardous liquids (primarily crude oil and refined petroleum products) include 5,727 reported incidents, 2,079 of which met the PHMSA definition of “significant incidents,” which accounted for 99.4% of the total volume spilled<sup>20</sup>. Data for onshore spills of all products are shown in Figures 4.3a&b. The trend of annual volume of spills (Figure 4.3b) is downward, though there is a lot of variance in the data. During the years 2010-2014 for non-gas related accidents, TMEP credible worst case scenarios were exceeded in 3 of the 5 years (Figure 4.3c).

Figure 4.3a: Number of U.S. Spills Reported on an Annual Basis. The increase in 2002 is likely because of a change in reporting procedure that accounts for smaller spills.

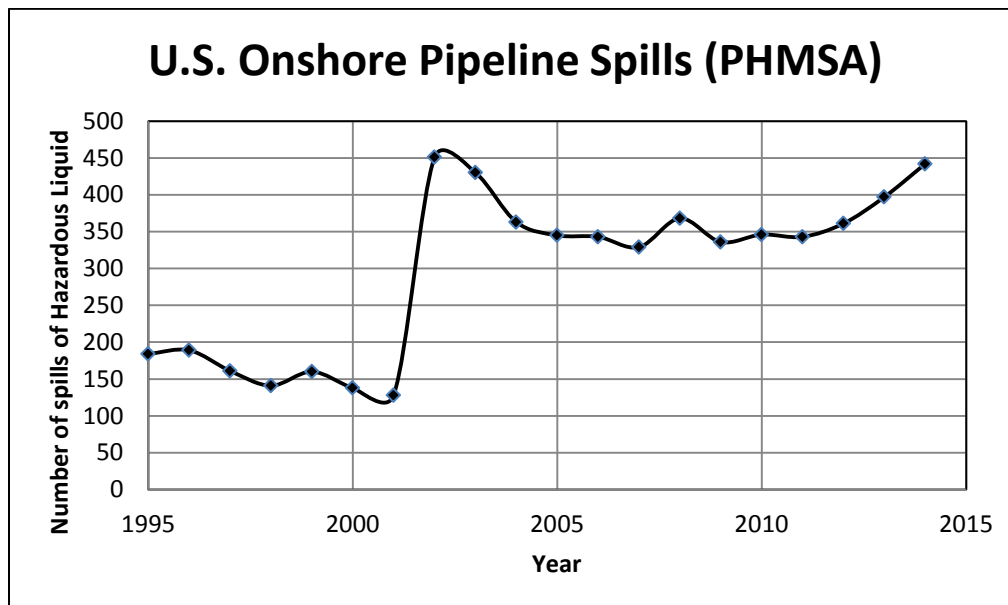


Figure 4.3b: Annual Volume of U.S. product spilled.

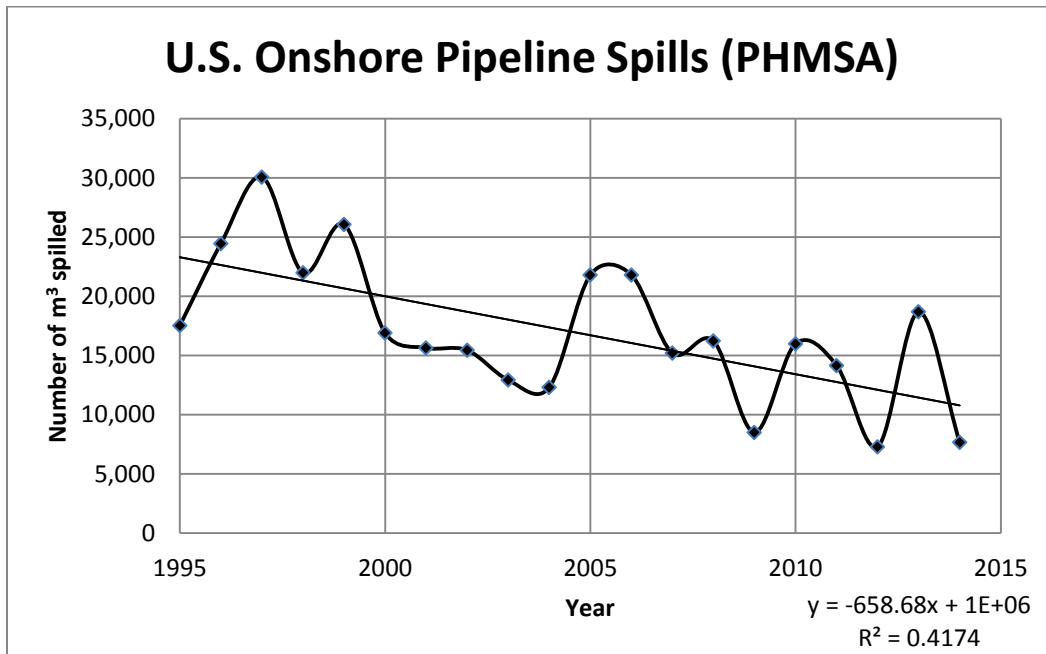
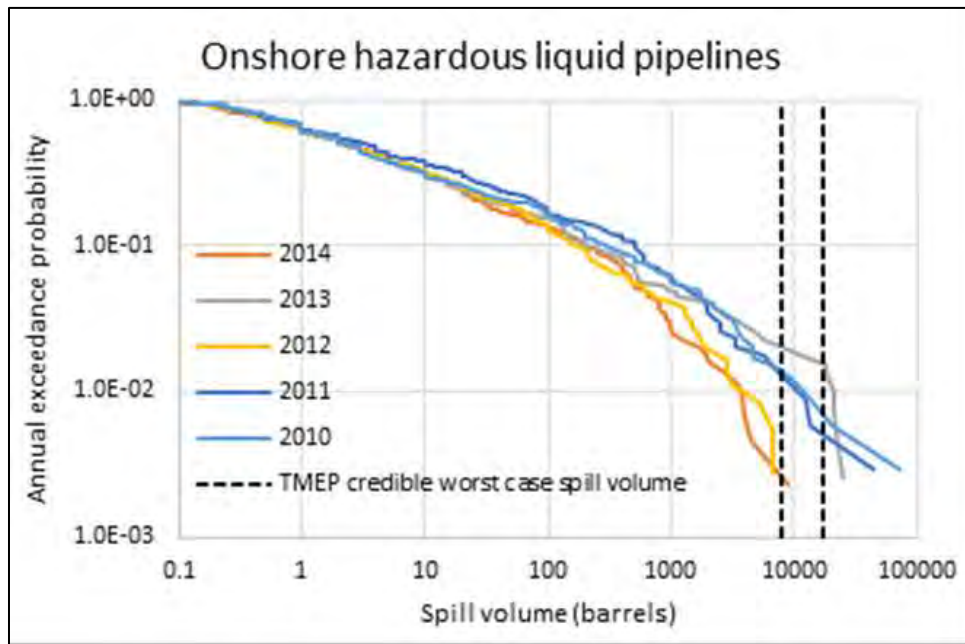


Figure 4.3c: Probability of Spill by Volume (PHMSA data, gas excluded), 2010-2014. TMEP credible worst case scenarios depicted by the vertical dashed lines were exceeded in 2010, 2011 and 2013.



- (16) Most of the spills in the U.S. data are oil, followed by liquid natural gas and gasoline (Figure 4.4). A non-trivial number of spills result in ignition (up to 4.5%) or explosion (up to over 1%) (Figure 4.5).

Figure 4.4: Volume of U.S. Product Spilled by Type

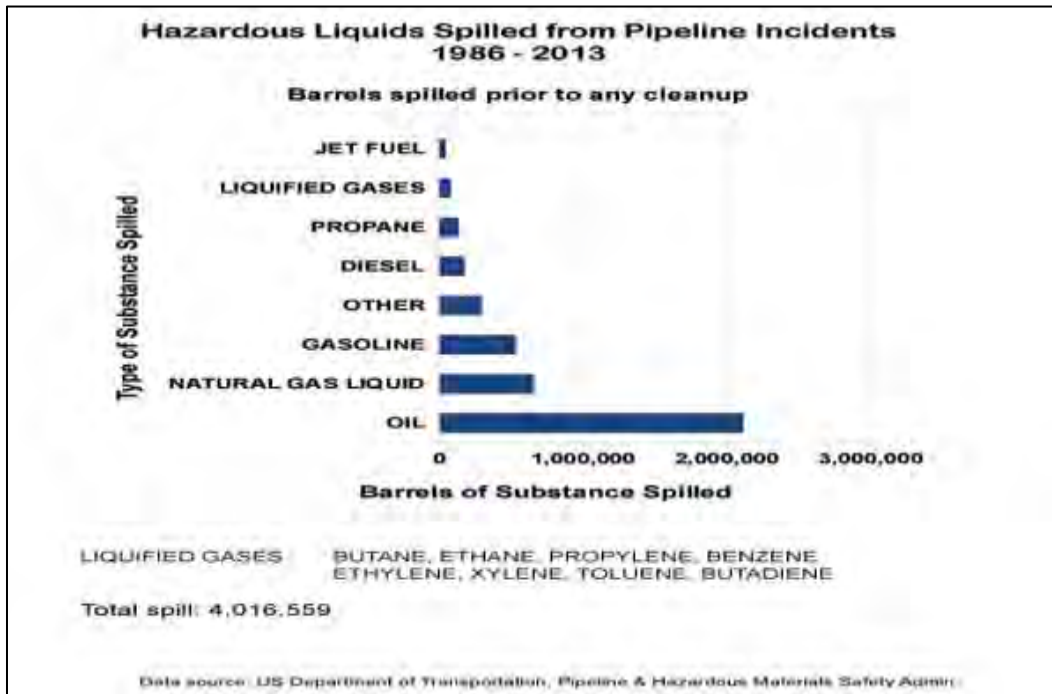
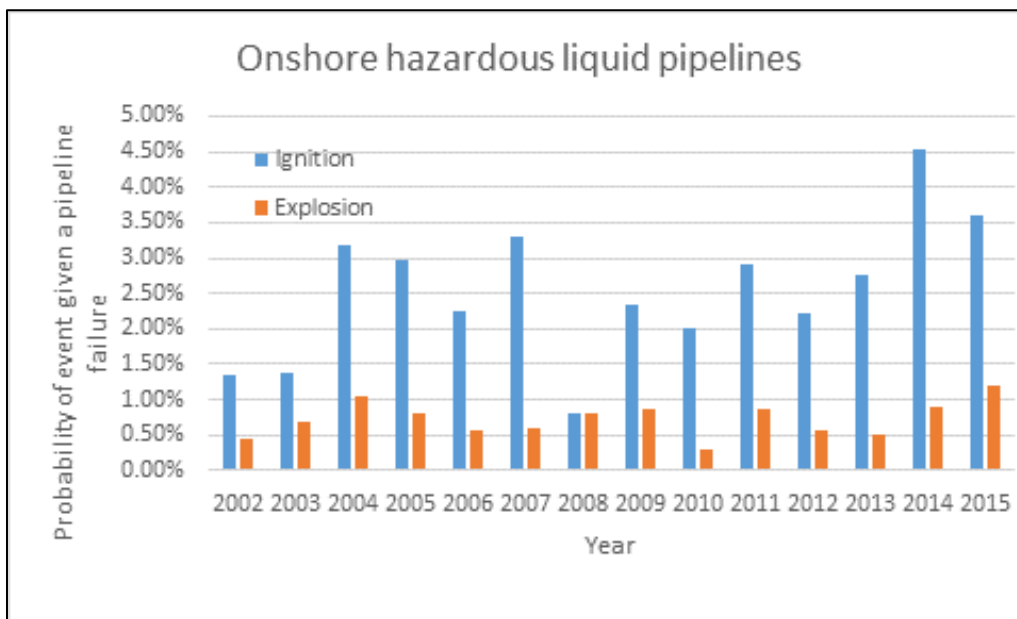
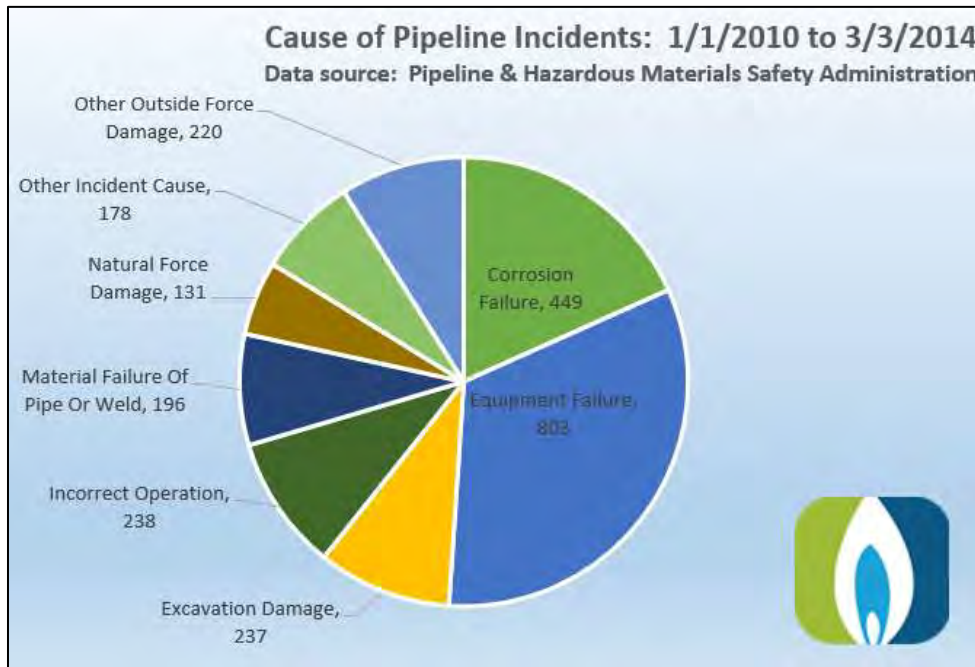


Figure 4.5: Probability of an accident due to ignition or explosion



- (17) The distribution of causes of these failures is shown in Figure 4.6<sup>21</sup>. These causes are averaged over long periods of time and large geographies, and may not represent cause-probabilities at specific projects and locations, such as SFU.

Figure 4.6: Causes of U.S. Pipeline Incidents. The most frequent cause is equipment failure, followed by corrosion. (Source: U.S. DOT-PHMSA)



- (18) **Canadian National Energy Board Data:** The National Energy Board (NEB) also keeps a record of pipeline accidents, and a dataset for Alberta<sup>22</sup> was obtained to provide Canadian context. Using SYSTAT to analyze sources, categories and types of spills, excluding gas and water incidents, result in the data shown in Tables 4.2. Larger frequencies are highlighted in yellow.

Table 4.2a: Alberta Pipeline Spills by Type of Pipeline (excluding gas and water). The top data row is the number of events and the bottom data row is the percentage of events

Values for SOURCE\$		
Crude Oil Pipeline	Multiphase Pipeline	Total
1,097	6,876	7,973
13.7%	86.2%	100.0%

Table 4.2b Alberta Pipeline Spills by Cause

Values for CAUSE\$						
Conversion	Equipment Failure	External	Operator Error	Procedural or Design	Unknown	Total
6,037	1,347	202	167	186	7	7,946
75.9%	16.9%	2.5%	2.1%	2.3%	0.1%	100.0%

Table 4.2c Alberta Pipeline Spills by Type.

Values for TYPE\$						
Accidental	Construction	Conversion	Defect	External Corrosion	Inadequate equipment	Inadequate procedure
89	140	6,037	41	261	4	32
1.1%	1.7%	75.9%	0.5%	3.2%	5.0%	0.4%

Internal corrosion	Malfunction	Mechanical/ Structural	Natural Phenomena	Non-procedural	Oversight	
771	85	189	23	34	44	
9.7%	1.1%	2.4%	0.3%	0.4%	0.5%	

Poor design	Third party Damage	Unknown	Vandalism	Total
10	168	7	11	7,946
0.1%	2.1%	0.1%	0.1%	100.0%

Table 4.2d Alberta Pipeline Spills by Failure Type 1

Values for FAILURETYPE\$				
Construction Damage	Corrosion At Girth or Fi	Corrosion External	Corrosion Internal	Damage By Others
418	25	1,405	3,150	954
5.2%	0.3%	17.6%	39.5%	11.9%

Earth Movement	Girth Weld Failure	Mechanical Pipe Damage	Miscellaneous	Miscellaneous Joint Fail	Operator Error
154	134	26	133	101	154
1.9%	1.6%	0.3%	1.6%	1.2%	1.9%

Other Weld Failure	Overpressure Failure	Pipe Failure	Valve Or Fitting Failure	Total
33	385	248	195	7,964
0.4%	4.8%	3.1%	2.4%	100.0%

Table 4.2e: Alberta Pipeline Spills by Failure Type 2

Values for FAILURE2\$			
Hit	Leak	Rupture	Total
379	6,674	920	7,973
4.7%	83.7%	11.5%	100.0%

- (19) It is clear that conversion<sup>1</sup>, equipment failure, corrosion and damage by others are the main factors that cause accidents in the NEB Alberta oil spill dataset, which are mostly leaks but with a significant number of ruptures (over 11%). Though increases in safety within the pipeline industry have been documented (for example, the declining volume of spills in U.S. data – see Figure 4.3b), the NEB Alberta dataset for all spills including gas, shows that the largest gas related spills in that province have been relatively recent. This brings into question how applicable increases in safety are in a Canadian context. Non-gas spills<sup>2</sup> (Figure 4.8), however, do not show the same trend, though the 2<sup>nd</sup> largest crude oil spill of 4,500 m<sup>3</sup>

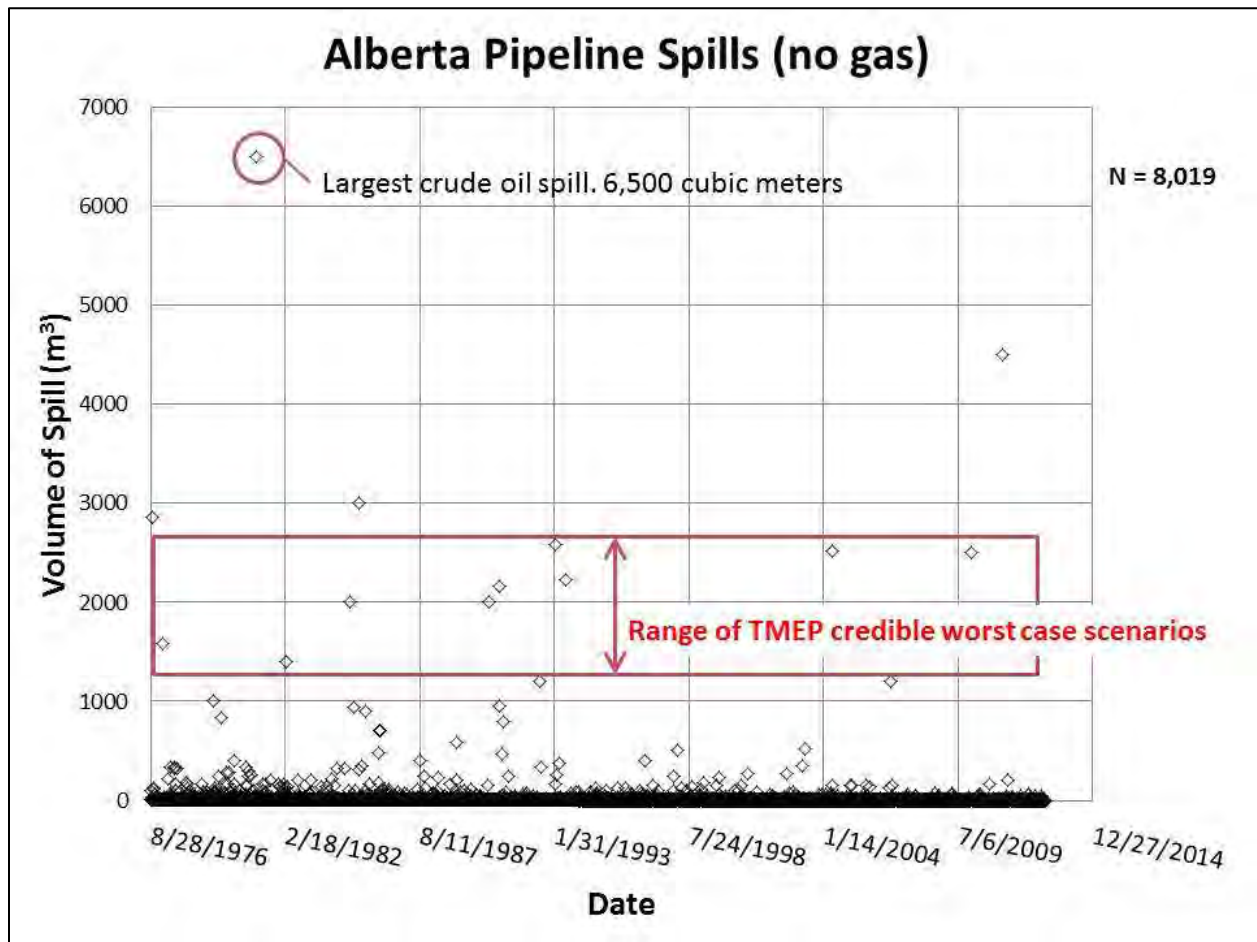
<sup>1</sup> Conversion refers to a change in service type. For example, an upstream pipeline is originally built as a production line and later converted to a water injection line. Or a gas pipeline is converted to a liquid line. Conversion usually causes a change in the corrosion mechanisms.

<sup>2</sup> Figures 4.7 to 4.9 exclude gas and water spills.



happened on April 29, 2011. Figures 4.7-4.9 (NEB non-gas, non-water pipeline spills) show the range of TMEP credible worst case scenarios as compared to historical spills. This comparison suggests that larger spills than the TMEP cases are possible, but a more detailed analysis (beyond the scope of this report) is required to comprehensively assess their selection of credible worst case scenarios.

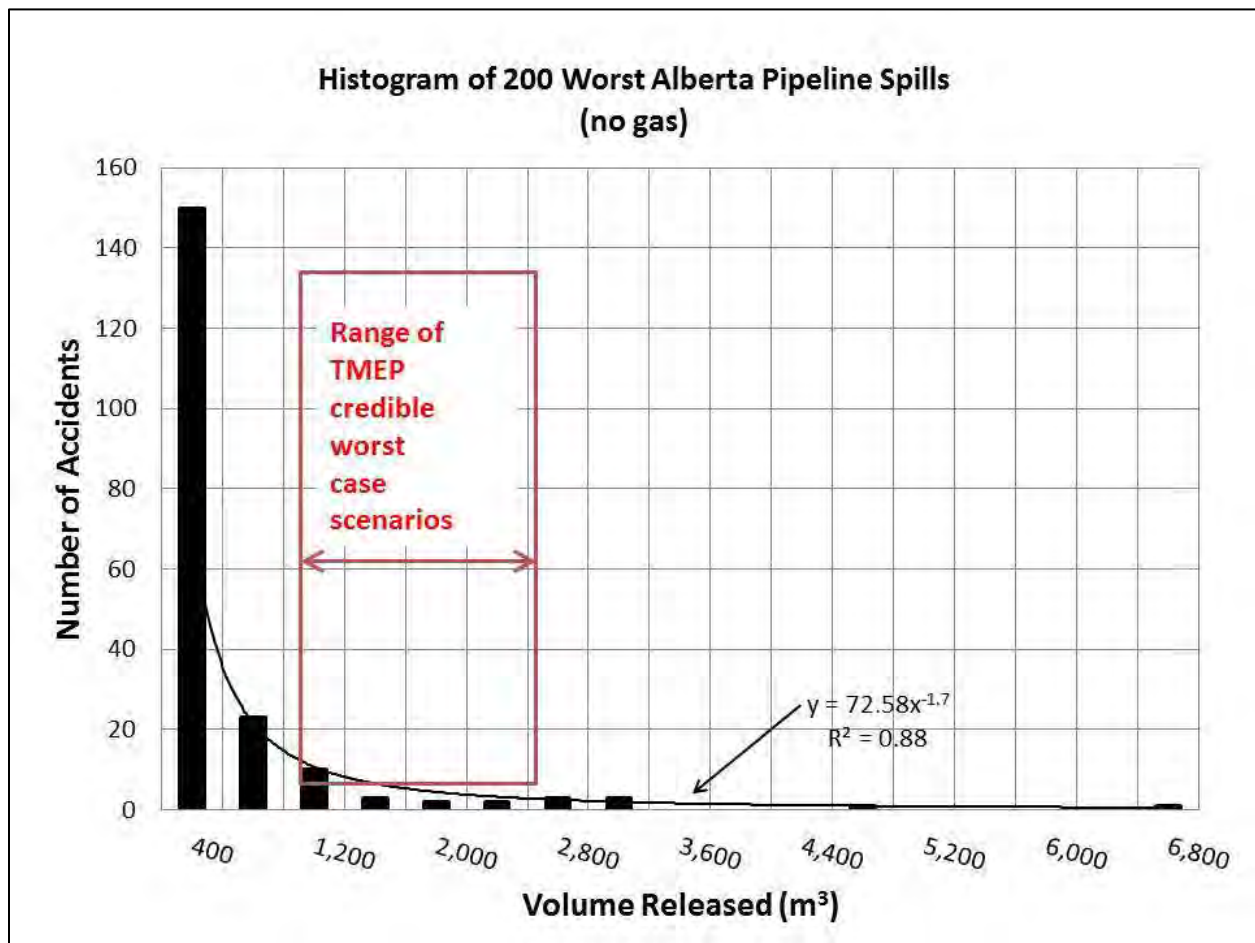
Figure 4.7: Timeline of Alberta Pipeline Spills (NEB data). The largest spill, of 6,500 m<sup>3</sup>, happened in December 6, 1980, and is 2.4 times as large as the largest credible worst case scenario used by TMEP in their risk analysis. This was a pipe failure during conversion that caused a crude oil spill due to a rupture. 781m<sup>3</sup> of the product was recovered.



- (20) **Spills and Power Laws:** Most of the spills are small, and when binned into categories of 1,500 m<sup>3</sup>, show a good fit to a power law distribution (Figure 4.8). This is important in terms of how risk analyses should be done. The nature of the hazard probability distribution plays an important role in whether or not exclusion of the largest possible events is reasonable. A normal or Gaussian distribution (the well-known 'bell curve') behaves very differently from one represented by a power law. The issue of low probability

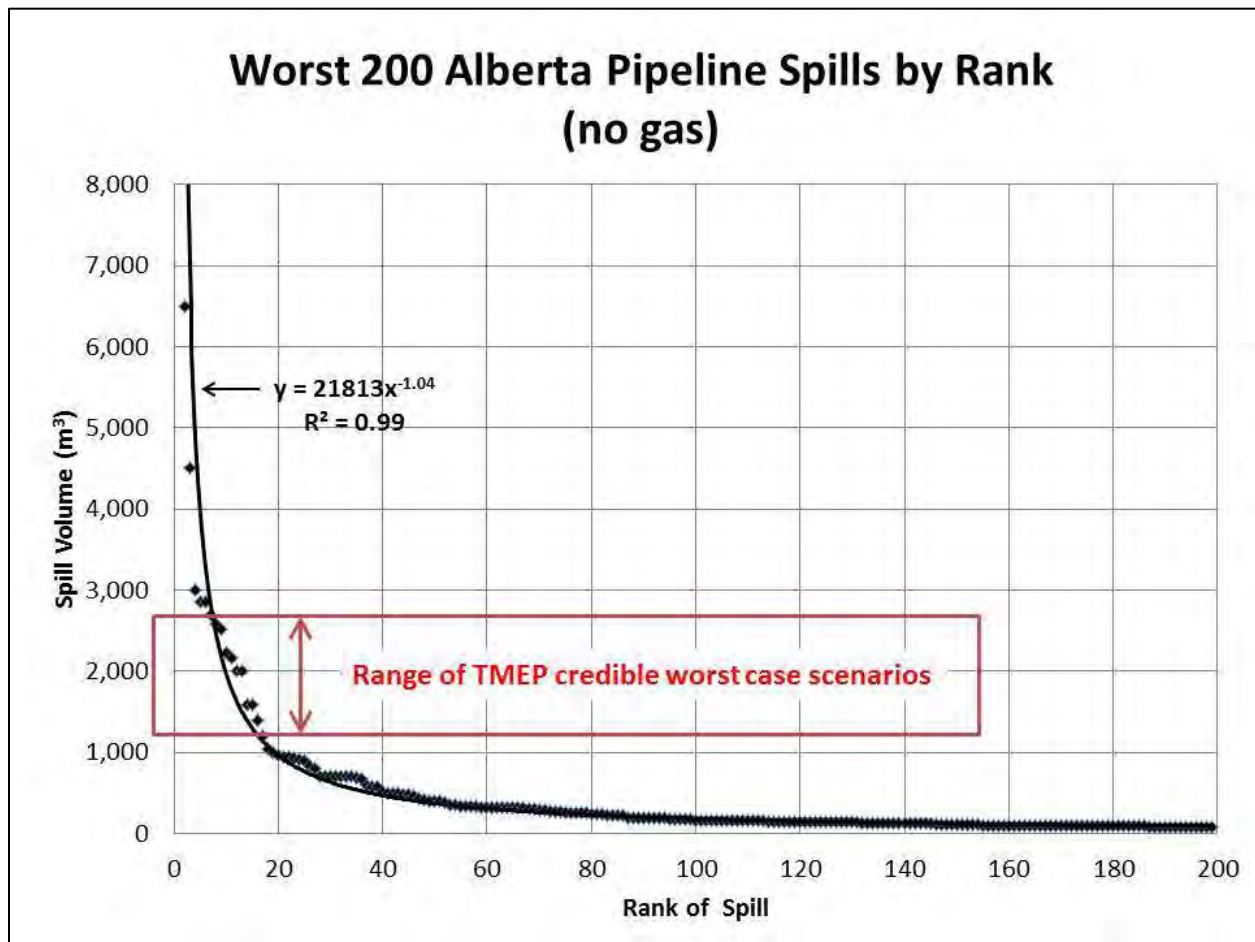
high consequence events is less important for hazards represented by normal distributions, and more important if they are represented by power laws. The reason is that rare events are a greater proportion of overall risk in the latter. *“Compared to many statistical distributions, power laws drop off more gradually, i.e. they have ‘fat tails’... This problem is intuitive. Power laws have fat tails so high casualty events are fairly common.”*<sup>23</sup>

Figure 4.8: Regression Analysis of Alberta Pipeline Spills (NEB Data) using a Power Law:  
( $y$  = number of spills and  $x$  = volume spilled in  $m^3$ )



- (21) When the data is rank ordered, with rank 1 representing the largest spill, it can be seen that the largest spills are of much greater magnitude than the more frequent events (Figure 4.9). The top 10 spills account for 21% of cumulative spill amounts (8,019 events). This is typical of disaster data sets, which are best represented by power law distributions. Because of this, risk analyses should include absolute worst case scenarios. This is significant with respect to the selection of ‘credible worst case scenarios’ made by TM in their risk analysis; if their selection of credible cases exclude absolute worst case scenarios, then their risk analysis is not including important possibilities.

Figure 4.9: Alberta Pipeline Spills (NEB data), Rank Ordered. Rank 1 = largest spill.  
Note how the top few spills account for much of the total volume.



#### 4.2.1 Credible Worst Case Scenarios

(22) Table 4.3<sup>24</sup> (Table 7.1.1 from the TM report) shows the credible worst case scenarios generated by TM. The credible worst cases use volumes no greater than 2,700  $m^3$ , which is 42% of the largest crude oil spill in the NEB Alberta database.

#### (23) RECOMMENDATION:

1. For emergency and disaster planning it is important that worst case scenarios be used for risk analyses and emergency planning. This is because disasters follow power law distributions, and rare high consequence events are an important part of total consequences. The TM scenarios, when compared to Alberta oil spills, indicate that they do not include worst case planning, and therefore they need to be closely examined to see if they are overly optimistic.

Table 4.3: Credible Worst Case Scenarios Selected by Trans Mountain

PIPELINE SPILL SCENARIO LOCATIONS			
Pipeline Location (RK)	Credible Worst Case Spill Volume (m <sup>3</sup> ) <sup>1</sup>	Smaller Spill Volume (65% of Credible Worst Case) (m <sup>3</sup> )	Notes
309.0	2,700	1,755	Athabasca River Scenario Location: approximately 10 km east of Hinton at a forest site approximately 200 m from the Athabasca River. Inland river system in Alberta: water supply, coldwater and coolwater fisheries and wildlife habitat for communities and Aboriginal groups.
766.0	1,400	910	North Thompson River Scenario Location: approximately 3 km north of Darrfeld at partially cleared lands approximately 100 m from the North Thompson River. Inland river system in BC: water supply, coldwater fisheries, and wildlife habitat for communities and Aboriginal groups.
1,072.8	1,300	845	Fraser River Near Hope Scenario Location: forested stream crossing site in west Chilliwack upstream from Trans-Canada Highway approximately 600 m from Vedder Canal, a Fraser River tributary. Coastal river system: water supply, coldwater fisheries, and wildlife habitat for communities, Aboriginal groups, recreation, and agriculture.
1,167.5	1,250	812.5	Fraser River and Delta Near Port Mann Bridge Scenario Location: approximately 500 m west of Port Mann Bridge at an industrial site on the south bank approximately 400 m from the Fraser River. Coastal river system and estuary: coldwater fisheries, shorebird habitat, and wildlife habitat for communities, Aboriginal groups, recreation, agriculture, and the commercial sector.

Notes: <sup>1</sup> Volume rounded to nearest 50 m<sup>3</sup>

#### 4.2.2 History of Kinder Morgan Pipeline Accidents

- (24) Kinder Morgan pipelines have had a number of accidents and safety violations<sup>25</sup>. These include the following:
- 24 citations by the U.S. government in 24 incidents, which led to five federal enforcement actions from 2006 to 2014<sup>25</sup>.
  - 36 "significant incidents" in Texas from 2003-2014.
  - at least 180 spills, evacuations, explosions, fires, and fatalities in 24 states since 2003.
- (25) Four spills along the TM route have occurred since 2005<sup>26</sup>:
- “Abbotsford 2005: A ruptured pipeline dumped a total of 210,000 litres of crude oil into the Abbotsford area and into Kilgard Creek.”*
  - “Burnaby 2007: A road crew ruptured a pipeline, causing 250,000 litres of crude oil to flow into Burrard Inlet Bay via the Burnaby storm sewer system.”*

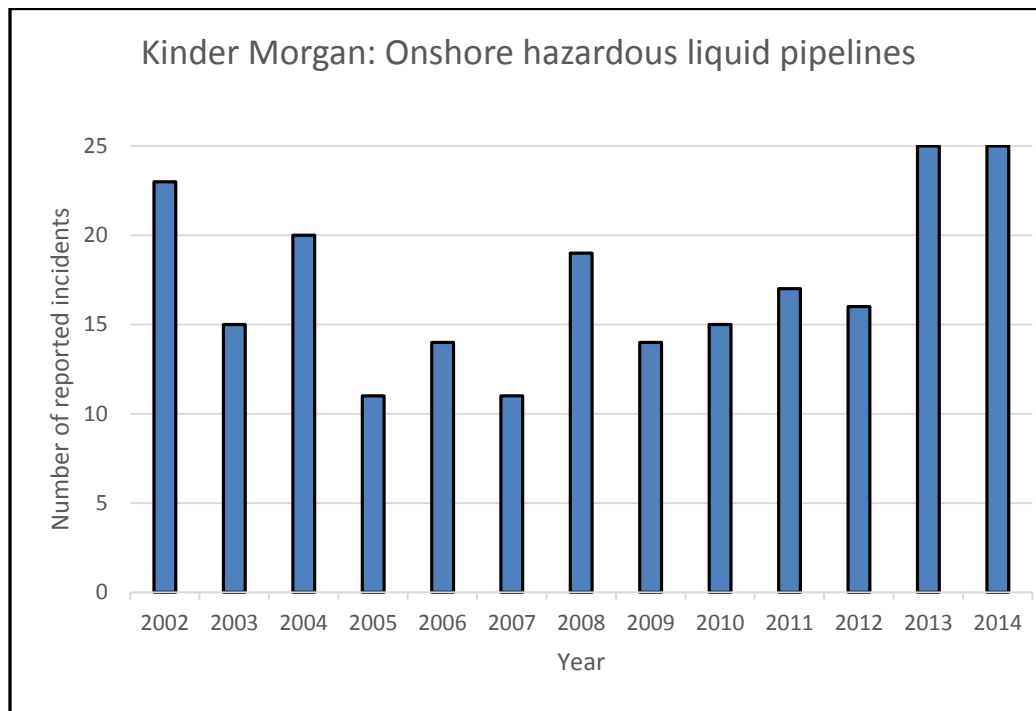
- c) *“Burnaby 2009: 200,000 litres seeped from a storage tank into a surrounding containment bay at the Burnaby Mountain tank farm.”*
- d) *“Sumas 2012: 110,000 litres of oil leaked from a Sumas Mountain holding tank, caused by freezing water placing pressure on a gasket. The National Energy Board’s investigation found that “the leak was detected later than it should have been,” the company’s management of procedures was “inadequate” and that the operator “failed to recognize the leak situation” on two occasions. It took three alarms and a shift change before someone was sent out to investigate.”*

(26) Figure 4.10 shows the number of Kinder Morgan pipeline accidents from 2002 to 2014. These incidents are of concern and suggest the need for closer examination of Kinder Morgan operating procedures and emergency planning, to assess whether or not they consistently meet best industry practices.

(27) **RECOMMENDATION:**

2. **Kinder Morgan has a history of damaging spills that brings into question their performance as it relates to their pipeline safety record. An examination of the history of Kinder Morgan incidents as they compare to industry averages should be undertaken as part of the risk analysis, in order to put the aggregated failure data into context, and within which to evaluate their emergency management protocols.**

Figure 4.10: Number of Kinder Morgan Pipeline Accidents



## 5 Risks Related to Tank Farm

- (28) A risk assessment of the Burnaby Terminal was done by Doug McCutcheon and Associates, Consulting<sup>27</sup>. The proposed expansion of 12 tanks to 26 tanks is, according to this report “*within the acceptable criteria as recommended by the MIACC “Risk Based Land Use Planning” guideline*”.
- (29) They analyze three risk scenarios:

- 1) Scenario 1: Tank Fire Caused by a Major Oil Tank release (heavy smoke)
  - i. Maximum distance of radiant heat impact from a pool fire = 733m (Table 9 of TM/McCutcheon and Associates report)
  - ii. Maximum distance of radiant heat impact from a tank top pool fire = 216 m (Table 9 of TM/McCutcheon and Associates report)

- 2) Scenario 2: Toxic Cloud Release from a Fire

Main concerns: (a) Creation of a black cloud of soot, and (b) Combustion of products with Sulphur content. Tables 5.1a&b below (Tables 12 and 13 from the TM/McCutcheon and Associates report) shows distances for worst case scenarios at various levels of

impact. **These distances critically engage SFU and require proper emergency planning. There is no evidence that TM has developed emergency plans relevant to SFU that address such scenarios. It is necessary that TM collaboratively engage SFU in this regard.**

Table 5.1a: Hazard Distances (SO<sub>2</sub>) for a Fully Involved Dyke Oil Fire

Toxic Exposure Level	Value (mg/m <sup>3</sup> )	100% Combustion Efficiency	70% Combustion Efficiency
ERPG-1 (Odour level)	1	17.7 km	14.8 km
ERPG-2 (Emergency planning level)	8	6.3 km	5.2 km
ERPG-3 (Impacting people's health)	39	2.8 km	2.4 km
IDLH (Immediately Dangerous to Life and Health level)	250	1.1 km	0.9 km

Table 5.1b: Hazard Distances (SO<sub>2</sub>) for a Fully Involved Tank Top Oil Fire

Toxic Exposure Level	Value (mg/m <sup>3</sup> )	100% Combustion Efficiency	70% Combustion Efficiency
ERPG-1 (Odour level)	1	7.4km	6.2 km
ERPG-2 (Emergency planning level)	8	2.6 km	2.2 km
ERPG-3 (Impacting people's health)	39	1.2 km	1.0 km
IDLH (Immediately Dangerous to Life and Health level)	250	0.5 km	0.4 km

- (30) In the TM/McCutcheon and Associates report discussion they note: *“Toxic concerns were identified for smoke (soot) and for SO<sub>2</sub> downwind of the site. These are both issues that should be included in the site emergency plan. From a risk exposure point of view the impacts are very hard to define due to weather conditions and just the turbulence created by the heat from a fire. The likely result will be significant mixing of any SO<sub>2</sub> in the air to reduce the impact at ground level. However it cannot be ignored that the emergency plan needs to extend outwards to 5.2km for SO<sub>2</sub> concerns assuming 70% combustion efficiency.”*
- 3) Scenario 3: Boil-Over: This is a rare high consequence event that applies to storage tanks of oil product mixed with water<sup>28</sup>. When it occurs, it can eject hot burning oil as high as 1,000 m above the tank. The report suggests that the proposed tanks are designed to prevent such a disaster. However, TM/McCutcheon and Associates recommend that *“similar incidents have caused major damage for several kilometers outward, and therefore emergency planning must include a response for this event.”*
- (31) In the report’s conclusions, TM/McCutcheon and Associates say *“The risks that are of concern are the pool fire inside the dyked area, the potential for a boil over incident and the smoke generated by a major fire. The greatest risk is a pool fire. The calculation assumes the fire will be vertical **with no wind present**”* (bold added). **The presence of a wind will greatly change the nature of the hazard, decreasing it upwind and magnifying it enormously downwind.** There is no evidence that TM has sufficiently considered local meteorological conditions in the vicinity of SFU, and this gap needs to be addressed.
- (32) The Burnaby Fire Department also analyzed how changes in the Burnaby Tank Farm might alter the risk environment, and note the following: *“the Burnaby Mountain Terminal is not the appropriate location for the expansion of the Burnaby Mountain Terminal as it poses significant constraints from an emergency/fire response perspective, including but not limited to safety of firefighters and effectiveness to combat fire; containment and extinguishment of fire/spill/release; evacuation of employees within the Burnaby Mountain Terminal facility; evacuation of adjacent neighbourhoods, as well as broader areas impacted by release of sulfur based gases and toxic smoke plumes; and, protection of adjacent properties, including conservation lands... TMEP lacks appropriate consideration for original facility fire protection premises and industry best practices in petroleum storage and fire protection, as the proposal only seeks to comply with minimum federal and provincial code requirements.”*
- (33) The report goes on to discuss how changes in tank spacing decrease the ability of the Fire Department to respond and increase the chances of escalation of a single tank fire to multiple tanks. Additionally, the position of the proposed tanks is closer to roads and fences, creating increased hazard.



(34) **RECOMMENDATIONS:**

3. **An accident at the Burnaby Tank Farm or TM pipeline could create hazards that would envelop part of all of the SFU campus on Burnaby Mountain, and make evacuation difficult or impossible. Therefore, emergency planning at SFU needs to include the scenario of an ERPG-2 event, at a minimum. Specifically, the TM/McCutcheon and Associates report suggest “Having an emergency plan in place with the ability for foam addition, and good road access from at least 2 directions is imperative.”**
4. **Though rare, boil over events are extremely dangerous. The TM/McCutcheon and Associates report and the report by the Burnaby Fire Department confirm that such events can discharge heated, molten crude oil to a height of 1 km and a range of .76 km. These distances would affect the SFU campus and should be explicitly accounted for in the emergency plans of both SFU and TM.**
5. **Wind direction within the boundary layer will largely determine hazard zones, given an incident that releases a plume or toxic chemicals. Though winds with a southerly or southwesterly component are rare at Vancouver airport, the Burnaby Mountain weather stations shows that they are much more frequent at that location. The scenarios analyzed in the TM/McCutcheon and Associates report are based upon a no-wind situation, but winds blowing towards SFU increase risk enormously. The scenarios should be reanalyzed using scenarios of boundary layer winds that blow towards SFU. Hazard planning distances should likewise take this into account.**

**5.1 Hazard Zones**

- (35) One way that risk is often presented is through the use of hazard zone maps. These zones are required by communities to understand their exposure to hazard and engage in effective emergency planning. Typically a pipeline hazard map will estimate distances of several levels of impacts (usually three) as a function of various spill sizes. In the case of toxic plumes the location of hazard zones will depend upon wind direction / magnitude, surface roughness and atmospheric stability.

In a summary on the use of hazard zones for pipelines Muhlbauer<sup>29</sup> notes that:

*“Hazard zones based on threshold intensities such as heat, overpressure, and toxicity/contamination are a function of three general sets of release conditions:*

- *Pipeline / product characteristics*
- *Dispersion potential*
  - *Topography effects if liquid release*
  - *Meteorology effects if gaseous release”*

*“Product characteristics are grouped with pipeline characteristics since the operating conditions—pressure, temperature, flowrate—will influence how the product behaves when released.”*

*“Three aspects of hazard zones should be considered in building a simplifying model: distance from event; the threshold of interest; and probability of the threshold appearing at a certain distance. The*

*objective is to model a manageable number of scenarios and, most importantly, have the chosen scenarios represent the full range of possibilities.”*

*“A conservative hazard zone distance adopted for an HVL pipeline release, for example, should be based upon a compilation of calculation results generally corresponding to the distance at which a full pipeline rupture, at maximum operating pressure, with subsequent ignition, could expose receptors to significant thermal damages, plus the additional distance at which blast (overpressure) injuries could occur in the event of a subsequent vapor cloud explosion. Sources of conservatism in this fixed hazard zone distance for HVL pipelines might include:*

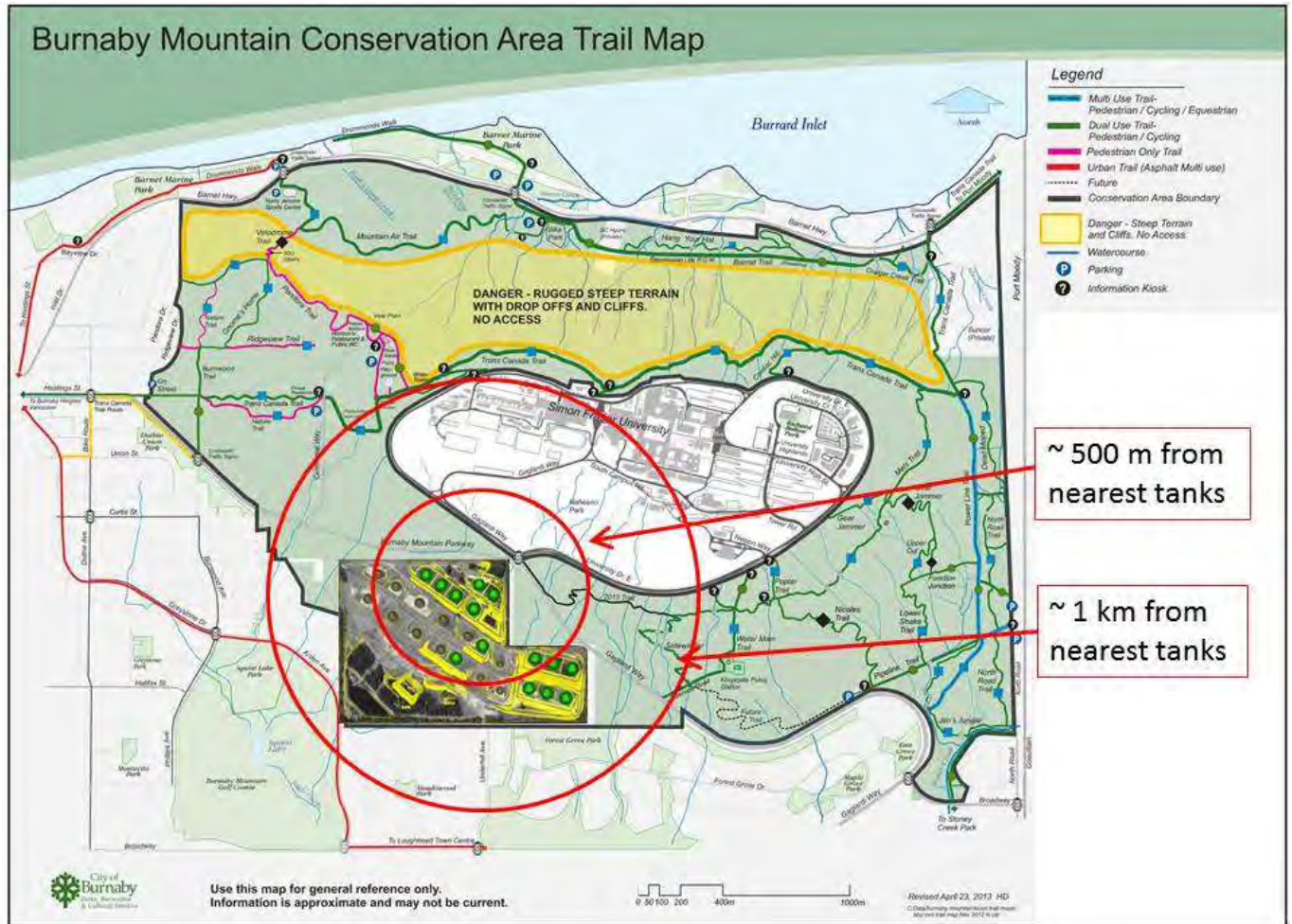
- *Overestimation of probable pipe hole size,*
- *Overestimation of probable pipeline pressure at release,*
- *Stable atmospheric weather conditions at time of release,*
- *Ground level release event,*
- *Maximum cloud size occurs prior to ignition,*
- *Extremely rare unconfined vapor cloud explosion scenario with overpressure threshold set at low level (corresponding to only minimal damages),*
- *Overpressure effects distance added to ignition distance (assume explosion epicenter is at farthest point from release), and/or*
- *Final distance used is longer than distance that models predict.”*

- (36) The TM risk analysis does not include hazard zones around the pipelines or tank farms adjacent to SFU. Figure 5.2 shows a map of the Burnaby Tank Farm relative to SFU. The proposed new tank locations are such that several of the scenarios described by TM/McCutcheon and Associates put SFU into highly dangerous hazard zones. The two red circles on the map are at approximate distances of 500m and 1 km from the nearest proposed tanks. Given that the most dangerous scenarios (IDLH) include distances of 1.1 km for no wind situations, it is clear that SFU is at very high risk from a catastrophic failure at the Burnaby tank farm. **Of particular concern is the proximity of the tanks to roads required for an SFU evacuation.**
- (37) FEMA has a simple modelling program, ALOHA, that estimates threat zones (Figure 5.3) from hazardous releases such as toxic gas clouds, fires and explosions<sup>30</sup>. *“ALOHA allows you to enter details about a real or potential chemical release, and then it will generate threat zone estimates for various types of hazards. ALOHA can model toxic gas clouds, flammable gas clouds, BLEVEs (Boiling Liquid Expanding Vapor Explosions), jet fires, pool fires, and vapor cloud explosions. The threat zone estimates are shown on a grid in ALOHA, and they can also be plotted on maps in MARPLOT, Esri's ArcMap, Google Earth, and Google Maps. The red threat zone represents the worst hazard level, and the orange and yellow threat zones represent areas of decreasing hazard.”* This program is available for download at no cost from the Environmental Protection Agency (EPA) website<sup>31</sup>.
- (38) Modelling plumes can be complex and depend upon a number of factors, and ALOHA may not be suitable for SFU because of the complexity of the topography and local climatology. Plumes can take a

variety of configurations; for example Figure 5.4<sup>32</sup> shows some of the different patterns that can occur, depending upon atmospheric conditions. Wind speed, surface roughness and atmospheric stability are particularly important in determining hazard zones.

- (39) This topic will be further discussed within the context of the Emergency Management Regulation and related standards and best practices in section 9 of this report, 'Risk Assessment'.

Figure 5.2: 500 m and 1 km hazard zones around proposed tanks closest to SFU



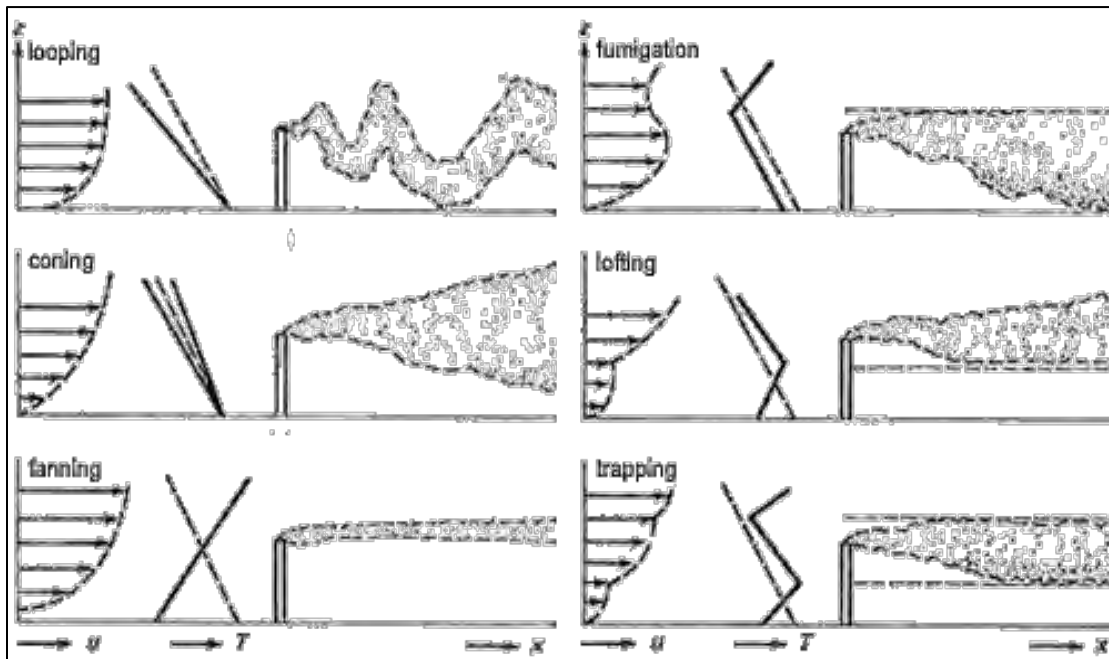
(40) **RECOMMENDATION:**

6. It is standard practise to create hazard maps as part of risks analyses. These provide nearby communities and stakeholders with a tool to evaluate their risk. Such hazard maps do not currently exist for the TM project. Because of the proximity of SFU to both pipelines and tank farms, the generation of hazard maps, including worst case scenarios for SFU, is a priority. A model of suitable complexity should be used, in order to address the topographic and climatic heterogeneities over the region around SFU.

Figure 5.3: Example of ALOHA Output with Three Hazard Zones. Note how a southwest wind creates several elliptical hazard zones downwind from the spill site<sup>33</sup>.



Figure 5.4: Idealized Plume Shapes for Six Typical Wind Velocity / Vertical Temperature Profiles<sup>34</sup>.



**5.2 Climatic and topographic context.**

(41) **Main Climate Controls:** The climate of the west coast lies within the westerlies, which means that it experiences a maritime climate – moist with temperatures moderated by the Pacific Ocean. The Koppen-Geiger classification is Cfb (mid-latitude, marine west coast – mild with no dry season and a warm summer). In winter the dominant atmospheric circulation feature is the Aleutian Low (Figures 5.5), which spawns storms that move eastward into British Columbia. In the summer the Aleutian Low moves northward and the dominant feature is an area of high pressure in the north Pacific, which results in fewer storms in the Vancouver area.

Figure 5.5a: Typical location of pressure systems in the North Pacific Ocean in January and July. “AL” refers to the low-pressure “Aleutian Low” and “NPH” refers to the high-pressure “North Pacific High” system<sup>35</sup>.

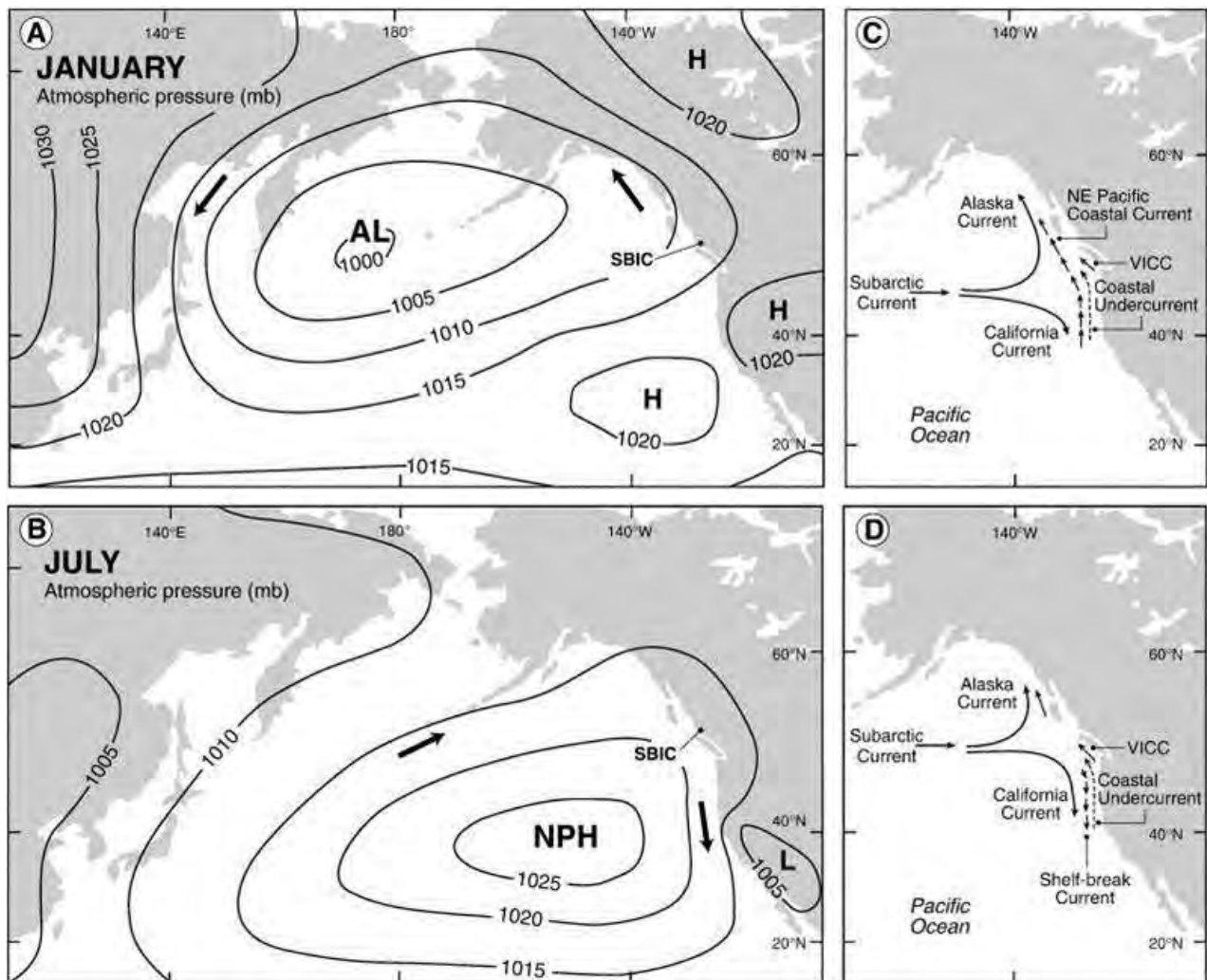
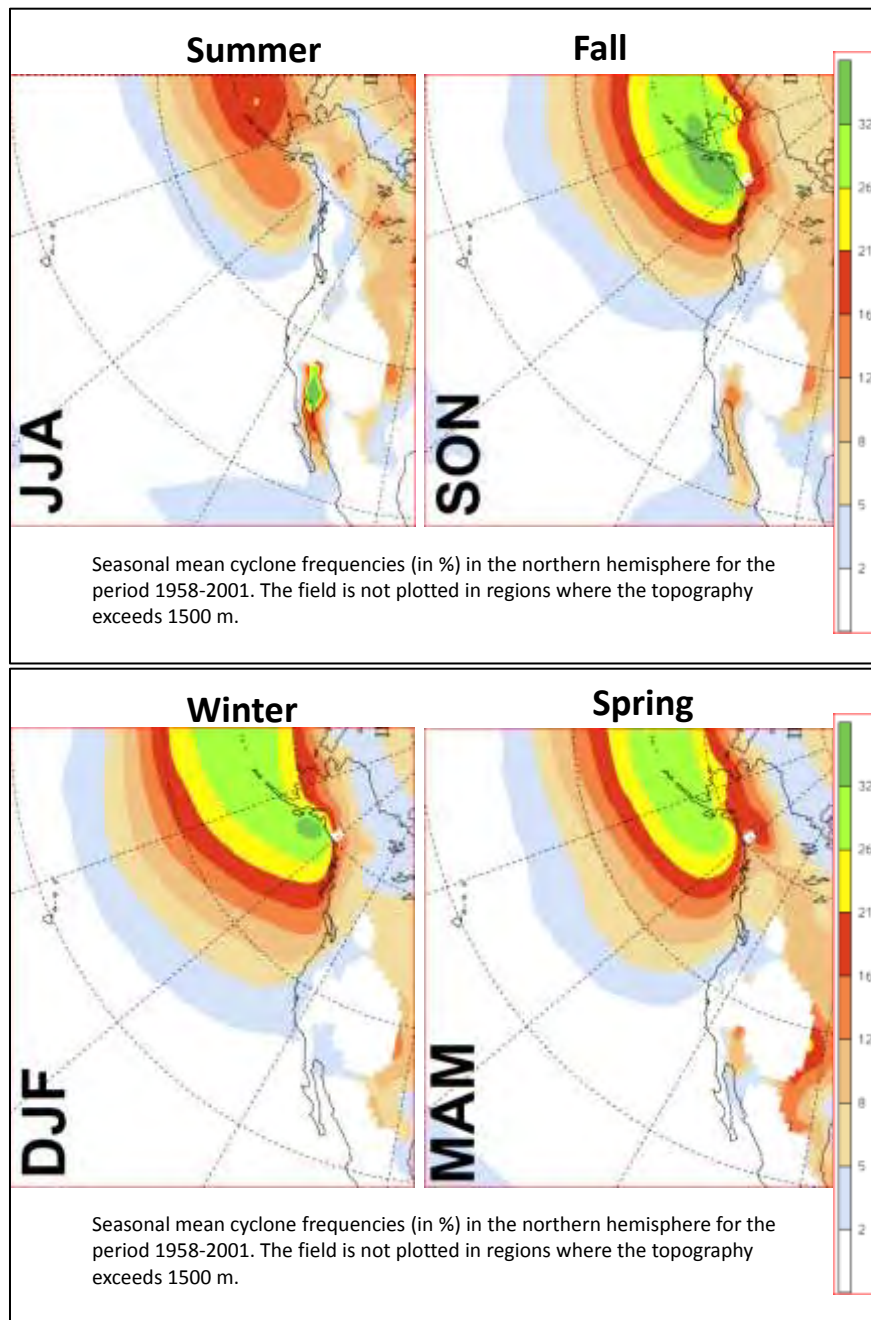


Figure 5.5b: Cyclone frequencies in the North Pacific. Note the high level of storminess in winter, spring and fall, and the lower level in summer<sup>36</sup>.



- (42) **Local Effects:** Simon Fraser University is located within a complex topography (Figure 5.6) that affects local weather conditions. Located on top of a hill at an elevation of 360 m, with Burrard Inlet and mountains to the north and the Pacific Ocean about 25 km to the west, and surrounded by urban areas, it is subject to complex interaction of micro and mesoscale climatological forces, including sea and land

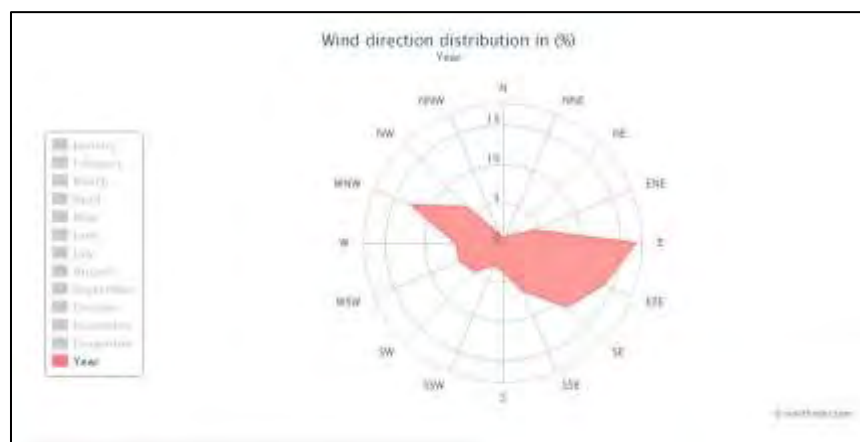
breezes, an urban heat island, large variations in surface roughness, and topographic funneling effects. Because of risks related to plumes, of particular concern is the wind field within the boundary layer. Winds at the university might be quite different than in the surrounding area, particularly at the Vancouver weather station at the airport. For example, wind speeds at the top of hills are stronger than below, and can become very turbulent to the lee of the hill.

Figure 5.6: Simon Fraser University, at the top of Burnaby Mountain. The Burnaby Tank Farm is visible to the right (south) of the university, as well as the only two access roads.



- (43) The nearest high quality Environment Canada weather station with a long term wind data record is Vancouver Airport. Winds vary by season, but are dominated by ESE and WNW directions (Figure 5.7).

Figure 5.7: Vancouver Airport Annual Wind Rose



- (44) The TM analysis used the weather station at Vancouver Airport, and there is no evidence to suggest that they have incorporated the data available from the Burnaby Mountain weather station. It is uncertain how representative Vancouver Airport wind data is, at an elevation of 5 m near the coast, to Burnaby

Mountain. Figure 5.7 shows an annual dominance of southeasterly and west-northwesterly winds, whereas three years of data from the university weather station at Burnaby Mountain shows a much higher frequency of winds with a southerly<sup>3</sup> component. Winds from a southerly direction pose a much greater threat to SFU from the TMEP since they would carry a plume from an accident at the Burnaby Tank Farm or TM pipeline towards SFU. A detailed calculation of the boundary layer wind field in the vicinity of SFU is fundamental to having a good understanding of risks from accidents at nearby tank farms and pipelines.

Table 5.2: Frequency of Wind Directions at Burnaby Mountain Weather Station, 2012-2014. Note the relatively high percentage of winds with a southerly component, as compared to winds at Vancouver Airport<sup>37</sup>.

Direction		Frequency
315° - 45°	northerly	24%
45° - 135°	easterly	32%
135° - 225°	southerly	27%
225° - 315°	westerly	17%

(45) **RECOMMENDATION:**

7. **There is no evidence that TM has incorporated local meteorological data from SFU in their analyses. With respect to risks to SFU from toxic plumes, sophisticated meteorological modeling of the boundary layer wind field that includes data from the Burnaby Mountain weather station is required. This is addressed further in Section 11 on air dispersion modelling.**

## 6 Application Compliance

- (46) The National Energy Board (NEB) regulates pipelines in Canada, including the construction and operation of inter-provincial and international pipelines. As an inter-provincial pipeline, Trans Mountain is principally regulated by the NEB. However, the B.C Oil & Gas Commission (OGC) is also responsible for pipeline safety, mainly in the form of consideration of applications for land access or permits. This has resulted in some shared regulatory responsibility between the B.C. OGC and the NEB. According to the OGC, its more specific objectives are "public safety and environmental soundness in the design, construction, testing, operation, maintenance, and spill response planning for natural gas and hazardous liquid pipeline facilities within B.C."<sup>38</sup>

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<sup>3</sup>This refers to winds coming from the south, and moving in a northerly direction



- (47) The Trans Mountain Expansion project application is therefore under the primary authority of the National Energy Board Onshore Pipeline Regulations (SOR/99-294), which includes a sub-section on emergency management (SOR/2013-49, s. 12), has the mandated responsibility to "...develop, implement and maintain an emergency management program that anticipates, prevents, manages and mitigates conditions during an emergency that could adversely affect property, the environment or the safety of workers or the public". Additionally, as part of ss. 4.1 (e) of the Onshore Pipeline regulations, 'all pipelines' must adhere to the provisions of CSA Z246.1, aimed primarily at preventing and minimizing the impact of security incidents rather than the broader goals of emergency management.
- (48) Unfortunately, this legislation does not provide a detailed breakdown of the requirements for an emergency management program. However, as the project exists within the joint jurisdiction of the NEB and the B.C. OGC, the more detailed requirements provided by the B.C. OG, are considered an adequate best practice and regulatory model for compliance of the Trans Mountain expansion project. Therefore some of the recommendations within this report refer specifically to the B.C. OGC Emergency Management Regulation.
- (49) Oil and Gas activities, including *"exploration, development, pipeline transportation and reclamation"*<sup>39</sup> are regulated by the B.C. Oil and Gas commission. This body provides clear regulations with which oil and gas industry projects primarily regulated by B.C. OGC must comply. The regulations include a comprehensive set of standards for emergency management plans and programs, which can be considered a benchmark for Oil and Gas projects in B.C. Such requirements provide a base-line for compliance, which is additionally supplemented and supported by industry best-practice. The Canadian Standards Association (CSA) Z1600 (Emergency and Continuity Management Program), developed through consultation with stakeholder groups such as the NEB as well as the Canadian General Standards Board (CGSB) and First Responder agencies across Canada, is strongly supported by the NEB and has been identified as an integral part of their mandate to support excellence in emergency management<sup>40</sup>.
- (50) As part of the TM facilities application to the NEB for authorization to expand the capacity of its pipeline, Kinder Morgan must submit an Environmental and Socio-economic Assessment (ESA) which *"must identify and assess the effects on workers, the public, and biophysical and socio-economic elements of all potential accidents and malfunctions"*<sup>41</sup>. Submissions of this kind must include all-hazard risk assessments for the project, including site-specific plans, as well evidence of a comprehensive emergency management program. The TM project facilities application, and therefore this analysis, includes a number of key documents intended for this purpose, including but not limited to the following key documents:
- Emergency Response Program Summary
  - Facilities application Volume 7: Risk Assessment & Management of Pipeline & Facility Spills
  - Facilities application Volume 6B: Pipeline Environmental Protection Plan
  - B279-3 - Attachment 2.1 Kinder Morgan Canada Inc. Incident Command System ICS Guide July 2013 - A4D3F0

- B279-4 - Attachment 2.2 Westridge Marine Terminal Emergency Response Plan ERP Publish Date July 2014 - A4D3F1
  - B279-5 - Attachment 2.3 Trans Mountain Pipeline ERP Publish Date July 2014 - A4D3F2
  - B279-6 - Attachment 2.4 Terminals and Tank Farms ERP Publish Date July 2014 - A4D3F3
  - B33-29\_-\_Trans\_Mountain\_Response\_to\_NEB\_IR\_No.\_1.98a-Attachment3\_-\_A3W9S5 (McCutcheon Report)
- (51) Prior to construction of any oil and gas project in B.C., and as part of the ESA, it is incumbent on the applicant to fulfil all requirements for Emergency Response Plans (ERP), which must meet full compliance with the aforementioned regulatory bodies and acts<sup>42</sup>.
- (52) This report will therefore assess each required element, including emergency plans, emergency programs, and risk assessments provided in the listed documentation. Given the absence of specific criteria set out in the NEB Onshore Pipeline regulations, these will instead be compared to the requirements set out in the B.C. OGC Emergency Management Regulation, as well as industry best practices, in order to assess their adequacy, especially in the context of impact to Simon Fraser University. In order to fully understand these distinct features, the following sections will also focus on defining the purpose and expectations defined in the EMR and CSA Z1600 for each element.

## **7 Emergency Management Overview**

- (53) Emergency management practitioners use a number of different frameworks to help organise the myriad of themes, responsibilities and tasks within the field. Among the more widely accepted is the four-pillar, or 'emergency management continuum'<sup>43</sup> approach which highlights four distinct elements: mitigation, preparedness, response and recovery. As shown in Figure 7.1, this approach includes the creation of plans and risk assessments as parts of a holistic emergency management system.
- (54) It is particularly important to understand emergency management within these categories given their central role in the production of standards, regulations and acts relating to public safety, including the oil and gas industry. The aforementioned standards and regulations relating to the development of oil and gas activities in B.C. use this cyclical framework as a basis for the development of emergency management practices, standards, plans and programs.

Figure 7.1: The Emergency Management Cycle<sup>44</sup>.

- (55) The EMR is one such regulation, its requirements being built on an understanding that applicants must seek to address all elements before a project can be approved. This is in tandem with other requirements of the ESA, which overlap when considering the human health, financial or other impacts of a disaster or emergency event.
- (56) The following sections aim to highlight specific requirements for a comprehensive emergency management system with reference to standards and industry best practices, but primarily defined by the EMR, as this is the enforcement mechanism in place for oil and gas projects. By comparing the contents of the materials provided by the NEB application to these standards and regulations, an assessment of its quality and adherence to the EMR are provided in each section, as well as specific recommendations for improvement and compliance.

## 8 Emergency Management Program

- (57) Within the context of best practices in the field of emergency management, an emergency management program provides a system or high-level framework within which all aspects of mitigation, preparedness, response and recovery reside. For all intents and purposes, the emergency management program is the umbrella which encompasses all aspects of organisational development, management and administration as they relate to emergency management functions.
- (58) The EMR provides the following requirements for an Emergency Response Plan (ERP):

A program which includes the creation and definition of the top level policies and procedures that guide the creation, management and implementation of an ERP should include:

- Framework for the development and implementation and coordination of activities such as research, training and education;
  - Training and exercises (roles, actions, scheduling etc.);
  - Evaluation of an emergency response (how to evaluate, criteria etc.);
  - Program Coordinator (role definition, responsibility etc.);
  - Review and update (provision for the continued update of program and plans);
  - Maintenance of Records.<sup>45</sup>
- (59) The CSA Z1600 provides a similar description, also identifying the four emergency management ‘pillars’ as core to program management. The following sections will seek to further define the requirements laid out by the EMR for elements of comprehensive emergency management systems including programs, plans and risk assessments. This will help guide the assessment of implications for SFU.

### 8.1 Emergency Management Regulation (EMR) Requirements: Programs

- (60) The expectations for programs are clearly laid out in the EMR, and reflect industry best practice.

Table 8.1: Emergency Management Regulation, summary, Part 3 ss.4. (1-8)

Section	Summary/description
1	Prepare and maintain an emergency response program and a response contingency plan
2a	Program must coordinate permit holders plans
2b	Conduct training and emergency response exercise programs for emergency response staff
2c	Evaluate the response to an emergency
3	A program coordinator must implement the program
4	The name and contact information of the program coordinator must be provided
5	Information (4) must be updated as soon as possible
6a	Review and update of the program must take place at least once every 3 years
6b	... or when significant change occurs in the types of hazards and risks arising from oil and gas activities
6c	...or after evaluating the response to a level 3 incident
7	Written records must be maintained
8	...in accordance with section 38 (1)(a)

- (61) This list of requirements is distinct from that of plans, as well as risk assessments and hazard identification, which are referred to in the EMR and the B.C. Oil and Gas Emergency Management Manual as part of section 7(3). The latter document also specifically refers to all-hazard planning within a comprehensive emergency management framework. This again recognises the four-pillar approach as well as the identification of hazards, with the aim of reducing the “*vulnerability of people, property, the environment and the economy*”<sup>46</sup>.
- (62) This framework provides guidance on a number of additional elements of business continuity and emergency management planning for the oil and gas industry. Among these elements, the EMR very clearly outlines the expectations for Emergency and Incident Response. This not only requires that a clear communication, notification and management process exist, but also that a permit holder implement adequate exercises training, and evaluation procedures.

## 8.2 Program Vs Plan

- (63) The TM emergency management plan and program are not adequately separated. These should be separate elements and are subject to different regulations – including audits every 3 years for an EM program (section 4 EMR) but every year for a plan (section 10 EMR). These review times are not specifically identified.

## 8.3 Plan Coordination

- (64) The OGAA specifically outlines the need for coordination of emergency plans and for specific mention of this process to be included in the emergency management program. However, the documentation provided does not provide specific details regarding the plan coordinator, nor the provisions for plan maintenance other than to say that updates will occur annually. While specific mention is made to 'plan maintenance' and while the responsibility for annual audits is identified, a program review and update process is not discussed. For example, section 4.8, Volume 7 of the facilities application document states "*the Emergency Management Program will be comprehensively reviewed and modified to address the needs of TMEP*" but at no point is this elaborated on, nor who this responsibility will fall to. In addition, the terms 'plan' and 'program' are used interchangeably throughout the document. While a specific position is identified for the maintenance and update of exercise plans (the operations training coordinator located at the Sherwood Park office), no similar designation seems to exist for the emergency program.
- (65) The coordination of the permit holders plans is a foundational and critical element of the EMR requirements and a comprehensive emergency management strategy, and the absence of specific details regarding this is a significant gap in the TMPL emergency management program provisions.

## 8.4 Exercises

- (66) No specific plan appears to exist for conducting training and emergency response exercise programs for emergency response staff. While the roles and responsibilities for response staff are highlighted through the Incident Command System (ICS) plan, the coordination, review and evaluation of exercises should be highlighted. As mentioned above, while the operations training coordinator is mentioned in relation to the implementation of specific training programs, including ICS level 100, there is no clear outline of how or what type of exercises will test the emergency response plans.

(67) **RECOMMENDATIONS:**

8. **Provide an account of the TM emergency management program as defined in ss. 4 of the EMR. This should include measures and personnel identified for coordination of all ERP, an outline of specific exercise development and management provisions, identification of a program coordinator, and provisions for the evaluation of response to an emergency in accordance with section 14 of the EMR**

9. **Define responsibility and mechanisms for the comprehensive review and modification of the emergency management program, and for each plan, respectively.**
10. **Ensure that provisions for ‘plans’ and ‘programs’ are addressed separately.**

## 9 Emergency Management Plans

- (68) The regulations and guidelines in B.C. for the preparation of plans are comprehensive. They include a number of different sub-areas for consideration including hazard planning distances, which are a foundational element to all other planning related to emergency management for the Oil and Gas industry. Some of these sections of the EMR are highlighted below:

Table 9.1: Emergency Management Regulation, summary of sections relating to Emergency Management Plans

Section	Summary description
5	Hazard planning distance is defined as horizontal, measured from the site of an oil and gas activity. It must be determined for fluids by considering the types of hazards and risks arising from the activity.
7(2)	Plans must be prepared for each of their oil and gas activities, including consideration of site-specific hazards and within emergency planning zones (defined in section 1)
10(1)	Plans must be updated at least once a year, after an evaluation of the response to an emergency is completed under section 14, or is site specific hazards and risks change significantly.

- (69) In order to fully realise an all-hazards, comprehensive approach, best practice highlights a need to include hazard identification, risk assessment and business impact analysis as part of the planning process, as summarised by CSA Z1600:

### Definitions:

- a) **Planning:** One element of Emergency Management Program (see above), alongside program management; implementation; evaluation; and management review.
- b) **Risk Assessment:** include evaluating the likelihood of a hazard or combination of hazards occurring, taking into account factors such as threat analysis, frequency, history, trends, and probability.
- c) **Response:** actions taken during or immediately after an emergency to manage its consequences
- d) **Response Plan:** Demonstrates how emergency responses are initiated and coordinated, and should include:
  - Criteria for assessing an emergency;

- Procedures for responding to an emergency;
- Procedures for mobilizing response personnel and agencies; and,
- Procedures for communicating and coordinating between all affected parties.
- Execution of emergency plans and operational activities.

e) **Hazard assessment:** Identification and monitoring of the hazards that can have an impact on operations or areas of responsibility. Hazards from the following categories shall be considered:

- natural;
- human-caused;
- technological.

(70) Industry best practices, standards and regulations are consistent in their approach to addressing EMP as an element within a comprehensive Emergency Management Program. As the definitions above illustrate, the expectations placed on Oil and Gas operators is for the provision of a program that establishes an Emergency Management Framework, through which all plans are coordinated. This is reflected quite clearly in the differing legislative and regulatory requirements for each aspect, as well as additional elements which are informed by, but exist outside, of either of these categories (such as hazard planning distances).

### 9.1 Evacuation

(71) TMPL's intention to address evacuation planning in conjunction with City of Burnaby, SFU, RCMP, BC Ambulance, and Burnaby Fire has been referenced in multiple IR's. However, BC ambulance and SFU are not identified as stakeholders in the existing plans, nor is this addressed specifically in the available documents. The Westridge Terminal plan, section 9.8 Public Evacuation Plan identifies the initial responsibility for evacuation measures as that of TM, but does not provide specific description of 'emergency duties' or their responsibilities. There is also no specific mention of the location-specific needs for evacuation at the Westridge Terminal or Burnaby Tank farm.

(72) Given the absence of Emergency Response and Emergency Response Zone maps respectively from the ERP and risk assessment documentation (Volume 7 of the facilities application and McCutcheon Report) and that maps have been redacted from the Terminal and Tank Farms ERP (section 7.2.6), it is not possible to assess the readiness or adequacy of provisions for evacuation or emergency response.

### 9.2 Notification

(73) While responsibility for the evacuation itself is not the responsibility of TMPL, they are responsible for the determination of recommendations relating to evacuation (e.g. identifying potential at-risk communities). This is not clearly identified in Volume 7 of the facilities application, site-specific plans, or the IR responses.

(74) The EMR requires that the emergency plans indicate how the applicant's or permit holder's response to an emergency may affect the person or entity receiving the information. This is especially significant in

site-specific plans, as the hazards, risks and therefore effects will vary from site to site, requiring different actions. While there are extensive descriptions of shelter-in-place procedures as well as mention of evacuation as a possible course of action (see above), the notification procedures are not specifically identified, and key stakeholders such as SFU are not identified.

- (75) TM has addressed the need for community awareness initiatives, which are detailed in Volume 7 of the application among others, however emergency communication systems for public and municipal notifications are not well defined (Volume 4.7.1 - community awareness and education). An emergency contact line is provided and staffed by TM, and while such a service is extremely helpful to response activities, it remains a passive, uni-directional instrument designed to facilitate updates to a situation already underway. Thus, it may not be effective for initial notification and awareness of an incident, and should be supplemented by additional communication measures, briefly touched upon in the application, such as social media, website updates and notification of municipal bodies. No specific strategies for these kinds of communication and notification have been explained in the TM application.
- (76) It should be noted that TM has stated an intent to work in collaboration with stakeholders such as the City of Burnaby and the province of BC to develop integrated approaches to communication and notification in IR's. This will certainly provide additional capacity and understanding between stakeholders if the project is granted approval, but does not satisfy the current concerns of stakeholders or the immediate needs of compliance with the Onshore Pipeline regulation section 33 and 34 respectively, as follows:
- "33. A company shall establish and maintain liaison with the agencies that may be involved in an emergency response on the pipeline and shall consult with them in developing and updating the emergency procedures manual.
  - 34. A company shall take all reasonable steps to inform all persons who may be associated with an emergency response activity on the pipeline of the practices and procedures to be followed and make available to them the relevant information that is consistent with that which is specified in the emergency procedures manual"<sup>47</sup>.
- (77) Additionally, the capacity of TM equipment and resources to address either overland or marine spills is not specifically mentioned. This makes it hard for stakeholders to know what size a spill will exceed Kinder Morgan's capacity to respond, which is important when determining what additional resources may be required, and at what point local municipal or SFU resources should be called upon.
- (78) Lastly, while the ICS plan provides a structure for incident response, including highlighting the role of a liaison having the responsibility for notification of stakeholders, no specific procedures for notification or communication are provided.

(79) **RECOMMENDATIONS:**

- 11. Within each site-specific plan, in accordance with ss. 3(2)(c) of the EMR, define how TM will notify entities receiving information regarding an**



**emergency, and appropriate response. This should address site-specific hazards and risks**

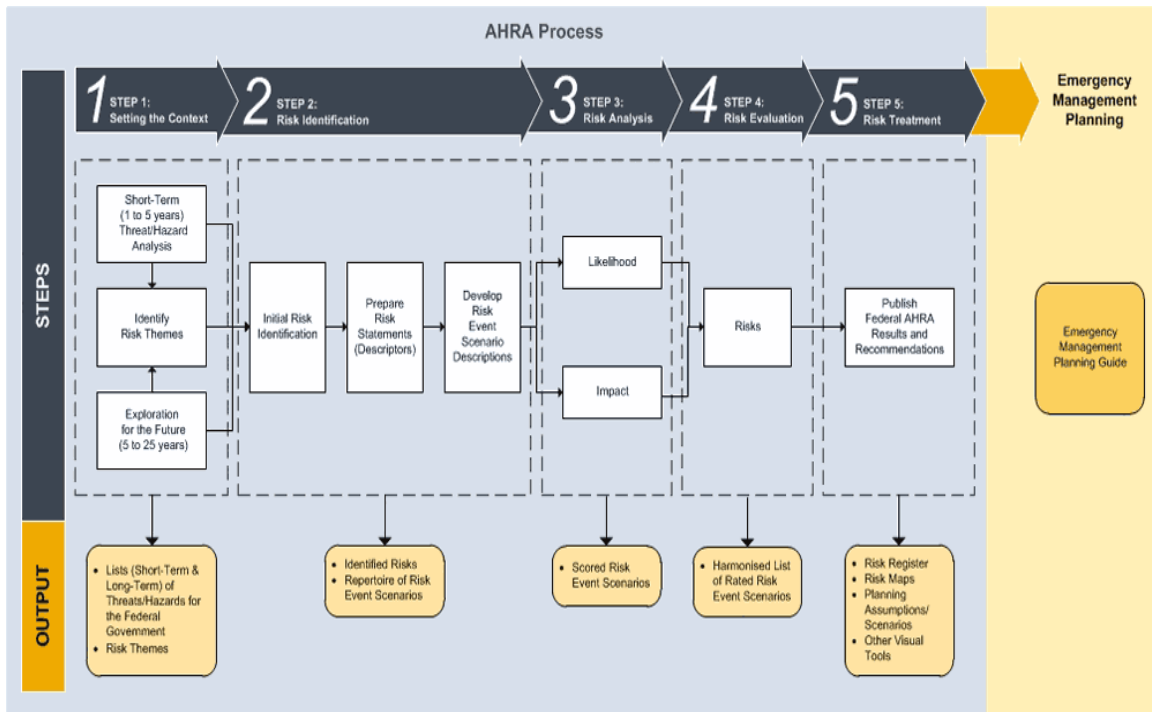
- 12. Clarify the types and sizes of potential incidents that would require the assistance of local emergency, municipal or SFU resources.**

## **10 Risk Assessment**

(80) The creation of all-hazard risk assessment is a cornerstone of any emergency management system. Most risk assessments typically include an assessment of risk to their own operations, as well as outward-looking assessments. This analysis can take place through a variety of methods, but are typically addressed through a process resembling the one provided by Public Safety Canada:

- a) **Setting the Context** – The process of articulating an institution's objectives and defining its external and internal parameters to be taken into consideration when managing risks.
- b) **Risk Identification** – The process of finding, recognizing, and recording risks.
- c) **Risk Analysis** – The process of understanding the nature and level of risk, in terms of its impacts and likelihood.
- d) **Risk Evaluation** – The process of comparing the results of Risk Analysis with risk criteria to determine whether a risk and/or its magnitude is acceptable or tolerable.
- e) **Risk Treatment** – The process of identifying and recommending risk control or Risk Treatment options.<sup>48</sup>

Figure 10.1: AHRA Process and link to Emergency Management Planning<sup>49</sup>



(81) While the above outline is more specifically designed for federal government institutions to address business continuity, it reflects risk management best practice. Other similar models, including the Hazard Identification and Risk Assessment (HIRA)<sup>50</sup> model employed in Ontario<sup>51</sup>, or Hazard, Risk and Vulnerability Analysis (HRVA) utilised by BC Emergency Management similarly understand risk as co-owned and co-managed. They also utilise an understanding of risk on two planes, hazard frequency and consequence (Table 10.1).

Table 10.1: Adapted from Emergency Management B.C. (EMBC) Hazard, Risk and Vulnerability Analysis. Risk to People, Communities and the Environment

### Risk to People, Communities and the Environment

<b>Hazard Probability</b> ↓						
<b>Very high</b>	High	High	Very High	Extreme	Extreme	
<b>High</b>	Moderate	High	High	Very High	Extreme	
<b>Medium</b>	Low	Moderate	High	Very High	Very High	
<b>Low</b>	Low	Low	Moderate	High	Very High	
<b>Very Low</b>	Very Low	Low	Moderate	High	High	
	Very Low	Low	Medium	High	Very High	<b>← Hazard Impact</b>

(82) In ss. 6.5 (1), the Onshore Pipeline Regulations require the following hazard identification and treatment for compliance:

- (c) establish and implement a process for identifying and analyzing all hazards and potential hazards;
- (d) establish and maintain an inventory of the identified hazards and potential hazards;(e) establish and implement a process for evaluating and managing the risks associated with the identified hazards, including the risks related to normal and abnormal operating conditions;
- (f) establish and implement a process for developing and implementing controls to prevent, manage and mitigate the identified hazards and the risks and for communicating those controls to anyone who is exposed to the risks;
- (g) establish and implement a process for identifying, and monitoring compliance with, all legal requirements that are applicable to the company in matters of safety, security and protection of the environment;

(83) The last of the aforementioned subsections provides specific guidance on referring to other applicable legal requirements, which in the case of Trans Mountain could also include the CSA Z1600 as well as the B.C. Oil and Gas Commission, which additionally require as well the inclusion of people, property, and/or environment impacts in any analysis. In addition to the wider scope of impact assessment, the EMR also requires that oil and gas operators “prioritize hazard controls to mitigate risks to people, property, and/or environment”<sup>52</sup>.

- (84) The following sections illustrate the role of a number of different elements that should be considered in the creation and use of a risk assessment. The subsequent analysis specifically addresses items laid out in the EMR, and reference best practices and other standards.

### 10.1 Maps

- (85) In order to meet EMR standards, as well as those outlined in CSA Z1600, maps that detail the oil and gas activities, hazard zones and potential impacts are required. Such maps should include an emergency response map which meets the requirements laid out in the EMR section 15. Such maps should be provided in the facilities application, to enable stakeholders to assess the potential likelihood and impact of events resulting from both normal oil and gas activity and accidents resulting in spills, fires or explosions.
- (86) The emergency response map is an especially important element of the overall emergency program and, and should be specifically designed for each site. The emergency planning zones for each scenario and event type will vary, and provide important insight for both TM and potentially affected entities.
- (87) Such maps are not provided in any of the facilities application materials. Those that have been included (the map titled 'TMPL\_V6\_25kMaps.mxd' includes Burnaby mountain and SFU) address the potential for overland flow of oil, but do not appear to take into account the recreational and forested areas of Burnaby Mountain Park or Conservation area. Volume 7 of the facilities application, (3.1.1 Oil Spill Risk Assessment Overview) states: *"A geographic information system (GIS) is used to identify High Consequence Areas (HCA) intersected by the spill pathways, and a scoring model is used to assign consequence scores"*. However, the omission of local parks and ecological areas in the analysis, even though it shows the built environment/population of SFU, results in an incomplete assessment for SFU and the surrounding communities, resulting in an incomplete HCA assessment.
- (88) Specifically, emergency planning zones have not been identified, thus neither have boundaries or areas adjacent to potential exposure. According to the EMR, such maps should include:

*"...roads...surface and environmental features and structures, including stream crossings and lakes... commercial or industrial operations; and the location of areas within the emergency planning zone that may be used by the public, including, without limitation, dwellings, schools, public facilities, campgrounds and recreation areas".<sup>53</sup>*

### 10.2 Hazard Planning Distances

- (89) Hazard planning distances are developed in order to *"identify a geographical area (a hazard planning zone) within which persons, property or the environment may be affected by an emergency."*<sup>54</sup> Without such measures, it is not possible to determine the extent to which emergency events resulting from oil and gas accidents could impact the surrounding area. Hazard planning distances are insufficiently addressed in the documentation provided to date (see section 5), and therefore TM does not meet the requirements laid out in the EMR. As this is considered both an industry best practice and a legislative

requirement for some pipeline operations within B.C., this clearly represents a particularly significant oversight from both a regulatory and public safety standpoint.

- (90) The B.C. Oil and Gas commission also states that such planning distances must take into consideration the types of hazards and risks arising from the oil and gas activity that is the subject of the plan. Before effective hazard planning distances can be created, comprehensive site-specific plans must first exist – these are addressed in the following section.

(91) **RECOMMENDATIONS:**

- 13. Provide a map of each TM site, which includes emergency planning zones pursuant to ss. 3(2) of the EMR.**
- 14. Provide hazard zone and emergency response maps for the Westridge Marine Terminal and Burnaby Tanker Farm, as well as any pipeline infrastructure passing through Burnaby and surrounding municipalities, in accordance with EMR section 15.**
- 15. Update HCA maps to include a comprehensive HCA of the Burnaby Mountain area including parkland and other previously omitted land-use types.**

### 10.3 Comprehensive all-hazards approach

- (92) The ICS plan for Kinder Morgan lays out the authority for response as well as the various functions within the Kinder Morgan structure. However, each plan is focused on emergency actions, support and legal implication with little or no mention of mitigation, preparedness and recovery.
- (93) Furthermore, site-specific ERP's focus on "*the response actions for the effects of radiant heat and air monitoring for plumes (smoke or otherwise), on the public, that result from a fire-event*", which is a risk-specific, not an all-hazards approach<sup>55</sup>. Both are required.
- (94) Within the TM expansion project facilities application, section 4.4, the following is stated: "*The current ERP for TMPL provides a generic response to a spill for any location along the pipeline, whereas the ERPs for Terminals/Tank Farms and for Westridge Marine Terminal are location-specific.*" These site-specific plans are defined as adopting an approach which considers 'multiple hazards'.
- (95) While the hazards included in site-specific plans are stated as being based on the ASME B31.8S guidelines, the plans do not include maps, hazard planning distances, or tools such as the MIACC "Risk Based Land Use Planning", which has been used in the McCutcheon Report analysis of the Burnaby Tank Farm site. Furthermore, the site-specific plan for the Westridge Marine Terminal includes sections on site-specific hazards as follows:
- Tornado
  - Flood
  - Earthquake

- (96) This is not a comprehensive list, and includes at least one hazard which has no applicability to this site (the risk of tornado is essentially zero). Furthermore, the Westridge Terminal emergency plan does not address the potential risk to the road infrastructure adjacent to SFU, or use thereof, and the site specific plan for the Burnaby tanker farm is either absent or so difficult to find that the authors are not aware of it. Given that the pipeline is situated adjacent to one of only 2 major road access points, as well as the proximity of the Burnaby Tanker Farm to both SFU and neighbouring residential areas, this absence of information is a critical gap in emergency planning.
- (97) The aforementioned McCutcheon Report contains a risk assessment of the Burnaby Tank Farm site; while comprehensive in its review of Fire and Explosion, Pool Fire, Tank Top Pool fire, black cloud soot and Dike Oil Fire, the analysis does not seem to be referenced in the site-specific emergency response plans and does not elaborate on the risk to access routes to Simon Fraser University (SFU). Such an event is deemed as having an 'acceptable' level of risk according to the interpretation of the MIACC standard, but also has the potential to block all road access to SFU, as in the dike fire scenario pictured below.

Figure 10.2: Summary of Risk Distances for Radiant Energy from a Dike Fire (for the existing site and expanded site)



(98) **RECOMMENDATIONS:**

16. In accordance with the EMR, ss. 3(2)(b), provide appropriate site-specific hazards and risks of the oil and gas activity that is the subject of the plan. This amendment should consider removal of 'Tornado' as a risk for the Westridge Marine terminal, and incorporation the types of hazards and risks more in line with those identified in the McCutcheon Report.
17. As recommended by the B.C. Oil and Gas commission, provide a systematic assessment of hazards, threats, risks and vulnerabilities for Westridge Marine Terminal and the Burnaby Tank Farm. If this has not been completed previously, supplementary information should be incorporated into existing emergency response plans.
18. Provide information regarding the 'values at risk' for site-specific operations in accordance with EMR ss. 7(3)(b)(ii). This should include and prioritise hazard controls to people, property, and environment, including road infrastructure and access to SFU.
19. Provide emergency management and response plans for the Burnaby Tank Farm, including hazard planning zones, evacuation, communications and notification plans and procedures.

## 11 Redactions

- (99) As alluded to in section 9.1, the difficulty of assessing provisions for evacuation without the inclusion of hazard zones or illustrative maps of Burnaby Tank Farm is heightened by redactions. The issue of redactions has been addressed through ruling no. 63 and 50 respectively, resulting in a decision that

“sufficient information has been filed from the existing EMP documents to meet the Board’s requirements at this stage in the process”<sup>56</sup>. However, as many sections of this report address, without the inclusion of adequate hazard identification maps, hazard planning distances and other elements required by the Emergency Management Regulation, and specifically identified by the B.C. Oil and Gas Commission as crucial elements for Emergency Response Planning and program development, it is almost impossible to adequately assess either the hazards and risk to SFU, and the steps taken to address them.

- (100) In addition, the recent ‘tactical risk analysis’ authored by Deputy Chief Bowcock of the Burnaby Fire Department<sup>57</sup> addresses some further deficiencies which could be addressed by unredacting certain sections (either in part or in full), including but not limited to section 6.8 ‘Bomb Threat Checklist and 7.4.1 Site Drainage of the Terminals and Tank Farms ERP. This comprehensive document contains strong conclusions relating to the increased ‘downwind sensitivities’ for local conservation areas, potential consequences of reduced storage tank isolation and insufficient firefighting deployment positions, to name a few. These concerns and many more highlighted in Bowcock’s analysis make a case to at least partially unredact relevant sections of the emergency response and emergency planning documentation provided in the NEB application, at the very least revealing the Evacuation Zone Map (section 7.2.6 of the Terminal and Tank Farm ERP) and sections which pertain to appendix G: Emergency Management Evaluation, which includes a draft matrix for “defining the adequacy of an HSE Case Study process”.
- (101) It is acknowledged that the redactions contained within the current TM facilities application represent sensitive and confidential information. Revealing this information in its entirety could potentially expose TM employees, operations or facilities to unnecessary risk, but conversely represents information which directly impacts intervenor’s interests. While the NEB has stated that its decision to leave redacted information as such, and not to compel the inclusion of further information relating to the ERP “does not mean that intervenors cannot test the already filed EMP information”<sup>58</sup>, it should also be noted that intervenors cannot affectively assess the risk to their own operations, personnel or facilities without more information. Lastly, it has been demonstrated in previous sections that the ERP and related emergency management documents in their current form fall short of provincial regulatory requirements, and as such represent a risk to many local interests, represented in part by intervenor requests.

## **12 Airborne Contaminants and Air Dispersion Modelling**

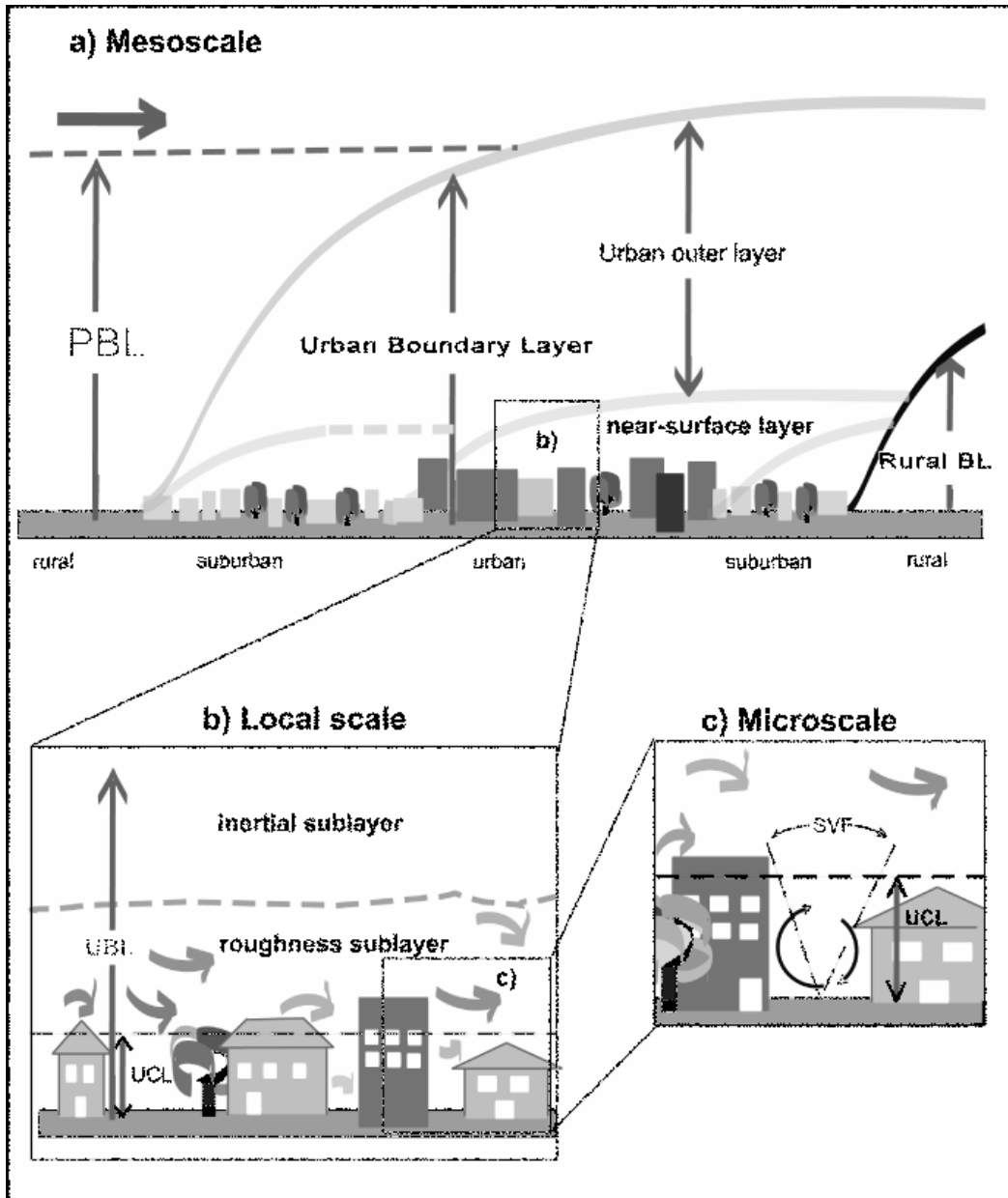
- (102) Air quality dispersion modelling approach is generally used to assess compliance of emissions with air quality regulations and standards. But it can be also used to plan new facilities (pipeline and storage tanks, for example), establishment of air quality monitoring networks, and air quality forecasting. In case of an accident (such as a large leakage of chemicals from a pipeline breakage or sudden release of toxic chemicals from burning storage fuel tanks), one can employ air pollution models to simulate such an event for the purpose of risk assessment (to human beings and properties) and to develop and put in place emergency management plan. Air pollution modelling becomes an essential tool for such a strategy when potentially dangerous infrastructures are located near urban centres. This requires



relatively realistic simulations of urban boundary layer dynamics on spatial and temporal scales of 100 metres and 10-15 minutes, respectively, if one is to develop an emergency mitigation strategy for abatement and mitigation against an explosive release of chemical contaminants from a large fuel storage tanks, for example.

- (103) Figure 12.1 shows qualitatively different scales of a 3-dimensional urban boundary layer structure indicating considerable complexity in the flow and turbulent dynamics of the layer. As atmospheric flow in the planetary boundary layer (PBL) crosses from surfaces of lesser roughness to an urban setting with increased roughness, it breaks up into different sub-structural layers, with increased turbulence and dispersion at the urban canopy layer (UCL). The UCL is embedded in the roughness sublayer (RS) and stretches from the ground to the average height of buildings and trees. Ideally, Monin-Obukhov Similarity Theory that describes mean vertical wind and temperature profiles based on scale analysis might be applicable within the inertial sublayer; it is significantly more difficult to simulate turbulent fluxes within the UCL where concentrations of chemical substances might accumulate. Studies of vertical urban boundary layer profiles of meteorological variables such as winds and temperature are relatively few, and location specific.
- (104) As with any modelling, an air quality dispersion modelling approach faces many uncertainties and limitations, particularly in the modelling of atmospheric transport and dispersion of chemical substances. Air pollution dispersion modelling is a complex process. For air pollution modelling at the urban scale, there are basically two different modelling approaches: (a) Lagrangian modelling and (b) Eulerian modelling. In Eulerian modelling, the area of interest is divided into a number of grid points.

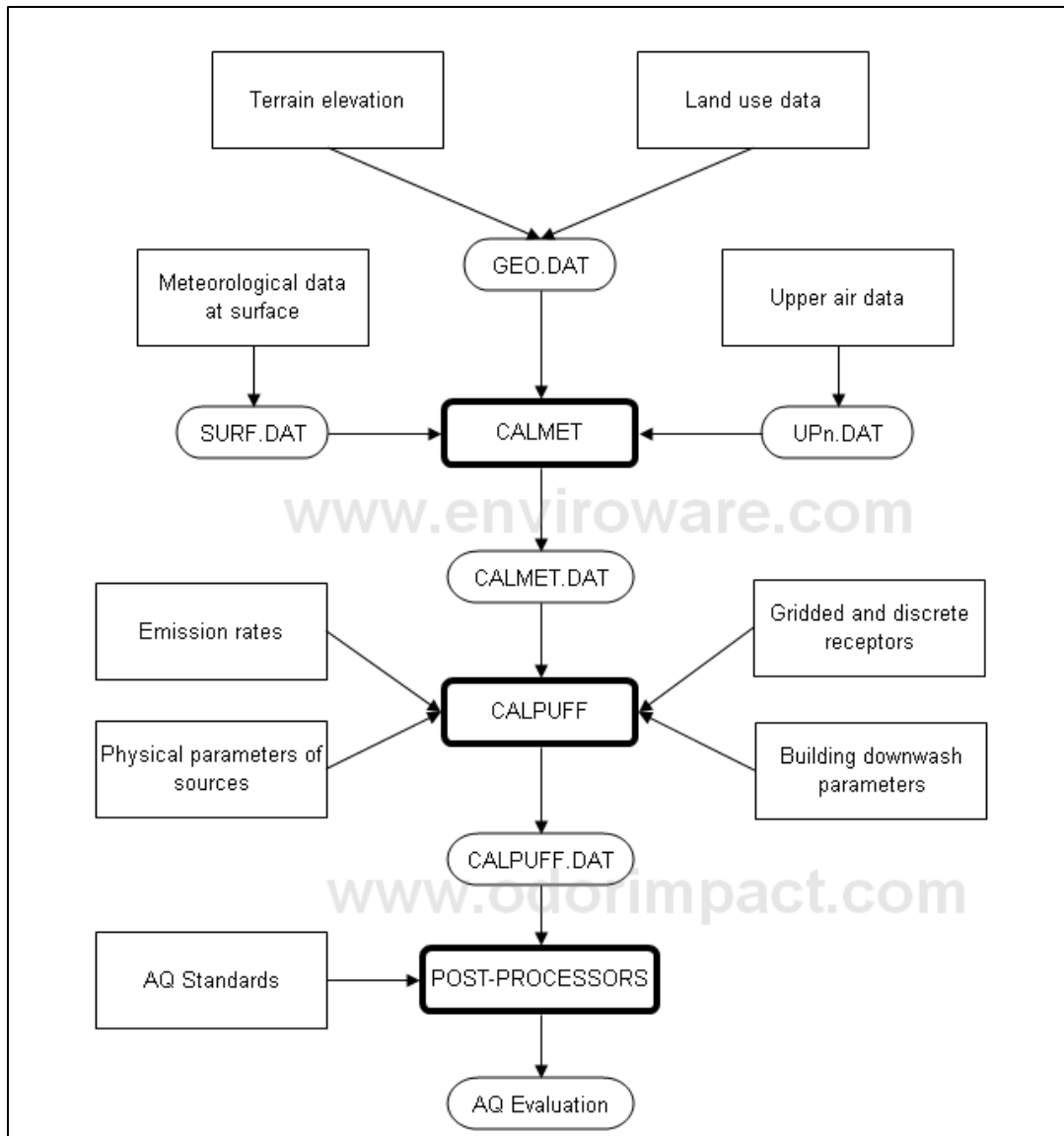
Figure 12.1. Planetary boundary layer structure evolved into the Urban Boundary Layer (UBL) that can be broken down to local scale and microscale. UCL=Urban Canopy Layer, SVF=Sky View Factor<sup>59</sup>.



- (105) At each grid point, meteorological variables and airborne contaminants are calculated. In Lagrangian modelling, an emission puff is followed along a trajectory. The identity of the puff is preserved, but can be split up if the puff covers more than a specified spatial resolution at a particular time after the emission. The CALMET-CALPUFF modelling system is a Lagrangian model.

## 12.1 CALPUFF Dispersion Modelling System

- (106) Based on the records from the National Energy Board (NEB) hearings, Trans Mountain has used the CALPUFF modeling system in an attempt to demonstrate that the operation at the storage tanks does meet the BC air quality regulations of ambient contaminants (such as volatile organic compounds), as well as emissions during the construction of the new pipeline. The model has been used also to determine the “best” location(s) of stations to monitor air quality. The California Puff Model (CALPUFF) modelling system has been recommended by the United States Environmental Protection Agency (USEPA) for use in transport and deposition of airborne contaminants. Consistent with the usage of the CALPUFF modelling system by Trans Mountain, it can be used for short range pollutant transport of less than 30-50 km, as long as the size of the plume covers sufficient number of model grid points to adequately resolve the width of the plume and regions of maximum chemical concentrations.
- (107) The main components of the CALPUFF dispersion modelling system are shown in Figure 12.2. The modelling system is basically composed of 3 components: CALMET, CALPUFF, and CALPOST (Post-Processing). It is a non-steady (as opposed to steady-state Gaussian plume models) Lagrangian meteorological and air quality modelling system. The modelling system requires geophysical and meteorological data and spatio-temporal characterisations of the chemical emission. Proper representation of meteorology in CALMET is fundamentally important because the transport and dispersion of pollutants depend crucially on the properties of atmospheric flow and turbulence.

Figure 12.2. The main components of the CALPUFF modelling system<sup>60</sup>

- (108) CALMET (California Meteorological Model) is a diagnostic mesoscale meteorological model that calculates a 3-dimensional time and space varying field of meteorological variables, such as wind, temperature and precipitation over complex terrain. It serves as an input to CALPUFF. Scire et al. (2000) gives a detailed description of the CALMET modelling approach<sup>61</sup>. The lower boundary of the model is specified by geophysical data such as terrain elevation and land use data. The model has sigma vertical coordinates and thus the bottom model level follows the curvature of the terrain. Land use classification is used to assign roughness length for calculation of frictional turbulence and drag. CALMET contains algorithm to handle the effects of sloping terrain, kinematic terrain and terrain blocking. It also includes a micrometeorological module for distinguishing over-land and over-water boundary layers<sup>62</sup>. Meteorology in CALMET can be driven by surface and upper air observation or by a gridded prognostic

model output from a mesoscale dynamical model such as MM5 (a limited-area, nonhydrostatic PSU/NCAR mesoscale dynamical model with terrain-following sigma vertical coordinate) or WRF (an operational Weather Research and Forecasting) model<sup>63</sup>. The major meteorological features of CALMET are summarised in Table 12.1 (obtained from “Protocol for the Application of the CALPUFF Model for Analyses of Best Available Retrofit Technology (BART)”) <sup>64</sup>:

Table 12.1: Major Meteorological Features of CALMET

- **Boundary Layer Modules of CALMET**
  - Overland Boundary Layer - Energy Balance Method
  - Overwater Boundary Layer - Profile Method
    - COARE algorithm
    - OCD-based method
  - Produces Gridded Fields of:
    - Surface Friction Velocity
    - Convective Velocity Scale
    - Monin-Obukhov Length
    - Mixing Height
    - PGT Stability Class
    - Air Temperature (3-D)
    - Precipitation Rate
  
- **Diagnostic Wind Field Module of CALMET**
  - Slope Flows
  - Kinematic Terrain Effects
  - Terrain Blocking Effects
  - Divergence Minimization
  - Produces Gridded Fields of U, V, W Wind Components
  - Inputs Include Domain-Scale Winds, Observations, and (optionally) Coarse-Grid Prognostic Model Winds
  - Lambert Conformal Projection Capability

- (109) CALMET is a diagnostic model that generates three-dimensional meteorological field driven by three different types of meteorological data input<sup>65</sup>: (1) Gridded meteorological data output only from prognostic models such as MM5, WRF, and GEM-LAM (Environment Canada). In this case, no observational data are required. (2) A hybrid mode in which surface observation is used in conjunction with the numerical model data output from (1). (3) CALMET meteorology is derived by using surface and upper air data. CALMET driven by gridded meteorological data from numerical mesoscale models has “significant advantages.” These are listed in Barclay and Seire (2011)<sup>66</sup>.
- (110) The CALPUFF model is a non-steady state Lagrangian puff and dispersion model. It advects non-steady emissions of Gaussian puffs from multiple sources. In the case of an accidental release of large plumes

of toxic chemicals from fuel storage tanks to the west and to the southwest of the Simon Fraser University campus on Burnaby Mountain, the model can be applied from a few tens of metres to a few tens of kilometres to investigate near-field effects such as building downwash and transitional plume rise. Outputs from the CALPUFF model includes hourly concentration values of airborne chemical species, as well as hourly dry and wet depositions, at user-specified receptor locations.

- (111) CALPUFF is driven by meteorological outputs from CALMET. The model's major features are summarised in Table 12.2 (obtained from "Protocol for the Application of the CALPUFF Model for Analyses of Best Available Retrofit Technology (BART)")<sup>67</sup>:

Table 12.2: Major Features of CALPUFF

- **Source types**
  - Point sources (constant or variable emissions)
  - Line sources (constant or variable emissions)
  - Volume sources (constant or variable emissions)
  - Area sources (constant or variable emissions)
- **Non-steady-state emissions and meteorological conditions**
  - Gridded 3-D fields of meteorological variables (winds, temperature)
  - Spatially-variable fields of mixing height, friction velocity, convective velocity scale, Monin-Obukhov length, precipitation rate
  - Vertically and horizontally-varying turbulence and dispersion rates
  - Time-dependent source and emissions data for point, area, and volume sources
  - Temporal or wind-dependent scaling factors for emission rates, for all source types
- **Interface to the Emissions Production Model (EPM)**
  - Time-varying heat flux and emissions from controlled burns and wildfires
- **Efficient sampling functions**
  - Integrated puff formulation
  - Elongated puff (slug) formulation
- **Dispersion coefficient ( $\sigma_y$ ,  $\sigma_z$ ) options**
  - Direct measurements of  $\sigma_v$  and  $\sigma_w$
  - Estimated values of  $\sigma_v$  and  $\sigma_w$  based on similarity theory
    - AERMOD turbulence profiles
    - Original turbulence profiles
  - Pasquill-Gifford (PG) dispersion coefficients (rural areas)
  - McElroy-Pooler (MP) dispersion coefficients (urban areas)
  - CTDM dispersion coefficients (neutral/stable)
- **Vertical wind shear**
  - Puff splitting
  - Differential advection and dispersion

- **Plume rise**
  - Buoyant and momentum rise
  - Stack tip effects
  - Building downwash effects
  - Partial penetration
  - Vertical wind shear
- **Building downwash**
  - Huber-Snyder method
  - Schulman-Scire method
  - PRIME method
- **Complex terrain**
  - Steering effects in CALMET wind field
  - Optional puff height adjustment: ISC3 or "plume path coefficient"
  - Optional enhanced vertical dispersion (neutral/weakly stable flow in CTDMPLUS)
- **Subgrid scale complex terrain (CTSG option)**
  - Dividing streamline,  $H_d$ , as in CTDMPLUS:
  - Above  $H_d$ , material flows over the hill and experiences altered diffusion rates
  - Below  $H_d$ , material deflects around the hill, splits, and wraps around the hill
- **Dry Deposition**
  - Gases and particulate matter
  - Three options:
    - Full treatment of space and time variations of deposition with a resistance model
    - User-specified diurnal cycles for each pollutant
    - No dry deposition
- **Overwater and coastal interaction effects**
  - Overwater boundary layer parameters (COARE algorithm or OCD-based method)
  - Abrupt change in meteorological conditions, plume dispersion at coastal boundary
  - Plume fumigation
- **Chemical transformation options**
  - Pseudo-first-order chemical mechanism for  $SO_2$ ,  $SO_4$ ,  $NO_x$ ,  $HNO_3$ , and  $NO_3$  (MESOPUFF II method)
  - Pseudo-first-order chemical mechanism for  $SO_2$ ,  $SO_4$ ,  $NO$ ,  $NO_2$ ,  $HNO_3$ , and  $NO_3$  (RIVAD/ARM3 method)
  - User-specified diurnal cycles of transformation rates
  - No chemical conversion
- **Wet Removal**
  - Scavenging coefficient approach
  - Removal rate a function of precipitation intensity and precipitation type

## 12.2 Why Use CALPUFF Dispersion Modelling System?

- (112) Air dispersion modelling is a tool by which one can assess the air quality of any location of interest downwind from an industrial activity that may, with a finite probability, emit airborne toxic pollutants that will have a dangerous impact on human health and socio-economic infrastructures. Of all the available air quality dispersion modelling systems available on the market, there has been an increasing number of case studies in which the CALPUFF dispersion modelling system has been employed. It has been used extensively, for example in North America<sup>68</sup>, Australia<sup>69</sup>, New Zealand<sup>70</sup> and China<sup>71</sup>. Many peer-reviewed studies have closely examined and critically assessed the modelling system<sup>72,73,74,75</sup>. These and other studies have shown that the CALPUFF dispersion modelling system can be used in near-field situations (emission-to-receptor distance less than 3-5 km) where the environment is characterised by complex terrain. The CALPUFF modelling system has also achieved regulatory approval by USEPA.
- (113) In the context of developing an emergency management strategy by SFU in response to a catastrophic release of chemical toxins into the atmosphere from a nearby tank and/or pipeline rupture, usually resulting in large explosive fires that would continue to burn for an extend period of time (usually in terms of hours) releasing buoyant materials, a non-steady state Lagrangian dispersion modelling system like the CALPUFF model seems to be an appropriate tool. However, as indicated in the previous subsection, since the CALPUFF modelling system is designed to be used nearly anywhere in the world, it has many variables or tuning parameters that require specific values that would configure the model to be used on a case-by-case basis for specific sites. How well the values of these tuning parameters are chosen will have a significant influence on the relative accuracy by which chemical dispersion is simulated.
- (114) As with any modelling, there are always uncertainties in prognostication of time-space dependent concentration field of airborne chemical species emitted from a source. The main objective of the recommendations identified below is to reduce the uncertainty as much as possible for SFU to develop a set of emergency response procedures.
- (115) **RECOMMENDATION:**
20. **There is no evidence that an extensive verification of the CALPUFF modelling system for the use over the Burnaby-SFU region has been done by TM. Such an analysis needs to be carried out.** Since the spatiotemporal dispersion of airborne toxic chemicals from an emission source (either slowly or catastrophically) depends crucially on the atmospheric flow pattern in the lower troposphere, it is crucial that any air quality dispersion model used should be able to simulate the necessary characteristics of the lower tropospheric flow patterns and turbulent fluxes.
- (116) Verification of the usefulness of the CALPUFF dispersion modelling system as applied to the Burnaby-SFU region by Trans Mountain is totally inadequate, verging on nonexistent. There is no evidence to show that Trans Mountain conducted adequate and sufficient number of air dispersion simulations of toxic chemical compounds resulting from a catastrophic release of these chemicals to form a scientifically sound basis for developing an emergency response management plan by SFU. As pointed out above, the modelling system contains many tuning parameters, the values of which are chosen by



the user to represent the characteristics of the event to be modelled and the environmental location in which the event occurs. There is no evidence to indicate that Trans Mountain has conducted an extensive validation of the CALPUFF model application; that is, test the sensitivity of the model performance to each of the parameters. Merely accepting recommended settings of these parameters is inadequate if the total cost (in terms of human casualties and property damage) that might occur due to a rare but disastrous explosion of fuel storage tanks or pipes is more than the cost of conducting the model verification study.

(117) So far, Trans Mountain has mainly used the CALPUFF modelling system to comply with the regulatory requirements of the British Columbia air quality standards. There is no evidence in various reports that are accessible from the National Energy Board hearing that Trans Mountain has conducted modelling simulations involving a catastrophic release of buoyant material from fuel storage tanks at the Westridge and Burnaby Terminals or a huge rupture in pipes at various locations close to urban centres. The impact of releasing a buoyant material into the atmosphere is quite different from releasing a puff or series of puffs of chemicals like CO<sub>2</sub> and CH<sub>4</sub> from slow continuous or intermittent sources at the ground level. It is very likely that a huge fire at a tank terminal will result in significant release of toxic chemical and soot that will break through the planetary boundary layer.

(118) **RECOMMENDATION:**

**21. There is no evidence that Trans Mountain has carried out simulations using a series of release of chemicals with different buoyancy characteristics under different meteorological stability conditions (neutral, stable, and unstable). Such simulations need to be done.**

(119) There is a very strong seasonal variation in the circulation pattern and atmospheric stability regime over the Burnaby-SFU region. Once there is an accidental catastrophic rupture in tanks at one of the storage depots, toxic chemical will disperse very quickly in the atmosphere. SFU needs to have a “play book” that contains different response strategies, each depending on the emission characteristics and meteorological conditions. In order to write this “play book,” Trans Mountain needs to conduct a number of CALPUFF simulations, showing various chemical evolutionary fields under different meteorological conditions that exist in different seasons. To do this, CALMET can be driven by gridded meteorological outputs from prognostic models like MM5 or WRF.

(120) **RECOMMENDATION:**

**22. SFU is located on the top of a high-rise plateau (Burnaby Mountain) bounded by a water body to the north and by a relatively flat urban development on rest of the area surrounding the campus. This topographical character around SFU adds another layer of complexity to the capability of the CALPUFF modelling system to simulate, at a realistic level of acceptance, the spatiotemporal dispersion of airborne toxic chemicals. Therefore, an extensive verification of the CALPUFF modelling system for the use over the Burnaby-SFU region needs to be carried out.**

**23. There are strong seasonal variations in atmospheric circulation and stability over the Burnaby-SFU area. This will have a significant influence on the dispersion**

**characteristics of any toxic chemicals with different buoyancy released into the atmosphere at different times of the year. There is no evidence that Trans Mountain has carried out simulations using a series of releases of chemicals with different buoyancy characteristics under different meteorological circulations and stability conditions (neural, stable, and unstable). Such simulations need to be conducted.**

### **13 Conclusion**

- (121) The authors were asked to review Trans Mountain emergency planning documents and air dispersion modelling, and the resulting implications for SFU. We have found that there are significant gaps in the planning process and dispersion modelling, which should be addressed in order for SFU to properly understand their risks, and to engage in appropriate emergency planning.
- (122) In particular, there are scenarios of tank or pipeline accidents that put SFU at severe risk, with the possibility of evacuation being difficult or impossible. The likelihood of such an event is very small, and represents a worst case scenario. The chances of such an event happening and a better understanding of how it might evolve and affect SFU, requires a more detailed and comprehensive analysis of the probabilities of hazardous events, local meteorological conditions, model tuning and detailed hazard mapping. Specifically, the authors make the following 24 recommendations that are listed in Appendix A.
- (123) It would be appropriate for SFU to request Trans Mountain to address many of these recommendations, and where possible to include them in their own local emergency planning process.

## Appendix A

### Recommendations: Trans Mountain Pipeline Expansion Facilities Application

- 1.** For emergency and disaster planning it is important that worst case scenarios be used for risk analyses and emergency planning. This is because disasters follow power law distributions, and rare high consequence events are an important part of total consequences. The TM scenarios when compared to Alberta oil spills indicate that they do not include worst case planning, and therefore they need to be closely examined to see if they are overly optimistic.
- 2.** Kinder Morgan has a history of damaging spills that brings into question their performance as it relates to their pipeline safety record. An examination of the history of Kinder Morgan incidents as they compare to industry averages should be undertaken as part of the risk analysis, in order to put the aggregated failure data into context, and within which to evaluate their emergency management protocols.
- 3.** An accident at the Burnaby Tank Farm or TM pipeline could create hazards that would envelop part of all of the SFU campus on Burnaby Mountain, and make evacuation difficult or impossible. Therefore, emergency planning at SFU needs to include the scenario of an ERPG-2 event, at a minimum. Specifically, the TM/McCutcheon and Associates report suggest “Having an emergency plan in place with the ability for foam addition, and good road access from at least 2 directions is imperative.”
- 4.** Though rare, boil over events are extremely dangerous. The TM/McCutcheon and Associates report and the report by the Burnaby Fire Department confirm that such events can discharge heated, molten crude oil to a height of 1 km and a range of .76 km. These distances would affect the SFU campus and should be explicitly accounted for in the emergency plans of both SFU and TM.
- 5.** Wind direction within the boundary layer will largely determine hazard zones, given an incident that releases a plume or toxic chemicals. Though winds with a southerly or southwesterly component are rare at Vancouver airport, the Burnaby Mountain weather stations shows that they are much more frequent at that location. The scenarios analyzed in the TM/McCutcheon and Associates report are based upon a no-wind situation, but winds blowing towards SFU increase risk enormously. The scenarios should be reanalyzed using scenarios of boundary layer winds that blow towards SFU. Hazard planning distances should likewise take this into account.
- 6.** It is standard practise to create hazard maps as part of risks analyses. These provide nearby communities and stakeholders with a tool to evaluate their risk. Such hazard maps do not currently exist for the TM project. Because of the proximity of SFU to both pipelines and tank farms, the generation of hazard maps, including worst case scenarios for SFU, is a priority. A model of suitable complexity should be used, in order to address the topographic and climatic heterogeneities over the region around SFU.
- 7.** There is no evidence that TM has incorporated local meteorological data from SFU in their analyses. With respect to risks to SFU from toxic plumes, sophisticated meteorological modeling of

the boundary layer wind field that includes data from the Burnaby Mountain weather station is required. This is addressed further in Section 12 on air dispersion modelling.

- 8.** Provide an account of the TM emergency management program as defined in ss. 4 of the EMR. This should include measures and personnel identified for coordination of all ERP, an outline of specific exercise development and management provisions, identification of a program coordinator, and provisions for the evaluation of response to an emergency in accordance with section 14 of the EMR.
- 9.** Define responsibility and mechanisms for the comprehensive review and modification of the emergency management program, and for each plan, respectively.
- 10.** Ensure that provisions for 'plans' and 'programs' are addressed separately.
- 11.** Within each site-specific plan, in accordance with ss. 3(2)(c) of the EMR, define how TM will notify entities receiving information regarding an emergency, and appropriate response. This should address site-specific hazards and risks
- 12.** Clarify the types and sizes of potential incidents that would require the assistance of local emergency, municipal or SFU resources
- 13.** Provide a map of each TM site, which includes emergency planning zones pursuant to ss. 3(2) of the EMR.
- 14.** Provide hazard zone and emergency response maps for the Westridge Marine Terminal and Burnaby Tanker Farm, as well as any pipeline infrastructure passing through Burnaby and surrounding municipalities, in accordance with EMR section 15.
- 15.** Update HCA maps to include a comprehensive HCA of the Burnaby Mountain area including parkland and other previously omitted land-use types.
- 16.** In accordance with the EMR, ss. 3(2)(b), provide appropriate site-specific hazards and risks of the oil and gas activity that is the subject of the plan. This amendment should consider removal of 'Tornado' as a risk for the Westridge Marine terminal, and incorporation the types of hazards and risks more in line with those identified in the McCutcheon Report.
- 17.** As recommended by the B.C. Oil and Gas commission, provide a systematic assessment of hazards, threats, risks and vulnerabilities for Westridge Marine Terminal and the Burnaby Tank Farm. If this has not been completed previously, supplementary information should be incorporated into existing emergency response plans.
- 18.** Provide information regarding the 'values at risk' for site-specific operations in accordance with EMR ss. 7(3)(b)(ii). This should include and prioritise hazard controls to people, property, and environment, including road infrastructure and access to SFU.
- 19.** Provide emergency management and response plans for the Burnaby Tank Farm, including hazard planning zones, evacuation, communications and notification plans and procedures.
- 20.** There is no evidence that an extensive verification of the CALPUFF modelling system for the use over the Burnaby-SFU region has been done by TM. Such an analysis needs to be carried out. Since

the spatiotemporal dispersion of airborne toxic chemicals from an emission source (either slowly or catastrophically) depends crucially on the atmospheric flow pattern in the lower troposphere, it is crucial that any air quality dispersion model used should be able to simulate the necessary characteristics of the lower tropospheric flow patterns and turbulent fluxes.

- 21.** There is no evidence that Trans Mountain has carried out an extensive set of simulations using the CALPUFF dispersion modelling system to obtain a general estimate of various possible evolutionary concentration patterns of toxic chemicals once they are released from a catastrophic rupture in storage tanks and/or pipes. Such a set of simulations need to be done.
- 22.** SFU is located on the top of a high-rise plateau (Burnaby Mountain) bounded by a water body to the north and by a relatively flat urban development on rest of the area surrounding the campus. This topographical character around SFU adds another layer of complexity to the capability of the CALPUFF modelling system to simulate, at a realistically level of acceptance, the spatiotemporal dispersion of airborne toxic chemicals. Therefore, an extensive verification of the CALPUFF modelling system for the use over the Burnaby-SFU region needs to be carried out.
- 23.** There are strong seasonal variations in atmospheric circulation and stability over the Burnaby-SFU area. This will have a significant influence on the dispersion characteristics of any toxic chemicals with different buoyancy released into the atmosphere at different times of the year. There is no evidence that Trans Mountain has carried out carried out simulations using a series of releases of chemicals with different buoyancy characteristics under different meteorological circulations and stability conditions (neural, stable, and unstable). Such simulations need to be conducted.

## 13 Endnotes

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**Hearing Order OH-001-2014**

**Trans Mountain Pipeline ULC**

**Application for the Trans Mountain Expansion Project**

## **Opinion on Potential Off-Site Risks of the Proposed Expansion of Burnaby Tank Farm**

**prepared for the City of Burnaby**

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**ASK Consultants**

**Bromley, UK**

**22 May 2015**

## **1 INTRODUCTION**

- 1.1 As part of the Trans Mountain Expansion Project, Kinder Morgan Canada has applied for approval of its plan to increase its crude oil storage at the Burnaby tank farm by doubling the number of tanks and more than trebling their total capacity.
- 1.2 I have been instructed on behalf of the City of Burnaby to provide an independent opinion on the off-site safety aspects of the application.
- 1.3 I have over thirty years' experience of research, lecturing and consultancy in fire and explosion hazards and related fields. I have both a Master's Degree and a Doctorate in Combustion Science and Pollution Control, with five years' post-doctoral research at Imperial College into problems of ignition and flammability. I am a Chartered Scientist, a Chartered Chemist and Member of the Royal Society of Chemistry, a Chartered Engineer and Fellow of the Institution of Chemical Engineers (and a member of its Loss Prevention Panel, and previously of its Environmental Protection Panel) and a Fellow of the Energy Institute. I have taught modules on safety, loss prevention and risk assessment at postgraduate level at several universities in the UK and overseas, and have given evidence on related matters in several criminal trials, as well as in public inquiries, High Court actions and in arbitrations in the UK, US and Australia.
- 1.4 My directly relevant experience includes, among various other projects: heading research into atmospheric dispersion from large pool fires, published in 2001; expert evidence to a Public Inquiry in 2004 into a proposed residential development near the Vopak oil terminal at Ipswich; membership of the internal investigation team appointed by Hertfordshire Oil Storage Limited following the vapour cloud explosion at the Buncefield terminal in December 2005; and leading a master class on process safety at the C5 Tank Storage Summit, Amsterdam, in Jan 2012. My CV is in Appendix 1.
- 1.5 I shall first present a simplified summary in Section 2 of the framework of regulation and assessment within which the risks at the Burnaby facility would be approached in the UK (and, with minor modifications, throughout the EU). In Section 3, I consider the risks themselves and their likely impact on the application had it been made in the UK. My conclusions are in Section 4.

## **2 THE UK APPROACH**

### **2.1 Regulation**

- 2.1.1 In the UK, the Burnaby facility and its proposed extension would be governed under the British implementation of the EU 'Seveso' Directive, namely the Control of Major Accident Hazards Regulations 2015 (COMAH) and the Planning (Hazardous Substances) Regulations 1992 (PHS<sup>1</sup>).

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<sup>1</sup> The PHS is in force in England and Wales; there are separate but similar regulations in Scotland.

## **COMAH**

2.1.2 The Competent Authority responsible for regulating the safety aspects of COMAH is the UK Health and Safety Executive (HSE). By virtue of its flammable inventory, even the existing installation would qualify as ‘top-tier’ under COMAH, obliging the operator, among other duties, to submit to the Competent Authority a safety report and an on-site emergency plan and to contribute to the off-site emergency plan, each of which is subject to revision periodically or if necessitated by some reason such as plant modification.

2.1.3 The core contents of the safety report are well summarised in an internal HSE document<sup>2</sup>. The safety report should:

*a) Show the application of due process for identification and analysis of hazards that is sufficiently rigorous, systematic and proportionate to risk.*

*b) Show how all measures necessary have been identified and linked to specified major accident hazards, and implemented to reduce risks to ALARP [As Low As Reasonably Practicable].*

*c) Justify why identified measures are not implemented by argument under ALARP principles (i.e. gross disproportion of effort or cost linked to risk benefit gained). ‘Argument’ can be made using qualitative or quantitative statements appropriate to the level of risk.*

*d) Show that an on-site emergency plan is in place, based on sound principles and reflecting the major accident scenarios identified.*

2.1.4 For a new site or major expansion of an existing site, the safety report can be submitted in two stages, pre-construction and pre-operation, the former in somewhat less detail. Nevertheless, for construction to go ahead, HSE must be satisfied at least that there are no serious deficiencies even at this stage in the safety report. An example of a serious deficiency would be failure to provide sufficient information on the process used for identifying the listed major hazards, which would in turn impact on the selection of countermeasures.

## **PHS**

2.1.5 The presence of hazardous substances above defined threshold quantities (well below the existing Burnaby capacity in the case of flammable liquids) triggers the requirement for a hazardous substances consent, usually obtained from the local planning authority.

2.1.6 The application is reviewed, among other statutory bodies, by HSE, which considers the hazards and risks to the public in advising whether or not consent should be granted. Consent is seldom granted against HSE’s advice.

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<sup>2</sup> HSE Safety Report Assessment Manual (freely available from HSE website)

2.1.7 Where HSE advises that consent should be granted, it produces a map of the area around the hazardous installation, with three zones delineated by contours representing defined levels of risk or hazard. Different types and intensities of development are subsequently permitted in each zone, much as set out in the MIACC Land Use Planning Guidelines.

## 2.2 Assessment

2.2.1 Where feasible, HSE draws the contours on the basis of individual risk, as follows:

- Inner zone: the risk of a dangerous dose =  $10^{-4}$  per year (1 in 10,000 per year)
- Middle zone: risk of a dangerous dose =  $10^{-5}$  per year (1 in 100,000 per year)
- Outer zone: risk of a dangerous dose =  $10^{-6}$  per year (1 in 1,000,000 per year)

A dangerous dose (of toxic inhalation, blast or thermal radiation) is approximately equivalent to the threshold of fatality (nominally 1%). Dangerous dose, rather than death, is used as a harm criterion, partly to take into account societal concerns about risks of injury short of death, but also because of technical difficulties in calculating risks of death in view of widely differing individual vulnerabilities.

2.2.2 Again, quantification of risks from fires such as those presented by large oil tank farms is complicated by uncertainty of ignition probabilities. Instead, HSE uses a 'protection based' approach, in which zone boundaries are set according to the consequences of the credible worst-case scenario, so that:

- at the boundary between the inner and middle zones, a typical exposed population would receive a dose corresponding to a significant likelihood (nominally 50%) of death;
- at the boundary between the middle and outer zones, a typical exposed population would receive a dangerous dose;
- at the outer boundary of the outer zone, a sensitive or vulnerable population (e.g. infants, ill or elderly people) would receive a dangerous dose.

2.2.3 In practice<sup>3</sup>, a scenario is considered credible if its estimated frequency exceeds  $3 \times 10^{-7}$  per year (three times in ten million years). Note that, both in advising on applications for hazardous substances consent and in setting zone boundaries, HSE assumes that the installation is built, maintained and operated in accordance with regulatory requirements and industry standards of good practice.

2.2.4 The above approach aims for a separation which gives almost complete protection for lesser and more probable accidents, and worthwhile protection for major but less probable accidents.

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<sup>3</sup> HSE (2008) evidence at Public Inquiry re Oval Cricket Ground, Lambeth, London

- 2.2.5 For thermal radiation, HSE has assessed that the above boundaries correspond to exposures of 1800, 1200 and 500 thermal dose units (TDU), respectively. Thermal dose units are a combination of the intensity and duration of thermal radiation received, weighted towards the former as this plays the greater part in causing harm. The intensity of thermal radiation a person receives depends on the intensity of the radiation emitted, as well as on a geometric ‘view’ factor – essentially, how much of the radiating surface the person’s body ‘sees’ from his location – and on atmospheric absorption.

### **3 RISKS AT THE BURNABY TANK FARM**

#### **3.1 Overview**

- 3.1.1 I understand that the tank farm predates the neighbouring residential area. The impacts of many of the worst industrial accidents – among them Buncefield, Pemex, Bhopal – were aggravated because residential and commercial development had been permitted to encroach on an originally remote hazardous installation.
- 3.1.2 In my opinion, if the residential area had been built up first, then even the existing terminal would have been refused planning permission in the UK, since HSE would have advised against the granting of a hazardous substances consent.
- 3.1.3 The subject application is for
- a very substantial increase in the number and average size of storage tanks;
  - necessitating a substantial increase in congestion, and thus an increased likelihood of incident escalation, both because of reduced inter-tank distances and increased complexity of firefighting tactics;
  - on a site with a marked slope, partly towards the residential area;
  - surrounded by forest containing ample combustible litter etc;
  - which, in turn, surrounds a university campus, whose sole evacuation route, I understand, passes next to the tank farm.
- 3.1.4 In view of the above, the applicant apparently omitting to consider possible alternative sites to Burnaby in which to locate extra storage capacity is of particular concern. In the UK (a far more crowded land than Canada, after all) this omission in itself would probably suffice to sink such an application.

#### **3.2 Nature of the risks**

- 3.2.1 Potential off-site risks are from thermal radiation from pool fires following ignition of large uncontrolled spills or from tank boil-over (see further below), and from inhalation of toxic vapours from unignited spills or toxic combustion products from ignited spills. Internal explosions could propel large tank fragments considerable distances; however, vapour cloud explosion is presumably ruled out by the nature of the flammable inventory.
- 3.2.2 The risk assessment by Doug McCutcheon and Associates contains several shortcomings and errors, of which the most important is the gross underestimate of the risk of boil-over. Two others are worth noting:



- 3.2.3 In case of an oil fire, the modelled hazard distance to the immediately dangerous toxic exposure level (IDLH) is given in Tables 12 and 13 on p25 as 0.4-1.1 km, varying with assumptions of fire area and combustion efficiency. Leaving aside the objection that the IDLH exposure would manifestly not, in fact, be reached anywhere at ground level in this scenario<sup>4</sup>, it is curious that this apparently serious hazard is not mentioned in either set of conclusions (p32 and p40).
- 3.2.4 The analysis on pp27-31 neglects the fact that the statistics are per tank. To a good approximation, the final result should be multiplied by 13 for the current situation and by 26 for the situation after the proposed expansion, i.e. to  $1.3 \times 10^{-4}$  (1.3 in 10,000) and  $2.6 \times 10^{-4}$  (2.6 in 10,000) per year, respectively, thus putting a question mark over whether the risk would exceed MIACC guidelines for the nearby residential area. Further, the range used in the analysis for tank leaks is, in my opinion, not conservative. The data sources for the analysis are several decades old. A more recent review<sup>5</sup>, on which HSE currently relies<sup>6</sup>, gives annual failure rates of  $1 \times 10^{-4}$  (1 in 10,000) for major releases (1000 mm hole diameter for large tanks) and  $2.5 \times 10^{-3}$  (2.5 in 1,000 or 1 in 400) for 'minor' releases (300 mm hole diameter). Based on these figures, the MIACC tolerability guidelines would very likely be exceeded.
- 3.2.5 Note that the MIACC guidelines are for development near a major hazard – and not for the converse situation: the construction or expansion of a major hazard near existing residential areas.
- 3.2.6 For the Burnaby tank farm, in my opinion, the risk is dominated by tank boil-over, since this scenario has by far the most severe and most extensive potential consequences and, though relatively infrequent, is wholly credible (has a far from negligible likelihood of realisation).

### 3.3 Boil-over

- 3.3.1 Some details of the mechanism are still uncertain and the subject of research, but in broad terms, boil-over occurs when water at the base of a tank of crude oil (or oil product with a wide boiling range) is suddenly turned to steam upon contact with a wave of heat that has been gradually descending through the oil from a full surface fire. The volume of steam being three orders of magnitude greater than that of the originating water, virtually the entire contents of the tank are explosively ejected and immediately ignited by the surface fire, generating a massive fireball supplemented by widely broadcast drops of burning fuel.
- 3.3.2 The fireball, though of short duration, has a surface emissive power of approximately  $150 \text{ kW/m}^2$ , which is a multiple of the mean surface emissive power of a (largely smoke obscured) crude oil pool fire<sup>7</sup>. Additionally, the geometric factor at nearby

<sup>4</sup> see e.g. Argyropoulos CD et al (2010) Modelling pollutants dispersion and plume rise from large hydrocarbon tank fires in neutrally stratified atmosphere. *Atmospheric Environment* 44(6) 803-813

<sup>5</sup> Glossop M (2001) Failure rates for atmospheric storage tanks for land use planning. Health and Safety Laboratory internal report RAS/01/06

<sup>6</sup> Failure rate and event data for use within risk assessments (28/06/2012) (available on HSE website)

<sup>7</sup> Casal J (2003) Evaluation of the effects and consequences of major accidents in industrial plants: 8 (Industrial Safety Series)(Elsevier)

locations is vastly greater than that of the unobscured portions of a pool fire on a tank, or even in a bund.

- 3.3.3 A number of prevention and mitigation measures have been tried, with varying results but to date always short of full success. In particular, it has not been feasible to ensure the removal of water from crude oil tanks. Likewise, various warning diagnostics of an impending boil-over have proved unreliable, thus putting fire fighters in danger. The highest death toll, more than 150 people, from a boil-over occurred in 1982 in Venezuela; a report of the incident appears in Appendix 2.
- 3.3.4 A simple formula and a set of constants have been developed by INERIS (a research institute connected to the French Competent Authority for the Seveso Directive) for hazard distances for fireballs emanating from boil-overs<sup>8</sup>. The exposures considered by INERIS are almost the same as those associated with HSE's harm criteria above, viz 1800, 1000 and 600 TDU. The relevant extract from the INERIS document appears in Appendix 3.
- 3.3.5 Using the INERIS formula, the maximum hazard distances, measured from the centre of the largest tank suffering the boil-over, are as follows<sup>9</sup>:

Tank capacity (bbl)	Hazard distance (m)		
	to 1800 TDU (~50% fatalities)	to 1000 TDU (dangerous dose; ~1% fatalities)	to 600 TDU (~dangerous dose to vulnerable people)
155K (existing max.)	310	410	500
335K (proposed max.)	440	580	700

- 3.3.6 From the above table, it appears that a boil-over, even in an existing tank, with less than half the capacity of the largest proposed tanks, would potentially endanger not only firefighters but also people off-site, especially those outdoors (spectators?), unless they had been evacuated in time.
- 3.3.7 Radiant heat from the fireball as well as the rainout of burning oil would be capable of igniting litter in the surrounding forest and a variety of exposed combustible materials on and around houses<sup>10</sup>. If an uncontrolled forest fire is a credible scenario, then evacuation of Simon Fraser University would be problematic, since both access roads pass very near to the tank farm and might be impassable during the incident.

<sup>8</sup> INERIS (2015) Standard boil-over and thin layer boil-over. Formalization of the knowledge and tools in the field of major risks (DRA-76). Study report DRA-15-111777-00792A

<sup>9</sup> I assume boil-over when tank half full and oil density = 800 kg/m<sup>3</sup>; the results are insensitive to density within the relevant range. Distances tabulated are within at most 10m of different results using the constants for light crude and heavy crude.

<sup>10</sup> Babrauskas V (2003) Ignition handbook (Issaquah: Fire Science Publishers)

- 3.3.8 Escalation would potentially also involve neighbouring tanks, especially any that were downhill of the originating tank. Involvement of multiple tanks would make firefighting still more complicated and hazardous.
- 3.3.9 Mr McCutcheon's risk assessment, which informs the application<sup>11</sup>, nominates three scenarios but declines to assess the risk of the one with the most severe consequences by far, namely boil-over. He states on p26 that it is hard to model, lists some prevention and mitigation measures that he understands are or will be in place, offers some advice on managing the residual risk, and concludes that "This scenario is considered not to be a factor in this analysis". The apparent implication, that the risk is too low to be credible, is reinforced in the first of his Conclusions, on p40, where he states that "The greatest risk is a pool fire". However, Conclusion no.7 perhaps hints at some unease in this regard and the report ends with the sentence "It is noted that similar incidents [boil-overs] have caused major damage for several kilometers outward, and therefore emergency planning **must** include a response for this event" [emphasis added].
- 3.3.10 The incidence of boil-over is by no means so low as to remove it from consideration as a credible scenario, especially in view of its potentially extreme severity.
- 3.3.11 Under the direction of Resource Protection International, a consortium of 16 oil companies has been pooling information including incident data in order to improve understanding of the fire risks associated with large atmospheric storage tanks - the LASTFIRE project<sup>12</sup>. Although most of this project, including the reports and analysis tools it has generated, is the confidential property of the consortium members, some information has found its way into the public domain. A 2011 presentation in Sweden<sup>13</sup> included statistics on various types of fire, according to which the predicted frequency of full surface fire - the usual precursor of boil-over - had risen from  $3.0 \times 10^{-5}$  (3 in 100,000) per tank per year in 1997 to  $4.21 \times 10^{-5}$  (4.21 in 100,000) in 2011. The probability of escalation to boil-over had been given in 1997 as 1: a certainty. This prediction was modified in the presentation but unfortunately the modification is not recorded. However, even assuming the predicted probability of escalation is now halved, the predicted frequency of boil-over in a terminal holding 26 tanks is greater than  $5 \times 10^{-4}$  (5 in 10,000 or 1 in 2,000) per year, or over 1000 times higher than HSE's cut-off frequency (see 2.2.3 above).
- 3.3.12 A review of incidents world wide by the Swedish National Testing and Research Institute<sup>14</sup> supports the LASTFIRE finding that full surface fires are likely to escalate: of 22 full surface fires (out of a total of 104 fires recorded), 16 went on to produce boil-over.

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<sup>11</sup> Trans Mountain Expansion Project vol 7: Risk assessment and management of pipeline & facility spills, para 3.2.2 and Appendix E

<sup>12</sup> [www.lastfire.org.uk](http://www.lastfire.org.uk)

<sup>13</sup> <http://www.sp.se/sv/units/fire/PublishingImages/BRd/ETANKFIRE/ETANK%20revised.pdf>

<sup>14</sup> Persson H, Lonnermark A (2004) Tank fires. Review of fire incidents 1951-2003. SP Fire Technology Report 2004:14

3.3.13 The statistics may well understate even the current risk at the Burnaby site, let alone the risk post-expansion. According to a recent study<sup>15</sup>, even in the Port of Rotterdam, where ample specialist firefighting personnel and equipment are available nearby, it takes the fire department up to four hours from the moment they receive the alarm to the moment they are able to apply firefighting foam premix to the fire. The report by the City of Burnaby Deputy Fire Chief<sup>16</sup> shows that the situation at Burnaby is far less favourable than at Rotterdam, markedly increasing the probability that a boil-over will occur before a full surface fire is extinguished.

#### **4 CONCLUSIONS**

- 4.1 The application for expanding the Burnaby Terminal would, in my opinion, have failed in the UK and, in all probability, throughout the EU. My reasons are as follows:
- 4.2 I have seen no evidence that the applicant has considered alternative sites for the extra storage tanks in appropriate detail or at all.
- 4.3 The risk assessment carried out on behalf of the applicant contains several serious deficiencies, the most important of which is that it fails to give due regard to the credible worst case scenario of tank boil-over and incorrectly states that the worst case is a pool fire.
- 4.4 A valid risk assessment (addressing both severity and likelihood), with due consideration of boil-over, would in my opinion lead to the conclusion that the risk is already high and would become intolerably high (by my understanding of MIACC as well as by UK criteria) if the expansion went ahead, in view of the logistical complexity of fire fighting on a congested and sloping site, the proximity of residential areas and forestry and the difficulty, in an emergency, of safely evacuating Simon Fraser University.

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<sup>15</sup> van Buren J (2013) Principles and management of information process for integrated management of fire safety at Seveso sites. PhD Thesis, University of Delft, The Netherlands

<sup>16</sup> Bowcock C (2014) Trans Mountain Tank Farm tactical risk analysis (version 3, 2014 July 01)

**TRANS MOUNTAIN PIPELINE ULC  
TRANS MOUNTAIN EXPANSION PROJECT  
NEB HEARING ORDER OH-001-2014  
REPLY EVIDENCE**

**Reply to the City of Burnaby  
“Burnaby Fire Department Trans Mountain  
Tank Farm Tactical Risk Analysis”**

**August 2015**

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## LIST OF APPENDICES

Appendix A Website References

## 1.0 INTRODUCTION

1 This report is Trans Mountain Pipeline ULC's (Trans Mountain) Reply to the City of Burnaby's  
2 intervener evidence report titled "Burnaby Fire Department Trans Mountain Tank Farm Tactical  
3 Risk Analysis" (Filing ID [A4L8F6](#) and [A4L8F7](#); the Burnaby Report).

4 The purpose of a risk assessment is to identify unwanted events that can happen and to  
5 determine the likelihood of occurrence. Trans Mountain's opinion is that the risk analysis report  
6 prepared by the Burnaby Fire Department is not a risk assessment. The report focuses on  
7 consequences of extreme events but does not give due consideration to the hazards required to  
8 create them, the likelihood of their occurrence especially given the engineered controls and  
9 safety managements systems applied for their prevention and mitigation. Rather than an  
10 assessment of risks the result is an inventory of extreme potential consequences, none of which  
11 are unknown to the Trans Mountain Expansion Project (the Project) or the industry in general.  
12 While public concern for these types of events is well founded, it is also reflected in the  
13 extensive requirements for regulation, design, and operation of storage facilities, all of which are  
14 in place today and required to continue. The Burnaby Report fails to properly consider hazards,  
15 likelihood, and mitigation, and therefore the consequences it purports to be "risks" are alarmist  
16 and speculative.

17 The Burnaby Report presents two general categories of hazards assumed for the expansion of  
18 the Burnaby Terminal: 1) hazards associated with the loss of containment of product from a  
19 tank; and 2) hazards associated with a fire in a tank. This replies contained in this Reply are  
20 therefore generally focused on the same hazards.

21 The author of the Burnaby Report makes three key errors. Firstly, the Burnaby Report missed or  
22 failed to acknowledge evidence submitted in the NEB process by Trans Mountain related to the  
23 facility design of the Burnaby Terminal and improvements to the fire protection system, as well  
24 as other mitigation measures. Secondly, in missing this evidence in its analysis, the Burnaby  
25 Report bases its conclusions about increased risk on the premise that "*the time prior to life and  
26 environmental impact will be significantly reduced by TMEP, as many of the engineered in  
27 facility configuration counter measures responsible for minimization of event growth and  
28 corresponding impact escalation have been greatly reduced from the original facility  
29 premises...*" (page 6). This is incorrect. In fact, as Trans Mountain demonstrates in the following  
30 sections, it is proposing to greatly increase the risk control measures at the Burnaby Terminal.  
31 Lastly, the Burnaby Report is founded upon the premise that Trans Mountain Expansion Project  
32 (TMEP) risk control measures are inadequate and will leave hazards unaddressed, which will  
33 quickly escalate to affect adjacent neighbourhoods. This premise is incorrect. Again, as  
34 reiterated in the following sections, Trans Mountain's proposed risk control measures are  
35 focused on identifying and controlling hazards to keep incidents from occurring and, in the  
36 unlikely event that an incident does occur, Trans Mountain's engineered controls and  
37 emergency response measures would prevent the escalation of the incident to adjacent  
38 neighbourhoods.

39 Trans Mountain addresses these three key errors in the Burnaby Report, as well as a number of  
40 other issues raised in the Report in the following sections of this Reply:

- 41 . Facility Siting and Design;
- 42 . Facility Risk Assessment; and
- 43 . Emergency Management Program.

1 level measurement and overflow protection. Redundant instrumentation for overflow protection will  
2 also be provided (Buncefield Major Incident Investigation Board 2008; Refer to Appendix A).

#### 4.0 EMERGENCY MANAGEMENT PROGRAM

3 Section 4.0 of this Reply addresses the assumptions and conclusions in the Burnaby Report  
4 related to Trans Mountain's emergency management program.

5 As discussed in detail in the previous two Sections of this Reply, the Burnaby Report outlines a  
6 number of potential, though unlikely, incidents that may occur at the Burnaby Terminal, which  
7 do not take into account the numerous controls in place to ensure the safety of the facility.

8 In the Trans Mountain response to NEB IR No.1.98a - Attachment 3 (Filing ID [A3W9S5](#)), Trans  
9 Mountain filed the risk assessment for the Burnaby Terminal expansion, which was prepared by  
10 Doug McCutcheon and Associates (the McCutcheon Report). The McCutcheon Report  
11 addressed the question of whether the expanded terminal, once completed and in operation,  
12 would pose acceptable levels of risk to the surrounding community. It is important to note that  
13 the Report analyzes potential impacts arising from a number of **unmitigated** tank fire scenarios,  
14 which are very unlikely to occur given the preventative measures currently in place, or planned  
15 to be put into place should the expansion proceed, at the Burnaby Terminal. In other words,  
16 under these potential unmitigated risk analysis scenarios, no fire detection, suppression or other  
17 actions are implemented to control a tank fire that has the potential to lead to a boil over event.  
18 The McCutcheon Report scenarios represent the most-credible worst-case scenarios for tank  
19 fires in terms of risk to the surrounding community. The fact that fire suppression and other  
20 emergency actions do not occur in the modelled scenarios adds materially to the conservatism  
21 of the conclusions of the McCutcheon Report.

22 As noted in Section 2.0 of this Reply, the current Burnaby Terminal facility has detection,  
23 mitigation and fire prevention measures in place for potential fires, including fire water reservoir  
24 and pump system, fixed and portable fire-fighting monitors, extensive stockpiles of fire-fighting  
25 foam concentrate and fire-fighting foam trailers. Each current external floating roof tank at the  
26 terminal is equipped with a semi-fixed foam placement system and an infrared fire eye detection  
27 system. The fire-fighting measures will be further enhanced as part of the Terminal expansion  
28 design.

29 The design and operation of the expanded Burnaby Terminal will include extensive,  
30 industry-leading fire protection equipment, including but not limited to, fixed tank rim seal and  
31 full-surface fire-fighting foam suppression systems for each new tank. Essentially ensuring rim  
32 seal and full-surface fire suppression systems can be deployed by the push of a button.

33 These systems will be backed up by portable foam and water monitors. The installed fire  
34 suppression measures will exceed applicable code requirements, and when combined with tank  
35 operating procedures to minimize the accumulation of water within the tanks as well as the  
36 extensive maintenance program, will reduce the likelihood of a fire let alone escalation to a  
37 full-surface fire or the potential to have a boil over event to an extremely low probability.  
38 The design of the expanded Burnaby Terminal will ensure safe access from two directions for all  
39 possible fire locations within the terminal facility.

40 On page 7 of the Burnaby Report (Filing ID [A4L8F6](#)) the author asserts that it was notified by  
41 KMC on May 30, 2014 that the facility no longer has the emergency response ability to  
42 extinguish fire events with internal facility resources. This statement is false. As Trans Mountain



1 has stated several times, the current Burnaby Terminal has the equipment and resources onsite  
2 to extinguish a rim seal fire, and the equipment necessary for extinguishment of a full-surface  
3 fire with external resources, as outlined in the response to the City of Burnaby IR No. 2.027e  
4 (Filing ID [A4H8A1](#)). Trans Mountain understands that the City of Burnaby cannot and will not  
5 respond to hydrocarbon fire events at Trans Mountain facilities however will respond to the  
6 impacts from the potential event on the surrounding community.

7 In Appendix H of the Burnaby Report (Filing ID [A4L8F6](#)) notes from a meeting that occurred  
8 between current operations personnel and the Fire Department which occurred on May 30,  
9 2014 have been included. Trans Mountain would like to highlight that *“no agenda was presented  
10 and no discussion or agreement was made as to the taking of formal meeting minutes or by  
11 whom formal meeting minutes would be taken,”* in fact the agreement to meet was on the  
12 condition that expansion would not be discussed and that the meeting was informal in nature.  
13 Additionally it has been recognized by both organizations that the independent notes taken do  
14 not constitute formal minutes and that the notes taken by Kinder Morgan Canada differ  
15 significantly from those presented in this appendix. The following are examples of incorrect  
16 information;

- 17 · Item 20 in the notes indicate that the facility has no personnel trained to operate the mobile  
18 fire protection equipment, this is untrue all facility personnel receive training on all aspects of  
19 the facility including the fire suppression equipment both fixed and mobile.
- 20 · Item 22 indicates a “significant” delay for night shift response, Kinder Morgan Canada  
21 indicated there would be a delay, however does not characterized this delay as significant.
- 22 · Item 32/33 indicates that Kinder Morgan Canada stated there was no Emergency Plan for  
23 the facility, this is incorrect. An Emergency Plan did and does exist for the facility; however,  
24 it was being updated to be more specific and separate from the pipeline Emergency  
25 Response Plan. At no time has there not been an Emergency Response Plan for the  
26 Burnaby Terminal.

27 The Burnaby Report outlines the following potential fire scenarios in the report, which if left  
28 unmitigated without response actions, could escalate in the manner described in their report.  
29 Trans Mountain believes that, in the unlikely event an incident were to occur at the Burnaby  
30 Terminal, it would not escalate to the magnitude of the hazards detailed in the Burnaby Report  
31 due to the preventative measures incorporated into the design of the Burnaby Terminal (refer to  
32 Section 3.1 of this Reply), as well as the immediate emergency response measures that would  
33 be undertaken to prevent escalation. Prevention and preparedness would effectively reduce the  
34 risk of escalation.

#### 4.1 Rim Seal Tank Fire

35 As the Burnaby Report points out, the typical cause of a rim seal fire is due to accumulated  
36 induced charge ignition from area lightning strikes, and the primary control for such a fire would  
37 be foam application to the rim seal area. As described in the response to NEB IR No. 3.093  
38 (Filing ID [A4H1V2](#)). Trans Mountain has committed to early fire detection systems and fixed  
39 automated full-surface fire suppression allowing for the application of foam to the rim seal area  
40 within minutes of confirmation of a fire on the tank being conducted by visual inspection.

41 The Burnaby Report states that *“the greatest risk associated with a rim seal fire is the event  
42 escalation to a full-surface tank fire,”* Trans Mountain agrees with this assessment in terms of

1 response; however by ensuring early detection as described above and a fixed fire suppression  
2 system the probability of escalation is reduced. The Burnaby Report further states that fire  
3 suppression systems are subject to a lack of maintenance. This statement is false. Trans  
4 Mountain has in place a maintenance and inspection schedule for all of its facilities including the  
5 existing fire suppression systems that includes annual flushing of all foam suppression lines,  
6 annual foam testing confirming accurate proportioning of foam as well as third party testing of  
7 foam concentrate. Third party inspection and testing of fire water pumps, hydrants, fire  
8 equipment, this level of maintenance will continue into the future. Trans Mountain is committed  
9 to the safety of its facilities and ensuring the response equipment is operational is part of that  
10 commitment.

#### 4.2 Full-Surface Tank Fire

11 Trans Mountain agrees with the Burnaby Report that a typical cause of a full-surface tank fire is  
12 from the escalation of a rim seal fire event, and that it may be obstructed or unobstructed in  
13 nature. The Burnaby Report points out that sustained foam solution application should be from  
14 mobile or fixed fire suppression systems at a rate that achieves or exceeds the rate required to  
15 extinguish the fire. Again, as outlined in the response to NEB IR No. 3.093 (Filing ID [A4H1V2](#)),  
16 Trans Mountain has committed to early detection systems and full-surface fire suppression  
17 systems with a manual back-up system. This system will be designed to exceed the calculated  
18 rate of application as outlined in the NFPA standards.

19 The Burnaby Report highlights that the consequences of a full-surface fire include slopover,  
20 frothover, boilover, adjacent tank fires and tank failure. By installing early detection systems  
21 coupled with fixed full-surface fire suppression capability with manual back-up systems Trans  
22 Mountain is confident that a tank fire may be detected and suppressed early to avoid prolonged  
23 burning, which leads to these types of events. The manual back-up systems will be available for  
24 operation by Trans Mountain personnel and third party industrial fire-fighting personnel, adding  
25 to a faster response with mobile equipment for adjacent tank cooling operations as the  
26 equipment will be stored onsite as it is today.

#### 4.3 Dike Spill Ignition

27 The Burnaby Report ascertains that the cause of a dike spill ignition fire is by a failure of some  
28 portion of the tank piping causing a large spill to the ground. In developing its conclusions, the  
29 Burnaby Fire Department relied on the more volatile components of lighter gasoline and other  
30 products that are not stored at the Burnaby facility to describe an expanding highly flammable  
31 vapour cloud, and resulting consequences. The Burnaby Fire Department does point out that  
32 loss of containment on crude oil presents a lower risk of flammable vapour generation.

33 Trans Mountain agrees with the Burnaby Report that early detection and isolation of the release  
34 source is critical. All current tanks and planned tanks have gauging alarms that detect high  
35 operating levels and deviations in tank contents, which indicate early on if there is an issue with  
36 the tank piping (*i.e.*, from a release), or if the tank is being overfilled. In addition the tank bays  
37 have hydrocarbon detection that alerts operations of a potential spill in the tank bay.  
38 As described previously, Trans Mountain has mobile equipment onsite that is capable of  
39 creating and sustaining a foam blanket over the spilled product, cutting the vapour, and  
40 reducing the chance of ignition of spilled product.

#### 4.4 Tank Spacing and Facility Design Impacts for Fire-fighting

1 The Burnaby Report has hypothesized that, as a result of the layout of the expanded tank farm,  
2 a fire would be inextinguishable due to the lack of safe fire-fighting positions. All new tanks to be  
3 installed at Burnaby Terminal will be spaced to meet AFC which is more stringent than NFPA 30  
4 (please also refer to a further discussion of tank spacing in Section 2.2 of this Reply). The  
5 facility response to an emergency is designed around the safety of first responders, as well as  
6 the public, with an automated full-surface fire suppression system that can be activated from a  
7 safe location onsite as well as offsite at Kinder Morgan Control Centre in Edmonton. Mobile  
8 manual back-up equipment onsite will be deployable from at least two locations for each tank,  
9 as it is today. The installation of industry-leading early detection systems and automated full-  
10 surface fire suppression systems on all new tanks, and all back-up mobile equipment stored  
11 onsite, will allow for safe extinguishment of a fire at the tank farm.

#### 4.5 Future Engagement with the City of Burnaby on Emergency Management Planning

12 Trans Mountain has committed to engaging with the City of Burnaby in the response to City of  
13 Burnaby IR No. 2.002 (Filing ID [A4H8A1](#)) in regards to the enhancements for the emergency  
14 management program. In the response to the City of Burnaby IR No. 2.001 (Filing ID [A4H8A1](#)),  
15 KMC has committed to pursuing a mutual aid agreement with the City of Burnaby, contingent on  
16 the interest of the City of Burnaby in such an agreement. Further to these commitments in  
17 regards to the emergency management program documentation and response agreements  
18 Trans Mountain has expressed its desire to meet with the City of Burnaby at a mutually  
19 agreeable time to discuss the design of the fire protection system at Burnaby Terminal prior to  
20 the design being finalized, as outlined in the response to the City of Burnaby IR No. 2.020  
21 (Filing ID [A4H8A1](#)). To date, the City of Burnaby has not agreed to meet to discuss any of these  
22 matters related to the Project.

#### 5.0 CONCLUSIONS

23 The Burnaby Report is a simple cataloguing of potential hazards at a hydrocarbon storage  
24 facility and provides no acknowledgement of the site-specific risk control measures Trans  
25 Mountain is proposing to add to the Burnaby Terminal, should the expansion proceed. The  
26 Burnaby Fire Department's Report is unsupported by any evidence or references and results in  
27 incorrect conclusions of the risk to the surrounding communities with the expanded Burnaby  
28 Terminal.

29 The Burnaby Report does not provide an accurate critique of the design of the Burnaby  
30 Terminal, as it does not acknowledge Trans Mountain's proposed risk control measures, and  
31 the facility risk assessment evidence presented by Trans Mountain in the NEB's proceeding.

#### 6.0 REFERENCES

- 32 Buncefield Major Incident Investigation Board. 2008. *The Buncefield Incident*  
33 *11 December 2005*. Final report of the Buncefield Major Incident Investigation Board  
34 (Volume 1). Buncefield, England. 104 pp.
- 35 CNN. 2015. *Lightning suspected in fire at North Carolina gasoline "tank farm."* Website:  
36 <http://www.cnn.com/2010/US/06/13/north.carolina.gas.fire/>. Accessed June 2015.

**TRANS MOUNTAIN PIPELINE ULC  
TRANS MOUNTAIN EXPANSION PROJECT  
NEB HEARING ORDER OH-001-2014  
REPLY EVIDENCE**

**Reply to Simon Fraser University  
“Hazards to Simon Fraser University Associated with the Trans  
Mountain Expansion Project: A Gap Analysis” (David Etkin, Kaz  
Higuchi, Sarah Thompson, Markus Dann)**

**August 2015**

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## ABBREVIATIONS AND ACRONYMS

This table lists the abbreviations and acronyms used in this report.

Term	Meaning
AER	Alberta Energy Regulator
API	American Petroleum Institute
BC	British Columbia
BCBC	British Columbia Building Code
BCFC	BC Fire Code
BC OGC	BC Oil and Gas Commission
Board	National Energy Board
CAER	Community Awareness and Emergency Response
CALMET	CALMET (a diagnostic 3-dimensional meteorological model)
CALPUFF	CALPUFF (an air quality dispersion model)
CO <sub>2</sub>	carbon dioxide
CPCN	Certificate of Public Convenience and Necessity
CSA	Canadian Standards Association
EGIG	European Gas Pipeline Incident Data Group
EMP	Emergency management program
EPZ	Emergency Planning Zone
ERCB	Energy Resources Conservation Board
ERPs	Emergency Response Plans
ICS	Incident Command System
IR	Information requests
km	kilometre
KMC	Kinder Morgan Canada Inc.
MIACC	Major Industrial Accidents Council of Canada
NEB	National Energy Board
NFPA	National Fire Protection Association
OGAA	Oil and Gas Activities Act
OPR	Onshore Pipeline Regulations
RSA	Regional Study Area
RWDI	Rowan Williams Davies and Irwin Inc. (RWDI) Consulting Engineers
SFU	Simon Fraser University
SRB	Sulphate reducing bacteria
SO <sub>2</sub>	sulphur dioxide
the Project	Trans Mountain Expansion Project
TM	Trans Mountain
TMEP	Trans Mountain Expansion Project
TMPL	Trans Mountain pipeline
TMPL system	Trans Mountain pipeline system
Trans Mountain	Trans Mountain Pipeline ULC as general partner of Trans Mountain
VCU	Vapour combustion unit
VOC	Volatile organic compounds
VRU	Vapour recovery units

## 1.0 INTRODUCTION

1 This report was prepared by Dynamic Risk, RWDI Air Inc., Bruce Jamer Energy Consulting, and  
2 the Facilities Engineering Team on the Trans Mountain Expansion Project (TMEP or the  
3 Project) to respond to the intervenor evidence submitted by Simon Fraser University, specifically  
4 the report titled “*Hazards to Simon Fraser University Associated with the Trans Mountain*  
5 *Expansion Project: A Gap Analysis*”, (David Etkin, Kaz Higuchi, Sarah Thompson, Markus  
6 Dann) (the Etkin Report) (Filing ID [A4Q0X4](#)).

7 As stated in Section 2.0, paragraph 6 of the Etkin Report, the purpose of their Intervenor  
8 Evidence was to evaluate Trans Mountain Pipeline ULC’s (Trans Mountain) emergency  
9 management program, as well as to examine the “risk assessment methodology related to air  
10 dispersion modelling” used by Trans Mountain in its application to the National Energy Board  
11 (NEB).

12 As Trans Mountain describes in the following sections, the Etkin Report relies on faulty  
13 assumptions and misinterprets references and literature to provide misleading conclusions  
14 about the risk assessments presented by Trans Mountain as well as Trans Mountain’s  
15 emergency management program (EMP). With respect to the Etkin Report findings on the air  
16 dispersion modelling undertaken by Trans Mountain, in most cases the findings confirm RWDI  
17 Air Inc.’s methodology for the air dispersion modelling undertaken to support the Application to  
18 the NEB as well as subsequent Technical Updates.

19 Trans Mountain’s Reply to the Etkin Report is organized into five sections based on the  
20 following topics:

- 21 . Jurisdiction
- 22 . Facility Risk Assessment
- 23 . Pipeline Risk Assessment
- 24 . Air Emissions and Modelling
- 25 . Emergency Management

## 2.0 JURISDICTION

26 In several instances, the Etkin Report references emergency planning legislation that is not  
27 applicable to the Project (*e.g.*, see paragraph 10, Sections 6, 8, and 9). Trans Mountain is a  
28 federally regulated pipeline system. It is regulated by the NEB, not the British Columbia Oil and  
29 Gas Commission (OGC). For example, the Etkin Report states in paragraph 10:

30 “Section 8 of this report will analyze the Trans Mountain emergency planning  
31 system, primarily through comparison to the National Energy Board Onshore  
32 Pipeline Regulations – SOR/99-294 and the Emergency Management Regulation  
33 (EMR), B.C. Reg. 204/2013 of the B.C. Oil and Gas Activities Act (OGAA). The  
34 former is the primary enforcement mechanism for inter-provincial pipeline  
35 operations in Canada, and the latter governs the Oil and Gas industry in B.C.  
36 Together, they outline a minimum standard for compliance for activities of the TM  
37 project and Kinder Morgan.”

1 In paragraph 46, the Etkin Report states:

2 “As an interprovincial pipeline, Trans Mountain is principally regulated by the  
3 NEB. However, the BC Oil and Gas Commission (BC OGC) is also responsible  
4 for pipeline safety, mainly in the form of consideration of applications for land  
5 access or permits. This has resulted in some shared regulatory responsibility  
6 between the BC OGC and the NEB. According to the OGC, its more specific  
7 objectives are “public safety and environmental soundness in the design,  
8 construction, testing, operation, maintenance, and spill response planning for  
9 natural gas and hazardous liquid pipeline facilities within BC.”

10 These statements are misleading for two reasons:

- 11 1) Companies regulated by the NEB are not simultaneously regulated by the BC OGC for  
12 pipeline operations and for emergency planning despite the Etkin Report’s interpretation of  
13 jurisdictional matters for inter-provincial pipelines. Trans Mountain can confirm that the  
14 operation of TMEP would be regulated solely by the NEB. Furthermore, a comparison of an  
15 EMP designed to meet the NEB’s requirements against the requirements of the OGC is not  
16 relevant and may present misleading conclusions about compliance perceived gaps in the  
17 program; and
- 18 2) The requirements for emergency planning under the NEB Onshore Pipeline Regulations  
19 (OPR) and the OGC are not intended to be interpreted together to outline the minimum  
20 standard of compliance for activities of the Project. The requirements of each jurisdiction are  
21 relevant to the assets regulated within that jurisdiction.

22 Accordingly, Trans Mountain contends that the aspects of the Etkin Report recommendations 8,  
23 11, 13, 14, and 16-18 that reference compliance with the OGC’s regulations, including its  
24 emergency planning requirements are not relevant for this Project.

25 After a review of the curriculum vitae of each of the authors, it is evident that none of the authors  
26 have specific experience in emergency planning for pipelines regulated by either the OGC or by  
27 the NEB, and therefore the misinterpretation of jurisdiction for the Project may be unintentional.  
28 Nevertheless, the conclusions drawn in the Etkin Report after comparing the emergency  
29 management documents provided by Trans Mountain, which are related to the existing Trans  
30 Mountain Pipeline System (TMPL) and not the Project, are incorrect and misleading. Please see  
31 a detailed examination of these conclusions in the following section of this Reply.

### 3.0 EMERGENCY MANAGEMENT PROGRAM

32 Section 3.0 provides Trans Mountain’s Reply to the Etkin Report findings related to the EMP for  
33 the Project, specifically Sections 7, 8, and 9 of the Etkin Report and the supporting  
34 recommendations. Trans Mountain notes that the Etkin Report authors appear to have reviewed  
35 the existing TMPL Emergency Planning documents to draw conclusions about Trans Mountain’s  
36 emergency planning capacity for the Project. As Trans Mountain has noted several times in  
37 response to past intervenor information requests (IRs), the existing EMP for TMPL will be  
38 updated and enhanced for the Project and will be in place prior to operation. The NEB does not  
39 require applicants to provide emergency response plans or other emergency planning  
40 documentation as part of its regulatory review process.



### 3.1 Burnaby Tank Farm Terminal

1 The Etkin Report advances the concern, with related recommendations 3 and 4, that a potential  
2 tank boil over event “...*would envelop part of all (sic) of the SFU campus on Burnaby Mountain,*  
3 *and make evacuation difficult or impossible...*” The Etkin Report further states that the area,  
4 estimated in the Etkin Report as up to 0.76 km from the affected tank, that could be impacted by  
5 a tank boil over incident originating from the Burnaby Terminal, should be explicitly accounted  
6 for in the emergency plans of both Simon Fraser University (SFU) and Trans Mountain.

7 In the Trans Mountain response to NEB IR No.1.98a - Attachment 3 (Filing ID [A3W9S5](#)), Trans  
8 Mountain filed the risk assessment for the Burnaby Terminal expansion, which was prepared by  
9 Doug McCutcheon and Associates (the McCutcheon Report). The McCutcheon Report  
10 addressed the question of whether the expanded terminal, once completed and in operation,  
11 would pose acceptable levels of risk to the surrounding community. It is important to note that  
12 the Report analyzes potential impacts arising from a number of **unmitigated** tank fire scenarios,  
13 which are very unlikely to occur given the mitigative measures currently in place, or planned to  
14 be put into place should the expansion proceed, at the Burnaby Terminal. In other words, under  
15 these potential unmitigated risk analysis scenarios, no fire suppression or other actions are  
16 implemented to control a tank fire that has the potential to lead to a boil over event. The  
17 McCutcheon Report scenarios represent the most-credible worst-case scenarios for tank fires in  
18 terms of risk to the surrounding community. The fact that fire suppression and other emergency  
19 actions do not occur in the modelled scenarios adds materially to the conservatism of the  
20 conclusions of the McCutcheon Report.

21 The current Burnaby Terminal facility has detection, mitigation, and fire prevention measures in  
22 place for potential fires, including fire water reservoir and pump system, fixed and portable  
23 firefighting monitors, extensive stockpiles of firefighting foam concentrate and firefighting foam  
24 trailers. Each external floating roof tank at the terminal is equipped with a semi-automatic foam  
25 placement system and an infrared fire eye detection system. The firefighting measures will be  
26 further enhanced as part of the Terminal expansion design. The design and operation of the  
27 expanded Burnaby Terminal will include extensive, industry-leading fire protection equipment,  
28 including but not limited to, fixed tank rim seal and full surface firefighting foam placement  
29 systems for each new tank. These systems will be backed up by portable foam and/or water  
30 monitors. The installed fire suppression measures will exceed applicable code requirements,  
31 and when combined with tank operating procedures to minimize the accumulation of water  
32 within the tanks, will reduce the likelihood of a tank boil over event to an extremely low  
33 probability event. The design of the expanded Burnaby Terminal will ensure safe access from  
34 two directions for all possible fire locations within the terminal facility.

35 The Etkin Report recommendation 4 goes on to quote the McCutcheon Report as follows:  
36 “*Having an emergency plan in place with the ability for foam addition, and good road access*  
37 *from at least 2 directions is imperative.*” For clarity, the context of the excerpt from the  
38 McCutcheon Report quoted in the Etkin Report Recommendation 4 was in relation to firefighting  
39 access within the expanded Burnaby Terminal and not to the road access to SFU.

40 The enhanced Kinder Morgan Canada Inc. (KMC) EMP, to be developed if approval of the  
41 Project is received from the NEB, will contain emergency response plans for all credible worse  
42 case emergency scenarios, including tank fires. The Application Volume 7, Section 4.8 (Filing ID  
43 [A3S4V5](#)) outlines the process to enhance KMC’s existing EMPs as they relate to the Trans  
44 Mountain pipeline system to address the needs of the Project. The final programs will be  
45 developed in a manner consistent with the NEB’s draft conditions 42, 52, 53 and 54. Trans

1 Mountain expects this process will address the relevant aspects of the Etkin Report  
2 recommendations 6, 8, 9, 10, and 19.

3 The McCutcheon Report documents, among its other findings, the results in terms of the  
4 determination of acceptable level of risk at the Burnaby Terminal site and surrounding areas in  
5 the City of Burnaby. The determination of acceptable levels of risk was made with reference to  
6 the Major Industrial Accidents Council of Canada (MIACC) criteria, which is regarded as the  
7 guide and best practice in Canada (Section 3.0 of this Reply). The proposed conceptual design  
8 of expanded Burnaby Terminal included in Section 3.4.3.1, Volume 4A of the Facilities  
9 Application (Filing ID [A3S0Y9](#)), meets the MIACC criteria for the risk from a secondary  
10 containment area (pool) fire. Subsequent to the preparation of the McCutcheon Report in 2013,  
11 Trans Mountain revisited a number of preliminary risk assessments, including the McCutcheon  
12 Report and in Technical Update #2 (Filing ID [A4A4D5](#)) proposed several changes to further  
13 refine the terminal design and reduce the risk to the surrounding community.

14 Trans Mountain believes that the expanded terminal, with its design incorporating extensive oil  
15 containment and industry-leading fire suppression systems, supported by appropriate  
16 procedures and operating practices, will greatly reduce the potential effect and duration of any  
17 fire event at the Burnaby Terminal, in the unlikely event a fire event were to occur. In the event  
18 of a fire, Burnaby Terminal operating staff would immediately deploy foam or other firefighting  
19 measures in accordance with enhanced procedures required to minimize the fire size, duration,  
20 and impacts on the public in the surrounding area. Trans Mountain expects that the extensive  
21 fire mitigation measures, combined with enhanced emergency response procedures,  
22 comprehensive terminal operating and maintenance practices and procedures, will minimize or  
23 eliminate the potential for loss of road access to and from SFU.

### 3.2 Access and Evacuation

24 Trans Mountain appreciates and understands the concerns expressed in the Etkin Report about  
25 access and potential negative effects to SFU operations if access were to be impaired during an  
26 emergency event. Trans Mountain also agrees that contingency planning for all credible  
27 emergencies is a necessary and prudent activity. The response to Province of BC IR No. 2.30c  
28 (Filing ID [A4H8W6](#)) summarizes KMC's role in resident/community evacuations, in the rare  
29 event that they become necessary:

30 "...Although KMC is not responsible for the emergency planning of other  
31 organizations, it welcomes the opportunity to work collaboratively with  
32 organizations and responders in developing a protocol/plan to ensure a safe and  
33 timely response to incidents at its facilities and along the pipeline, including  
34 evacuations should that be required to ensure the safety of nearby residents.  
35 KMC will continue to offer to review emergency response plans (ERP), educate  
36 their personnel on our operations, and provide advice on proper response  
37 techniques. KMC prefers to jointly manage incidents with the local, provincial,  
38 and federal authorities in the jurisdiction of the emergency using Unified  
39 Command within the Incident Command System (ICS)..."

40 To assist SFU in updating their emergency plans to reflect the nearby Trans Mountain Burnaby  
41 Terminal, KMC and TMEP initiated discussions of the KMC ERPs, existing and anticipated  
42 expansion facilities with SFU emergency planning and response personnel in September and  
43 December, 2014. KMC expects to conduct a series of further information sharing meetings of  
44 this type in future.

1 The organizations which have the authority and responsibility to conduct evacuations are  
2 discussed in the response to City of Burnaby IR No. 2.058c (Filing ID [A4H8A1](#)):

3 “...Kinder Morgan Canada Inc. (KMC) expects to work co-operatively with the  
4 municipal emergency responders in the unlikely event of an emergency  
5 occurring. KMC anticipates working collaboratively with the local first responders  
6 through an Incident Command System (ICS) structure to coordinate air  
7 monitoring and other activities in the unlikely event the need arises. KMC would  
8 consult with the local municipal authority to determine the best course of action to  
9 protect the public. KMC will provide municipal emergency services with air quality  
10 measurements as they are gathered to assist in their response. The decision as  
11 to the best course of action and subsequent actions taken to evacuate residents  
12 are the responsibility of local emergency services. KMC does not have the  
13 legislative authority to undertake evacuations...”

14 KMC’s role in working with municipal officials who have the authority to issue an evacuation or  
15 shelter in place order is explained in the response to City of Burnaby IR No. 2.058d (Filing  
16 ID [A4H8A1](#)):

17 “...KMC’s role in notification of schools, businesses, and residents will primarily  
18 be to provide local emergency services agencies with air quality measurements  
19 and other relevant status information on an ongoing basis through the ICS  
20 Liaison Officer or other appropriate position in ICS as it becomes available to  
21 assist them in their response in the local community. The decisions made as to  
22 the best course of action and subsequent actions taken to direct residents to  
23 shelter in place or to evacuate are the responsibility of local municipal emergency  
24 services. This includes the communication of instructions for shelter in place...”

### 3.3 Emergency Response Programs and Plans

25 As noted in Section 2.0 of this Reply, the Etkin Report findings and recommendations that are  
26 premised on the Project being subject to OGC legislation and requirements for emergency  
27 management planning are incorrect.

28 The Etkin Report notes that the existing Trans Mountain Emergency Response documents do  
29 not adequately separate Programs and Plans. Trans Mountain is aware of the distinction  
30 between Emergency Response Programs and Plans in the context discussed in the Etkin  
31 Report. It is Trans Mountain’s belief that the current KMC EMP and ERPs contain the  
32 information required by the NEB and have been written and organized in such a way as to fully  
33 comply with NEB requirements as described in NEB OPR Sections 32 to 35 inclusive. Trans  
34 Mountain believes that the current KMC EMP and KMC ERPs are robust for the existing system  
35 and provide full compliance with NEB requirements. KMC has incorporated any changes  
36 recommended or ordered by the NEB during numerous emergency planning exercises and  
37 during actual responses, which were attended by the NEB over the past number of years. KMC  
38 also monitors the regulations and practices of other jurisdictions, including the OGC so that  
39 ongoing improvements and best practices can be identified and, where needed, incorporated  
40 into KMC’s Program and Plans on an ongoing basis.

41 If a Certificate of Public Convenience and Necessity (CPCN) is granted and the Project  
42 proceeds, Trans Mountain will begin the development of an enhanced EMP for the expanded  
43 pipeline system. Consultation with stakeholders on relevant aspects of the enhanced EMP and

1 its components such as ERPs will be a key activity to be completed by Trans Mountain prior to  
2 pipeline system operation commencing. Input received from communities and First Nations  
3 groups during the consultations and also suggestions received through other means such as  
4 intervenor evidence will be considered for inclusion in the enhanced EMP and in its constituent  
5 ERPs and other documents.

6 Trans Mountain disagrees with the opinion stated in the Etkin Report (PDF page 41 of 67) that  
7 the existing EMP and various ERPs are not compliant with the NEB OPR Sections 33 and 34.  
8 The compliance of KMC's existing EMP is not within the scope of this current proceeding;  
9 however, the NEB regulates the existing EMP as well as all other aspects of the existing TMPL  
10 within its jurisdiction throughout the lifecycle of the system.

11 With respect to how the EMP for the Project will comply with the NEB's requirements, and more  
12 specifically to Sections 33 and 34 of the NEB OPR, Trans Mountain initiated the process of  
13 working with SFU personnel in December 2014 to provide information as the university  
14 contemplates changes to its own ERPs that reflect the proposed Burnaby Terminal expansion.  
15 The initial meeting was the first of what Trans Mountain hopes and expects will be a series of  
16 working meetings intended to provide SFU with relevant information for updating its Emergency  
17 Planning documents. Through these meetings, it is Trans Mountain's intention to share relevant  
18 information from its existing and future enhanced ERPs with SFU emergency planning and  
19 response personnel, also to inform them of the practices and procedures to be followed in the  
20 event of an incident at Burnaby Terminal or along the pipeline.

21 Trans Mountain has always endeavored to ensure that it fully compliant with NEB requirements  
22 and promptly addresses and tracks all audit findings of the NEB related to its documents and  
23 operations.

### 3.4 Exercises

24 The Etkin Report states that it appears that Trans Mountain has no specific plan for conducting  
25 emergency response exercises for emergency response staff. The Etkin Report goes on to  
26 assert that there is no clear outline of how or what type of exercises will test the Trans Mountain  
27 ERPs.

28 Volume 7, Section 4.6.2 (Filing ID [A3S4V5](#)) states that "...KMC conducts, on average, 20 to 25  
29 training, table-top, and deployment exercises at locations along the pipeline each year..." KMC  
30 maintains a plan and a schedule for staging effective and successful emergency exercises for  
31 the existing TMPL and will continue to do so once the EMP has been developed and  
32 implemented for the Project.

33 The KMC emergency exercise plan and annual schedule, which form a part of the existing KMC  
34 EMP do exist but were not part of evidence filed to date as they pertain to the existing TMPL,  
35 not the Project. KMC, operator of the Trans Mountain Pipeline system, conducts emergency  
36 response training and exercises ranging from table top exercises to equipment deployments to  
37 worst-case emergency response drills and has done so for many years. A full listing of  
38 exercises conducted in the past five years is provided in the response to NEB IR No. 1.69a  
39 (Filing ID [A3W9H8](#)). Classroom training was also conducted on various topics, including but not  
40 limited to:

41           · Incident Command Training;

- 1           · Incident Safe Approach;
- 2           · Fire Systems Trainings;
- 3           · Specialized equipment training;
- 4           · Jet boat operation;
- 5           · Security systems training;
- 6           · Hazardous Waste Operations and Emergency Response; and
- 7           · Course refresher training as needed.

8 KMC sets the exercise priorities on an annual basis in accordance with the requirements of the  
9 NEB OPR and the KMC EMP management system. The exercise schedule for the Project will  
10 take into consideration any NEB conditions related to emergency management.

11 Local government and external agencies are invited to many training events. Trans Mountain  
12 will continue to invite these groups to take part in the planning and execution of the exercise  
13 within their respective jurisdictions, where exercises take place.

14 KMC's Emergency Response team creates and maintains annual plans and schedules for  
15 emergency response exercises for training KMC's emergency response staff. Due to the  
16 dynamic nature of the exercise schedules, KMC has found it to be most effective to create the  
17 annual plan for emergency response exercises and administer the schedule within the  
18 Emergency Response team rather than publishing it in ERPs, which would then require frequent  
19 revisions for changes to the exercise schedule and distribution of the changes to the ERPs.  
20 Employees and other participants are scheduled for specific exercises and are advised well in  
21 advance by email. Participation in annual emergency response training and exercises forms  
22 part of each KMC field operations employee's individual training plan, which in turn form part of  
23 their respective annual performance and development plans.

### 3.5 KMC Evacuation

24 The Etkin Report observes that the current KMC ERPs contain no specific mention of location-  
25 specific needs for evacuation at Westridge or Burnaby Terminals. Trans Mountain agrees that  
26 there is no specific mention of location-specific evacuation needs at Westridge Marine or  
27 Burnaby Terminals. Employee information on appropriate circumstances and actions to  
28 evacuate a terminal site can be found elsewhere in EMP documents. The response to City of  
29 Burnaby IR No. 2.024d (Filing ID [A4H8A1](#)) states that evacuation plans such as those  
30 requested in the question for existing facilities, are documents that form part of the KMC EMP.  
31 Trans Mountain will develop location-specific employee/contractor evacuation plans for the  
32 expanded Burnaby and Westridge Terminals as part of the enhanced EMP.

### 3.6 Stakeholder Inclusion

33 The Etkin Report contains the observation that both SFU and the BC Ambulance Service are  
34 not identified as stakeholders in ERPs. Trans Mountain agrees that the absence of SFU and BC  
35 Ambulance Service as stakeholders in the KMC Emergency documentation is a valid  
36 observation and this oversight will be corrected in future revisions of the Program for the  
37 existing TMPL and for the Project.

### 3.7 Communication and Notification

1 The Etkin Report asserts that the KMC Emergency Response Plan has no specific procedure  
2 for notification or communication with SFU in the event of an incident. The current KMC ERPs  
3 contain an effective general contact procedure that is well-suited for use in many different types  
4 of events in varying locations. The absence of information in existing ERPs regarding specific  
5 procedures for contacting SFU in the event of an incident that might impact that institution is a  
6 valid observation. The earlier-referenced emergency planning discussions with SFU, which  
7 commenced in December 2014, will include discussion of contact processes to specifically  
8 address SFU notification in the event of an incident. Once the specifics of the contact process  
9 have been finalized the information will be incorporated into the appropriate KMC ERPs. Until  
10 this has occurred, the existing contact procedure in KMC ERPs will continue to be used. The  
11 existing contact procedure has provision for contacting local governments and impacted  
12 communities, such as SFU.

### 3.8 Assistance from Local First Responders

13 The Etkin Report states that the KMC ERPs do not identify the types of incidents requiring the  
14 assistance of local emergency, municipal and SFU resources. Trans Mountain's view is that the  
15 Emergency Level of a given incident (Level 1, 2 or 3) is what ultimately determines the  
16 necessity of KMC seeking assistance from local emergency, municipal and/or SFU resources.  
17 General descriptions of what events and impacts fall into the different Emergency Levels are  
18 described in Volume 7, Section 4.3, Table 4.3.1 (Filing ID [A3S4V5](#)).

19 KMC has an ongoing program to provide information to local first responders along the pipeline  
20 system. The program is known as the Community Awareness and Emergency Response  
21 (CAER) programs, and is delivered by a combination of trained KMC field and emergency  
22 response staff in sessions of 2 to 3 ½ hour duration depending on the specific needs and  
23 requirements of the local responders. The CAER program is a key activity for promoting  
24 information exchange with local first responders and contributes to meeting the requirements of  
25 the NEB OPR Section 35. CAER training is described in Volume 7, Section 4.7 (Filing  
26 ID [A3S4V5](#)).

27 The CAER sessions provide information to first responders on the types and properties of  
28 petroleum transported through the pipeline and stored at terminal facilities, types of potential  
29 incidents, and generally when and how to respond safely in terms of safe approach and  
30 required personal protective equipment. When additional, specific information is needed, KMC  
31 is happy to conduct follow up meetings with concerned community first responders. KMC  
32 remains committed to the exchange of detailed information with SFU that will assist it in  
33 formulating its own ERPs, which began at an initial meeting in December 2014.

### 3.9 Impact Zones

34 The Etkin Report asserts that hazard distances are not adequately addressed in documentation  
35 for the expanded pipeline system, and therefore Trans Mountain does not meet requirements of  
36 BC OGC Emergency Management Regulation.

37 Trans Mountain agrees with the Etkin Report recommendation 6 that updated detailed hazard  
38 distance maps will be needed in the enhanced ERPs for potential fire events at the prospective,  
39 expanded terminal facilities. Radiant heat radius maps (initial fire hazard zone distances) are  
40 documented in the existing KMC EMP. The enhanced KMC EMP, which will include updated  
41 ERPs, will be developed if NEB approval of the Facilities Application is received and will include

1 updated heat radius (fire hazard zone distance) maps. The maps will include the expanded  
2 Trans Mountain Pipeline system terminal facilities, such as Burnaby and Westridge Terminals.  
3 Further, as stated in the response to Province of BC IR No. 2.30a (Filing ID [A4H8W6](#)): "...KMC  
4 confirms that it has carried out assessments of potential evacuation zones in relation to its  
5 storage terminal facilities. The existing emergency response plans for these facilities include  
6 aerial photo maps outlining the initial evacuation zones for fire events including potential  
7 roadblock location. These maps provide a means to expedite decisions by the unified command  
8 or incident commander in the early stages of an incident. Please refer to the response to  
9 Province of BC IR No. 2.21b. (Filing ID [A4H8W6](#)). The enhanced EMP will be developed,  
10 including similar analysis of potential evacuation zones, to reflect the needs of the expanded  
11 pipeline system if Line 2 is approved..."

12 Trans Mountain is aware that the Canadian Standards Association (CSA) is currently in  
13 discussions with industry and regulators about what, if any, changes, enhancements, or  
14 guidance notes are needed concerning Emergency Planning Zone (EPZ) distances. Current oil  
15 and gas regulations contain some requirements for EPZs and Trans Mountain will continue to  
16 monitor developments in terms of these discussions.

#### 4.0 FACILITY RISK ASSESSMENT

17 Section 4.0 provides Trans Mountain's Reply to the Etkin Report findings related to the Burnaby  
18 Terminal Risk Assessment, specifically Section 5 and the associated recommendations in the  
19 Etkin Report.

#### 4.1 Burnaby Terminal Storage Tank Spacing

20 In paragraph 33 of the Etkin Report, the authors imply that the tank spacing and position creates  
21 a hazard for the surrounding area and that the tank spacing "*increases the chance of escalation*  
22 *of a single tank fire to multiple tanks.*" For the reasons provided by Trans Mountain in the  
23 following paragraphs, and given the fire prevention and emergency response measures outlined  
24 in Section 3.1 of this Reply, Trans Mountain does not agree with the Etkin Report findings.

25 Trans Mountain believes that the City of Burnaby community planning principles, including the  
26 zoning of neighborhoods with respect to industrial and residential uses and the set-backs  
27 established in the City of Burnaby bylaws, are primarily intended to protect the safety of the  
28 residents. The location of the proposed new storage tanks will result in set-backs greater than  
29 those established in the City of Burnaby bylaws for the M7a Marine District 2, which is a set-  
30 back requirement for the storage of petroleum products of 61 m (200 ft.).

31 The NEB OPR requires that pipeline systems be designed in accordance with CSA Standard  
32 Z662. CSA Standard Z662, Clause 4.15.1.2 requires that the location and spacing of storage  
33 tanks be in accordance with National Fire Protection Association (NFPA) Code 30. NFPA 30,  
34 Clause 22.4.2.1 requires that floating roof storage tanks have a spacing of 1/4 times the sum of  
35 adjacent tank diameters, where open diking is provided (as is the case at Burnaby Terminal).  
36 This is consistent with the spacing of 0.25 times the sum of adjacent tank diameters required by  
37 the BC Fire Code (BCFC), Division B, Part 4, Clause 4.3.2.2. Trans Mountain notes that the  
38 topography of the Burnaby Terminal site will make the minimum spacing defined by NFPA 30  
39 relevant only for adjacent tanks within each terrace and within the two-tank or three-tank  
40 groupings proposed. The spacing between tanks on different terraces and in different groupings  
41 will be not less than one diameter and in most cases substantially greater.

1 Trans Mountain selected initial tank diameters and laid out the tanks to optimize the use of the  
2 available space at Burnaby Terminal, respecting the NFPA Code 30 and the BCFC tank spacing  
3 and property line set-back requirements. Tank numbers and capacities were tested through  
4 simulation modelling to ensure that the proposed expanded operation of Westridge Marine  
5 Terminal could be effectively supported. Trans Mountain assessed the containment capacity  
6 requirements of the BCFC, including consideration of shared containment. Three-dimensional  
7 topographical and civil design models were used to determine if the required containment  
8 capacities could be practically achieved. The process was repeated iteratively, resulting in the  
9 currently proposed design. Consideration was also given to the potential extent of secondary  
10 containment pool fire radiant heat contours and small adjustments were made to the surface  
11 areas and locations of the secondary containment areas.

12 Due to the topography at the terminal, the tank to tank spacing in the south to north (uphill)  
13 direction is much greater than that required by NFPA Code 30. The following are a few  
14 illustrative examples:

- 15           · Tank 75 to Tank 74
  - 16               - NFPA 30 spacing: 29.3 m
  - 17               - Proposed spacing: 77.7 m
  - 18               - Proposed / NFPA 30 ratio: 2.65
- 19           · Tank 89 to Tank 86
  - 20               - NFPA 30 spacing: 25.5 m
  - 21               - Proposed spacing: 64.3 m
  - 22               - Proposed / NFPA 30 ratio: 2.52
- 23           · Tank 97 to Tank 98
  - 24               - NFPA 30 spacing: 27.4 m
  - 25               - Proposed spacing: 55.5 m
  - 26               - Proposed / NFPA 30 ratio: 2.02

27 Trans Mountain notes that the distances identified in the McCutcheon Report, for a radiant heat  
28 level of  $37.5 \text{ kW/m}^2$  (sufficient to cause damage to process equipment) do not extend beyond  
29 the secondary containment areas.

30 The statutory requirement for tank spacing, in NFPA Code 30, is identical to the requirement in  
31 the National Fire Code of Canada and the BCFC, reflecting broad acceptance of its  
32 appropriateness. Trans Mountain believes the statutory requirement was developed to achieve  
33 a reasonable balance between risk and the efficient use of space. In fact by utilizing the tank  
34 spacing allowed by the statutory requirements, Trans Mountain is able to maximize the  
35 distances to residential areas for the same number of tanks, thus reducing the potential  
36 consequences from what they might otherwise be if a greater spacing were to be used.

## 4.2 Burnaby Terminal Risk Mitigation Measures

37 As noted in Section 3.1 of this Reply, the McCutcheon Report indicates that the proposed  
38 expansion meets the MIACC criteria for acceptability, even without mitigation measures, such  
39 as fire protection. Nevertheless, Trans Mountain has chosen to include a robust fire protection  
40 system, which exceeds the statutory requirement for fire protection. Trans Mountain's proposed



1 mitigation measures address the statements in paragraph 1 of the Etkin Report that the Burnaby  
2 Terminal will result in increased risk for SFU and that “...previous levels of safety will be  
3 *decreased by densification of the tank farm...*”

4 The risk mitigation measures that Trans Mountain intends to implement for the proposed new  
5 storage tanks during detailed engineering and design, construction, and operations, are  
6 generally outlined below:

7 · Design of the proposed new storage tanks at Burnaby Terminal will be in accordance with  
8 the latest edition of the American Petroleum Institute (API) Standard 650, as per the  
9 legislative requirements. API Standard 650 identifies specific design provisions for seismic  
10 stability and seismic design parameters in accordance with the British Columbia Building  
11 Code, as applicable. Seismic design, including consideration of sloshing and other effects,  
12 will be in accordance with API 650, Annex E. All designs, including seismic considerations,  
13 will be undertaken by experienced and competent registered professional engineers.  
14 Geotechnical programs, which will include borehole and other investigative methods to  
15 obtain subsurface data, will be conducted, and the results and recommendations of  
16 registered professional engineers and geologists will be used to inform the seismic designs.  
17 Trans Mountain will also consider applicable topography and soil conditions in the design of  
18 tanks, tank foundations, and containments systems.

19 · All proposed new storage tanks at Burnaby Terminal will be located within secondary  
20 containment designed in accordance with CSA Standard Z662 and NFPA Code 30.

21 · Fabrication of components, construction, and installation will be rigorously inspected to  
22 ensure that the prescribed designs are followed and structural integrity will be verified by  
23 testing, as applicable. General information on design and quality verification principles is  
24 included in Sections 2.1 through 2.7, Volume 4A (Filing ID [A3S0Y8](#)) and Sections 3.4.8  
25 through 3.4.13, Volume 4B (Filing ID [A3S0Y8](#)) of the Facilities Application. Numerous other  
26 references to design principles and features and quality assurance methods exist  
27 throughout Volume 4A and 4B of the Facilities Application.

28 · Following construction, each storage tank will be hydrostatically tested (with water) which is  
29 more dense (heavier) than crude oil.

30 · Trans Mountain is highly confident that the proposed new storage tanks at Burnaby  
31 Terminal can be safely constructed in the vicinity of existing operational tanks, based on the  
32 recent successful experience, over a three year period, with constructing 16 new large  
33 diameter storage tanks immediately adjacent to the existing operating tanks at Edmonton  
34 Terminal. Site-specific safe work procedures and mitigation measures will be developed  
35 during detailed construction planning.

36 · Storage tank protective device design will generally include radar gauging, overflow  
37 protection, fire detection, leak detection, hydrocarbon detection in secondary containment  
38 areas, and terminal fire protection systems as outlined in Section 3.4, Volume 4A of the  
39 Facilities Application (Filing ID [A3S0Y8](#)).

40 · Trans Mountain will provide overflow protection in accordance with API Standard 2350,  
41 Overflow Protection for Storage Tanks in Petroleum Facilities. All proposed tanks will be  
42 equipped with a radar gauging system for liquid level measurement and overflow protection.  
43 Redundant instrumentation for overflow protection will also be provided. For tanks not

- 1 designated as mainline relief tanks, the overfill protection system will automatically cause  
2 the tank valve to close if the liquid reaches a predetermined level. The overfill protection  
3 arrangement will be finalized during the detailed engineering and design phase of the  
4 Project.
- 5 · The under-tank leak detection system proposed for each new storage tank will consist of  
6 perforated pipes which will drain to a sump adjacent to the tank. The leak detection system  
7 design will be in accordance with API Standard 650, Annex I.
- 8 · Lightning protection for the proposed tanks will be determined during the detailed  
9 engineering and design phase of the Project, following the requirements of API Standard  
10 650, API Recommended Practice 545 and other recognized lighting protection standards  
11 and guidelines.
- 12 · Several types of fire detection technologies are available for tanks, including linear wire heat  
13 detector technology, linear fibre heat detector technology, and triple infrared detector  
14 technology. The most suitable technology for the proposed tanks will be selected during the  
15 detailed engineering and design phase of the Project. When the design basis for the  
16 proposed fire protection systems is finalized, during detailed engineering and design,  
17 specifications and drawings will be developed under the supervision of experienced and  
18 competent professional engineers, specializing in fire protection. Trans Mountain also  
19 retains the services of an industrial fire-fighting specialist to provide advice on conceptual  
20 and detailed design.
- 21 · Risk mitigation measures are also a subject of ongoing Hazards and Operability (HazOp)  
22 reviews. The first of a series of HazOp reviews was completed in Q2, 2014. This HazOp  
23 review focused on the primary elements of the crude oil process piping at Burnaby Terminal.  
24 Additional HazOp reviews were conducted in Q2, 2015 to complete the process piping at  
25 Burnaby Terminal. Additional reviews will be required to assess the fire-water / foam  
26 systems, and the non-process elements of the terminal design (*i.e.*, such as emergency  
27 response) at Burnaby Terminal. The risk assessment for Burnaby Terminal will be  
28 considered in coordination with the HazOp reviews and the implementation of any  
29 recommendations arising from the HazOp reviews.
- 30 · Trans Mountain intends to install fire protection systems on or nearby the proposed new  
31 storage tanks, as applicable, that will be designed to address the following spill or fire  
32 scenarios:
- 33 - Tank floating roof rim seal fire (fixed to tank, automated foam application).
  - 34 - Tank full surface fire (fixed to tank, automated foam application).
  - 35 - Tank full surface fire (application by portable foam monitors).
  - 36 - Adjacent tank cooling (application by portable water / foam monitors).
  - 37 - Release to secondary containment (application by portable foam monitors for odorous &  
38 combustible vapour suppression).
- 39 Trans Mountain notes that the fixed, automated, full-surface fire protection feature proposed for  
40 the new tanks at Burnaby Terminal was not included in the Facilities Application and has been  
41 added to further enhance the robustness of the fire protection systems.
- 42 Trans Mountain anticipates that the Burnaby Terminal fire protection system will also include the  
43 following elements:

- 1           ·    Fire Water System:
  - 2                   -    make-up water connection from the City of Burnaby;
  - 3                   -    expanded fire water reservoir;
  - 4                   -    two fire water pumps (one diesel-powered and one electric-powered);
  - 5                   -    fire water distribution system;
  - 6                   -    hydrants located throughout the expanded areas of the terminal; and
  - 7                   -    portable water monitors.
  
- 8           ·    Fire Foam System:
  - 9                   -    foam storage tank and injection system;
  - 10                  -    foam distribution system;
  - 11                  -    fire detection equipment on the new storage tanks;
  - 12                  -    foam distribution and application systems on the new storage tanks;
  - 13                  -    foam manifolds located throughout the expanded areas of the terminal; and
  - 14                  -    portable foam monitors.

15   Operating and maintenance procedures, routine inspection and maintenance activities, and  
16   facility integrity management, which will generally safeguard the proposed storage tanks, are  
17   described in Sections 5.0, 6.0 and 8.0, Volume 4C of the Facilities Application (Filing  
18   ID [A3S1L1](#)).

19   Trans Mountain uses a Qualitative Risk Assessment Matrix to review facility integrity hazards  
20   and to qualitatively assess the risk of hazards. The matrix also considers the prevention,  
21   detection, and protection measures applied to control hazards at facilities. In general, each  
22   preventive control measure reduces the likelihood of a hazard, while each detective and / or  
23   protective control measure reduces the consequence. Refer to NEB IR No. 3.093 (Filing  
24   ID [A4H1V2](#)) for additional information on the risk assessment matrix.

### 4.3           Radiant Heat Distances

25   The Etkin Report paragraph 29, states “Maximum distance of radiant heat impact from a pool  
26   fire = 733 m” and “Maximum distance of radiant heat impact from a tank top pool fire = 216 m”,  
27   which were based on a 1.0 kW/m<sup>2</sup> radiant heat intensity distance as indicated in the  
28   McCutcheon Report. However, the values referenced in the Etkin Report from the McCutcheon  
29   Report are based on a smokeless fire, which is unlikely for crude oil. A crude oil fire will  
30   undoubtedly generate heavy smoke, which will significantly reduce the 1.0 kW/m<sup>2</sup> heat intensity  
31   maximum distances to 536 m for a secondary containment pool fire and to 184 m for a full  
32   surface tank fire. Furthermore, based on the additional information provided below, Trans  
33   Mountain believes that in the highly unlikely event of a secondary containment pool fire or a full  
34   surface tank fire, the 4.0 kW/m<sup>2</sup> heat intensity maximum distance of 224 m for a secondary  
35   containment pool fire and 71 m for a full surface tank fire are more representative of the  
36   conditions that could be expected to cause significant injuries.

37   A figure showing the 4.0 kW/m<sup>2</sup> radiant heat intensity contour for tank secondary containment  
38   pool fires is provided for the Burnaby Terminal in NEB IR No. 4.33a - Attachment 3 (Filing  
39   ID [A4K4X7](#)). The effect of the 4.0 kW/m<sup>2</sup> radiant heat intensity level used in the risk assessment  
40   is defined as significant injury to people after approximately 100 seconds of exposure and no  
41   significant damage to equipment. Significant injury could include second degree burns if it is not  
42   possible for those impacted to obtain protection or to move to a safe distance from the fire within

1 the specified time period. With second degree burns, there is a risk of fatalities. For a radiant  
2 heat intensity level below  $4.0 \text{ kW/m}^2$ , the risk of fatalities is essentially zero.

3 Trans Mountain notes that the  $4.0 \text{ kW/m}^2$  contour was chosen, for risk assessment purposes, as  
4 the threshold for potential injury to the public and is not intended to imply damage to public  
5 lands. Damage to public lands would require a much higher level of radiant heat, perhaps as  
6 high as  $25.0 \text{ kW/m}^2$ , which would occur much closer to the tanks and secondary containment  
7 areas than the  $4.0 \text{ kW/m}^2$  radiant heat level.

8 A figure showing the  $1.0 \text{ kW/m}^2$  radiant heat intensity contour for tank secondary containment  
9 pool fires is provided for the Burnaby Terminal in NEB IR No. 4.33a - Attachment 6 (Filing ID  
10 [A4K4Y0](#)). The radiant heat intensity level of  $1.0 \text{ kW/m}^2$  is anticipated to be equivalent to injury  
11 received from a sunburn (*i.e.*, first degree burn).

12 The radiant heat distance calculations in the McCutcheon Report assume there is no wind  
13 present and the fire is essentially vertical. Wind will affect the flame slightly, which in turn could  
14 affect the radiant heat impact distance. However, the difference in the radiant heat impact  
15 distance caused by wind is expected to be small in comparison to the somewhat large distances  
16 related to the radiant heat intensity values of  $1.0$  and  $4.0 \text{ kW/m}^2$ .

17 Trans Mountain provided a revised proposed tank layout for Burnaby Terminal in Technical  
18 Update No. 2, Part 2, Conceptual Design of Burnaby Terminal and Westridge Marine Terminal  
19 (Filing ID [A4A4D5](#)) and in Part 2, Attachment 1.0-1, Proposed Plot Plan - Burnaby Terminal  
20 (Filing ID [A4A4D6](#)). The update indicated changes to the diameters of three of the 14 tanks from  
21 those that were identified in the Facilities Application. The rationale for the changes was to allow  
22 a minor reconfiguration of two shared secondary containment areas to draw the  $4.0 \text{ kW/m}^2$   
23 contour further away from a neighbouring residential area to the south. The only material tank  
24 spacing change that was made was a slight increase in the distance between Tank 77 and  
25 Tank 79 as a result of segregating the secondary containment in that area. Trans Mountain also  
26 provided a revised radiant heat intensity contour, in Part 2, Attachment 1.0-3, Secondary  
27 Containment Fire  $4\text{kW/m}^2$  Radiant Heat Intensity Contour - Burnaby Terminal (Filing  
28 ID [A4A4D8](#)). Since the changes were specifically made for the purpose of slightly reducing the  
29 radiant heat risk, the overall conclusions of the Burnaby Terminal Risk Assessment were  
30 unchanged. Trans Mountain has not changed the number or sizes of the tanks since Technical  
31 Update No. 2 was filed.

32 As indicated, drawings showing the  $4.0 \text{ kW/m}^2$  and  $1.0 \text{ kW/m}^2$  radiant heat intensity contours for  
33 Burnaby Terminal are included in the response to NEB IR No. 4.33a (Filing ID [A4K4W3](#)). These  
34 drawings more accurately show the radiant heat intensity contours and the sensitive elements  
35 within the contours but do not change the conclusions of the McCutcheon Report.

#### 4.4 Burnaby Terminal Access and Egress

36 Trans Mountain has two operational access / egress roads at Burnaby Terminal and a third  
37 egress could easily be created by minor improvements to a former road (Section 3.1 of this  
38 Reply). Trans Mountain has not considered or prepared plans to identify the need for or to  
39 facilitate the construction of a secondary emergency egress road to or from SFU for the  
40 following reasons:

- 41 · Municipal infrastructure is in the City of Burnaby's jurisdiction.

- 1           · Trans Mountain is proposing to install a robust fire protection system to  
2           significantly reduce the risk of fires associated with the proposed new tanks.
- 3           · Burnaby Terminal existed prior to the construction of SFU. Presumably, SFU  
4           and City of Burnaby planners assessed the potential risks to the campus at the  
5           time of site selection, have done so in the intervening years, and have  
6           concluded that the current egress is acceptable.

7 In the hypothetical case of a tank fire boil over at the Burnaby Terminal, depending on which  
8 tank is considered, it is possible that access to Gaglardi Drive or Burnaby Mountain Parkway  
9 could be temporarily impacted. However, a tank fire boil over is expected to take a significant  
10 amount of time to develop, which should provide ample time for the KMC Burnaby Terminal  
11 Emergency Response Plan measures to be implemented. Emergency response procedures in  
12 such a case may include temporary closure of Gaglardi Drive and / or Burnaby Mountain  
13 Parkway. Trans Mountain looks forward to engaging with SFU and the City of Burnaby during  
14 the update of the Burnaby Terminal Emergency Response Plan associated with the Project.

#### 4.5 History of Kinder Morgan Pipeline Accidents

15 The Etkin Report (Section 4.2.2) states “*Burnaby 2009: 200,000 litres seeped from a storage*  
16 *tank into a surrounding containment bay at the Burnaby Mountain tank farm.*” This statement is  
17 incorrect. The product release to secondary containment was caused by a third party  
18 contractor’s pump connection failure that occurred during tank cleaning work. Product did not  
19 seep from the storage tank, which the Etkin Report implies that a storage tank leak occurred.

#### 5.0 PIPELINE RISK ASSESSMENT

20 Section 5.0 provides Trans Mountain’s Reply to the Etkin Report findings related to the pipeline  
21 risk assessment, specifically Section 4 and the associated recommendations in the Etkin  
22 Report.

23 After a review of the curriculum vitae of each of the authors, it is evident that none of the authors  
24 have specific experience in pipeline risk assessment, pipeline design or pipeline operations.  
25 This leads Trans Mountain to believe that the authors of the Etkin report do not have the  
26 relevant experience to provide expert evidence on these subjects, and that this might be the  
27 underlying reason for the many significant errors made in their approach and findings in matters  
28 related to pipeline risk assessment.

29 The errors in approach and findings may be unintentional, since it could be argued that these  
30 are attributed to a lack of familiarity with the subject matter. Nevertheless, on several occasions,  
31 the authors engaged in poor reporting practices, where cited information has been  
32 misappropriated, misapplied, and even misrepresented, such that when considered collectively,  
33 the document contains a large amount of erroneous and misleading information.

34 By way of example, the text contained on PDF page 8 of the Etkin Report cites the European  
35 Gas Pipeline Incident Data Group (EGIG) in Reference 9. Reference 9, meanwhile, does not  
36 correspond with an EGIG publication, but rather with The Energy Institute (2010), *Technical*  
37 *Guidance on Hazard Analysis for Onshore Carbon Capture Installations and Onshore Pipelines.*  
38 Regardless, when evaluating pipeline incident data, care should be taken to ensure that the  
39 source of those data is consistent with the type of facilities to which the data are intended to be  
40 applied. As stated by the authors of Reference 9, cited in the Etkin Report:

1            *“Whilst there is a small body of failure rate data for carbon dioxide pipelines and*  
2            *a larger body of data for other pipelines, it is important to analyse the data and*  
3            *understand the likely failure modes for carbon dioxide versus other pipelines to*  
4            *ensure that appropriate comparisons are being drawn.”*

5            The avoidance of misappropriation of incident data is one of the most fundamental precepts of  
6            sound pipeline risk assessment practice – a violation of which constitutes a significant error in  
7            methodology. It should be clear therefore, that incident data pertinent to CO<sub>2</sub> pipelines, or  
8            European natural gas pipelines are not particularly relevant to a North American oil transmission  
9            pipeline, which is the subject under consideration in the Project facilities application. Above all,  
10           the broad assumption should not be made that the threat environment and failure rates  
11           associated with either CO<sub>2</sub> pipelines or European natural gas pipeline infrastructure can be used  
12           for the purposes of deriving failure incident trends for liquids pipelines.

13           This fundamental error of citing industry incident data that are not representative of the facilities  
14           that are the subject of evaluation is found in the following locations of the Etkin Report:

- 15                    .     Figure 4.2a, found on PDF page 9;
- 16                    .     Figure 4.2b, found on PDF page 9; and
- 17                    .     Figure 4.2c, found on PDF page 10.

18           Each of the above figures represent copy-and-paste image captures of figures that were  
19           originally published in the 7<sup>th</sup> Report of the EGIG, December, 2008 (since superseded by the 8<sup>th</sup>  
20           Report of the European Gas Pipeline Incident Data Group, December, 2011) (EGIG 2008).  
21           Furthermore, as illustrated below, in each case, the authors of the Etkin report changed the  
22           caption associated with the figure copied from the original EGIG document, such as to provide  
23           misleading information that misrepresents the findings and conclusions of the authors of that  
24           original EGIG report.

25           By way of example, Figure 4.2a of the Etkin Report is captioned “Effect of Age on Failure,” and  
26           it supports the claim made in the Etkin Report that “beyond a pipeline age of about 20 years,  
27           failures increase rapidly.” This conclusion is offered without condition, and is presented as a  
28           relationship that is generally true of all pipelines, unattributed to threat.

29           Meanwhile, the same figure that was used by the authors of the Etkin Report to create their  
30           Figure 4.2a was originally published as Figure 24 in the EGIG Report cited above, where its  
31           caption was “Relationship Between Construction Defect / Material Failure, Size of Leak and  
32           Year of Construction Class”, and it was used to support the conclusion: “Technological  
33           improvements are thought to have resulted in reduced construction defect / material failures”.  
34           These two sets of conclusions, based on the same graphical evidence are completely  
35           inconsistent with one another.

36           Similar alterations of original captions and misrepresentations of information were made by the  
37           authors of the Etkin Report to create Figures 4.2b and 4.2c, based on copy-and-paste image  
38           captures from Figures 18 and 20, respectively of the EGIG Report.

39           The poor standard of analysis and reporting that is found throughout the Etkin Report extends  
40           beyond the simple misrepresentation of the findings of the papers that they reference. In some  
41           cases, and as summarized in the Table below, the source of the information that conclusions  
42           are based upon is of questionable relevance to the subject being commented upon. The

1 following Table provides background information for two Figures that are presented in the Etkin  
 2 report that were once again based on copy-and-paste image captures taken from papers  
 3 published by other authors.

<b>Etkin Report Figure No.</b>	<b>Supported Claim</b>	<b>Concerns Regarding Applicability and Accuracy of Conclusions Drawn</b>
4.2d	Failure probability increases with pressure	<ul style="list-style-type: none"> <li>• Original, referenced paper is of questionable quality</li> <li>• Referenced paper presents results of sensitivity calculations done using a highly-simplistic corrosion failure model developed by the authors</li> <li>• Referenced paper does not identify the type of pipeline that the findings might be relevant to, type of products, whether the model relates to internal or external corrosion, and ignores effects of important factors such as ILI</li> <li>• No discussion provided by authors of referenced paper that their model was ever validated or calibrated by incident data</li> <li>• Etkin Report fails to mention that the trends conveyed by them were the result of a series of example simulations using a highly simplistic model relating to only one threat category, rather than a depiction of real-world trends independent of threat category</li> <li>• In reality, wall thickness generally increases with increasing pressure, and the probability of failure generally decreases with increasing wall thickness.</li> <li>• Another paper cited in the Etkin Report (Reference 17) provides contradictory evidence: “the data indicated a declining leak incident rate as operating pressure increased.” This illustrates <i>the exact opposite trend</i> that is claimed to exist in the Etkin Report.</li> </ul>
4.2e	Failures increase as temperature increases	<ul style="list-style-type: none"> <li>• The trend between temperature and failure frequency is represented in the Etkin Report as being general and without conditions</li> <li>• In fact, the Figure used to support their assertion was derived from a paper entitled “Effect of Temperature in SRB Growth for Oil and Gas Pipeline”, and is specific to sulphate reducing bacteria (SRB) attack</li> <li>• The trend between SRB attack and temperature presented by authors of original paper is specific to internal corrosion only</li> <li>• Internal corrosion due to SRB attack is a highly-specific threat, and requires, as a pre-requisite, a pipeline that carries a product that is prone to SRB attack</li> </ul>

4 Based upon poor analysis and misrepresentation of facts such as illustrated in the above  
 5 examples, the authors of the Etkin Report appear to attempt build a case for their assertion that  
 6 the failure record of oil pipelines in Canada is indicative of what they term ‘disaster datasets’.

7 Figure 4.2f of the Etkin Report forms part of the background for that case, in that it supports the  
 8 assertion: “Hazardous liquid transportation has the highest probability of failure.” It should be  
 9 noted, however, that the information presented in this Figure is relevant only in the context of  
 10 the criteria that are used to define reportable incidents. Specifically, while a spill volume of  
 11 5 gallons is used as the spill volume reporting criterion for Hazardous Liquids pipelines, a spill  
 12 volume of 3,000,000 ft<sup>3</sup> is used as the spill volume reporting criterion for natural gas pipelines.  
 13 Therefore, the claim made in the Etkin Report regarding the failure rates of liquids vs. other

1 pipelines is misleading, since the definition of a reportable incident is not consistent across the  
2 various product class categories.

3 Once again, building towards their conclusion regarding ‘disaster datasets’, on PDF page 14 of  
4 the Etkin Report, the authors make the following observation:

5 “...most of the spills in the U.S. data are oil, followed by natural gas and gasoline  
6 (Figure 4.4). A non-trivial number of spills result in ignition (up to 4.5%) or  
7 explosion (up to over 1%) (Figure 4.5).”

8 The information presented in Figure 4.4 in the Etkin Report is neither normalized by length of  
9 pipeline infrastructure, nor by volume of throughput transported, and is further made  
10 meaningless by the aforementioned lack of consistency in reporting criteria across the various  
11 product categories.

12 With respect to the observation regarding ignition and explosion, the information presented in  
13 Figure 4.5 in the Etkin Report is not specific to crude oil, which is the only product that is  
14 relevant to the TMEP Application. Rather, as pointed out in Figure 4.4, the broad classification  
15 of ‘hazardous liquids’ includes products such as jet fuel, liquefied gases (butane, ethane,  
16 propylene, etc.), propane, gasoline, and natural gas liquids – all of which have significantly  
17 higher vapour pressures than crude oil, and are much more likely to ignite in the event of a spill.  
18 As outlined in Trans Mountain’s response to Wright K IR No. 1.2.4 (Filing ID [A3X6W5](#)), industry  
19 experience has shown that crude oil does not readily ignite in consideration of a potential  
20 pipeline release, even in contemplation of a credible worst-case scenario full-bore rupture. By  
21 way of illustration, Attachment 1 to that IR response (Filing ID [A3X6W6](#)) is a report by Dr. F.  
22 Jeglic, of the NEB in which it was observed that no ignition of spilled product occurred in any of  
23 the pipeline ruptures involving low vapour pressure liquid products (the class of product into  
24 which crude oil falls) over the 20 year analysis period reviewed.

25 On PDF page 21 of the Etkin Report, under the heading of “NEB *Data*,” reference is made to a  
26 “*dataset for Alberta*” that was obtained by the authors of the Etkin Report to provide Canadian  
27 context. The reference provided for this dataset for Alberta was a news article, which in turn did  
28 not cite NEB data, but rather, data from the Alberta Energy Resources Conservation Board  
29 (now the Alberta Energy Regulator or AER). This distinction is particularly relevant, as it speaks  
30 to the importance of ensuring that incident data are relevant to the type of facilities that they are  
31 purported to represent (as opposed to misappropriating data from one type of infrastructure in  
32 order to attribute similar trends to a completely different type of infrastructure).

33 AER infrastructure is dominated by upstream gathering systems that collect raw or partially-  
34 treated products, often containing large amounts of free water, solids, hydrogen sulphide, CO<sub>2</sub>,  
35 and other aggressive materials in a heavily networked pipeline infrastructure that is difficult to  
36 inspect and maintain. The failure rates associated with this type of infrastructure are well  
37 established as being significantly greater than that associated with transmission pipeline  
38 infrastructure. Oil transmission pipelines transport treated transmission-grade products in which  
39 basic sediment and water contents are typically limited to 0.5%. Unlike gathering infrastructure,  
40 they do not transport multi-phase products, and they tend to be regularly inspected and  
41 maintained using state-of-the-art internal inspection tools.

42 The attempt by the Etkin Report to present failure rate information that is relevant to upstream  
43 gathering networks as being characteristic of a transmission pipeline system is a gross  
44 misrepresentation that constitutes unsound analysis. On the basis of this misrepresentation, the



1 Etkin Report, either unaware of the fact that the data it cites are not that of the NEB, or  
2 deliberately misattributing the source, on PDF page 17 of the Etkin Report concludes:

3 “...the NEB Alberta dataset for all spills including gas, shows that the largest gas  
4 related spills in that province have been relatively recent. This brings into  
5 question how applicable increases in safety are in a Canadian context.”

6 Extrapolating the incident data that they have misappropriated from a source that is grossly  
7 unrepresentative of the facilities that are the subject of the Project, the Etkin Report goes on to  
8 make the following sensational statement:

9 “This is typical of disaster data sets, which are best represented by power law  
10 distributions. Because of this, risk analyses should include absolute worst-case  
11 scenarios. This is significant with respect to the selection of ‘credible worst-case  
12 scenarios’ made by TM in their risk analysis; if their selection of credible cases  
13 exclude absolute worst-case scenarios, then their risk analysis is not including  
14 important possibilities.”

15 Given the source of information from which this claim was made, it cannot be considered to be  
16 credible. The Etkin Report Recommendation 1, which pertains to the need for worst-case  
17 scenarios to be used in risk analysis and emergency planning, is predicated on the erroneous  
18 conclusions that the authors draw based on their error-ridden methodology and the  
19 misapplication of incident data. Specifically, failure rate data and associated spill volume data  
20 derived largely from gathering systems were used to represent a transmission pipeline system,  
21 and data relating to the ignition potential of highly volatile liquids were used to represent the  
22 ignition potential of pipeline crude oil spills. Therefore, the flawed basis for the Etkin Report  
23 Recommendation 1 is not relevant to the Project.

24 While risk assessments and emergency planning measures should be guided by worst-case  
25 scenarios, Trans Mountain contends that those scenarios should also be realistic. It is not  
26 realistic to perform a risk assessment for a transmission pipeline by using gathering system  
27 incident data, nor is it realistic to use ignition rates associated with highly volatile liquids as the  
28 basis for guiding emergency planning on a pipeline that carries crude oil.

29 As was described in Section 3.1.6 of Volume 7 of the Application (Filing ID [A3S4V5](#)), for the  
30 purposes of characterizing outflow volumes and consequences associated with a rupture, Trans  
31 Mountain’s outflow analysis was based on a ‘most-credible worst-case scenario’.

32 Trans Mountain’s most-credible worst-case scenario involves a full-bore rupture, followed by  
33 drain-down to the fullest extent possible, given the elevation profile and valve configuration. A  
34 series of multi-layered conservative assumptions are included in the most-credible worst-case  
35 scenario, including a ten minute period before pump shutdown occurs following a full-bore  
36 rupture event. No account is taken of any potential response, intervention, or of any attenuation  
37 of volumes prior to reaching a high consequence area. In this respect the volumes modelled are  
38 highly idealized and conservative, and a review of information relating to past incidents would  
39 support the contention that these should not be taken to be representative of expectations for  
40 real-life spill events, which factor in intervention and response.

41 The results of the outflow model are used as input to the overland and streamflow model. This  
42 model predicts overland spill trajectories that correspond to the full projected extent, without  
43 curtailment after a set time period. Again, as no mitigation, response or intervention is assumed,

1 this adds another layer of conservatism to Trans Mountain’s analysis. The conservatively  
2 calculated spill trajectories are then used for the purpose of High Consequence Area  
3 identification and consequence scoring within the risk model. As an additional layer of  
4 conservatism, Trans Mountain considers not only those locations that are intersected by the  
5 physical alignment of the pipeline, but also those that could be affected by these spill  
6 trajectories.

## 6.0 AIR EMISSIONS

7 Section 6.0 provides Trans Mountain’s Reply to the Etkin Report findings related to the selection  
8 of hazard endpoints, modelling approach and choice of dispersion estimation tools, specifically  
9 Section 12 and the associated recommendations in the Etkin Report.

10 The Etkin Report recommendation 3 notes that:

11 “An accident at the Burnaby Tank Farm or TM pipeline could create hazards that  
12 would envelop part of all of the SFU campus on Burnaby Mountain, and make  
13 evacuation difficult or impossible. Therefore, emergency planning at SFU needs  
14 to include the scenario of an ERPG-2 event, at a minimum. Specifically, the  
15 TM/McCutcheon and Associates report suggest “Having an emergency plan in  
16 place with the ability for foam addition, and good road access from at least  
17 2 directions is imperative.”

18 Trans Mountain agrees with the Etkin Report recommendation that ERPG-2 would be an  
19 acceptable endpoint for evaluating potential health effects from an accident at the Burnaby  
20 Terminal. ERPG-2 is the maximum airborne concentration below which it is believed that nearly  
21 all individuals could be exposed for up to one hour without experiencing or developing any  
22 irreversible or other serious health effects or symptoms that could impair their abilities to take  
23 protective action. As noted in the discussion on pages 22 to 25 of *Scenario Two – Toxic Cloud  
24 Release from a Fire* in the McCutcheon Report, ERPG-2 was used as the endpoint for both  
25 smoke/soot and SO<sub>2</sub> arising from a hydrocarbon fire. Trans Mountain agrees that emergency  
26 planning should be based on this endpoint, and the McCutcheon Report specifies as much in  
27 the summary on page 25. The McCutcheon Report states “*Toxic concerns were identified for  
28 smoke (soot) and for SO<sub>2</sub> downwind of the site. These are both issues that should be included in  
29 the site emergency plan.*”

30 The Etkin Report recommendation 4 notes that:

31 “Though rare, boil over events are extremely dangerous. The TM/McCutcheon  
32 and Associates report and the report by the Burnaby Fire Department confirm  
33 that such events can discharge heated, molten crude oil to a height of 1 km and  
34 a range of .76 km. These distances would affect the SFU campus and should be  
35 explicitly accounted for in the emergency plans of both SFU and TM.”

36 Trans Mountain agrees with the Etkin Report findings and as noted previously, the  
37 recommendations in the McCutcheon Report would serve as a starting point for developing  
38 emergency planning and response plans. *Scenario Three – Boil Over* on page 26 of the  
39 McCutcheon Report provides a qualitative assessment of this type of accident as it is difficult to  
40 accurately model and quantify. The McCutcheon Report finds that Trans Mountain follows  
41 recommended practices for tank design with respect to preventing boil over scenarios by  
42 including an external floating roof tank and management practices that include active monitoring

1 and removal of any water layers from the tank (Section 3.1 of this Reply). The McCutcheon  
2 Report also noted that the tanks are equipped with a foam application capability to which an  
3 inerting capability could be considered.

4 The Etkin Report recommendation 5 notes that:

5 “Wind direction within the boundary layer will largely determine hazard zones,  
6 given an incident that releases a plume or toxic chemicals. Though winds with a  
7 southerly or southwesterly component are rare at Vancouver airport, the Burnaby  
8 Mountain weather stations shows that they are much more frequent at that  
9 location. The scenarios analyzed in the TM/McCutcheon and Associates report  
10 are based upon a no wind situation, but winds blowing towards SFU increase risk  
11 enormously. The scenarios should be reanalyzed using scenarios of boundary  
12 layer winds that blow towards SFU. Hazard planning distances should likewise  
13 take this into account.”

14 As recommended in the Etkin Report, the toxic cloud modelling in the McCutcheon Report  
15 accounted for both wind speed and wind direction. Wind speed was used as part of the  
16 atmospheric stability class determination described in Table 6 of the McCutcheon Report, which  
17 in turn was used in the dispersion modelling. Moreover, and as a modelling conservatism, the  
18 risk assessment approach presented in the McCutcheon Report assumed that the receptor of  
19 interest is always downwind of the hazard/release point. As such, the risk of exposure from a  
20 toxic fire would not be expected to increase based on wind direction (*i.e.*, the probability of the  
21 wind blowing towards SFU was always 1.0 or 100% of the time for this assessment).

22 To be clear, the “no wind” approach was only adopted in the McCutcheon Report for pool fire  
23 scenarios. Additional analysis completed by RWDI Air Inc. indicated that wind speed will change  
24 the tilt or shape of the flame, but will not significantly change the downwind extent of radiation  
25 levels as reported in the McCutcheon Report.

26 The Etkin Report recommendation 6 notes that:

27 “It is standard practice to create hazard maps as part of risks analyses. These  
28 provide nearby communities and stakeholders with a tool to evaluate their risk.  
29 Such hazard maps do not currently exist for the TM project. Because of the  
30 proximity of SFU to both pipelines and tank farms, the generation of hazard  
31 maps, including worst-case scenarios for SFU, is a priority. A model of suitable  
32 complexity should be used, in order to address the topographic and climatic  
33 heterogeneities over the region around SFU.”

34 As noted above, the McCutcheon Report provides a risk assessment of the Burnaby Terminal,  
35 not an emergency response plan. As noted on page 5 of the McCutcheon Report, the analysis  
36 provides hazard contours and the focus of the report was to determine whether the facility met  
37 MIACC land-use risk criteria (Sections 3.0 and 4.0 of this Reply). As noted previously, the  
38 McCutcheon Report concluded that the proposed expansion to 26 storage tanks would be within  
39 acceptable MIACC land-use criteria. Trans Mountain is using the findings of the McCutcheon  
40 Report to inform detailed engineering and design.

41 The model approach that was used in the McCutcheon Report represents industry standard for  
42 risk assessments and provides a conservative representation of several worst-case scenarios.  
43 For the Burnaby Terminal, RWDI Air Inc. agrees that a refined model such as

1 CALMET/CALPUFF would account for the various terrain complexities as discussed in the Etkin  
2 Report recommendations 20 to 23. The McCutcheon Report indicated ERPG-2 levels for SO<sub>2</sub> to  
3 5.2 km in any direction. Some wind directions may have different ERPG-2 distances than others  
4 due to terrain effects, though RWDI Air Inc. is uncertain whether any of these distances would  
5 be larger than 5.2 km. It should be noted that, in the event of an accidental release and fire,  
6 specialized versions of dispersion models, in combination with real-time air quality sample  
7 readings that are used by Incident Command and to provide useful data to municipal  
8 responders to help inform their decisions on directives such as shelter in place or evacuation.

9 The Etkin Report recommendation 7 notes that:

10 "There is no evidence that TM has incorporated local meteorological data from  
11 SFU in their analyses. With respect to risks to SFU from toxic plumes,  
12 sophisticated meteorological modelling of the boundary layer wind field that  
13 includes data from the Burnaby Mountain weather station is required."

14 Trans Mountain agrees with the Etkin Report findings that sophisticated meteorological  
15 modelling be conducted so topographical influences on turbulence and the associated boundary  
16 layer wind fields can be properly characterized. In 2013, it was recognized by RWDI Air Inc. that  
17 the study area surrounding the Westridge Marine Terminal and Burnaby Terminal included  
18 complex terrain in combination with a marine environment, both of which had to be accounted  
19 for in the meteorological and dispersion models used for the air quality assessments. As  
20 requested by the BC Ministry of the Environment and Metro Vancouver, RWDI Air Inc. prepared  
21 a detailed model plan (see Appendix B of the Air Quality and Greenhouse Gas Technical  
22 Report, Volume 5C-4, Filing ID [A3S1U3](#)) that outlined, among other parameters, a list of the  
23 meteorological stations to be included in the CALMET meteorological model. Table 7 of the  
24 work plan lists the ten Metro Vancouver stations, including the Burnaby Mountain station at  
25 SFU, in the simulation of 3-D wind flow patterns. Table 8 lists the 16 surface meteorological  
26 stations used in the marine air quality assessment. About 8,760 hours (one year) of valid hourly  
27 records based on year 2011 for each of the 26 stations were used in the meteorological  
28 simulation of the 24 km by 24 km Terrestrial Air Quality and 150 km by 150 km Marine Air  
29 Quality regional study areas (RSAs), both of which included SFU.

## 6.1 Airborne Contaminants and Dispersion Modelling

30 The Etkin Report provides a detailed discussion in favour of the CALMET/CALPUFF dispersion  
31 modelling system that was used extensively for Trans Mountain for evaluating the effects  
32 related to normal Project operations of the storage terminals in Alberta and BC as well as the  
33 effects of marine traffic, both with and without the Project. Some upset release scenarios were  
34 also modelled related to failures of the vapour combustion unit (VCU) and the vapour recovery  
35 units (VRUs) at the Westridge Marine Terminal. The SFU discussion in this section relate to the  
36 hazards associated with accidental spills of product and resulting fires and explosions. The four  
37 SFU recommendations addressed below are more general in nature and refer to verifying the  
38 performance of the CALMET/CALPUFF model with respect to important local influences that are  
39 expected to affect plume behaviour such as the use of site-specific weather observations,  
40 terrain, land use, seasonality, turbulence and the density of the stored and handled products.

41 The Etkin Report recommendation 20 notes that:

42 "There is no evidence that an extensive verification of the CALPUFF modelling  
43 system for the use over the Burnaby-SFU region has been done by TM. Such an

1 analysis needs to be carried out. Since the spatiotemporal dispersion of airborne  
2 toxic chemicals from an emission source (either slowly or catastrophically)  
3 depends crucially on the atmospheric flow pattern in the lower troposphere, it is  
4 crucial that any air quality dispersion model used should be able to simulate the  
5 necessary characteristics of the lower tropospheric flow patterns and turbulent  
6 fluxes.”

7 Trans Mountain agrees with the Etkin Report finding that an understanding of the atmospheric  
8 flow patterns under a variety of weather conditions for various times of the days and days of the  
9 year be achieved so topographical influences on turbulence and associated dispersion patterns  
10 be properly characterized. In 2013, it was recognized by RWDI Air Inc. that the study area  
11 surrounding the Westridge Marine Terminal included complex terrain in combination with a  
12 marine environment, both of which had to be accounted for in the meteorological and dispersion  
13 models used for the air quality assessments. As requested by the BC Ministry of the  
14 Environment and Metro Vancouver, RWDI prepared a detailed model plan (see Appendix B of  
15 the Air Quality and Greenhouse Gas Technical Report, Volume 5C-4, Filing ID [A3S1U3](#)) that  
16 outlined, among other parameters, a list of the meteorological stations to be included in the  
17 CALMET meteorological model. Table 7 of the work plan lists the ten Metro Vancouver stations,  
18 including Burnaby Mountain at SFU, in the simulation of 3-D wind flow patterns. Table 8 lists the  
19 16 surface meteorological stations used in the marine air quality assessment. About 8,760  
20 hours (one year) of valid hourly records based on year 2011 were used in the meteorological  
21 simulation of the 24 km by 24 km Terrestrial Air Quality and 150 km by 150 km Marine Air  
22 Quality RSAs, both of which included SFU.

23 With respect to verification of the CALMET/CALPUFF modelling system, several intervenors  
24 asked for a comparison of the modelled meteorological parameters used in the simulation and  
25 those measured at local airports and surface stations. In Appendix B of the Supplemental Air  
26 Quality Technical Report No. 2 in Part 3 of the Technical Update #2 dated August 22, 2014  
27 (Filing ID [A4A4E3](#)), a comparison between the Weather Research Forecast model used in  
28 CALMET and several airports and the Metro Vancouver Burnaby-Burmount station (station  
29 closest to Westridge Marine Terminal and Burnaby Terminal) was made for the following  
30 parameters including:

- 31 · surface winds;
- 32 · surface temperature;
- 33 · vertical temperature profiles (indicative of atmospheric stability including  
34 examples of neutral, unstable and stable atmospheric conditions); and
- 35 · wind flow patterns or wind fields based on neutral, unstable and stable  
36 atmospheric conditions.

37 The Etkin Report recommendation 21 notes that:

38 “There is no evidence that Trans Mountain has carried out simulations using a  
39 series of release of chemicals with different buoyancy characteristics under  
40 different meteorological stability conditions (neutral, stable, and unstable). Such  
41 simulations need to be done.”

1 See the response to Recommendation 20. A variety of chemicals being released to the  
2 atmospheric environment under varying atmospheric conditions and buoyancy characteristics  
3 were accounted for in the CALPUFF dispersion modelling. For example, the Project-related  
4 emission sources of interest included:

- 5           · combustion products discharged from the VCU at Westridge Marine Terminal  
6           and marine engines that would release hot gases capable of significant plume  
7           buoyancy flux effects;
- 8           · un-destructed volatile organic compounds from (VOCs) venting during the  
9           loading at Westridge Marine Terminal from the VRUs, which are expected to be  
10          near ambient temperature condition and could be neutrally buoyant or slightly  
11          dense gases (*i.e.*, mass is heavier than air);
- 12          · standing, and working losses from storage tanks due to product filling and  
13          removal, which are expected to be near ambient temperature conditions and  
14          could be neutrally buoyant or slightly dense gases; and
- 15          · infrequent venting of VOC's from tankers at anchorage or underway could  
16          release VOC vapours near ambient temperature conditions which could be  
17          neutral or slightly dense gases.

18 The Etkin Report recommendation 22 notes that:

19           “SFU is located on the top of a high-rise plateau (Burnaby Mountain) bounded by  
20           a water body to the north and by a relatively flat urban development on rest of the  
21           area surrounding the campus. This topographical character around SFU adds  
22           another layer of complexity to the capability of the CALPUFF modelling system to  
23           simulate, at a realistic level of acceptance, the spatiotemporal dispersion of  
24           airborne toxic chemicals. Therefore, an extensive verification of the CALPUFF  
25           modelling system for the use over the Burnaby-SFU region needs to be carried  
26           out.”

27 See the response to Recommendation 20. The topographical influence of Burnaby Mountain  
28 and the Burnaby SFU region was accounted for in the CALMET/CALPUFF modelling system of  
29 airborne toxic chemicals based on the approved model work plan as follows. Terrain elevations  
30 24 km by 24 km Air Quality RSA were obtained from 1:50,000 scale Canadian Digital Elevation  
31 Data available from GeoBase. Land use information for the Westridge Marine Terminal and  
32 Burnaby Terminal were obtained from baseline thematic (BTM) maps available from GeoBC.

33 The Etkin Report recommendation 23 notes that:

34           “There are strong seasonal variations in atmospheric circulation and stability over  
35           the Burnaby-SFU area. This will have a significant influence on the dispersion  
36           characteristics of any toxic chemicals with different buoyancy released into the  
37           atmosphere at different times of the year. There is no evidence that Trans  
38           Mountain has carried out simulations using a series of releases of chemicals with  
39           different buoyancy characteristics under different meteorological circulations and  
40           stability conditions (neural, stable, and unstable). Such simulations need to be  
41           conducted.”

1 See the response to Recommendation 20. The seasonal variations in atmospheric circulation  
2 and atmospheric stability were accounted for in the CALMET/CALPUFF modelling system by  
3 using an entire year of hourly meteorological observations that included the stability conditions  
4 as requested. As noted in the response to Recommendation 21, the chemical releases  
5 considered varying buoyancy characteristics for the applicable emission sources as well, where  
6 appropriate.

## 7.0 SUMMARY OF NEW COMMITMENTS

7 · Trans Mountain will include Simon Fraser University and the BC Ambulance Service as  
8 stakeholders in the existing emergency management program for the Trans Mountain  
9 pipeline and the future emergency management program for the Project.

## 8.0 CONCLUSIONS

10 The Etkin Report provides several recommendations related to the risk assessments  
11 undertaken by Trans Mountain in support of the Project as well as the EMP for the Project that  
12 are based on faulty assumptions, misinterpreted information and data, as well as a lack of  
13 understanding of the jurisdiction within which the Project would be undertaken. Furthermore, the  
14 Etkin Report recommendations made related to the air dispersion modelling undertaken by  
15 Trans Mountain reinforce Trans Mountain's choice of methodology and inputs for this same  
16 modelling. Trans Mountain concludes that the findings and recommendations in the Etkin  
17 Report related to risk assessment and emergency planning are irrelevant to the current  
18 proceeding; those findings and recommendations related to the air dispersion modelling do not  
19 contain any new information that has not already been considered in this regulatory review.

## 9.0 REFERENCE

20 European Gas Pipeline Incident Data Group (EGIG). 2008. "7<sup>th</sup> EGIG Report 1970-2007."  
21 Doc. No. EGIG 08.TV-B.0502, December, 2008.

August 17<sup>th</sup>, 2016

## Trans Mountain Expansion Ministerial Panel

Good morning. My name is Mark LaLonde and I am here before you today in my official capacity as Chief Safety Officer for Simon Fraser University.

Noting that my time to speak is limited and there are many other voices wishing to be heard here today, I would like to provide a very brief overview of the contextual concerns Simon Fraser University has specific to the proposed Trans Mountain Expansion Project.

These comments are found within our May 2015 written submission to the National Energy Board. Given the significance of our concerns relating to the safety of the Simon Fraser University community should the Trans Mountain Expansion Project proceed, we felt it important to re-state our concerns here today.

1. Simon Fraser University is a public research university located in the City of Burnaby, British Columbia. SFU's main campus is located on the top of Burnaby Mountain and is less than 1.7km from the current Trans Mountain Burnaby Tank Farm. If the Trans Mountain Expansion Project is approved, SFU's Burnaby Mountain campus will be less than 1km from the new tanks to be located in the northeast corner of the Tank Farm.
2. It is important to note that there are only two intersecting roads that create a single access point through which people must travel to get on or off Burnaby Mountain, and post expansion this intersection would be within 200 meters of the new tanks in the northeast corner and eastern side of the Tank Farm.
3. SFU's first priority is the health, safety and well-being of its students, faculty and staff. The primary focus of these submissions is SFU's need for assurances that the level of risk posed to the SFU community will, at a minimum, not exceed current risk levels of the existing Trans Mountain storage terminal in Burnaby.
4. SFU currently has 29,802 undergraduate students and 5,339 graduate students along with over 5,000 faculty and staff. SFU has over 1,500 students living in its five different residences. In addition there are also three childcare facilities located on Campus that are operated by the SFU Childcare Society and which provide care to 314 children.
5. As well, in the UniverCity community adjacent to the Campus are the University Highlands Elementary School with an additional 235 children and an urban village which is home to 5,000 residents, and expected to grow to 9,000.
6. There could be in excess of 35,000 people going to or leaving the top of Burnaby Mountain on a regular basis who could be impacted by an emergency event at the Tank Farm.



7. Given its proximity to the Tank Farm, and with only a single access point through which people must travel to get off the mountain in the event of emergency, SFU has specific concerns about the increased risks associated with the Trans Mountain Expansion Project, and specifically with the expansion of the Tank Farm. SFU has the responsibility at law and under the *University Act* to ensure that the Campus is a safe environment and workplace for its faculty, students and staff. This responsibility includes obligations to respond to and protect the Campus and its students, faculty and staff during an emergency event and develop and implement its own emergency response plans for all emergency scenarios.
8. While we appreciate the ongoing dialogue SFU has with Trans Mountain regarding emergency preparedness, planning and response in relation to the Project, it is SFU's position that Trans Mountain has not provided an accurate assessment of the potential risks to SFU and the communities adjacent to the Tank Farm arising from a significant event, such as a major fire, tank blowout, boil-over or multiple tank fires at the Tank Farm. The failure to provide an accurate assessment of the potential risks prevents the Government from accurately determining if the expansion of the Tank Farm creates a level of risk beyond that which exists at present.
9. SFU submits that exposing the adjacent communities to increased levels of risk of harm must be an important element in the criteria applied by the Government in determining whether the Trans Mountain Expansion Project should proceed at all, or in the alternative, as planned by Trans Mountain.
10. Furthermore, SFU's evidence is clear that its ability to assess and plan for the potential impacts on SFU of the existing and expanded Tank Farm and to develop appropriate safety plans and procedures is severely limited due to gaps in Trans Mountain's risk assessment.
11. SFU is unwilling to accept any increase in the risk to the Campus or access to and from SFU as a result of the Trans Mountain Expansion Project. SFU acknowledges that the Tank Farm has been in its present location for many years and that SFU was constructed atop Burnaby Mountain after the Tank Farm was constructed. However, the Trans Mountain Expansion Project results in the construction of new and much larger tanks within the Tank Farm, which results in the tanks being closer to the Campus, the residential communities adjacent to the Tank Farm, and the boreal forest preserve on Burnaby Mountain.
12. Studies we have commissioned in the past raise serious concerns about the risks of this proposed project to the health and safety of the SFU community.
13. The evidence of SFU is that the increased density of storage tanks within the Tank Farm, as well as the additional new tanks on the north and east boundaries of the Tank Farm, substantially increases the risks faced by SFU and adjacent communities. It is incumbent upon the Government to consider the increase in risk to SFU and ensure that Trans Mountain's Emergency Plans include plans to deal with the worst case scenario emergency event and the consequences of such an event.
14. SFU is encouraged by National Energy Board condition that requires Trans Mountain to complete additional risk assessments for the Tank Farm, including but not limited to a boil-over event. SFU is also encouraged by Draft Condition 123 that requires Trans Mountain to file enhanced terms for emergency response planning.
15. SFU is encouraged by the stated willingness of Trans Mountain to work with local authorities, including SFU, to determine the best course of action to protect the public. SFU remains committed to a broad consultative process with other stakeholders, first responders and Trans Mountain to review emergency management plans.
16. SFU is also encouraged by the NEB condition that Trans Mountain engage in in open and transparent dialogue to address the concerns of SFU regarding challenges associated with an emergency evacuation of the Burnaby campus.

17. However it is SFU's position that final consideration of whether the project should be approved should be withheld until these assessments and processes are completed, and their results are known to SFU and others, as well as government.
18. SFU acknowledges that many of the risks associated with the existing Tank Farm and pipeline, as well as the increased risks associated with the proposed expansion are not exclusive to SFU, and that many of SFU's concerns are shared by the City of Burnaby and those living in Burnaby and adjacent municipalities.
19. SFU will continue to work with Trans Mountain, local emergency services and other stakeholders in an effort to ensure the health and safety of our campus community.
20. SFU's submissions focus on the potential risks and impacts of the Trans Mountain Expansion Project to SFU only. These submissions should not be construed in any way as minimizing any submission by any organization, municipal government, or residential group living in Burnaby (or elsewhere) regarding the Project.
21. SFU's position remains that we view as unacceptable any expansion that would result in an increased risk to the health and safety of the SFU community.

Thank for your time and consideration.



Mark W. LaLonde, MA  
Chief Safety Officer  
Safety & Risk Services



SFU

ANDREW PETTER  
PRESIDENT AND VICE-CHANCELLOR

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November 25, 2016

The Honourable Jim Carr  
Minister of Natural Resources  
580 Booth Street, 21<sup>st</sup> Floor  
Ottawa, ON K1A 0E4

Via Email: [NRCan.Minister-Ministre.RNCan@Canada.ca](mailto:NRCan.Minister-Ministre.RNCan@Canada.ca)

Dear Minister Carr,

I am writing to communicate Simon Fraser University's objection to Kinder Morgan's proposal to triple the capacity of its tank farm on Burnaby Mountain as part of the Trans Mountain Expansion Project (TMEP).

For the past two years, SFU has raised concerns about this proposal with federal agencies and with the company. In 2015, the university was granted status as an intervenor before the National Energy Board (NEB). SFU submitted evidentiary documents relating to a wide-range of health and safety concerns about the proposal to the NEB hearings in 2015 and 2016.

In August 2016, the university again communicated its concerns to the federal Ministerial Panel reviewing the NEB decision.

SFU staff have also attempted to work with Kinder Morgan to address the health and safety issues raised through the review process.

This fall, SFU commissioned a report from PGL Environmental Consultants summarizing the risks of the tank farm expansion to the SFU community. A draft of this report was received by the SFU Board of Governors on November 24, 2016.

The report confirms that plans to expand the tank farm on Burnaby Mountain pose significant health and safety risks to the university community. These include:

- the increased number and closer spacing of tanks, combined with the greater volume of refined bitumen, will increase the risks of fire, boil-over and exposure to toxic chemicals;
- the increased difficulty and complexity in fire-fighting scenarios resulting from the expansion will increase the risks of being unable to contain and extinguish a fire;

Second page ...



SIMON FRASER UNIVERSITY  
ENGAGING THE WORLD

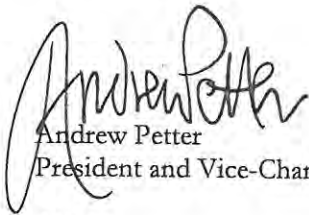
Minister Carr  
November 25, 2016

- the increased presence of toxic chemicals will increase the risk of adverse health impacts, particularly for vulnerable populations; and,
- the increased number of tanks, and their proximity to the intersection of Burnaby Mountain Parkway and Gaglardi Way, will increase the risk of access to and from SFU being cut off in the event of a fire or other emergency, leaving people on the mountain stranded.

I am attaching a copy of the full report for your information. The risks it identifies are significant and deeply concerning. SFU has been clear that any increase in risks to the health and safety of the SFU community resulting from the tank farm expansion is unacceptable to the university.

I urge you to take these risks and our objection to the tank farm expansion into account in making decisions relating to the TMEP, and I would be pleased to provide further information or to discuss this report with you.

Yours sincerely,



Andrew Petter  
President and Vice-Chancellor

AP:lz

Attachment

c. Office of the Prime Minister

Mr. Terry Beech, Minister of Parliament for Burnaby North-Seymour

g:\16\12.2.2\carr,j.docx

# Trans Mountain Expansion Project (TMEP): Evaluation of Risks to SFU



## PREPARED FOR:

Simon Fraser University  
8888 University Drive  
Burnaby, BC V5A 1S6

Attention: Mark Lalonde, Chief Safety Officer

## PREPARED BY:

PGL Environmental Consultants  
#1200 – 1185 West Georgia Street  
Vancouver, BC V6E 4E6  
M. Shum, Ph.D., & L. Beckmann, M.A.

PGL File: 1549-02.03 Rev5

November 2016



solve and simplify

## Executive Summary

The Trans Mountain Expansion Project (TMEP) is a proposal by Trans Mountain Pipeline ULC (Trans Mountain) to expand petroleum export capacity to Asia. Components of the project include twinning the pipeline, expanding storage capacity at several locations along the pipeline route, and the addition of berthing capacity at the Westridge Marine Terminal.

The existing infrastructure carries and stores a wide range of grades and varieties of petroleum products. These are generally divided into four categories – heavy crude including bitumen; light crude; gasoline; and distillates – based on how refined they are.

All of these products are currently moved through Kinder Morgan's existing pipeline infrastructure. The increased capacity associated with the TMEP will be used to carry a proportionately larger volume of heavy crudes, including bitumen that has been diluted by distillates (diluted bitumen or "dilbit") so that it is fluid enough to flow through the pipeline.

Simon Fraser University (SFU) retained PGL Environmental Consultants (PGL) to evaluate the risks to SFU from the TMEP. This report contains PGL's findings.

In brief, PGL finds that there is an increased risk to SFU from the TMEP.

Specific components of the TMEP that contribute to the increased risk and safety concern for SFU are:

- The significant increase of volume of product (including dilbit, which is more flammable than other crude products) through the twinning of the pipelines;
- A greater proportion of the product is expected to be heavy crudes, including dilbit;
- The increased number and density of storage tanks at the Burnaby Tank Farm (storage capacity/volume will increase from 267,900m<sup>3</sup> to 894,320m<sup>3</sup>) from 12 to 26 tanks; additionally, new tanks are closer to each other than the existing tanks; and
- The plan to locate some of the proposed tanks closer to fences and roads.

These operational characteristics (i.e., increase in product flow, increase storage, densification of tanks, and placement of new tanks close to fences/roads) increase the potential for accidents or malfunctions (like spills or ruptures) that may lead to:

- Fires near or on SFU property, leading to risks to the public and damage to property or infrastructure;
- The release of smoke or other toxic emissions to the atmosphere near or on SFU property resulting in exposure to the public; and/or
- Disruption or blockage of the single evacuation route from the SFU campus, such that students/staff/visitors on campus may be stranded on Burnaby Mountain.

In addition, a further risk stems from inadequate information; TMEP has not made public the characterization of potential accidents or malfunctions. This means that SFU cannot adequately plan for the safety of the community on Burnaby Mountain.

The risk of community impacts outside of the tank farm increase by 70% because of the increase in likelihood of adverse events (City of Burnaby Fire Department, 2015). The body of the report provides additional detail regarding these risks. The report is structured as follows:

- Section 1.0, **Background**, contains overview information about the TMEP. This section also includes a brief *primer on petroleum chemistry* relevant to the discussion;
- Section 2.0, **Risk Setting**, identifies the physical characteristics of SFU that leave it susceptible to risk, as well as the potential accidents that could cause harm;
- Section 3.0, **Risk Findings Summary**, identifies the specific incidents and associated consequences of the TMEP, specific to SFU;
- Section 4.0, **Discussion**, explores each potential hazard in greater detail such that decision-makers can understand how SFU may be affected. This discussion is divided into subsections by hazard:
  - Section 4.1 – Chemical Exposure Hazards to SFU;
  - Section 4.2 – Fire/Air Quality Hazards to SFU; and
  - Section 4.3 – Incomplete Emergency Planning at SFU (due to lack of information).
- Section 5.0 contains our standard limitations; and
- Section 6.0 contains source information for references made in the report.

*This Executive Summary is subject to the same standard limitations as contained in the report and must be read in conjunction with the entire report.*

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## List of Acronyms

<b>CLWB</b>	-	Cold Lake Winter Blend
<b>NEB</b>	-	National Energy Board
<b>PGL</b>	-	PGL Environmental Consultants
<b>SFU</b>	-	Simon Fraser University
<b>TMEP</b>	-	Trans Mountain Expansion Project

## 1.0 BACKGROUND

Trans Mountain Pipeline ULC (Trans Mountain) is proposing to expand its pipeline system between Edmonton, AB and Burnaby, BC. The current system transports heavy crude (e.g., diluted bitumen, unrefined), light crude (e.g., conventional crude oil, unrefined), synthetic crude (e.g., processed bitumen, semi-refined), and refined petroleum (e.g., gasoline and diesel, refined). The Trans Mountain Expansion Project (TMEP) will transport the same petroleum products that are shipped today, but the increase in capacity is mainly allocated for unrefined products (e.g., diluted bitumen and conventional crude oil).

The proposed expansion involves:

- Completing the twinning of the pipeline in Alberta and BC with 987km of new buried pipeline;
- New and modified facilities, including pump stations and tanks;
- Additional tanker loading facilities at the Westridge Marine Terminal in Burnaby, BC; and
- Additional tanker traffic to export petroleum products to markets in Asia.

Specific infrastructure for Burnaby Mountain will include:

1. New pipelines carrying more product to the Burnaby Terminal, and an additional 14 storage tanks to hold the additional volume; and
2. New pipelines between the Burnaby Terminal and Westridge Marine Terminals.

The additional storage tanks, which will increase storage capacity from 300,000 barrels per day to 890,000 barrels per day, are proposed on the north and east sides of the site, closer to the Simon Fraser University (SFU) fence lines and the single roadway to/from campus.

In May 2015, on behalf of SFU, PGL Environmental Consultants (PGL) prepared an evidence report with our opinion of the human health risk assessment work completed for the proposed TMEP and submitted to the National Energy Board (NEB). The report identified several areas that were not clearly addressed, which meant that conclusions in the human health risk assessments may have been incomplete. The report concluded that the NEB may risk approving a project that has not fully considered the health risks associated with a realistic emergency situation, lacks appropriate response plans, and potentially exposes the SFU community to unknown health risks.

This current report builds on the previous report by identifying additional risks to SFU.

### 1.1 Petroleum Products Overview

To understand the potential risk to SFU, it is important to understand the petroleum products at issue. As noted in the Executive Summary, four general categories of petroleum products are currently transported through the Kinder Morgan system:

- **Heavy crude:** these are long-chain hydrocarbons that have been minimally refined. They tend to be very viscous (thick), move very slowly, and are less volatile and harder to ignite.
  - **Bitumen** is an extremely heavy crude. It is too viscous to move freely at room temperature, and cannot be moved through pipelines as extracted. The TMEP will not transport bitumen.

- **Diluted bitumen** ("dilbit") is bitumen that has been thinned by "diluent" made of very "light" petroleum products so that it can flow through pipelines. The diluents are less dense, more mobile, lighter than water, volatile, and highly flammable.

Dilbit is frequently discussed in terms of its "blend." Typically, dilbit is 70 to 80% bitumen, and 20 to 30% "diluent." Different blends are based on the specific proportions and diluents. Two such blends are "Wabiska Heavy" and "Cold Lake Winter."

Dilbit is more flammable than other crude products, as measured by flash point (which is the temperature at which the product gives off sufficient vapour to ignite).

Other heavy crudes include products like "bunker C" fuel oil which fuels many large marine vessels.

- **Light crude:** these are more refined products that flow freely at room temperature. They have fewer impurities and are valuable on the market because they can be more efficiently refined to diesel and gasoline.
- **Gasoline:** this is a still lighter (smaller hydrocarbon chain length) petroleum product used in most internal combustion machines.
- **Petroleum distillates:** these are the "lightest" hydrocarbons, many of which are volatile (vaporize) at room temperature. This group of products includes a number of solvents that can be used as feedstocks for producing a range of plastics. The diluents used to dilute bitumen are petroleum distillates.

A number of chemical compounds found in all petroleum products have been studied for their health effects. Relevant for this discussion are several of these components: **benzene**, **ethylbenzene**, **toluene**, and a class of compounds called **xylene**s; their effects are discussed in Section 4.1.

## 2.0 RISK SETTING – BURNABY MOUNTAIN

SFU's main campus is on Burnaby Mountain overlooking Burrard Inlet to the north. It includes a complex of interconnected buildings spanning 1.7km across Burnaby Mountain. On any given day, there are thousands of students, faculty members, staff, and visitors on campus.

The area between SFU and the Burnaby Terminal is predominately forest with only two access routes, which cross at a single junction, to the campus. The nearest new storage tank is proposed to be approximately 150m from the junction of Burnaby Mountain Parkway and Gaglardi Way, or 700m from SFU campus.

Spilled or leaked product will flow downhill, and/or be absorbed into the ground, and will not have a direct effect on SFU which is at a higher elevation than the pipeline or tank farm. However, SFU could be affected by fires or explosions, or airborne emissions resulting from a leak or spill. The increased potential for these events will increase risk for SFU.

Dilbit is already transported through the Kinder Morgan system along with other petroleum products. The increased risk from the TMEP stems from:

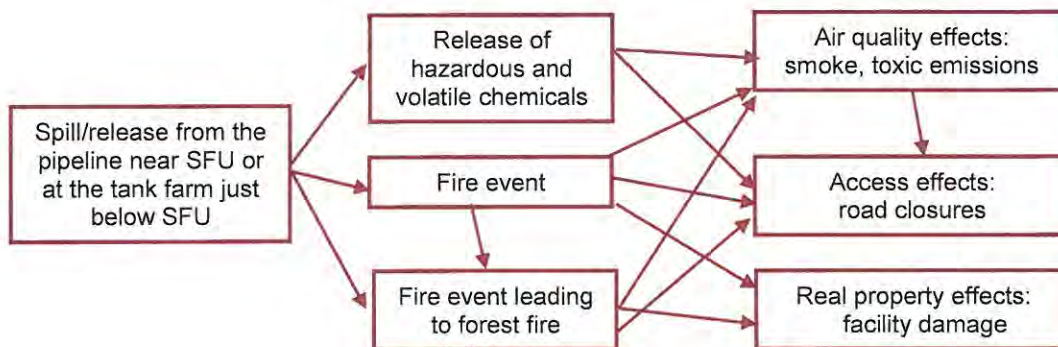
- Movement of a greater volume of product through the pipelines for storage at the Burnaby Tank Farm (storage capacity will increase from 267,900m<sup>3</sup> to 894,320m<sup>3</sup>, from 12 to 26 tanks). A greater proportion of the product is expected to be heavy crudes, including dilbit;

- The increased number and density of storage tanks at the tank farm (new tanks are closer to each other than the existing tanks); and
- Proposed tanks that are in closer proximity to fences and roads.\

In simple terms, the chains of events that increase risk could include any of the following:

- A spill/release from the pipeline near SFU or at the tank farm just below SFU could lead to an immediate release of hazardous and volatile chemicals, impacting air quality;
- A fire event, which would lead to smoke and toxic air emissions; and/or
- Air-borne emissions (chemical or fire related) could migrate from the tank farm to areas that could potentially include the Burnaby Mountain Parkway (~100m to the nearest tank), and/or Gaglardi Way (~60m to the nearest tank).

If a fire spread to the adjacent forest, access routes to/from SFU and infrastructure at the UniverCity and on campus could be compromised. This is summarized graphically below.



### 3.0 REVIEW FINDINGS SUMMARY

PGL has reviewed and summarized available information filed with the NEB to identify the key issues/risks to SFU and its campus.

The scope of our review work was not expected to be exhaustive; rather it was intended to identify and present some of the issues of key concern. Much of the information is from Etkin et al. (2015), City of Burnaby Fire Department (2015), and PGL (2015).

The summary of the key issues and their potential effects are listed in the table below, followed by a detailed discussion of the issues.

Incident/Issue	Consequence/Effect
Liquid release: Release of petroleum products under transport or storage, from spill, accident, or natural disaster	Exposure to volatile substances at levels that potentially lead to health issues.
Fire or explosions along the pipeline or at the tank farm	Hazardous/toxic emissions from fire events include soot and particulate matter, SO <sub>2</sub> , carbon monoxide, sulphur and nitrogen oxides, volatile organic compounds such as benzene, and semi-volatile compounds such as polycyclic aromatic hydrocarbons.
Fire spreading from tank farm to surrounding forest	Fire could envelop the university, and block access to and from SFU, thus making an evacuation difficult or impossible.
	Hazardous/toxic emissions from fire events include soot and particulate matter, SO <sub>2</sub> , carbon monoxide, sulphur and nitrogen oxides, volatile organic compounds such as benzene, and semi-volatile compounds such as polycyclic aromatic hydrocarbons.
	Loss of natural terrestrial habitat, adverse impacts to watercourses and to downgradient surface water features, and potential contamination with fire-fighting chemicals.
Boil-over and fire	Discharge of heated, molten crude oil to a height of up to 1km above ground and a range of up to 0.76 km, potentially impacting the adjacent roadway's to SFU, or SFU directly.
Configuration and densification of storage tanks at the Burnaby Mountain facility	Increased risk of a multiple tank fire by decreasing the ability of firefighters to isolate an active tank fire.
	Insufficient safe access routes and operating positions from which firefighters could apply protective streams to isolate or extinguish fire events
Inability of SFU to design sufficient emergency plans	If an uncontrolled event (fire, smoke, etc.) occurs at the tank farm, access to and from SFU may be compromised. This would lead to potentially greater exposure and risk to SFU from smoke and emissions, and potential isolation of the campus by blockage of egress routes. If egress routes are compromised, escape will not be a viable emergency response option and the population on Burnaby Mountain will be confined to SFU until the emergency is resolved.

#### 4.0 REVIEW FINDINGS DISCUSSION

The proposed pipeline and tank farm expansion on Burnaby Mountain increases risk to SFU, in part because of the greater volume of product that will be flowing through the pipelines and stored in an enlarged tank farm.

The following section provides a more detailed discussion of our review findings in the context of chemical exposure, fire, and air quality and emergency planning. Although the discussion below has been grouped under these headings, the reality is that they are all related and any particular incident has multiple consequences.

#### 4.1 Chemical Exposure Hazards to SFU

*Incident/Issue 1* – There are a variety of hazards that can result in spills or product leaks from pipelines as a result of cracking, fractures, or corrosion. Natural causes include earthquakes and landslides; technological causes include corrosion and equipment failure; and human causes include incorrect operation and construction errors.

*Consequence/Effect 1* – Uncontrolled product releases can lead to unacceptable human exposure to chemicals. For SFU, exposure would occur through inhalation of volatile substances.

Diluted bitumen is currently the major product that will be transported through the TMEP (Intrinsik, 2013, 2014). Since the greater pipeline capacity will move proportionately more heavy crude, the likelihood is that any spilled product will be diluted.

One dilbit blend – Cold Lake Winter Blend (CLWB) – has been tested for health effects and has been shown to contain chemicals sufficiently volatile to be a potential acute hazard to human health from inhalation exposure (Intrinsik, 2014, Table 4-4, Table 4-6). These compounds and their effects are identified in the table below.

While CLWB is the most common dilbit to pass through the pipeline, other dilbit will also be shipped. Most of these other blends have not yet been tested for their specific content or health effects, so the potential health effects of a spill of these other blends is unknown.

Chemical Groups	CLWB Chemical Components	Potential Effects
Aliphatic C1-C4 group	iso-Butane, n-Butane, Propane	Neurological effects
Aliphatic C5-C8 group	iso-Pentane, n-Pentane, Aliphatics C6-C8	Unspecified
Aliphatic C9-C12 group	Aliphatics >C8-C10, Aliphatics >C10-C12	Unspecified
Aromatic C9-C12 group	Aromatics >C8-C10 <sup>2</sup> , Aromatics >C10-C12	Eye irritation
Benzene	Benzene	Immunological effects, known carcinogen
Dibenzothiophene	Dibenzothiophene	Unspecified
Dimethyl sulphide group	Dimethyl sulphide, Methyl ethyl sulphide	Unspecified
Ethanethiol group	Ethanethiol, iso-Propanethiol, Thiophene/sec-Butanethiol, n-Butanethiol, n-Hexanethiol	Respiratory irritation
Ethylbenzene	Ethylbenzene	Neurological effects
Toluene	Toluene	Eye and nasal irritation, neurological effects
Trimethylbenzenes	1,2,4-Trimethylbenzene	Neurological effects
Xylenes	Xylenes	Respiratory irritation, neurological effects

Acute/short-term exposure to the substances listed in the table is known to cause neurological and immunological effects, and they are irritants to the eye, nasal, and respiratory systems. Depending on the extent of the release event, the location, and weather patterns, there would be potentially greater exposure and risk to the SFU population. There might also be restrictions on egress routes, preventing escape from exposure.

Additionally, benzene (shown above) is a known carcinogen (i.e., cancer-causing agent) in humans (Health Canada, 2013; US EPA, 2016; WHO, 2010).

#### 4.2 Fire/Air Quality Hazards to SFU

The TMEP changes to the tank farm will alter the “risk environment” associated with fires on Burnaby Mountain in several ways.

The Burnaby Fire Department, in their analysis of the changes to fire safety and risk, indicate the Burnaby Mountain Terminal is not the appropriate location for the expansion for a number of reasons:

- The slopes and general topography are not appropriate;
- Limited site area and access; and
- Close proximity to a number of neighbourhoods including SFU and sensitive conservation areas.

Some of these factors/issues pose significant challenges for:

- Ensuring firefighter safety;
- Combatting, containing, and extinguishing fires;
- Evacuating Burnaby Mountain Terminal employees and adjacent neighbourhoods; and
- Protecting adjacent properties, including conservation areas.

Components of this risk are discussed below.

Incident/Issue 2 – Changes in the Burnaby tank farm will alter the “risk environment” in the area.

Consequence/Effect 2 – The risk of community impacts outside of the tank farm increase by 70% because of the increase in likelihood of adverse events (City of Burnaby Fire Department, 2015).

Incident/Issue 3 – The TMEP proposal includes densification of the facility, adding more and larger product storage tanks. The addition of storage tanks decreases the distance between each tank.

Consequence/Effect 3 – There is increased hazard because the original fire protection premise of the facility degrades or deteriorates in the TMEP scenario based on a greater potential for multiple tank fires (fire spreading from tank to tank) and increased complexity in a fire-fighting scenario.

The distance between storage tanks is a key design and engineering feature provided to allow firefighters to effectively isolate an active tank fire, preventing a multiple-tank fire event. The TMEP proposal effectively increases the risk associated with a multiple-tank fire event due to the reduction in storage tank spacing.

Additionally, the general configuration proposed does not provide sufficient safe access routes and operating positions from which firefighters could apply protective streams to isolate or extinguish fire events. The elevation changes (i.e., slopes) within the tank farm do not provide multiple firefighting positions or consideration for approach elevations to enable safe and effective operations for all potential wind directions. In order to extinguish a tank fire within the tank farm, emergency responders could be forced to significantly risk their personal safety in order to overcome the design inadequacies of the facility. Specifically, the configuration of the tank farm on a hillside in such a tight footprint would require firefighting personnel to operate in elevated positions above the tank, exposing them to potentially excessive heat and smoke outfalls. In these instances, emergency responders would likely be forced to allow the tank fire to burn out while adjacent tanks are protected.

*Incident/Issue 4* – Petroleum products are flammable by nature; dilbit is more flammable than other crude products. Spill or release may be more likely to result in fires or explosions.

*Consequence/Effect 4* – Fire/explosion events are extremely dangerous. Increased heavy crude storage (including dilbit) results in increased risk to SFU by virtue of increased risk of fire. McCutcheon and Associates (2013) discussed various fire scenarios and their effects. The three specific scenarios considered were:

- A tank fire caused by a major oil-tank release;
- A toxic cloud release from a fire (includes smoke and SO<sub>2</sub>); and
- A boil-over (specific type of fire scenario).

Two effects – **radiant heat** and **smoke** – were considered most significant. The potential impact extent was estimated for radiant heat, the smoke plume, and sulphur (SO<sub>2</sub>). The immediate impact of radiant heat from fire at the facility is estimated to be up to 224m from the dike walls and as far as 536m<sup>1</sup>. The modelled concentrations for smoke and SO<sub>2</sub> were compared to Emergency Response Planning Guidelines and Immediately Dangerous to Life and Health levels. Smoke is estimated to drift downgradient up to 43km. SO<sub>2</sub> is modelled to extend as far as 5.2km. The SFU campus is less than 1km northeast of the Burnaby Terminal component of the TMEP.

In the case of one type of fire known as a **boil-over event**, which is extremely rare, heated, molten crude oil can be discharged to a height of 1km and a range of 0.76km. These distances would affect the SFU campus. The consequences of boil-over exposure would include human injuries to emergency responders and un-evacuated civilians, mass tree-top based wildland fire initiation, structural fire initiation to many residential buildings, potential tank fire initiation within the tank farm and the Shellmont Tank Farm, and significant isolation of the SFU and UniverCity communities.

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<sup>1</sup> At 536m, the radiant heat energy is equivalent to a sunburn (1.0 kWfm<sup>2</sup>) (McCutcheon and Associates, 2013).



*Incident/Issue 5* – There is no evidence of the extent of verification completed of the modelling system for the Burnaby-SFU region.

*Consequence/Effect 5* – The air quality modelling completed by Trans Mountain may not adequately represent the exposure/risk from plumes impacting air quality since there was no specific modelling completed for the unique environment of Burnaby Mountain.

Trans Mountain mainly used the CALPUFF<sup>2</sup> modelling system to comply with the regulatory requirements of the British Columbia air quality standards. Etkin et al. (2015) noted these potential errors in the application of the methodology, as follows:

1. The model has been completed using baseline weather data from YVR and without corrections for topography, suggesting that the model may not accurately represent baseline conditions at SFU;
2. There is a lack of site-specific verification of the model's applicability to the site; and
3. There is no evidence to show that Trans Mountain conducted adequate and a sufficient number of air dispersion simulations of toxic chemical compounds resulting from a catastrophic release of these chemicals.

Taken together, these flaws reduce the confidence in the risk assessment as it applies specifically to SFU.

#### 4.3 Emergency Planning Impact for SFU

As above, this section is divided into several discrete incidents.

##### 4.3.1 Information for Evacuation Planning

*Incident/Issue 6* – Trans Mountain's intention to address evacuation planning in conjunction with the City of Burnaby, SFU, RCMP, BC Ambulance, and Burnaby Fire has been referenced in multiple Information Requests. However, SFU is not identified as a stakeholder in the existing plans, nor is this addressed in the available documents (Etkin et al., 2015).

*Consequence/Effect 6* – Responsibility for evacuation of the campus lies with SFU. In order for effective evacuation plans, SFU requires solid information regarding risks. Trans Mountain is responsible for providing this information (i.e., they are responsible for determining recommendations relating to evacuation, such as identifying potential at-risk communities). This is not clearly identified in the facilities application, site-specific plans, or the Information Request responses. As a result, SFU does not have adequate information to develop provisions for evacuation or emergency response.

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<sup>2</sup> CALPUFF is an advanced modelling system for the simulation of atmospheric pollution dispersion. It simulates the effects of time- and space-varying meteorological conditions on pollution transport, transformation, and removal. CALPUFF can be applied for long-range transport and for complex terrain.

#### 4.3.2 Poor Design for Emergency Response

Incident/Issue 7 – Worst-case scenarios of fires or explosions, and exposure to resulting plumes, have the potential to impact, or even envelop the university.

Consequence/Effect 7 – Because of the decreased distance between the new storage tank locations and the junction of Burnaby Mountain Parkway and Gaglardi Way, SFU becomes more vulnerable to isolation; if the sole access/egress point is blocked, escape ceases to be a viable emergency response option.

#### 4.3.3 Insufficient Modelling for Response Planning

Incident/Issue 8 – There is no evidence to show that Trans Mountain conducted adequate and a sufficient number of air dispersion simulations of toxic chemical compounds resulting from a catastrophic release.

Consequence/Effect 8 – There is no scientifically sound basis for SFU to develop an emergency response management plan because of the insufficient information.

### 5.0 STANDARD LIMITATIONS

PGL prepared this letter report for our client and its agents exclusively. PGL accepts no responsibility for any damages that may be suffered by third parties as a result of decisions or actions based on this letter report.

PGL relied on the listed documents for site information to prepare this opinion and as such, the limitations of our review are at least as great as those documents.

The findings and conclusions are site-specific and were developed in a manner consistent with that level of care and skill normally exercised by environmental professionals currently practising under similar conditions in the area. Changing assessment techniques, regulations, and site conditions means that environmental investigations and their conclusions can quickly become dated, so this report is for use now. The report should not be used after that without PGL review/approval.

The project has been conducted according to our instructions and work program. Additional conditions, and limitations on our liability are set forth in our work program/contract. No warranty, expressed or implied, is made.

Respectfully submitted,

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MGS/LMB/ml/slr  
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## **APPENDIX B1**

### **RISK ASSESSMENT SUMMARY REPORT BURNABY TERMINAL**

### **FOR THE TRANS MOUNTAIN PIPELINE ULC TRANS MOUNTAIN EXPANSION PROJECT NEB CONDITION 22**

**March 1, 2017**

Prepared for:



**TRANSMOUNTAIN**

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## **1.0 INTRODUCTION**

In compliance with Condition 22 of Order XO-T260-010-2016, Trans Mountain has completed an updated risk assessment for Burnaby Terminal. The risk assessment forms part of the document entitled "Burnaby Terminal Expansion Risk Assessment Report", prepared by Genesis Oil & Gas Consultants Ltd (the "Genesis Report"), which is included in Appendix B2. The Genesis Report demonstrates that for risks that cannot be eliminated, the risks at Burnaby Terminal have been reduced to As Low As Reasonably Practicable (ALARP) while complying with the Major Industrial Accidents Council of Canada (MIACC) criteria for risk acceptability.

## **2.0 THE GENESIS REPORT**

Given the similarities in methodology required for the approaches to fire risk assessment (the primary subject of Condition 22) and the risk-based approaches used to demonstrate the adequacy of tank containment, impoundment and retention areas (the subject of Condition 24), the Genesis Report includes the technical information supporting both Conditions. The Genesis Report is organized in such a way that the inputs, assumptions, and results related to each Condition are separately identified. In the following discussion, the elements of the Genesis Report that are relevant to Condition 22 for Burnaby Terminal are specifically identified, where applicable.

## **3.0 DESIGN VARIANCES**

Trans Mountain has been issued a Certificate of Public Convenience and Necessity (CPCN) OC-64 as related to the Trans Mountain Expansion Project and amendments to two existing CPCNs as related to existing facilities and pipeline segments: OC-2 and OC049. In addition, the Board issues five orders as related to temporary workspace, pump stations, terminal development and the deactivation of an existing pump station. Of relevance to this condition is Order XO-T260-010-2016, which authorizes the construction of tanks and related infrastructure at Burnaby Terminal.<sup>1</sup>Figure 5-3 in the Genesis Report shows the revised configuration of Burnaby Terminal.

More specifically, with respect to the tanks and the secondary containment areas, the following are the principle elements of the design which are materially different from the design that was reflected in the original TMEP Application and Technical Update No. 2 and approved in Order XO-T260-010-2016:

Tank Sizes (nominal or shell volumes):

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<sup>1</sup> Order XO-T260-010-2016 also authorized construction of tanks and related infrastructure at the Edmonton Terminal West Tank Area and Sumas Terminal.

- Tank 74 and Tank 76: Each reduced from 53,300 m<sup>3</sup> (335,000 bbls) to 45,300 m<sup>3</sup> (285,000 bbls) by reducing the diameter from 60.95 m (200 ft.) to 56.40 m (185 ft.).
- Tank 78: Reduced from 53,300 m<sup>3</sup> (335,000 bbls) to 26,200 m<sup>3</sup> (165,000 bbls) by reducing the diameter from 60.95 m (200 ft.) to 42.70 m (140 ft.).
- Tank 80 and Tank 89: Each reduced from 45,300 m<sup>3</sup> (285,000 bbls) to 40,500 m<sup>3</sup> (255,000 bbls) by reducing the diameter from 56.40 m (185 ft.) to 53.40 m (175 ft.).

Tank Spacing (between the tanks identified):

- Tank 74 and Tank 76: Increased from 0.5 diameters to 0.58 diameters.
- Tank 76 and Tank 78: Increased from 0.5 diameters to 0.80 diameters (of Tank 76).
- Tank 80 and Tank 86: Increased from 0.5 diameters (of Tank 80) to 0.81 diameters (of Tank 80).
- Tank 85 and Tank 89: Increased from 0.5 diameters (of Tank 89) to 1.12 diameters (of Tank 89).
- Tank 91 and Tank 93: Increased from 0.5 diameters to 0.77 diameters.
- Tank 93 and Tank 95: Increased from 0.5 diameters to 0.93 diameters.
- Tank 95 and Tank 97: Decreased from 0.9 diameters to 0.77 diameters.
- Tank 96 and Tank 98: Increased from 0.5 diameters to 0.62 diameters.

*Note 1: As discussed in Trans Mountain's response to City of Burnaby IR No. 1.08.03a (Filing ID A3Y2E6), CSA Z662, Clause 4.15.1.2, requires that the location and spacing of storage tanks be in accordance with National Fire Protection Association (NFPA) Code 30, Flammable and Combustible Liquids Code. NFPA 30, Clause 22.4.2.1, requires that floating roof storage tanks have a spacing of ¼ times the sum of adjacent tank diameters, where open diking is provided (as is the case at Burnaby Terminal). This is consistent with the spacing of 0.25 times the sum of adjacent tank diameters required by the British Columbia Fire Code (BCFC), Division B, Part 4, Clause 4.3.2.2.*

*Note 2: ¼ (0.25) times the sum of adjacent tank diameters is equivalent to 0.5 times the diameter of one of the tanks, for adjacent tanks of equal diameter.*

Secondary Containment:

- Tank 74, Tank 76 and Tank 78: one three-tank shared secondary containment area reconfigured to one two-tank shared secondary containment area (Tank 74 and Tank 76) and one single-tank secondary containment area (Tank 78).
- Tank 71, Tank 85 and Tank 89: one three-tank shared secondary containment area reconfigured to one two-tank shared secondary containment area (Tank 85 and Tank 89) and one single-tank secondary containment area (Tank 71).
- Tank 91, Tank 93, Tank 95, and Tank 97: one three-tank shared containment area (Tank 91, tank 93, and Tank 95) and one single-tank shared containment area (Tank 97) reconfigured to two two-tank shared secondary containment areas (Tank 91 and Tank 93 / Tank 95 and Tank 97).
- Partial Remote Impoundment Area deleted.

A full description of the secondary containment scheme at Burnaby Terminal is included in Section 6.6 of the Genesis Report.

## 4.0 RISK REDUCTION BY DESIGN

Although the approved design (represented in the Application, Technical Update No. 2) was in accordance with the applicable governing regulation, codes, and standards, Trans Mountain focused on several core risk-reduction principles in the evolution of the design and incorporated them to the extent reasonably practicable:

- reduce tank sizes, while maintaining operational service levels;
- increase tank spacing;
- eliminate three-tank shared containment areas;
- reduce the secondary containment surface areas; and



- Overflow connectivity between adjacent secondary containment areas.

Trans Mountain was able to follow these principles, as demonstrated by the following:

- five tanks were reduced in diameter, with the resulting aggregate volume being reduced by 50,880 m<sup>3</sup> (320,000 bbls) or approximately 8%;
- the spacing between seven pairs of adjacent tanks was increased by an average of 61%;
- three three-tank shared secondary containment areas were eliminated;
- with the elimination of the three-tank shared secondary containment areas, the associated surface areas were reduced by approximately 50%; and
- overflow connectivity between adjacent secondary containment areas was provided.

## 5.0 FIRE EVENT RISKS (INDIVIDUAL RISK AND RISK ACCEPTABILITY CRITERIA)

Genesis describes in their report, individual risk as “the probability of an individual experiencing a fatal injury” per year. Individual risk values at various locations surrounding a facility were calculated by Genesis and summarized in their report as contours of equal risk and then overlaid on a map of land use types to be able to compare to the MIACC acceptability criteria. The MIACC acceptable land use criteria, which appear in Section 9.2 of the Genesis Report, are summarized in **Table 1**, below.

**Table 1: MIACC Risk Acceptability Criteria (Annual Individual Risk)**

Annual Individual Risk Range	Allowable Land Use
Greater than $1 \times 10^{-4}$	None
$1 \times 10^{-4}$ to $1 \times 10^{-5}$	Manufacturing, warehouses, open spaces (parkland, golf courses, etc.)
$1 \times 10^{-5}$ to $1 \times 10^{-6}$	Commercial, offices, low-density residential
Less than $1 \times 10^{-6}$	All other uses, including institutions, high-density residential, etc.

If the calculated individual risk values represented by the risk contours correspond with the acceptable level of risk identified for the overlaid land use types, then the facility is considered to have an acceptable risk profile.

## 6.0 FIRE EVENT RISK ACCEPTABILITY FOR BURNABY TERMINAL

Section 13.0 of the Genesis Report includes multiple figures which show the individual risk contours associated with various events at Burnaby Terminal. Figure 13-11 shows the combined individual risk contours associated with all events. This also appears in Section 14.0, Figure 14-1 and Section 3.0, Figure 3-1. Trans Mountain has produced an illustrative map of Burnaby Terminal and the surrounding area, included in Appendix B3, which enhances the view of the physical relationship between the individual risk contours and the land uses. This illustrative map demonstrates the expanded Burnaby Terminal meets the MIACC criteria of acceptability. In particular, the areas enveloped by the  $1 \times 10^{-6}$  individual risk contour include low-density residential housing (two small areas directly south of the Terminal), agricultural, parkland, and industrial land uses. In addition, the  $1 \times 10^{-5}$  contours do not extend beyond the Terminal property.

According to Genesis’s individual risk contour map, the entirety of the currently developed Simon Fraser University (SFU) campus lies outside of the  $1 \times 10^{-7}$  individual risk contour (in blue), as does Forest Grove Elementary School, which demonstrates these land uses are acceptable. The planned future SFU

development areas, south of the currently developed campus (bordering University Drive), lie outside the  $1 \times 10^{-6}$  contour (in green), demonstrating these future land uses are also acceptable.

## 7.0 SPILL EVENT (OVERFLOW) RISK

Genesis was also able to analyze various spill events, fire events causing spills, and the assessment of overflow risk from secondary containment areas, to determine the adequacy of secondary containment.

For Burnaby Terminal, this part of the risk assessment is further addressed in the filing for Condition 24.

## 8.0 SPECIFIC RISK ASSESSMENT REQUIREMENTS

There are a number of individual requirements that make up Condition 22. The following discusses how each of the requirements is addressed in the Genesis Report for Burnaby Terminal. All references are to sections or figures in the Genesis Report.

a) *The effect of any revised spill burn rates*

The formulae and approach to burning rates are included in Section 7.3 (Fire) of the Genesis Report.

b) *The potential consequences of a boil-over*

A boil-over is not a primary event but a type of escalation (domino or knock-on) event. The formulae and approaches for calculating boil-over parameters are included in Section 7.3 (Boil-Over) of the Genesis Report. The thermal radiation contours resulting from boil-overs, for Burnaby Terminal, are included in Section 11.5 (Figure 11-9). The fall-out affected area is identified in Section 11.5 (Figure 11-10). The individual risk contours are included in Section 13.0 (Figure 13-7).

Boil-over was previously discussed at length in Trans Mountain's response to NEB IR No. 6.23 (Filing ID A4R614). The following points were identified in the response and these points are reinforced in Section 7.3 (Boil-Over) and Section 8.4:

- The new tanks will be designed with features to prevent the accumulation of water, which is necessary to cause a boil-over event.
- The new tanks will be fitted with fixed automated full-surface fire-suppression systems and back-up mobile systems.
- Boil-over events (in the cases where fires cannot be extinguished) take many hours to develop, allowing emergency management plans (i.e. evacuation) to be initiated.

As identified in Section 7.2, the probability of boil-over, given a full surface tank fire, is taken to be 1.0 per the available literature. This has been done for the statistical analysis required of the NEB condition, and assumes the fixed, automated and back-up full surface fire suppression systems included in the design (which will be installed, tested and maintained in order to suppress a full-surface tank fire) are ineffective or inoperable when required.

As shown in Section 7.3 (Boil-Over), Table 7-4, Genesis has calculated the minimum time to boil-over for the smallest (36.6 m) tanks at Burnaby Terminal (Tanks 71, 72 and 73), with low levels of stored liquid (25% full), is approximately five hours. For larger tanks (i.e. Tanks 80, 89, 96 and 98), with low levels of stored liquid (25% full), the boil-over time is approximately seven hours. The times are much longer for tanks with higher levels of stored liquid, nearly 24 hours for larger tanks at 75% full.

These are significant time periods that would provide opportunity to implement tactical response plan to suppress and extinguish a fire well before a boil-over event were to occur. This period also affords opportunity for tiered emergency management plans, if it became necessary. This is reinforced by considering the risk equations presented in Section 9.1.2. of Genesis report. In these equations the term  $P(I/E_i)$  represents the probability of individual (I) being present at the time that the escalation event (in this case a boil-over) occurs. Implementation of emergency management measures (proximity control and evacuation) will reduce the value of  $P(I/E_i)$  to zero and thus the individual risk at any location within the fall-out effected area to zero.

c) *The potential consequences of flash fires and vapor cloud explosions.*

The formulae and approaches for calculating flash fire and vapor cloud explosion parameters are included in Section 7.3 (Flash Fire) and Section 7.3 (Explosion [Blast]) of the Genesis Report. The thermal radiation contours resulting from flash fires, for Burnaby Terminal, are included in Section 11.3 (Figure 11-7). The thermal radiation contours resulting from vapour cloud explosions, for Burnaby Terminal, are included in Section 11.4 (Figure 11-8). The individual risk contours for flash fires and vapour cloud explosions are included in Section 13.0 (Figure 13-5) and Section 13.0 (Figure 13-6), respectively.

d) *The cumulative risk based on the total number of tanks in the terminal considering all potential events (pool fire, boil-over, flash fire, vapor cloud explosion).*

The cumulative individual risk contours for all events, for Burnaby Terminal, are included in Section 13.0 (Figure 13-10) of the Genesis Report. The events considered include all of the tanks in the Terminal and include tank fires, boil-overs, pool fires, flash fires, and explosions, triggered by various causes. The consequences considered include the effects of heat and smoke.

e) *The domino (knock-on) effect caused by the release of the contents of one tank on the other tanks within the terminal's common impoundment area(s) or on other tanks in adjacent impoundment areas.*

The approaches to the assessment of domino (knock-on) effects are included in Section 8.0 of the Genesis Report. The individual risk contours for all events with domino effects included are included in Section 13.0 (Figure 13-11). These are the governing contours for the determination of fire risk acceptability.

f) *Risk mitigation measures, including ignition source control methods.*

The methods for risk assessment established by Genesis, following accepted practices, do not include risk mitigation measures. As they have been derived from statistical analyses of event data, the event frequencies included in Section 7.1 (Table 7-1) and Section 7.2 (Tables 7-2 and 7-3) and the ignition probabilities included in Section 7.3.4 (Figure 7-10) inherently consider preventative controls that are features of typical industrial facilities. For risk assessment purposes fire-suppression is assumed not to have an immediate enough effect to prevent the initial impacts of heat and smoke. However, even with the use of standardized frequencies and probabilities and without Trans Mountain's enhanced risk mitigation measures being quantitatively taken into consideration, the risk assessment shows that the combined individual risk from all events that could occur within Burnaby Terminal is acceptable based on the MIACC criteria.

Mitigation measures such as fire-suppression and emergency management are important elements of overall risk-management, to prevent the potential for fire escalation and bring fire situations under control, thereby limiting continuing impacts. Fire-fighting systems and emergency management will be addressed in detail in the compliance filings for Conditions 118, 119, 120, 123, 124, 125, 127(a), 136 and 153.

## 9.0 **MINIMIZATION OF RISKS (TO AS LOW AS REASONABLY PRACTICABLE)**

As discussed in the preceding sections, the fire risks arising from Burnaby Terminal, without additional mitigation measures being specifically included, are extremely low and are acceptable in accordance with the MIACC criteria. In Design Variances and Risk Reduction by Design, above, Trans Mountain has identified the enhancements made to the design, all intended to reduce the risk associated with both fire and spill events. Trans Mountain has not identified any additional changes that can be made to the design without materially affecting the operational viability of the post-expansion Trans Mountain system. The number of tanks, size combinations, and aggregate capacity are required to fulfill the throughput requirements and service levels (including commodity segregation). Trans Mountain has optimized the physical arrangement of the tanks in the most logical, efficient, and practical way, for development and the constraints of the property. In the response NEB IR No. 3.093b (Filing ID A4H1V2) Trans Mountain has described preventative and mitigative controls designed to reduce the risk of fires and spills. A number of the controls exceed those required by regulation. As such, risks associated with the Burnaby Terminal have been reduced to As Low As Reasonably Practicable (ALARP).



## APPENDIX B1

# SECONDARY CONTAINMENT BURNABY TERMINAL SUMMARY REPORT

## FOR THE TRANS MOUNTAIN PIPELINE ULC TRANS MOUNTAIN EXPANSION PROJECT NEB CONDITION 24

March 1, 2017

Prepared for:



Trans Mountain Pipeline ULC

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Calgary, Alberta T2P 5J2  
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## 1.0 INTRODUCTION

In compliance with Condition 24, applicable to the of Order XO-T260-010-2016 Trans Mountain Expansion Project (Project), Trans Mountain Pipeline ULC (Trans Mountain) has completed the final design (physical arrangement) of the expanded Burnaby Terminal and an assessment of the adequacy of the secondary and tertiary containment systems. The final design is included in the document entitled “Final Design - Burnaby Terminal Secondary Containment,” provided in Appendix B2. The assessment of the adequacy of secondary and tertiary containment, commensurate with the final design, is comprised of two components: 1. demonstrated technical compliance of the design with applicable codes and criterion set out by the NEB in condition 24; and 2. risk-based assessment, also based on criterion established by the NEB in condition 24. The risk assessment forms part of the document entitled “Burnaby Terminal Expansion Risk Assessment Report”, prepared by Genesis Oil & Gas Consultants Ltd (the “Genesis Report”), which is included in Appendix B2.1. The Genesis Report demonstrates that the extremely low probability of spilled oil (originating from storage tank releases) leaving the Burnaby Terminal property is within an acceptable range and thus demonstrates the adequacy of the secondary and tertiary containment systems.

## 2.0 DESIGN SUMMARY

The Secondary Containment Burnaby Terminal – Physical Arrangement (“Physical Arrangement Report”), attached as Appendix B2, includes several drawings which convey the fundamental parameters of final designs of the tanks and secondary containment areas. These drawings include:

- Drawing 01-13283-BB00-SK200, FEED Layout
- Drawing 01-13283-BB00-SK-GA1000, Plot Plan
- Drawing 01-13283-BB00-SK007, Overflow Path Analysis
- Drawing 01-13283-BB00-MT1060, Tank to Tank Shell Spacing
- Drawing 01-13283-BB00-MT1061, Tank to Property Line Spacing
- Drawing 01-13283-BB00-MT1062, Secondary Containment Data

The information contained in these drawings is consistent with the information used by Genesis as input to the risk assessment.

## 3.0 RISK ASSESSMENT

Given the similarities in methodology required for the approaches to fire risk assessment (the primary subject of Condition 22) and the risk-based approaches used to demonstrate the adequacy of tank secondary containment areas (the subject of Condition 24), the Genesis Report includes the technical information supporting both Conditions. The Genesis Report is organized in such a way that the inputs, assumptions, and results related to each Condition are separately identified. In the following discussion, the elements of the Genesis Report that are relevant to Condition 24, for Burnaby Terminal secondary and tertiary containment, are specifically identified.

## 4.0 DESIGN VARIANCES

Trans Mountain has been issued a Certificate of Public Convenience and Necessity (“Certificate”) OC-064 as related to the Trans Mountain Expansion Project and amendments to two existing Certificates as related to existing facilities and pipeline segments: OC-2 and OC-49. In addition, the Board issued five orders as related to temporary workspace, pump stations, terminal development and the deactivation of an existing pump station. Of relevance to this condition is Order XO-T260-010-2016, which authorizes the construction of tanks and related infrastructure at Burnaby Terminal.<sup>1</sup>

In an application being filed in parallel to this submission, Trans Mountain seeks to vary Order XO-T260-010-2016 for Burnaby Terminal to reduce the nominal capacity of five tanks, and to undertake a revision to the secondary containment design. In this application, Trans Mountain requested the Board to

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<sup>1</sup> Order XO-T260-010-2016 also authorizes construction of tanks and related infrastructure at Edmonton Terminal West Tank Area and Sumas Terminal.

incorporate compliance filings to Conditions 22 (as related to Burnaby Terminal) and Condition 24 in the hearing of that application. Drawing 01-13283-BB00-SK-GA1000, in the Physical Arrangement Report, and Figure 5-3, in the Genesis Report, show the revised configuration of the new tanks and the secondary containment.

With respect to the tanks and the secondary containment, the following are the principal elements of the design which are materially different from the design that was reflected in the Project Application (Technical Update No. 2) and approved under Order XO-T260-010-2016:

Tank Sizes (nominal or shell volumes):

- Tank 74 and Tank 76: Each reduced from 53,300 m<sup>3</sup> (335,000 bbls) to 45,300 m<sup>3</sup> (285,000 bbls) by reducing the diameter from 60.95 m (200 ft.) to 56.40 m (185 ft.).
- Tank 78: Reduced from 53,300 m<sup>3</sup> (335,000 bbl) to 26,200 m<sup>3</sup> (165,000 bbl) by reducing the diameter from 60.95 m (200 ft.) to 42.70 m (140 ft.).
- Tank 80 & Tank 89: Each reduced from 45,300 m<sup>3</sup> (285,000 bbl) to 40,500 m<sup>3</sup> (255,000 bbl) by reducing the diameter from 56.40 m (185 ft.) to 53.40 m (175 ft.).

Tank Spacing (between the tanks identified):

- Tank 74 and Tank 76: Increased from 0.5 diameters to 0.57 diameters.
- Tank 76 and Tank 78: Increased from 0.5 diameters to 0.80 diameters (of Tank 76).
- Tank 80 and Tank 86: Increased from 0.5 diameters (of Tank 80) to 0.82 diameters (of Tank 80).
- Tank 85 and Tank 89: Increased from 0.5 diameters (of Tank 89) to 1.12 diameters (of Tank 89).
- Tank 91 and Tank 93: Increased from 0.5 diameters to 0.77 diameters.
- Tank 93 and Tank 95: Increased from 0.5 diameters to 0.92 diameters.
- Tank 95 and Tank 97: Decreased from 0.9 diameters to 0.77 diameters.
- Tank 96 and Tank 98: Increased from 0.5 diameters to 0.64 diameters.

*Note 1: As discussed in Trans Mountain's response to City of Burnaby IR No. 1.08.03a (Filing ID A3Y2E6), CSA Z662, Clause 4.15.1.2, requires that the location and spacing of storage tanks be in accordance with National Fire Protection Association (NFPA) Code 30, Flammable and Combustible Liquids Code. NFPA 30, Clause 22.4.2.1, requires that floating roof storage tanks have a spacing of ¼ times the sum of adjacent tank diameters, where open diking is provided (as is the case at Burnaby Terminal). This is consistent with the spacing of 0.25 times the sum of adjacent tank diameters required by the British Columbia Fire Code (BCFC), Division B, Part 4, Clause 4.3.2.2.*

*Note 2: ¼ (0.25) times the sum of adjacent tank diameters is equivalent to 0.5 times the diameter of one of the tanks, for adjacent tanks of equal diameter.*

Secondary Containment:

- Tank 74, Tank 76 and Tank 78: one three-tank shared secondary containment area reconfigured to one two-tank shared secondary containment area (Tank 74 and Tank 76) and one single-tank secondary containment area (Tank 78).
- Tank 71, Tank 85 and Tank 89: one three-tank shared secondary containment area reconfigured to one two-tank shared secondary containment area (Tank 85 and Tank 89) and one single-tank secondary containment area (Tank 71).
- Tank 91, Tank 93, Tank 95 and Tank 97: one three-tank shared containment area (Tank 91, tank 93, and Tank 95) and one single-tank shared containment area (Tank 97) reconfigured to two two-tank shared secondary containment areas (Tank 91 and Tank 93 / Tank 95 and Tank 97).
- Partial Remote Impoundment Area deleted.

A full description of the secondary containment scheme at Burnaby Terminal is included in Section 6.6 of the Genesis Report.



## 5.0 RISK REDUCTION BY DESIGN

Although the approved design (represented in the original TMEP Application and updated in Technical Update No. 2) was in accordance with the applicable governing regulation, codes, and standards, Trans Mountain focused on several core risk-reduction principles in the evolution of the design and incorporated them to the extent reasonably practicable:

- Reduce tank sizes, while maintaining operational service levels;
- Increase tank spacing;
- Reduce the number three-tank shared containment areas;
- Reduce the secondary containment surface areas; and
- Provide overflow connectivity between adjacent secondary containment areas.

Trans Mountain was able to follow these principles, as demonstrated by the following:

- Five tanks were reduced in diameter, with the resulting aggregate volume being reduced by 50,880 m<sup>3</sup> (320,000 bbls) or approximately 8%;
- The spacing between seven pairs of adjacent tanks was increased by an average of 61%;
- Reduction in the number of three three-tank shared secondary containment areas to one three-tank shared secondary containment area;
- Total surface area of the secondary containment were reduced by approximately 50%;
- Overflow connectivity between adjacent secondary containment areas was provided.

Section 6.7 (Figure 6-3) of the Genesis Report identifies the overflow pathways that will be integrated into the design of the expanded Burnaby Terminal. The design will be such that in almost all foreseeable cases released oil will preferentially flow through pipes leading from one (typically higher elevation) secondary containment area to an adjacent (typically lower elevation) secondary containment area, before overtopping the secondary containment berm (the flow paths are identified in red). This approach maximizes the general availability of secondary containment for the tanks on Terraces 2, 3, and 4. The design also considers extreme high-rate release cases where the overflow pipes are unable to conduct all of the overflow volume. In these cases, where oil overtops one or more secondary containment berms, the design incorporates surface drainage channels which lead towards the tertiary containment. The high-capacity drainage channel and berm on the south side of the property ensures that released oil does not leave the property before reaching the tertiary containment.

## 6.0 OFF-SITE RELEASE RISKS (OVERFLOW EVENT PROBABILITIES AND RISK ACCEPTABILITY CRITERIA)

As the Major Industrial Accidents Council of Canada (MIACC) acceptable land use criteria cannot be applied to off-site spill risk assessments, Genesi has applied the UK Health & Safety Executive (UKHSE) "Safety & Environmental Standards for Fuel Storage Sites" standard and the Environment Agency for England & Wales (EA EW) "Integrated Pollution Prevention & Control Environmental Assessment of BAT" in order to address risk tolerability for offsite releases. Although referenced in Condition 22, the MIACC acceptable land use criteria cannot be applied for off-site spill risk assessments.

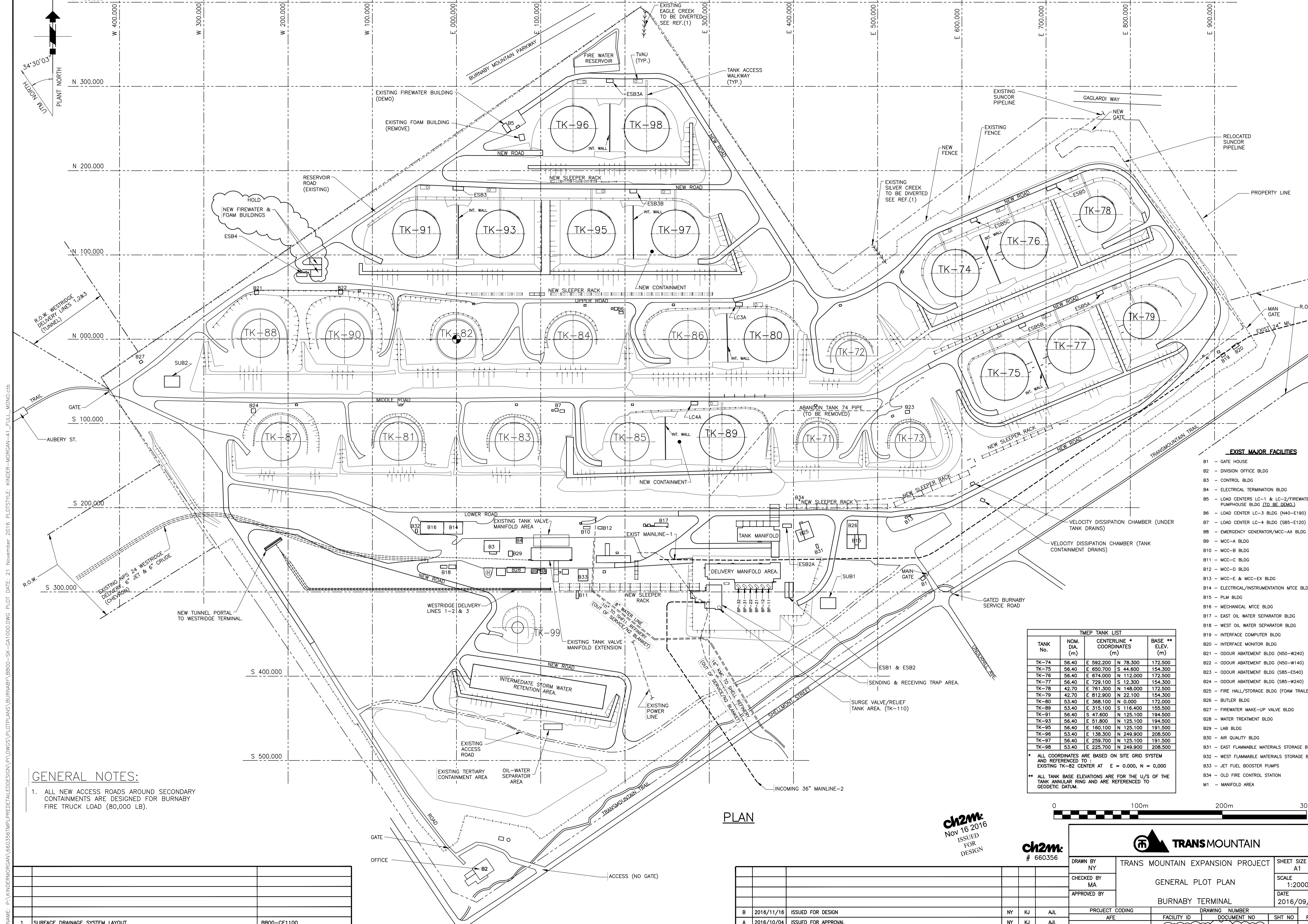
## 7.0 ADEQUACY OF SECONDARY AND TERTIARY CONTAINMENT AT BURNABY TERMINAL

Appendix A-1 of the Genesis Report includes multiple tables that document the on-site release (secondary containment overflow) probabilities for the Burnaby Terminal caused by earthquakes (Table A-2), pool fires (Table A-3), and general spills unrelated to earthquakes and fires (Table A-1). These include "cascading" cases where a secondary containment is overwhelmed and the released oil travels to one or more adjacent secondary containment areas. This cascading effect is the explanation for the higher probabilities of overflow from secondary containment areas on the lower terraces (i.e. the secondary containment for Tank 85 and Tank 89), even though the volumetric capacity of these secondary containment areas is somewhat higher relative to the storage volume of the tanks they serve.

At Burnaby Terminal, on-site releases which are not contained by the secondary containment areas travel to the tertiary containment area. If the tertiary containment area is overwhelmed, the released oil will travel off-site. Section 12.0 (Table 12-1) of the Genesis Report presents the calculated off-site release (tertiary containment overflow) probabilities for the Burnaby Terminal. These are also summarized in Section 14.2, Table 14-1 and Section 3.2, Table 3-1 of the Genesis Report

Genesis conclusions are that the 1 in 10 year rainfall event and the 1 in 100 year rainfall event are well within the "Tolerable if ALARP" region.





**GENERAL NOTES:**

1. ALL NEW ACCESS ROADS AROUND SECONDARY CONTAINMENTS ARE DESIGNED FOR BURNABY FIRE TRUCK LOAD (80,000 LB).

**EXIST MAJOR FACILITIES**

- B1 - GATE HOUSE
- B2 - DIVISION OFFICE BLDG
- B3 - CONTROL BLDG
- B4 - ELECTRICAL TERMINATION BLDG
- B5 - LOAD CENTERS LC-1 & LC-2/FIREWATER PUMPHOUSE BLDG (TO BE DEMO.)
- B6 - LOAD CENTER LC-3 BLDG (N40-E190)
- B7 - LOAD CENTER LC-4 BLDG (S85-E120)
- B8 - EMERGENCY GENERATOR/MCC-AX BLDG
- B9 - MCC-A BLDG
- B10 - MCC-B BLDG
- B11 - MCC-C BLDG
- B12 - MCC-D BLDG
- B13 - MCC-E & MCC-EX BLDG
- B14 - ELECTRICAL/INSTRUMENTATION MICE BLDG
- B15 - PLM BLDG
- B16 - MECHANICAL MICE BLDG
- B17 - EAST OIL WATER SEPARATOR BLDG
- B18 - WEST OIL WATER SEPARATOR BLDG
- B19 - INTERFACE COMPUTER BLDG
- B20 - INTERFACE MONITOR BLDG
- B21 - ODOUR ABATEMENT BLDG (N50-W240)
- B22 - ODOUR ABATEMENT BLDG (N50-W140)
- B23 - ODOUR ABATEMENT BLDG (S85-E540)
- B24 - ODOUR ABATEMENT BLDG (S85-W240)
- B25 - FIRE HALL/STORAGE BLDG (FOAM TRAILER)
- B26 - BUTLER BLDG
- B27 - FIREWATER MAKE-UP VALVE BLDG
- B28 - WATER TREATMENT BLDG
- B29 - LAB BLDG
- B30 - AIR QUALITY BLDG
- B31 - EAST FLAMMABLE MATERIALS STORAGE BLDG
- B32 - WEST FLAMMABLE MATERIALS STORAGE BLDG
- B33 - JET FUEL BOOSTER PUMPS
- B34 - OLD FIRE CONTROL STATION
- M1 - MANIFOLD AREA

TANK No.	NOM. DIA. (m)	CENTERLINE * COORDINATES (m)	BASE ** ELEV. (m)
TK-74	56.40	E 592.200 N 78.300	172.500
TK-75	56.40	E 650.700 N 44.600	154.300
TK-76	56.40	E 474.000 N 122.000	172.500
TK-77	56.40	E 729.100 S 12.300	154.300
TK-78	42.70	E 761.300 N 148.000	172.500
TK-79	42.70	E 812.900 N 22.100	154.300
TK-80	53.40	E 368.100 N 0.000	172.000
TK-89	53.40	E 315.100 S 116.400	155.500
TK-91	56.40	S 47.600 N 125.100	194.500
TK-93	56.40	E 51.800 N 125.100	194.500
TK-95	56.40	E 160.100 N 125.100	191.500
TK-96	53.40	E 138.300 N 249.900	208.500
TK-97	56.40	E 259.700 N 125.100	191.500
TK-98	53.40	E 225.700 N 249.900	208.500

\* ALL COORDINATES ARE BASED ON SITE GRID SYSTEM AND REFERENCED TO :  
EXISTING TK-82 CENTER AT E = 0.000, N = 0.000

\*\* ALL TANK BASE ELEVATIONS ARE FOR THE U/S OF THE TANK ANNULAR RING AND ARE REFERENCED TO GEODETIC DATUM.

**PLAN**

**ch2m**  
Nov 16 2016  
ISSUED FOR DESIGN

**ch2m**  
# 660356



NO.	REFERENCE DRAWING TITLE	REFERENCE DRAWING NO.
1	SURFACE DRAINAGE SYSTEM LAYOUT	BB00-CE1100

NO	DATE	REVISION	DRN	CHK	APPR
B	2016/11/16	ISSUED FOR DESIGN	NY	KJ	AJL
A	2016/10/04	ISSUED FOR APPROVAL	NY	KJ	AJL

**TRANS MOUNTAIN**

TRANS MOUNTAIN EXPANSION PROJECT

GENERAL PLOT PLAN

BURNABY TERMINAL

PROJECT CODING: 01-13283

FACILITY ID: BB00 - SK-GA1000

DRAWING NUMBER: BB00 - SK-GA1000

SHEET SIZE: A1

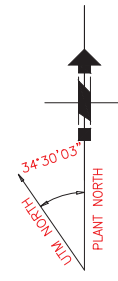
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DATE: 2016/09/22

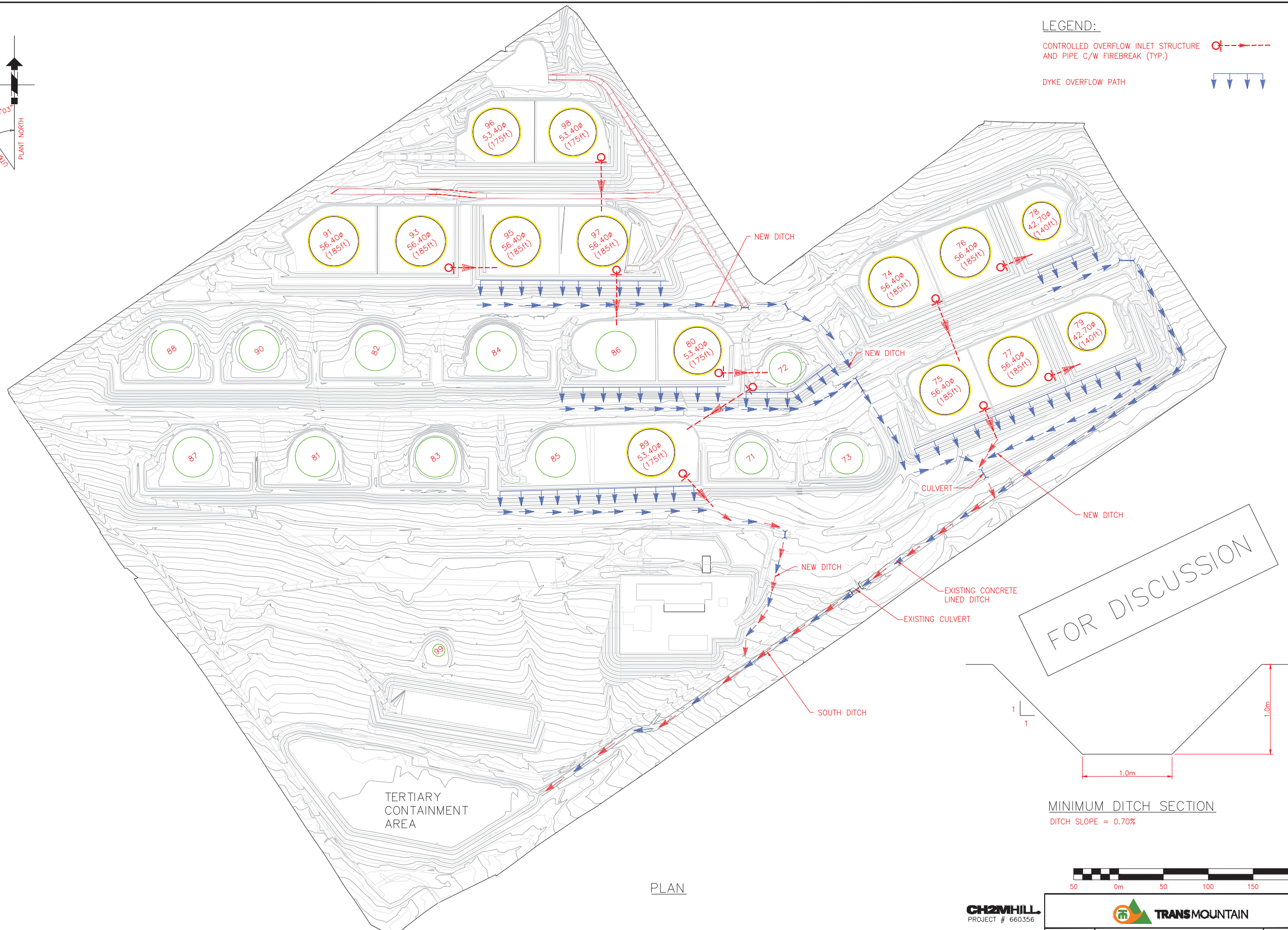
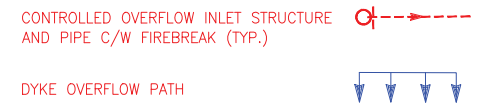
PROJECT CODING: AFE

REVISION: B

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**LEGEND:**



PLAN

**MINIMUM DITCH SECTION**  
DITCH SLOPE = 0.70%



**CH2MHILL**  
PROJECT # 660356

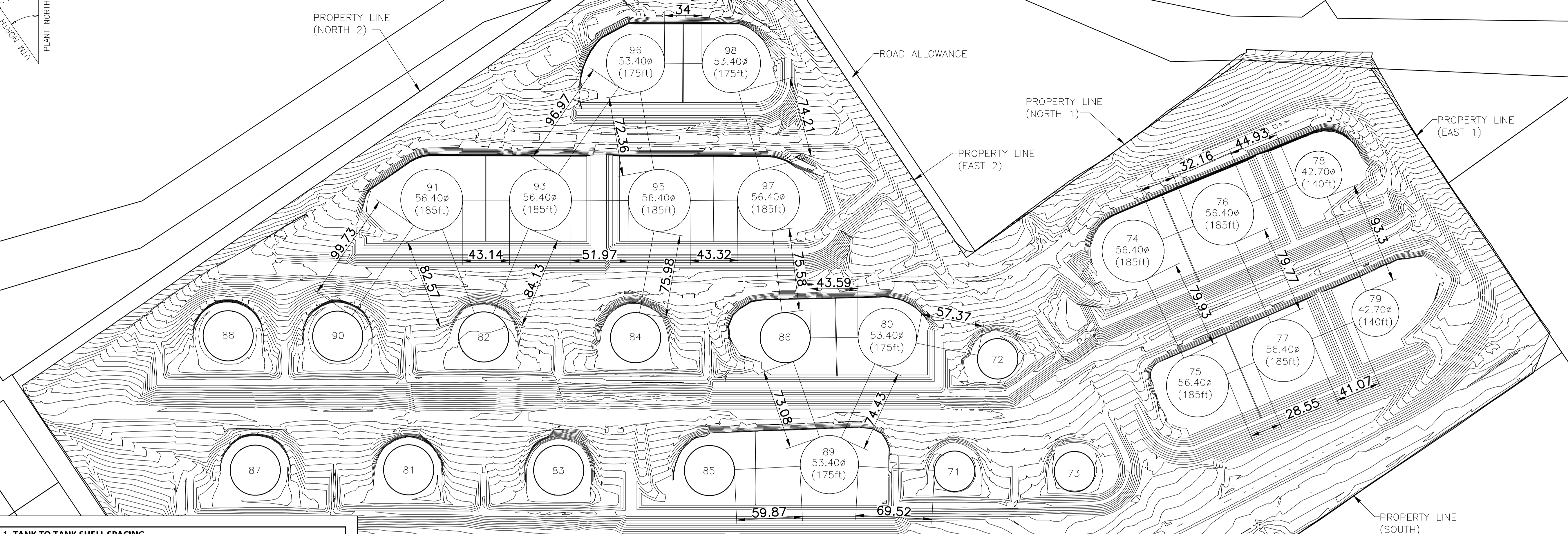
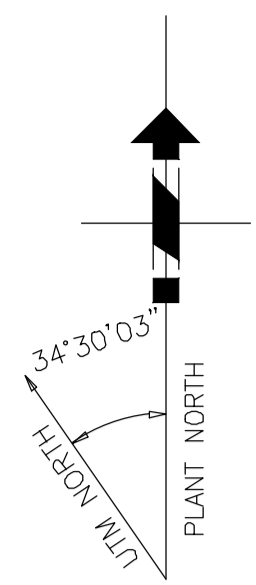
**TRANS MOUNTAIN**

DRAWN BY ED	TRANS MOUNTAIN EXPANSION PROJECT NEW TANKS	SHEET SIZE A1
CHECKED BY JPP		SCALE 1:2000
APPROVED BY	OVERFLOW PATH ANALYSIS BURNABY TERMINAL	DATE 27APR2016
PROJECT CODING AFE	DRAWING NUMBER FACILITY ID DOCUMENT NO	SHT NO REV
01-13283	BB00 - SK 007	

NO.	REFERENCE DRAWING TITLE	REFERENCE DRAWING NO.	NO.	DATE	REVISION	DRN	CHK	APPR
			A	2016/05/10	ISSUED FOR DISCUSSION	ED	JPP	

FILE NAME: P:\KINDERMORGAN\660356\PRELIM\DESIGN\GEN\PERMITTING\WEB\SECONDARY CONTAINMENT\_GENERAL\REFDRAWINGS\SK 007-TANK 1-75 & 77 LIQUID OVERFLOW RISK ANALYSIS.DWG PLOT DATE: 6 February 2017 PLOTTITLE: -----

FILE NAME: P:\KINDERMORGAN\660355\MP\PREDETAILDESIGN\CAD\DWG\BURNABY\_2D\_DWG\MT1060-NEW TANKS\_LAYOUT\_TANK TO TANK SHELL SPACING.DWG PLOT DATE: 16 February 2017 PLOT STYLE: KINDER-MORGAN-A1\_FULL\_MK00.ctb



**TABLE 1. TANK TO TANK SHELL SPACING**

From Tank #	Tank Dia. (m)	To Tank #	Tank Dia. (m)	Required Shell/Shell (m) per NFPA30 Table 22.4.2.1	Provided Shell/Shell (m)	Compliance
74	56.40	75	56.40	28.20	79.93	YES
74	56.40	76	56.40	28.20	32.16	YES
75	56.40	77	56.40	28.20	28.55	YES
76	56.40	77	56.40	28.20	79.77	YES
76	56.40	78	42.70	24.78	44.93	YES
77	56.40	79	42.70	24.78	41.07	YES
78	42.70	79	42.70	21.35	93.30	YES
80	53.40	72	36.60	22.50	57.37	YES
80	53.40	86	45.72	24.78	43.59	YES
89	53.40	71	36.60	22.50	69.52	YES
89	53.40	80	53.40	26.70	74.43	YES
89	53.40	85	45.72	24.78	59.87	YES
89	53.40	86	45.72	24.78	73.08	YES
91	56.40	82	45.72	25.53	82.57	YES
91	56.40	90	45.72	25.53	99.73	YES
91	56.40	93	56.40	28.20	43.14	YES
93	56.40	82	45.72	25.53	84.13	YES
93	56.40	95	56.40	28.20	51.97	YES
93	56.40	96	56.40	28.20	96.97	YES
95	56.40	84	45.72	25.53	75.98	YES
95	56.40	96	53.40	27.45	72.36	YES
95	56.40	97	56.40	28.20	43.32	YES
96	53.40	98	53.40	26.70	34.00	YES
97	56.40	86	45.72	25.53	75.58	YES
97	56.40	98	53.40	27.45	74.21	YES

PLAN

**ch2m**  
Feb 16 2017  
ISSUED FOR INFORMATION

**ch2m**  
PROJECT # 660356

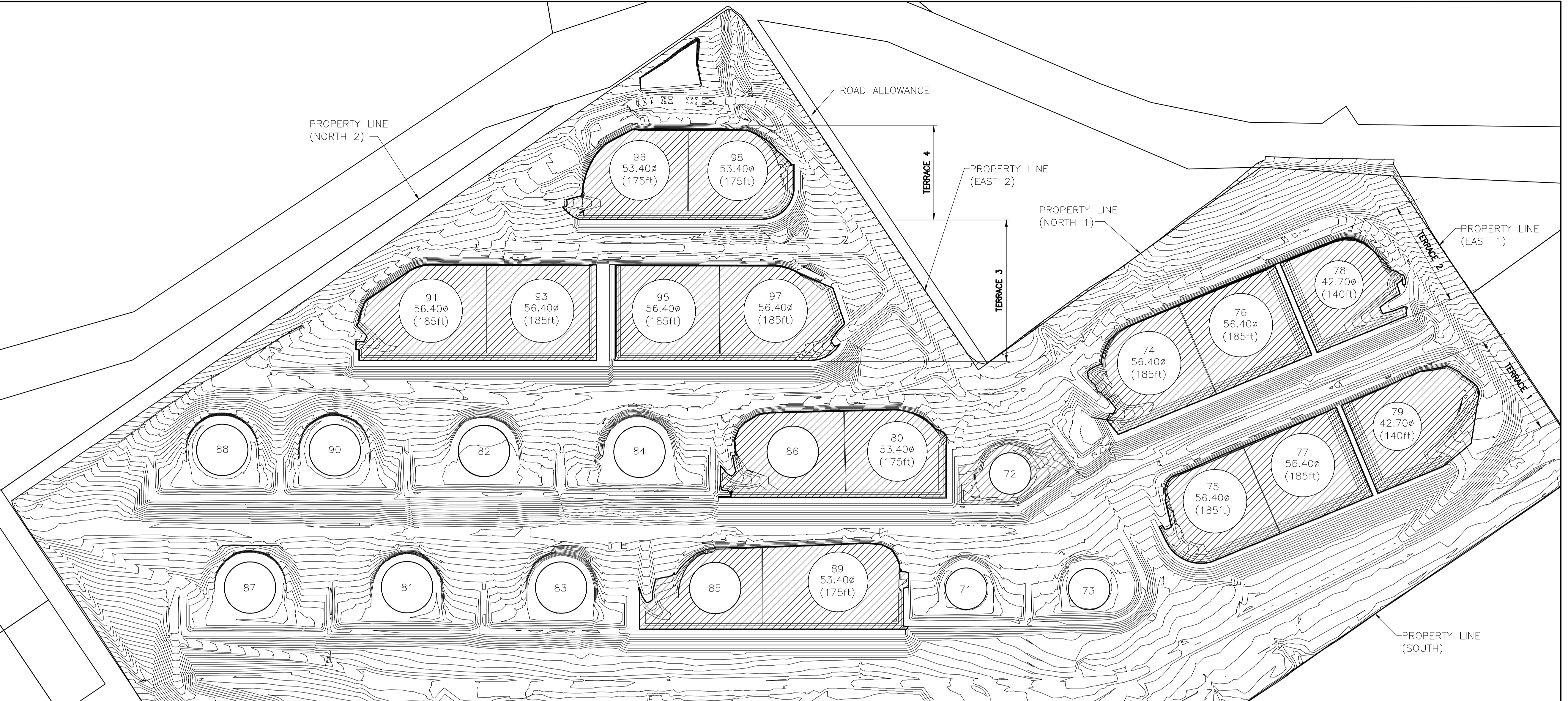
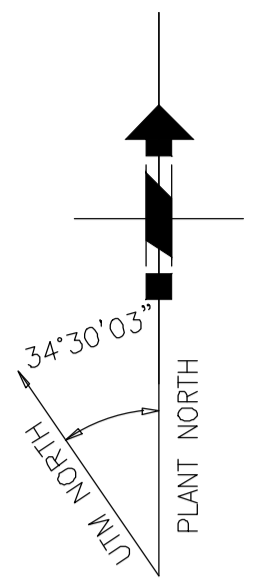


DRAWN BY	YZ	TRANS MOUNTAIN EXPANSION PROJECT	SHEET SIZE	A1
CHECKED BY	MBC	TANK TO TANK SHELL SPACING	SCALE	1:2000
APPROVED BY		BURNABY TERMINAL	DATE	2014/10/20
PROJECT CODING	AFE	FACILITY ID	DOCUMENT NO	SHT NO
	01-13283	BB00	MT1060	REV
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NO.	REFERENCE DRAWING TITLE	REFERENCE DRAWING NO.	NO	DATE	REVISION	DRN	CHK	APPR
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			A	2015/05/25	ISSUED FOR INFORMATION	YZ	JP	-



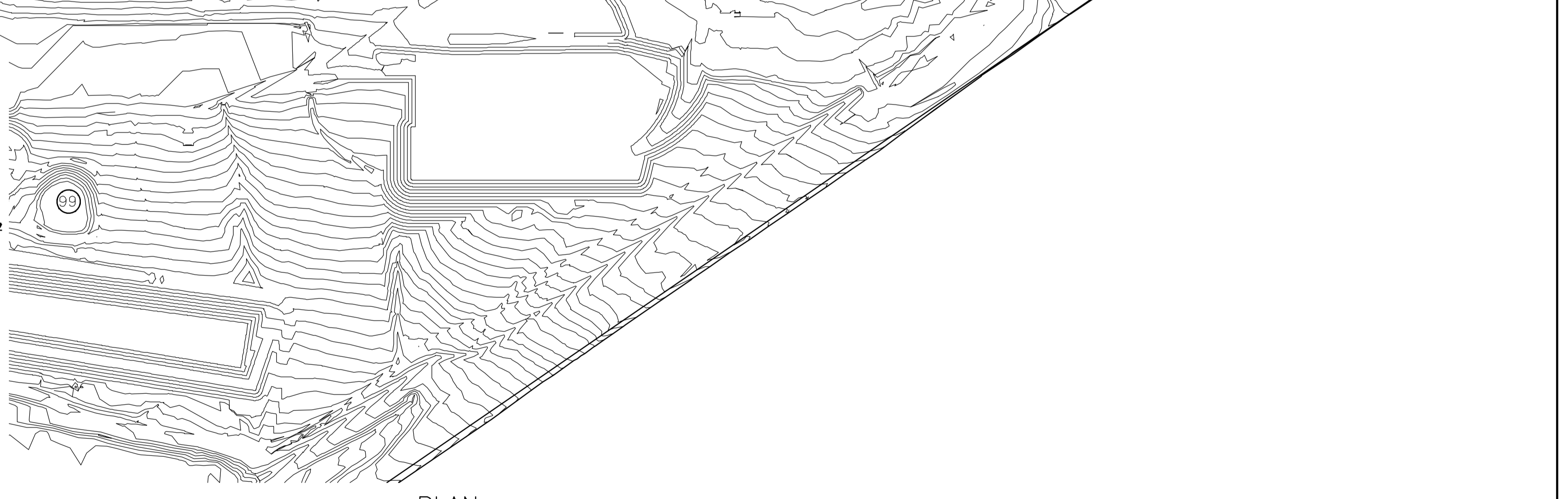
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SECONDARY CONTAINMENT DATA

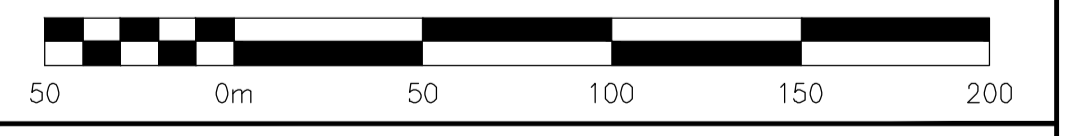
No.	Nom. Vol. Largest Tk	Vol. largest tank at High working Level	Req. Cap <sup>y</sup> =D*1.1	CF	CE(F) =F-E	CB(T)	T	CB =H-I	CE(B) =J-E	AP	CEP(F) =G-L	CEP(B) =K-L	
A	B	C	D	E	F	G	H	I	J	K	L	M	N
<b>1-Tank &amp; 2-Tank Containment Areas</b>													
74/76	285,000	270,750	43,046	47,350	56,426	9,076	72,693	11,737	60,956	13,606	3032	6,044	10,574
75/77	285,000	270,750	43,046	47,350	49,986	2,636	66,567	10,988	55,579	8,229	3017	-381	5,212
78	165,000	156,750	24,921	27,413	28,438	1,025	30,450	6,722	30,450	3,037	1455	-430	1,582
79	165,000	156,750	24,921	27,413	34,347	6,934	36,600	6,293	36,600	9,187	1536	5,398	7,651
80/86	255,000	242,250	38,515	42,366	35,937	-6,429	44,832	5,254	39,578	-2,788	2767	-9,196	-5,555
85/89	255,000	242,250	38,515	42,366	43,553	1,187	53,399	6,074	47,325	4,959	3077	-1,890	1,882
91/93	285,000	270,750	43,046	47,350	51,614	4,264	65,846	9,240	56,606	9,256	3195	1,069	6,061
95/97	285,000	270,750	43,046	47,350	48,358	1,008	62,376	9,240	53,136	5,786	3325	-2,317	2,461
96/98	255,000	242,250	38,515	42,366	45,982	3,616	59,393	9,385	50,008	7,642	3014	602	4,628
<b>3-Tank Containment Areas</b>													
Exist 72	80,000	65,578	10,426	11,469	13,400	1,931	14,100	4,203	9,897	N/A	1455	N/A	N/A
72/80/86	255,000	242,250	38,515	42,366	45,440	3,074	58,932	9,457	49,475	7,108	4,222	-1,148	2,886

Overflows to Tank 72



PLAN

**Notes:**  
 CF = Capacity Available to Freeboard Level (excluding Cylinder of 2<sup>nd</sup> Tank)  
 CE(F) = Excess (Net) Capacity to Freeboard Level, excluding precipitation  
 CB = Capacity Available to Top of Berm (excluding Cylinder of 2<sup>nd</sup> Tank)  
 CE(B) = Excess (Net) Capacity to Top of Berm, excluding precipitation  
 AP = Accumulated Precipitation (1 in 100-year 24-hour storm)  
 CEP(B) = Excess (Net) Capacity to Top of Berm, including precipitation  
 Tank 78 & 79 Col J Values include the tank cylinder volume as they are single tank containments  
 Existing Tank 72 Col N value is the excess (Net) Capacity to top of berm available to contain overflow from 80/86  
 72/80/86 Col N value is the excess (Net) Capacity in Tank 72 containment after receiving overflow from 80/86  
 CF 72/80/86 is a unique calculation using some numbers outside of this table:  
 CF 72/80/86 = 35,937 + 13,400 - [(Tank 72 Volume to FB) = 3,897 m<sup>3</sup>] = 45,440 m<sup>3</sup>



ch2m PROJECT # 660356



DRAWN BY YZ MBC PH		TRANS MOUNTAIN EXPANSION PROJECT		SHEET SIZE A1	
CHECKED BY YZ MBC		SECONDARY CONTAINMENT DATA		SCALE 1:2000	
APPROVED BY		BURNABY TERMINAL		DATE 06JUL2014	
PROJECT CODING 01-13283		DRAWING NUMBER BB00 - MT1062		SHT NO. 1	
FACILITY ID		DOCUMENT NO		REV F	

NO.	REFERENCE DRAWING TITLE	REFERENCE DRAWING NO.	NO.	DATE	REVISION	DRN	CHK	APPR
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E			2017/02/23	RE-ISSUED FOR INFORMATION	YZ	MBC		
D			2017/02/21	RE-ISSUED FOR INFORMATION	YZ	MBC		
C			2017/02/16	RE-ISSUED FOR INFORMATION	YZ	MBC		
B			2015/12/14	RE-ISSUED FOR INFORMATION	YZ	MBC		
A			2015/05/25	ISSUED FOR INFORMATION	YZ	JP		



**VIA ELECTRONIC SUBMISSION**

July 14, 2017

National Energy Board  
Suite 210, 517 Tenth Avenue S.W.  
Calgary, Alberta T2R 0A8

To: Ms. Sheri Young, Secretary, National Energy Board

Dear Ms. Young:

**Re: Trans Mountain Pipeline ULC (“Trans Mountain”)  
Trans Mountain Expansion Project (“Project” or “TMEP”)  
Burnaby Terminal Variance Application (“Variance Application”)  
Trans Mountain’s filings pursuant to Conditions 22 and 24 of Order XO-T260-010-2016 (“Order”)  
NEB File: OF-Fac-Oil-T260-2013-03 02**

In relation to Trans Mountain’s Variance Application and compliance filings pursuant to Conditions 22 and 24 of the Order, Trans Mountain is in receipt of the National Energy Board’s (the “Board” or “NEB”) letter dated June 5, 2017 which describes a written process to consider the Variance Application and compliance filings pursuant to Conditions 22 and 24 of the Order.

Mr. Gregory J. McDade, counsel for the City of Burnaby (“Burnaby”) filed a letter of comment in relation to this matter on June 30, 2017. Trans Mountain has reviewed and assessed these comments, and pursuant to the Board’s letter direction, offers this reply.

**1. City of Burnaby Letter of Comment**

In its letter, Burnaby communicates its view that Trans Mountain has failed to discharge its obligation to consult Burnaby in advance of filing its Condition reports, that it provided no opportunity for independent technical review of Condition 22 and 24 reports of which Burnaby also maintains that through its subsequent review, contain significant errors and omissions. Burnaby also describes a number of concerns specific to the risk assessment supplied in the Condition 22 Report.

Burnaby’s position is as follows:

- Trans Mountain’s compliance with the NEB Report, including Conditions 14, 22 and 24 requires that it engage in good faith consultation with Burnaby in respect of the significant public interest issues engaged in those conditions;



- Trans Mountain's failure to engage Burnaby in consultation on the Condition 22 and 24 reports, and significant errors and omissions in those reports, render them inadequate for the purposes for which they were intended and non-compliance with the NEB Report; and
- Trans Mountain's Variance Application, which is premised on the results of the Condition 22 and 24 reports, is premature.

Burnaby requests that the Board:

- Return the Condition 22 and 24 reports to Trans Mountain and require that it consult with Burnaby to address Burnaby's outstanding concerns and significant matters of accident risk and public safety
- Postpone consideration of the Variance Application until after the Condition 22 and 24 reports are finalized in consultation with Burnaby.

## **2. Trans Mountain Reply –Consultation with the City of Burnaby**

### **2.1 Project Engagement and Consultation History**

Trans Mountain has an extensive history of engagement with the City of Burnaby dating back to when Trans Mountain commenced operations in 1953. Specific to the Project, Trans Mountain commenced engagement activities with Burnaby in May 2012.

Burnaby withdrew from discussions with respect to the Project more than two years ago on the basis that it preferred to deal with matters of concern through a "formal" process (i.e. through the NEB proceeding or the Courts). Since that time, Trans Mountain has continued to provide Burnaby with timely information regarding the Project, including opportunities to meet, and has sought Burnaby's feedback on various Project-related reports, as required by the Conditions of the Certificates and Orders for the Project. Consultation and engagement opportunities, including outreach to Burnaby administration are ongoing. Reports on consultation activities completed between May 2012 and June 30, 2015 were filed with the Board in the Project Application.<sup>1</sup>

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<sup>1</sup> Volume 3A: Public Consultation (Filing ID [A3S0R2](#), [A3S0R3](#), [A3S0R4](#), [A3S0R5](#)) and were updated in four Consultation Update filings (Consultation Update No. 1 and Errata (Filing ID [A3V3L8](#), [A3Z8E6](#)); Consultation Update No. 2 (Filing ID [A62087](#), [A62088](#)); Consultation Update No. 3 (Filing ID [A4H1W2](#), [A4H1W3](#), [A4H1W4](#), [A4H1W5](#), [A4H1W6](#), [A4H1W7](#), [A4H1W8](#)); Consultation Update No. 4 (Filing ID [A4S7G2](#), [A4S7G3](#), [A4S7G4](#), [A4S7G5](#), [A4S7G6](#), [A4S7G7](#)); A table summarizing consultation with Burnaby from May 2012 through June 2014 was also previously filed with the Board (Filing ID [A3Y7F5](#)).

## **2.2 Emergency Management Engagement**

Trans Mountain's Emergency Management representatives have made multiple attempts to engage with the City of Burnaby Fire Department with respect to the Project. Since Project engagement activities commenced, Trans Mountain has extended invitations to Burnaby for all geographically relevant Project Emergency Management workshops, emergency response exercises and training, information sessions and one on one meetings. Burnaby has either declined, clearly stating that they would only discuss existing operational matters, or has not responded to these requests, with the exception of one recent event, described below.

In meetings with Burnaby to discuss ongoing operational matters of interest that took place on September 11, 2015 and March 31, 2016, Trans Mountain extended an invitation to meet to discuss the Project. At these meetings, the City of Burnaby Fire Department requested that Trans Mountain extend an invitation to engage in writing. Trans Mountain followed up in writing as requested, and Burnaby either declined to discuss the Project or did not respond to Trans Mountain's requests.<sup>2</sup>

As is the case with all geographically relevant emergency response exercises, Trans Mountain extended an invitation to Burnaby to participate in an emergency response exercise at Burnaby Terminal that took place on June 29, 2017. Trans Mountain was pleased that Burnaby chose to participate, noting that this was the first time that Burnaby has participated in approximately three years.

## **2.3 Project Conditions Engagement**

While Trans Mountain makes every effort to engage with government stakeholders through the lifecycle of the Project, in order to identify and adequately address concerns regarding the Project's potential effects on governments, Trans Mountain notes that there are specific conditions to the Project Certificates and Orders that require certain consultation activities to take place. As related to emergency management, Condition 118 – Firefighting capacity at terminals and Condition 123 – Evacuation plans, both have consultation requirements.

On January 31, 2017 at a meeting with Burnaby related to operational matters, Trans Mountain provided an overview of planned firefighting capacity (Condition 118) and evacuation plans (Condition 123). Burnaby agreed that they would need to be engaged on both Conditions. Later, at a meeting on March 15, 2017 also related to operational matters, Trans Mountain reviewed key components of the Condition 118 and 123 documents and requested to engage with the City of Burnaby Fire Department on these two conditions. In response, Burnaby requested that all Project emergency management related topics be tabled at the established Technical Working Group Meetings.

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<sup>2</sup> From September to December 2016, Trans Mountain made six (6) attempts to engage, as described in Trans Mountain's (Osler) letter to the Board dated March 24, 2017 (Filing ID [A82241](#)).

Unlike Conditions 118 and 123, Conditions 22 and 24 have no advance consultation requirement. Trans Mountain filed its Variance Application to vary the Order concurrent to compliance filings for Conditions 22 and 24. In January 2017 Trans Mountain held a public open house in Burnaby where information was shared about detailed design and construction plans. Burnaby was invited but did not attend. In consideration of external communications to Burnaby and to stakeholders and Aboriginal groups, Trans Mountain is mindful that the applied for variance serves to *reduce* the previously approved scope of construction by the Order by decreasing the size of five tanks by a total of 50,880 m<sup>3</sup> (320,000 barrels) or 8%, and to *reduce* the risk by increasing the spacing between seven pairs of adjacent tanks (by an average of 61%) and eliminating three, three-tank shared secondary containment.

## 2.4 Technical Working Groups

Pursuant to Condition 14, Trans Mountain has formed a Technical Working Group (“TWG”) with Burnaby. Trans Mountain and Burnaby are currently working towards agreeing to Terms of Reference (“TOR”) for the TWGs.

The TOR are not final, but the current version of the draft TOR states:

*Trans Mountain will provide notice of compliance filings. Input into regulatory documents requiring consultation will continue to be sought during the specified consultation windows. **Inputs outside the consultation window is welcomed and will be considered for input to the extent practicable. The TMEP is open to reviewing Condition details with the City as requested.*** [Emphasis added]

At the July 5, 2017 TWG meeting between Burnaby and Trans Mountain, Burnaby confirmed that it was interested in forming an Emergency Management Sub Working Group (“SWG”) to discuss topics of mutual interest related to emergency management. A representative from Burnaby and a representative from Trans Mountain’s emergency management team were tasked with discussing how they work together as a SWG.

Trans Mountain is encouraged by Burnaby’s willingness to engage and participate in the TWG and SWG, and also by Burnaby’s recent participation in the emergency response exercise at Trans Mountain’s Burnaby Terminal. However, in relation to the Project, Trans Mountain was not afforded an opportunity to consult with Burnaby despite multiple attempts to engage. That being said, Trans Mountain is aware that the Variance Application serves to reduce the total tank capacity, and to modify secondary containment to increase the spacing between certain tanks, and to reduce the number of three-tank shared compartments, which as supported by the Condition 22 risk assessment, results in reduced overall risk. As the proposed scope within the Variance Application is arguably well within the parameters of the approved scope in the Order, and given the reduced risk of the proposed scope as shown in the Condition 22 risk assessment, in the absence of Burnaby’s feedback, Trans Mountain had no reason to believe that the

Variance Application and compliance filings for Conditions 22 and 24 would not be in the public interest. For these reasons, Trans Mountain disagrees with Burnaby's position that it failed to engage in good faith consultation with Burnaby.

### **3. Trans Mountain Reply – Risk Assessment and Secondary Containment Design**

Trans Mountain retained Genesis Oil and Gas Consultants Ltd. ("Genesis") to undertake a risk assessment that included a quantification of the probabilities and potential consequences of events resulting from process and non-process hazards at the expanded Burnaby Terminal. Genesis used sophisticated computational methods to aggregate risk calculations into an overall assessment of risk for Burnaby Terminal, which was then assessed against the Major Industrial Accidents Council of Canada ("MIACC") criteria for risk acceptability. A risk-based approach was also used to demonstrate the adequacy of secondary containment. The risk assessment addressed spill, fire, explosion, and boil-over scenarios, initiated by earthquakes and other causes, and included domino (knock-on) effects, the effects of heat from fire, SO<sub>2</sub> and CO concentrations in smoke, and secondary containment overflow (concurrent with rainfall events). The Burnaby Terminal Expansion Risk Assessment Report was prepared by Genesis, and filed pursuant to Condition 22 and Condition 24, and is herein referred to as the "Genesis Report".

Trans Mountain notes that Burnaby questions the modelling assumptions and methods used by Genesis. However, Burnaby does not identify specific and recognized approaches that they believe are more appropriate. In a number of their comments Burnaby infers that risk acceptability should be based on the possible consequences of a specific event, without regard for the probability of such an event. The computational approach used by Genesis is able to aggregate the results of thousands of scenarios (including the impacts at thousands of discrete locations around the terminal) to establish an overall picture of risk.

Trans Mountain notes that Genesis does not include fire suppression capability in the risk assessment calculations. While Trans Mountain is of the view that proposed rim-seal area and full-surface fire suppression systems will be highly effective at extinguishing tank fires, thereby preventing escalation events (such as boil-over), there are no established extinguishment factors in the literature and Genesis has conservatively decided not to consider fire extinguishment. Nevertheless, the Genesis Report demonstrates that the overall individual risk is acceptable based on the MIACC criteria. Had fire-extinguishment factors been included, the individual risk values would have been lower at each location.

Trans Mountain notes that Burnaby's comments include a focus on the potential consequences of boil-over events. However, as discussed in the Risk Assessment Summary Report, Burnaby Terminal ("Summary Report") Section 8.0(b), boil-over events occur many hours after the start of a full-surface fire, assuming the fire is not extinguished. These time periods allow for strategic and tactical emergency response, including evacuation from the area that might be impacted by the fall-out or secondary events (such as forest fires). From a risk perspective, therefore, the

probability of exposure to boil-over effects is essentially zero, reducing the individual risk to essentially zero.

Trans Mountain notes that Burnaby provides a number of specific comments in relation to Condition 22 and 24 compliance filings. Burnaby's concern, and Trans Mountain's reply to each concern is provided below.

### **3.1 Condition 22 – Updated Terminal Risk Assessment**

#### **3.1.1 Boil-Over**

*Burnaby Concern:*

*Fundamentally flawed modelling* – the report models a boil-over event as a pool fire, which is fundamentally wrong. Modelling boil-over on these parameters significantly understates the risks and consequences of such an event - both the diameter of the fireball as well as the duration of the event are grossly underrepresented. As a result, any characterization of the resulting thermal dose of such an event on an individual and/or the environment based on these parameters is wrong.

*Trans Mountain Reply:*

Boil-over is modeled following the recommendations found in the industry recognized and widely-accepted UK OGP 434-7. Furthermore, the time and duration of boil-over was calculated based on well-known published reference documents and dissertations. Please see references #13, 14, 15, 17 and 18 in the Genesis Report. Trans Mountain notes that Burnaby has not provided an alternative analytical approach to model boil-over.

*Burnaby Concern:*

*Important secondary event risks not addressed* – the risk assessment is premised on complete evacuation of the impacted area within the timeframe prior to boil-over. It does not address the fact that all fire suppression personnel would also need to be evacuated, leading to the significant risk of subsequent fire events resulting from the boil-over. There is clear precedent for such risk which is not addressed in the report.

*Trans Mountain Reply:*

The Genesis Report specifically addresses the potential impact of a boil-over on public safety. Evacuation is a means to protect the public from the adverse effects of a fire and potential boil-over. Extinguishing a fire is the best method of preventing a boil-over, therefore Trans Mountain would not suspend firefighting operations to evacuate responders due to the risk of a boil-over. As demonstrated in Section 7.3, Table 7-4 of the Genesis Report, the approximate time from the initiation of a fire to potential boil-over can be calculated based on the size of the tank and the

liquid level, providing responders with a known and significant period of time to undertake fire-fighting activities before they would need to be evacuated.

*Burnaby Concern:*

*Failure to address precedent* – the report states that, based on review of literature and prior boil-over incidents, that there is no evidence on which to qualify or quantify “the escalation in the form of a boil-over causing any fire in the near-by tanks or forest fires in the surrounding area”. The report fails to address important instances of boil-over events that have resulted in such secondary impacts, including the 1982 Tacoma, Venezuela event.

The report is entirely inadequate in characterizing a boil-over event and the potential harms, both direct and indirect, caused by such an event. The critical errors in this analysis completely undermine the risk assessment filed pursuant to Condition 22. Trans Mountain must be required to amend its risk assessment so that the risk and consequences of a boil-over event are properly characterized, including the risk of secondary fires and the impacts on fire suppression resulting from complete evacuation from the event area.

*Trans Mountain Reply:*

Boil-over is a significant event, which has been assessed in the Genesis Report. The referenced boil-over event in Tacoma, Venezuela led to loss of lives (specifically amongst a large crowd of power plant workers and local residents which gathered to watch the burning tank) but there is no evidence found to suggest that the boil-over caused any escalation of events in the near-by tanks.<sup>3</sup>

As discussed in Section 8.4 of the Genesis Report, there are no analytical methods available in the literature to quantify the risk of secondary fires. As discussed in Section 8.0(b) of the Summary Report, application of the risk equations at the time that a boil-over occurs (5 to 24 hours after the initiation of an uncontrolled full-surface fire) would yield extremely small individual risk probabilities, given that evacuation from the fallout areas would have taken place. The possibility of secondary fires will be given proper consideration in emergency management plans.

### **3.1.2 Vapour Cloud Explosion**

*Burnaby Concern:*

*Faulty dispersion modelling* – the dispersion model used by Trans Mountain’s consultant relies on the presence of wind. Where conditions are calm, the formula breaks down and does not

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<sup>3</sup> The 1982 Tacoma, Venezuela event was discussed in Trans Mountain’s response to NEB IR No. 6.23 (Filing ID [A4R614](#)).

provide a sound basis for modelling dispersion. Accurate predictions for dispersion require state of the art models that are highly specific to the location in question.

*Trans Mountain Reply:*

Dispersion modeling is based on the most commonly used approach in the industry.<sup>4</sup> The probability associated with the calm conditions is combined with the minimum speed that the dispersion modeling is valid for. Furthermore, according to the Environmental Protection Agency Risk Management Plan, the worst-case scenario is 1.5 m/s with F stability class.<sup>5</sup> Based on the wind data provided by Trans Mountain, the calm conditions (no wind) account for very small probabilities.

The implied suggestion to utilize a computational fluid dynamics approach to dispersion modeling for such a large terminal would be inefficient and would not guarantee an accurate result.

*Burnaby Concern:*

*Inaccurate ignition probability* – The ignition probability curve used by Trans Mountain's consultant is based on the wrong fuel type (ie. diesel and fuel oil). Using the appropriate fuel scenario, the ignition probability could be between 5 and 50 times higher than what is shown on the Ignition Probability curve in the report.

The consequences of a vapour cloud explosion would be extreme given the short notice and evacuation period. Trans Mountain must be required to update its report so as to correctly model the key elements of vapour cloud dispersion and ignition probability. Among other things, this will require development of a custom model for dispersion. Until such time as this risk is correctly modelled, there is no adequate basis for assessing risk or consequences.

*Trans Mountain Reply:*

Based on Lees' Loss Prevention in the Process Industries (Reference #51 in the Genesis Report), the probability of explosion for a small size cloud is between 0.01 and 0.1.

In Section 7.3.8 of the Genesis Report, Scenario 13 found in the UK OGP 434-6.1 gives the ignition probability of 0.015. Including the probability of explosion will result in a probability of 0.0015 which is smaller than the probability of 0.0024 used in the study. Thus, the ignition probability used in the study implicitly accounts for the probability of explosion and is more conservative.

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<sup>4</sup> Center for Chemical Process Safety

<sup>5</sup> US EPA Risk Management Program Guidance for Offsite Consequence Analysis, EPA 550-B-99-009, March 2009.



### 3.1.3 Knock-on Effects

*Burnaby Concern:*

*Flawed knock-on risk assessment* - The methodology utilized for the purposes of the knock-on analysis is flawed in important respects. There is no reference to heat impact modelling, which should have been accounted for as part of the risk assessment. The methodology does not account for the ignition potential of a boil-over event against hydrocarbon tank structures and within highly combustible forest areas.

Trans Mountain must be required to develop a more comprehensive analysis of the impacts of various factors on the risk of knock-on events, including tank structure materials, the local forested environment and heat exposure at higher elevations. This more comprehensive knock-on analysis must be properly integrated into the risk assessment.

*Trans Mountain Reply:*

Please refer to Sections 8.0 and 7.5.1 of the Genesis Report that describes knock-on effect (domino) and tank response assessment to fire. As presented in Section 8.1, boil-over due to pool fire event is one of the scenarios that was investigated in the study. Full 3-D advanced finite element analysis was performed to investigate the response of the tank to thermal exposure.

Section 6 of Trans Mountain's Emergency Response Plans identify multiple hazards including specific wildfire hazards and response to wildfires that have the potential to impact Trans Mountain facilities. There are a number of different response mechanisms that would be deployed depending on the threat and the type of incident. Supplemental wildfire response plans for the Burnaby terminal will be specifically addressed in compliance filings pursuant to Condition 125 (Emergency Response Plans for the Pipeline and for the Edmonton, Sumas and Burnaby Terminals).

*Burnaby Concern:*

*Inadequate assessment of knock-on effects from secondary containment pool fire* - As described in the report, secondary containment pool fires will presumptively spread to other tanks in the same secondary containment area. As a result of the proposed Terminal expansion design, discharges to tertiary containment will also in many cases pass through additional secondary containment units, resulting in spreading of the fire event to these units and increasing risk of knock-on effects and event escalation. Further, the design of the route to tertiary containment (ie. in close proximity to secondary containment) is such that, even where the fire event does not spread directly through additional secondary containment units, it is more likely to spread by way of heat impact.

Trans Mountain must be required to assess and account for risk of knock-on effects from spill fire events travelling directly between secondary containment areas and from heat impacts associated with spill fire travelling on the proposed tertiary containment route.

*Trans Mountain Reply:*

The secondary containment design for the expanded Burnaby Terminal, which includes shared containment concepts, is fully compliant with required regulations, codes and standards. However, after contemplation of multiple-tank failure scenarios, including extreme scenarios raised by the Board and Intervenors, Trans Mountain considered ways to maximize the effectiveness of the available containment. The approach selected was to involve adjacent containment via controlled flow paths. Trans Mountain believes that engaging adjacent secondary containment areas, where possible, in extreme release scenarios, is preferable to allowing excess released oil to flow directly to the tertiary containment area.

The Genesis Report reflects the design for Burnaby Terminal represented in the Variance Application. As such, the risks associated with the current secondary containment configuration and overflow paths have been assessed.

A preliminary cross section of the controlled overflow inlet structure can be seen in Section C of Figure 6-5 in Section 6.7 of the Genesis Report. The configuration of the inlet is such that fire cannot propagate to the adjacent secondary containment areas via the controlled overflow pathways.

### **3.1.4 Secondary and Tertiary Containment**

*Burnaby Concern:*

*Flawed secondary containment design* - the containment design change contemplated in the report involves transfer of oil between secondary containment units once one reaches capacity as opposed to routing it directly to tertiary containment by way of an external dike system. As an example, controlled transfers of releases from T96-98 & T91-93 appear to be required to pass through T95-97. This design change in fact increases the potential for fire event spread to uninvolved tanks, therefore expanding potential event scope and significantly increasing overall risk.

Trans Mountain must be required to address the issue of spreading fire events as a result of proposed terminal design changes. The changes as currently proposed create additional risk

*Trans Mountain Reply:*

Please see Tran's Mountain reply to *Inadequate assessment of knock-on effects from secondary containment pool fire*, above.

*Burnaby Concern:*

*Faulty secondary containment overflow drainage configuration* - The high-capacity drainage channel and berm proposed for the south side of the terminal effectively blocks the primary entry or road access to the facility. In the case of a secondary containment overspill event, the transmission of oil in this channel creates the potential for surface fire at the main entry of the facility. This would significantly undermine the efforts of first responders, including fire suppression units. It would also put first responders at extreme risk in responding to such an event.

Trans Mountain must be required to amend its design to appropriately control and manage the travel of oil over its property in the case of overspill from secondary containment to reduce the level and complexity of fire risk, and to ensure that first responders are able to effectively access the terminal property for fire suppression and other emergency services without being put in a high risk situation.

*Trans Mountain Reply:*

The drainage channel will only be active in the event of certain extremely unlikely multiple tank failure scenarios. A large-diameter culvert has been provided to direct any flow in the ditch system under the main access road and allow for continued site access/egress. In a case where the main access road is blocked by fire or otherwise, emergency site access is available at the south and northwest corners of the site. Full firefighting capability and emergency access for the terminal will be addressed in one or more of the responses to the following NEB Conditions:

- Condition 118: Firefighting Capacity at Terminals
- Condition 123: Evacuation Plan
- Condition 125: Emergency Response Plans for the Pipeline and for the Edmonton, Sumas and Burnaby Terminals
- Condition 127: Terminal Fire Protection and Firefighting Systems

*Burnaby Concern:*

*Unacceptable tertiary containment overflow risk* - the assessment results for tertiary containment overflow highlight critical design flaws with the Burnaby Terminal expansion. In particular, the overflow risk frequency in the case of both 1/10 and 1/100 year rainfall events falls outside of the “acceptable” range based on the risk tolerability criteria used by Trans Mountain’s consultant. Notably, these standards were adopted from UK and EU sources because neither Canada nor the USA has published environment and safety risk criteria for oil overspill from terminal boundaries.

It is unacceptable that Trans Mountain has failed to reduce overflow risk to an acceptable standard based on the environmental risk criteria adopted by its consultant. The lack of

published risk criteria for the overspill risk in question necessitates a highly cautious approach to risk assessment using the most conservative standards available. Given the extreme nature of the environmental and public health implications of an overspill event, and the scope and duration of the project, the ALARP standards for risk tolerability are simply not appropriate. Trans Mountain must be required to consider and address further mitigation and risk reduction measures in accordance with the most conservative environment and safety risk tolerability standards.

*Trans Mountain Reply:*

In the Genesis Report, the overarching conclusions of risk acceptability, for events which result in released oil leaving the Burnaby Terminal property, are tied to the concept of the “tolerability of risk”. The tolerability is defined in Section 9.3 of the Genesis Report by using the UK Health & Safety Executive (“UKHSE”) “Safety & Environmental Standards for Fuel Storage Sites” the Environment Agency for England & Wales (“EAEW”) “Integrated pollution Prevention & Control”. These tolerability criteria were selected as there are no suitable North American criteria available in the literature. Although referenced in Condition 22, the MIACC acceptable land use criteria cannot be applied for off-site spill risk assessments. The MIACC criteria are designed for point source applications and require a determination of individual risk, for which there is no practical approach for oil travelling through off-site drainage courses.

The UKHSE and EAEW references combine notional health, safety, and environmental damage effects to define several consequence categories ranging from Category 1 (Minor) to Category 6 (Catastrophic). These are reproduced in Section 9.3 (Table 9-2) of the Genesis Report. Genesis has selected Category 5 (Major) to reasonably reflect the effects of an off-site release from Burnaby Terminal, although Trans Mountain notes that Category 6 (Catastrophic) identified in Section 9.3 (Table 9-1) has the same tolerability criteria as Category 5. Table 1, below, which has been extracted from Section 9.3 (Table 9-1), identifies the tolerability criteria for events resulting in Category 5 consequences:

**Table 1: Tolerability Levels Based on Event (Consequence) Probabilities (Category 5 – Major)**

<b>Event Probability Range</b>	<b>Tolerability</b>
Greater than $1 \times 10^{-4}$	Unacceptable
$1 \times 10^{-4}$ to $1 \times 10^{-6}$	Acceptable, if reduced to as low as reasonably practicable (ALARP)
Less than $1 \times 10^{-6}$	Acceptable

Trans Mountain and Genesis believe that the tolerability criteria used are both appropriate and conservative. According to the risk matrices of major companies (such as CPChem, SASOL and

BP), the “extremely improbable” frequency for catastrophic events is in the order of  $10^{-4}$  to  $10^{-5}$ . Also, per Lees’ Loss Prevention in the Process Industries (Reference #51), for a catastrophic consequence that entails a severe permanent or long-term environmental damage in a significant area or land, the acceptable frequency is  $10^{-5}$  per year.

The aggregate probability of overflow (including 1 in 100-year rainfall events) is  $8.23 \times 10^{-6}$ . The aggregate probability of overflow (including 1 in 10-year rainfall events) is  $9.11 \times 10^{-6}$ . These probabilities are in the range of acceptability, following the UKHSE and EAEW criteria (where the probability has been reduced to as low as reasonably practicable) thus demonstrating the adequacy of the secondary and tertiary containment systems.

In addition, Trans Mountain notes that Section 7.3.8 (Figure 7-10) of the Genesis Report identifies the probability of ignition of released hydrocarbon as  $2.4 \times 10^{-3}$ . Therefore, the probability of an ignited off-site release can be calculated as  $2.19 \times 10^{-8}$  ( $9.11 \times 10^{-6} \times 2.4 \times 10^{-3}$ ), which is a little more than one chance in 50 million. Trans Mountain is of the view that a probability this low is acceptable by any standard.

Furthermore, the risk assessment conservatively does not take into consideration the mitigative benefits of emergency management in reducing exposure to an off-site release.

### **3.1.5 Additional Risk Factors**

#### *Burnaby Concern:*

*Inappropriately narrow scope of risk assessment* - the scope of the risk assessment conducted by Trans Mountain’s consultant is such that it fails to account for fire events triggered by external acts such as arson, terrorism and/or vandalism, standard failure rates of facility components, and/or forest fires. Accounting for these realistic contingencies would necessarily increase the risk of fires, explosions and/or boil-over events.

Trans Mountain must be required to update its risk frequency assessment with all possible risk contingencies and consult with Burnaby on potential risk components so that calculated risk frequency values are not artificially low.

#### *Trans Mountain Reply:*

Trans Mountain conducts detailed security risk assessments at all sites to assess the probability and consequence of potential third-party activity, and to implement measures to prevent such activities. Such activities include arson, terrorism, vandalism and civil disobedience.

The probabilities of tank fires used in the Genesis Report inherently include those caused by component failures. Trans Mountain is of the view that failures of components in other areas of the terminal such as manifold areas, even if they resulted in fires, would not create risks to the public. These areas are located far from the terminal fence lines and have relatively limited

amounts of fuel available to cause escalation, especially considering all of the valve isolation available within these facilities. Trans Mountain does not see the value of expanding the risk assessment to quantitatively include component failures.

Trans Mountain's response to events such a failure of facility components and forest fires, among other things, are addressed in Trans Mountain's Emergency Response Plans.

*Burnaby Concern:*

*Faulty wind direction analysis* - the wind direction analysis discloses variable wind directions and speeds at the Burmount location. This highlights the need for risk assessment that accounts for the possibility of high winds from all possible directions. Furthermore, any risk assessment must account for topographical and geographical differences between Burmount and the Burnaby Terminal that could render the results of the current wind speed data inaccurate. The impacts of unanticipated wind scenarios on the risk of spreading fire events, and associated harm to the lands and citizens of Burnaby, are extreme and must be properly understood in the report.

Trans Mountain must be required to update its risk assessment to consider and address all possible wind scenarios, and provide a comprehensive analysis of how these scenarios would impact fire events and escalation. Further, wind charts must be developed that are specific to Burnaby Terminal to avoid the issues of site-specificity noted above. The data relied on in developing these wind charts must be provided to Burnaby for review.

*Trans Mountain Reply:*

Appended to this response is a discussion of the validity of the wind rose selected for use in the risk assessment (Attachment 1). The Genesis methodology utilizes the wind data (direction and strength) in a probabilistic fashion in their risk calculations. In this way the effects of all statistically valid wind strengths and directions are included in the analysis of overall risk. The approach suggested by Burnaby (to consider and address the possibility of high winds from all directions) ignores the probabilities associated with wind events and the resulting determination of risk as a product of probability and consequence. The potential consequences of possible events will be addressed through emergency planning.

*Burnaby Concern:*

*Inadequate seismic risk assessment* - The report deals briefly with the issue of knock-on effects due to earthquake events. Among other things, it notes that "it is assumed that the primary event will affect all tanks at the site, i.e. if the PGA [peak ground acceleration] is large enough to cause failure of each tank, there will be a fire at every secondary containment area...". It is clear that an earthquake could have catastrophic consequences for the health and safety of nearby Burnaby residents, as well as surrounding public lands. The report does not provide sufficient analysis or assessment with respect to the increase in risk of fire events or knock-on effects associated with

an earthquake. This is completely unacceptable given the extreme implications of such an event, and the location of the project on a seismically active coastline.

Trans Mountain must be required to provide thorough risk assessment and analysis in respect of the impacts of an earthquake on the expanded Burnaby Terminal, and develop specific mitigations, including detailed action plans, in relation to such an event.

*Trans Mountain Reply:*

Section 8.3 of the Genesis Report provides a discussion of domino effects due to earthquakes. Section 13 (Figure 13-8) of the Genesis Report provides a discussion of thermal effects as a result of earthquakes. The statement from the Genesis Report that Burnaby has selected to make their point was intended to illustrate the analysis methodology. The scenario in the statement is associated with an infinitesimally low probability. Similarly to the consideration of wind effects, the Genesis analysis aggregates a range of earthquake events, with varying probabilities and consequences to establish an overall picture of seismic risk.

### **3.1.6 Flawed Risk Assessment Methodology**

*Burnaby Concern:*

*Unduly narrow risk assessment methodology* - the risk assessment methodology is premised on individual risk, or the risk of fatal injury per year. This methodology is inadequate under the circumstances in that it:

- fails to account for risk of damage and/or loss other than loss of life, including damage to adjacent public lands and non-fatal harm to individuals;
- fails to account for the non-direct (consequential) impacts of fire events, including:
  - secondary forest fire events on Burnaby Mountain;
  - isolation of Burnaby Mountain residents from critical emergency response and health care;
  - long-term toxicology impacts; and
  - impacts to wetlands.

This risk assessment model fails to account for risk to important values in Burnaby beyond risk of human fatality, which is inconsistent with the requirements of Condition 22. Trans Mountain must be required to consult with Burnaby on important values that would be impacted, directly and indirectly, by pool fires, boil-overs, flash fires and vapour cloud explosions, as well as consequential events such as forest fires. Trans Mountain must modify its risk assessment methodology and risk assessment report to account for risk of harm to these values and develop appropriate mitigations.

*Trans Mountain Reply:*

The purpose of the risk assessment is to demonstrate whether or not the expansion is acceptable using the MIACC individual risk criteria (and the proposed UK criteria for overflow scenarios). Trans Mountain is of the view that the level of detail and analysis in the risk assessment is very extensive and unprecedented for a pipeline terminal. The potential consequences of a wide variety of events will be addressed through emergency planning.

### **3.1.7 Additional Concerns**

*Burnaby Concern:*

*Missing risk reduction methodologies* - there are a number of key practical risk frequency reduction methodologies that have not been considered in the risk assessment and are not appropriately accounted for in the ALARP (As Low as Reasonably Practicable) analysis. These practical methodologies include the conversion of all tanks to internal floating roof design; automatic full surface tank fire suppression systems for all tanks; and automatic Containment Bay Suppression Systems.

Trans Mountain must be required to consider all practical risk reduction methodologies as part of the ALARP analysis, including, but not limited to, those set out above.

*Trans Mountain Reply:*

In Section 3.0 (Design Variances) and 4.0 (Risk Reduction by Design) of the Summary Report, Trans Mountain has identified that significant enhancements have been made to the design, all intended to reduce the risk associated with both fire and spill events. Trans Mountain has not identified any additional changes that can be made to the design without materially affecting the operational viability of the post-expansion Trans Mountain system. The number of tanks, size combinations, and aggregate capacity are required to fulfill the contractual throughput requirements and service levels (including commodity segregation). Trans Mountain has optimized the physical arrangement of the tanks in the most logical, efficient, and practical way. In response to NEB IR No. 3.093(b) Trans Mountain has described a full suite of preventative and mitigative controls designed to reduce the risk of fires and spills.<sup>6</sup> A number of the controls exceed those required by regulation. Trans Mountain is of the view that there are no additional controls which are reasonably practicable to implement. As such, Trans Mountain is of the view that the risks have been reduced to as low as reasonably practicable (ALARP).

As instructed by the Board, Trans Mountain is required to consider risk mitigation measures that are “reasonably practicable”, not all “possible” or “practicable” measures. Trans Mountain is of

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<sup>6</sup> Filing ID [A4H1V2](#)



the view that the risk assessment results, which establish acceptable risk levels, do not provide a compelling rationale to add numerous additional measures.

*Burnaby Concern:*

*Misapplication of the MIACC Guidelines* - the Condition Report classifies the Simon Fraser University areas as “institutional” for the purposes of acceptable/tolerable individual risk, failing to consider or address the fact that this area also includes a high density residential area (UniverCity).

The risk assessment must be revised to assess risk on the basis of the actual uses of the areas in question, including the Simon Fraser University areas.

*Trans Mountain Reply:*

The UniverCity area is addressed in the second paragraph of Section 6.0 of the Summary Report. The individual risk criterion for “institutions” and the “high-density residential” is the same.

*Burnaby Concern:*

*Faulty risk assessment modelling* - the report contains fundamental flaws in its approach to risk assessment modelling, including its use of the Monte Carlo simulation, which is not an appropriate simulation or computational model.

*Trans Mountain Reply:*

Monte Carlo simulation is the standard approach for all simulation modelling. The risk assessment is based on the most widely-accepted approaches in the petrochemical industry and employs advanced levels of analyses.

The risk assessment approach employed has been presented in several conferences including the 66th Canadian Chemical Engineering Conference in 2016. Trans Mountain notes that Burnaby has failed to identify what alternative approach they believe is more appropriate.

### **3.2 Condition 24 – Secondary Containment**

*Burnaby Concern:*

*Inadequate access/approach to tanks* – the proposed terminal road access does not provide for safe approach to within 60 meters of all tanks as is required in emergency event scenarios, based on elevations and wind data provided in the risk assessment.

Trans Mountain must be required to develop a roadway system within the terminal, in consultation with Burnaby's emergency response departments, that allows for safe approach to within 60 meters of storage tanks in emergency situations.

*Trans Mountain Reply:*

Safe approach road access will be constructed within 60m of storage tanks in accordance with the *British Columbia Fire Code* Clause 4.3.2.4.

*Burnaby Concern:*

*Further inadequacies with secondary containment plan* – the secondary containment design is inadequate and/or based on faulty premises/calculations, including that:

- the report significantly underrepresents water generated from potential firefighting activities for the purposes of assessing the ability of secondary and tertiary containment to accommodate multiple-tank ruptures;

*Trans Mountain Reply:*

The individual secondary containment area calculations include adequate capacity for fire-fighting water in conjunction with single tank failure scenarios (full tank) in each area. For multiple-tank failures which lead to potential overflow scenarios, the risk assessment includes a probabilistic approach to incorporating fire-fighting water.

For scenarios which include fires, volume of water generated from potential firefighting activities in accordance with Clause 4.3.7.3 of the *British Columbia Fire Code* and Section 6.13 of the Genesis Report is included in the analysis.

*Burnaby Concern:*

- the report does not adequately account for potential standing water present in secondary containment and dike features at the time of a spill; and

*Trans Mountain Reply:*

The individual secondary containment area calculations include adequate capacity for standing water from a 1 in 100-year 24 hour rainfall event in conjunction with single tank failure scenarios (full tank) in each area. For multiple-tank failures which lead to potential overflow scenarios, the risk assessment includes a probabilistic approach to incorporating rainfall events. As identified in Section 7.6 (Figure 7-32) of the Genesis Report, a broad range of scenarios resulting in tank leaks and failures (including multiple tank leaks and failures), combined with rainfall events, are considered in the probabilistic assessment of the adequacy of secondary and tertiary containment.

Rainfall events, when they coincide with the assessed scenarios are assumed to result in the accumulation of water in the secondary containment areas for the entire 24-hour periods prior to the scenarios occurring. The probabilities of the rainfall events coinciding with the assessed scenarios are associated with their return periods. Although Condition 24 only requires inclusion of 1 in 100-year rainfall events, Genesis also included 1 in 10-year rainfall events. These have slightly lower total rainfall amounts but a 10-fold greater probability of occurrence and thus a slightly larger influence on the probabilities of overflow.

*Burnaby Concern:*

- Additional design components and other mitigations, which would reduce the frequency of overflow events, are available and within the scope of what is reasonably practicable;

*Trans Mountain Reply:*

Secondary containment design at Burnaby Terminal has been developed in accordance with applicable regulations, codes and standards as identified in the TMEP s.52 Application, responses to information requests, the Variance Application and the Condition reports. Trans Mountain notes that Burnaby has not provided clarity on what the additional “reasonably practicable” design components and other mitigations are to reduce the frequency of overflow events. Given that the probability of overflow events is infinitesimally low and meets a recognized standard of tolerability, Burnaby has not provided a compelling rationale for why such additional measures are necessary.

As demonstrated through Trans Mountain’s reply to Burnaby’s concerns, Trans Mountain is of the view that there are no significant errors or omissions in the Condition 22 and 24 compliance filings, and that Trans Mountain’s Variance Application, which incorporates the Condition 22 and 24 reports, is complete, addresses the requirements of the NEB Filing Manual, and should be considered by the Board as submitted.

#### **4. Conclusion**

Trans Mountain endeavors to proactively engage with stakeholders, Aboriginal groups and Appropriate Government Authorities whose interests may be impacted by Trans Mountain activities. Trans Mountain has sought to and continues to communicate using a variety of outreach avenues and opportunities. In the case of the Project, Trans Mountain was not afforded the opportunity to consult with Burnaby, despite multiple attempts to engage.

Trans Mountain believes the applied for design change demonstrates incorporation of the comprehensive risk assessment results in the modified (reduced storage volume) design of Burnaby Terminal. In Trans Mountain’s reply to Burnaby’s concerns in Section 3 of this letter,



Trans Mountain does not agree that there are significant errors or omissions in the Genesis or Summary Reports as demonstrated in its reply.

As such, Trans Mountain is of the view Condition 22 and 24 compliance filings support a modified (reduced storage volume) design which is preferable to that authorized by the Order, the Condition 22 and 24 compliance filings and the Applications are robust and complete and not in any way premature. Accordingly, Trans Mountain respectfully requests that the Board's consideration of these submissions proceed without delay to facilitate a planned construction start date of September 1, 2017.

Should you have any questions or wish to discuss this matter further, please contact the undersigned at [regulatory@transmountain.com](mailto:regulatory@transmountain.com) or (403) 514-6400.

Yours truly,

*Original signed by*

Scott Stoness

Vice President, Regulatory and Finance  
Kinder Morgan Canada Inc.

Enclosure: Attachment 1 - Discussion of the validity of the wind rose selected for use in the risk assessment

cc: Mr. Gregory J. McDade, Q.C., Ratcliff & Company LLP

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## **City of Burnaby Comments on Trans Mountain’s Response to the National Energy Board’s Information Requests Nos. 1, 2, and 3 on the Burnaby Terminal Variance**

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The City of Burnaby (“Burnaby”) provides the following comments on Trans Mountain’s responses to information requests no. 1, 2, and 3 of the National Energy Board (the “NEB” or the “Board”) concerning the Burnaby Terminal variance.

### **City of Burnaby’s Position**

Burnaby maintains our position as outlined in the submissions to the Board dated June 30, 2017 that Trans Mountain has failed to provide sufficient information with respect to risks to critical interests and values in the area surrounding the Burnaby Terminal, and emergency response in order for the Board to consider the variance of the Burnaby Terminal design. As outlined below with respect to specific information requests of concern to Burnaby, Trans Mountain has either failed to provide the information requested – merely defending the deficiencies in its risk assessment methodology highlighted by Burnaby and the Board – or deferred the collection of the information requested until after construction of the Burnaby Terminal is complete.

Further, in the information request responses, Trans Mountain states that it would be engaging with Burnaby with respect to the variance application and emergency response. Burnaby can report that such engagement has not occurred and that many matters that are critical to protecting interests in Burnaby remain outstanding.

It is Trans Mountain’s obligation to put forward a credible risk assessment and to provide evidence that it has or will mitigate all risks from the expansion to Burnaby and its residents to As Low As Reasonably Practicable (ALARP), without assuming any reliance on Burnaby services. Trans Mountain has failed to provide such evidence, and merely asserts that risks have been reduced to ALARP without evidence or justification. No future consultation or emergency response plan will provide for the opportunity to address risk through tank farm design. These matters of critical importance to public safety in Burnaby must be addressed prior to consideration of the Burnaby Terminal variance and prior to commencing construction.

### **IR No. 1.3 – Fire Water Reservoir and Firefighting**

The proposed fire water reservoir is under sized and does not meet the supply requirements of the expanded facility according to the Burnaby Fire Department.

The scenario identified as the largest water requirement is invalid. Previous versions of the KMC TMTF Emergency Response Plan utilize and reference the scenario expectation of a full surface containment bay fire. The current version of the KMC TMTF Emergency Response Plan replaced full surface containment bay fire with a small spill event. Therefore, the short fall in the proposed fire/foam system infrastructure was not addressed by Trans Mountain by adjusting the

volume or flow capability of the firefighting systems, but by reassessing the “credible worst case scenario” to a scenario that requires less firefighting capacity and capability.

According to the Burnaby Fire Department, the firefighting requirements for a full surface containment bay fire is as follows:

- 22,014 usgpm for 20 minutes of firefighting foam solution applied to the entire containment bay area. This volume requirement exceeds the discharge limitations of the equipment proposed by Trans Mountain.
- Alternately, a fire attack is possible, where only a quarter of the containment bay area is applied in a single application, made four times over. This application strategy requires increased flow requirements to both cool the tank shell in areas where foam application is delayed, and foam application in areas where a foam blanket has previously been applied in order maintain the foam blanket’s integrity. The flow and total volume of this strategy, based on the requirements of NFPA 11, is a minimum of 5,878 usgpm for 80 minutes - requiring 7,121 m<sup>3</sup> of fire water.

Therefore, the fire water reservoir is undersized by 1,121 m<sup>3</sup>.

Further, Trans Mountain’s statement with respect to impairment remains unclear. The response infers impairment, and a loss of firefighting ability due to system change-over. However, Trans Mountain does not state how it will address this impairment.

### **IR No. 1.6 – Consultation with Potentially Affected Stakeholders**

The Board expressly recognized in the NEB report the requirement of Trans Mountain to continue to engage with impacted municipalities in order to address outstanding concerns. Burnaby and its residents will bear the burden of the risks of the expansion of the Burnaby Terminal. Yet, Trans Mountain has failed to engage with Burnaby with respect to the risk assessment for the tank farm and the need to vary the tank farm design in order to reduce risk.

In fact, Trans Mountain recently cancelled the Emergency Management Engagement Workshops with Burnaby residents scheduled for the end of April 2018, due to Trans Mountain’s shutdown of non-essential operations. Clearly, Trans Mountain does not consider emergency management in Burnaby an essential part of its operations in the City to warrant continued spending.

Trans Mountain lists in the response to the IR No. 1.6 of the Board the planned future opportunities to engage with Burnaby on the variance to the tank farm and emergency response. Burnaby can report that these discussions with Trans Mountain did not eventuate, and that Burnaby’s concerns with respect to the tank farm remain outstanding. Trans Mountain has made no effort to update its filings for Conditions 22 and 24 in order to address or incorporate the concerns of Burnaby. Burnaby’s outstanding concerns remain as set out in our submission of June 30, 2017 and include the following:

- **Missing Critical Site-specific Information** – Trans Mountain has not completed an inventory of the values that will potentially be impacted by an emergency event at the Burnaby Terminal. The assumptions made in Trans Mountain’s risk assessment and variance application are not grounded in an understanding of the values in the area surrounding the tank farm and the resources available for emergency response. Without this site-specific information, Trans Mountain’s risk assessment that underlies the variance application is inaccurate and incomplete.
- **Risks of Boilover and Vapour Cloud Explosion not accounted for** – Trans Mountain underrepresents the risk of boilover and vapour cloud explosion. Trans Mountain makes assumptions in the risk assessment that may not be possible given the location of the Terminal – for example Trans Mountain assumes complete evacuation of the impacted area would be possible before a boilover event. Trans Mountain further underrepresents the potential for event domino effects where fire suppression is not possible due to the location of the tank farm, the lack of safe firefighting positions and the need to evacuate all personnel.
- **Narrow Risk Assessment** – The scope of Trans Mountain’s risk assessment remains unacceptably narrow in terms of the risks that it quantifies. Trans Mountain has not provided further information with respect to the risk of external events such as arson, vandalism, or forest fire impacting the tank farm. Given the urban location of the tank farm, and the controversy surrounding the Project, these are credible risks that need to be accounted for in the risk assessment.
- **Improper Risk Assessment Methodology** – Trans Mountain still fails to account for risk of impacts other than loss of life, including damage to values of local concern within Burnaby and non-fatal harm to residents. In failing to consider these risks, Trans Mountain has not developed mitigation measures to reduce or address these risks contrary to the requirements of Condition 22.
- **Failure to Consider Available Mitigation Measures** – Trans Mountain has failed to justify as to why it should not be required to employ all available risk reduction measures, given the location of the tank farm directly adjacent to neighbourhoods. Trans Mountain does not provide any evidence to the Board as to why certain risk reduction measures are not reasonably practicable, or as to why Trans Mountain is not able to adjust tank capacity in order to allow for certain measures to be implemented such as increased capacity for secondary containment.

### **IR No. 2.3 – Emergency Management (indirect impacts of boil over and secondary fire events)**

In response to IR 2.3 of the Board, Trans Mountain defers dealing with the non-direct impacts raised in Burnaby’s submissions to surrounding lands, people and evacuation routes until the emergency management plans due only six months prior to commencing operations. However, these issues are relevant to the risk assessment and to the tank farm design. Mitigation of these

risks should be dealt with now, not at the last step when there is no opportunity to change the layout of the tank farm to reduce risk.

### **IR No. 2.5 – Ignition Probability**

In response to IR 2.5 of the Board, Trans Mountain agrees with Burnaby’s submissions that it used the ignition probability curve based on the wrong fuel type (diesel and fuel oil) and “that it intends to store heavy, light, and synthetic crude oil, not diesel or fuel oil, and that the various types of crude oil will be stored at conditions above their flash points.”. This is a significant admission from Trans Mountain of the flaws within its risk assessment methodology.

However, Trans Mountain then goes on to state that the very conservative application of the other factors in the risk assessment equations makes the selection of the wrong ignition probability curve appropriate. Trans Mountain’s failure to address the errors in its assessment of ignition probability is unacceptable. Trans Mountain has underrepresented the ignition risk by choosing the wrong fuel type in circumstances where Trans Mountain proposes to store crude oil above flash point – Trans Mountain must be made to provide accurate information on ignition probability and risk.

In the event that Trans Mountain’s statement that intends to store crude oil above flash point is incorrect, Trans Mountain still has not justified its use of the wrong ignition probability curve and the consequent underrepresentation of the risks to individuals surrounding the Burnaby Terminal.

### **IR No. 3.1 – Event Trees**

Despite the concerns of Burnaby, Trans Mountain again takes the position in its response to the Board that “base and escalation events that do not result in fatal injury do not contribute to individual risk”, and does not account for risks that do not result in fatalities but may result in damage to property/people. A risk assessment based on such a flawed methodology cannot be relied upon.

Trans Mountain further only considers a very narrow set of initiating events (tank rupture, full surface fire, secondary containment fire and earthquake) – ignoring the potential for human error, vandalism, arson, forest fire and other credible initiating events. Trans Mountain neglects to consider a number of domino and escalating effects, such as toxic exposure, effectively underrepresenting the risk of emergency events at the Burnaby Terminal and the need to account for these risks in tank farm design prior to construction.

The assumption underlying much of Trans Mountain’s risk assessment is that there will be emergency response personnel immediately available to respond to fires, spills or other emergency events, which negates the need to consider escalating effects such as toxic exposure or fire spread. The immediate availability of emergency response personnel with the necessary training to respond to hydrocarbon events is not borne out on the evidence put forward by Trans Mountain. As previously stated, a proper response should not rely on the assumption that Burnaby services will be available. Trans Mountain’s safety plans must stand on their own.



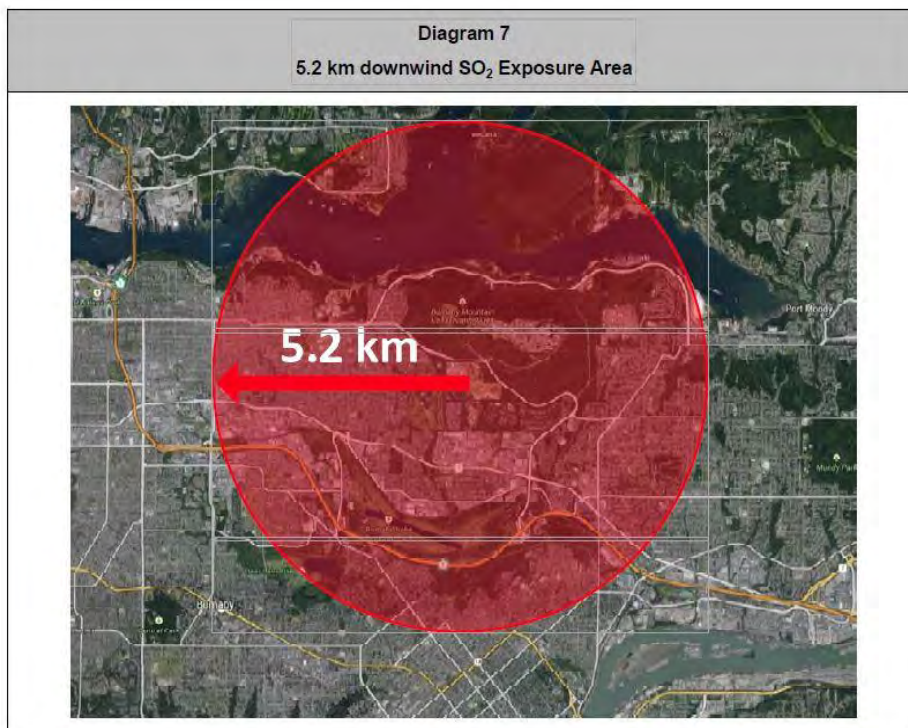
Further, it is clear that Burnaby will not be able to provide technical hydrocarbon firefighting within the fenceline and the elapse time for Trans Mountain to provide this specialized support is 6–8 hours (on site personnel are not trained to operate with specialized firefighting equipment outside the safe working area). As such, Trans Mountain’s risk assessment needs to be redone in order to account for domino or escalating effects of exposure to a long term spill or fire event – ignoring the potential for long term events is not a credible approach to risk assessment.

### Figure 3.1A – Tank Rupture

Trans Mountain states in this response that the “Toxic (CO, SO<sub>2</sub>) exposure effects are neglected here due to short event duration.”

Given the proximity of the Burnaby Terminal to residential neighbourhoods, the toxic exposure effects cannot be neglected in any credible risk assessment of a tank rupture and associated fire event with respect to the Burnaby Terminal. Trans Mountain’s failure to consider this credible risk to Burnaby residents is a serious deficiency in the risk assessment that is of critical concern to Burnaby. Burnaby provided evidence to the Board during the NEB hearing of the risks of toxic exposure in the “Trans Mountain Tank Farm Tactical Risk Analysis” as follows (see pp. 5, 68-73):

Highly toxic Hydrogen Sulfide will very quickly, upon facility release, expose residential areas to conditions that are immediately dangerous to life. Smoke outfalls from fire event may contain Sulphur Dioxide (SO<sub>2</sub>), in which KMC analysis shows a potential health concern could be felt up to 5.2 km. downwind.



Trans Mountain acknowledged in its own risk assessment before the Board that “there is a possibility some of the oil will contain small amounts of Sulphur which will be converted to Sulphur Dioxide (SO<sub>2</sub>) in a fire, the analysis shows a potential health concern could be felt up to 5.2 km downwind” (see p. 3).

We are advised by the Burnaby Fire Department that a containment bay fire could require application of foam solution from 20 minutes to 80 minutes, and a full surface tank fire with a displaced or damaged roof structure could require application of foam solution from 55 minutes to 65 minutes based on the flow requirement identified in NPFA 11. During this application time, the smoke and products of combustion will be present and will create a toxic SO<sub>2</sub> and CO exposure of significance that cannot be neglected. Further, during a boilover event, there is the potential for a fire to escalate and ignite surrounding tanks, making firefighting unsafe and quick suppression of the fire impossible (a multiple tank fire includes the potential of having to allow one or several storage tanks to burnout over 2-4 days).

### **Figure 3.1B – Full Surface Fire – external or internal floating roof tank**

Trans Mountain’s event tree for a full surface fire is based on the incorrect assumption that only direct flame contact will create a fire escalation to a neighboring tank. We are advised by the Burnaby Fire Department that the mere heating of the tank surface without direct flame contact can ignite a neighboring tank. Further, for a tank fire event initiated by a structural roof displacement or where a structural roof displacement occurs during the fire event, much greater heat impact will be discharged. These risks are not accounted for in Trans Mountain’s assessment.

Furthermore, due to tank farm design configuration, many of the locations required for mobile firefighting devices, and thus where firefighting personnel will be forced to operate, will create thermal radiation exposure exceeding safe working conditions regardless of PPE worn. In addition, due to tank farm design configuration, many of the locations required for mobile firefighting will create a SO<sub>2</sub> and CO toxic exposure requiring all personnel to operate and function exclusively from self-contained breathing apparatuses. The elapse time for the facility to provide this level of personnel and equipment is 6–8 hours. This situation would create an unmitigated discharge time of heat and toxic SO<sub>2</sub> and CO into the neighboring community for 6 – 8 hours. The domino effects of such exposure are not accounted for by Trans Mountain.

The portion of the assessment identifying boilover consequence assumes the withdrawal of all firefighting personnel prior to boilover to a safe distance in order to achieve the stated risk to life utilized in this model. However, the consequence of firefighter withdrawal to protect their lives and achieve the stated risk to life utilized, is the abandonment of fire control measures to confine or restrict the fire’s growth within the facility. This potentially could create fire extension to a second or third tank, the release of heat and toxic products over a much longer time frame, and fire extension to adjacent high risk areas outside the fence line. These domino effects of a boilover scenario are not accounted for in Trans Mountain’s assessment.

### **Figure 3.1D – Earthquake**

Again, the omission of the toxic effects of SO<sub>2</sub> and CO as a result of extended fire operations is inappropriate and significantly impacts the accuracy of the analysis provided. During an earthquake, contributing factors to even escalation of structural tank breakdown or failure, the loss of firefighting water systems and the consequential inability to confine, restrict and suppress toxic products and heat outfall are not considered.

### **IR No. 3.3 – Hazard Distances**

The figures provided as an attachment to IR No. 3.3 appear to be hand drawn and do not provide an accurate basis to identify the contour impacts and distances.

### **Figure 11-1**

This figure identifies an outfall heat impact to the forested area immediately adjacent to the potential tank fire location of up to 15 kWm<sup>-2</sup>. According to the Burnaby Fire Department, this heat impact in an uphill direction would be unquenchable with fire streams based on:

- insufficient firefighting discharge device ability;
- insufficient safe deployment position within fire stream reach; and
- high risk to firefighting personnel to operate mobile equipment in the uphill downwind direction.

### **Figure 11-2**

According to the Burnaby Fire Department, the SO<sub>2</sub> lethality of a tank full surface fire has the following potential impacts:

- impact at 50% fatality into the medium density residential area;
- impact at 1% fatality at 250m into the medium density residential area;
- a 30 minute exposure to potential fatality due to outfall toxic exposures occurs prior to the reasonable ability for firefighting personnel to extinguish the initiating fire event; and
- impacts that require all fire operations to be conducted within the protection of self-contained breathing apparatus. The stated elapse time for the facility to provide this level of personnel and equipment has been provided as 6 – 8 hours. This situation would create an un-mitigated discharge time of toxic SO<sub>2</sub> into the neighboring community for 6 – 8 hours.

### **Figure 11-3**

According to the Burnaby Fire Department, the CO lethality of a tank full surface fire has impacts that require all fire operations to be conducted within the protection of self-contained breathing apparatuses. The elapse time for the facility to provide this level of personnel and

equipment has been provided as 6 – 8 hours. This situation would create an unmitigated discharge time of toxic CO into the neighboring community for 6 – 8 hours.

#### **Figure 11-4**

According to the Burnaby Fire Department, the thermal radiation impacts of a containment bay fire include:

- fire spread likely 200m into high risk forested areas adjacent to the facility, specifically in the unpreventable uphill, upwind direction;
- firefighting personnel will be required to operate with full firefighting bunker gear and behind fire stream protection within 100m of the fire event. This distance is the very edge of the stream reach of the mobile fire device identified within the application, and assumes (a) safe location and (b) access is available for meaningful fire attack to prevent fire growth and spread throughout the facility. The stated elapse time for the facility to provide this level of personnel and equipment has been provided as 6 – 8 hours. This situation would create an unmitigated discharge time of thermal radiation into the neighboring community and fire growth potential for 6 – 8 hours;
- traversing the roadway access north of the facility to and from SFU would require full firefighting bunker gear ensemble and fire stream protection; and
- areas within the facility where firefighting personnel would need to strategically and tactically position would create the high risk of personal injury by exposure to thermal radiation of up to  $20 \text{ kWm}^{-2}$  – double the heat impact of a tolerable and maximum 3 minute exposure.

#### **Figure 11-5**

According to the Burnaby Fire Department, the SO<sub>2</sub> lethality of a containment bay fire includes the following impacts:

- impact at 100% fatality into community areas and the SFU access roads adjacent to the facility;
- impact at 50% fatality at 300m into the medium density residential area;
- impact at 50% fatality at 10m into the SFU building campus area; and
- impact at 1% fatality at 600m into the medium density residential area.

#### **Figure 11-7**

According to the Burnaby Fire Department, the thermal radiation lethality of a boilover event includes the following response:

- requires full firefighting bunker gear ensemble and fire stream protection 350m into the medium density residential area; and
- a no entry zone 150m into the medium density residential area.

### **IR No. 3.5 – ALARP**

Trans Mountain has underrepresented the risk of the Burnaby Terminal by only considering risks that would result in immediate human fatality. This is an inappropriate risk assessment methodology. As a result, Trans Mountain has not addressed some risks or mitigated those risks to ALARP.

In response to IR 3.5, Trans Mountain notes that it “has included the ALARP principle in the approach by including all reasonably practicable design changes intended to reduce risk”. However, Trans Mountain then goes on to acknowledge some of the changes that were not reasonably practicable due to the physical constraints of the property and other factors, including:

- 1) The ability to move Westridge Marine Terminal destined design volumes through Burnaby Terminal while maintaining appropriate segregation levels was materially compromised. Throughput and segregation capabilities are both reduced when the number of tanks and their capacities are reduced.
- 2) Adding mitigation measures, such as greater secondary containment capacities relative to tank capacities, could not be practically achieved due to physical constraints, such as available area (complicated by terrain considerations). In considering the physical layout, there is a fundamental trade-off between adding secondary containment capacity to reduce the risks associated with spills and reducing secondary containment surface areas to reduce the risks associated with fires. Increasing the height of secondary containment berms, to increase capacity without increasing surface area, is also problematic due to space constraints (berms become wider as they become higher) and seismic stability.
- 3) Adding mitigation measures could not be practically achieved due to limitations in the application of systems, such as additional fire-suppression, which is constrained by water supply, storage, and pumping system capacity, foam distribution system complexity, and foam application technology.

Trans Mountain does not provide evidence as to why the above measures are reasonably impracticable, but merely makes the bald assertion that such mitigation measures are not available without any evidence.

Trans Mountain does not put forward any evidence of alternate tank configurations that were considered in order to further reduce risk and allow for the safe deployment of firefighting personnel. Further, Trans Mountain does not justify why reducing the storage capacity at the Burnaby Terminal was not considered as a means to reduce risk and to allow for, for example, further secondary containment capacity. The terrain and physical constraints of the Burnaby Terminal are not matters that should be used to justify the failure to implement mitigation measures in circumstances where Trans Mountain did not put forward alternative locations for the terminal – if mitigation measures are not possible within the confines of the site then Trans Mountain should be made to consider reducing tank capacity to accommodate those measures.

The sole reliance on fixed firefighting systems as opposed to the use of trained firefighting personnel and mobile equipment to augment fixed systems is unreasonable and impracticable. According to the Burnaby Fire Department, equipment system options exist and facility areas are present on site to support the addition of further:

- access roadways to allow for the safe deployment of firefighting personnel and equipment;
- fire suppression equipment (fixed or mobile);
- water supply reservoirs;
- higher capacity pumps;
- higher capacity proportioners;
- higher capacity fire water main distribution;
- higher capacity discharge systems; and
- higher capacity application devices to further manage the risks.



## Application to Participate ([A94414](#))

Filing Date: 2018-10-02

### Hearing Information

Project Name: Trans Mountain Expansion Project - Reconsideration- MH-052-2018

Company: Trans Mountain Pipeline ULC

File Number: OF-Fac-Oil-T260-2013-03 59

### I am Applying as:

- An Individual
- Authorized Representative on Behalf of an Individual
- A Group

Select which one best describes your group:

- Company
- Association (Special Interest Group)
- Aboriginal
- Federal Government
- Provincial Government
- Territorial Government
- Municipal Government
- Others

Concerned Residents of Burnaby Mountain

- My group is an organization that will represent its own interests
- My group is a collection of individuals with common interest

I have permission to identify and speak on behalf of the people listed below:

Deepa Murthy  
Vivian Lee  
Tara Parsons

## Contact Information:

- If you apply as individual, the contact information is for the Person Applying to Participate.
- If you apply as Authorized Representative, the contact information is for the Individual you are representing.
- If you apply as Group, the contact information is for the Group's main contact.

Salutation: Ms.

Last Name: Andersen

First Name: Holly

Title: Dr.

Organization: Concerned Residents of Burnaby  
Mountain

Telephone: 604-349-7807

Facsimile:

Email Address:

hkandersen@gmail.com

Address:

86-9229 University Crescent  
Burnaby, British Columbia V5A4Z2  
Canada

## Authorized Representative(s) Information:

*If you do not have an authorized representative this section will be blank.*

## Method of Participation

**I wish to participate as a:**

- Commenter  
 Intervenor

## Interest or Expertise

- The Group I am representing is **directly affected** by the proposed Project  
 The Group I am representing has **relevant information or expertise**

## Connection to Project Issues

517 Tenth Avenue SW  
Calgary, Alberta T2R 0A8

517, Dixième Avenue S.-O.  
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<http://www..neb-one.gc.ca>  
1-800-899-1265



2.

(For new applicants only) The Board's Reconsideration hearing will consider any necessary changes or additions to its May 2016 Report, in light of the inclusion of Project-related marine shipping in the "designated project" under the CEEA 2012. This includes issues related to factors described in paragraphs 19(1)(a) through (h) of the *Canadian Environmental Assessment Act, 2012* (CEEA 2012) and to section 79 of the *Species at Risk Act* (SARA):

1. The environmental effects of Project-related marine shipping, including adverse effects on species at risk, and the significance of those effects.
2. Measures that are technically and economically feasible, and that would mitigate any significant adverse environmental effects of Project-related marine shipping. *Given that the Board found four significant adverse effects related to Project-related marine shipping in its original assessment\* (i.e., greenhouse gas emissions, Southern resident killer whale, traditional Aboriginal use associated with Southern resident killer whale, and the potential effects of a large or credible worst-case spill), the consideration of mitigation measures will focus on these four matters. This will include consideration of whether the mitigation measures will change the Board's previous significance findings.*
3. Alternative means for carrying out Project-related marine shipping that are technically and economically feasible, and the environmental effects of such alternative means.\*\*
4. Requirements of any follow-up program in respect of Project-related marine shipping.
5. Measures to avoid or lessen the adverse effects of Project-related marine shipping on SARA-listed wildlife species and their critical habitat, including monitoring, and consideration of how the undertaking of such measures could be ensured. *The Board's original assessment identified the SARA-listed marine fish, marine mammal, and marine bird species that could be found in the area of, or affected by, Project-related marine shipping,\*\*\* providing a focus for this issue. Any marine species that have been newly listed, or any species that have seen a change to their designation, since the issuance of the Board's Report and that could be affected by Project-related marine shipping would also require consideration under the SARA.*
6. Whether there should be any changes or additions to the Board's recommendations for the Project, or recommended terms or conditions, in light of the above issues.

The consideration of the above issues will be limited to Project-related marine shipping between the Westridge Marine Terminal to the 12-nautical-mile territorial sea limit.

The Board is of the view that certain issues described above, in particular Issue a), were thoroughly canvassed in the OH-001-2014 Certificate hearing and may not require additional evidence. The Board is particularly interested in new, additional evidence (including comments from the public, community knowledge, and Indigenous traditional knowledge) on Issues b) to e).

\* See the Board's Report at pages 337, 350-351, 363, 378, and 397-398.

\*\* For greater clarification, the Board does not intend to reconsider alternate locations for the Westridge Marine Terminal as this was previously considered.

\*\*\* See the Board's Report at pages 338, 341, and 352.

We are residents who live on top of Burnaby mountain, directly and deeply impacted by the tank farm on the south flank of Burnaby Mountain. We have tried to register concerns about this tank farm in the original NEB process, and found that 1) our concerns were assimilated to 'tankers', even though we repeatedly emphasizes 'tanks', and 2) that only SFU, our neighbouring organization, and UniverCity Trust, a real estate development organization, were consulted about the tank farm. We are firmly of the opinions that 1) our interests were not adequately represented in the original process, 2) that neither SFU nor UniverCity Trust speak on behalf of the residents up here, having no governance authority over residents of a democracy nor any delegated authority to speak for people who live here, and have interests that are sometimes in tension with the residents up here, and 3) that the safety issues associated with the location of the tank farm, combined with the road structure of Burnaby Mountain, is a sufficiently serious safety concern that should be taken alongside safety concerns about marine shipping in the Burrard Inlet to the Westridge Marine Terminal.

The original plan relied on an expansion of the existing tank farm on Burnaby Mountain, to triple its current capacity, as a cost-saving mechanism that meant marine traffic had to navigate through the inlet to almost its narrowest point, near Barnet Marine Park. Tankers would only be required to navigate such a difficult stretch of terrain if Westridge Marine Terminal is utilized. There is essentially a small town of about 5k-8k people (most of whom are not associated with SFU) living behind a single intersection that is directly next to and downwind of the tank farm. In the event of any incident at the tank farm, especially one involving fire or explosive event, the entire mountaintop community is cut off. We have been told only to 'hunker in place' because we cannot evacuate and no emergency personnel could reach us. The main reason, as we can see it, that the Westridge Terminal was selected instead of Tsawassen or other locations was the lower price for that route. However, there is a very steep safety concern that was not adequately addressed in the first NEB process about the Burnaby Mountain Tank Farm.

The safety of the entire system of the Tank Farm on the south side of the mountain and the Westridge Marine Terminal on the north side of the mountain are connected issues; the safety of marine traffic has downstream consequences for the residents of this mountains. It is on the basis of 1) Burnaby Mountain residents not having been adequately represented in the original process and 2) how deeply affected we are as residents in a very dense development area behind a single evacuation intersection controlled by the tank farm and Westridge Marine Terminal that we request intervenor status.

## Access, Notification and Service

Which official language do you wish to use in correspondence with the Board and at the public hearing?

English  French

Documents submitted electronically are available on the Board's electronic document repository, (Click 'View' under 'Regulatory Documents' at [www.neb-one.gc.ca](http://www.neb-one.gc.ca)). If you have the capability to access the repository, the Board and other Participants in this proceeding may serve you by notifying you that a document has been filed and is available in the repository, instead of serving you with a hard copy of the document.

Are you able to access the Board's electronic document repository?

Yes  No

Notification by email advising that a document has been filed will be sent to the following email addresses:

Holly Andersen [[hkandersen@gmail.com](mailto:hkandersen@gmail.com)]

**RATCLIFF & COMPANY** LLP  
Lawyers



October 3, 2018

File No. 13-0010-000  
Reply to: Gregory J. McDade, Q.C.  
Email: gmcdade@ratcliff.com

**VIA ELECONTRIC FILING**

National Energy Board  
517 10<sup>th</sup> Ave SW  
Calgary, AB T2R 0A8

**Attention: Sheri Young, Secretary of the Board**

Dear Ms. Young:

**Re: Trans Mountain Pipeline ULC (“Trans Mountain”)  
Application for the Trans Mountain Expansion Project (“Project”)  
National Energy Board (NEB or Board) reconsideration of Recommendation  
Report (Report)  
Hearing Order MH-052-2018  
File OF-Fac-Oil-T260-2013-03 59**

We are legal counsel for the City of Burnaby (Burnaby”). These comments are filed on behalf of Burnaby in respect of the Board’s letter dated September 26, 2018.

Burnaby was an intervenor before the NEB in hearing, as well as a Party in the application before the Federal Court of Appeal challenging the Governor in Council’s approval of the Project. Burnaby has registered as an Intervenor in the Reconsideration process.

**Project – Related Marine Shipping**

Project related marine shipping should be included in the designated project to be assessed under the *Canadian Environmental Assessment Act, 2012* (“CEA 2012”).

Further, the Board should not artificially limit its consideration to impacts within the 12 nautical mile territorial sea, but should consider the whole of Canada’s 200 nautical mile exclusive economic zone, contiguous zone and territorial sea. Impacts within this area could have significant impact on Canada.

### **Amended Factors and Scope of the Factors and Draft List of Issues**

The Federal Court of Appeal determined that “[t]he unjustified exclusion of marine shipping from the scope of the Project led to successive, unacceptable deficiencies in the Board’s report and recommendations.”<sup>1</sup>

Further, the Court accepted that “the resulting flawed conclusion about the environmental effects of the Project was critical to the decision of the Governor in Council”, and therefore the Governor in Council could not “legally make the kind of assessment of the Project’s environmental effects and the public interest that the legislation requires”.<sup>2</sup>

It is clear that the Board must make a fresh assessment both of the significance of the environmental effects (factoring in marine shipping) and whether or not the Project is in the public interest.

The Board, in its original Report recognized that there are both benefits and burdens from this Project, and that to make a determination of ‘public convenience and necessity’ or a recommendation in respect of the ‘public interest’ necessitated a delicate balancing of those benefits against those burdens.<sup>3</sup> The Board also recognized that the benefits were largely national and, the burdens local. The Board also acknowledged that in that balancing the Board “placed significant weight on the economic benefits”<sup>4</sup> which outweighed the significance of the environmental burdens.

With the new factors and new evidence, the Board must address each of those balances from a fresh perspective.

To the extent that subsequent to the time of the Board’s original Report there is new and better information that impacts either the significance of the adverse environmental effects or the balancing of the public interest, the Board should consider such new information. Accordingly, the List of Issues for the reconsideration hearing should include an additional issue:

- Any new information with respect to the List of Issues that were before the Board in the original OH-001-2014 hearing including the need for the Project, and whether the Project is in the public interest.

The List of Issues is somewhat vague in respect of ‘environmental effects’. It should be clear in Issue 1, that environmental effects specifically include the effects of ‘accidents or malfunctions’ that could arise in the marine shipping environment. We recommend adding the words “including potential accidents or malfunctions” in Issue 1.

Similarly, we recommend the Board clarify that its ‘cumulative effects’ assessment will be redone, to include project-related marine shipping, in combination with all other cumulative

<sup>1</sup> *Tsleil-Waututh Nation v. Canada (Attorney General)*, 2018 FCA 153, para 5

<sup>2</sup> *Tsleil-Waututh Nation*, para 766

<sup>3</sup> NEB Report, section 2.3, p. 17-18

<sup>4</sup> NEB Report, section 2.3, p 17-18

effects.

### Alternatives

Given the Board's failure to properly consider Project-related marine shipping in the previous definition of the Project, the Board must reconsider alternative locations for a terminal. The Board's footnote 7, indicating a refusal to consider alternative locations for the Westridge Marine Terminal, is not acceptable. A key factor in "marine shipping" is the significance of the location where much shipping will originate.

In the Board's original Report, the Board rejected alternative locations even though the evidence was that such locations would reduce marine shipping risk. The Board must freshly consider this evidence.

Accordingly, Issue 3 should be reworded (without the restrictive footnote):

- 3: Alternative means and locations for carrying out Project related marine shipping that are technically and economically feasible and the environmental effects of such alternative means and locations.

### Design of the Hearing Process

The hearing process must include an opportunity for cross-examination of Trans Mountain in respect of the evidence filed within the List of Issues.

Oral cross-examination is a superior method of reaching the truth. The Federal Court of Appeal decision recognized that the Board has discretion in this regard, and "[t]he heart of this inquiry is directed to whether the parties had a meaningful opportunity to present their case fully and fairly."<sup>5</sup>

However, in that regard, the Court's determination relied on the fact that there were two rounds of information requests and an opportunity to bring motions to seek further and better answers.

In the timeline provided by the Order in Council, it is suggested that the time for information requests and motions to reconsider will not be sufficient in order to be meaningful. It would be much more time-efficient to set aside a week or two for cross-examination. [Although there are likely to be a significant number of participants, the Board could provide time limits, or provide opportunities for the most affected parties and/or groups of intervenors to have 'representative' cross-examination.]

If Trans Mountain is to submit new evidence in this hearing, it must do so early in the process and well in advance of any evidence to be filed in response by the Intervenors.

In particular, although the timelines are likely to be short, if additional expert evidence is provided by Trans Mountain, it is essential that intervenors have sufficient time to review that

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<sup>5</sup> *Tsleil-Waututh Nation*, para 250

evidence and to retain and provide opposing evidence. The period to respond to expert evidence must be at least 4 weeks.

At the conclusion of the evidentiary phase, it is essential that the Board provide an opportunity for an oral hearing by way of oral submissions. This Project is one of significant public controversy, and to have decisions made behind closed doors or in writing is simply unacceptable.

**Public Authorities**

We have no comments on behalf of Burnaby upon which government departments or bodies that the Board should acquire information from during the hearing.

Yours truly,  
RATCLIFF AND COMPANY LLP



GREGORY J. MCDADE, Q.C.  
Barrister and Solicitor

GJM:mt

\*Gregory J. McDade Law Corporation

cc. Trans Mountain – [Regulatory@transmountain.com](mailto:Regulatory@transmountain.com)

November 20, 2018

National Energy Board  
Suite 210, 517 Tenth Avenue SW  
Calgary, AB T2P 5J2

**Attention: Ms. Sheri Young, Secretary of the Board**

Dear Ms. Young,

**Re: NEB Reconsideration of 2016 Trans Mountain Expansion Project Report  
Hearing Order MH-052-2018 and File OF-Fac-Oil-T260-2013-03 59**

The Simon Fraser Student Society (“the SFSS”) represents 25,633 undergraduate students at Simon Fraser University (“SFU”) in Burnaby, Vancouver, and Surrey, British Columbia. The SFSS would like to respond to the National Energy Board (“NEB”) request for letters of comment on the reconsideration of the 2016 NEB Report associated with “Project-related marine shipping” for the Trans Mountain Expansion project (“the Project”) as directed by the Governor in Council. The purpose of this letter is to respond to the request for letters of comment and provide new and updated information regarding potential adverse environmental effects that will impact students at SFU Burnaby Campus.

### **LETTER OF COMMENT**

The Simon Fraser University Burnaby Campus is located on Burnaby Mountain, spanning 1.7 kilometres across the Mountain and hosts thousands of students, faculty members, staff and visitors. SFU students are a demographic that is disproportionately and increasingly vulnerable to the serious health, safety, and environmental risks due to Trans Mountain marine shipping, especially those related to the distribution centre of the Burnaby Terminal, located just 700 metres from SFU campus<sup>1</sup>.

Burnaby Terminal and the SFU campus is separated largely by a forest with two access routes, which intersect at one junction<sup>2</sup>. The Burnaby Terminal is at the end point of the Trans Mountain (TM) Pipeline System and is an important site for the distribution of crude oil and refined products to local terminals, including the Westridge Marine Terminal.

The SFSS will comment on issues listed in Appendix 1 of Hearing Order MH-052-2018. The SFSS is particularly concerned about the environmental effects of malfunctions or accidents, which may include crude or refined oil spills. The May 2016 NEB Report on the Project concluded that a catastrophic bitumen spill in the Salish Sea was highly unlikely. Additionally, the NEB approved

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<sup>1</sup> PGL Environmental Consultants, *Trans Mountain Expansion Project (TMEP): Evaluation of risks to SFU*, [http://world.350.org/vancouver/files/2017/02/5\\_SFU\\_TMEP-Risk-Summary-PGL.pdf](http://world.350.org/vancouver/files/2017/02/5_SFU_TMEP-Risk-Summary-PGL.pdf), (November 2016).

<sup>2</sup> *Ibid*

TM's commitment to "review and revise" the existing Emergency Management Program (EMP). The SFSS has concerns with both the perceived likelihood of a spill in the Burrard Inlet, increased fire risk and the revision of the EMP.

**Issue 1: The environmental effects of project-related marine shipping, and the significance of these effects**

- a. According to the Burnaby Fire Department report (2015), "*the risk of fire is always present when flammable commodities are stored, handled, or transported*"<sup>3</sup>.
- b. In the event of a project-related marine shipping incident causing fire, such as a fire during transportation or a boil-over fire of a tank at the Westridge Marine Terminal, there is potential for it to spread to surrounding forests. The fire may result in a loss of natural terrestrial habitat, have adverse impacts to the watercourse, and potentially contaminate ecosystems with fire-fighting chemicals and molten crude oil during emergency response.<sup>4</sup>
- c. The Westridge Marine Terminal Upgrade and Expansion Project will result in increased marine shipping activity. This expansion will increase crude oil shipment in the area, increasing the likelihood of spills. The adverse environmental effects of a spill, particularly a crude oil spill, could create an emergency situation for SFU students if the two egress routes off Burnaby Mountain are blocked. The statement from page 155 of the NEB report "*The Board finds that an effective response does not guarantee recovery of all spilled oil, and that no such guarantee could be provided, particularly in the event of a large terrestrial, freshwater, or marine spill. The oil spill preparedness and response commitments made by Trans Mountain cannot ensure recovery of the majority of oil from a large spill*" is of particular concern to the SFSS due to the severity and longevity of the environmental effects if a spill were to occur.
- d. The TM geohazard risk assessment identified seismic activity as a concern. In the 2016 Report, TM identified that there are no guidelines in Canada that set a performance standard for seismic design of pipelines (page 64). Additionally, the existence of potentially active faults in the area is not known, and the investigation of potentially active faults by the SFU Department of Earth Sciences has not been completed (page 65). Seismic activity could have the potential to cause destruction to oil tanks and pipelines, creating the spills, leakage, chemical exposure and large-scale environmental destruction<sup>5</sup>.
- e. A report prepared by PGL Environmental Consultants (2016) for SFU identified serious Project-related health and safety risks for the SFU community. The report identified the risk of *liquid release: release of petroleum products under transport or storage, from spill, accident, or natural disaster*. The transportation of both crude and refined oil from the Burnaby Terminal to the Westridge Marine Terminal may increase the potential for these disasters to occur. Chemical exposure, especially to volatile

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<sup>3</sup> Burnaby Fire Department, *Trans Mountain tank farm tactical risk analysis*, <https://www.burnaby.ca/AssetFactory.aspx?did=16919>, (2015).

<sup>4</sup> *Ibid*

<sup>5</sup> PGL, *supra* note 1.



- substances at levels that could potentially lead to health issues, is a concern for SFU students<sup>6</sup>.
- f. SFU students' normal enjoyment of life and property are threatened by potential environmental incidences related to risks of project-related marine shipping. These risks include both aforementioned fire and spill risks, but also construction risks. Construction, particularly the effects of increased vehicle traffic and idling, can create elevated levels of emissions in the area surrounding SFU. Burnaby Mountain is a well-known location for students to participate in mountain biking, trail-running, and hiking. Furthermore, Burnaby Mountain is home to numerous wildlife species, such as black bears, owls, coyotes, cougars, and raccoons and deer. The potential loss of air quality, terrestrial habitat, watercourses, and animal and plant species would negatively impact the enjoyment of these natural features while studying at SFU<sup>7</sup>.

**Issue 2: Measures that are technically and economically feasible, and that would mitigate any significant adverse environmental effects of Project-related marine shipping**

- a. In order to mitigate any significant adverse environmental effects related to Project-related marine shipping, TM should submit an enhanced EMP and associated emergency response plans (ERPs) that include(s) the area surrounding the Westridge Marine Terminal. This program and associated emergency plans should incorporate significant input from both the SFU community and the Burnaby Fire Department, particularly with regards to mitigation measures. This input would be gathered through the consultation process. The risk of seismic activity and the proximity of tens of thousands of people to the Westridge Marine Terminal should be better addressed in these plans.
- b. TM should provide a hazard zone and emergency response map for the Westridge Marine terminal, Burnaby Terminal, and any pipeline infrastructure running through Burnaby. TM should work with SFU, local governments, and emergency response service providers to develop these maps as well as emergency planning zones. These groups should establish contact personnel to ensure that all mitigation measures are well-coordinated and any changes to the project are communicated.
- c. Adverse environmental effects, such as fire or chemical leakages related to marine shipping for the Project should have mitigation measures developed that include assessment of health risks to members of the public. External bodies, such as the Metro Vancouver Regional District and Vancouver Coastal Health, should be consulted. SFU students and the SFU community should engage in dialogue to discuss mitigation measures that include compensation for potential losses associated with adverse environmental effects.

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<sup>6</sup> PGL, *supra* note 1

<sup>7</sup> Simon Fraser University Safety & Risk Services, *Wildlife safety*, <https://www.sfu.ca/srs/security/personal-security/sfu-programs/personal-safety-guide/wildlife-safety.html>, (2018).

**4. Requirements of any follow-up program in respect of Project-related marine shipping**

- a. Emergency Management Plan, including but not limited to all ERPs and the Geographic Response Plans (GRPs), should be developed on a more aggressive timeline than was previously accepted by the NEB to ensure all concerns about these plans are alleviated pre-construction.

The SFSS thanks you for taking the time to consider our concerns.

Best,

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*on behalf of the Simon Fraser Student Society*