Fisheries and Oceans Canada | Pêches et Océans Canada
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Canadian Science Advisory Secretariat
Pacific Region **Science Response 2015/022**

TECHNICAL REVIEW OF PREDICTED EFFECTS AND PROPOSED MITIGATION OF UNDERWATER NOISE AND POTENTIAL VESSEL STRIKES ON MARINE MAMMALS, FROM THE DECEMBER 2013 FACILITIES APPLICATION AND SUPPLEMENTAL INFORMATION FOR THE TRANS MOUNTAIN EXPANSION PROJECT

Context

Trans Mountain Pipeline ULC (Trans Mountain) is proposing an expansion of its current 1,150 km pipeline system between Strathcona County, AB and Burnaby, BC (the Trans Mountain Expansion Project, hereafter 'the Project'). On December 16, 2013, Trans Mountain filed a Facilities Application for the Project with the National Energy Board (NEB), pursuant to the *National Energy Board Act*, and on April 2, 2014, the NEB determined that the Application was complete, thereby commencing a 15-month environmental assessment review under the *Canadian Environmental Assessment Act, 2012*.

As part of the application, NEB included a requirement that the Proponent (Trans Mountain) consider the environmental and socio-economic effects of the increase in marine tanker traffic; this was delivered by way of issue # 5 in the NEB's list of Issues that will be considered at the Hearings (NEB 2013a) and was provided to Trans Mountain in a letter outlining its filing requirements with respect to this topic (NEB 2013b).

Through scoping, the Proponent has identified underwater noise from Project-related marine vessel traffic as a potential source of sensory disturbance to marine mammals. They consider ship strikes to marine mammals as a potential accident or malfunction that could occur between marine mammals and Project-related traffic. The assessment of potential effects of the increase in Project-related marine vessel traffic is centered on the established in-bound and out-bound marine shipping lanes in the Marine Regional Study Area (Marine RSA) (Figure 1).

As an intervenor in the environmental assessment hearing process for the Trans Mountain Project, Fisheries and Oceans Canada (DFO) will be presenting written evidence to the NEB in relation to its expertise on the effects of the Project on marine fish and fish habitat and marine mammals (including aquatic species at risk), the efficacy and adequacy of mitigation and offsetting measures, monitoring and follow-up programs proposed by the Proponent, and the conclusions reached in Facilities Application for the Project.

DFO's Pacific Region Fisheries Protection Program (FPP) is responsible for reviewing potential effects of the marine terminal and shipping components of the Project on fish, fish habitat and marine mammals. In December 2014, FPP requested that DFO Science Branch conduct a sufficiency review of the information on the effects of marine shipping on marine mammals in the Facilities Application for the Project, and in February 2015, DFO Science Branch published a Canadian Science Advisory Secretariat (CSAS) Science Response (SR) to this request. This CSAS SR contributed to DFO's information request (DFO IR No.2) filed with the NEB in

Round 2 of information requests made of the Proponent. Trans Mountain responded to DFO IR No.2 on February 13, 2015.

Based on information provided by the Proponent within the Facilities Application and in relevant supplemental filings with the NEB (including Trans Mountain's response to DFO IR No. 2), FPP is now requesting DFO Science Branch provide advice on whether the Proponent's assessment of effects related to underwater noise and ship strikes on marine mammals from increased Project-related vessel traffic supports their conclusions. Furthermore, FPP is seeking advice to understand if effects related to underwater noise and ship strikes on marine mammals are measureable in relation to current conditions, and whether there are mitigation measures available to reduce these effects. DFO Science Branch has been asked to focus its review on direct effects on marine mammals, not including potential effects of underwater noise on prey species, such as fish. The assessment and advice arising from this CSAS SR will assist in the development of DFO's written evidence submission to the National Energy Board for the Trans Mountain Expansion Project.

The objective of this SR is to review information provided by the Proponent in the December 2013 Facilities Application and in relevant supplemental filings with the NEB to answer the following questions:

1. Does the Proponent's assessment of the effects of underwater noise and ship strikes on marine mammal indicator species (i.e., the Southern Resident Killer Whale, Humpback Whale, and Steller Sea Lion) accurately characterize potential direct effects on these marine mammal species within the Marine Regional Study Area[1] (Marine RSA), and does their assessment support their conclusions?
2. For this project, is it possible to measure the effect of underwater noise and mammal-vessel ship strikes from increased Project-related vessel traffic on marine mammal indicator species above the status quo (i.e., current noise conditions), and if so, how does this effect differ from current conditions?
3. If measureable effects exists in (2) above, are there mitigation measures that may be implemented to reduce the residual effect on the marine mammals indicator species?

This Science Response Report results from the Science Response Process of March 20, 2015 on the Technical review of predicted effects and proposed mitigation of underwater noise and potential vessel strikes on marine mammals, from the December 2013 Facilities Application and supplemental information for the Trans Mountain Expansion Project.

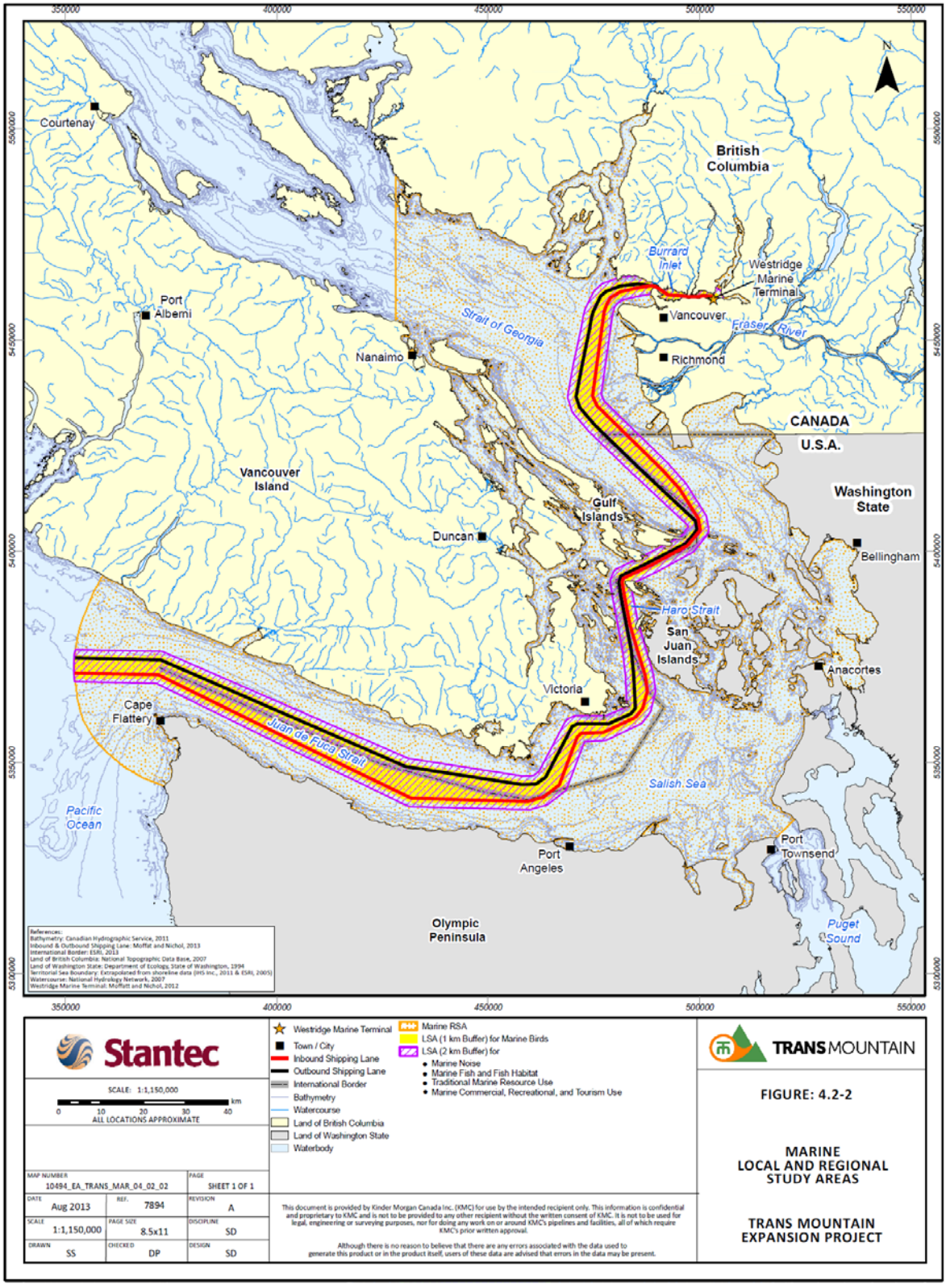

Figure 1. The Marine Regional Study Area (RSA). (from Trans Mountain Pipeline ULC, 2013. Trans Mountain Expansion Project – An Application Pursuant to Section 52 of the National Energy Board Act, Volume 8A - Marine Transportation).

Background

The existing Trans Mountain pipeline (TMPL) system commenced operation in 1953, and transports a range of crude oil and petroleum products from Western Canada to locations in central and southwestern British Columbia (BC), Washington State, and offshore. The proposed Project would create a twinned pipeline, increasing the capacity of the system from approximately 300,000 barrels per day to 890,000 barrels per day. Key project components include 994 km of new pipeline, reactivation of 193 km of existing pipeline, 12 new pump stations and expansion of existing pump stations and storage tanks, and the addition of three new vessel berths at the Westridge Marine Terminal in Burnaby, BC.

For this particular Science Branch review, the marine vessel traffic that will transport the petroleum products is of relevance. The proposed expansion is forecasted to increase marine vessel traffic from 5 tankers per month calling at the Westridge Marine Terminal to approximately 34 tankers per month (i.e., an additional 720 tanker transits each year). At present, the maximum size of petroleum tankers that call at the Westridge Terminal are Aframax class, which have an average cargo carrying capacity of 750,000 barrels. The maximum size of tankers is not expected to change as part of the Project. These vessels will transit the Marine Regional Study Area (Marine RSA) using existing in-bound and out-bound shipping lanes (Figure 1). It will take each Project-related Marine vessel approximately 12 hours to complete one transit of the Marine RSA; and, on average, there will be two transits every 24 hours. This will be in addition to existing traffic in the shipping lanes and other traffic in the Marine RSA.

There are 22 species of marine mammals identified by the Proponent as being present in the Marine RSA. The most commonly observed species of toothed whales in the Marine RSA include Killer Whales (*Orcinus orca*), Harbour Porpoises (*Phocoena phocoena*), Dall's Porpoises (*Phocoenoides dalli*), and Pacific White-sided Dolphins (*Lagenorhynchus obliquidens*). Designated Critical Habitat for the Southern Resident Killer Whale population listed as endangered under the *Species at Risk Act* (SARA) overlaps almost entirely with the Marine RSA (Figure 2). The Humpback Whale (*Megaptera novaeangliae*), which is listed as threatened under the *SARA*, is the most commonly observed baleen whale, and the western-most portion of the Marine RSA overlaps proposed Humpback Whale Critical Habitat (Figure 2). Other baleen whales including the Minke Whale (*Balaenoptera acutorostrata*) and Grey Whale (*Eschrichtius robustus*), as well as the occasional Fin Whale (*Balaenoptera physalus*) are also observed. The Harbour Seal (*Phoca vitulina*), and Steller (*Eumetopias jubatus*) and California (*Zalophus californianus*) Sea Lions are the most common pinnipeds observed in the Marine RSA, as well as the occasional Northern Elephant Seal (*Mirounga angustirostris*). Sea Otters (*Enhydra lutris*) are also occasionally sighted. The Proponent's assessment of potential effects is on three marine mammal species identified as indicators of toothed whales, baleen whales and pinnipeds in the Marine RSA; respectively these are Southern Resident Killer Whales, Humpback Whales, and Steller Sea Lions.

An increase in marine vessel traffic associated with the Project has the potential to result in sensory disturbance to marine mammals from underwater noise and an increased risk of injury and mortality associated with mammal-vessel strikes. Disturbance responses associated with increased Project-related vessel traffic could range from temporary displacement to reduced foraging efficiency, to disruption of mating and social behaviours. The potential for these effects to affect recovery of the Southern Resident Killer Whale is of critical importance, as fewer than 80 individuals are estimated to be present in the wild. Furthermore, the Proponent has noted in the Project Application that although the Project's contribution to overall sensory disturbance effects on the species is small, the potential effects of increased Project-related marine vessel traffic are determined to be significant for Southern Resident Killer Whales. This species is therefore of the greatest conservation concern in the Marine RSA.

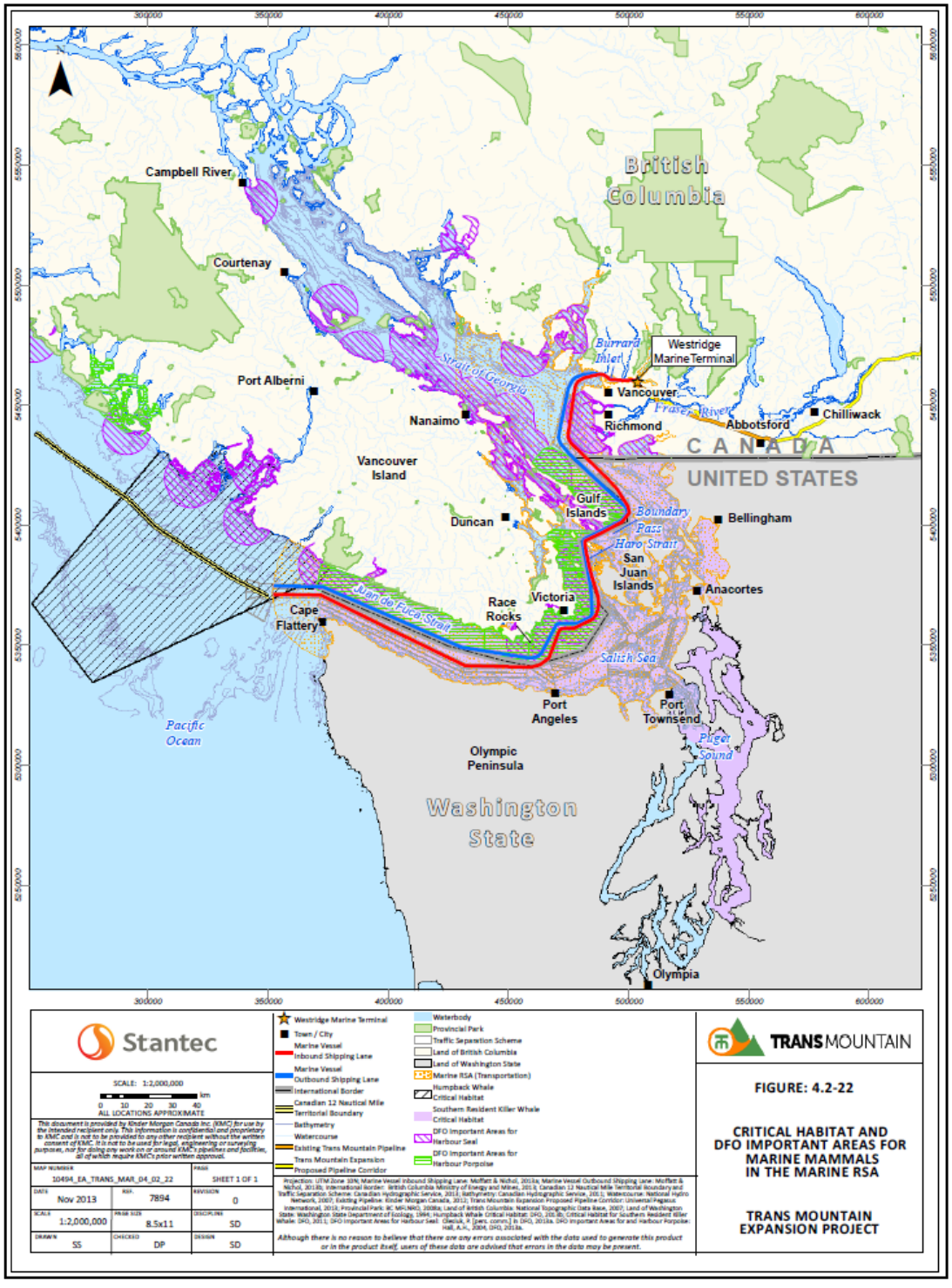

Figure 2. Critical Habitat for Southern Resident Killer Whales, proposed Critical Habitat for Humpback Whales and other important areas for marine mammals in the Marine RSA (from Trans Mountain Pipeline ULC, 2013. Trans Mountain Expansion Project – An Application Pursuant to Section 52 of the National Energy Board Act, Volume 8A - Marine Transportation).

Analysis and Response

Science Branch responses to the three technical assessment questions posed by DFO FPP (see Context above) are detailed below.

To prepare this response, the following documents from the Proponent were reviewed:

1. Trans Mountain Pipeline ULC. 2013. Trans Mountain Expansion Project – An Application Pursuant to Section 52 of the National Energy Board Act, Volume 8A - Marine Transportation. Submitted to the Secretary of The National Energy Board.
2. JASCO Applied Sciences. 2014. Supplemental Underwater Noise Modelling for Trans Mountain Expansion Project. Prepared for Stantec Ltd. Document 00542, Version 5.0: 51 p.
3. Trans Mountain Pipeline ULC. 2014. Trans Mountain Response to The National Energy Board Information Request No. 1. NEB Hearing Order OH-001-2014. Trans Mountain Document Number: A3W9H8. Submitted to the Secretary of The National Energy Board.
4. Trans Mountain Pipeline ULC. 2014. Trans Mountain Response to Information Request from Val Veirs. NEB Hearing Order OH-001-2014. Trans Mountain Document Number: A3X6V7. Submitted to the Secretary of The National Energy Board.
5. Moffat & Nichol. 2013. TERMPOL 3.2 – Origin, Destination & Marine Traffic Volume Survey. Trans Mountain Expansion Project. Prepared for Trans Mountain. Trans Mountain Document Number: A3S4R7 and A3S4R8. Submitted to the Secretary of The National Energy Board.
6. Trans Mountain Pipeline ULC. 2014. Trans Mountain Response to The National Energy Board Information Request No. 2. NEB Hearing Order OH-001-2014. Trans Mountain Document Number: A3Z4T9. Submitted to the Secretary of The National Energy Board.
7. Fisheries and Oceans Canada. 2015. Sufficiency review of the information on effects of underwater noise and the potential for ship strikes from marine shipping on marine mammals in the facilities application for the Trans Mountain expansion Project. DFO Can. Sci. Advis. Sec. Sci. Resp. 2015/007.
8. Trans Mountain Pipeline ULC. 2015. Trans Mountain Response to Government of Canada Information Request No. 2. NEB Hearing Order OH-001-2014. Trans Mountain Document Number: A4H6A5. Submitted to the Secretary of The National Energy Board.

Does the Proponent's assessment of the effects of underwater noise and ship strikes on marine mammal indicator species (i.e., the Southern Resident Killer Whale, Humpback Whale, and Steller Sea Lion) accurately characterize potential direct effects on these marine mammal species within the Marine Regional Study Area (Marine RSA), and does their assessment support their conclusions?

Underwater Noise

The Proponent has provided a comprehensive review of the current literature on underwater noise and its potential effects on marine mammals, with particular emphasis on the three indicator species; the Southern Resident Killer Whale, Humpback Whale, and Steller Sea Lion. In the absence of Canadian standards or guidelines for exposure of marine mammals to chronic (i.e., non-pulsed) underwater anthropogenic noise, the Proponent has used thresholds for auditory injury (Temporary Hearing Threshold Shifts TTS, and Permanent Hearing Threshold Shifts PTS) recommended by Southall et al. (2007) and thresholds for behavioural disturbance currently used in the US (NOAA 2013). These are commonly applied standards that have also been used by DFO in the past (e.g. Lawson and Lesage 2012). The Proponent has also

provided a detailed assessment of the anticipated noise sound fields radiating from transiting Project-related tankers and escorts, based on a state-of-the-art model that incorporates important parameters related to acoustic propagation characteristics in the Marine RSA (JASCO's Marine Operations Noise Model (MONM)). Modelled sound levels at various distances from a theoretical ship and escort tug were considered relative to existing acoustic thresholds, reported as sound pressure or exposure levels in decibels (dB) associated with auditory injury as well as potential behavioural disturbance (Southall et al. 2007; NOAA 2013). The resulting outputs are measures of the distance, in kilometres, from the ship at which noise above these thresholds would occur in various scenarios of vessel configuration and speed.

As noted in DFO's sufficiency review of the Project Application (DFO 2015), this model, while exemplary, was not applied in a manner that fully assesses ship noise in the Marine RSA, and thus the assessment of the potential effects of Project-related noise on indicator species is incomplete. In particular, three areas of deficiency were identified in this review. First, the modelling exercise only considered predicted noise properties at four locations along the 296 km long transit corridor (shipping lanes in Figure 1) for Project-vessels in the Marine RSA. While these locations may be reasonably representative of conditions over much of the Marine RSA, they do not necessarily reflect acoustic propagation properties that might occur in some important areas within the designated Critical Habitat of Southern Resident Killer Whales. Second, the dataset originally used in the MONM assessment is inferior to other available datasets (DFO Institute of Ocean Sciences Data Archive. Ocean Sciences Division), in terms of seasonal sound speed profiles. Third, the MONM was used to assess the impact of a single Project-related ship with an escort tug passing a single stationary marine mammal. A complete assessment of the impacts of this Project would require that the model be used to estimate the frequency with which such events would occur from all shipping in the Marine RSA to a theoretical stationary marine mammal. This is necessary to assess chronic and additive noise levels in the context of shipping activity associated with the Project. Model outputs that include additive and cumulative effects of Project-related and existing ship noise would be a more accurate measure of the noise environment to which the marine mammals would be exposed. Specifically, the impacts of additional ship noise associated with Project-related vessels on periods of relative quiet should be modeled in addition to existing shipping in the Marine RSA.

In response to DFO's requests that these deficiencies be addressed (Trans Mountain Pipeline ULC 2015), the Proponent stated that the four locations used in the MONM were sufficiently representative of other areas within the Marine RSA, and any differences would be unlikely to change their conclusions with respect to impacts of underwater vessel noise on marine mammals (Response to IR No. 2.088 in Trans Mountain Pipeline ULC 2015). In addition, the Proponent maintained that modeling of noise from existing shipping in the Marine RSA was not possible due to a lack of data on current ambient noise in the region (Response to IR No. 2.087 in Trans Mountain Pipeline ULC 2015). However, there is a considerable amount of ambient noise data available for the Strait of Georgia from hydrophones on the VENUS cabled observatory (Ocean Networks Canada). There are also considerable AIS (Automatic Identification System) data on transits of all types of commercial shipping vessels in the Marine RSA in recent years (e.g., Simard et al. 2014) and typical source sound pressure levels of noise generated by vessel type are readily available (e.g., McKenna et al. 2012). A recent coast-wide assessment of shipping noise in BC using AIS data was recently published by Erbe et al. (2012 and 2014).

The Proponent's conclusions with regard to impacts of underwater noise due to Project-related vessel traffic on marine mammals in the Marine RSA are presented in Volume 8 of the Project Application, **Section 4.3.7.5 Potential Residual Effects** and Table 4.3.7.8. They conclude that the only residual effect of increased Project-related marine vessel traffic on all marine mammals indicator species includes *Sensory disturbance due to underwater noise from vessels (may*

include temporary displacement, startle response, increased energy expenditure, reduced foraging efficiency, communication masking, change in activity state, and/or increased stress).

The significance of this residual effect for each of the three indicator species is evaluated in **Section 4.3.7.6** and summarized in Table 4.3.7.9. For Southern Resident Killer Whales, the Project Application concludes that there would be a significant residual environmental effect, which is defined as "a high probability of occurrence of a permanent or long-term residual effect of high magnitude that cannot be technically or economically mitigated". The criteria used to reach this conclusion include the duration of the disturbance (long-term), its frequency of occurrence (periodic), its reversibility (or time to recover from a disturbance event – immediate), magnitude of the disturbance (high), its probability of occurrence (high), and confidence that the assessment of significance is correct (low). Of the various reasons given for the low confidence in this significance assessment, the "greatest source of uncertainty is the linkage of sensory disturbance effects to population-level consequences and the degree to which such effects can be attributed to underwater noise from Project-related marine vessels and other ships and boats". For Humpback Whales and Steller Sea Lions, any residual effect is deemed to be not significant.

Overall, while the Proponent's assessment is largely qualitative and has a low level of confidence, their conclusion that there would be a significant residual effect from Project-related vessel noise on Southern Resident Killer Whales is still consistent with DFO Science advice; given the current state of knowledge and declining trend of this population in recent decades. However, it is important to note that their assessment is based only on Project-related activities, and does not consider the potential cumulative and/or additive effects of noise generated by Project-related vessels on top of existing shipping. Thus, sound exposure levels would likely be in excess of those estimated in their assessment, as would the proportion of time that whales would be exposed to potentially disturbing levels of shipping noise. Of the criteria used to determine significance of residual effects, their conclusion that reversibility would be immediate, i.e., within two days, appears unrealistic. Based on the Proponent's predicted two Project-related ship transits through the Marine RSA per day, amounting to exposures of potentially disturbing noise levels (>120 dB re: 1 µPa) for up to 8% of the day, such immediate reversibility may not occur.

The Proponent concludes that potential residual effects of Project-related vessel noise on Humpback Whales would not be significant. The rationale for this conclusion appears to be based mostly on the anticipated low numbers of individuals exposed relative to the population abundance of Humpback Whales in BC and the North Pacific generally. However, their assessment fails to take into consideration the strong long-term site fidelity exhibited by individual Humpback Whales to particular feeding areas (e.g., Rambeau 2008; Ford et al. 2009). The Marine RSA overlaps with a significant concentration area for Humpback Whales at the western entrance to Juan de Fuca Strait, which was recently identified as potential Critical Habitat (Nichol et al. 2009). Furthermore, more than 100 individual Humpback Whales have been photo-identified in Juan de Fuca Strait south and west of Victoria, and a substantial proportion of these have been observed to use these waters in multiple years (Malleson et al. 2014). Because of potentially high densities of individuals with strong site fidelity, Humpback Whales using the Marine RSA have the potential for repeated exposure to Project-related shipping noise at levels that could potentially cause behavioural disturbance. Thus, the residual effect on humpback whales, from underwater noise generated by Project-related vessel traffic, may be greater than the Proponent has identified, and should be taken into consideration in the determination of significant residual adverse effects.

Based on DFO's review, the residual effect of underwater noise from increased Project-related marine vessel traffic on Steller Sea Lions has been accurately characterized in the Proponent's

assessment, and their assessment supports their conclusion that potential residual effects would be negligible.

Ship Strike

As discussed in detail in DFO's sufficiency review of the Project Application (DFO 2015), the Proponent considered ship strike risk only in the context of "Accidents and Malfunctions" and not as a result of routine operations. As such, a detailed quantitative assessment was not undertaken of potential residual effects of ship strikes on marine mammals from Project-related vessel traffic. Although their qualitative conclusion that risk to Southern Resident Killer Whales and Steller Sea Lions from Project-related vessel collision may be reasonable (extremely low or negligible), this may not be the case for Humpback Whales. There is ample scientific evidence that Humpback Whales are regularly struck and injured or killed by large commercial vessels, including oil tankers (e.g., IWC 2014). Despite the rarity of documented ship strike events in BC waters and the Marine RSA in particular, such records are known to underestimate their true frequency of occurrence. Because of the appreciably higher density of Humpback Whales in Juan de Fuca Strait and its western entrance (within the Marine RSA) than was suggested by the Proponent, the risk to individuals of this species could be greater than portrayed in their assessment. Thus, it is likely that the Proponent's assessment of potential direct effects on Humpback Whales from Project-related vessel collision is inaccurate.

For this project, is it possible to measure the effect of underwater noise and mammal-vessel ship strikes from increased Project-related vessel traffic on marine mammal indicator species above the status quo (i.e., current noise conditions), and if so, how does this effect differ from current conditions?

Underwater Noise

A comprehensive assessment of the potential effects of increased Project-related vessel noise and the cumulative and additive effects of this increased noise in combination with existing vessel-related noise in the Marine RSA is possible but has not yet been undertaken. Such an assessment would require:

1. detailed characterization of existing ambient noise generated by marine traffic throughout the Marine RSA and expanded modelling of the noise propagation properties over the transit corridor; and
2. improved understanding of the effects of increased vessel noise on the behaviour and population dynamics of the marine mammal species of concern (primarily Southern Resident Killer Whales).

Noise characterization

As described above, an assessment of existing shipping traffic noise in the Marine RSA is possible, but was not undertaken by the Proponent. Sufficiently high-resolution AIS data for the region, including vessel type and speed, are available to quantify vessel activity throughout the year. From these data, estimated noise levels could be derived using nominal source sound pressure level data available for the various types of ships involved. These estimates would be preliminary, but could be improved by analysis of existing data on ambient noise in the Marine RSA that have been collected by DFO (DFO Cetacean Research Program; unpublished data), the VENUS project (Ocean Networks Canada) and Williams et al. (2013). Such an analysis is currently being conducted as part of the Marine Environmental Observation Prediction and Response Network (MEOPAR) funded project titled "Modeling Ship Movements: Application for Noise Exposure to the Marine Ecosystem", a collaboration among researchers with the University of Victoria, DFO and others. Similar efforts that are being promoted as part of Port

Metro Vancouver's Enhancing Cetacean Habitat and Observation (ECHO) Program, and through a new Whale Tracking Network project involving DFO, will add considerably to the collection of ambient acoustic data for the Marine RSA. With baseline data on existing noise levels in the Marine RSA, additional noise levels due to Project-related vessels could be modelled to determine cumulative and/or additive levels of exposure of acoustic disturbance on marine mammals.

Effects of Noise on Marine Mammals

Details on the effects of chronic industrial noise on marine mammals, including that emanating from shipping, are not well understood. Existing knowledge of the short-term responses of Killer Whales and Humpback Whales to anthropogenic noise is described in the Proponent's impact assessment. Field studies on Resident Killer Whales in BC and Washington State suggest that behavioural disturbance due to vessels and accompanying noise has the potential to disrupt life processes such as communication, echolocation and foraging. However, the long-term consequences of such disturbance in terms of its effects on population dynamics (e.g., mortality and birth rates) are not known. The Recovery Strategy for Resident Killer Whales (Fisheries and Oceans Canada 2011b) identifies several threats in addition to anthropogenic noise, such as bioaccumulating persistent organic pollutants (POPs) and food supply, and these may act synergistically. The poor survival and birth rates of Southern Resident Killer Whales over the past 20 years suggest that current habitat quality, including that of designated Critical Habitat within the Marine RSA, is insufficient to allow for recovery of this population. Although ambient noise from shipping is only one of several anthropogenic stressors, existing noise levels may already be having a significant effect on population survival. However, in the absence of information needed to quantify the impact of existing noise conditions in the Marine RSA on Southern Resident Killer Whales population dynamics, it is not possible to predict what further effects might be anticipated from future Project-related vessel traffic. Recent efforts to develop frameworks to quantify the cumulative effects of noise and other stressors on population dynamics of marine mammals (e.g., the Population Consequences of Acoustic Disturbance (PCAD) model, NRC 2005; Lawson and Lesage 2012 may provide a means of measuring such future impacts.

Ship strike

It is possible to estimate the current risk to marine mammal indicator species from ship strikes in the Marine RSA and the additional risk that could result from Project-related vessel traffic, but such estimates would likely have a high degree of uncertainty. As described previously, quantifying the spatial and temporal distribution of existing ship movements through the Marine RSA can be accomplished using archived AIS data that are readily available (e.g., Simard et al. 2014). However, high resolution spatial data on the densities of marine mammal indicator species are lacking, particularly for the Humpback Whale, which is the only species that is at significant risk of collision. Thus, an accurate quantitative assessment of risk to Humpback Whales from existing shipping traffic is not feasible at this time, nor is an estimate of the increased risk associated with Project-related vessels.

If measureable effects exist in (2) above, are there mitigation measures that may be implemented to reduce the residual effect on the marine mammals indicator species?

Underwater Noise

Underwater noise generated by commercial shipping vessels and their effects on marine mammals is of growing concern internationally. Recently, there have been increasing efforts to characterize in detail the noise spectrum and levels from modern shipping (e.g., McKenna et al.

2013), and to develop means of reducing the noise output of ships through propeller and ship design (e.g., RMC 2009, unpublished report[1]). There are a number of initiatives, both internationally and regionally, that focus on anthropogenic ocean noise and its mitigation, including noise caused by marine shipping. For example, the European Union (EU) has initiated a multinational collaborative project called SONIC (Suppression Of underwater Noise Induced by Cavitation) which aims to develop tools to investigate and mitigate the effects of underwater noise generated by shipping. Another EU-supported initiative is the AQUO (Achieve QUieter Oceans) project, a consortium of European government, industry and academic organizations with the objective of assessing and mitigating noise impacts of the maritime transportation on the marine environment. The final goal of this project is to provide policy makers with practical guidelines, acceptable to shipyards and ship owners, needed to mitigate underwater noise footprints due to shipping and to prevent negative consequences to marine life. In the US, the National Oceanic and Atmospheric Administration (NOAA) has recently developed an Ocean Noise Strategy, a 10-year program to develop management actions to reduce the acute, chronic, and cumulative effects of noise. To date, DFO has not endorsed nor implemented any particular shipping noise management program.

In Pacific Region, there are several initiatives underway to document underwater shipping noise and to develop means of mitigating this noise. World Wildlife Fund (WWF) Canada has recently convened a workshop "to discuss various methods for minimizing and mitigating underwater noise, and to develop tools for planners and regulators to draw from as they move forward in planning processes, reviewing environmental assessments, and recovery planning for species listed under the *Species at Risk Act* (SARA)". The workshop report (WWF-Canada 2013) describes the various approaches that are currently being developed in different jurisdictions to mitigate noise from shipping. Port Metro Vancouver (PMV) is also assessing potential options for noise mitigation through its ECHO program. One initiative is a pilot study that Transport Canada is planning that involves the use of All-Sea Whale Shark hull cleaning technology within PMV jurisdiction. The pilot will review what impact hull cleaning has on both fuel efficiency and underwater noise outputs. DFO has participated in working groups to identify data gaps and proposed studies to address the gaps, but a national ocean noise strategy does not currently exist.

In summary, there are potentially a variety of different methods by which increased exposure of marine mammals to noise by Project-related vessels in the Marine RSA could be mitigated.

Ship Strike

There has been considerable international effort in recent years to quantify the risk of ship strikes to various species of whales in different regions, and to develop methods of mitigation (e.g., Vanderlaan and Taggart 2007; Redfern et al. 2013, Silber et al. 2012; van der Hoop et al. 2013). Mitigation of ship strike risk to whales is achieved primarily through reduction in vessel speed (to 10 knots or less) and/or by altering shipping corridors to avoid concentrations of animals. Both methods have been proven effective in reducing ship strikes on endangered North Atlantic Right Whales. In 2007, the International Maritime Organization adopted the Roseway Basin "Area to Be Avoided" on the Scotian Shelf as a voluntary conservation initiative and this was implemented by Canada (Vanderlaan and Taggart 2009). This initiative led to a significant decrease in the risk of strikes to Right Whales. In 2008, NOAA issued mandatory time-area vessel speed restrictions along the US eastern seaboard, which also significantly reduced the risk of lethal strikes to Right Whales (Conn and Silber 2013). In 2013, the

[1] RMC (Renilson Marine Consulting Pty. Ltd.) 2009. Reducing Underwater Noise Pollution from Large Commercial Vessels. Unpubl. Report to International Fund for Animal Welfare.

Canadian Coast Guard, in collaboration with Parks Canada and other stakeholders, introduced voluntary seasonal speed restrictions for shipping vessels in the Saguenay-St. Lawrence Marine Park, and also recommended an area to be avoided for Blue Whales (Canadian Coast Guard 2013).

In summary, there are potential options for ship strike mitigation that could be applied in the Marine RSA to reduce the risk of mammal-vessel collisions. The Proponent has recognized that alterations in ship speed and routing can be effective mitigation measures to reduce ship strike risk, but has not proposed to adopt such measures (Trans Mountain Response to NEB IR No. 2, pg 254). The *Marine Mammal Regulations*, under the *Fisheries Act*, specifically prohibit the disturbance of whales and other marine mammals; however there are currently no regulatory or policy frameworks specific to mitigation of potential ship strike impacts on marine mammals within the Marine RSA.

Conclusions

The information provided by the Proponent in the Project Application, and in subsequent responses to information requests by DFO, was determined to have insufficiencies. As a result, DFO's ability to definitively conclude if the Proponent has accurately assessed direct effects of underwater noise or ship strikes from Project-related vessel traffic on marine mammals is reduced. Based on the information available, DFO's review of the Project Application and subsequent responses has yielded the following conclusions.

Underwater Noise

The Proponent's assessment likely does not accurately characterize the effects of underwater noise on certain marine mammal indicator species in the Marine RSA. Despite the use of a state-of-the-art noise model, only four sites were modelled along the 296 km shipping corridor, and these sites may not be representative of acoustic properties throughout all portions of the shipping corridor. In addition, model inputs on oceanographic conditions used in the assessment could be improved. Furthermore, the assessment only addressed the noise produced and propagated from Project-related ships, and did not consider the potential cumulative and/or additive effects of such noise in combination with noise produced by existing shipping activity. The Proponent's conclusion that there would be a significant residual effect from Project-related vessel noise on Southern Resident Killer Whales is plausible; but the potential impact of such an effect on the long-term population viability of the marine mammal indicator species within the Marine RSA is unknown.

It is likely that the Proponent has underestimated the potential residual effects of underwater noise on Humpback Whales in the Marine RSA. There are greater seasonal densities of Humpback Whales in the western portions of the Marine RSA than the Proponent has noted, and the strong site fidelity to specific feeding grounds for this species is likely to increase the exposure of individuals to potentially disturbing noise levels from increased Project-related vessel traffic.

There are a variety of initiatives underway, both locally and globally, to develop mitigation measures to reduce levels of underwater noise generated by commercial shipping. However, there are currently no specific measures that have been implemented or required within the Marine RSA for mitigation of underwater noise generated by vessels.

Ship Strike

The Proponent has not considered ship strike risk to marine mammals in the context of routine operations of Project-related marine vessels. As such, a detailed quantitative assessment of

potential residual effects of ship strikes on marine mammals from Project-related vessel traffic was not undertaken. Although the risk to Killer Whales and Steller Sea Lions from collisions with large ships is negligible, this may not be the case for Humpback Whales. Humpback Whales can be vulnerable to strikes from large ships including tankers, and there are higher seasonal densities of this species in the western portions of the Marine RSA than suggested by the Proponent. As a result, the Proponent's assessment of potential direct effects on Humpback Whales from collisions with Project-related vessels is likely an underestimate.

There are currently no specific ship-strike mitigation guidelines or measures that have been implemented in the area of the Marine RSA or in Pacific Canadian waters. The Proponent has recognized that alterations in ship speed and routing can be effective mitigation measures to reduce ship strike risk, but has not proposed to adopt such measures because it does not own or operate the shipping vessels, or possess the regulatory authority to require such alterations.

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