PORT of vancouver | Vancouver Fraser Port Authority

IR2020-3 Avoidance and mitigation measures for project operation and marine shipping incidental to the project

Background

In his letter of August 24, 2020 (CIAR Document #2067[1]), the minister of environment and climate change (the minister) requested additional information regarding avoidance and other mitigation measures related to underwater noise effects on and vessel strike risk to southern resident killer whales (SRKW) from the proposed Roberts Bank Terminal 2 (RBT2) Project operation and marine shipping incidental to the project.

To avoid or reduce effects to SRKW from project operation and marine shipping incidental to the project, the Vancouver Fraser Port Authority (the port authority) proposed the following mitigation measures during the public hearing (CIAR Document #2001[2]), which were considered by the review panel in its recommendation report:

- Monitor and adaptively manage underwater noise during project operation through a dedicated operation underwater noise follow-up program element (commitment #81, Table C13)
- Collaborate and communicate with regulatory authorities, Indigenous groups, and marine pilots regarding marine shipping and marine mammals, with the intent of reducing the potential interactions between SRKW and container vessels (commitment #3 of Appendix B and #56 of Appendix A)
- Participate in regional and/or multi-stakeholder initiatives that will inform effective management and recovery of SRKW (commitment #55 of Appendix A)

The port authority is collaborating with the Government of Canada, Indigenous groups, and others to address risks to SRKW, including potential acoustic and physical disturbance and vessel strikes. For example, the port authority launched the Enhancing Cetacean Habitat and Observation (ECHO) Program in 2014 to better understand and reduce the potential cumulative effects of shipping on at-risk whales throughout the southern coast of British Columbia, with a focus on SRKW. **Appendix IR2020-3-A** provides additional information on the ECHO Program initiatives and their effectiveness.

The long-term goal of the ECHO Program is to develop and implement initiatives that result in a reduction in threats to whales from commercial shipping activities. Through its role in the ECHO Program, the port authority has led the development and implementation of initiatives that achieved measurable noise reductions and reduced adverse effects on foraging time of SRKW. Vessel slowdowns in Haro Strait have been demonstrated to reduce vessel source levels and ambient noise levels during vessel transits, leading to reductions in predicted disturbance to SRKW (Joy et al. 2019; Burnham et al. 2021). For example, in 2020 the ECHO Program Haro Strait and Boundary Pass vessel slowdown reduced underwater broadband noise ranging from 2.5 to 2.8 dB (a 44% to 48% reduction in sound intensity) with an estimated reduction in lost foraging time ranging from 17% to 20% (VFPA 2021a). The port authority leads the management of the ECHO Program and works with a diverse range of partners and advisors, including Indigenous groups, government agencies (including Transport Canada and Fisheries and Oceans Canada (DFO)), the marine transportation industry, conservation and environmental groups, and scientists from Canada and the United States to advance and guide the direction of ECHO Program initiatives. The port authority-led ECHO Program has also collaboratively developed a range of educational

[1] CIAR Document #2067 From the Minister of Environment and Climate Change to the Vancouver Fraser Port Authority re: Information Request. https://iaac-aeic.gc.ca/050/documents/p80054/135827E.pdf
[2] CIAR Document #2001 From the Vancouver Fraser Port Authority to the Review Panel re: Updated Project Commitments (See Reference Documents #1738 and #1934). https://iaac-aeic.gc.ca/050/documents/p80054/130776E.pdf

resources targeted at raising mariners' awareness of navigating safely in the presence of marine mammals in B.C. waters, including SRKW, to help reduce the risk of physical and acoustic disturbance.

This response provides new and additional information to confirm the container vessel traffic projections associated with the project and provides projections beyond 2035. In response to feedback received from Indigenous groups and government agencies, an updated RBT2 container vessel call forecast study was completed, which includes the analysis of the most-realistic and alternative scenarios (**Appendix IR2020-3-B**). For the most-realistic scenario, the updated study projected that the number of container vessels calling at the Port of Vancouver in the future will be the same with or without RBT2. This is because once RBT2 is operational, the distribution of container vessel calls within the Port of Vancouver is expected to change as shipping lines respond to the additional container terminal capacity at RBT2. We expect shipping lines will respond to the increased demand for containerized cargo at the Port of Vancouver overall and container handling capacity by increasing the sizes of container vessels calling at the Port of Vancouver, rather than by increasing the number of vessels. The port authority anticipates that, on average, 208 to 260 container vessels will call the RBT2 terminal each year once it is fully operational, in approximately 2040.

To further support the minister's request and provide additional conservatism, the port authority conducted analyses to assess the potential effects on SRKW from project operation and marine shipping incidental to the project under less likely high-case container vessel traffic scenarios and evaluated future contingency mitigation options. The assessments, studies, and mitigation developed to support our response are based on the vessel traffic projections using the most-realistic and less likely high-case vessel scenarios (**Appendix IR2020-3-B**).

The port authority acknowledges the importance of SRKW and concerns regarding acoustic and physical disturbance as heard from Indigenous groups, the public, and stakeholders throughout planning of RBT2. Guided by consultation with Indigenous groups and engagement with government agencies, the port authority has identified additional mitigation measures since the review panel's report to further reduce impacts to SRKW from underwater noise and the risk of vessel strikes to SRKW from project operation and marine shipping incidental to the project beyond what the review panel considered. Many of these measures and commitments align with the recommendations made by the review panel. The port authority proposes that these additional mitigation measures be incorporated into the draft conditions for the project. These mitigation measures are discussed in more detail in subsequent sections of this response.

The following additional operational mitigation measures are discussed in this response:

- Delay container vessels from unberthing and departure, during daylight hours, when SRKW are present
- Evaluate the potential effectiveness of technologies to reduce underwater noise associated with tug activities (e.g., electric tugs) and implement once feasible for project operation
- Provide shore power connections for container vessels
- Contractually require the terminal operator to require RBT2-bound container vessels to participate in applicable initiatives of the ECHO Program (or equivalent)
- Continue to manage the ECHO Program and its initiatives and sign on to an additional five years of the *Species at Risk Act* (SARA) Section 11 Conservation Agreement to Support the Recovery of the SRKW, if other parties agree

The port authority also proposes developing and implementing a marine shipping follow-up program element[3] to verify predictions of container vessels calling at the Port of Vancouver with the project and associated potential acoustic effects on SRKW, in collaboration with Indigenous groups, Transport Canada, DFO, and other applicable federal authorities. The minister can be confident that the additional actions and measures available under the

[3] The marine shipping follow-up program element also includes verifying predictions of container vessels incidental to the project calling at the Port of Vancouver and unanticipated additional effects on current use by Indigenous groups in the marine shipping area in the event there is an exceedance of container vessel numbers and/or size classes that is attributable to the project.

follow-up program element would be implemented if an increase in sound exposures to SRKW from container vessels is higher than predicted under the most-realistic vessel traffic scenario. For this response, the port authority has also assessed potential contingency mitigation options that could be implemented if underwater noise from container vessels calling at the Port of Vancouver is higher than predicted under the most-realistic scenario. Marine shipping is within the jurisdiction of Transport Canada, Pacific Pilotage Authority, and the Canadian Coast Guard and so modified or additional mitigation measures as part of the marine shipping follow-up program element would be implemented in collaboration with applicable federal authorities.

The effectiveness of the proposed operational and marine shipping mitigation was assessed and quantified using models developed for the environmental impact statement (EIS) and also other predictive models specifically developed to support the response to the minister's request. These models include the updated operation noise model (**Appendix IR2020-3-C**), the new acoustic effects model (**Appendix IR2020-3-D**), the new marine shipping transit exposure model (**Appendix IR2020-3-E**), and the new SRKW acoustic footprint exposure model (**Appendix IR2020-3-F**).

Indigenous groups have expressed high interest in measures to mitigate effects to SRKW and in understanding their effectiveness. As part of this ongoing work, the port authority has consulted with Indigenous groups on the proposed approach and the work undertaken to support the response to the minister's request. Their input is reflected in the response.

The additional mitigation measures identified by the port authority since the public hearing will further reduce the potential for acoustic and physical disturbance effects to SRKW from project operation and marine shipping incidental to the project, and are beyond what was considered by the review panel. The port authority is confident that with the measures in place, including monitoring through the follow-up program element, potential adverse effects of project operation and marine shipping incidental to the project will be mitigated and will not jeopardize the survival or recovery of SRKW.

Response

1. Container vessel projections

Minister's request: Confirm the projections for container vessel traffic associated with the Project. The information shall include numbers of ship calls, capacity of container vessels calling on the Project. Projections beyond 2035 shall be included.

This response to the minister's request is based on updated and extended projections of container vessel numbers and sizes expected to call the RBT2 terminal and at the Port of Vancouver overall. **Appendix IR2020-3-B** (Updated RBT2 Container Vessel Call Forecast Study by Mercator International (2021)) includes additional information on the approach used to forecast container vessel calls (i.e., number of container vessels) and associated capacities, forecast outcomes and supporting rationale, and comparisons to the prior (2018) container vessel call forecast study (CIAR Document #1362[4]). We analysed a "most-realistic scenario" as well as six alternative scenarios to obtain a range in the vessel traffic projections. The alternative vessel call scenarios were analyzed to estimate the potential range in the number of container vessels calling at the Port of Vancouver, and are considered less likely to occur than the most-realistic scenario. The updated study provides projections from 2025 to 2045 in five-year increments for the most-realistic scenario and the potential range in vessel traffic projections for the alternative scenarios for 2045. The project is anticipated to be operational by 2035 (initial phase of operation), with throughput capacity ramping up and reaching terminal operating capacity by 2040.

The results of the most-realistic scenario indicate that over the forecast period of 2035 to 2045 the average number of container vessels projected to call at the project each week would range from three to four; and that four to five container vessels could call the project each week in the high-case scenario. In the EIS we assumed

[4] CIAR Document #1362 From the Vancouver Fraser Port Authority to the Review Panel re: 2018 Container Vessel Call Forecast Study and Ship Traffic Information Sheet. https://iaac-aeic.gc.ca/050/documents/p80054/126252E.pdf

that, on average, five container vessels would call RBT2 weekly based on 2010 container vessel data (including container shipping schedules) and projected container shipping services and vessel size characteristics. For this response, the port authority used the project-related vessel projections to assess the potential effects from project operations (i.e., from vessel arrival, berthing, unloading and loading containers, unberthing, and departure) because these effects occur specifically in the vicinity of the marine terminal. To assess the potential effects of marine shipping, we used the container vessel traffic projections for the Port of Vancouver overall. This is more useful because it represents forecasted container vessel traffic through the marine shipping area as a whole. The results of the most-realistic scenario indicate that, overall, the number of container vessels forecasted to call at Port of Vancouver container terminals would be the same with or without RBT2 (**Table IR2020-3-1**; **Appendix IR2020-3-B**), and would be on average 16 or 17 weekly container vessel calls to the Port of Vancouver in the future. The less likely alternative scenarios indicate that container vessel calls in 2045 could range from 16 to 20 calls per week on average (i.e., approximately 52 fewer to 156 additional vessel calls per year) depending on the alternative scenario (**Appendix IR2020-3-B**).

Due to the industry trend of increasing container vessel sizes (**Appendix IR2020-3-B**), Fraser Surrey Docks is expected to lose its weekly foreign container vessel services when container vessel sizes exceed the limits of the Fraser River (i.e., by 2035 with or without RBT2; **Table IR2020-3-1**). Existing Port of Vancouver container terminals will be operating close to their design capacity (100% capacity) by the time RBT2 would be operational (**Appendix IR2020-3-B**). From an operating efficiency standpoint, a utilization rate of around 85% of terminal design capacity represents maximum efficient (or effective) use of a container terminal.[5] If RBT2 proceeds, there would be a gradual redistribution of container vessels that would otherwise call at other existing container terminals in the Port of Vancouver to RBT2, as shown in **Table IR2020-3-1**. Based on past container terminal capacity increases in the Port of Vancouver and elsewhere, we anticipate that as RBT2 ramps up operation (capacity expansion in two phases), container vessels will gradually redistribute in the Port of Vancouver when shipping lines renew contractual arrangements with terminal operators. Since cargo demand is anticipated to continue to increase, even with a redistribution of container vessels to RBT2, existing Port of Vancouver terminals are expected to continue to be highly utilized. An example of container vessel redistribution that could occur within the Port of Vancouver (and the projected size composition of vessels calling at RBT2) is as follows:

- By 2035 (initial phase of RBT2 operation), two weekly calls would move from Burrard Inlet terminals to RBT2 and one call from Deltaport would move to RBT2. To meet forecasted cargo demand in 2035, one Large Post Panamax vessel (with capacity ranging from 9,000 to 12,999 twenty-foot equivalent units (TEUs)) and two Neo-Panamax vessels (each with capacity of 13,000 to 14,999 TEUs) are projected to call at RBT2.
- An additional vessel per week is expected to call at RBT2 instead of Deltaport by 2040, once RBT2 has reached terminal operating capacity. Half of the container vessels calling at RBT2 are expected to be Mega-Max class vessels (each with capacity greater than 18,000 TEUs).
- By 2040 and 2045, since all services with Mega-Max class vessels are expected to call at RBT2 and Deltaport,[6] all services with Small Post Panamax vessels (capacity less than 9,000 TEUs) are predicted to call at the Burrard Inlet terminals, as are the majority of services with Large Post Panamax vessels.

The port authority confirms that, for the most-realistic scenario, the updated projections of container vessel calls and vessel size (capacity) are similar to those previously presented by the port authority in 2018 (CIAR Document #1362). For example, at Roberts Bank when RBT2 is fully operational, the projected number of weekly container vessels calling at RBT2 and Deltaport stated in the earlier (2018) forecast study was nine, and based on the updated forecast study the projected number of weekly container vessel calls in 2035 and 2040 to Roberts Bank terminals is eight, and seven weekly calls in 2045.[7] Along with fewer projected calls at Roberts Bank terminals (in

[5] Ocean Shipping Consultants 2016 Container Traffic Forecast Study; Appendix IR1-03-A in CIAR Document #934.
[6] Vessels larger than 14,500 TEUs (Neo-Panamax class) must call at Roberts Bank due to height limitations of the Lions Gate/First Narrows bridge. Refer to **Appendix IR2020-3-B** for more information.
[7] Predicted reduction is based on small changes in the distribution of container vessel sizes—refer to Section 4 in **Appendix IR2020-3-B** for more information.

the updated forecast study), the proportion of larger vessels[8] calling at Roberts Bank container terminals is predicted to increase relative to predictions from the earlier forecast study. Overall, the number of larger container vessels calling the Port of Vancouver is projected to increase in the future; however, more container vessels in the largest size classes would call at the Port of Vancouver with RBT2 than without RBT2 (**Figure IR2020-3-1**). For more comparative information on projected container vessel calls at the Port of Vancouver, refer to Section 4 in **Appendix IR2020-3-B**.

The updated projections are similar to the approximately 15 to 17 weekly container vessels calling at the Port of Vancouver in the past two decades. Further information on historic data at the Port of Vancouver is presented in **Section 2**.

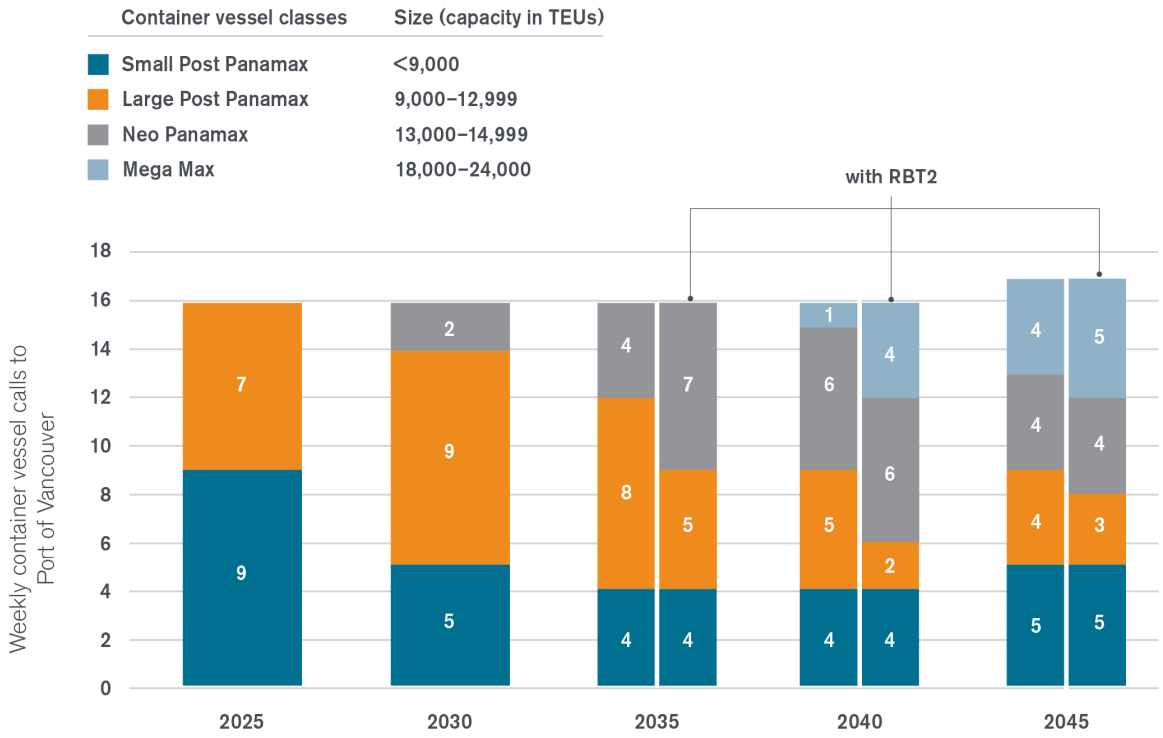
Table IR2020-3-1: Projected weekly calls to Port of Vancouver container terminals for forecast period 2025 to 2045 for the most-realistic scenario

Precinct	Terminal	Vessel class	2025	2030	2035		2040		2045	
					Without RBT2	With RBT2	Without RBT2	With RBT2	Without RBT2	With RBT2
Burrard Inlet	Vanterm	SPPX	3	2	2	2	2	2	1	1
		LPPX	1	1	1	1	1	1	1	1
		NPX		1	1	1	1	1	2	2
	Centerm	SPPX	3	1	2	2	2	2	4	4
		LPPX	1	3	2	1	3	1	2	1
		NPX			2	1	1	1	1	1
Fraser River	Fraser Surrey Docks	SPPX	2	2						
Roberts Bank	Deltaport	SPPX	1							
		LPPX	5	5	5	2	1		1	
		NPX		1	1	3	4	2	1	
		MMX					1	2	4	3
	Roberts Bank Terminal 2	LPPX				1				1
		NPX				2		2		1
		MMX						2		2
Port of Vancouver	**Weekly total**		**16**	**16**	**16**	**16**	**16**	**16**	**17**	**17**

Notes: SPPX = Small Post Panamax (capacity <9,000 TEUs); LPPX = Large Post Panamax (capacity 9,000 – 12,999 TEUs); NPX = Neo Panamax (capacity 13,000 – 14,999 TEUs); MMX = Mega-Max (capacity 18,000 – 24,000 TEUs).

[8] Larger vessels include the Mega-Max vessel class with capacity greater than 18,000 TEUs.

Figure IR2020-3-1: Projected container vessel sizes calling weekly at Port of Vancouver container terminals for forecast period 2025 to 2045 for the most-realistic scenario



2. Terminal capacity

Minister's request: Explain whether the capacity of the terminal could be controlled in order to limit vessel transits associated with the Project to reduce or avoid potential effects to Southern Resident Killer Whales.

Limiting the capacity of the RBT2 terminal to less than the design capacity of 2.4 million TEUs per annum will not alter container vessel transits to the Port of Vancouver and, accordingly, will not reduce or avoid potential effects to SRKW. RBT2 terminal capacity will dictate the number of containers that could be handled at the terminal, but RBT2 terminal capacity would not affect the number of container vessels calling at the Port of Vancouver. Regardless of RBT2 terminal capacity, or even whether or not RBT2 proceeds, under the most-realistic vessel traffic scenario container vessels will continue to call at multiple ports in the region, and the number of vessels calling the Port of Vancouver are projected to remain the same with or without the RBT2 project (**Figure IR2020-3-1**).

If RBT2 terminal capacity was limited, shipping companies are likely to divert cargo from RBT2 to other Port of Vancouver container terminals or other ports, including the Port of Prince Rupert and U.S. ports (Section 4 in **Appendix IR2020-3-B**). Limiting terminal capacity is unnecessary in view of the measures that would be able to mitigate potential effects to SRKW (**Section 6.4**).

The container vessel call projections for each five-year increment summarized in **Table IR2020-3-1** and **Figure IR2020-3-1** represent the projected weekly number of calls (and corresponding vessel sizes) at the Port of Vancouver for the most-realistic scenario based on the current container shipping industry characteristics and expected trends. The terminal capacity of RBT2 would not affect or limit the number of container vessel transits (or vessel calls) associated with the project or the Port of Vancouver based on these characteristics and trends. Container shipping lines often form alliances, and operate vessel services to the Pacific Northwest region with scheduled calls, usually weekly, at multiple ports (i.e., Vancouver, Puget Sound, Prince Rupert) due to the importance of serving each of these ports within the region and the relatively low incremental cost associated with

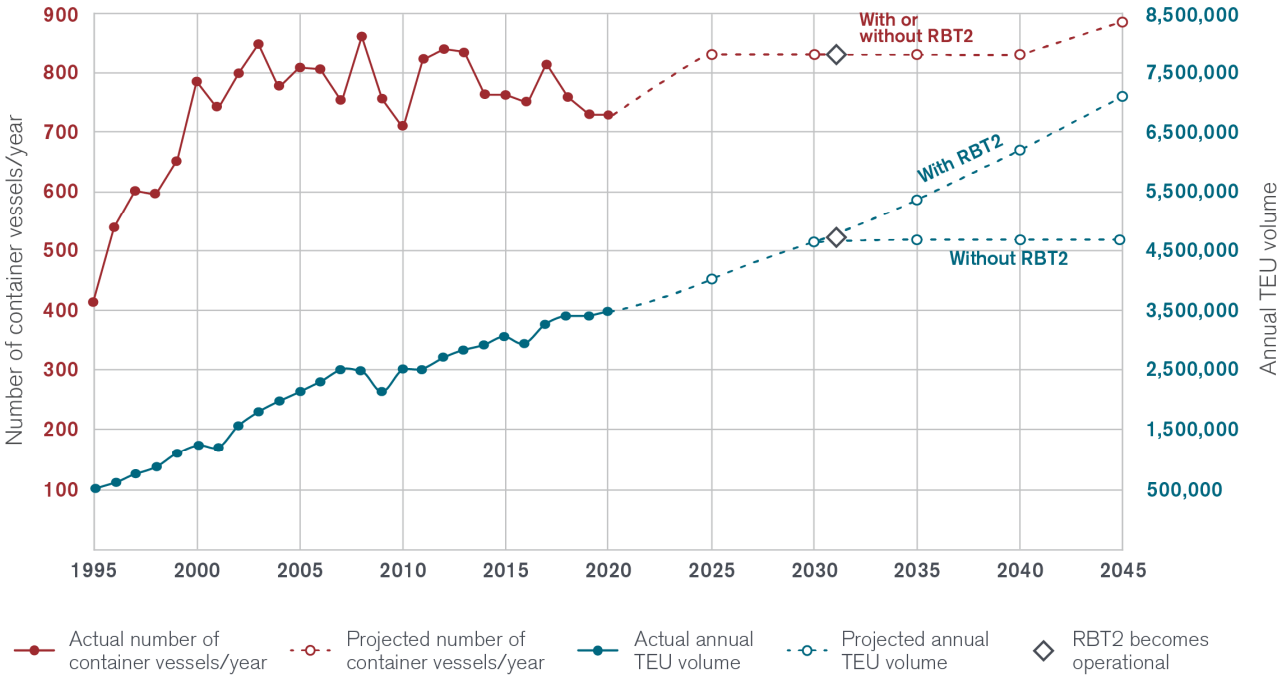
multiple port calls. The alliances structure routes and schedules in ways that make the most sense to them and their customers, based on strategic, commercial, and volume drivers. Ultimately, their goal is to maximize the efficient use of their vessel assets.

The preferred method for container shipping lines to meet either decreased or increased cargo demand is to adjust vessel sizes, rather than adjust the number of vessel services (i.e., change the number of vessels; Sections 2 to 4 in **Appendix IR2020-3-B**). This preference is illustrated for the Port of Vancouver in **Figure IR2020-3-2**, which presents historic (actual) annual container vessel calls and cargo volumes from 1995 to 2020, as well as the updated five-year increment container vessel calls and cargo volumes forecasts to 2045. The number of container vessels calling at the Port of Vancouver normally varies from year to year depending on a variety of global and local factors that may be irrespective of Port of Vancouver operations or the proposed RBT2. Regardless, on average, the number of container vessels calling the Port of Vancouver annually is relatively consistent. Annual variation is expected based on historic container vessel traffic calls, but an upward trend in vessel calls with increasing cargo volume (alongside container terminal capacity expansions) has not been observed. Cargo demand has been and can be met at the Port of Vancouver by shipping lines assigning the largest container vessels that can be effectively utilized in each vessel deployment, not by the deployment of additional vessels (Section 4 in **Appendix IR2020-3-B**). It is reasonable to expect these patterns from shipping lines to continue in the future.

Imposing a limit on the capacity of RBT2 less than the 2.4 million TEU per annum design capacity is not only likely to be ineffective as mitigation, but it can also have harmful, unintended impacts. In the end, it would amount to economic rather than environmental regulation. The port authority's mandate is to provide the capacity required to meet Canada's trade objectives, and the Port of Vancouver handles mostly Canadian exports and imports moving to or from Asia. The lack of sufficient container terminal capacity in the Port of Vancouver, should RBT2 terminal capacity be limited (or in the absence of RBT2), would likely have a harmful economic effect, as once west coast Canadian ports reach capacity, containers would be rerouted through U.S. ports. The lack of capacity, and eventual rerouting to U.S. ports, would increase costs to consumers, delay the movement of cargo, affect access to foreign markets that is critical to small and medium-sized Canadian businesses, and adversely affect the broader economic interests of Canada served by Canadian ports, without an associated reduction in environmental impact or the number of vessel transits to the Port of Vancouver. The future of Canada's economic prosperity depends on being able to get goods and resources to and from other markets efficiently and reliably.

The avoidance and reduction of potential acoustic and physical disturbance to SRKW from the project can be achieved through other measures proposed by the port authority. As described in **Section 6**, the port authority plans to further mitigate potential effects to SRKW from project operation and marine shipping incidental to the project with a number of newly identified mitigation measures (**Appendix IR2020-3-G**), which we have the authority to implement, as discussed in **Section 7**.

Figure IR2020-3-2 Annual container vessel calls and cargo at the Port of Vancouver (1995 to 2020) and projected container vessel calls and cargo for the most-realistic forecast scenario (2025 to 2045)



3. Sound exposure levels

Minister's request: Update estimates of sound exposure levels for Southern Resident Killer Whales from Project operations and marine shipping associated with the Project based on analysis of ship source level noise measurements and predicted composition of older and newer vessels calling to the Project over its operational period and especially during the initial phase of operation when full transition to newer vessels has not been achieved.

The port authority provides its response to this request in two parts: the age composition of container vessels is presented first, followed by the updated sound exposure levels.

3.1. Composition of older and newer container vessels calling at the project

The age composition of vessels calling at the project is not expected to change from 2025 to 2045, based on the assessment of the global container vessel fleet, as well as container vessels that currently call at the Port of Vancouver. The current average age of container vessels in the global fleet is about 11.9 years, and 11.6 years for container vessels that currently call at the Port of Vancouver from the dominant (Asia – Pacific Northwest) trade lane.

The average age of container vessels calling at the Port of Vancouver is expected to continue to be about 11 to 12 years over the forecast period, based on predicted fleet renewal[9] patterns continuing and greater reliance on Mega-Max class vessels as the fleet is renewed (as shown in **Figure IR2020-3-1** for the Port of Vancouver). For more information on the progressive reduction in the number of vessels in the fleet from a given construction

[9] Fleet renewal refers to aging container vessels being withdrawn from service and new vessels (across the range of sizes) being introduced to the fleet to meet the requirements across worldwide trade lanes. Per **Appendix IR2020-3-B** (Section 5), the expected life of a container ship is less than 30 years, with approximately 70% of container vessels being withdrawn from service by the time they are 25 years old.

cohort year and the pace at which aging vessels are withdrawn from service, refer to Section 5 in **Appendix IR2020-3-B**.

Container vessel age has not been identified as a key factor influencing underwater noise emissions (MacGillivray et al. 2020). Nevertheless, the Government of Canada, through the Quiet Vessel Initiative, is looking at ways to protect the marine environment and foster the development of new technology, quiet vessel designs, and operational practices to reduce underwater vessel noise. In addition, the International Maritime Organization has adopted guidelines on reducing underwater noise from commercial shipping.[10]

The average age of vessels is anticipated to stay the same in the future because vessels within the fleet are renewed continuously; however, this means that in the future, vessels will be newer compared to those calling the Port of Vancouver today. As the container vessel fleet calling at the Port of Vancouver is renewed and as quieter vessel designs and operational practices are adopted, underwater noise emissions are expected to decrease in the future. However, potential lower noise emissions from future vessels were not assumed in the analyses completed to support this response and described below. This makes the updated noise emission predictions used in the assessment more conservative.

3.2. Sound exposure levels

To respond to this request, the Impact Assessment Agency of Canada (IAAC) clarified that the port authority should use equivalent continuous sound level (L_{eq}) to assess potential sound exposure levels for SRKW from project operation and marine shipping incidental to the project in the new acoustic modelling studies (**Appendix IR2020-3-C**, **Appendix IR2020-3-E**). This metric reflects the long-term, time-averaged noise level received at a given location from passing container vessels over a one-year period and is directly related to the total sound exposure level (SEL) over the same period. These sound exposure estimates are representative of continuous sound levels near the proposed terminal and from container vessels transiting the marine shipping area. The estimates provide a measure of the quality of the acoustic environment for those times when SRKW are present and allow comparisons to be made between different future conditions to assess potential changes in the acoustic environment with the project.

The new acoustic modelling studies estimated the sound exposure levels (in terms of L_{eq}) for the most-realistic scenario (the prediction that the number of container vessels that call the Port of Vancouver will be the same with or without RBT2, with 16 to 17 container vessel calls per week on average calling at the Port of Vancouver). We also estimated sound exposure levels for the high-case vessel scenarios. As described in **Section 1**, we evaluated high-case vessel traffic scenarios that could result in container vessel traffic ranging from 18 to 20 per week on average in 2045 at the Port of Vancouver (16 to 19 calls for 2040). For the marine shipping area, depending on the alternative scenario, this corresponds to one, two, or three additional container vessel calls weekly (52, 104, or 156 calls annually) in any of the forecast years. If RBT2 is operational, it is expected that one of those additional weekly vessel calls would be at RBT2 (52 vessel calls annually).

L_{eq} was estimated corresponding to when RBT2 would be operational (2035, 2040, and 2045) using source level measurements for the different container vessel classes predicted and currently calling at the Port of Vancouver. IAAC also clarified that the port authority should take a conservative approach to estimate the underwater noise source level of the largest vessel class, Mega-Max, which is not yet calling at the Port of Vancouver. A source level for the Mega-Max vessel class was estimated by extrapolating from sound measurements of other vessel class trends (based on length, draft, and speed) reported by the ECHO Program's recently published vessel noise correlations study (MacGillivray et al. 2020), resulting in the use of a precautionary source level for Mega-Max vessels that is louder than container vessels currently calling the Port of Vancouver (see **Appendix IR2020-3-C** for the detailed methods).

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[10] International Maritime Organization (2014), Guidelines for the Reduction of Underwater Noise from Commercial Shipping to Address Impacts on Marine Life. https://wwwcdn.imo.org/localresources/en/MediaCentre/HotTopics/Documents/833%20Guidance%20on%20reducing%20underwater%20noise%20from%20commercial%20shipping,.pdf

As described in **Section 1**, based on the most-realistic scenario, the number of container vessels calling at the Port of Vancouver is predicted to be the same with or without RBT2 (**Figure IR2020-3-1**). In addition, the number of larger container vessels calling at the Port of Vancouver is projected to increase in the future regardless of RBT2, while the proportion of container vessels in the largest size classes would increase with RBT2. Container vessel size influences the amount of underwater noise generated (i.e., source level), with larger vessels currently calling at the Port of Vancouver typically being louder than smaller vessels (MacGillivray et al. 2020). Hence, changes in vessel size class composition could lead to changes in sound exposure levels for SRKW. Vessel speed also influences underwater noise, with slower transiting speeds resulting in less noise. As demonstrated by evidence presented during the public hearing, newer, larger container vessels such as Mega-Max generally have similar engine size as Neo-Panamax vessel, and smaller engines are associated with slower maximum design speeds.[11] Therefore, as discussed at the public hearing, if a larger vessel having lower maximum design speed is transiting at a slow speed, underwater noise will be lower than expected based on their size. IAAC clarified that a more conservative approach should be adopted for the new acoustic studies (**Appendix IR2020-3-C, Appendix IR2020-3-D, Appendix IR2020-3-E, Appendix IR2020-3-F**). The port authority therefore conservatively assumed that the larger Mega-Max vessels would transit at similar speeds through the marine shipping area as other container vessel classes currently calling at the Port of Vancouver and that they would be louder. Further, for the high-case vessel scenarios, we conservatively assumed that any additional container vessels would be the loudest (i.e., Mega-Max vessels).

3.2.1. Project operation

Most of the underwater noise that will be generated during the operation of RBT2 will be from container vessel arrival, berthing, unberthing, and departure. As noted by Indigenous groups, some underwater noise from on-board machinery will also be generated while vessels are at berth unloading and loading containers. To assess the potential effects of underwater noise on SRKW for this response, the port authority expanded its assessment of activities during project operation, compared to the EIS, to include underwater noise from container vessel arrival, berthing, unberthing, departure, and vessels at berth. For container vessel arrivals, three tugs with capacity to berth and unberth container vessels were assumed to travel from the tug basin to meet the container vessel that has exited from the inbound shipping lane to approach the terminal.[12] The container vessel and tugs would then transit together towards the terminal, the tugs would berth the container vessel by manoeuvring it into place, and then the tugs would return to the tug basin. While at berth, container vessels would have their engine running to power on-board machinery and equipment required during container loading and unloading.[13] Time at berth would vary based on vessel class and cargo load (i.e., time required to handle the containers). For container vessel departures, the three vessel-assist tugs (i.e., tugs that assist with berthing and unberthing) would transit from the tug basin to the container vessel at the terminal, unberth the vessel from the terminal, accompany it to a point where the container vessel is able to transit independently to the outbound shipping lane, and then return to the tug basin.

The updated estimates are presented by two metrics: L_{eq} and lost foraging time for SRKW. The L_{eq} estimates reflect noise emissions from terminal operation in 2035, 2040, and 2045 for the most-realistic (on average three to four vessels at RBT2 per week) and high-case (on average four to five vessels per week) vessel scenarios (**Table**

[11] CIAR Document #1900 From the Vancouver Fraser Port Authority to the Review Panel VFPA response to Undertaking #36: Vessel Class Descriptions. https://iaac-aeic.gc.ca/050/documents/p80054/130260E.pdf
[12] Currently, container vessels calling at Deltaport terminal at Roberts Bank up to 14,999 TEU (i.e., Neo Panamax) require two berthing tugs under most circumstances. Only the Mega-Max container vessels are anticipated to require three vessel-assist tugs (i.e., tugs that assist with berthing and unberthing). A line tug may also assist berthing and unberthing all container vessels. Underwater noise contributions from these vessels are considered through the conservative assumption that all container vessels will require three berthing tugs.
[13] This response does not consider any vessel using shore power, which the port authority proposes to facilitate by providing shore power connections that allows vessels not to rely on onboard engines to power machinery and equipment required while at berth. This measure would reduce the project's contribution to underwater noise as discussed in **Section 6**.

IR2020-3-2). We adopted a conservative approach to assess the effects from underwater noise and assumed that the additional vessel calling at RBT2 each week in the high-case scenario would be a Mega-Max vessel.

Table IR2020-3-2: Projected weekly and annual container vessel calls for RBT2 terminal operation based on the most-realistic and high-case vessel scenarios in 2035, 2040, and 2045

Scenario	Description	2035	2040	2045
Most-realistic	Projected weekly calls at RBT2	3	4	4
	Projected annual calls at RBT2	156	208	208
High-case	Projected weekly calls at RBT2 (an additional one container vessel)	4	5	5
	Projected annual calls at RBT2 (an additional 52 container vessels)	208	260	260

The change in sound exposure level is calculated relative to existing noise levels at Roberts Bank in 2015, set as the background condition since the EIS and presented to the review panel in 2018.[14] The L_{eq} estimate is independent of other potential future underwater noise changes at Roberts Bank.[15] Existing background noise levels near the proposed terminal are already elevated due to existing shipping traffic and marine terminals at Roberts Bank (such as Westshore and Deltaport) as noted by Indigenous groups, compared to levels in areas where there is little underwater noise from anthropogenic activities. Underwater noise from RBT2 terminal operations will add to existing underwater noise near the terminal and increase these background levels. Thus, underwater noise levels in the vicinity of the terminal will be higher with the project than without. This approach for calculating sound exposure level does not reflect expected increases in future background (i.e., non-project related) noise due to changes in non-RBT2 vessel traffic, including both changes in recreational and commercial vessel traffic. If the future background noise were to increase and be taken into account, the project's relative contribution to future underwater noise levels would be lower.

As concluded in the EIS, with the project, sound exposure levels are predicted to increase locally at Roberts Bank near the proposed terminal as container vessels are redistributed from other terminals to call at RBT2 (**Appendix IR2020-3-C**)**.** In 2018, underwater noise modelling representing project operation (without considering vessels at berth) was updated[14] and discussed at the public hearing.[16] The 2018 modelling predicted increases in annual time-averaged sound level ($L_{eq\text{-}1yr}$) at Roberts Bank with RBT2 relative to background condition (i.e., 121.7 dB in 2015) to be 2.8 dB in 2030, based on 260 Large Post-Panamax annual container vessel calls at RBT2 at a distance of approximately 300 m from the berth face.

To respond to this request, annual time-averaged sound levels were estimated for the most-realistic (on average 3 to 4 vessels calling the terminal per week or ~156 to 208 per year) and high-case vessel scenario (1 additional vessel per week or 52 additional container vessels per year; ~208 to 260 per year) for 2035, 2040, and 2045 (**Appendix IR2020-3-C**). We estimated annual time-averaged sound levels for four locations at increasing distances from the terminal (0.3 km, 0.75 km, 1.5 km, and 3 km) to evaluate differences in the acoustic environment at locations within the SRKW transit corridor based on SRKW sightings data (**Appendix IR2020-3-D**). The 1.5 km distance corresponds to the distance where most SRKW have been sighted relative to the

[14] Existing conditions reflect underwater noise conditions in 2015 as presented in CIAR Document #1363 (From the Vancouver Fraser Port Authority to the Review Panel re: RBT2 Project Operational Scenario Update https://iaac-aeic.gc.ca/050/documents/p80054/126254E.pdf)
[15] The EIS and submissions presented at the public hearing assessed both project contribution relative to existing conditions and relative to expected future conditions, including future vessel projections from other projects.
[16] CIAR Document #1800 From the Vancouver Fraser Port Authority to the Review Panel re: Undertaking #20 – Underwater Noise Documents. https://iaac-aeic.gc.ca/050/documents/p80054/129951E.pdf

proposed terminal location. The results for each scenario are provided below and do not include proposed mitigation measures.

a. Most-realistic vessel scenario

Without mitigation, the annual time-averaged sound level ($L_{eq\text{-}1yr}$) near the terminal berth face (~0.3 km) at Roberts Bank is predicted to increase relative to background noise levels (i.e., 121.7 dB in 2015) by 3.5 dB in 2035, 4.7 dB in 2040, and 4.6 dB in 2045, representing 156 annual container vessel calls at RBT2 in 2035 and 208 in 2040 and 2045 (**Table IR2020-3-3**). Further away from the terminal, where SRKW predominantly transit Roberts Bank, sound exposure levels would be lower because the noise from vessels at berth dissipates with increasing distance (sound levels from vessels at berth with the potential to cause behavioural disturbance to SRKW extend to approximately 500 m in summer and approximately 700 m in winter perpendicular to the berth face). At 1.5 km, the increase in $L_{eq\text{-}1yr}$ relative to background noise levels would range from 0.5 to 0.7 dB, while levels at a distance of 3 km from the terminal would range from 0.3 to 0.4 dB for all three projection years (**Table IR2020-3-3**).

These sound exposure level estimates consider a longer arrival through departure process (~1.5 times longer) than modelled for the EIS[17] and underwater noise from container vessels while loading and unloading containers at berth (**Appendix IR2020-3-C**, **Appendix IR2020-3-D**). The modelled sound exposure levels for 2040 and 2045 varied little (0.1 dB) with the difference in container vessel size classes predicted to call at RBT2. This small difference is because sound exposure levels are dominated by underwater noise generated from the vessel-assist tugs during berthing and unberthing, which were assumed to be the same regardless of the difference in predicted container vessel size.

To put these underwater noise increases in context of potential acoustic effects on SRKW from project operation, an acoustic effects simulation model of the overlap between operational vessel noise footprints and SRKW transits was used to estimate potential lost foraging time based on the most-realistic vessel scenario (on average 3 to 4 vessels calling the terminal per week or ~156 to 208 per year) (**Appendix IR2020-3-D**). Vessel activities associated with project operation were predicted to result in on average 2.0 hours (95% confidence interval: 0–10.1 hours) of lost foraging time per SRKW per year due to behavioural response, without the proposed mitigation measures, which is similar to what was predicted in the EIS (**Appendix IR2020-3-D**).

b. High-case vessel scenario (+52 container vessels annually at RBT2)

When considering the high-case vessel scenario (4 to 5 vessels calling the terminal per week or ~208 to 260 per year), $L_{eq\text{-}1yr}$ near the terminal berth face (~0.3 km) at Roberts Bank is predicted to increase relative to background noise levels by up to 5.2 dB (re 1 uPa) in 2040 (the year with the largest predicted effects). The increase in $L_{eq\text{-}1yr}$ for the high-case scenario is 0.5 dB more than the most-realistic scenario. At 1.5 km, $L_{eq\text{-}1yr}$ relative to background noise levels would be 0.8 dB, and levels at a distance of 3 km from the terminal would be 0.5 dB for 2040 (**Table IR2020-3-3**).

[17] We included additional stages of operation for the updated underwater noise modelling study. We conservatively included the time in the shipping lane when container vessels start slowing down to arrive and turn towards RBT2. We also included the entire time vessel-assist tugs and container vessels are travelling together and separately during departure, including time outside the port's jurisdiction. In comparison, the studies for the EIS considered the duration of arrival and departure activities within the jurisdiction of the port authority.

Table IR2020-3-3: Annual time-averaged underwater sound levels ($L_{eq\text{-}1yr}$, unweighted, broadband) at various distances from the berth face during project operation and increases (dB) above 2015 background conditions based on the most-realistic and high-case vessel scenarios in 2035, 2040, and 2045

Scenario	Description	Annual time-averaged sound levels ($L_{eq\text{-}1yr}$)															
		2015				2035				2040				2045			
		0.3 km	0.75 km	1.5 km	3 km	0.3 km	0.75 km	1.5 km	3 km	0.3 km	0.75 km	1.5 km	3 km	0.3 km	0.75 km	1.5 km	3 km
Most-realistic	Estimated sound level with RBT2	121.7				125.2	123.5	122.2	122.0	126.4	124.1	122.4	122.1	126.3	124.1	122.4	122.1
	Increase above 2015 background	0.0				3.5	1.8	0.5	0.3	4.7	2.4	0.7	0.4	4.6	2.4	0.7	0.4
	Projected weekly calls at RBT2	0				3				4				4			
	Projected annual calls at RBT2	0				156				208				208			
High-case	Estimated sound level with RBT2	121.7				125.9	123.7	122.3	122.0	126.9	124.2	122.5	122.2	126.8	124.2	122.5	122.2
	Increase above 2015 background	0.0				4.2	2.0	0.6	0.3	5.2	2.5	0.8	0.5	5.1	2.5	0.8	0.5
	Projected weekly calls at RBT2	0				4				5				5			
	Projected annual calls at RBT2	0				208				260				260			

Potential lost foraging time per SRKW due to behavioural response for all projection years evaluated was estimated to be on average 3.0 hours per year (95% confidence interval: 0–11.3 hours). The average predicted lost foraging time was on average one hour per SRKW per year higher for the high-case scenario compared to the most-realistic vessel scenario, which is attributable to one more Mega-Max vessel calling RBT2 weekly. These estimates are without mitigation.

These estimates do not account for any proposed mitigation for the project that is described in **Section 6**. The additional mitigation measures proposed by the port authority for project operation can effectively mitigate potential acoustic effects to SRKW from underwater noise generated by vessel activities at and in the vicinity of the marine terminal under the most-realistic and high-case vessel scenarios, based on their combined effectiveness (**Section 6**).

3.2.2. Marine shipping incidental to the project

Marine shipping incidental to the project is defined as the project-bound container vessels transiting through the shipping lanes within the marine shipping area (the area outside the port authority's jurisdiction to the 12 nautical mile limit of Canada's territorial sea) to the point where they leave or re-enter the shipping lanes to call at or depart the proposed terminal. As described in **Section 1**, based on the most-realistic vessel scenario, the number of container vessels calling at the Port of Vancouver is predicted to be the same with or without RBT2, while the proportion of container vessels in the largest size classes would increase with RBT2. Using the transit exposure model (**Appendix IR2020-3-E**), sound exposure levels were estimated at three representative locations, each with three receivers modelled at different distances from the shipping route for 2035, 2040, and 2045. The three model locations were selected within SRKW critical habitat to represent Strait of Georgia, Juan de Fuca Strait, and Haro Strait, as each unique basin has different sound propagation conditions. Calculation of sound exposure levels focused on changes to container vessel traffic associated with RBT2 (i.e., sizes, speeds, and numbers of container vessels).

Sound exposures were evaluated using two metrics: L_{eq} and annual exceedance hours above the behavioural disturbance threshold (120 dB re 1 µPa unweighted broadband sound pressure level). L_{eq}, as previously mentioned, is the equivalent continuous sound level at a location in the marine shipping area estimated over one year. Exceedance hours is the average time that the three modelled receivers in each of the locations could be exposed to underwater noise above the behavioural disturbance threshold for SRKW[18] in the marine shipping area over one year, which provides additional context for interpreting the noise increases in terms of potential noise exposure effects to SRKW, with and without the project. Communication masking is incorporated into the assessment of behavioural response with the use of the behavioural disturbance acoustic effect threshold (broadband 120 dB) and captured in the acoustic effects model in evaluating mitigation effectiveness (**Appendix IR2020-3-D**).

Sound exposure levels were estimated for the most-realistic scenario (i.e., 16 or 17 container vessel calls per week at the Port of Vancouver with or without RBT2) and less likely high-case vessel scenarios. For high-case scenarios, we evaluated alternative scenarios that would range from 18 to 20 container vessel calls per week on average calling at the Port of Vancouver for each projection year (2035, 2040, and 2045). This corresponds to approximately 52, 104, and 156 additional container vessels annually in the marine shipping area in 2035, 2040, and 2045. We also conservatively assumed the additional weekly calls would be serviced by the loudest type of container vessel (i.e., Mega-Max) (**Appendix IR2020-3-E**).

We assessed sound exposures for the most-realistic and the high-case vessel scenarios considering 1) container vessel traffic alone and 2) other vessel traffic. We first estimated sound exposures considering container vessel traffic alone. However, there is more vessel traffic than only container vessels in the marine shipping area and therefore we also assessed the project's contribution to underwater noise accounting for the existing noise conditions from other vessel traffic in the marine shipping area.

[18] The behavioural disturbance threshold of 120 dB sound pressure level (broadband) was selected to define the range of acoustic effects to compare with and without RBT2 (see **Appendix IR2020-3-D** for details on thresholds).

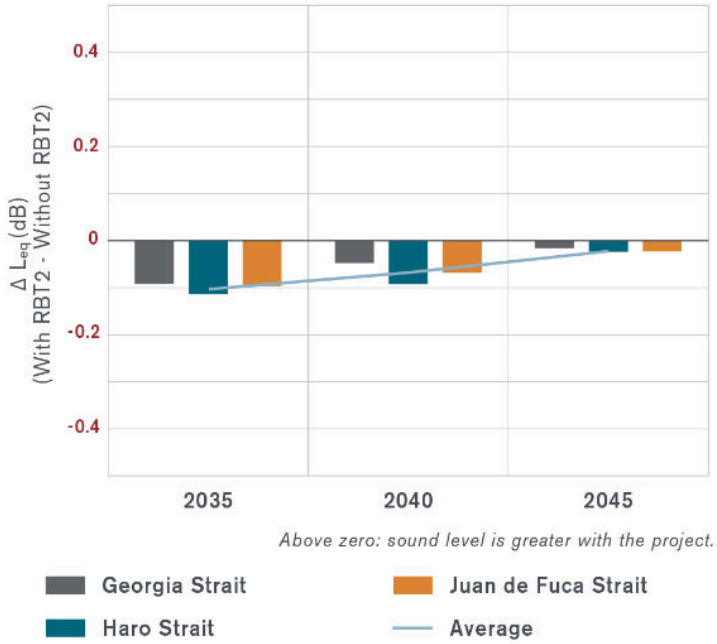
3.2.2.1. Container vessel traffic alone

The port authority estimated sound exposure levels (without mitigation) considering container vessel traffic for the most-realistic (i.e., 16 or 17 calls per week at the Port of Vancouver with or without RBT2, or 832 to 884 calls annually) and the less likely high-case vessel scenarios (i.e., 18 to 20 calls per week at the Port of Vancouver, or 936 to 1,040 calls annually).

a. Most-realistic vessel scenario

The estimates of sound exposure levels provided in **Appendix IR2020-3-E** confirm that, with or without the project, sound exposure levels would vary by only minor amounts depending on location and year and are relatively similar over the forecasted period (i.e., 2035, 2040, and 2045). With all three model locations combined, the annual time-averaged sound level ($L_{eq\text{-}1yr}$) for the most-realistic vessel scenario is anticipated to be the same with or without RBT2 (i.e., differences are so small as to be considered not measurable; **Figure IR2020-3-3**), even though container vessels calling at RBT2 are projected to be larger on average and the source levels of these larger vessels were conservatively estimated to be higher (**Appendix IR2020-3-E**). These results are consistent with what was presented at the public hearing, where it was concluded that there would be no appreciable increase in sound exposure levels in the marine shipping area with the project based on the 2018 projection (Mercator International 2018).

Figure IR2020-3-3: Difference (delta) in annual time averaged equivalent continuous sound level (L_{eq}, unweighted, broadband) in decibels (dB) at three representative marine traffic locations with and without RBT2 based on the most-realistic vessel scenario (the number of container vessels calling at the Port of Vancouver would be the same with or without RBT2)

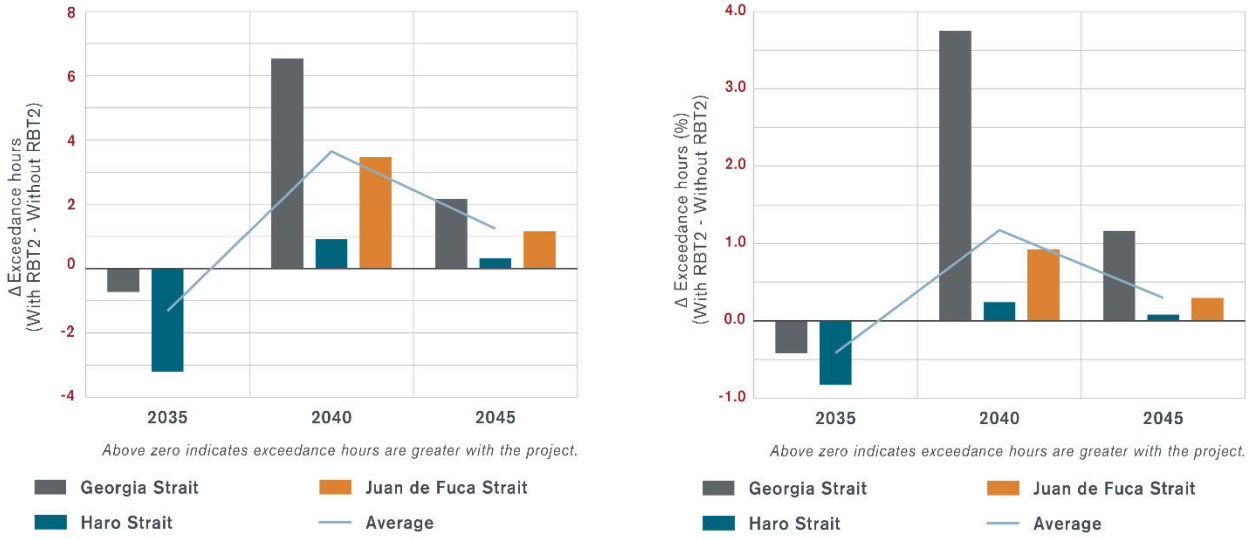


As illustrated in **Figure IR2020-3-3**, $L_{eq\text{-}1yr}$ ranged from less than 0.1 dB lower with RBT2 in 2035 and 2040 to less than 0.03 dB lower in 2045 with the project (**Appendix IR2020-3-E**). Even though not considered a measurable difference, $L_{eq\text{-}1yr}$ is predicted to be slightly lower with RBT2 in 2035 as Neo-Panamax container vessels are predicted to replace the Large Post Panamax container vessels that were predicted to call at the Port of Vancouver without the project. This is because measured noise emissions from the Large Post Panamax vessels class are slightly higher than the larger Neo-Panamax (**Appendix IR2020-3-E**; MacGillivray et al. 2020).

In the case of exceedance hours above the behavioural disturbance threshold (120 dB), the average difference in annual exceedance hours with RBT2 is predicted to be small (**Appendix IR2020-3-E**). The estimated difference

with RBT2 is predicted to be approximately 1 hour (0.5%) lower in 2035 to ~3.5 hours (~1%) higher in 2040 and ~1 hour (0.5%) higher in 2045, on average for all three locations combined (**Figure IR2020-3-4**). The approximately 1% increase in exceedance hours in 2040 with RBT2 is a result of comparatively more Mega-Max vessels predicted to call at the Port of Vancouver with RBT2 than without (i.e., four versus one vessel) (**Figure IR2020-3-4**). Acoustic modelling suggests that exceedance hours increase more with vessel size than L_{eq}, as a consequence of sound propagation conditions in the marine shipping area and how container vessel source levels change with vessel size.

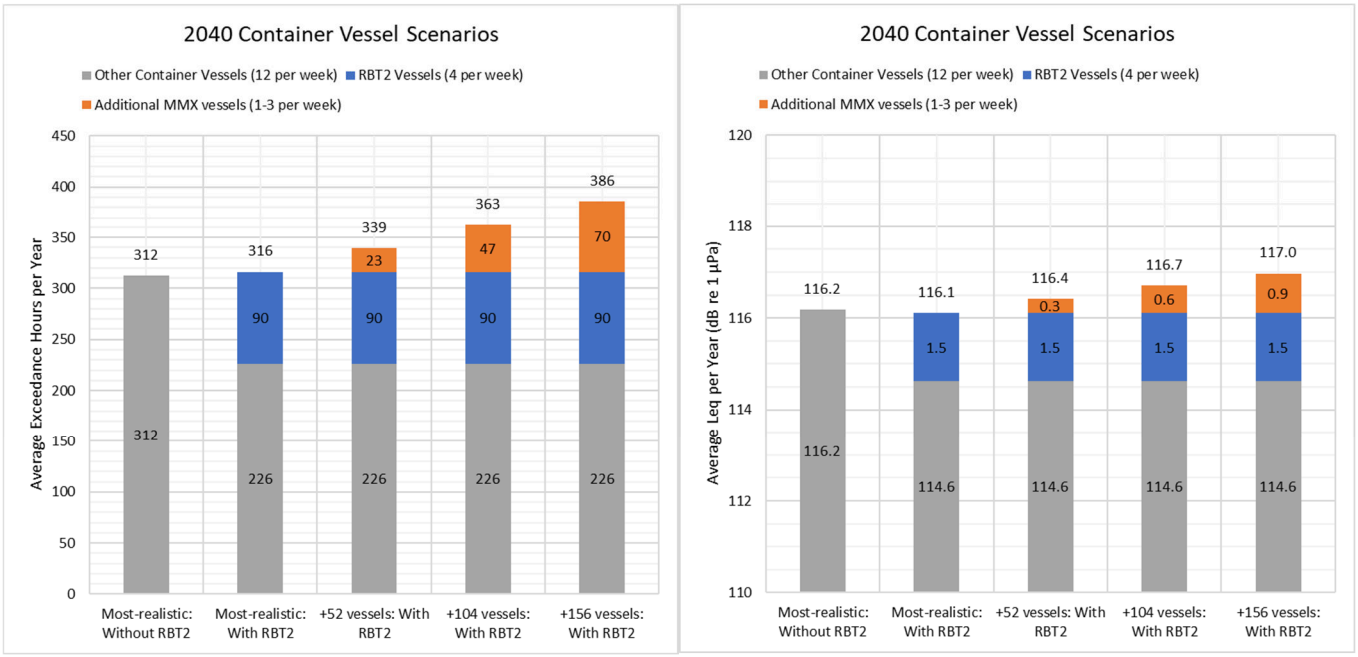
Figure IR2020-3-4: Differences in exceedance hours (left panel) and percentage (right panel) above SRKW acoustic disturbance threshold of 120 dB re 1 µPa broadband sound pressure level based on the most-realistic vessel scenario



b. High-case vessel scenarios

Under the less likely high-case vessel scenarios, the annual time-averaged sound level ($L_{eq\text{-}1yr}$) is predicted to increase by 0.3 dB to 0.9 dB with an additional one to three calls per week (or 52 to 156 container vessels annually) transiting the marine shipping area in 2040 compared to the most-realistic scenario of 832 container vessel calls annually with or without RBT2 (**Figure IR2020-3-5**). For exceedance hours, it is estimated that additional container vessels could increase exceedance hours by 23 hours to 70 hours (7% to 22%) under the high-case vessel scenarios of an additional 1 to 3 Mega-Max container vessels transiting the marine shipping area per week (**Figure IR2020-3-5**). As exceedance hours increase with vessel size, the conservative assumption that additional vessels would be the largest vessel class (i.e., Mega-Max container vessels) influences the increase in exceedance hours under the high-case vessel scenarios.

Figure IR2020-3-5: Annual time averaged equivalent continuous sound level (dB; $L_{eq\text{-}1yr}$, unweighted, broadband) (right panel) and exceedance hours above SRKW acoustic disturbance threshold of 120 dB re 1 µPa broadband sound pressure level (left panel) from container vessels calling at the Port of Vancouver in 2040 based on the most-realistic scenario and high-case vessel scenarios. Gray bars represent the contribution of non-RBT2 vessels under the most-realistic scenario, blue bars represent the contribution of RBT2 vessels under the most-realistic scenario, and orange bars represent the contribution of additional Mega-Max class vessels under the high-case scenarios

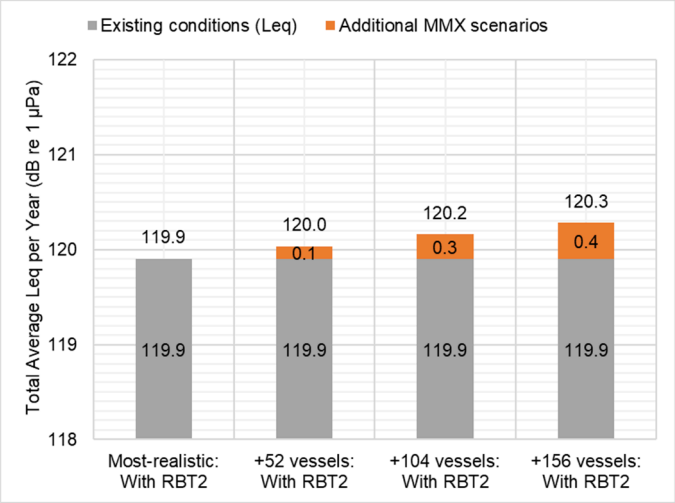


3.2.2.2. Other vessel traffic in the marine shipping area

A regional context is required to evaluate the project's potential contribution to underwater noise in the marine shipping area. The port authority averaged data from three sources to estimate existing underwater noise conditions in the marine shipping area. These include the modelled existing conditions data (2012) developed as part of the Regional Commercial Vessel Traffic Underwater Noise Modelling Study (MacGillivray et al. 2014) for the EIS, and underwater noise measurements collected by the ECHO Program at the underwater listening station in the Strait of Georgia and at the hydrophone at Lime Kiln in 2016-2017 (Warner et al. 2019). From these data, it was estimated that the existing annual time averaged underwater noise level within the marine shipping area is 119.9 dB re 1 µPa ($L_{eq\text{-}1yr}$, unweighted, broadband) (**Figure IR2020-3-6**; **Appendix IR2020-3-E**).

Under the most-realistic vessel scenario (the number of container vessels calling at the Port of Vancouver would be the same with or without the RBT2 Project) and accounting for the existing noise conditions in the marine shipping area, it is predicted that there would be no change in the annual time-averaged sound level ($L_{eq\text{-}1yr}$) (i.e., the project contribution to noise levels is 0 dB; **Figure IR2020-3-6**). Under the less likely high-case vessel scenarios, underwater noise ($L_{eq\text{-}1yr}$) is predicted to increase by between 0.1 dB (+52 container vessels) to 0.4 dB (+156 container vessels) in 2040 without mitigation (**Figure IR2020-3-6**). Note, the project's contribution is lower when accounting for existing noise conditions from other commercial vessel traffic in the marine shipping area. For example, under the highest-case scenario (+156 container vessels), $L_{eq\text{-}1yr}$ from the project is 0.5 dB lower when accounting for the existing noise conditions compared to assessing container vessel traffic on its own.

Figure IR2020-3-6: Time-averaged underwater sound levels (L_{eq-1yr}, unweighted, broadband; gray bars) in marine shipping area and increases (dB; orange bars) above existing conditions for the most-realistic (the number of container vessels calling at the Port of Vancouver would be the same with or without the RBT2 project) and the less likely high-case vessel scenarios (an additional 52, 104, and 156 Mega-Max (MMX) container vessels) when accounting for all commercial vessel traffic in the marine shipping area



Overall, based on the most-realistic vessel scenario for marine shipping incidental to the project, only small changes are predicted in the sound exposure level metrics with the project. These small increases do not take into account any avoidance or other mitigation measures that are described in **Section 6**. These estimates also do not account for potential contingency mitigation options that could be implemented in collaboration with agencies and Indigenous groups, if acoustic effects to SRKW are greater than predicted under the most-realistic scenario. Marine shipping incidental to the project is not anticipated to reduce the quality of the acoustic environment in a way that would affect SRKW's ability to forage or affect other life functions, and the implementation of the proposed mitigation measures would further increase confidence in this conclusion.

4. Echolocation masking

Minister's request: Re-assess total masking of Southern Resident Killer Whale's echolocation from continuous noise exposure from vessels during operations and marine shipping associated with the Project by assessing noise signal masking for more than one frequency, including frequencies where vessel noise is more prominent.

Acoustic masking occurs when underwater noise interferes with a marine mammal's ability to detect, interpret, and/or discriminate a sound. Acoustic masking can affect a marine mammal's ability to effectively communicate, detect important predator, prey, and/or conspecific signals, and/or detect important environmental features associated with spatial orientation (Clark et al. 2009). In the case of killer whales, echolocation is used to forage. Killer whales send out a series of clicks and listen to the echo coming back to locate their prey (adult salmon in the case of SRKW). Masking of echolocation clicks by other noise sources can limit the distance at which SRKW can send and receive echolocation clicks from potential prey, thereby reducing their foraging efficiency.

Total masking of SRKW echolocation was re-assessed for this response by quantifying the effects of noise generated from vessel operation and marine shipping incidental to the project at two frequencies (20 kHz and 50 kHz) for the most-realistic container vessel class projections calling at RBT2 and at the Port of Vancouver and high-case vessel scenarios, respectively (**Appendix IR2020-3-B**). For the EIS, the port authority provided an assessment of echolocation click masking at a frequency of 50 kHz, the center frequency of killer whale clicks (Au et al. 2004). In advance of the public hearing, DFO noted that the approach taken for acoustic masking of echolocation "appears well-developed, using the best information available as inputs, and its output seems

reasonable."[19] Since the public hearing, the science surrounding masking assessments has advanced but there are still no specific received sound levels thresholds for explicitly assessing effects from echolocation click masking. IAAC clarified that the port authority should assess masking at a frequency of 20 kHz (in addition to 50 kHz) to respond to this request (see **Appendix IR2020-3-D** for details). The 20 kHz frequency captures the second most important frequency for killer whale echolocation after 50 kHz.

4.1. Project operation

For project operation (i.e., the movements of container vessels and support tugs during arrival, berthing, unberthing, and departure outside the shipping lanes and vessels at berth), the effects from echolocation click masking were re-assessed using the acoustic effects model, developed since the public hearing (**Appendix IR2020-3-D**). This model estimates potential lost foraging time per killer whale by simulating the predicted overlap between SRKW transits with acoustic footprints of vessel-assist tugs and container vessels projected to call at RBT2 for each of the three projection years (2035, 2040, and 2045) (**Appendix IR2020-3-D**). Modelled acoustic footprints, representing operation, indicated that the extent (i.e., distance) of the 20 kHz echolocation masking threshold is farther than for 50 kHz (**Appendix IR2020-3-C**). This is because attenuation of sound with distance is weaker at 20 kHz than at 50 kHz and vessel noise emissions associated with project operation are higher at 20 kHz than at 50 kHz. Therefore, the 20 kHz acoustic footprints were added to the model to estimate the total echolocation click masking effects on SRKW, by estimating the potential lost foraging time beyond that estimated based on behavioural disturbance thresholds only (**Appendix IR2020-3-D**).

The port authority assessed the effects from echolocation click masking on SRKW potential lost foraging time for the most-realistic (on average 3 to 4 vessels calling the terminal per week or ~156 to 208 per year) and the high-case vessel scenario at the terminal (1 additional Mega-Max container vessel per week or 52 additional container vessels per year).

a. Most-realistic vessel scenario

Accounting for total echolocation masking increased the estimated lost foraging time by 0.1 to 0.2 hours (6 to 12 minutes) per SRKW per year when compared to estimates based on behavioural disturbance thresholds alone described in **Section 3** (**Table IR2020-3-4**; **Appendix IR2020-3-D**). This is based on the largest modelled masking acoustic footprint (i.e., at 20 kHz) assuming the most-realistic vessel scenario. These estimates of lost foraging time do not account for the proposed mitigation measures. The estimated lost foraging time did not vary noticeably between 2035, 2040, and 2045 (**Table IR2020-3-4**) because the main contributor to echolocation click masking at the 20 kHz frequency is propeller cavitation noise from vessel-assist tugs during berthing and unberthing. The number of vessel-assist tugs (three) needed to support berthing and unberthing operation at RBT2 will likely not increase for the larger Mega-Max vessels; therefore, the same number of tugs was used in all years.

b. High-case vessel scenario (+52 container vessels annually at RBT2)

For the less likely high-case vessel scenario at the terminal, the consideration of total echolocation masking resulted in an additional 0.2 hours (approximately 12 minutes) per SRKW per year compared to behavioural disturbance alone (**Table IR2020-3-4**; **Appendix IR2020-3-D**). The estimated lost foraging time under the high-case vessel scenario was approximately 1 hour higher than under the most-realistic scenario. These estimates of lost foraging time do not account for the proposed mitigation measures.

Proposed mitigation measures, described in detail in **Section 6**, will reduce the small potential acoustic effects to SRKW from project operation, including effects on echolocation click masking.

[19] CIAR Document #1630 From Fisheries and Oceans Canada to the Review Panel re: Written Submission for the Roberts Bank Terminal 2 Public Hearing. https://iaac-aeic.gc.ca/050/documents/p80054/129340E.pdf

Table IR2020-3-4: Estimated potential lost foraging time (mean hours (95% confidence interval)) per SRKW per year from project operation based on the most-realistic vessel scenario and the less likely high-case vessel scenario in 2035, 2040, and 2045, accounting for additional echolocation click masking beyond the behavioural disturbance threshold of 120 dB based on the largest modelled masking acoustic footprint (i.e., at 20 kHz). Potential lost foraging time estimates are rounded to one decimal place.

Scenario	Thresholds	Estimated potential lost foraging time (hours) per SRKW per year		
		2035	2040	2045
Most-realistic	Behavioural disturbance	1.5 (0-9.0)	2.3 (0-10.6)	2.3 (0-10.6)
	Echolocation click masking at 20 kHz	0.1 (0-0.7)	0.2 (0-0.8)	0.2 (0-0.8)
	Total for thresholds combined	1.6 (0-9.5)	2.5 (0-11.1)	2.5 (0-11.0)
	Projected weekly calls at RBT2	3	4	4
	Projected annual calls at RBT2	156	208	208
High-case	Behavioural disturbance	2.4 (0-10.5)	3.3 (0-11.6)	3.2 (0-11.7)
	Echolocation click masking at 20 kHz	0.2 (0-0.8)	0.2 (0-0.9)	0.2 (0-0.9)
	Total for thresholds combined	2.5 (0-10.9)	3.5 (0-12.1)	3.4 (0-12.1)
	Projected weekly calls at RBT2	4	5	5
	Projected annual calls at RBT2	208	260	260

4.2. Marine shipping incidental to the project

Total click masking of SRKW echolocation from marine shipping incidental to the project was also re-assessed by incorporating the 20 kHz and 50 kHz thresholds in the sound exposure estimates. As noted in **Section 3**, marine shipping incidental to the project is defined as the project-bound container vessels transiting through the shipping lanes in the marine shipping area to the point where they leave or re-enter the shipping lanes to call at or depart the proposed RBT2 terminal.

The re-assessment considered container vessel traffic calling at the Port of Vancouver with and without RBT2 at the three representative model locations along the shipping route (Strait of Georgia, Juan de Fuca Strait, and Haro Strait), each with three receivers modelled at different distances from the shipping route for 2035, 2040, and 2045. The re-assessment examined echolocation click masking for the most-realistic vessel scenario (i.e., 16 or 17 calls per week at the Port of Vancouver with or without RBT2) and the less likely high-case vessel scenarios (i.e., 18 to 20 calls per week or an additional one, two, or three Mega-Max class container vessel calls weekly in the marine shipping area (i.e., 52, 104, and 156 annually)). Similar to the previous response for marine shipping incidental to the project (**Section 3**), modelled sound exposure levels for echolocation click masking were evaluated using two metrics: $L_{eq\text{-}1yr}$ and annual exceedance hours (in this case, the amount of time above the echolocation click masking thresholds (based on 20 kHz frequency)).

Sound exposure levels at the echolocation click masking frequencies are predicted to be larger at 20 kHz than 50 kHz, similar to project operation. Total echolocation click masking is predicted to increase slightly with RBT2. This is because echolocation click masking increases with container vessel size (i.e., class) and, as noted in the previous response on the composition of container vessels, more larger container vessels (i.e., Mega-Max) are projected to call at the Port of Vancouver with RBT2 (**Figure IR2020-3-1**). Larger vessels have deeper drafts, which are associated with higher noise emissions (i.e., especially above 1 kHz), as documented by MacGillivray et al. (2020).

The port authority assessed total click masking of SRKW echolocation as L_{eq} (at 20 kHz) and annual exceedance hours (above the echolocation click masking thresholds based on 20 kHz) for the most-realistic scenario and the high-case vessel scenarios in the marine shipping area.

a. Most-realistic vessel scenario

With all three representative locations combined, the average difference in predicted $L_{eq\text{-}1yr}$ at 20 kHz with the project compared to without, based on the most-realistic vessel scenario, is small, ranging from <0.4 dB in 2035 and 2045 to 1.3 dB in 2040 (**Table IR2020-3-5**; **Appendix IR2020-3-E**). The approximately 1.3 dB increase in $L_{eq\text{-}1yr}$ in 2040 would occur because more Mega-Max container vessels are predicted to call at the Port of Vancouver with RBT2 than without (i.e., four versus one vessel weekly) (**Figure IR2020-3-1**).

In the case of exceedance hours above the echolocation masking threshold, the average difference in annual exceedance hours with RBT2 compared to without RBT2 is relatively small. The estimated difference with marine shipping incidental to the project is predicted to be less than 21 hours (5%) for all projection years (**Table IR2020-3-5**; **Appendix IR2020-3-E**). These estimates do not account for any mitigation.

Table IR2020-3-5: Differences in annual time-averaged underwater sound levels ($L_{eq\text{-}1yr}$, unweighted, 1/3-octave band) and annual exceedance hours above SRKW echolocation click masking threshold (20 kHz frequency) from container vessels in the marine shipping with and without RBT2 based on the most-realistic vessel scenario

Description	2035	2040	2045
Difference in annual time-averaged sound levels ($L_{eq\text{-}1yr}$ (dB))	0.1	1.3	0.4
Difference in annual exceedance hours	4 hours (0.9%)	21 hours (4.7%)	7 hours (1.5%)

b. High-case vessel scenarios

The average difference in predicted $L_{eq\text{-}1yr}$ at 20 kHz based on the less likely high-case vessel scenarios ranged from 1.8 to 2.8 dB in 2040 (the year with the largest predicted effects) without mitigation when accounting for an additional 52 to 156 Mega-Max container vessels annually in the marine shipping area (**Table IR2020-3-6**; **Appendix IR2020-3-E**). This represents an increase of approximately 0.5 dB to 1.5 dB compared to the most-realistic vessel scenario.

In the case of exceedance hours, the addition of 52 to 156 container vessels annually in the marine shipping area would increase annual exceedance hours by 57 hours to 129 hours (12.7% to 28.7%), respectively, compared to the most-realistic scenario (**Table IR2020-3-6**; **Appendix IR2020-3-E**). The estimates are deemed conservative based on the assumption that the additional vessels would be the largest vessel class (i.e., Mega-Max container vessels).

Table IR2020-3-6: Differences in annual time-averaged underwater sound levels (L_{eq-1yr}, unweighted, 1/3-octave band) and annual exceedance hours above SRKW echolocation click masking threshold (20 kHz frequency) from container vessels in the marine shipping with and without RBT2 based on the less likely high-case vessel scenarios in 2040

Description	Most-realistic scenario	High-case scenario		
		+52 Mega-Max vessels annually	+104 Mega-Max vessels annually	+156 Mega-Max vessels annually
Difference in annual time-averaged sound levels (L_{eq-1yr} (dB))	1.3	1.8	2.3	2.8
Difference in annual exceedance hours	21 hours (4.7 %)	57 hours (12.7%)	93 hours (20.7%)	129 hours (28.7%)

It is important to note these estimates do not account for any mitigation. Mitigation measures, described in detail in **Section 6**, would further reduce the small potential acoustic effects to SRKW (including echolocation click masking) from marine shipping incidental to the project. Further, with mitigation, echolocation click masking (including at the additional frequency of 20 kHz) associated with marine shipping incidental to the project is unlikely to further reduce the quality of the acoustic environment in a way that would affect SRKW's ability to forage or affect other life functions as explained in **Section 0**.

5. Assessment of behavioural response (Gomez et al. 2016)

Minister's request: Update assessment of behavioural response rates of Southern Resident Killer Whales to continuous noise exposure from vessels during operations and marine shipping associated with the Project to address uncertainties identified in Gomez et al 2016; Gomez, C., Lawson, J.W., Wright, A.J., Buren, A.D., Tollit, D., Lesage, V. 2016. A systematic review on the behavioural responses of wild marine mammals to noise: the disparity between science and policy. Canadian Journal of Zoology, 2016, 94(12): 801-819, https://doi.org/10.1139/cjz-2016-0098.

Gomez et al.'s review and meta-analysis presents the important aspects relevant to selecting appropriate behavioural disturbance thresholds and identifies a number of key factors and uncertainties to consider when setting appropriate generic multispecies behavioural response thresholds. The authors recommend applying a species-specific approach using both observational and acoustic data and to focus on a relevant sound source type (e.g., vessel noise). They identified other contextual factors that should be considered such as previous exposure to the noise source, proximity to it, and demographic factors (e.g., sex and age). The studies completed for the RBT2 EIS incorporated the key recommendations from Gomez et al. For RBT2, data used to derive SRKW-specific behavioural response thresholds were from resident killer whales exposed to vessel noise, which addresses the recommendation by Gomez et al. to use species-specific data and a relevant sound source. These data were collected from whales with previous exposure to the sound source type that were captured at various distances to the noise sources and likely from different demographics (e.g., sex and age), which addresses the recommendation by Gomez et al. to consider contextual factors such as previous exposure, proximity, and demographic factors. Two of the co-authors of the Gomez et al. paper[20] developed a model for the RBT2 assessment to estimate potential lost foraging time to SRKW from project operation to respond to this information request (**Appendix IR2020-3-D**). The model includes the relevant contextual factors in setting SRKW-specific behavioural response thresholds to estimate acoustic effects (**Appendix IR2020-3-H**).

[20] Dr. A. Buren, Ecofish Research Ltd., and Dr. D. Tollit, SMRU Consulting, are both key members of the RBT2 marine mammal team and are co-authors of Gomez et al. 2016 scientific paper.

Further, DFO previously described the approach adopted by the port authority in the EIS for deriving behavioural response thresholds as superior to using generic thresholds.[21] The acoustic behavioural disturbance thresholds developed to assess effects of the project are founded on the premise that a cetacean is more likely to respond and experience adverse effects to loud anthropogenic noise than to quiet noise (**Appendix IR2020-3-D** and **Appendix IR2020-3-F**). To further capture remaining uncertainties related to variability in the behavioural responses of SRKW to anthropogenic noise levels, the new acoustic effects model in **Appendix IR2020-3-D** tested higher behavioural response probabilities from an acoustic disturbance (i.e., higher likelihood of an adverse response) and used the more conservative, fine-scale, and adaptable model to quantify project operation acoustic effects and mitigation effectiveness described in **Section 6**.

6. Mitigation plan

Minister's request: Provide an avoidance and mitigation plan for underwater noise due to operational activities (e.g., berthing, vessel movements, and maintenance activities within the VFPA's jurisdiction) as well as, to the extent possible, for marine shipping associated with the Project within the marine shipping area, that would address impacts to Southern Resident Killer Whales (e.g., behavioural disturbance, communication and echolocation masking). If not feasible provide the rationale.

Minister's request: Describe potential measures (e.g., vessel slow downs) to reduce risk of vessel strikes for the Project bound vessels within VFPA's jurisdiction and within the international shipping lanes.

Minister's request: Provide a plan using vessel slow downs or other measures to reduce risk of vessel strikes within VFPA's jurisdiction and within the international shipping lanes.

Further to the minister's request, IAAC clarified that the port authority should identify measures to mitigate acoustic effects to SRKW from project operation and marine shipping incidental to the project and evaluate their potential effectiveness. In addition, IAAC clarified that modelling of communication masking (0.5 kHz to 15 kHz) was not required but to focus on mitigation. Indigenous groups also requested additional information on the effectiveness of the proposed mitigation measures, evaluation of noise from vessels at berth, and concerns about overall underwater noise. The proposed mitigation plan addresses these concerns and will reduce potential acoustic effects to SRKW and potential strike risk from project operation and marine shipping incidental to the project. The following presents the port authority's plan to mitigate (including through avoidance and reduction measures) the potential for underwater noise effects and vessel strike risk to SRKW from project operation and marine shipping incidental to the project.

The port authority has dealt with the three above-noted requests from the minister in one mitigation plan. The plan and mitigation measures to address all three requests are set out in this **Section 6**. The port authority is proposing that these additional mitigation measures be incorporated into the draft conditions for the project.

6.1. Project operation

The key noise-generating activities during project operation that may result in potential acoustic effects to SRKW are RBT2 container vessel arrival, berthing, vessels at berth, unberthing, and departure (as described in **Section 3**). The dominant noise source during operation is from vessel-assist tugs when manoeuvring container vessels at the terminal (i.e., pushing and pulling them in place) during the berthing and unberthing process. In the Federal Review Panel Report, the review panel, along with DFO, agreed that vessel strikes are unlikely during project operation due to the low transiting speed of container vessels and vessel-assist tugs during arrival, berthing, unberthing, and departure activities.[22]

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[21] CIAR Document #919 From the Review Panel Secretariat to the Review Panel re: Fisheries and Oceans Canada's Technical review of Roberts Bank Terminal 2 Environmental Impact Statement and Marine Shipping Supplement Report: Effects on Marine Mammals. https://iaac-aeic.gc.ca/050/documents/p80054/117102E.pdf
[22] CIAR Document #2062 Report of the Review Panel, Vancouver Fraser Port Authority Roberts Bank Terminal 2 Project. https://iaac-aeic.gc.ca/050/documents/p80054/134506E.pdf

Since the public hearing, the port authority has identified additional mitigation measures to further reduce the potential for acoustic effects to SRKW from project operation and evaluated their predicted effectiveness for the most-realistic and high-case vessel scenarios with regards to behavioural disturbance and echolocation click masking (i.e., 20 kHz and 50 kHz) (**Appendix IR2020-3-D**). Measures to reduce underwater noise are also expected to reduce the potential for masking of SRKW communication calls (i.e., communication calls for socializing, mating, and prey sharing) (**Appendix IR2020-3-D**).

The port authority plans to implement additional operation-phase mitigation measures beyond those considered by the review panel (**Appendix IR2020-3-G**). The operations mitigation plan will be finalized prior to operation with input from Indigenous groups and engagement with government and will allow for consideration of additional feasible mitigation measures or technologies that may become available by that time. The port authority proposes the operations mitigation plan include the following measures:

1. Delay unberthing and departure of container vessels during daytime when SRKW are present
2. Evaluate the potential effectiveness of technologies to reduce underwater noise associated with tug activities (e.g., electric tugs) and implement once feasible for project operation
3. Provide shore power connections for container vessels
4. Contractually require the terminal operator to require RBT2-bound container vessels to participate in applicable initiatives of the ECHO Program (or equivalent)

As noted above, the port authority is proposing these mitigation measures be incorporated into the draft project conditions. These measures, and their effectiveness, are each described further below.

1. Delay unberthing and departure of container vessels, during daylight hours, when SRKW are present

   For this proposed mitigation measure, the port authority would establish methods to detect SRKW near the RBT2 terminal prior to container vessel unberthing. If SRKW are in the vicinity of the terminal at the time of a planned vessel departure, its departure (including deployment of tugs) would be delayed until the SRKW have left the area of potential acoustic disturbance. This mitigation measure would avoid potential acoustic effects on SRKW by reducing the overlap between SRKW and noise emissions from unberthing and departure activities (**Appendix IR2020-3-D**). The port authority proposes to develop the SRKW detection plan for operations based on elements of the SRKW detection plan for construction. The operational SRKW detection plan will be described in the Operational Marine Mammal Management Plan, which will be developed in consultation with the Canadian Coast Guard, DFO, Transport Canada, Pacific Pilotage Authority, Indigenous groups, and industry (**Appendix IR2020-3-G**).

   The SRKW detection methods would include early detection sources, including both visual and acoustic detection data sources,[23] and marine mammal observers. The port authority heard that there is high interest from Indigenous groups for marine mammal monitoring to incorporate Indigenous knowledge and Indigenous involvement. Indigenous groups also provided suggestions related to monitoring whales during nighttime and extending delayed unberthing to nighttime, and the port authority has evaluated the feasibility of nighttime detection and delayed unberthing. The mitigation measure would have very limited benefit to SRKW because there are so few SRKW transits near Roberts Bank at night and very few of their transits would both coincide with a vessel departure and overlap with the underwater noise from unberthing. To apply this mitigation measure at night, a method to detect SRKW in darkness near the terminal would be required, such as a passive acoustic monitoring system. The addition of a passive acoustic monitoring system to monitor SRKW during the day and at night was estimated to only further reduce potential lost foraging time by approximately 17 minutes (i.e., 0.28 hours) per SRKW per year (95% confidence interval: 0–1.1 hours). Moreover, the cost

[23] Early detection sources could include shared sightings by the Canadian Coast Guard (i.e., Marine Mammal Desk), community groups (e.g., Saturna Islanders), near real-time whale notifications to commercial vessel operators via the BC Cetacean Sightings Network's Whale Report Alert System application, or detections by hydrophones such as from DFO's Whale Tracking Network, Transport Canada's Underwater Listening Station in Boundary Pass, Oceans Network Canada, Department of National Defence, or Saturna Island Marine Research and Education Society (SIMRES).

of the system would be substantial. In view of the high cost, limited effectiveness, and small benefit to SRKW, it would not be economically feasible or effective to detect SRKW and delay unberthing at night. The effectiveness of delayed daytime unberthing was estimated and is presented below for the most-realistic and high-case vessel scenarios, assuming the use of early detection and marine mammal observers.

Effectiveness on potential acoustic effects

a. Most-realistic vessel scenario

The acoustic effects model predicts that, for the most-realistic vessel scenario, delaying daytime unberthing will reduce potential lost foraging time by ~15% from an estimated ~2.2 hours (95% confidence interval: 0–10.5 hours) to ~1.9 hours (95% confidence interval: 0–10.1 hours) per SRKW per year, considering behavioural disturbance and echolocation click masking (**Appendix IR2020-3-D**).

b. High-case vessel scenario (+52 container vessels annually at RBT2)

In the case of the less likely high-case vessel scenario, delaying unberthing will reduce potential lost foraging time by ~13% from an estimated ~3.2 hours (95% confidence interval: 0–11.7 hours) to ~2.8 hours (95% confidence interval: 0 to 11.2 hours) per SRKW per year, considering behavioural disturbance and echolocation click masking (**Appendix IR2020-3-D**).

Effectiveness on potential vessel strike risk

Delaying unberthing and departure of container vessels when SRKW are present would also further reduce the risk of vessel strikes from project operation, which has already been found to be low. Reducing the number of potential interactions between vessels and SRKW has been identified by McWhinnie et al. (2018, 2021) as an effective tool to reduce vessel strike risk.

2. Evaluate the potential effectiveness of technologies to reduce underwater noise associated with tug activities (e.g., electric tugs) and implement once feasible for project operation

For this proposed mitigation measure, the port authority would continue to undertake desktop analyses to investigate the effectiveness of quieter tugs (e.g., electric tugs) to reduce underwater noise associated with berthing and unberthing activities and implement such vessels once feasible. Adopting quieter tugs is likely to further reduce the potential for acoustic effects to SRKW from project operation. There is some quantitative evidence of the noise reduction effectiveness for transiting hybrid and electric vessels, although this is limited by small sample sizes. Research indicates that electric ferries were 10 dB to 25 dB quieter than diesel ferries (Parsons et al. 2020), while hybrid vessels (mainly cruise ships) were 5 dB to 17 dB quieter than diesel (but 2 dB to 9 dB louder at slower speeds; Kipple 2002; Litwin et al. 2019; Spence et al. 2007). However, cavitation from the vessel propeller (rather than engine noise) is often the dominant noise source from tugs. Noise from cavitation is highest while vessel-assist tugs are actively pushing and pulling the container vessel during berthing and unberthing (which occur at slower speeds), and therefore the effectiveness of noise reduction from hybrid or electric engines can be overshadowed by propeller noise from cavitation (Matthews et al. 2018; Kendrick and Terweij 2019) (**Appendix IR2020-3-D**). The port authority will continue to monitor advancements in quiet tug technology (e.g., electric, hybrid, and liquefied natural gas (LNG) tugs), including work undertaken through Transport Canada's Quiet Vessel Initiative.

It is likely that tugs with quiet vessel notations (a quiet vessel notation from a ship classification society) will be available for future project operation. For example, HaiSea Marine recently announced a partnership to design, build, and operate new battery-powered and low emissions tugs that will be used for the LNG Canada Project in Kitimat. In addition to reducing air emissions, the port authority anticipates that these types of tugs would also produce less underwater noise. The port authority proposes to continue monitoring development of these types of tugs and implementing them when feasible for RBT2 terminal operations. In addition, these quieter tugs would also likely service other terminals at Roberts Bank and so reductions in underwater noise from this measure could extend beyond the RBT2 Project. This measure would be equally effective for the

most-realistic and high-case vessel scenarios, as the number of vessel-assist tugs were assumed to be the same for each vessel.

3. Provide shore power connections for container vessels

The port authority will provide and maintain shore power connection for vessels equipped to plug into land-based electric power while berthed at the RBT2 terminal so that they will not need to use auxiliary engines. Based on a recent underwater noise study, a container vessel connected to shore power while at berth produced less underwater noise (~5.8 dB broadband lower) compared to when the vessel was not connected to shore power (**Appendix IR2020-3-D**; Angadi et al. 2020). The port authority conducted acoustic modelling (**Appendix IR2020-3-C**) to estimate the effectiveness of shore power to reduce the distance where sound levels could affect SRKW. We modelled various numbers and sizes of container vessels operating at berth simultaneously. We conservatively assumed that the proportion of container vessels equipped to connect to shore power would be the same as today.[24] The effectiveness of this mitigation measure was evaluated by estimating the change in the acoustic footprint, the reduction in sound exposure levels ($L_{eq\text{-}1yr}$) at Roberts Bank, and the reduction in potential lost foraging time.

Connecting one of two or three container vessels to shore power while at berth is anticipated to reduce the behavioural disturbance zone (120 dB) from approximately 600 m to less than 550 m on average in summer and from approximately 750 m to 600 m in winter perpendicular to the berth face (**Appendix IR2020-3-D**). The use of shore power is anticipated to reduce sound exposure level ($L_{eq\text{-}1yr}$) near the terminal. Without shore power, the sound exposure level modelled near the terminal berth face (~0.3 km) was estimated to be on average 4.7 dB for the most-realistic scenario (3.9 dB, 5.2 dB, and 5.1 dB, for 2035, 2040, and 2045, respectively). With the assumption that 30% of vessels would use shore power, $L_{eq\text{-}1yr}$ near the terminal berth face (~0.3 km) was on average 4.3 dB for the most-realistic scenario (3.5 dB, 4.7 dB, and 4.6 dB, for 2035, 2040, and 2045, respectively). The sound exposure level ($L_{eq\text{-}1yr}$) was therefore on average 0.4 dB lower with shore power than without shore power in the most-realistic vessel scenarios for 2035, 2040, and 2045 (**Appendix IR2020-3-C**). For the high-case vessel scenario, the sound exposure levels estimated without shore power would be similarly reduced with the implementation of shore power. For example, in 2040, the sound exposure level near the berth face would be reduced by 0.5 dB with shore power compared to without (**Appendix IR2020-3-C**). When taking into account reductions in acoustic footprints from vessels at berth, shore power would have minimal effect to potential lost foraging time since the acoustic footprints of this activity rarely overlaps with transiting SRKW based on 16 years of observation data. There were very few overlaps because the majority of SRKW transits occur at approximately 1.5 km from the terminal berth face while the acoustic footprints from vessels at berth are estimated at ~550 m to 750 m (**Appendix IR2020-3-D**). Under the most-realistic vessel scenario, shore power would reduce potential lost foraging time by 0.9 minutes from an estimated ~6.8 minutes (95% confidence interval: 0.1–31.6 minutes) to ~5.9 minutes (95% confidence interval: 0.1–30.1 minutes) per SRKW per year (**Appendix IR2020-3-D**). Under the less likely high-case vessel scenario, shore power would reduce potential lost foraging time by 0.9 minutes from an estimated ~8.9 minutes (95% confidence interval: 0.2–38.0 minutes) to ~8.0 minutes (95% confidence interval: 0.2–36.4 minutes) per SRKW per year (**Appendix IR2020-3-D**).

Shore power does not have a large measurable reduction in potential lost foraging time for SRKW since unmitigated noise generated by vessels at berth (i.e., behavioural disturbance acoustic footprint) rarely overlaps transiting SRKW, based on 16 years of observation data (2002-2017). In addition to reducing air emissions, shore power will reduce the underwater noise generated by container vessels operating at berth near the terminal. Forecasts predict shore power demand will increase in the future. The port authority provides incentives to vessels that use shore power through the EcoAction program (VFPA 2021b).

[24] This is based on the proportion of vessels (34%) currently calling at the Port of Vancouver that have shore power capability (VFPA 2021b)

4. Contractually require the terminal operator to require RBT2-bound container vessels to participate in applicable initiatives of the ECHO Program (or equivalent)

   The port authority has the authority to contractually require the terminal operator to require RBT2-bound container vessels to participate in applicable initiatives of the ECHO Program (or future equivalent program) and the noise reductions that are likely to result from their participation would mitigate remaining predicted acoustic effects to SRKW from project operation. This measure would provide greater confidence that RBT2 vessels will participate in the initiatives, or equivalent, in the long-term. For example, the effectiveness of RBT2-bound vessels participating in the ECHO Program Haro Strait and Boundary Pass vessel slowdown was evaluated using a model estimating SRKW acoustic exposures, as described in **Appendix IR2020-3-F**. Here, we have evaluated how reducing SRKW exposures to noise in the marine shipping area could mitigate acoustic effects on SRKW from project operation at the terminal (**Appendix IR2020-3-F**). The SRKW acoustic footprint exposure model estimated the number of SRKW acoustic exposures to container vessel noise above the behavioural disturbance noise threshold of 120 dB (unweighted, broadband) predicted from project operation at Roberts Bank. These operational acoustic exposures were compared to the reduction in acoustic exposures from container vessels slowing down in areas of high SRKW use in the marine shipping area (e.g., Haro Strait and Boundary Pass) (Ashe et al. 2010, Noren and Houser 2016, Cominelli et al. 2018, Olson et al. 2018).

   We estimated the effectiveness of RBT2-bound container vessels participating in a seasonal initiative by slowing down to 14.5 knots (from the normal averaged 18 knots transiting speed) during a six-month summer period (May to October) through Haro Strait and Boundary Pass. For the most-realistic and high-case vessel scenarios, the annual median SRKW acoustic exposures from project operation could be counterbalanced by reducing SRKW acoustic exposures in the marine shipping area. The model results indicate that this can be achieved by 10% of RBT2-bound vessels reducing speed to 14.5 knots through Haro Strait and Boundary Pass over a six month summer period, or ~12% of vessels slowing down over five months (**Appendix IR2020-3-F**)**.** This mitigation measure is predicted to mitigate potential adverse effects to SRKW from median value acoustic exposures to operational noise (based on 120 dB threshold exposure modelling). To mitigate project operation acoustic exposures to the upper 95% confidence interval requires 30% of RBT2 vessels participating in ECHO Program slowdowns to travel at 14.5 knots over a six month period (or 36% of RBT2 vessels for a five-month period) (**Appendix IR2020-3-F**). We assumed that RBT2 vessels would achieve a 95% participation rate (considering that due to safety reasons there may be times container vessels will not be able to participate), compared to 80% ECHO Program 2020 participation rates[25] based on voluntary participation. The additional 15% participation of RBT2 container vessels in slow downs through Haro Strait and Boundary Pass mitigates effects from operation (i.e., SRKW acoustic exposures) by approximately 1.5 times (median exposure ratio) with 14.5 knot slowdowns occurring over six months and by 1.2 times (median exposure ratio) with slow downs occurring over five months, noting five months is the maximum length of current ECHO Program slowdown.

   Requiring RBT2-bound container vessels to participate in the ECHO Program-led seasonal underwater noise reduction initiatives would also reduce potential increases in vessel strike risk. For example, current applicable ECHO Program initiatives include vessel slowdowns in Haro Strait, Boundary Pass, and Swiftsure Bank. Reducing vessel speed is an effective mitigation measure for reducing the likelihood and lethality of vessel strikes (Vanderlaan and Taggart 2007; McWhinnie et al. 2018, 2021; Schoeman et al. 2020).

As communicated at the public hearing, the port authority, in the context of the ECHO Program's work to develop marine mammal educational materials and engage with regional mariners, will distribute marine mammal awareness materials (commitment #56). Through raising awareness and encouraging additional marine mammal educational efforts, this measure is predicted to reduce interactions between vessels (container vessels and tugs) and SRKW and thus support the reduction of potential acoustic effects and vessel strike risk to SRKW. The port authority will also implement the necessary requirements to mitigate acoustic effects on SRKW from in-water operational maintenance activities (such as maintenance dredging). For example, the port authority would

[25] Based on average rates modelled for the ECHO Program 2020 slowdown to assess its effectiveness to reduce potential lost foraging time on SRKW (VFPA 2021c).

schedule potential future terminal maintenance dredging to avoid the SRKW peak use period from June 1 or the date when SRKW are confirmed to be present in the Salish Sea, whichever is later,[26] to September 30. The potential acoustic effects on SRKW from short-term maintenance dredging are anticipated to be minor because this activity would occur infrequently and will be scheduled to avoid the SRKW peak use period.

In addition to the measures listed above, the potential effectiveness of reducing vessel-assist tug travelling speeds in the interim before quiet tugs are implemented was evaluated. We evaluated the effectiveness of a vessel-assist tug travelling at 5 knots rather than the typical 8 knots when transiting back and forth from the tug basin to assist the container vessel during arrival and departure. While it is technically feasible to slow tugs down, this would not be an effective mitigation measure because in some situations the tug slowdown increases potential lost foraging time. This is because even though slower tugs have a smaller acoustic footprint, the time required for slower tugs to transit back and forth from the tug basin to the container vessel is longer thus there is a higher probability the travelling tug overlaps a transiting SRKW. Hence, the port authority is not proposing to implement this measure as it is not effective.

The port authority will implement the four measures listed above in addition to the other previously proposed mitigation measures that were considered by the review panel, many of which will be part of the Operational Marine Mammal Management Plan (**Appendix IR2020-3-G**). As noted earlier, knowledge about underwater noise and SRKW is continually expanding, and the plan will therefore be finalized prior to operation with input from Indigenous groups and engagement with government and may incorporate additional feasible measures or technologies available at the time. In addition to these mitigation measures, the port authority will also implement an underwater noise follow-up program element (commitment #81, Table C13) to monitor underwater noise from project operation to verify predictions and apply contingency measures, if required.

The port authority has proposed additional measures to further mitigate the potential effects to SRKW from project operation. We propose measures to delay unberthing and departure of container vessels during daytime hours when SRKW are present, evaluate the potential effectiveness of technologies to reduce underwater noise associated with tug activities (e.g., electric tugs) and implement when feasible, provide shore power connections for container vessels, and contractually require the terminal operator to require RBT2-bound container vessels to participate in applicable initiatives of the ECHO Program (or equivalent). The measures outlined in this plan will further reduce potential behavioural disturbances, echolocation masking, communication masking, and strike risk from project operation, beyond what was considered by the review panel.

6.2. Marine shipping incidental to the project

Under the most-realistic vessel scenario, only small changes are predicted in the sound exposure level metrics with the project and, with mitigation, marine shipping incidental to the project is not anticipated to reduce the quality of the acoustic environment in a way that would affect SRKW's ability to forage or affect other life functions (see **Sections 3** and **4**). The risk of vessel strikes is not expected to increase with the project because the total number of container vessels transiting the marine shipping area is not predicted to change with the project. However, while less likely to occur, the high-case vessel scenarios could cause incremental effects to SRKW and so the port authority has identified the following measures to further reduce the potential for acoustic effects and strike risk to SRKW in the marine shipping area.

The marine shipping mitigation plan would include the following measures:

1. Participate in regional and/or multi-stakeholder initiatives that will inform effective management and recovery of SRKW (commitment #55 of Appendix A)
2. Continue to manage the ECHO Program and its initiatives and sign on to an additional five years of the Conservation Agreement to Support the Recovery of the SRKW, if other parties agree

[26] If SRKW are not present in the Salish Sea by June 1, the activities could continue until the date that SRKW are confirmed present in the Salish Sea by hydrophone data or ECHO Program marine mammal observers (or equivalent).

These measures are each described further below.

1. Participate in regional and/or multi-stakeholder initiatives that will inform effective management and recovery of SRKW (commitment #55 of Appendix A)

   The port authority, as previously committed, plans to participate in regional initiatives (commitment #55 of Appendix A and commitment #3 of Appendix B) and support relevant federal authorities with initiatives aimed at effective management and recovery of SRKW. This includes Government of Canada initiatives under the Oceans Protection Plan, as well as ongoing consultation with Indigenous groups, regulators, agencies, and stakeholders. These initiatives aim to protect and support recovery of SRKW by addressing key threats and are anticipated to lead to additional measures to avoid or reduce effects to SRKW. Examples of existing regional initiatives supported by the port authority include the Government of Canada initiatives under the Oceans Protection Plan and the Whales Initiative, and the Ocean Wise pollution tracker. The port authority will also support and work with the Canadian Coast Guard's Marine Mammal Desk however it can.

2. Continue to manage the ECHO Program and its initiatives and sign on to an additional five years of the Conservation Agreement to Support the Recovery of the SRKW, if other parties agree

   In May 2019, the port authority entered into a *Species at Risk Act* (SARA) Section 11 Conservation Agreement with DFO, Transport Canada, Pacific Pilotage Authority, and five marine transportation industry partners to support the recovery of the SRKW (**Appendix IR2020-3-A**). The Conservation Agreement formalizes the role of the ECHO Program and the participation of the marine industry and government to continue working collaboratively with the goal of reducing acoustic and physical disturbance of large commercial ships operating in SRKW critical habitat, in particular those vessels that call at the Port of Vancouver.

   To meet the goals of the Conservation Agreement, the port authority manages the ECHO Program and works with a diverse range of partners and advisors to continue implementing existing voluntary initiatives, to develop and implement new threat reduction measures and to guide the overall direction of the ECHO Program with a view to supporting the recovery of the SRKW. Along with a core ECHO Program Advisory Working Group comprising government agencies, the marine transportation industry, Indigenous communities and conservation groups, an ECHO Program Vessel Operators Committee also supports in the evaluation, development and implementation of safe and operationally feasible seasonal noise reduction measures such as vessel slowdowns and lateral displacement initiatives. The Vessel Operators Committee is transboundary in nature and includes representation from government agencies, including Canadian Coast Guard, U.S. Coast Guard, Transport Canada, Pacific Pilotage Authority, and Royal Canadian Navy; commercial marine industry, including BC Coast Pilots, shipping associations, agents, and vessel owners; and regional ferry operators, including BC Ferries and Washington State Ferries.

   Since the public hearing, the port authority has confirmed that it would continue to manage the ECHO Program and its initiatives (which will require discussion with ECHO Program partners) and sign on to an additional five years of the Conservation Agreement to Support the Recovery of the SRKW, if the other Conservation Agreement parties agree.

Marine shipping is within the jurisdiction of Transport Canada, Pacific Pilotage Authority, and DFO through the Canadian Coast Guard and so measures to reduce acoustic effects in the marine shipping area require collaboration among several government agencies. The port authority is an active participant in the efforts that the Government of Canada is taking to address the threats facing SRKW and to reduce the potential for acoustic effects to SRKW from commercial vessel traffic.

The port authority has led the development and implementation of several initiatives to reduce underwater noise in the marine shipping area through its role in the ECHO Program, including vessel slowdowns in Haro Strait, Boundary Pass, and Swiftsure Bank, which are key foraging areas for SRKW. Over the last five years, these initiatives have been effective in better understanding and reducing effects of underwater noise from large commercial vessels on SRKW. For example, vessel slowdowns in Haro Strait and Boundary Pass have achieved high levels of participation (consistently over 80% from 2018 to 2020) and measurable broadband noise reductions by 2.5 dB to 2.8 dB in 2020 (a 44% to 48% reduction in sound intensity), with an estimated reduction in

lost foraging time of 17% to 20% (VFPA 2021a). These results have contributed to meeting targets set to quantifiably reduce threats to SRKW from large commercial vessels as part of the Conservation Agreement to Support the Recovery of the SRKW (VFPA 2021d). The ECHO Program has also collaboratively developed many educational resources targeted at raising mariners' awareness of navigating safely in the presence of marine mammals in B.C. waters to help reduce the risk of physical or acoustic disturbance to SRKW.

Current ECHO Program initiatives are reviewed and adapted from year to year based on scientific findings from previous years to maximize reductions to acoustic and physical disturbance. New ECHO Program research projects or initiatives may also be added over time. As new information comes forward and as additional areas of interest are identified within SRKW critical habitat, the ECHO Program works with its advisors to assess new data and evaluate the feasibility of implementing additional measures. For example, in 2021, the ECHO Program is working with its advisors to evaluate the feasibility of expanding the slowdown area to include the participation of commercial vessels in the inbound lane of the Traffic Separation Scheme in Swiftsure Bank in 2022.

In addition, the port authority is supporting the Government of Canada in building global awareness of underwater noise mitigation strategies through the input and support of the ECHO Program. In June 2021, the Government of Canada was successful in securing a commitment from the International Maritime Organization (IMO)'s Marine Environment Protection Committee to review the 2014 Guidelines for the reduction of underwater noise from commercial shipping to address adverse impacts on marine life (MEPC.1/Circ.833, April 2014) and to identify next steps. The ECHO Program has shared data and input to the development of the Government of Canada's proposal to the IMO and will continue to support these efforts.

The port authority has proposed additional mitigation measures to further mitigate the potential effects to SRKW from marine shipping incidental to the project. We propose to continue to manage the ECHO Program and its initiatives, sign on to an additional five years of the Conservation Agreement to Support the Recovery of the SRKW, if other parties agree, and support and participate in regional initiatives that will inform effective management and recovery of SRKW. These measures will further reduce the potential for acoustic effects and strike risk to SRKW in the marine shipping area. The port authority will also develop and implement a marine shipping follow-up program element in consultation with Indigenous groups and government agencies to verify the predictions of effects of underwater noise to SRKW from container vessels, and we identified potential contingency mitigation options that could be implemented if the effects exceed predictions.

6.3. Marine shipping follow-up program element

The port authority proposes a marine shipping follow-up program element to verify the predictions of underwater noise for the most-realistic vessel scenario presented in this response. The follow up-program element would monitor the underwater noise from container vessels, number of vessel calls, and size classes destined to the Port of Vancouver (**Appendix IR2020-3-I**).

As part of the marine shipping follow-up program element, underwater noise predictions from container vessels would be verified using a modelling approach to estimate associated sound exposure to SRKW in the marine shipping area. Sound exposure would be estimated using metrics such as L_{eq} and/or exceedance hours (time above SRKW acoustic disturbance threshold of 120 dB re 1 µPa broadband sound pressure level). The port authority will collect noise source level measurements from container vessels calling the Port of Vancouver to confirm the model assumptions. For example, sound source level measurements could be collected using Transport Canada's underwater listening station in Boundary Pass provided it is still in operation. If the Boundary Pass underwater listening station is not available, the port authority would seek an alternative station or deploy alternative hydrophones, if needed, to verify vessel source levels. The follow-up program element will enable the port authority to confirm the predicted underwater noise effects from the project and determine the need to implement additional mitigation measures, consistent with the *Canadian Environmental Assessment Act, 2012* framework. If underwater noise from container vessels calling at the Port of Vancouver exceeds predictions for the most-realistic vessel scenario presented in this response, then modified or additional measures would be identified and implemented in collaboration with Indigenous groups, Transport Canada, DFO, and applicable federal authorities.

The additional mitigation measures proposed in **Sections 6.1** and **6.2** above will be effective in both the most-realistic scenario and high-case scenario. For this response, the port authority has also identified and assessed potential feasible contingency mitigation options that could be implemented if underwater noise is higher than predicted under the most-realistic scenario. These options are described below.

6.4. Potential contingency mitigation for SRKW

The port authority has identified and assessed effectiveness of potential contingency mitigation options that could be implemented if underwater noise from container vessels is higher than predicted (i.e., if a less likely high-case scenario were to occur). We focused on vessel slowdowns as mitigation options because these methods are available today and have been proven to be effective in reducing underwater noise and potential acoustic effects on SRKW, despite longer transit times (Joy et al. 2019; MacGillivray et al. 2019; Burnham et al. 2021; VFPA 2021a).

We used the transit exposure model and evaluated several mitigation options to illustrate the potential effectiveness of container vessel slowdowns (**Appendix IR2020-3-E**). Before being implemented, the feasibility of specific slowdown measures would require consultation with industry, Indigenous groups, and government agencies, specifically the Pacific Pilotage Authority and the Canadian Coast Guard, to confirm measures could be enacted safely.

The contingency mitigation options we evaluated, in addition to no mitigation, are presented in **Figure IR2020-3-7**, **Figure IR2020-3-8**, and **Figure IR2020-3-9**, and include the following:

1. 95% of RBT2-bound vessels slow down for six months from 18 knots to 14.5 knots in Haro Strait, Boundary Pass, and at Swiftsure Bank (“14.5 kn only RBT2 vessels”)
2. 95% of RBT2-bound vessels and 80% of all other container vessels slow down for six months from 18 knots to 14.5 knots in Haro Strait, Boundary Pass, and at Swiftsure Bank (“14.5 kn all container vessels”)
3. 95% of RBT2-bound vessels and 80% of all other container vessels slow down for six months from 18 knots to 11 knots in Haro Strait, Boundary Pass, and at Swiftsure Bank (“11 kn all container vessels”)
4. 95% of RBT2-bound vessels and 80% of all other container vessels slow down for six months from 18 knots to 11 knots in Haro Strait, Boundary Pass, and at Swiftsure Bank; and in additional areas of Juan de Fuca Strait and/or the Strait of Georgia (“11 kn expanded slowdown all container vessels”)

We used the marine shipping transit exposure model to illustrate effectiveness of these potential contingency mitigation options (**Appendix IR2020-3-E**). The difference in sound exposure levels (i.e., exceedance hours above the behavioural disturbance threshold of 120 dB) was calculated for each mitigation scenario across the range of high-case vessel scenarios (i.e., one, two, or three additional container vessel calls weekly or 52, 104, and 156 additional container vessels annually in the marine shipping area) (**Appendix IR2020-3-E**). The mitigation scenarios assumed a 95% participation in the slowdowns for RBT2-bound container vessels and 80% for all other container vessels to reflect current ECHO Program participation rates, consistent with approach in **Section 6.1** for measure 4. The results are presented for 2040, which is the year evaluated with the largest anticipated effects.

Potential acoustic effects from broadband noise from an increase in container vessel underwater noise could be mitigated as follows for each high-case vessel scenario:

- 52 additional Mega-Max vessels annually could be mitigated by further reducing transit speed for six months from 14.5 knots to 11 knots (**Figure IR2020-3-7**).
- 104 additional Mega-Max vessels annually could be mitigated by further reducing the transit speed for six months to 11 knots combined with expanding the slowdown area to include Juan de Fuca Strait and the Strait of Georgia (**Figure IR2020-3-8**).

- 156 additional Mega-Max vessels annually could be mitigated by further reducing the transit speed for six months to 11 knots combined with expanding the slowdown area to include Juan de Fuca Strait and the Strait of Georgia (**Figure IR2020-3-9**).

The analysis of the contingency mitigation options showed that, compared to broadband noise, the more expansive measures would be needed to reduce sound levels from marine shipping in the 20 kHz and 50 kHz echolocation bands. Under the unlikely high-case scenario of an additional 156 Mega-Max calls per year, contingency mitigation options beyond those considered in this study would be needed to reduce sound levels in these two echolocation bands, for example, by expanding slowdown durations beyond 6 months.

These examples of contingency mitigation measures are potential options that could be implemented through the port authority's marine shipping follow-up program element if underwater noise is higher than predicted in the marine shipping area. These measures would also reduce vessel strike risk. Consultation with industry, Transport Canada, Pacific Pilotage Authority, and DFO through the Canadian Coast Guard would be required to finalize the measures.

Knowledge about underwater noise is increasing and technological changes are being pursued by the Government of Canada (e.g., Transport Canada's Quiet Vessel Initiative) and others. The port authority will continue to consult with Indigenous groups and applicable federal authorities during the development of the marine shipping follow-up program element and throughout its implementation. As noted previously, marine shipping is within the jurisdiction of Transport Canada, Pacific Pilotage Authority, and DFO through the Canadian Coast Guard and measures to reduce acoustic or strike risk effects in the marine shipping area require collaboration between several federal government agencies. The port authority would collaborate with government and industry to implement marine shipping mitigation measures if they are necessary to mitigate unanticipated effects from marine shipping incidental to the project to SRKW. This proposed coordinated approach provides additional confidence that potential unanticipated effects to SRKW could be mitigated through additional measures in the future.

Figure IR2020-3-7: The effectiveness of potential contingency mitigation measures under the high-case vessel scenario of an additional 52 Mega-Max (MMX) container vessels annually in the marine shipping area. Measures include further reducing vessel speed and extending the area in which container vessels slow down. Exceedance numbers shown in the figure are rounded to the nearest whole hour.

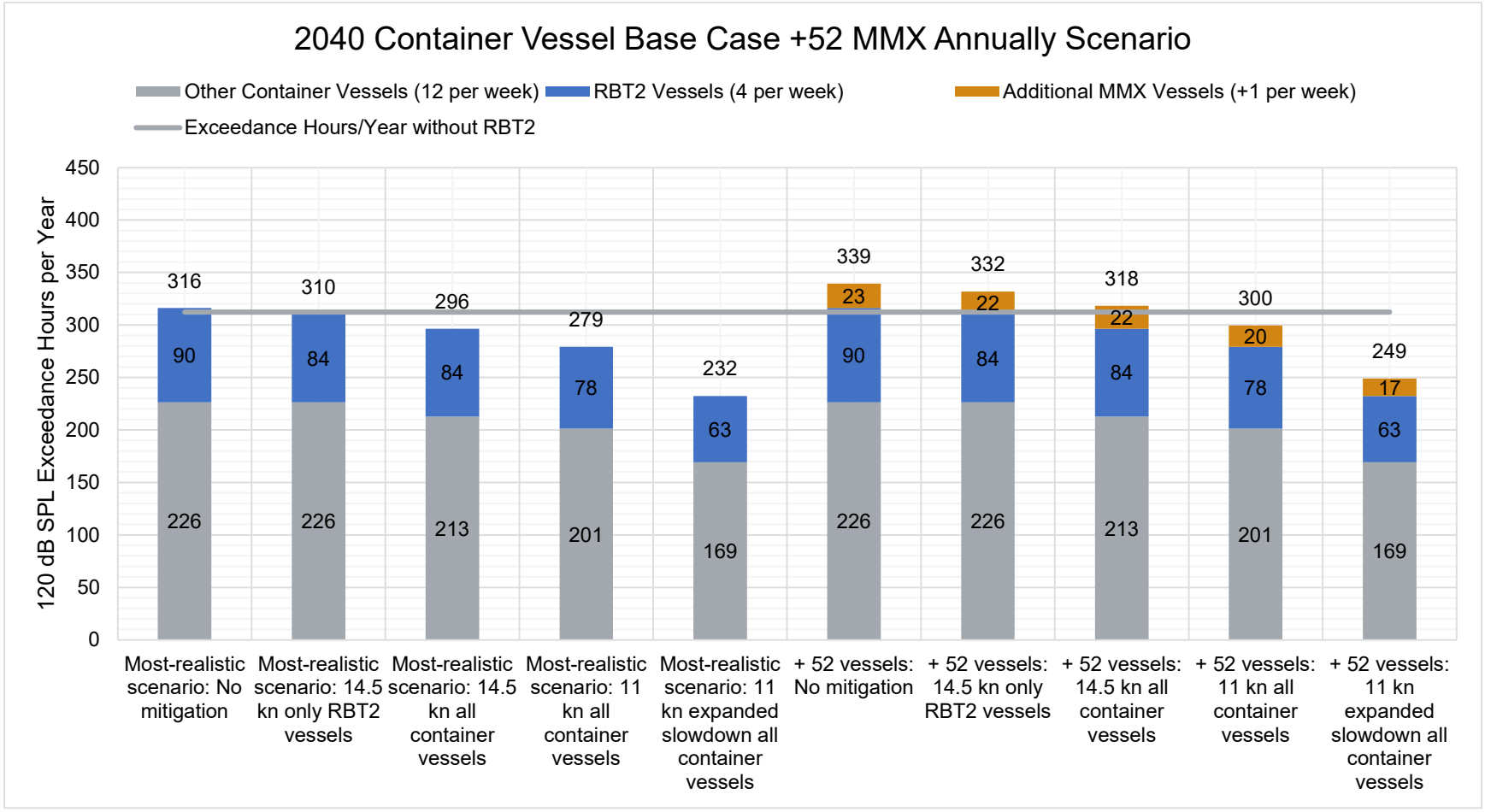


Figure IR2020-3-8: The effectiveness of potential contingency mitigation measures under the high-case vessel scenario of an additional 104 Mega-Max (MMX) container vessels annually in the marine shipping area. Measures include further reducing vessel speed and extending the area in which container vessels slow down. Exceedance numbers shown in the figure are rounded to the nearest whole hour.

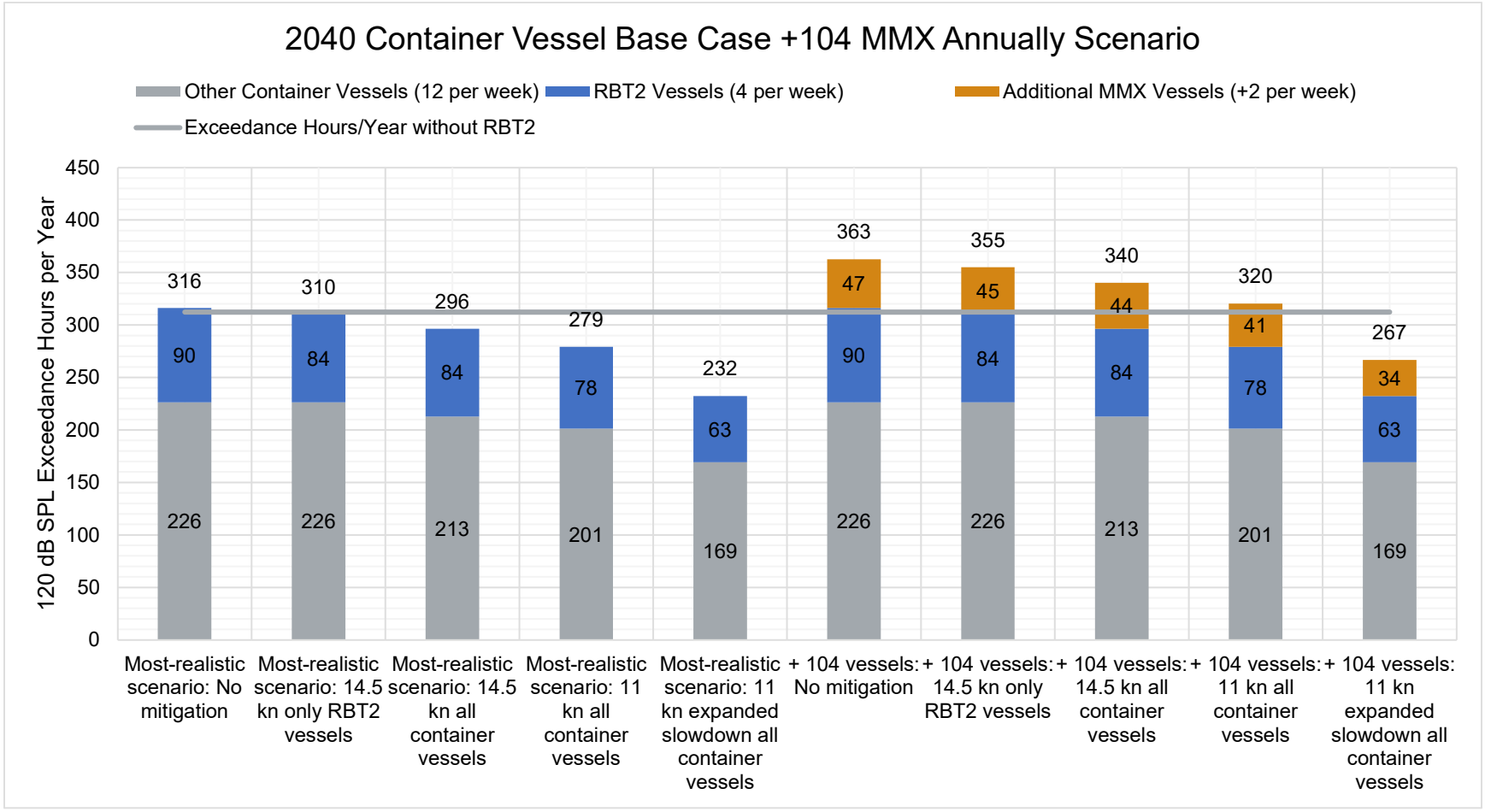
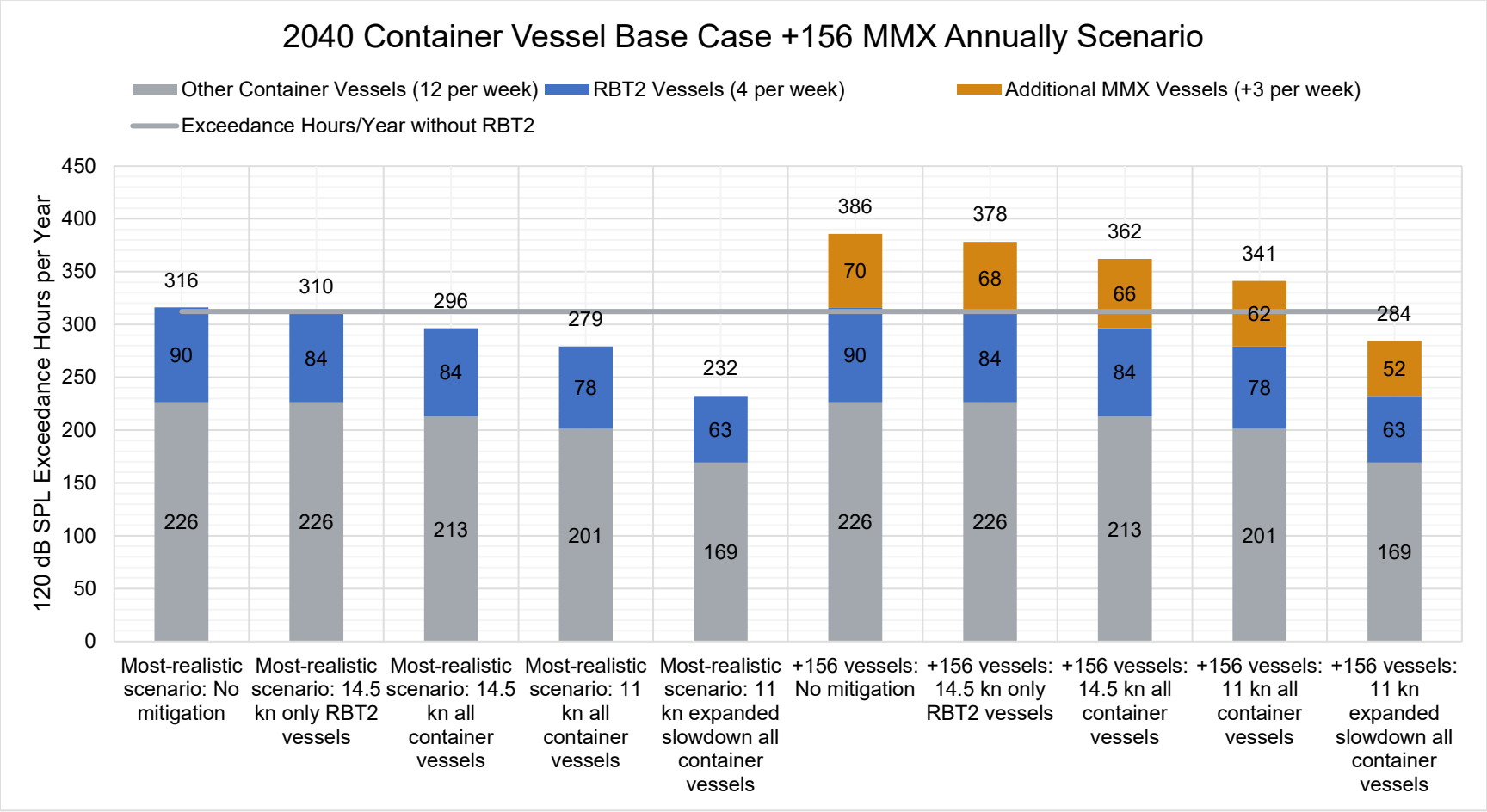


Figure IR2020-3-9: The effectiveness of potential contingency mitigation measures under the high-case vessel scenario of an additional 156 Mega-Max (MMX) container vessels annually in the marine shipping area. Measures include further reducing vessel speed and extending the area in which container vessels slow down. Exceedance numbers shown in the figure are rounded to the nearest whole hour.



7. Vancouver Fraser Port Authority control and authority

Minister's request: Indicate which measures in the mitigation plan are within the control and/or authority of VFPA to implement and how.

Minister's request: For those measures outside VFPA's control and/or authority, describe how VFPA intends to work collaboratively to carry out the mitigation measures.

Each of the measures the port authority plans to apply to mitigate acoustic and physical disturbance to SRKW are listed in **Table IR2020-3-7** along with information about which measures are within the control and/or authority for the port authority to implement. To provide context to assist in better understanding the responses, we first provide a brief explanation of the port authority's statutory role and authority.

The port authority is a corporation continued under the *Canada Marine Act*. It has the authority given to it under the *Canada Marine Act*, the *Port Authorities Operations Regulations*, the Port Authorities Management Regulations, and its Letters Patent.

Generally, the port authority can enter into agreements with terminal operators, subject to advancing the public interest in the competitive, efficient, commercially oriented operation of port facilities, and to regulate, among other activities, the loading of vessels. In addition, under the *Canada Marine Act* and *Port Authorities Operations Regulations*, the port authority can regulate certain aspects of navigation within the waters of the Port of Vancouver. As a result, the port authority has available to it several mechanisms to implement mitigation measures for the RBT2 Project, including measures for the protection of SRKW.

The port authority's power as regulator and as the owner of federal lands is subject to certain limits. Like all statutory bodies, the port authority must exercise its powers lawfully and in good faith in accordance with its statutory mandate. Those powers are generally limited to the waters and lands within the geographic limits of the port itself. However, even where its direct regulatory power is limited, it has the capacity to cooperate with other entities, including government agencies, to advance initiatives.

An important example of an initiative that the port authority supports, but cannot itself implement in full, is the ECHO Program. The port authority leads the implementation of the program and provides substantial services and funding to it. The port authority does not have the authority to regulate vessel traffic or force vessels to slow down outside Port of Vancouver waters; however, the ECHO Program works collaboratively to bring together government agencies (including Transport Canada, Pacific Pilotage Authority, and the Canadian Coast Guard, who have jurisdiction within the marine shipping area), the marine transportation industry, Indigenous groups, conservation and environmental groups, and scientists to coordinate the development and implementation of threat reduction initiatives such as the Haro Strait and Boundary Pass vessel slowdown. The pilot reported participation rate in the Haro Strait and Boundary Pass slowdown has been consistently high (over 80% from 2018 to 2020), demonstrating the effectiveness of this collaborative approach. The port authority agrees that it would be appropriate to use the power it does have to impose a requirement on the terminal operator requiring participation of RBT2-bound vessels in the ECHO Program seasonal noise reduction initiatives. Though its direct power is limited, the port authority views its role in managing the ECHO Program as a good example of the use of its influence and resources to convene regional interests and work collaboratively to implement meaningful measures that reduce threats from commercial shipping and support the recovery of the SRKW.

Table IR2020-3-7: Previous project commitments and additional proposed mitigation measures that are within the control and/or authority of the Vancouver Fraser Port Authority to implement and those which would require collaboration

Commitment / mitigation measure	Within the control and/or authority of the Vancouver Fraser Port Authority (VFPA) to implement directly	Description of intention to work collaboratively to carry out
Delay unberthing of container vessels, during daylight hours, when SRKW are present	Yes – The VFPA has authority to regulate the loading of vessels by terminal operators.	
Evaluate the potential effectiveness of technologies to reduce underwater noise associated with tug activities (e.g., electric tugs) and implement once feasible for project operation	Yes – The VFPA has the authority to enter into prudent commercial agreements with terminal operators and tug operators providing for the adoption of electric tugs.	
Provide shore power connections for container vessels	Yes – The VFPA has authority to: • regulate the loading of vessels by terminal operators • enter into prudent commercial agreements with terminal operators	
Participate in regional initiatives (project commitment #55 and marine shipping commitment #3) and support relevant federal authorities with initiatives aimed at effective management and recovery of SRKW	No – The VFPA will generally not have control or direct authority to directly implement regional or federal initiatives. The VFPA may have authority or control over some aspect of an initiative.	The VFPA has the authority to join initiatives with other parties so long as those initiatives fall within its mandate as a port authority under the *Canada Marine Act* and its Letters Patent. The VFPA is entitled to participate in those initiatives; however, it may or may not have the authority to undertake any particular action identified in the regional initiatives. That is true of all of the participants.
Continue to manage the ECHO Program and its initiatives and sign on to an additional five years of the *Species at Risk Act* (SARA) Section 11 Conservation Agreement to Support the Recovery of the SRKW, if other parties agree, to reduce acoustic and physical disturbances to SRKW by large commercial vessels in Pacific Canadian waters, in particular those vessels that call at the Port of Vancouver, or otherwise operate in SRKW critical habitat	Yes – The VFPA can continue to manage the ECHO Program and its initiatives and sign on to an additional five years of the *Species at Risk Act* (SARA) Section 11 Conservation Agreement. Note that while the VFPA can participate, it may or may not have the have control or authority to directly implement aspects of those measures.	

Commitment / mitigation measure	Within the control and/or authority of the Vancouver Fraser Port Authority (VFPA) to implement directly	Description of intention to work collaboratively to carry out
Contractually require the terminal operator to require that RBT2-bound container vessels to participate in the applicable initiatives of the ECHO Program (or equivalent)	Yes – The VFPA has authority to: • regulate the loading of vessels • enter into prudent commercial agreements with terminal operators Through the use of its authority, the VFPA can contractually require the terminal operator to require participation in applicable initiatives in the ECHO Program. However, the VFPA does not have authority to regulate navigation outside the Port of Vancouver.	
Implement a marine shipping follow-up program element—if container vessel projections and their associated underwater noise exceed predictions with the project, then we would seek to apply additional measures to reduce underwater noise, which could include expanded vessel slowdowns	Yes – The VFPA has the authority to implement a follow-up program element for the project and to monitor the underwater noise from, and number and size of, container vessels calling at the Port of Vancouver and their acoustic effects on SRKW. The VFPA may or may not be the authority to directly implement all aspects of any particular follow-up measure. For example, the VFPA can contractually require participation in an expanded vessel slowdown, but cannot directly regulate navigation outside the Port of Vancouver.	

8. Conclusion

This response addresses the minister's request for additional information regarding avoidance and other mitigation measures related to underwater noise effects on and vessel strike risk to SRKW from project operation and marine shipping incidental to the project.

This response provides new and additional information to confirm the container vessel traffic projections associated with the project and provide projections beyond 2035 and includes analysis of the potential effects of marine shipping incidental to the RBT2 Project for the most-realistic, and less likely high-case, container vessel traffic scenarios. For the most-realistic scenario, the updated study projected that the number of container vessels calling at the Port of Vancouver in the future will be the same with or without RBT2. The port authority has proposed additional measures to further mitigate the potential effects to SRKW from project operation and marine shipping incidental to the project. For operations, we propose measures to delay unberthing and departure of container vessels during daylight hours when SRKW are present, evaluate the potential effectiveness of technologies to reduce underwater noise associated with tug activities (e.g., electric tugs) and implement when feasible, provide shore power connections for container vessels, and contractually require the terminal operator to require RBT2-bound container vessels participate in applicable initiatives of the ECHO Program (or equivalent). For marine shipping, we propose to continue to manage the ECHO Program and its initiatives, sign on to an additional five years of the Conservation Agreement to Support the Recovery of the SRKW, if other parties agree, and support and participate in regional initiatives that will inform effective management and recovery of SRKW. The port authority also proposes to develop and implement a marine shipping follow-up program element in collaboration with Indigenous groups, Transport Canada, DFO, and applicable federal authorities to verify the predictions of effects of underwater noise to SRKW from container vessels, and we identified potential contingency mitigation options that could be implemented if the effects exceed predictions for the most-realistic scenario.

The port authority anticipates that, on average, 208 to 260 container vessels will call the terminal each year once it is fully operational, in approximately 2040. At the RBT2 terminal location, with mitigation, potential lost foraging time from project operations would be ~1.8 hours (95% confidence interval: 0–10.0 hours) per SRKW per year under the most-realistic vessel scenario. These effects would be counterbalanced by mitigation applied in the marine shipping area under the ECHO Program. The port authority would contractually require the terminal operator to require RBT2-bound container vessels to participate in ECHO Program initiatives. We assume that RBT2 vessels would achieve a 95% participation rate compared to 80% ECHO Program 2020 participation rates based on voluntary participation. This increase participation rate would reduce SRKW exposures to noise in the marine shipping area and would mitigate the potential adverse effects to SRKW from acoustic exposures to operational noise by approximately 1.5 times. Though the measure would occur in a different spatial area, it would be an effective mitigation for SRKW because the underwater noise reductions would occur in key SRKW foraging habitats.

The port authority also anticipates that the most-realistic container vessel scenario for marine shipping is that with or without the project the number of container vessels calling the Port of Vancouver will be the same. The container vessel forecast indicates that, in 2040 and 2045, approximately 16 and 17 weekly vessel calls (or 832 and 884 calls per year), respectively, would call at the Port of Vancouver. We acknowledge uncertainty inherent in forecasting and have assessed the potential effect of project-related marine shipping on SRKW in several high-case scenarios under which there would be up to 20 container vessel calls per week (or 1,040 calls per year) to the Port of Vancouver. If there are 20 container vessels per week (or an additional 156 Mega-Max vessels per year compared to the most-realistic scenario) calling at the Port of Vancouver, underwater noise would increase by 0.4 dB (unweighted, broadband). This increase accounts for existing noise conditions from other commercial vessel traffic in the marine shipping area. If container vessel calls were to increase, the underwater noise from the additional vessels could be offset using vessel slowdowns by further reducing vessel speed and/or expanding slowdown areas.

The proposed mitigation measures, combined with the proposed follow-up program element, increases confidence in the prediction that project operation and marine shipping incidental to the project are not anticipated to interfere with SRKW's life functions (detecting and capturing prey, socializing, mating, and prey sharing) within its critical habitat and will not jeopardize SRKW survival or recovery.

Glossary

Term	Definition
ambient noise	All-encompassing sound at a given place, usually a composite of sound from many sources near and far (ANSI S1.1-1994 R2004), e.g., shipping vessels, seismic activity, precipitation, sea ice movement, wave action, and biological activity.
attenuation	The gradual loss of acoustic energy from absorption and scattering as sound propagates through a medium.
background noise	Total of all sources of interference in a system used for the production, detection, measurement, or recording of a signal, independent of the presence of the signal (ANSI S1.1-1994 R2004). Ambient noise detected, measured, or recorded with a signal is part of the background noise.
broadband sound level	The total sound pressure level measured over a specified frequency range. If the frequency range is unspecified, it refers to the entire measured frequency range.
continuous sound	A sound whose sound pressure level remains above ambient sound during the observation period (ANSI/ASA S1.13-2005 R2010). A sound that gradually varies in intensity with time, for example, sound from a marine vessel.
ensonified	Exposed to sound.
equivalent continuous sound level (L_{eq})	This metric reflects the long-term, time-averaged noise level received at a given location from passing vessels over a one-year period and is directly related to the total sound exposure level over the same period. $L_{eq\text{-}1yr}$: annual time-averaged sound level.
sound exposure level (SEL)	A cumulative measure related to the sound energy in one or more pulses. Unit: dB re 1 $\mu Pa^2 \cdot s$. SEL is expressed over the summation period (e.g., 24-hour SEL).
sound pressure level (SPL)	The decibel ratio of the time-mean-square sound pressure, in a stated frequency band, to the square of the reference sound pressure (ANSI S1.1-1994 R2004). For sound in water, the reference sound pressure is one micropascal (p0 = 1 µPa) and the unit for SPL is dB re 1 µPa2: $L_p = 10 \log_{10}(p^2/p_0^2) = 20 \log_{10}(p/p_0)$ Unless otherwise stated, SPL refers to the root-mean-square (rms) pressure level. Non-rectangular time window functions may be applied during calculation of the rms value, in which case the SPL unit should identify the window type.
source level	The sound level measured in the far-field and scaled back to a standard reference distance of 1 metre from the acoustic centre of the source. Unit: dB re 1 µPa·m (pressure level) or dB re 1 µPa2·s·m (exposure level).

Appendices

Appendix IR2020-3-A	Enhancing Cetacean Habitat and Observation (ECHO) Program: Creating quieter oceans for healthier whales
Appendix IR2020-3-B	Updated Roberts Bank Terminal 2 container vessel call forecast study, Mercator International 2021
Appendix IR2020-3-C	Technical data report (TDR) – Underwater Noise Modelling of RBT2 Project Operation
Appendix IR2020-3-D	TDR – Assessing effectiveness of mitigation at the terminal to reduce potential acoustic effects on Southern Resident Killer Whales from project operation
Appendix IR2020-3-E	TDR – Underwater Noise Modelling of RBT2 Marine Shipping: Container Vessel Transit Exposure Model
Appendix IR2020-3-F	TDR - Effectiveness of RBT2 container vessel slowdowns to mitigate SRKW acoustic exposures from project operation
Appendix IR2020-3-G	Proposed mitigation measures – project operation and marine shipping incidental to the project
Appendix IR2020-3-H	Gomez et al.'s (2016) findings relevant to 2020 Minister's information request regarding avoidance and other mitigation measures for Southern Resident Killer Whales from RBT2 operations and marine shipping associated with the project
Appendix IR2020-3-I	Marine shipping follow-up program element framework

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