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November 18, 2016

The Right Honourable Justin Trudeau, P.C., M.P.
Langevin Block
80 Wellington Street
Ottawa, Ontario
K1A 0A2

Cc: The Honourable Catherine McKenna, Minister of Environment and Climate Change
The Honourable James Gordon Carr, Minister of Natural Resources
The Honourable Dominic LeBlanc, Minister of Fisheries and Oceans

Dear Prime Minister Trudeau,

As we near the deadline for your government's final decision on the Trans Mountain Kinder Morgan Expansion Project, I am becoming increasingly worried you may be about to lead our province in a dangerous direction. In both my professional and political capacity, and my role as a Trans Mountain intervener, I can state with certainty that this project must be rejected.

Over the past few weeks, there has been a lot of publicity generated about B.C.'s pristine coastline and the government initiatives protecting it (despite a 33 day diesel spill near Bella Bella). While the efforts being made are largely commendable, I feel the need to emphasize that they in no way negate the threat a 580% increase in diluted bitumen (dilbit) tanker traffic would bring.

Regarding the Ocean Protection Plan, Premier Clark said she was gratified to say it addressed the gaps the province had identified in our current ability to respond to marine spills. I agree the plan includes some positive additions that will help preserve our coastline, but we must not lose sight of the hazardous and cavernous gap that remains – we still have no capacity to clean up a heavy oil spill.

There is also speculation that a heavy oil tanker ban for the North Coast of B.C. may be on the horizon, but that too would not be enough. As far as the environment is concerned, the coastal waters and ecosystems that border British Columbia are not separated into northern, central, and southern categories. We simply can't just protect one section of it and say risks have been mitigated, We need to protect the entire coast.

Given the constituency I represent (Oak Bay Gordon Head) and my scientific background, I wanted to highlight my top concerns related to the risks associated with marine oil spills. My focus is primarily on the following four issue areas:

1. *Trans Mountain has failed to adequately represent the degree of risk associated with the potential environmental and socio-economic effects of marine shipping activities that would result from the proposed project, including the potential effects of accidents or malfunctions that may occur.*
2. *Contingency planning for spills, accidents or malfunctions, during construction and operation of the project are not supported by rigorous science. The scientific studies presented by Trans Mountain with regard to the fate and behaviour of diluted bitumen in a marine environment fail to adequately support its assumption that diluted bitumen will float in the event of a spill.*
3. *Trans Mountain has failed to represent a clear and satisfactory ability to respond to an oil spill in a manner that would sufficiently mitigate the negative effects as well as adequately contain and recover the spilled oil.*
4. *Trans Mountain has neglected to represent the full scope of effects the Project could have on human health, the environment and local communities, such as the riding of Oak Bay-Gordon Head.*

Background

I sought intervention status in the Trans Mountain National Energy Board Hearing both as a Member of the Legislative Assembly of British Columbia and as a scientist with a doctorate in applied mathematics and with specialty in physical oceanography and atmospheric and climate science. As an MLA, I represent the constituency of Oak Bay-Gordon Head, which is located along the Trans Mountain Tanker Sailing Route on the southeastern tip of Vancouver Island. I believe this is particularly important, as I was the only BC MLA with intervenor status in the hearing process.

As a scientist, I served as Lansdowne Professor and Canada Research Chair in climate modeling and analysis in the School of Earth and Ocean Sciences at the University of Victoria, where I worked for over 20 years. I have been a Lead Author on the United Nations Intergovernmental Panel on Climate Change's 2nd, 3rd, 4th and 5th scientific assessments and have authored and co-authored over 200 peer-reviewed, scientific papers. I am a Fellow of the Royal Society of Canada, Canadian Meteorological and Oceanographic Society, the American Meteorological Society, the American Geophysical Union and the American Association for the Advancement of Science. Throughout this process, I have applied my scientific expertise, particularly in physical oceanography and modelling, to evaluate the evidence provided in this Application.

1. Probability of a Tanker-Based Oil Spill

As a part of their Application to the National Energy Board, Trans Mountain was required to assess the relative additional risk the Project would pose in the tanker sailing route. Trans Mountain made its case, as summarized in sections 5.2 and 5.3 of Volume 8A, based primarily on two reports: TERMPOL 3.8 –

Casualty Data Survey and TERMPOL 3.15 – General Risk Analysis and Intended Methods of Reducing Risk. Together, these reports form the basis of Trans Mountain's case regarding the degree of risk posed by the Project.

As will be outlined below, we have no credible way of assessing the validity of TERMPOL 3.15 and hence should give it no weight in its consideration.

The Risk Analysis

Through TERMPOL 3.15, Trans Mountain set out to build the case that the additional risk posed by and relating to Project oil tankers could be successfully mitigated by additional risk reduction measures, namely the extended escort tug and the moving exclusion zone. In building their case, they attempted to estimate the baseline risk posed by current marine traffic, the additional risk posed by Project tankers and the extent to which the risk reduction measures could help mitigate that additional risk.

According to the analysis, the return period for a spill of any size is 309 years at present conditions. With the implementation of the Trans Mountain Expansion Project, the return period drops to 46 years. However, with the addition of the extended escort tug and the moving exclusion zone, DNV calculates that the return period will increase to 237 years.

The accuracy of those estimates depends predominantly on the extent to which the model – MARCS – accurately represents real world conditions in the marine study area. The first questions one must ask, therefore, are: Have the baseline parameters of MARCS and the risk reduction factors been validated for the marine study area? Has a sensitivity analysis been conducted on the overall model and on each risk reduction factor? How has the model been calibrated to avoid 'tuning', so as to ensure its predictive abilities?

There are two essential ways of answering these questions: The first is to have the model be made available to participants in the hearing process so that they may conduct independent analyses of its representative and predictive abilities. Unfortunately, MARCS is a proprietary model and, hence, access to the model was denied.

The other is to provide the information necessary to answer these questions in the absence of access to the model. At a minimum, one would need any back-up, peer-reviewed and independent evaluations of the model. DNV references several back-up studies, but none were provided on record. Moreover, one would also need the actual validation and sensitivity analyses that were conducted for the overall model and for the individual risk reduction factors. Unfortunately, Trans Mountain has not provided this information.

At the end of the hearing process, here is where the information stood:

1. The general discussions of the sensitivity and validation of MARCS provided in Section 11 of TERMPOL 3.15 remain entirely insufficient and do not provide the information necessary to adequately evaluate the accuracy of the model.

2. We know the basic parameters of MARCS are based on North Sea average shipping operations in the mid to late 1990s. Yet no information has been provided as to how the model has since been calibrated for current and local conditions along the Trans Mountain Tanker Sailing Route.

We therefore have no way of knowing if the basic parameters of MARCS are truly representative of local conditions for the purposes of this Project.

3. Not a single validation or sensitivity analysis was provided for any of the risk reduction factors applied to MARCS. We therefore cannot have confidence that those factors have been applied accurately and that they truly represent real world conditions along the tanker sailing route.

4. The fact that MARCS may have successfully represented past cases is not sufficient evidence to conclude that MARCS can accurately represent future cases, including the Trans Mountain Expansion Project. This is because one can 'tune' over errors and inconsistencies in the model to achieve the desired result, without actually ever addressing those errors. Trans Mountain has failed to provide sufficient information to discount 'tuning' as a realistic and reasonable possibility. As such, one still cannot have confidence in the predictive abilities of MARCS.

In the absence of this information, one simply cannot properly evaluate the representative or predictive nature of MARCS as it pertains to the Risk Analysis conducted for the Project. Without this ability, one has no way of knowing if the results of the MARCS analysis are accurate or not. Given the serious impact a spill could have on the region, it would be irresponsible to accept the assertions provided in Trans Mountain's Application in the absence of evidence.

It is for this reason that I argue that the risk analysis provided in TERMPOL 3.15 should not be given any weight.

2. Fate and Behaviour of Diluted Bitumen in Marine Environments

Trans Mountain based their entire analysis of the fate and behaviour of dilbit in the marine environment on the faulty assumption that dilbit floats. Published evidence, together with a Federal government study and an Environment Canada presentation to the Royal Society of Canada's Expert Panel on *The Behaviour and Environmental Impacts of Crude Oil Released into Aqueous Environments* clearly conclude otherwise. Unlike other crude oils, dilbit can sink in the presence of suspended particulate matter (e.g. sediment particles in the ocean). Suspended particulate matter is very common in B.C.'s coastal waters, meaning that any dilbit spill would likely lead to submerged oil. Currently there is no ability to effectively clean up oil that sinks below the surface, making dilbit a particularly risky substance to transport.

Trans Mountain based the assessment of the fate and behaviour of diluted bitumen in the marine environment on two submissions. The first contained a comparison of the properties of diluted bitumen with other oils. The second commissioned report, referred to as the Gainford study, undertook tank experiments using saline water (typical of Burrard inlet) that did not include suspended sediments.

There is strong evidence that dilbit could sink in seawater containing sufficient suspended sediments of which there are no shortage in our coastal waters. The Salish Sea receives year round sediment-laden freshwater discharge from the Fraser River. The tank experiments conducted in A4H9A1 where sediments were accounted for noted that:

"*high-energy wave action mixed the sediments with diluted bitumen, causing the mixture to sink or be dispersed as floating tarballs,*"

Similarly, the Environment Canada presentation to the RSC Expert Panel noted that in the presence of fine to medium suspended sediments with fresh to moderate weathering, a large part of the oil sinks as fine oil particles as in the case of what occurred in the Kalamazoo spill.

It is clear that unless required to do so, Trans Mountain has no intention of conducting additional tank and/or field studies to explore the fate and behaviour of diluted bitumen in the coastal environment where sediments are present in the water column. Until such time as these studies are available, it is simply not possible to properly assess the risk and potential damages associated with a diluted bitumen spill in the Salish Sea. I submit that in light of the glaring gap in scientific understanding, it would be reckless to approve the Trans Mountain project at this time.

Furthermore two subsequent independent expert assessments validate my assertion by making it abundantly clear that we simply to not know enough to properly assess the risk and potential damages associated with a diluted bitumen spill in the Salish Sea. The two expert assessment are The Royal Society of Canada Expert Panel Report entitled: *The Behaviour and Environmental Impact of Crude Oil Released in Aqueous Environments*, and the US National Academy of Science's report entitled *Spills of Diluted Bitumen from Pipelines: A Comparative Study of Environmental Fate, Effects, and Response*

Incomplete and Uncertain Ocean Modeling Analysis

Trans Mountain conducted a number of ocean model simulations using the proprietary H3D model. As also noted by intervenor Dr. David Farmer, FRS, FRSC, who has extensive expertise in ocean physics and particular small scale ocean mixing processes, tidal fronts, vortex sheet tilting, breaking internal waves and whirlpools play a key role in mixing and subduction in the Strait of Juan de Fuca. Many of these complex mixing processes are non-hydrostatic. As such the use of a hydrostatic model is not appropriate in the present context.

I also posed numerous questions with respect to the validation of H3D. The proponent argued several times "The primary validation of an oceanographic model concerns the reproduction of observed tidal heights". This statement is simply incorrect. Tidal heights are easy to reproduce with much simpler models than H3D. For ocean model validation, an assessment is required of the three dimensional velocity, temperature and salinity fields. In the case of oil spill modeling, it's critical to evaluate the three-dimensional current fields.

The proponent discussed only one form of current evaluation in the original submission - Bob Lord fell in the water on July 25, 1993 and his drift was subsequently simulated. In my more than three decades of ocean and climate modeling research, I have never before heard of a person falling out of a ship being used as a data point for model validation.

While evidence exists to suggest that the model does a reasonable job capturing the magnitude of the long channel flow, the model clearly did not capture the across channel flow. But it is precisely this across channel flow that is critical in assessing where oil ends up if a spill occurs.

In addition, no evaluation of vertical flow was provided. This information is critical if one wants to assess the adequacy of the model in capturing the mixing and subduction processes mentioned above. And given that the model is hydrostatic, there will be no vertical acceleration. As a result the vertical velocity field, and subsequently any vertical advection of tracers, will almost certainly be unrealistic leading one

to question the suitability of H3D for this application in light of the complex oceanography of the region and the unique properties of dilbit.

It is therefore my expert opinion that the proprietary ocean model that has been used to predict the fate and behavior of a potential dilbit spill in the Salish Sea is not the appropriate tool to address the questions being asked.

3. Proposed and Existing Oil Spill Response and Recovery Capacity

Western Canada Marine Response Corporation's "Future Oil Spill Response Approach Plan" outlines WCMRC and Trans Mountain's proposal for enhancing existing oil spill response capacity in the event that the Project is approved. While the proposed enhancements would certainly constitute a significant improvement, I argue that even with those enhancements, insufficient capacity will exist to adequately respond to a dilbit spill. There are three primary reasons:

1. As previously noted, dilbit can sink or submerge in the presence of suspended particulate matter, which is common in the marine study area. Based on the information provided, it is clear that WCMRC currently does not, and, under the proposed enhancements still would not, have any capacity to recover submerged or sunken oils.

2. Under proposed enhancements, WCMRC would have to rely on cascading equipment in from other jurisdictions to respond to a spill larger than 20,000 tonnes. Yet, the proponent has failed to adequately outline the scope, ability and potential complications associated with cascading in the additional equipment. One therefore has no way of evaluating whether this is an effective approach or not, yet it is clear from Trans Mountain's descriptions that it is a highly uncertain process.

3. Even a 20,000 tonne response capacity does not imply the ability to recover all 20,000 tonnes of spilled oil. Recovery rates on average are only 5 to 15%, which, I would argue, is too low to demonstrate sufficient ability to mitigate the risks of this project.

Arachne Reef Oil Spill Response Simulation Study

Meanwhile the simulated spill scenario that was provided by EBA and WCMRC at Arachne reef to demonstrate the effectiveness of the proposed spill response enhancements, can only be seen as a completely unrealistic scenario.

I submit that collectively the assumptions applied to this simulation are not adequately representative of conditions that response crews will likely encounter in the event of a spill along the Trans Mountain Tanker Sailing Route. The representativeness of a scenario's assumptions influences the accuracy of the results as evaluative or representative outputs. By not applying sufficiently representative assumptions to the simulation, the authors were able to derive better-than-average results that would likely not be representative of real world conditions.

The assumptions include:

1. The enhanced spill response regime would be available, despite the fact that the enhancements are still only a proposal and without providing a comparable baseline simulation applying only existing capacity.

2. No oil would sink or submerge, thereby allowing the response to be unimpeded by the fact that WCMRC has no current or proposed capacity to recover sunken or submerged oil.

3. Twenty hours of daylight would be present to facilitate spill response, despite the fact that one would have to be around the same latitude as Tuktayuktuk in the Arctic Ocean for there to exist any day in August with 20 hours of daylight.

4. No adverse weather conditions occurred to prevent or complicate response efforts, despite the fact that 30 to 60% of the time, wind and wave conditions along the tanker sailing route would make recovery efforts difficult if not impossible.

5. No toxic or explosive hazards were present that would prevent responders from immediately approaching the spill site.

6. There was no need to cascade equipment in to support recovery efforts, and hence no need to factor in resulting delays or complications.

As noted by WCMRC and EBA, the speed of containment of a spill is a significant determinant of success of recovery efforts. Should wind and wave conditions, responder approach time, or equipment availability prevent recovery efforts for hours or even days, it could significantly impede containment efforts and therefore recovery rates. None of these complications were simulated in Trans Mountain's Application. While individually each of these assumptions could be argued to represent a "realistic" condition, collectively they paint an unrepresentatively ideal scenario from a spill response standpoint.

In contrast, in the United States, vessels must be certified as having sufficient spill response resources, assuming complications by adverse weather. Recognizing that no single scenario will fully represent the range of conditions experienced along the tanker sailing route, Trans Mountain could have included an additional scenario representing "conservative assumptions" from a spill response stand point. Since Trans Mountain has denied a request that it provide such a scenario, one does not have sufficient information to judge the range of recovery rates that may occur throughout the year under different conditions. One is therefore unable to make a comprehensive judgment, based on the information provided by Trans Mountain, as to the effectiveness of current or proposed spill response capacity, except to derive that the success rate would likely be significantly lower than that resulting in the Arachne Reef scenario.

Finally, Trans Mountain's refusal to provide any analyses and simulations assuming a total loss spill scenario should be interpreted as an unwillingness to consider the full scope of risk associated with the Project. It must also be seen as a failure to meet the basic requirements of demonstrating that Trans Mountain and its partner organizations have the capacity to mitigate the full scope of risk the Project would create.

4. Human Health Risk Assessment of Facility and Marine Spill Scenario Technical Report

My office also did a review of the Human Health Risk Assessment of Facility and Marine Spill Scenarios Technical Report (HHRA) for the Trans Mountain Expansion Project. These filings outlined the potential human health effects associated with a number of simulated marine and facility oil spill scenarios. These tests were conducted in order to provide "a more detailed analysis of the potential health effects that might occur in relation to each of the simulated oil spill scenarios than the earlier qualitative

assessments in order to further enhance awareness and understanding of the nature and extent of such effects."

Looking through the HHRA, it became clear that the lack of understanding of how heavy oil will behave in water, and the subsequent lack of modelling of a heavy oil spill affected the conclusions reached in this report. Specifically, it is my belief that Trans Mountain has failed to represent an accurate spill scenario, providing neither a worst case, not a sufficiently conservative scenario that portrays the actual risks to human health which discredit the HHRA that has been conducted. Unless a realistic and conservative oil spill scenario is used, the conclusions of an HHRA are restricted to the unique and unrealistic scenario found in the report. This is of little use to us in gauging the risks associated with the Project and to authorities, who must use this information to plan their responses.

Furthermore, the report was structured in such a way that the exposure pathways considered are limited by the conditions applied to the report, without considering other realistic exposure pathways that may present themselves in a spill scenario, particularly one that involves heavy oil. The HHRA provided by Trans Mountain look at a scenario that centers on the summer season, with low wind speed and almost low vertical mixing in the water column. All of these factors may be fine for an airborne exposure pathway – but my concern is they also bias which pathways they consider.

While the HHRA Technical report appears to maximize the potential for the airborne exposure pathway, the obvious question is whether scenarios that include high wind and wave conditions, and/or the presence of particulate matter in the marine environment, may result in more oil becoming submerged, evading containment booms, ending up on shorelines, or becoming ingested by aquatic organisms. Should any of these instances occur, they would present two additional pathways, ingestion or physical contact, for human exposure that are not dealt with in a sufficiently rigorous manner in this report, while the question of submerged oil appears to be ignored all together.

Given the uncertainties about how submerged heavy oil behaves, I fail to see whether the decision to not conduct a scenario that included the possibility of submerged oil accurately represents the potential for other exposure pathways to exist, and whether the inhalation pathway has been sufficiently represented.

The failure to adequately model what a spill would look like, and the failure to consider other exposure pathways are directly connected. The report glosses over any possibility of oil becoming submerged, weather conditions moving oil to different locations or limiting response measures, the possibility of a far larger spill than Trans Mountain's definition of a CWC.

Without addressing these concerns, I fail to see how the conclusions reached in the HHRA can be extended to any scenario beyond the idealized scenario envisioned by Trans Mountain. As such, Trans Mountain has thus far failed to meet its requirements to address issues 5 and 12 on the approved issues list, as they pertain to the HHRA.

Community Impacts from a Marine Oil Spill

In terms of local community impacts, one of my primary concerns is around the projected demands a diluted bitumen oil spill will place on local communities and emergency and first responders. Whether it be additional need for police forces to quarantine areas, extra burden placed on fire departments, or increased demand on hospitals, each of these local resources comes with costs and limited means. Trans

Mountain has neglected to fully consider the impacts and demands an oil spill could have on local emergency services in its hypothetical spill scenarios. As such, at this time we have no idea if communities will have the capacity to respond to any size or type of oil spill along their coastlines, let alone a large-sized spill of diluted bitumen complicated by adverse weather or submerged oil.

Instead, communities are left to rely on Trans Mountain's assertions that outside services will provide any and all support the communities will need and that these services themselves have the capacity to respond to all possible spill scenarios.

In their own attempt to determine local government marine oil spill preparedness and response capability, the Georgia Strait Alliance conducted a report assessing these issues in the Georgia Strait Region. This report presented a number of concerning conclusions, including that, according to government members themselves, "local governments are unprepared and unable to effectively engage in marine oil spill preparation and response activities."

The area that I represent is home to a diverse marine habitat and an economy that relies heavily on its ecotourism and fishing industries. An oil spill along this coastline could not only have devastating short-term and long-term impacts on local marine life, but could also have serious negative impacts on local economies and business. When I asked the Proponent to provide an estimate of the expected oil spill response costs associated with various-sized oil spills at Arachne Reef, as well as their best estimate of where the financial costs would come from, the proponent was unable to provide a solid answer.

I am concerned that the costs of a tanker spill could well exceed the maximum oil spill compensation regime, as has happened in the past. Should this happen, there is no guarantee the responsible entity would be able to cover the additional costs. Trans Mountain has neglected to account for this scenario and for the consequent burden that could be placed on local and provincial governments.

By not adequately accounting for baseline costs to health care and emergency services that may be incurred by local communities in the event of a small spill, Trans Mountain has failed to account for the full scope of initial impacts the Project could have on local communities. By neglecting to consider larger spill scenarios and the possibility of submerged and sunken oils, Trans Mountain has also failed to account for a reasonable range of complications that could incur additional costs and burdens on local governments.

These concerns are perhaps most evocatively exemplified in Trans Mountain's statement that "oil spills can have both positive and negative effects on local and regional economies." Taking that point even further, they say that "spill response and cleanup creates business and employment opportunities for affected communities, regions, and clean-up service providers."

Trans Mountain includes this statement without once adequately analyzing the economic impact of a marine-based oil spill resulting from the Project. Moreover, when asked for evidence in support of this claim, the evidence Trans Mountain provided unequivocally concluded that oil spills have a clear net negative impact.

The Proponent's approach in portraying the positive economic impacts of an oil spill without adequately representing the full scope of net-negative effects reflects a mindset that is simply out of touch with the values of British Columbians. In a process where the Proponent provides insufficient evidence in support of its assertions, examples such as these further support the point that a 'trust us' approach to

managing the serious risks of this Project is simply not good enough. The effects of a diluted bitumen spill in our waters would be catastrophic.

Neither Science, nor British Columbians support this project. I hope the upcoming decision will be made to reflect that.

With best wishes,

Dr. Andrew Weaver, OBC, FRSC, FAGU, FAMS, FAAAS, FCMOS
MLA Oak Bay – Gordon Head
Leader, BC Green Party