Impact Assessment Agency Ref Number: 80054

IMPACT ASSESSMENT AGENCY

IN THE MATTER OF an application by the Vancouver Fraser Port Authority pursuant to the *Canadian Environmental Assessment Act, 2012*, SC, c 19, s 52 to build the Roberts Banks Terminal 2 Project.

SUBMISSIONS OF DAVID SUZUKI FOUNDATION, GEORGIA STRAIT ALLIANCE, RAINCOAST CONSERVATION FOUNDATION & WILDERNESS COMMITTEE RE: VANCOUVER FRASER PORT AUTHORITY INFORMATION REQUEST RESPONSES AND IMPACT ASSESSMENT AGENCY DRAFT CONDITIONS

March 15, 2022
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Date submitted

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I. Overview

1. The Vancouver Fraser Port Authority (the "Proponent" or "VFPA"), is proposing to build a new container shipping terminal at Roberts Bank in Delta, British Columbia.[1]

2. The proposed Roberts Bank Terminal 2 Project (the "Project" or "RBT2"):

> would require the conversion of 177 ha of intertidal and subtidal habitat on Roberts Bank to construct a new three-berth container terminal, expand an existing causeway and enlarge an existing tug basin. The Project would be situated immediately adjacent to Tsawwassen First Nation Lands, existing port infrastructure and close to the community of Tsawwassen and the City of Delta, British Columbia. The Project is located on Roberts Bank in the Fraser River estuary, an ecologically productive and sensitive area of coastal British Columbia. Roberts Bank is located on the Pacific Flyway for migratory birds and is adjacent to a provincial wildlife management area and an international Ramsar site. Some of the largest salmon runs in the world utilize and migrate through Roberts Bank as juveniles and adults. Roberts Bank also encompasses critical habitat for the Southern Resident Killer Whale (SRKW) listed as endangered under the *Species at Risk Act*.[2]

3. The Project would also include the vessel traffic to and from the terminal ("Project Related Shipping").[3]

4. A review panel (the "Panel") established under the Canadian Environmental Assessment Act, 2012 ("CEAA 2012") completed an environmental assessment of the Project and issued a final report (the "Panel Report"), after which the Minister made further information requests to VFPA. VFPA has provided responses to the information requests (the "IR Responses").

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[1] Document #181, "Environmental Impact Statement – Volume 1 – Sections 1.0-7.0", (27 March 2015), at PDF p 1 [*EIS*], online: <https://iaac-aeic.gc.ca/050/documents/p80054/101388E.pdf>. A note on footnotes: Where footnotes indicate "PDF p", the pinpoints refer to the page number of the indicated PDF. Where footnotes indicate only "p", the pinpoint refers to the page number belonging to the referred-to document itself, usually found at the bottom right-hand corner of the document pages.

[2] Document #2062, "Report of the Review Panel, Vancouver Fraser Port Authority Roberts Bank Terminal 2 Project", (27 March 2020), at PDF p 15 [*Panel Report*], online: <https://iaac-aeic.gc.ca/050/documents/p80054/134506E.pdf>.

[3] *EIS*, *ibid* at PDF pp 53-68, 94-97; Document #1532, "From the Review Panel to the Minister of Environment and Climate Change re: Response to letter regarding Proposed Amendments to the Terms of Reference and Environmental Impact Statement Guidelines", (15 March 2019), online: <https://www.ceaa-acee.gc.ca/050/documents/p80054/128038E.pdf>; Document #1530, "Letter from the Minister of the Environment and Climate Change to the Review Panel re: Proposed Amendments to the Review Panel Terms of Reference and Environmental Impact Statement Guidelines (Note: Updated March 12, 2019)", (8 March 2019), online: <https://iaac-aeic.gc.ca/050/evaluations/document/128033>.

5. The Impact Assessment Agency (the "Agency"), after examining the IR Responses, has released proposed draft conditions for inclusion in a potential decision statement approving the Project (the "Draft Potential Conditions").[4]

6. The IR Responses and Draft Potential Conditions are subject to a comment period ending on March 15, 2022.

7. In this submission, the David Suzuki Foundation, Georgia Strait Alliance, Raincoast Conservation Foundation, and the Wilderness Committee (the "Conservation Coalition"), who previously participated in the environmental assessment, provide their comments on: 1) the new evidence in VFPA's IR Responses concerning the Project's effects and potential mitigation, and the Minister's forthcoming decision with respect to significance, and what the Minister's duties are under the *Species at Risk Act* ("SARA"); and 2) the Draft Potential Conditions that the Agency has prepared to inform the Minister or Cabinet's decision with respect to the conditions that will apply if they approve the Project.

8. With respect to both the new evidence and the draft conditions, the Conservation Coalition relies on two new expert opinions appended to these submissions: 1) a report of David Scott (the "Scott Report")[5], concerning the Project's impacts on juvenile Chinook salmon, and 2) a report of Dr. Scott Veirs and Dr. Val Veirs (the "Veirs' Report")[6], concerning the Project's impacts on Southern Resident killer whales (the "Southern Residents" or "SRKW").

9. To summarize, the Conservation Coalition's position on the new information is that nothing in VFPA's IR Responses – including new information regarding offsetting – alters the validity and gravity of the Panel's findings that the Project will have significant adverse effects on and contribute to cumulative significant adverse effects on Fraser River Chinook salmon and the Southern Residents, even after taking proposed mitigation into account. Specifically:

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[4] Document #2086, "Potential conditions under the *Canadian Environmental Assessment Act, 2012*", (15 December 2021), [*Draft Potential Conditions*], online: <https://iaac-aeic.gc.ca/050/documents/p80054/142133E.pdf>.

[5] David Scott, "Ecojustice Memo Re: RBT2 Final IR Responses and Draft Conditions", (2022), (Appendix 1), [*Scott Report*].

[6] Dr. Scott Veirs and Dr. Val Veirs, "Conservation coalition review of 'Agency conditions and VFPA responses to Minister's Information Requests'", (4 March 2022), (Appendix 2), [*Veirs Report*].

a. The Project will still require the conversion and loss of intertidal and subtidal habitat on Roberts Bank, that cannot be replaced *in situ*. The proposed offsetting projects will not credibly replace the habitat that will be lost, nor will they be functional on the timeline that is necessary for the affected Fraser River Chinook salmon populations – some of which are already of conservation concern.

b. The Project will still expand a physical barrier to salmon migration from the Fraser River. VFPA now concedes that the existing causeway is already impeding salmon migration. The proposed mitigation – a single 10 metre wide culvert somewhere along the causeway or at the terminal – is not adequate to offset the scale of the impact to migration, and does nothing to address the degradation of salmon habitat from the operation of the terminal.

c. The significant adverse environmental effects on Fraser River Chinook salmon are also significant adverse environmental effects on the Southern Residents, whose primary prey is Chinook salmon, and on their critical habitat, which includes the availability of Chinook salmon.

d. The Project will also impact the Southern Residents and their critical habitat (which includes a sufficiently quiet underwater environment) through the increase in noise from the Project operations at the terminal and Project Related Shipping. VFPA claims that the effects of this increase will be mitigated or offset; the Conservation Coalition and their experts disagree, and Fisheries and Oceans Canada ("DFO") has found that the effectiveness and adequacy of VFPA's proposed approach are "highly uncertain."

e. According to VFPA's revised future vessel traffic projections, the addition of the Project to the Vancouver ports would mean a transition to larger, noisier ships. While the transition to larger ships could potentially result in a reduction in overall *projected* vessel numbers, as VFPA argues, the addition of the Project will mean that *actual* vessel numbers remain at *current unsustainable* numbers. The Project would therefore lock in a volume of traffic that is already impacting the acoustic quality of the Salish Sea and posing an imminent threat to the Southern Residents' survival and recovery even assuming VFPA's vessel projections are correct.

f. The additional information provided by VFPA does not addresses the Panel's finding that a lethal vessel strike of a single individual Southern Resident could have significant adverse consequences at a population level.

g. The additional information provided by VFPA includes minor mitigation measures for Project operations and does not include any new measures to address the impacts on Southern Residents from Project Related Shipping.

10. The Conservation Coalition is also concerned about the Draft Potential Conditions, including the overall lack of specificity and uncertainty about their effectiveness and implementation, as well as particular shortcomings of many individual conditions.

11. Furthermore, the Conservation Coalition submits that the additional information on mitigation provided by VFPA and the conditions proposed by the Agency fail to satisfy the requirement in s. 79(2) of SARA to "ensure measures are taken to avoid or lessen" the effects of the Project on Southern Residents before any approval, and the requirement in s. 77(1) of SARA that "all feasible measures will be taken to minimize the impact of the activity on the species' critical habitat".[7]

12. Finally, the Conservation Coalition notes that, because VFPA's proposed mitigation and offsetting plan cannot be credibly relied on to mitigate the Project's impacts on Chinook salmon and Southern Residents in a timely or effective way, the Department of Fisheries and Oceans (DFO) will still be in the difficult position – raised by DFO during the hearings, noted by the Panel in its Report, and raised again in DFO's comments on the IR responses – of being potentially unable to issue SARA-compliant *Fisheries Act* permits that would be necessary for the Project to proceed, due to jeopardy to the Southern Residents' survival and recovery. It is not possible under Canadian law to issue a permit for an activity that may jeopardize the survival and recovery of a SARA-listed marine species.

13. Thus, the Conservation Coalition takes the position is that the Project will result in significant adverse effects on Chinook salmon and the Southern Residents that will not be adequately mitigated and cannot be justified in the circumstances.

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[7] *Species at Risk Act*, SC 2002, c 29, at s 79(2) [*SARA*], online: <https://canlii.ca/t/55cfs>.

II. The CEAA 2012 process to date

14. The Project was assessed by an independent Panel under CEAA 2012.[8]

15. The environmental assessment process conducted by the Panel included a public hearing from May 14 to June 24, 2019 (the "Hearing"), written submissions, and written closing remarks. The Panel was thus able to gather and test relevant information to inform its review of the potential environmental effects of the Project and Project Related Shipping.[9]

16. The Conservation Coalition participated in the Panel's assessment. Their participation emphasized their concerns about the Project's significant adverse environmental effects on salmon and salmon habitat and on marine species at risk, especially the endangered Southern Residents.

17. The Panel issued its final report (the "Panel Report") on March 27, 2020.[10] It concluded that the Project would have significant adverse environmental effects and contribute to cumulative environmental effects on, among other things, juvenile Chinook salmon and the Southern Residents. These conclusions are summarized in greater detail under heading IV below.

18. The next step in the process, according to s. 47(1) and 51 of CEAA 2012, would be for the Minister of Environment and Climate Change (the "Minister") to make a decision under s. 52(1) concerning whether the Project is likely to cause significant adverse environmental effects, after taking the Panel Report into account (the "Significance Decision").

19. Before doing so, on August 24, 2020, the Minister wrote to VFPA requesting additional information pursuant to s. 47(2) of CEAA 2012 concerning effects on juvenile salmon and the Southern Residents and options available to mitigate those effects.

20. The Conservation Coalition was informed by Agency staff via emails to legal counsel that they would be told when VFPA provided its answers to the Minister's information requests to the Agency, that they would have an opportunity to comment on these IR Responses,

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[8] SC 2012, c 19, s 52 [*CEAA 2012*], online: <https://canlii.ca/t/52zzf>.
[9] Document #1476, "Public Hearing Procedures", (1 March 2019), online: <https://www.ceaa-acee.gc.ca/050/documents/p80054/126871E.pdf>.
[10] *Panel Report*, *supra* note 2.

and that the Agency would then prepare draft conditions on which they would have a separate opportunity to comment.

21. On September 24, 2021, VFPA provided the IR Responses to the Agency. The IR Responses were not posted on the Agency's webpage for the Project at that time, although they are dated September 24, 2021 on the webpage.[11]

22. On November 30, 2021, after reading a Vancouver Sun article in which a VFPA spokesperson stated that VFPA filed the IR Responses in summer 2021[12], and after confirming that the IR Responses were still not available on the Agency's webpage for the Project, the Conservation Coalition emailed the Agency via legal counsel to ask whether VFPA had submitted the IR Responses.

23. The Agency informed the Conservation Coalition's legal counsel on December 9, 2021 that VFPA had submitted the IR Responses and that they were now available on the Agency's webpage for the Project. The Conservation Coalition then verified that the IR Responses had been added to the webpage at some time between the November 30 and December 9 emails.

24. On December 15, 2021, the Impact Assessment Agency (the "Agency") posted a document entitled "Potential conditions under the *Canadian Environmental Assessment Act, 2012*" (the "Draft Potential Conditions"), setting out the potential conditions for the Project that it is considering recommending to the Minister for inclusion in a decision statement.[13]

25. Also on December 15, 2021, the Agency announced a single 60-day public comment period on both the IR Responses and the Draft Potential Conditions, ending February 13, 2022. On February 9, 2022, the comment period was extended to March 15, 2022.

26. This submission is the Conservation Coalition's response to the Agency's request for comments on the IR Responses and on the Draft Potential Conditions. The Conservation Coalition instructed its experts to focus on the most the most consequential information

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[11] Document #2083, "From Vancouver Fraser Port Authority to Impact Assessment Agency of Canada re: Response to Information Requests" (24 September 2021), online: <https://iaac-aeic.gc.ca/050/evaluations/document/142382>.

[12] Derrick Penner, "Port's Roberts Bank clears hurdle in assessment of container proposal", *Vancouver Sun* (29 November 2021), online: <https://vancouversun.com/business/local-business/roberts-bank-rival-clears-hurdle-in-assessment-of-container-proposal>.

[13] *Draft Potential Conditions*, *supra* note 4.

and conclusions in VFPA's IR Responses. Therefore, we caution that the experts' silence on any given point should not be read as agreement with the IR Responses.

27. The next step in the process is for the Minister to decide that VFPA has complied with the requirement to provide necessary information under s. 47(2) of CEAA 2012, at which point the timeline for the Minister's Significance Decision, which is paused under s. 48(c), will resume.

III. The legal framework for the Minister's Significance Decision

28. The Minister's Significance Decision must conform to the requirements of CEAA 2012 and SARA.[14] The submissions below set out the process for the Significance Decision and the provisions it must comply with, as well as the meaning of key concepts within those provisions, and the purposes of the statutes, all of which inform the Minister's decision.

A. CEAA 2012

1. Requirements under CEAA 2012 for the Minister's Significance Decision

29. As stated above, once the Minister decides that VFPA has complied with his request for additional information under s. 47(2), the timeline for the Minister's Significance Decision will resume.[15]

30. The Minister must then decide, under s. 52(1) of CEAA 2012, whether, taking into account any mitigation that he considers appropriate, the Project is likely to cause significant adverse environmental effects. (The meanings of "mitigation" and of "significance" in this context are addressed below.) When making his Significance Decision, the Minister must take into account the Panel's findings as set out in the Panel Report.[16]

31. If the Minister decides that the Project is likely to cause significant adverse environmental effects, s. 52(2) requires him to refer the question of whether those effects are "justified in

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[14] *Tsleil-Waututh Nation v Canada (Attorney General)*, 2018 FCA 153 [*Tsleil-Waututh*], online: <https://canlii.ca/t/htq8p>. See also Document #1605, "Written Submissions of David Suzuki Foundation, Georgia Strait Alliance, Raincoast Conservation Foundation and Wilderness Committee", CCR Vol 1, (15 April 2019), at paras 28-59, [*Conservation Coalition Written Submissions Vol. 1*], online: <https://ceaa-acee.gc.ca/050/documents/p80054/129297E.pdf>.

[15] *CEAA 2012*, ss 47(2), 48(c).

[16] *Ibid*, ss 47(1), 51.

the circumstances" to the Governor in Council, which must decide whether they are or are not justified in the circumstances.[17] (The meaning of "justified" is addressed below.)

32. If the Minister decides that the effects are not significant, or the Governor in Council decides that they are justified, s. 53(1) of CEAA 2012 requires that decision maker to establish the conditions with which the Proponent must comply. Conditions must include "the implementation of the mitigation measures that were taken into account" in the Significance Decision, as well as the implementation of a "follow-up program".[18] A "follow-up program" is for "verifying the accuracy of the environmental assessment" and "determining the effectiveness of any mitigation measures"[19]; the definition of "mitigation" is addressed in the next section. The Agency has prepared the Draft Project Conditions for the Minister's, or Governor-in-Council's, consideration.

33. As explained below, "significance" is defined in policy, and the Panel, following those policies, and keeping in mind the purposes of CEAA 2012, found that there would be significant adverse environmental effects. Unless VFPA's new evidence alters those conclusions – and the Conservation Coalition submits it does not – the Minister must uphold the Panel's finding of significant adverse environmental effects.

2. The purposes of CEAA 2012 guide the Minister's Significance Decision

34. The Significance Decision must be consistent with the purposes of CEAA 2012, and must be made in a manner that protects the environment and applies the precautionary principle.[20]

35. CEAA 2012's purposes, set out in s. 4(1), include:

    a. protection of the environment within federal jurisdiction from significant adverse environmental effects caused by a designated project;[21]

    b. ensuring that designated projects are considered in a careful and precautionary manner to avoid significant adverse environmental effects;[22] and

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[17] *Ibid*, s 52(2), (4).
[18] *Ibid*, s 53(4).
[19] *Ibid*, s 2(1).
[20] *Ibid*, s 4(1) and (2).
[21] *Ibid*, s 4(1)(a).
[22] *Ibid*, s 4(1)(b).

c. encouraging federal authorities to take actions that promote sustainable development in order to achieve or maintain a healthy environment and a healthy economy.[23]

36. "Sustainable development", referred to in s. 4(1)(c), is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."[24] The principle of sustainable development reflects the ecological reality that, to ensure natural systems will continue to function into the future, decision-makers must be mindful to recognize, understand, and respect system limits. Legal scholars explain that "[s]ustainable development is development that can happen within the 'carrying capacities' of the biosphere."[25]

37. The precautionary principle referred to in section 4(2) is not defined in CEAA 2012, but the Supreme Court of Canada has held that it requires that:

> [e]nvironmental measures must anticipate, prevent and attack the causes of environmental degradation. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.[26]

38. The Panel applied these purposes and principles in the Panel Report, including by taking a conservative approach to its factual findings where there were uncertainties about the data.[27] The Panel also required a higher or more conservative standard for mitigation when there were uncertainties respecting the feasibility, functionality or effectiveness of proposed mitigation.[28]

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[23] *Ibid*, s 4(1)(h) and s 2(1), definition of "sustainable development".

[24] *Report of the World Commission on Environment and Development "Our Common Future"*, UNGAOR, 42nd Sess, Annex, Agenda Item 3, UN Doc A/42/427 (1987) at p 24, online: <https://digitallibrary.un.org/record/139811?ln=en>.

[25] Natasha Affolder, "The Legal Concept of Sustainability" (Symposium on Environment in the Courtroom: Key Environmental Concepts and the Unique Nature of Environmental Damage, 23-24 March 2012) (Calgary: Canadian Institute of Resources Law, University of Calgary, 2012) at PDF p 6, online: <https://cirl.ca/files/cirl/natasha_affolder-en.pdf>.

[26] *114957 Canada Ltée v Hudson*, 2001 SCC 40 at para 31, online: <https://canlii.ca/t/51zx>.

[27] *Panel Report*, *supra* note 2 at PDF p 41.

[28] *Ibid* at PDF pp 155-156

3. *The meaning of "mitigation" in the Significance Decision*

39. Mitigation is defined in CEAA 2012, and its standards have been interpreted by the courts. If the definition and standards are not satisfied, then in law, there is no mitigation.

40. Mitigation measures are defined in s. 2 of CEAA 2012 as "measures for the elimination, reduction or control of adverse environmental effects" and the term "includes restitution for any damage to the environment caused by those effects through replacement, restoration, compensation or any other means".[29]

41. Mitigation measures are intended to be actual, identifiable measures which will eliminate, reduce, or control adverse effects of a project. Courts have been clear that "vague hopes for future technology" to address effects do not constitute mitigation measures.[30] Vague assurances of adaptive management, further study, and conceptual and unproven ideas do not constitute mitigation measures.[31]

42. The Panel found, with respect to the meaning of mitigation, that:

    a. while "voluntary initiatives […] are encouraged […] voluntary measures do not suffice as mitigation"[32]; and

    b. initiatives that are not "directly controlled by the proponent" may not be achieved, and therefore that VFPA's assumptions based on such initiatives could be overly optimistic, with the result that effects might be worse than those VFPA has modelled[33].

43. The Panel, citing the purposes provision of CEAA 2012, specifically noted that the Project was "to be considered in a careful and precautionary manner to avoid significant adverse environmental effects."[34] Consistent with this, and as explained above with respect to what constitutes mitigation, the Panel stated that it did not consider "future management plans"

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[29] *CEAA 2012*, s 2(1), definition of "mitigation measures".

[30] *Pembina Institute for Appropriate Development v Canada (Attorney General)*, 2008 FC 302 at para 25, [*Pembina*] online: <https://canlii.ca/t/1vxtx>.

[31] *Taseko Mines Limited v Canada (Environment)*, 2017 FC 1099 at paras 101, 122-124 [*Taseko*], online: <https://canlii.ca/t/hp4hn>; upheld on appeal: *Taseko Mines Limited v Canada (Environment)*, 2019 FCA 319, online: <https://canlii.ca/t/j46rs>.

[32] *Panel Report*, *supra* note 2 at PDF p 59.

[33] *Ibid* at PDF p 91.

[34] *Ibid* at PDF p 39.

to be "a substitute for providing technical[ly] and economical[ly] feasible mitigation measures", nor did it consider "adaptive management appropriate as a response to uncertainty about the significance of environmental effects."[35] This precautionary approach is particularly appropriate in the context of impacts on SARA-listed species.

44. As part of its precautionary approach, the Panel found that "if there is uncertainty about whether the Project would be likely to cause a significant adverse environmental effect, a commitment to monitoring Project effects and to manage adaptively is not sufficient", and that "if evidence from the follow-up programs indicate unforeseen adverse Project-related effects, offsetting those effects is not the appropriate first line of corrective action for the elimination, reduction or control of the adverse environmental effects."[36]

45. The Panel additionally found that "[m]onitoring and follow-up without some assurance that mitigation measures are readily available to fully mitigate effects that arise from the Project leads to uncertainty in the Proponent's ability to mitigate in an effective and timely manner." In applying this to the Project, it found that "[i]n almost all cases, the Proponent's Environmental Management Plans did not provide the necessary details on the technical and economic feasibility of measures that are available in the event of an adverse environmental effect."[37]

46. When assessing whether something rises to the level of a mitigation measure, the Conservation Coalition submits that the Minister should consider the reliability, feasibility and effectiveness of the measure to reduce the identified impact on the particular species. Consistent with the requirement to avoid or lessen impacts on SARA-listed species, discussed below, the Conservation Coalition submits that these criteria are critical given that species at risk lack the resilience of healthy populations to absorb losses and thus cannot afford for mitigation to fail.

47. Finally, follow-up programs are a separate requirement under CEAA 2012 and should not be confused with mitigation. They are defined as "a program for (a) verifying the accuracy

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[35] *Ibid* at PDF p 40.
[36] *Ibid* at PDF p 40.
[37] *Ibid* at PDF p 487.

of the environmental assessment of a designated project; and (b) determining the effectiveness of any mitigation measures."[38]

4. *The meaning of "significant" in the Significance Decision*

48. "Significance" includes the Project's effects, and cumulative effects. Subsection 19(1) of CEAA 2012 requires that environmental assessments take into account:

    a. the environmental effects of the designated project, including the environmental effects of malfunctions or accidents that may occur in connection with the designated project and any cumulative environmental effects that are likely to result from the designated project in combination with other physical activities that have been or will be carried out; [and]

    b. the significance of the effects referred to in paragraph (a).[39]

49. Significance is not defined in CEAA 2012. However, there is a relevant Canadian Environmental Assessment Agency guidance document, and a relevant Environment Canada SARA policy, and the Panel interpreted significance consistently with those policies.

50. The Panel adopted the same criteria for determining significance that appear in the Canadian Environmental Assessment Agency's guidance document: magnitude, spatial extent, frequency, duration, and reversibility.[40]

51. Because this guidance document does not establish thresholds, the Panel selected thresholds it believed were appropriate, taking into account "the ecological and social context of the environmental component", such as being listed under SARA.[41] The Panel explained that it:

> took into account the ecological and social context of the environmental component when considering the key criteria to better characterize whether

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[38] *CEAA 2012*, s 2(1), definition of "follow-up program".

[39] *Ibid*, s 19(1).

[40] *Panel Report*, *supra* note 2 at PDF p 39, relying upon Canadian Environmental Assessment Agency, "Determining Whether a Designated Project is Likely to Cause Significant Adverse Environmental Effects under CEAA 2012", (November 2015), [*CEAA 2012 Policy*], online: <https://www.canada.ca/en/environmental-assessment-agency/news/media-room/media-room-2015/determining-whether-designated-project-is-likely-cause-significant-adverse-environmental-effects-under-ceaa-2012.html> (which was cited in *Conservation Coalition Written Submissions Vol. 1*, *supra* note 14 at para 41).

[41] *Panel Report*, *ibid* at PDF pp 39-40.

> adverse effects are significant. For example, when an environmental component was designated as a ‘threatened’ or ‘endangered’ species under the *Species at Risk Act*, the Panel took into consideration how even minor effects of the Project on such species or on the habitat upon which such species relied on [*sic*] could adversely affect the species.[42]

52. This approach was also consistent with Environment Canada’s SARA policy, which states that, for the purposes of assessing the significance of adverse effects on SARA-listed species, “the status of species at risk should be taken into consideration.”[43]

53. The Panel’s approach constitutes a rejection of VFPA’s narrow and extreme definition of significance; it specifically contrasted its approach with VFPA’s.[44] VFPA argued before the Panel that significance only applies to something that affects one or more individuals, or results in a change to critical habitat such that “a feature would not be available when needed for a life function”, and does so “to the extent which could jeopardize survival or recovery of the species.”[45] The Proponent does not appear to have addressed this question in its IR Responses as the Minister did not ask about it; therefore, the Conservation Coalition assumes this is still the Proponent’s position, and the Panel’s rejection of it still stands.

5. The meaning of “justified” in a potential Governor in Council decision

54. “Justified in the circumstances” is not defined in CEAA 2012, and the Panel did not opine on whether the significant adverse effects it identified would be “justified in the circumstances”

55. Dictionary definitions of “justified” include: having a good reason for something;[46] to prove or show to be just, right or, reasonable; to show to have had a sufficient legal

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[42] *Ibid* at PDF pp 39-40.

[43] Environment Canada and Parks Canada, “Addressing Species at Risk Act Considerations under the Canadian Environmental Assessment Act for Species under the Responsibility of the Minister Responsible for Environment Canada and Parks Canada”, (Ottawa: Government of Canada, 2010), [*SARA Policy*], online: <https://publications.gc.ca/collections/collection_2010/ec/CW66-281-2010-eng.pdf>. Cited in Document #1605, “Written Submissions of David Suzuki Foundation, Georgia Strait Alliance, Raincoast Conservation Foundation and Wilderness Committee”, CCR Vol 2, at Appendix F, PDF p 293, online: <https://ceaa-acee.gc.ca/050/documents/p80054/129296E.pdf>.

[44] *Panel Report*, *supra* note 2 at PDF p 39.

[45] Document #316, “Marine Shipping Addendum, Sections 1-8”, (26 October 2015), at PDF p 260, [*Marine Shipping Addendum*], online: <https://www.ceaa-acee.gc.ca/050/documents/p80054/103688E.pdf>.

[46] *English Oxford Living Dictionaries*, sub verbo “justified”, online: <https://www.lexico.com/definition/justified>.

reason.[47] In case law interpreting the equivalent provision in the previous *Canadian Environmental Assessment Act* of 1992, the Federal Court defined justification as a balancing of adverse environmental effects against social, economic and other non-environmental benefits.[48] The Conservation Coalition submits that the requirements of other federal laws and Canada's international commitments are also among the "circumstances" relevant to the justification analysis; any decision under a federal statute may be challenged in Federal Court if it is "contrary to law".[49]

56. As explained below, the purposes and provisions of SARA, set out below, limit the Governor in Council's discretion or power to justify adverse effects under CEAA 2012. SARA requires that adverse effects on listed species must be addressed, not simply deemed "justified", and it contains prohibitions and permitting requirements that are additional to the CEAA 2012 process.

57. The Conservation Coalition submits that it is not legally possible to "justify", under CEAA 2012, significant adverse effects on a federally protected endangered species, in particular where it is apparent from the evidence that the effects will not be adequately mitigated, will violate provisions of SARA, or will jeopardize survival and recovery of the species.

B. SARA

58. SARA imposes additional requirements to CEAA 2012 that are directly or indirectly relevant to decisions under CEAA 2012.

59. First, s. 79(2) of SARA directly imposes requirements beyond those of CEAA 2012 for measures to avoid or lessen the Project's effects. The decision maker under CEAA 2012 – whether the Minister under s. 52(1) or the Governor in Council under s. 52(2) – must also fulfill the requirements of s. 79(2) of SARA, to ensure measures to avoid or lessen effects on SARA-listed species and their critical habitat. Subsection 77(1) provides that the Project cannot be authorized unless all feasible measures will be taken to minimize its impacts on SARA-listed species' critical habitat. The Minister, or Cabinet, must now, if the Project

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[47] *Cambridge Dictionary*, sub verbo "justified", online: <https://dictionary.cambridge.org/dictionary/english/justified>.

[48] *Prairie Acid Rain Coalition v Canada (Minister of Fisheries and Oceans)*, 2004 FC 1265 at para 93, online: <https://canlii.ca/t/1jhc7>.

[49] *Federal Courts Act,* RSC, 1985, c F-7, s 18.1(4)(f), online: <https://canlii.ca/t/7vgp#sec18.1>.

proceeds, ensure that all feasible measures will be taken and that there are measures in place to avoid or lessen *all effects* on Southern Residents and to monitor them.

60. Second, VFPA will require a SARA-compliant *Fisheries Act* authorization for the construction and operations phases of the Project. An approval under CEAA 2012 does not guarantee that further necessary permits under other statutes will issue. This is particularly so where the Project will affect SARA-listed species such as the Southern Residents. Section 74 of SARA makes it clear that a permit for an activity affecting a listed wildlife species or any part of its critical habitat issued under another Act of Parliament, such as the *Fisheries Act*, may only issue if, as required by s. 73(3)(c) of SARA, "the activity will not jeopardize the survival or recovery of the species".[50]

1. The Project cannot be approved unless SARA s. 79(2) requirements are met

61. The purposes of SARA include preventing wildlife species from being extirpated or becoming extinct, and providing for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity.[51]

62. Providing legal protection for species at risk through SARA is intended to meet Canada's commitments under the *United Nations Convention on the Conservation of Biological Diversity* ("*Convention on Biological Diversity*")[52] – the first principle of which is the conservation of biodiversity.[53] Thus, the *Convention on Biological Diversity* is part of the context to consider in interpreting SARA.[54] There is a presumption that Canadian domestic law is meant to comply with Canada's international commitments and should be interpreted consistently with them; interpretations of Canadian law that would put Canada in breach of its international commitments should therefore be avoided.[55] The Project is likely to have adverse effects on matters covered by existing international agreements and commitments made by Canada, including with respect to biodiversity.

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[50] *SARA*, ss 73 and 74.

[51] *Ibid*, s 6.

[52] *Ibid*, preamble.

[53] *United Nations Convention on the Conservation of Biological Diversity*, 5 June 1992, 1760 UNTS 69 (entered into force 29 December 1993), Article 1, online: <https://www.cbd.int/doc/legal/cbd-en.pdf>.

[54] *Environmental Defence Canada v Canada (Fisheries and Oceans)*, 2009 FC 878 at paras 38-39, online: <https://canlii.ca/t/25l43>.

[55] *R v Hape*, 2007 SCC 26 at paras 53-56, online: <https://canlii.ca/t/1rq5n>; Ruth Sullivan, *Sullivan on the Construction of Statutes*, 5th ed (Markham: LexisNexis Canada Inc, 2008), pp 538-543.

63. SARA creates a scheme to ensure the fulfillment of its purposes[56] in which s. 79 plays an integral role. Section 79 works with the other protective provisions in SARA to protect listed wildlife species from existing threats and to ensure that the adverse effects of new activities do not exacerbate pre-existing problems or create new problems for already struggling species, in order to prevent extinction and allow for recovery.

64. The content of the s. 79(2) duty is clear from the plain language of the provision. Section 79(2) of SARA applies when a project that is being reviewed under CEAA 2012 is likely to affect a listed species or its critical habitat.[57] These requirements apply for all federally protected species that are likely to be affected by the Project, including, but not limited to, the Southern Residents. They also apply to these species' critical habitat, which in this case includes the Southern Residents' prey, Chinook salmon.[58]

65. Subsection 79(2) provides that the "person" required to ensure that a CEAA 2012 environmental assessment of a project is conducted (in this case, the Panel):

> must identify the adverse effects of the project on the listed wildlife species and its critical habitat and, if the project is carried out, must ensure that measures are taken to avoid or lessen those effects and to monitor them. The measures must be taken in a way that is consistent with any applicable recovery strategy and action plans.[59]

66. This provision also creates obligations for the decision-maker, whether it is the Minister or the Governor in Council. The Federal Court of Appeal has confirmed that s. 79(2) requires the review panel in question to provide an "exposition of all technically and economically feasible measures that are available to avoid or lessen the Project's effects on the Southern resident killer whale" (or other species at issue), so that, "[a]rmed with this information the [Minister or] Governor in Council would be in a position to see that, if approved, the

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[56] *David Suzuki Foundation v Canada (Fisheries and Oceans)*, 2010 FC 1233 at para 13, online: <https://canlii.ca/t/2dw8l>.

[57] *SARA*, s 79(1). Note that s 79(1) now refers to Canada's newer federal impact assessment legislation, the *Impact Assessment Act* (SC 2019, c 28, s 1): see *SARA*, s 79 as it appeared in May 2016 (when the Roberts Bank Terminal 2 environmental assessment review panel was established), online: <https://canlii.ca/t/7vxm#sec79>.

[58] DFO, "Recovery Strategy for the Northern and Southern Resident Killer Whales (*Orcinus orca*) in Canada" (2018), at PDF p 61, [*SRKW Recovery Strategy*], online: <https://wildlife-species.canada.ca/species-risk-registry/virtual_sara/files/plans/Rs-ResidentKillerWhale-v00-2018dec-Eng.pdf>.

[59] *SARA*, s 79(2). For the last version of *SARA* that applied to *CEAA 2012* assessments rather than the *Impact Assessment Act*, see *SARA* as it appeared from August 8-27, 2019, online: <https://canlii.ca/t/5439b>.

Project was not approved until all technically and economically feasible mitigation measures within the authority of the federal government were in place."[60]

67. Therefore, s. 79(2) requires the following things above and beyond CEAA 2012:

   a. a requirement that the environmental assessment identify all adverse effects of the Project on a listed wildlife species and its critical habitat, and, if the Project is carried out, further requirements to ensure that those effects are both mitigated and monitored;

   b. a requirement to ensure that measures are taken to avoid or lessen all "adverse effects" of the Project on listed wildlife species and critical habitat, regardless of the significance of those effects; and

   c. a requirement that, if a recovery strategy or action plan exists for the species, the measures must be taken in a way that is consistent with that recovery strategy or action plan; and

   d. a requirement that the Minister or Governor in Council must not approve the Project until all technically and economically feasible measures within federal jurisdiction are in place.

68. The above interpretation is consistent with Environment Canada's policy for "Addressing *Species at Risk Act* Considerations under the *Canadian Environmental Assessment Act*" (the "SARA Policy").[61] The SARA Policy is the only Government of Canada operational policy statement that addresses s. 79 of SARA. The SARA Policy clearly states that s. 79 obligations are in addition to the requirements of CEAA 2012, and that they apply regardless of the significance of the effects on SARA-listed species.[62]

69. The Southern Residents are listed as endangered under SARA.[63] Chinook salmon populations are not yet listed under SARA, but multiple populations in the Fraser River watershed have been assessed as "at risk" by the Committee on the Status of Endangered Wildlife in Canada ("COSEWIC") and are awaiting SARA listing decisions, including the

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[60] *Tsleil-Waututh*, *supra* note 14 at para 456.
[61] *SARA Policy*, *supra* note 43.
[62] *Ibid* at PDF pp 253, 256-257.
[63] *SARA*, Schedule 1, Part 2.

ocean-type Lower Fraser Chinook population, which COSEWIC assessed as threatened, and which the Panel found will experience significant adverse effects from the Project.[64] The Panel also found that the Project will have significant adverse impacts on south Thompson Chinook – the *only* not-at-risk population of Fraser River Chinook. Maintaining at least one reasonably healthy Chinook population in the Fraser is important for the ecosystem as a whole, and for the Southern Residents. Critically, Chinook salmon are also an identified and legally protected attribute of Southern Resident critical habitat – prey availability.[65] Subsection 79(2) therefore imposes obligations on the Minister (and potentially Governor in Council) with respect to both the Southern Residents themselves and their critical habitat, which includes certain Chinook salmon populations, that are preconditions to any approval under s. 52 of CEAA 2012.

2. The Project cannot be approved unless SARA s. 77(1) requirements are met

70. Subsection 77(1) of SARA requires that "any person or body, other than a competent minister, authorized under any Act of Parliament, other than this Act, to issue or approve a licence, a permit or any other authorization that authorizes an activity that may result in the destruction of any part of the critical habitat of a listed wildlife species" can only do so "if the person or body has consulted with the competent minister, has considered the impact on the species' critical habitat, and is of the opinion that" two conditions are met: "(a) all reasonable alternatives to the activity that would reduce the impact on the species' critical habitat have been considered and the best solution has been adopted", and "(b) all feasible measures will be taken to minimize the impact of the activity on the species' critical habitat." [66]

71. Subsection 77(2) clarifies that the prohibition on critical habitat destruction in s. 58(1) still applies if such an authorization is issued.

72. In this case, this requirement applies to the Minister or Cabinet if they decide to approve the Project, which will destroy part of Southern Resident critical habitat. The competent

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[64] *Panel Report*, *supra* note 2 at PDF p 198.

[65] *Ibid* at PDF pp 228-229; *SRKW Recovery Strategy*, *supra* note 58 at PDF p 64.

[66] *SARA*, s 77(1).

minister for the Southern Residents, as defined in s. 2(1), is both the Minister and the Minister of Fisheries and Oceans.

3. *Project approval cannot be contrary to SARA prohibitions and permitting provisions*

73. The Panel found that the Project will require a permit or authorizations under the *Fisheries Act* and SARA,[67] because the project will be built directly on top of and thus destroy intertidal and subtidal fish habitat on Roberts Bank. The Project footprint is also physically within designated critical habitat of the Southern Residents. Thus, DFO told the Panel that a SARA-compliant *Fisheries Act* authorization would be required for construction and footprint related impacts, as they would destroy Southern Resident critical habitat.[68]

74. Under SARA, no agreements, permits, or authorizations can issue for the harming of a listed marine species or its critical habitat that would the jeopardize survival or recovery of the species.[69]

75. Individuals of an aquatic species listed as endangered or threatened under SARA are automatically protected from harm.[70] Subsection 32(1) of SARA prohibits the killing, harming harassing, capturing or taking an individual of listed wildlife species.[71]

76. Once critical habitat is identified for aquatic species, it must be legally protected from destruction either under SARA or other laws of Canada.[72] Subsection 58(1) of SARA makes it an offence to destroy any part or biological attribute of critical habitat of an aquatic species. Subsection 58(1) applies to the Southern Residents' critical habitat through the operation of the *Southern Resident Critical Habitat Protection Order*.[73]

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[67] *Panel Report*, *supra* note 2 at PDF p 19.

[68] *Ibid* at PDF p 224.

[69] *Canada v David Suzuki Foundation*, 2012 FCA 40, at paras 121, 122, 124, 125, online: <https://canlii.ca/t/fq4v4>.

[70] *SARA*, s 32(1).

[71] *Ibid*, s 2(1), definition of "residence", and s 33.

[72] *Ibid*, ss 57, 58(5).

[73] Critical Habitat of the Killer Whale (Orcinus orca) Northeast Pacific Southern Resident Population Order, (2019) C Gaz II, 4797, at PDF p 59, online: <https://wildlife-species.canada.ca/species-risk-registry/virtual_sara/files/g2-152264.pdf>.

77. “Destruction” of critical habitat is not defined in SARA. Citing policy, DFO defined critical habitat destruction before the Panel as:

> The degradation of part of the critical habitat, either permanently or temporarily, such that it would not serve its function when needed by the species, resulting from a single or multiple activities at one point in time or from the cumulative effects of one or more activities over time.[74]

78. SARA explicitly requires that no permits be issued for activities that will harm a species at risk or any part of its critical habitat, where those activities will jeopardize survival and recovery of that species.[75]

79. SARA permits for activities affecting protected wildlife species or their critical habitat may only issue if three statutory preconditions are met under s. 73(3):

    a. all reasonable alternatives to the activity that would reduce the impact on the species have been considered and the best solution has been adopted;

    b. all feasible measures will be taken to minimize the impact of the activity on the species or its critical habitat or the residences of its individuals; and

    c. the activity will not jeopardize the survival or recovery of the species.[76]

80. Regardless of the Minister’s or Governor in Council’s decision under s. 52, the Project cannot proceed if these preconditions cannot be satisfied.

81. The permitting process conducted by DFO under the *Fisheries Act* and SARA for the construction and operation of the Project is a separate process that would happen after the current CEAA 2012 process.[77] In the permitting process, the Minister of Fisheries and Oceans and her delegates are bound by the statutory requirements of the *Fisheries Act* and SARA.

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[74] Document #1797, “Review Panel Public Hearing Transcript”, (22 May 2019), at PDF p 118, [*Public Hearing Transcript, May 22, 2019*], online: <https://ceaa-acee.gc.ca/050/documents/p80054/129908E.pdf>.

[75] *SARA*, ss 73-74.

[76] *Ibid*, s 73.

[77] Document #2407, “Submission of Fisheries and Oceans Canada to the Impact Assessment of Canada Regarding Vancouver Fraser Port Authority Responses to New Information Requirements for the Proposed Roberts Bank Terminal 2 Project”, (11 February 2022), at p 16, [*DFO Submissions*], online: <https://iaac-aeic.gc.ca/050/evaluations/proj/80054/contributions/id/57155>.

82. It is the Conservation Coalition's position that the Project cannot be approved under CEAA 2012 if it will violate SARA prohibitions or jeopardize survival or recovery of the Southern Residents. Effects that cannot be permitted under SARA cannot be justified under CEAA 2012.

IV. The Panel Report

83. Following extensive public, Indigenous, and technical hearings, the Panel found that the Project would have numerous significant adverse environmental effects, including effects on wetlands and wetland functions at Roberts Bank, SARA-listed Barn owl, Dungeness crab, ocean-type Chinook from the Lower Fraser and South Thompson Rivers, the SARA-listed Southern Residents, the use of lands and resources for traditional purposes for multiple First Nations, cultural heritage for two First Nations, human health, and agricultural land.[78] The Panel also found that "in many instances, the mitigation measures proposed by the Proponent would not be as effective as the Proponent predicted."[79]

A. The Panel's findings on Chinook salmon

84. The Panel found, taking into account the mitigation and offsetting proposed by VFPA, that the Project is likely to have significant adverse environmental effects on juvenile Chinook salmon, and specifically on ocean-type populations from the Lower Fraser and Southern Thompson Rivers. The findings that led to this overall conclusion are summarized below. As described further below, and in the attached report of biologist David Scott, the findings of the Panel continue to be relevant and appropriate despite the supplemental information provided by the Proponent.

85. With respect to the terminal footprint's impact on salmon, the Panel found that it "would add to any existing disruption effects from the existing terminal and causeway and further restrict the access of juvenile salmon to productive habitats within the inter-causeway area".[80] VFPA conducted a recent analysis which found that juvenile Chinook densities were higher in spring on the north side of the existing causeway relative to the inter-

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[78] *Panel Report*, *supra* note 2 at PDF pp 15-17.
[79] *Ibid* at PDF p 487.
[80] *Ibid* at PDF p 201.

causeway area, confirming that the existing causeway is a barrier to juvenile Chinook migration.[81]

86. With respect to mitigation of these effects, the Panel noted DFO's conclusion in its submissions to the Panel "that the Proponent should reconsider Project design to reduce the adverse effects of the Project and potential effects on fish and fish habitat or increase proposed offsetting in order to meet DFO's policy objectives under the *Fisheries Act*."[82] The Panel agreed with DFO that "the negative effects of the Project would need to be reduced, or alternatively the offsetting would need to be increased."[83]

87. The Panel concluded "that the proposed offsetting plan, totaling 29 hectares, is not sufficient to compensate for the reduction in productivity associated with the habitat loss of 177 hectares at Roberts Bank."[84] The Panel further cautioned that "it is unlikely that there are sufficient onsite offsetting opportunities in the vicinity of the Project in order to compensate for the loss of productivity."[85] As discussed further below and also in the Scott Report 2022, despite identifying additional offsets, VFPA's offsetting plan is still not sufficient to compensate for the habitat lost as a result of the Project.

88. Counter to the suggestion of the Proponent, and as explained further in the Scott Report, the Panel did not endorse VFPA's modelling approach. Rather, the Panel concurred with DFO's concern "that using total functional group biomass as an equivalency metric was an unusual approach" and did not necessarily focus on "habitat features of interest" that would be lost due to the Project.[86] The Panel endorsed, based on advice from DFO, "the necessity to achieve habitat equivalency such that offset productivity is commensurate with the adverse effects of the Project on fish productivity."[87] Finally, the Panel found that VFPA had failed to demonstrate habitat equivalency, which is "a relevant yardstick to measure mitigation effectiveness", and had "introduce[ed] uncertainty into the ability of the

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[81] *Scott Report, supra* at note 5 at PDF p 6, citing S Phillips and V Karpouzi, "Roberts Bank Terminal 2 Follow-up Program: Juvenile Salmon Density Annual Data Report – 2020" (2021) prepared for Vancouver Fraser Port Authority.

[82] *Panel Report, supra* note 2 at PDF p 154.

[83] *Ibid* at PDF p 156.

[84] *Ibid*.

[85] *Ibid*.

[86] *Ibid* at PDF p 15.

[87] *Ibid* at PDF p 195.

proposed offsets to mitigate Project effects."[88] As explained below and in detail in the Scott Report, the failure to replace lost habitat with equivalent habitat type continues to be a problem with VFPA's offsetting plan.

89. With respect to impacts on salmon from terminal operations, the Panel found that there would be "minor decreases in chum and ocean-type Chinook salmon productivity due to mortality in the acoustic and light environments" and that the effects "would not be mitigated and therefore would result in a residual adverse effect."[89]

90. The Panel found that effects on salmon would primarily be on Lower Fraser and South Thompson ocean-type Chinook, which spend more time in the estuary habitats than river type salmon.[90] These populations of Chinook are of significant importance as a prey of the critically endangered Southern Residents.[91]

91. Based on the above, the Panel concluded that "the Project will have an adverse residual effect on juvenile Chinook salmon due to migration disruption, coupled with minor adverse effects in the acoustic and light environments during construction and operations. This effect would be high in magnitude, local in extent, permanent in duration, and irreversible", and "significant".[92] The Panel further found that it was "reasonable to expect that past effects on juvenile Chinook salmon would combine with the Project effects to result in a significant cumulative effect."[93] The significant adverse effects, including cumulative effects, would be on ocean-type juvenile Chinook salmon populations from the Lower Fraser and South Thompson Rivers.[94]

B. The Panel's findings on impacts to the Southern Residents

92. The Panel found that "the Project and marine shipping associated with the Project would result in a significant adverse cumulative effect on" the Southern Residents, for the reasons

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[88] *Ibid*.
[89] *Ibid* at PDF 201.
[90] *Ibid* at PDF pp 201-202.
[91] *Ibid* at PDF p 228.
[92] *Ibid* at PDF p 201.
[93] *Ibid* at PDF p 202.
[94] *Ibid*.

detailed below.[95] As explained further below in Part V and in the attached Veirs' Report, the Panel's findings remain valid in light of the IR Responses.

93. The Panel noted DFO's submissions with respect to the DFO's May 2018 Imminent Threat Assessment, which concluded that the Southern Residents are "facing an imminent threat to their survival and recovery", which is "imminent in the sense that intervention is required to allow for survival and eventual recovery."[96]

94. With respect to the Project's impacts on Chinook salmon (its findings on which are summarized above), the Panel found that "there is a demonstrated relationship between Chinook salmon abundance and SRKW survival."[97] It further found that "sufficient availability of Chinook salmon is one of the features of critical habitat necessary for the survival and recovery of SRKW, and DFO highlighted that reduced prey availability is the main factor affecting SRKW survival and recovery."[98]

95. The Panel noted DFO's "statement that construction of the Project would result in impacts to Chinook salmon habitat, and would therefore result in the destruction of SRKW critical habitat."[99] It found that the ocean-type Lower Fraser and South Thompson River populations of Chinook are "particularly vulnerable to the Project's effects due to their life history and extensive use of Roberts Bank habitat", and that it is "important […] that Chinook salmon spawning runs originating from the lower Fraser River system and the South Thompson River are of greatest overall importance in the diet of" the Southern Residents.[100]

96. The Panel concluded with respect to effects on prey availability that:

> the Project would result in a residual adverse effect on prey availability for SRKW, and the effect would be moderate in magnitude due to the nutritionally stressed state of the population. The effects would be regional in extent, permanent in duration, irreversible, and continuous. This residual

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[95] *Ibid* at PDF p 230.
[96] *Ibid* at PDF p 224.
[97] *Ibid* at PDF p 228.
[98] *Ibid* at PDF pp 228-229.
[99] *Ibid* at PDF p 228.
[100] *Ibid*.

> effect would result in the partial loss of legally defined critical habitat for SRKW.[101]

97. The Panel noted DFO's submission that, based on the imminent threat, it was of the opinion that the Project's construction and footprint "would likely require issuance of a SARA compliant *Fisheries Act* authorization for the destruction of SRKW critical habitat", which could not be issued unless the Minister was "of the opinion that section 73(3) preconditions could be met, including that the activity would not jeopardize the survival or recovery of SRKW. DFO told the Panel that "they were uncertain that the section 73(3) preconditions could be met for the Project."[102]As discussed further below, despite additional information provided by VFPA, DFO maintains this position.

98. With respect to underwater noise effects on the Southern Residents from terminal construction, the Panel foudn that construction effects could be fully mitigated with noise dampening, the adoption of a buffer zone, marine mammal observers, and avoidance of impact-pile driving at night", but that "the ability of the mitigation measures to eliminate residual effects of construction noise on SRKW is highly dependent on the ability for SRKW to be detected within prescribed buffer zones."[103]

99. With respect to the risk of a vessel strike due to Project-Related Shipping, the Panel noted "that DFO advised that the loss of even a single SRKW could have population level consequences", and it found that vessel strikes are "an emerging threat as outlined in the Recovery Strategy", noting evidence of past vessel strikes of Southern Residents.[104] It concluded that "the magnitude […] could range from low to high, depending on the severity and lethality of the strike, and the effects of a strike, although unlikely to occur, could be irreversible and could lead to population consequences."[105] It noted that "vessel speed has been correlated with the probability and severity of vessel strikes."[106]

100. Finally, with respect to underwater noise effects on the Southern Residents from Project Related Shipping, the Panel found that "underwater noise levels in the Salish Sea are

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[101] *Ibid* at PDF p 229.
[102] *Ibid* at PDF p 224.
[103] *Ibid* at PDF p 227.
[104] *Ibid* at PDF p 229.
[105] *Ibid*.
[106] *Ibid*.

already high, and are too noisy for SRKW."[107] It found that "underwater noise […] is one of the threats to SRKW survival and recovery."[108] It noted DFO's submission that additional acoustic disturbance could, in the Panel's words, "potentially lead to […] reduced survival and compromised recovery."[109]

101. The Panel found that:

> while there are limitations with the models used by the proponent, as highlighted by DFO, the underwater noise from marine shipping […] has the potential to reduce underwater foraging efficiency. Further, the Panel notes that acoustic disturbance from vessels in and of itself could be considered destruction of critical habitat.[110]

102. The Panel rejected VFPA's revised evidence that reduced the number of predicted vessel calls at the terminal; VFPA revised this evidence at multiple points in the environmental assessment process, and has now revised it again in the IR Responses. The Panel applied "a conservative approach" to conflicting evidence on the number of ships,[111] used VFPA's original evidence instead of its later replacement evidence that claimed there would be no increase in vessels,[112] and deemed the original evidence "realistic and conservative".[113] This resulted in a finding that the 260 vessels per year would call at the terminal, or, put differently, there would be 520 vessel transits through the marine shipping area in the Salish Sea due to Project Related Shipping.[114]

103. Similarly, with respect to noise projections, the Panel relied upon VFPA's earlier, more conservative numbers.[115]

104. The Panel found that "the Proponent's conclusion that marine shipping […] would make a small additional contribution to underwater noise" was "subject to uncertainty because of

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[107] *Ibid* at PDF p 132.
[108] *Ibid* at PDF p 124.
[109] *Ibid* at PDF p 223.
[110] *Ibid* at PDF p 229.
[111] *Ibid* at PDF p 41.
[112] *Ibid* at PDF p 45.
[113] *Ibid* at PDF p 48.
[114] *Ibid* at PDF p 229.
[115] *Ibid* at PDF p 130.

the lack of direct information about noise emissions from larger classes of ships that are anticipated to call at the Project in the future."[116]

105. With respect to mitigation for underwater noise, the Panel further noted that "existing and currently used programs and initiatives" relied upon by VFPA "have the potential to reduce levels of underwater noise", but "are not specifically tied to the Project and are on a voluntary basis."[117] Therefore, the Panel found that VFPA's Enhancing Cetacean Habitat and Observation ("ECHO") program initiatives "are not mitigation measures as defined under CEAA 2012 since they are not being implemented specifically to mitigate the effects of the proposed Project."[118] Similarly, with reference to Canada's efforts under "the Oceans Protection Plan, the Whales Initiative, and other programs to support the survival and recovery of SRKW", and "renewal of commitments to the SRKW Conservation Agreement", the Panel found that "many of these initiatives are voluntary, and cannot be relied upon to mitigate the effects of marine shipping associated with the Project."[119] This is consistent with the Panel's definition of mitigation, described above.

106. The Panel concluded that, "in the absence of mandatory mitigation measures to reduce underwater noise generated by marine shipping associated with the Project, there would be a residual adverse effect on the acoustic environment that is moderate in magnitude within SRKW critical habitat."[120]

107. The Panel concluded that:

> Based on the effects due to the Project and marine shipping associated with the Project on underwater noise, Chinook salmon prey availability and potential ship strikes, and in the absence of effective and mandatory mitigation measures, the Panel concludes that there would be a significant adverse effect on the Southern Resident Killer Whale.[121]

108. The Panel found that the cumulative effects of the Project interacting synergistically with other past, present, and future activities would be significant.[122] It noted that VFPA had

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[116] *Ibid* at PDF p 132.
[117] *Ibid*.
[118] *Ibid* at PDF p 229.
[119] *Ibid* at PDF pp 229-230.
[120] *Ibid* at PDF pp 230.
[121] *Ibid*.
[122] *Ibid*.

conceded that "it was reasonable to assume that past projects and activities […] have already had a significant adverse effect on SRKW", such that, "with the contribution of acoustic disturbance from Project operations, effects were anticipated to remain significant."[123]

109. Thus, the Panel concluded with respect to significance under CEAA 2012 that:

> a reduction in prey availability due to the Project, exposure to underwater noise and risk of vessel strike due to marine shipping associated with the Project have the potential to interact synergistically with the effects of past, present, and future Projects and activities, and would result in a significant adverse cumulative effect.[124]

110. The Panel also acknowledged "that if the population of SRKW were to decline any further, there could be serious population consequences, and the survival of SRKW could be significantly compromised."[125]

111. The Panel additionally found with respect to SARA that Chinook salmon impacts would destroy critical habitat and that underwater noise could also "be considered destruction of critical habitat."[126] This would be in violation of s. 58(1) of SARA. The Panel's findings about the lack of "effective and mandatory mitigation measures" also speak to a failure to satisfy ss. 79(2) and 77(1) of SARA.

V. The Project will result in significant adverse environmental effects which are not justifiable in the circumstances, and will be contrary to SARA, even with the updated measures proposed by VFPA

112. The Conservation Coalition submits that the Project is likely to result in significant adverse environmental effects to many components of the Salish Sea ecosystem despite the additional information provided and mitigation proposed by VFPA. These effects include adverse effects on federally protected species at risk that will not be fully mitigated.

113. These comments focus on the impacts of the Project and Project Related Shipping on Southern Residents and Chinook salmon. The Conservation Coalition's focus should not be interpreted as a suggestion that these are the Project's only significant adverse effects.

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[123] *Ibid*.

[124] *Ibid*.

[125] *Ibid* at PDF p 458.

[126] *Ibid* at PDF p 229.

For example, Barn owl, a species listed as threatened under SARA, would be subject to significant cumulative effects.[127] As well, with respect to impacts on migratory birds, the Panel could not conclude with certainty about the Project's potential effect on polyunsaturated fatty acid production in biofilm, a potentially critical nutritional component for western sandpiper.[128] The Panel was unable to conclude that the Project would or would not have a residual adverse effect on western sandpiper.[129]

114. In IR2020-4, VFPA provided additional analysis related to biofilm, which did not address the knowledge gap identified by the Panel with respect to Project's impacts on polyunsaturated fatty acid production in biofilm. Instead, VFPA provided an empirical review of biofilm literature and reiterated the Panel findings about other aspects of the Project's impact on biofilm.[130] In other words, the IR Responses do not alter the Panel's finding that the effects of the Project on polyunsaturated acid production are inconclusive.

115. As part of its participation in the environmental assessment, Environment and Climate Change Canada ("ECCC") reviewed scientific literature on biofilm and found that Project-related changes to the salinity regime would impact the quality and quantity of biofilm available to shorebirds, and that no practical mitigation measures exist to address these impacts.[131] ECCC therefore concluded that the Project poses an "unmitigable species-level risk to Western Sandpipers, and shorebirds more generally, and that therefore the only way to be confident of avoiding the impacts on biofilm and shorebirds from these predicted geomorphological processes is with a Project redesign."[132] After reviewing VFPA's response to the Minister's request for more information on Project's potential effects on biofilm and migratory shorebirds, ECCC stated that their "opinion remains that effects of the Project, as designed, will likely be unmitigable and irreversible, resulting in an

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[127] *Ibid* at PDF p 16.
[128] *Ibid* at PDF p 15.
[129] *Ibid* at PDF pp 15-16.
[130] Document #2083, "Appendix IR2020-4-A: Effects to Biofilm and Migratory Birds", (24 September 2021), online: <https://iaac-aeic.gc.ca/050/documents/p80054/141577E.pdf>.
[131] Document #2133, "ECCC Closing Panel Submissions RBT2", (26 August 2019), at p 3, online: <https://registrydocumentsprd.blob.core.windows.net/commentsblob/project-80054/comment-56833/ECCC%20Closing%20Panel%20Submission%20RBT2.pdf>.
[132] *Ibid* at p 4.

increased risk to the population viability of the Western Sandpiper species, in particular."[133]

116. Western Sandpipers are protected under the *Migratory Birds Convention* and the *Migratory Birds Convention Act*, the purpose of which is "to implement the Convention by protecting and conserving migratory birds – as populations and individual birds – and their nests."[134] Therefore, Canada has both international and domestic obligations to protect western sandpipers, which includes protecting their habitat and food sources. The Conservation Coalition's submissions do not address the adequacy of VFPA's analysis and mitigation measures for biofilm and western sandpipers, or the other 19 bird species[135] of conservation concern potentially affect by the Project. However, the outstanding knowledge gap about the impacts of the Project on these species shows that further consideration is required before the Minister can reasonably determine whether the Project's impacts on migratory birds, their habitat, and their food sources are likely to be significant.

117. The Conservation Coalition explains below, first with respect to Chinook salmon (subheading A) and then with respect to the Southern Residents (subheading B):

a. what VFPA's IR Responses do or do not change with respect to the Project's effects and related measures;

b. why VFPA's proposed mitigation in the IR Responses is inadequate;

c. why the IR Responses do not alter the Panel's conclusion that the Project will have significant adverse environmental effects;

d. why SARA mitigation requirements have not been for this Project, why the Project will violate SARA prohibitions, and why the Project will not qualify for a SARA-compliant *Fisheries Act* authorization; and

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[133] Document #2212, "Environment and Climate Change Canada (ECCC) Review of Information Request 2020-4: Biofilm and Effects to Migratory Birds, and Appendix IR2020-4-A", (4 February 2022), at p 1, online: <https://registrydocumentsprd.blob.core.windows.net/commentsblob/project-80054/comment-56952/20220204_RBT2_ECCC%20comments%20on%20final%20IR%20response_final.pdf>.

[134] *Migratory Birds Convention Act*, SC 1994, c 22, s 4, online: <https://canlii.ca/t/7vs6#sec4>.

[135] *Panel Report*, *supra* note 2 at PDF p 248. VFPA did not assess impacts of the Project on every bird species of conservation concern, instead relying on assessment of "representative" species from groups of bird species.

e. why the Project's significant adverse environmental effects cannot be justified in the circumstances under CEAA 2012.

A. Significant adverse effects on Chinook salmon

118. Similar to its approach in the EIS and its submissions to the Panel, VFPA's main approach to addressing fish and fish habitat impacts remains offsetting. VFPA does propose some direct measures to mitigate the impacts of the project such as a single breach in either the causeway or at the terminal for fish passage to address the impact on salmon migration, as well as a small reduction in the total Project footprint. Considered against the scale and nature of the Project's impacts, the proposed offsets, breach, and reduced footprint are unlikely to prevent or fully mitigate the significant adverse and cumulative impacts to juvenile Chinook salmon predicted by the Panel.[136]

1. Information provided by VFPA on impacts to salmon and salmon habitat

119. VFPA IR Responses IR2020-1.1, IR 2020-1.2, IR2020-2.1, and IR2020-2.2 all deal with impacts to salmon and salmon habitat. The IR Responses explain, and in some cases expand on, previous offsetting plans presented to the Panel.

120. VFPA addresses the overall offsetting plan in IR2020-1.2, in which it claims that the Project will actually result in "a net gain in juvenile salmon habitat and productivity" and will mitigate disruption of juvenile salmon migration.[137] This conclusion is based on the assumption, discussed further below, that the habitat it is creating is of higher value than the habit that it will destroy if the Project proceeds.

121. In addition to offsetting, VFPA addresses "avoidance and reduction measures" in IR2020-2.1 and IR2020-2.2. In IR2020-2.1, it explains a proposal to reduce the footprint of the terminal and causeway. In IR2020-2.2, it explains a proposal for a breach or fish passage in the causeway, as well as mitigation for noise and light. It claims that these will

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[136] *Scott Report*, *supra* note 5 at p 16.

[137] Document #2083, "IR2020-1.2: RBT2 Proposed Fish and Fish Habitat Offsetting Plan", (24 September 2021), at p 1, [*IR2020-1.2*], online: <https://iaac-aeic.gc.ca/050/documents/p80054/141558E.pdf>.

"significantly reduce potential project impacts."[138] VFPA lists and explains the individual offsetting and mitigation proposals in IR2020-1.1.[139]

122. It is important to understand when considering the proposed offset list as a whole, that some are "potential contingency offsetting projects" which would only be "considered" by VFPA at some time in the future if "any of the habitat developed for the offsetting plan does not function as intended, and remedial measures are unavailable or unsuccessful".[140] The summary of mitigation measures indicates which proposals are identified as "New", some of which are only characterized as "potential", including "Potential additional project footprint reduction", "Potential breaching mitigation", and "Potential contingency projects".[141]

123. The Conservation Coalition is particularly concerned that, throughout the IR Responses, VFPA continues to rely on its Environmental Impact Statement ("EIS"), provided to the Panel during the environmental assessment, which concluded that effects on juvenile salmon productivity from migration disruption and light and noise-related effects would be "negligible".[142] VFPA does this without mentioning that the Panel, after reviewing the totality of the evidence from all parties, including DFO, rejected the EIS conclusions in the Panel Report and found significant adverse effects on juvenile Chinook salmon, as explained above.

2. *VFPA's proposed mitigation for salmon is inadequate*

a) *Shortcomings of the offsetting plan*

124. The Conservation Coalition submit that the offsetting plan cannot credibly be relied upon to offset the Project's significant adverse impacts on vulnerable Chinook salmon. The Project will result in the destruction of 96 hectares of juvenile Chinook habitat, a greater physical area of habitat than the offsetting plan will replace. The Panel found it "unlikely

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[138] *Ibid*.

[139] Document #2083, "IR2020-1.1: RBT2 fish and fish habitat potential offsetting projects", (24 September 2021), at pp 3-4, [*IR2020-1.1*], online: <https://iaac-aeic.gc.ca/050/documents/p80054/141552E.pdf>. Identifies "New" or "Adapted" plans for offsetting and for contingency offsetting. The remainder of the document describes each offsetting project.

[140] *Ibid* at p 36.

[141] *IR2020-1.2*, *supra* note 137 at p 7.

[142] Document #2083, "IR2020-2.2: Avoidance and Mitigation Measures for Project Construction – Juvenile Salmon", (24 September 2021), at pp 2, 4, 22, [*IR2020-2.2*], online: <https://iaac-aeic.gc.ca/050/documents/p80054/141570E.pdf>; *IR2020-1.2*, *ibid* at p 3.

that there are sufficient onsite offsetting opportunities in the vicinity of the Project."[143] Further, the type of habitat destroyed by the Project – tidal sand and mud flats and adjacent sub tidal zone – is in particularly short supply due to cumulative development of the Fraser River delta. Because of this, VFPA's offsetting plan relies on projects that are both distant from the Project, and of a different kind of habitat than tidal flats on Roberts Bank. VFPA's assertion that not only will their offsetting plan work, but it "will provide more than four times the productivity than that lost due to the project footprint,"[144] relies on several assumptions, discussed below, about how well these offsets will work to replace the habitat lost. These assumptions create significant uncertainty for the offsets, which uncertainty is compounded by the spotty history of past offsets' ability to function as designed.

125. The Project VFPA's proposed onsite, offsite, and habitat bank offset projects are shown in Figure IR2020-1.1-1, reproduced below.

Figure IR2020-1.1-1: Locations of offsetting projects currently being advanced for RBT2

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[143] *Panel Report*, *supra* note 2 at PDF p 156.

[144] *IR2020-1.2*, *supra* note 137 at p 2.

126. VFPA's claim that its offsetting plan "fully offsets" adverse effects on juvenile Chinook salmon, fish, and fish habitat,[145] is based on the assumption that the offsets will cause a net gain of "habitats that are of higher relative importance" to juvenile Chinook salmon and more productive than those lost to the Project footprint.[146] VFPA has quantified the "net benefits" based on the "value of the offsetting habitat relative to the value of the underlying (i.e., existing) fish habitat."[147] VFPA's documentation of the "net gain" in habitat shows that only its weighting of what it decided was "the relative importance of habitat to juvenile Chinook salmon" took the Project from being a net loss of 96.2 ha to a claimed net gain of 37.4 ha.[148] In other words, the area that VFPA proposes to "create" through its offset plan is not larger than the area lost, but VFPA calls it a net gain, because it deems the offset project to be more productive.

127. The Conservation Coalition is concerned that VFPA's asserted habitat gains are premised on assumptions that ignore the important and contextual role that the lost Roberts Bank habitat plays in the development of out-migrating juvenile Chinook salmon that have exited the Fraser River and are heading south along Roberts Bank. Further, VFPA continues to ignore the evidence of past failed offsetting project or address the absence of field evidence showing their actual ability to replicate habitat that was lost.

128. The expert evidence of salmon biologist David Scott questions VFPA's conclusions about the efficacy of their offsetting plan, for the following reasons:

    a. **When the commonly used approach of net change in habitat area is applied the Project will result in a net loss of juvenile salmon habitat.** The actual ratio of offset habitat to habitat lost by the Project footprint, using physical area, is 0.4:1;[149]

    b. **VFPA's modelling approaches ignore the importance of different habitat types through the various stages of the life cycle of salmon**. The productivity, relative values, and footprint vs. non-footprint effects modelling approaches that VFPA used in assessing offset value rely on the problematic assumption that the habitat created

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[145] *Ibid* at p 11.
[146] *Ibid*.
[147] *IR2020-1.1, supra* note 139 at p 6 and see *IR2020-1.2*, *ibid*, for more.
[148] *IR2020-1.2, ibid* at p 23.
[149] *Scott Report*, *supra* note 5 at pp 8, 14.

by the offsets is of more value to juvenile salmon than the habitat lost.[150] This assumption ignores the larger picture of how juvenile salmon use different habitats in the Project area, and the result is a high degree of uncertainty about the benefits of the offsets to juvenile salmon.[151] Juvenile salmon rely on a "continuum of habitats during their estuary rearing period" which support their transition from the Fraser River to the ocean entry.[152] This includes the sand and mud flat habitats along Roberts Bank and adjacent sub-tidal areas that will be destroyed by the Project footprint and which are not "replaced" through VFPA's offsetting plan. All habitat types, including sand and mud flats, play an important role in preparing juvenile salmon for ocean entry.[153] VFPA's assessment assigns very little value to sub-tidal, sand flat, and mud flat habitats, without scientific justification, leading to uncertainty in whether their models accurately reflect the impact of the Project and offsetting plan on juvenile salmon.[154]

c. **Offsetting plan proposes different (out-of-kind) type of habitat.** The proposed offsets are different habitat types than the habitat which will be lost as a result of the Project, and therefore will not compensate for the impacts of the Project on juvenile salmon habitat. According to DFO policy, in-kind offsetting is preferable when there is an absence of data supporting the equivalency of out-of-kind offsets.[155] As explained above, the assumptions underlying VFPA's methods to quantify the benefits of the proposed offsets are insufficient to justify an out-of-kind approach. The Westham Island, Finn Slough, and Tilbury Island offsetting projects, as well as the habitat bank projects (Gladstone Park, Timberland Basin and Glenrose tidal marsh project), are all freshwater marsh habitat restoration projects. Freshwater marsh habitat is fundamentally different from the brackish and saline habitats which will be lost due to the Project footprint. As well, the created habitat will be accessible

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[150] *Ibid* at p 9.

[151] *Ibid* at pp 9-11, 13.

[152] *Ibid* at p 9.

[153] *Ibid* at pp 9-11.

[154] *Ibid* at p 13 citing Table IR2020-1.2-D4 in *IR2020-1.2*, *supra* note 137.

[155] DFO, "Policy for applying measures to offset adverse effects on fish and fish habitat under the *Fisheries Act*", (December 2019), at p 19, [*DFO Offsetting Policy*], online: <https://waves-vagues.dfo-mpo.gc.ca/Library/40939698.pdf>.

to fish at different times than the destroyed habitat. The freshwater marsh creation projects will only be accessible at high tide, and therefore will not compensate for the loss of sub-tidal areas that serve as low-tide refugia for juvenile salmon.[156] It is uncertain if the offsets will compensate for the impacts of the Project because the proposed offsets are different habitat types than the habitat lost, are not in the same area as the habitat lost, and are not in the same salinity range as the habitat lost.[157] This uncertainty warrants a higher offsetting ratio than the current ratio which is less than one-to-one.[158]

d. **Offsetting projects are distant from the Project site.** The majority of the proposed offsets are "offsite", many kilometers away from the Project area, and therefore will not compensate for the residual adverse effects of the Project on juvenile salmon in the Project area.[159] These offsite offsets have a higher degree of uncertainty associated with their potential to mitigate impacts of the Project. DFO policy requires a "robust rationale" for locating offsets away from the geographic area of a work, and says it is "preferable that they be located within the vicinity of a work".[160]

e. **Saltwater marsh creation is not a proven technique.** The largest proposed offset, the South Arm Tidal Marsh Project, would require VFPA to create a marsh habitat on sand and mud flat areas where marsh has never existed, and located several kilometers away from the existing extent of natural marsh habitat. It is highly uncertain whether the created marsh habitat will ever become functional, and this particular offset project has a high risk of failure. This adds additional uncertainty to the effectiveness of the offsetting plan as a whole.[161] As well, this goes against DFO policy which says offset measures should prioritize restoration of degraded fish habitat, which is different from creating a type of habitat in a location where it has never existed.[162]

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[156] *Scott Report*, *supra* note 5 at p 14.
[157] *Ibid*.
[158] *Ibid* at p 9.
[159] *Ibid*.
[160] *DFO Offsetting Policy*, *supra* note 155 at pp 8-9.
[161] *Scott Report*, *supra* note 5 at p 9.
[162] *DFO Offsetting Policy*, *supra* note 155 at p 8. *Scott Report*, *ibid*.

f. **The proposed offsets will become less productive over time**. Due to sea level rise, the proposed offsets will become less productive over time because they will be flooded. Ongoing maintenance, which is not addressed in VFPA's offsetting plan, will be required to keep pace with sea level rise. This adds even more uncertainty to the question of whether the offsets will function as VFPA predicts.[163] This is especially problematic because the impacts of the footprint and operation of the Project will persist over the long term, indefinitely, and DFO Policy states that the "benefits of the measures to offset fish and fish habitat should last at least as long as the adverse effects from the works, undertakings or activities being authorized."[164]

g. **The time lag between offset construction and functionality is not meaningfully accounted for in VFPA's offset plan**. VFPA applies a time lag discount of a small percentage to the predictions of productivity of the proposed offsets.[165] However, this is meaningless to the three full generations of salmon that will be disrupted by the Project before the offsets are predicted to be functional.[166] In reality there will be a period of zero productivity following the destruction of the Roberts Bank habitat and little account is given the impact of that period of no habitat on highly stressed and vulnerable salmon populations. As a consequence, there is uncertainty about the ability of the offsets to mitigate short term impacts on salmon. Additionally, during the same time that the offsets have not yet gained function, the already threatened Harrison River Chinook salmon population is expected to decline by 31 to 100 percent.[167] A better approach, given the vulnerability and importance of Chinook salmon, would be to require VFPA to complete offset projects and demonstrate offset functionality *before* undertaking activities that will adversely affect juvenile salmon and their habitat.[168] Such an approach would be in line with DFO policy, which states

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[163] *Scott Report*, *ibid* at pp 9, 10.

[164] *DFO Offsetting Policy*, *supra* note 155 at p 11.

[165] *IR2020-1.2*, *supra* note 137 e.g. at pp 4, 5, 12. *Scott Report*, *supra* note 5 at p 11.

[166] *Scott Report*, *ibid*.

[167] *Ibid* at p 12.

[168] *Ibid* at pp 12, 15.

that "Proponents should make all reasonable efforts to avoid time lags between the adverse effects and the implementation of measures to offset."[169]

h. **Offset projects do not always function as planned and frequently fail.** There is a high degree of uncertainty as to whether the proposed offsets will become functional within the predicted time, if ever, based on the underwhelming performance of VFPA's offsets for other projects. As noted by David Scott in both his 2022 and his previous expert opinion provided to the Panel during the hearings (Scott Report 2019), VFPA's recent offsetting projects demonstrate that offsets do not always function as intended.[170] For example, VFPA's Roberts Bank East Causeway habitat offsetting site has failed to achieve its productivity targets after more than ten years of adaptive management.[171] Another example is the Glen Rose Tidal Marsh project, which is performing less well than predicted due to slow marsh vegetation establishment and herbivory impacts from geese.[172] Goose herbivory is emerging as an "extremely challenging" issue for offset projects that rely on the establishment of salt marsh vegetation.[173] Yet another example is the Boundary Bay salt marsh restoration project, where the high energy marine environment has led to log accumulation which requires ongoing maintenance and has slowed the establishment of salt marsh vegetation.[174] It is reasonable to expect that VFPA's proposed offset plan for the Project will face similar challenges. The Conservation Coalition's expert evidence shows that "[g]iven these stressors, there is a high degree of uncertainty regarding the potential productivity of the proposed offsetting projects and whether they will protect the productivity of juvenile salmon in the Fraser River estuary."[175]

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[169] *DFO Offsetting Policy*, *supra* note 155 at p 10.

[170] Document #1605, David Scott, "RBT2 EIA Expert Report", (April 2019), CCR Vol 2 Tab B, at PDF pp 99-101, [*2019 Scott Report*], online: <https://ceaa-acee.gc.ca/050/documents/p80054/129296E.pdf> (and appended to 2022 *Scott Report*, *supra* note 5). See PDF p 100 of *2019 Scott Report* citing a review by Lievesley *et al*. (2017) finding that only one third of compensation sites throughout the Lower Fraser constructed between 1983 and 2010 had achieved their intended function, in terms of both area of the site and proportion of native species established. Increased time since construction did not significantly influence project success.

[171] *Scott Report*, *supra* note 5 at p 10.

[172] *Ibid*.

[173] *Ibid* at p 11 quoting *IR2020-1.1*, *supra* note 139 at pp 43-44.

[174] *Ibid* at pp 10-11.

[175] *Ibid* at p 11.

129. Based on these concerns about VFPA's offsetting plan, Mr. Scott is of the opinion that it is "highly unlikely that the proposed offsetting plan will counterbalance [the Project's] effects on Chinook salmon."[176] The conclusions in the Scott Report are consistent with DFO's opinion that "at this time DFO cannot fully determine whether the offsetting plan would counterbalance residual effects to fish and fish habitat."[177]

b) Shortcomings of avoidance and reduction measures

130. Although its primary approach to addressing the impacts of the Project on fish and fish habitat is through offsetting, VFPA has proposed some direct measures to reduce the impacts of the project. VFPA addresses "avoidance and reduction measures" in IR2020-2.1 and IR2020-2.2, by proposing to reduce the footprint of the terminal and causeway, add a breach for fish passage, and mitigate effects of noise and light. It claims that these will "significantly reduce potential project impacts."[178] The Conservation Coalition remains concerned that the scale of the avoidance and reduction measures is not adequate to avoid or mitigate the scale of the Project's impacts on fish and fish habitat, and therefore the Project's effects on Chinook salmon will remain significant.

(1) Light and noise

131. VFPA relies on measures identified for the Southern Residents to address noise impacts on Chinook salmon.[179] However, the measure related to quieter tugs, as described below, is simply a proposal for research and potential future implementation, not actual mitigation, and the shore power measure will have a relatively small impact, as also described below.[180]

(2) Reduced footprint

132. VFPA states that it is "technically and economically feasible" to reduce the previously proposed marine terminal footprint, by either 6 or 10.3 ha, and that reducing it by 10.3 ha

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[176] *Ibid* at p 13.
[177] *DFO Submissions*, *supra* note 77 at PDF p 24.
[178] *IR2020-1.2*, *supra* note 137.
[179] *IR2020-2.2*, supra note 142 at pp 21-22.
[180] *Ibid*; Document #2083, "IR2020-3: Avoidance and mitigation measures for project operation and marine shipping incidental to the project", (24 September 2021), at pp 25-26, [*IR2020-3*], online: <https://iaac-aeic.gc.ca/050/documents/p80054/141574E.pdf>.

would reduce adverse effects.[181] No analysis is provided for the 6 ha option, which is all that would be achievable if VFPA takes the option to use zero-emission cargo handling equipment. VFPA states that it is also "technically and economically feasible" to reduce the footprint of the widened causeway, but it alternately states that this would not alter VFPA's previous effects assessment and itemizes ways in which it would reduce effects.[182]

133. The Conservation Coalition supports efforts to reduce the terminal footprint, but notes that VFPA's proposed reduction is "very minor relative to the overall footprint and does not mitigate the increase in migration disruption" caused by the Project.[183]

(3)Breach for Fish Passage

134. A breach in the causeway or the terminal would hypothetically allow juvenile salmon to swim from the north side of the project into the inter-causeway area, or into the area west of the existing Roberts Bank terminal in the case of the terminal breach.

135. VFPA summarizes options for a breach at any one of three locations in the causeway, or at the terminal (see Figure IR2020-2.2-1, reproduced below). It states that a terminal breach would be "technically and economically feasible", and that a causeway breach is "feasible based on engineering designs and constructability evaluations" but its technical and economic feasibility have yet to be determined given that VFPA does not own the causeway.[184] As noted above, VFPA suggests that any one of the breaches would fully mitigate the migration disruption that the Project will cause (and which is in addition to the already significant migration disruption caused by the existing terminal and causeway structure). It proposes to incorporate either a terminal or a causeway breach – with a preference for the terminal, unless the Minister directs it to choose the causeway option instead following a feasibility report – and does not address the possibility of moving forward with multiple breach options.[185]

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[181] Document #2083, "IR2020-2.1: Avoidance and mitigation measures for project construction – Fish and fish habitat" (24 September 2021), at pp 2, 4, 9, [*IR2020-2.1*], online: <https://iaac-aeic.gc.ca/050/documents/p80054/141560E.pdf>. (The potential for reduction in effects from a 6 ha reduction is not described.)

[182] *Ibid* at pp 2, 6, 9-10.

[183] *Scott Report*, *supra* note 5 at p 4.

[184] *IR2020-2.2*, *supra* note 142 at p 5.

[185] *Ibid* at p 7.

Figure IR2020-2.2-1: Potential breach locations evaluated for reducing potential disruption of juvenile salmon migration

136. The Conservation Coalition questions the assumption that any of the four breach locations would perform equally in mitigating salmon migration disruption, mainly due to differences in tidal connectivity. Further they submit that, even the "best" breach option advanced by VFPA is inadequate, on its own, to mitigate migration disruption, because it is highly uncertain whether it will function as planned. A single breach of the causeway or terminal, especially as planned by VFPA, is unlikely to mitigate migration disruptions of juvenile salmon, and therefore VFPA's breach plan in IR2020-2.2 does not change the Agency's conclusion that the Project will have significant adverse effects on juvenile salmon. DFO also questions VFPA's assumption that the four breach locations will be equally effective, and in their comments on the IR Responses DFO notes that the

proposed locations differ in the risk posed to juvenile salmon by light, noise, and predation.[186]

137. The Conservation Coalition bases its concern on the expert opinion provided by fisheries biologist David Scott, who has significant expertise and experience in the use of breach technology in the restoration of connectivity of fish habitat in the Fraser Estuary.[187] After reviewing VFPA's proposed breach plans Mr. Scott is of the opinion that:

a. **The four proposed breach locations are not equal**. Each breach will only have a water depth sufficient to allow juvenile salmon to swim through for a portion of the tidal cycle. The breach at causeway location 1, furthest east and closest to shore, will be connected only 9% of the time. That percentage increases further from shore, with the terminal breach location connected 86% of the time.[188] This disparity in connectivity means it is false to assume any breach would equally mitigate juvenile salmon migration disruption.

b. **The proposed breaches are too narrow.** According to the expert evidence, "[a] breach of such a small magnitude relative to the length of the disruption requires fish swim very close by to find the breach and it is likely only a small portion of out-migrating fish would find the breach."[189] Evidence from Mr. Scott's recent experience with breaches of the Steveston Jetty shows that breaches need to be much wider to be useful for juvenile salmon migration. For example, wide-open (not culvert) breaches of 50 metres width in the Steveston Jetty represent the scale of breaches required.[190]

c. **Juvenile salmon are unlikely to be attracted to the long dark culverts proposed as breaches**. The breaches will require culverts of 170-220 metres, which will not allow natural light. VFPA plans to light the culverts during the daytime to attract fish. However, during the spring migration, the time that the culverts will be lit will not overlap with the time the culverts are most connected by the tide cycle. During

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[186] *DFO Submissions*, *supra* note 77 at pp 11-12.
[187] See *Scott Report*, *supra* note 5 at p 2.
[188] *Ibid* at p 6 citing *IR2020-2.2*, *supra* note 142 at p 12.
[189] *Ibid* at p 13.
[190] *Ibid* at p 7.

the spring juvenile salmon migration, the highest tides will be at night when the culverts will be dark. Additionally, at night the terminal lights have the potential to disrupt juvenile salmon migration. Therefore, the plan to light the culverts during the daytime will not fix the problem of the long, dark culverts being unattractive to juvenile salmon during the outmigration. Leaving the culvert lights on at night is not a feasible option, because it would increase the risk of predation of juvenile salmon.[191] Thus there is significant uncertainty about whether the salmon will use the culverts as designed.

d. **The breaches are likely to become clogged with debris**. Due to the volume of debris in the estuary any breach risks being clogged. The screens proposed to prevent logs from blocking the breach will likely become clogged with smaller debris such as eelgrass. Blockages would further limit the breach’s effectiveness.[192]

138. Thus, Mr. Scott concludes that “it is highly unlikely that the scale, number and design of breaches being proposed will mitigate the project-related disruption of juvenile Chinook salmon migration caused by the project.”[193] Further,

> [a]lthough a small percentage of the juvenile Chinook migrating through the area may find the terminal breach, the remainder of the fish will have to navigate an even longer disruption and are therefore much more likely to be disrupted in their migration and fail to reach the inter-causeway area, further impacting their marine survival.[194]

139. Mr. Scott proposes that, to have a greater likelihood of mitigating migration disruption caused by the Project, VFPA should, at a minimum, be required to construct a series of breaches in the causeway as well as the terminal breach.[195]

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[191] *Ibid* at pp 6-7, 13.
[192] *Ibid* at pp. 6-7
[193] *Ibid* at p 7.
[194] *Ibid* at p 16.
[195] *Ibid* at p 7.

3. Proposed mitigation will not offset the Project's significant adverse effects on Chinook salmon

140. VFPA's IR Responses do not resolve the Panel's finding about the need for reduction of impacts or increased offsetting, and they do not alter the Panel's conclusion that the Project will have significant adverse environmental effects, including cumulative effects, on ocean-type Lower Fraser and South Thompson Chinook salmon.

141. The evidence on the status of Fraser River Chinook salmon is stark. Of the 13 populations of Fraser River Chinook recently assessed by COSEWIC, 11 were determined to be threatened or endangered; this includes ocean-type Lower Fraser Chinook salmon, assessed as threatened, which the Panel found would experience significant adverse environmental effects.[196] Final decisions on the listing of these species under SARA by the Governor in Council are pending. Recent efforts aimed at improving Chinook abundance by restricting commercial and recreational fisheries have not yielded significant results.[197]

142. With respect to cumulative effects, the Conservation Coalition's expert David Scott has noted that over 85 per cent of floodplain habitats in the Lower Fraser River and estuary have already been lost or disconnected, and that recent research by VFPA has demonstrated that the current causeway and terminal are already resulting in juvenile Chinook salmon failing to reach the inter-causeway area, which is an area of particularly high productivity.[198]

143. As stated above, Mr. Scott has found that VFPA's IR Responses do not address the Panel's concern about reducing Project impacts, as the breaches proposed by VFPA are insufficient to mitigate juvenile Chinook salmon disruption, nor do they address the Panel's concerns about offsetting, as VFPA overstates the efficacy of the offsets, which are highly unlikely to counter the Project's effects.

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[196] *Conservation Coalition Written Submissions Vol. 1*, *supra* note 14 at para 212; see also Document #1605, "Summary of COSEWIC Wildlife Species Assessments", November 2018, CCR Vol 2, Tab B, Attachment 2, at PDF pp 131-132, [*COSEWIC Assessment Summary*], online: <https://ceaa-acee.gc.ca/050/documents/p80054/129296E.pdf>.

[197] Document #1605, "2019 Fraser River Chinook Conservation Measures", CCR Vol 2, Tab B, Attachment 4, at PDF pp 143-159, online: <https://ceaa-acee.gc.ca/050/documents/p80054/129296E.pdf>.

[198] *Scott Report*, *supra* note 5 at pp 15, 9.

144. Therefore, the Minister should not diverge from the Panel's finding that the Project will have significant adverse effects on some populations of Chinook salmon, even after mitigation.

4. SARA requirements are not met for Chinook salmon, which are part of Southern Resident critical habitat

145. Chinook salmon are part of the critical habitat of the Southern Residents and therefore legally protected as under SARA. Sseveral sections of SARA operate to protect listed species and their critical habitat from the approval of undertakings, such as the Project, that could harm listed species and their critical habitat, including sections 73 and 74 (permitting), 77 (authorizations under other Acts of Parliament) and 79 (project review). Sections 77(1) and 79(2) are relevant to the Significance Determination under CEAA 2012. Sections 73 and 74 are SARA's permitting provisions which limits the future ability to issue permits necessary for the Project to proceed. The Project as proposed does not meet the requirements of these provisions.

a) The project does not meet SARA requirements for project review or for authorization under other Acts of Parliament

146. Section 77 of SARA states that "any person or body" other than the competent Minister, (such as the Governor in Council), authorized under any federal Act other than SARA, (such as CEAA 2012), must consult with the competent Minister under SARA and ensure "all feasible measures will be taken to minimize the impact of the activity on the species critical habitat" *before* the person or body makes an "any authorization" allowing an activity that may result in the destruction of any part of critical habitat (such as the Project).

147. Section 77 applies in this case to any approval decision made under CEAA 2012, by either the Governor in Council or the Minister of Environment and Climate Change. With respect to aquatic species, such as Southern Resident Killer Whales, the Minister of Fisheries and Oceans is competent Minister under SARA.[199]

148. Section 79(2) requires all feasible measures to be in place before a Project that may impact a listed species or its critical habitat can proceed.

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[199] *SARA*, s 2(1), definition of "Competent Minister".

149. The evidence on mitigation indicates that VFPA does not propose to take all feasible measures to avoid or lessen the Project's adverse effects on the availability of Chinook salmon prey in critical habitat for Southern Residents.

150. VFPA proposes to do less than all feasible measures, including by proposing to apply only one of the identified terminal or causeway breach options. Further, VFPA plans to destroy more habitat than it will replace even on the assumption that it develops the "potential contingency" 22 ha of offsets. VFPA's offsetting plan could better reflect and address the actual effects of the Project. Finally, the offsetting plan, if it operates as planned, will not be fully functional for up to 12 years. Which means that under optimal conditions three generations of salmon will struggle with reduced productivity. It is certainly possible for VFPA to delay the development of the Project to narrow this time lag.

151. Furthermore, VFPA's proposed measures are legally inadequate under SARA s. 79(2) due to their uncertainty. The Minister should not rely on VFPA's uncertain and untested offsetting plan, in light of the evidence of the challenges VFPA have experienced with offsets in the past. As stated above, the Federal Court has cautioned that it is not reasonable to rely on vague commitments to adaptive management.[200]

b) The Project does not meet requirements for SARA authorizations

152. The Project will result in the direct loss and large-scale destruction of important habitat for Fraser River Chinook populations that are both at risk and in decline.[201]

153. As confirmed by the Recovery Strategy for Northern and Southern Resident Killer Whales (*Orcinus orca*) in Canada (the "Recovery Strategy"), reduced availability of Chinook salmon prey is one of the key threats pushing the Southern Residents towards extinction.[202] The Project is located within Southern Resident critical habitat, and prey availability is identified in the Recovery Strategy as an attribute of critical habitat for the Southern Residents; the Panel noted that sufficient availability of Chinook is a feature of critical habitat necessary for the survival and recovery of the Southern Residents.[203] As DFO told

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[200] *Taseko*, *supra* note 31 at paras 101, 122-124. See also *Conservation Coalition Written Submissions Vol. 1*, *supra* note 14 at paras 39, 184.

[201] *Public Hearing Transcript, May 22, 2019*, *supra* note 74 at p 1590; for evidence on declining Chinook see also *COSEWIC Assessment Summary*, *supra* note 196.

[202] *SRKW Recovery Strategy*, supra note 58 at PDF p 27.

[203] *Ibid* at PDF pp 60-62; *Panel Report*, *supra* note 2 at PDF pp 228-229.

the Panel in the Hearing, the Project's impacts on Chinook salmon would therefore constitute destruction of a legally protected biological feature of critical habitat, contrary to s. 58(1) of SARA.[204] The Panel agreed that the Project's impacts to Chinook salmon habitat would result in the destruction of Southern Resident critical habitat.[205]

154. Terminal construction will require authorization under s. 35 of the federal *Fisheries Act* to authorize the harmful alteration, disruption or destruction of fish habitat. The potential for destruction of critical habitat would also trigger the permitting provisions of SARA in ss. 73-74.

155. The government's Imminent Threat Assessment confirms that declining availability of Chinook salmon prey is one of the key threats that led to the determination that the Southern Residents face an imminent threat to their survival and recovery.[206] Thus, as the Project will adversely affect Chinook salmon, the Project is a threat to the Southern Residents' survival and recovery. This should prevent issuance of a SARA-compliant *Fisheries Act* authorization, as it is contrary to s. 73(3)(c) of SARA.

156. The Panel noted that DFO had warned it that that it was uncertain that the s. 73(3) requirements for its minister to issue a SARA-compliant *Fisheries Act* permit could be met for the construction of the terminal.[207] DFO specifically flagged the s. 73(3)(c) requirement that activities being permitted not jeopardize survival or recovery.[208]

157. Thus, DFO and the Conservation Coalition both take the position that the development of the Project, even without changes in vessel traffic, would jeopardize survival and recovery of the Southern Residents. Such an effect would necessarily be significant.

158. The Conservation Coalition submits that it would be unreasonable for the Minister to recommend approving or seeking to justify a Project that would destroy critical habitat and

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[204] *Public Hearing Transcript, May 22, 2019*, *supra* note 74 at p 1593.

[205] *Panel Report*, *supra* note 2 at PDF p 229.

[206] Document #1605, "Government of Canada, Southern Resident Killer Whale: Imminent Threat Assessment", (24 May 2018), CCR, Vol 2, Appendix R, at PDF p 464 [*Imminent Threat Assessment*], online: <https://ceaa-acee.gc.ca/050/documents/p80054/129296E.pdf>.

[207] *Panel Report*, *supra* note 2 at PDF p 224.

[208] Document #1630, "Fisheries and Oceans Canada's response to the Roberts Bank Terminal 2 Project Review Panel's March 5, 2019 letter", (15 April 2019), s 6.3.1 at p 55, online: <https://www.ceaa-acee.gc.ca/050/documents/p80054/129340E.pdf>; *Public Hearing Transcript, May 22, 2019*, *supra* note 74 at p 1595.

that would jeopardize survival and recovery of the Southern Residents, and that DFO believes it could not lawfully permit under SARA.

5. The significant adverse effects on salmon are not justified in the circumstances

159. Given the scale and importance of Chinook salmon habitat loss, uncertainty about the effectiveness of VFPA's offsetting plan, and Fraser River Chinook's conservation status, the Conservation Coalition submits that the effects of the Project on Chinook salmon are likely to be adverse and significant, as the Panel found, even after VFPA's proposed mitigation.

160. Salmon are an icon of the pacific Coast. The continued decline of wild salmon is a tragedy for both Indigenous and settler communities throughout British Columbia that rely on Chinook salmon. The extinction of Fraser River salmon populations would constitute an ecological catastrophe. Given the above submissions on the insufficiency of the proposed mitigation and uncertainty of the offsetting plan, and taking into account the significance of the adverse effects on Fraser River Chinook and their perilous conservation status, the Conservation Coalition submits that the significant adverse effects on Chinook salmon are not justified in these circumstances, should the Minister refer that decision to the Governor in Council.

161. Further, the importance of Fraser River Chinook as the primary prey of the critically endangered and the nutritionally stressed Southern Residents further indicates the significance of the adverse effects of the Project on Chinook salmon. The Conservation Coalition submits that the Governor in Council cannot "justify" under CEAA 2012 effects that are contrary to, and could not be authorized under, SARA.

B. Significant adverse effects on the Southern Residents

162. The IR Responses should not alter the Panel's conclusion that the Project will have significant adverse effects on the Southern Residents and their critical habitat.

1. Information provided by VFPA on impacts to Southern Residents

163. To summarize, the changes to VFPA's evidence since the Panel Report are:

a. a range of vessel numbers scenarios from "realistic-case" to "high-case" scenarios;

b. an admission that the larger vessels that will call at the Project will be louder;

c. the introduction of a follow-up program to monitor mitigation and effects, which was previously missing;

d. four new mitigation measures related to underwater noise in the marine terminal area, including:

    i. delaying unberthing if Southern Residents are present, which appears to depend largely on visual detection and applies only in the daytime;

    ii. a proposal to study quieter tugs with no commitment or timeline to transition to quieter tugs;

    iii. providing shore power for vessels; and

    iv. requiring shippers calling at the terminal to participate in ECHO;

e. a claim that VFPA can mitigate increased underwater noise from operations in the terminal area and from Project Related Shipping using ECHO's vessel slowdowns in the marine shipping area;

f. a list of potential contingency measures, which consist of different configurations for ECHO initiatives, which would only be implemented if noise from Project Related Shipping turns out to be higher than VFPA's "realistic-case"; and

g. based on the above, a claim that underwater noise will be mitigated.

164. This new information is explained in more detail below.

a) Construction effects and related measures

165. In IR2020-2.3, VFPA identified vibratory pile installation as the only feasible alternative to impact pile driving.[209] Through the additional analysis conducted for IR2020-2.3, VFPA found that four out of the 59 piles that will be driven during Project construction will require impact pile driving, while the remaining piles will be driven entirely by vibratory hammer.[210] The Minister asked VFPA to provide a "detailed description of the sound dampening technologies that would be used should impact piling occur […] and a

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[209] Document #2083, "IR2020-2.3: Avoidance and Mitigation Measures for Project Construction – Underwater Noise and Southern Resident Killer Whales", (24 September 2021), at pp 2, 3, [*IR2020-2.3*], online: <https://iaac-aeic.gc.ca/050/documents/p80054/141572E.pdf>.

[210] *Ibid* at p 3.

description of their potential effectiveness."[211] VFPA concluded that confined bubble curtains, isolation casings, and double-walled piles are all feasible sound dampening technologies which could achieve reductions of at least 10 – 15 dB at 10 m.[212] Drs. Scott and Val Veirs recommend that VFPA should use double-walled pilings.

166. VFPA also claims to have "developed an approach to plan the noisiest activities outside the highest SRKW seasonal use period."[213] The plan involves avoiding certain activities (all vibratory and impact pile driving; vibro-densification of the caisson foundation mattress rock; and removal of piles for temporary barge ramps) from June 1 or the date when Southern Residents are confirmed to be present in the Salish Sea, whichever is later, to September 30.[214] Some activities that generate underwater noise will still occur during the identified Southern Resident peak use period.[215] DFO and the Veirs' Report cautions that these assumptions about Southern Resident presence may not be accurate.[216] The Drs. Veirs suggest a more limited window for pile-driving.[217]

167. VFPA conducted analysis to determine the radius of Southern Resident exclusion zones necessary for various construction activities.[218] Exclusion zone radii ranged from 0.5 km for impulsive noise from impact pile driving to 7.25 km for continuous noise from vibratory pile installation. VFPA outlined the detection methods and stop work procedures they would employ in order to enforce the exclusion zones.[219] DFO has warned that the effectiveness of this measure depends heavily on successful detection of Southern Residents, and that this is more challenging in the winter months.[220]

168. The Minister asked VFPA to provide a contingency plan in case Southern Residents should be present outside of anticipated seasonal habitat use. However, VFPA states that the construction plan "already considers all effective measures that are feasible within the

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[211] *Ibid* at p 3.
[212] *Ibid* at pp 3-4.
[213] *Ibid* at p 4.
[214] *Ibid* 209 at pp 4-5.
[215] *Ibid* at p 6.
[216] *DFO Submissions*, *supra* note 77 at PDF p 29.
[217] *Veirs Report*, *supra* note 6 at PDF pp 4, 6-8; *DFO Submissions*, *ibid* at PDF pp 31-32.
[218] *IR2020-2.3*, *supra* note 209 at p 9, Table IR2020-2.3.1.
[219] *Ibid* at pp 10-12.
[220] *DFO Submissions*, *supra* note 77 at PDF p 31.

construction design and timing; we have not reserved any mitigation measures for contingency measures."[221] In the event that "unexpected issues" arise, VFPA's plan is to extend stop-work measures until Southern Residents leave the area.[222]

169. VFPA estimates that, with its proposed mitigation measures, the Southern Residents would experience "approximately 2 hours (1.2 h – 7.6 h) of potential lost foraging time per killer whale" during construction.[223]

b) Project operations and Project Related Shipping effects and related measures

170. VFPA provides revised information about the future vessel traffic at the terminal and also at Port Vancouver overall. For both, VFPA's evidence on vessel projections refers to a "most-realistic scenario" and a "high-case scenario". The Conservation Coalition takes the position that, based on the fragility of the Southern Residents, the Minister should take a precautionary approach and pay close attention to the anticipated effects associated with both scenarios.

171. With respect to the number of vessels calling at RBT2 during Project operations, VFPA initially estimated an average of five container vessels per week in the EIS. It later revised this figure, but, as noted above, the Panel preferred the more conservative estimate of five. VFPA now estimates a "most-realistic scenario" of three to four and a "high-case scenario" of four to five vessels calling at RBTW, and Transport Canada accepts this estimate.[224]

172. Regarding Project Related Shipping effects, VFPA's evidence is based on its vessel traffic projections for container terminals at the Port of Vancouver overall, which it claims, in the "most-realistic scenario", will be the same with or without the Project.[225] In the scenarios it refers to as "less likely", there would be anywhere from "approximately 52 fewer to 156

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[221] *IR2020-2.3, supra* note 209 at p 12.
[222] *Ibid*.
[223] *Ibid* at p 13.
[224] *IR2020-3, supra* note 180 at pp 3-4; Document #2298, Transport Canada, "TC RBT2 Comment", (9 February 2022), at PDF p 5, [*Transport Canada Submissions*], online: <https://registrydocumentsprd.blob.core.windows.net/commentsblob/project-80054/comment-57045/TC%20RBT2%20Comment%20(February%209,%202022).pdf>.
[225] *IR2020-3, ibid* at PDF p 4.

additional vessel calls per year".[226] In the "high-case scenario", 52 of those additional annual calls would be at RBT2, for a total of 260 at RBT2 by 2040 and 2045.[227]

173. With respect to the anticipated size and noise of the vessels, the Proponent previously would not concede that there would be more or the larger ships with the Project (taking the position that ship size would increase whether or not the Project is built), and previously claimed that newer ships had smaller engines and slower maximum design speeds, such that they would not be louder.[228]

174. VFPA now estimates that by 2035, one Large Post Panamax vessel (9000-12,999 twenty-foot equivalent units, or, TEUs) and two Neo-Panamax vessels (13,000-14,999 TEUs) will call at RBT2 per week, and by 2040, half of the container vessels calling at RBT2 will be Mega-Max class vessels, which have the largest capacity at 18,000 TEUs.[229] VFPA states that "more container vessels in the largest size classes would call at the Port of Vancouver with RBT2 than without RBT2."[230]

175. Further, having been told by the Agency to take a conservative approach to choosing source level projections on which to base the projected sound exposure levels for Southern Residents, VFPA now estimates that the individual vessels will be louder than it previously told the Panel. VFPA estimated an underwater noise source level for Mega-Max vessels "by extrapolating from sound measurements of other vessel class trends (based on length, draft, and speed)", resulting in a louder source level than the smaller vessel types currently calling at the Port of Vancouver, which VFPA characterizes as "precautionary".[231] Elsewhere it simply refers to Mega-Max as "the loudest type of container vessel".[232] VFPA states that "[c]ontainer 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".[233]

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[226] *Ibid*.
[227] *Ibid* at PDF pp 9, 11.
[228] Document #1900, "Undertaking #36: From the Vancouver Fraser Port Authority – Vessel Class Descriptions", (11 June 2019), online: <https://ceaa-acee.gc.ca/050/documents/p80054/130260E.pdf>.
[229] *IR2020-3*, *supra* note 180 at PDF p 4.
[230] *Ibid* at PDF p 5.
[231] *Ibid* at PDF p 9.
[232] *Ibid* at PDF p 14.
[233] *Ibid* at PDF p 10.

176. VFPA's evidence is that the number of vessels calling at the Port of Vancouver will not change (in its "most-realistic" scenario), but that noise will increase because the individual vessels will be louder.[234] Furthermore, Drs. Scott and Val Veirs' evidence, based on VFPA's modelling, is that "Mega-Max ships will be 5-10 dB more intense at frequencies precisely in the frequency range where the SRKW hear best" (emphasis added).[235]

177. VFPA therefore states that the Project will increase underwater noise levels in the vicinity of the terminal.[236] VFPA's evidence has included "underwater noise from container vessel arrival, berthing, unberthing, departure, and vessels at berth", for the first time in this process.[237] This includes three tugs meeting each vessel and berthing it, then returning to unberth it, as well as the container vessels having their engines running while at berth.

178. VFPA states that if noise in the area from other sources increased, "the project's relative contribution […] would be lower."[238] The Conservation Coalition notes that VFPA has followed a pattern throughout the environmental assessment of downplaying its own "residual" contribution to underwater noise and ignoring or undermining cumulative effects assessment.[239] This statement is another example of this approach, which fails to acknowledge the problem of cumulative effects and should be ignored in the Minister's significance determination.

179. VFPA has modelled underwater noise in terms of sound exposure levels measured in decibels and lost foraging time measured in hours per year for Southern Residents. It projects increased sound exposure levels and increased lost foraging time for Southern Residents in both the "most-realistic" and "high-case" scenarios (before mitigation).[240] VFPA says that, before mitigation, the "most-realistic scenario" will result in two hours per Southern Resident per year of lost foraging time, or three hours in the "high-case scenario" in the terminal area due to Project operations.[241] It further says that accounting for

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[234] *Ibid* at PDF p 6.
[235] *Veirs Report*, *supra* note 6 at p 14.
[236] *IR2020-3*, *supra* note 180 at PDF p 11.
[237] *Ibid* at PDF p 10.
[238] *Ibid* at PDF p 11.
[239] *Panel Report*, *supra* note 2 at PDF pp 479-483.
[240] *IR2020-3*, *supra* note 180 at PDF p 12.
[241] *Ibid* at PDF pp 12-13.

echolocation masking increases the lost foraging time by 0.1 to 0.2 hours in the "most-realistic" case, for a total of 1.6 in 2035 and 2.5 in 2040 and 2045, and by 0.2 hours in the "high-case" scenario, for a total of 2.5 in 2035, 3.5 in 2040, and 3.4 in 2045.[242]

180. With respect to noise in the marine shipping area, as opposed to the terminal area, VFPA says, again, that in the "most-realistic scenario", the Project will not change the number of container vessels calling at the Port of Vancouver overall.[243] It projected sound exposure in terms of sound exposure levels, and "annual exceedance hours above the behavioural disturbance threshold", using a 120 dB threshold, which it says incorporates communication masking.[244]

181. VFPA estimated both the noise from container vessel traffic alone and the Project's contribution to underwater noise.[245] VFPA also states that "the project's contribution is lower when accounting for existing noise conditions from other commercial vessel traffic in the marine shipping area."[246] Again, the Conservation Coalition notes that this ignores the reality of cumulative effects on the Southern Residents. Cumulative effects must be kept in mind when considering effects on the Southern Residents, which experience noise cumulatively, and the Minister's significance decision is required under CEAA 2012 to take cumulative effects into account.

182. For container vessel traffic alone, VFPA claims the sound exposure level in the marine shipping area will vary "only by minor amounts" that are not measurable, with or without the Project, in the "most-realistic" scenario; VFPA previously said this during the hearing before the Panel.[247] VFPA claims the increase in annual exceedance hours with the Project in the "most-realistic" scenario will be "small", at about 3.5 hours higher in 2040 and about one hour higher in 2045, due to Mega-Max vessels, as exceedance hours increase more with vessel size than sound exposure does.[248] In the "high-case scenario", the sound level

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[242] *Ibid* at PDF pp 19-20.
[243] *Ibid* at PDF p 14.
[244] *Ibid*.
[245] *Ibid*.
[246] *Ibid* at PDF p 17.
[247] *Ibid* at PDF p 15.
[248] *Ibid* at PDF pp 15-16.

would increase by 0.3-0.9 dB in 2040, and exceedance hours would increase by 23-70 hours.[249]

183. Drs. Scott and Val Veirs note that VFPA's modelled source level frequency spectra indicate that Mega-Max vessels will be 5-10 dB louder at frequencies in the range where the Southern Residents hear best.[250]

184. The Agency required VFPA to add an assessment of masking at a frequency of 20 kHz to the IR Responses, whereas during the hearing it only assessed it at 50 kHz.[251] Project Related Shipping is projected to increase echolocation masking, as this increases with vessel size due to greater sound exposure levels at relevant frequencies.[252] For its "most-realistic" scenario, VFPA estimates increases of sound exposure levels at this frequency at 0.1 dB, 1.3 dB, and 0.4 dB in 2035, 2040, and 2045 respectively, or 1.8-2.8 in 2040 in the "high-case" scenario.[253] For exceedance above the echolocation masking threshold, VFPA estimates that the Project will increase exceedance hours above the echolocation masking threshold at a 20 kHz frequency by 4 hours in 2035, 21 hours in 2040, and 7 hours in 2045 in the "most-realistic" scenario, or 57-129 hours in 2040 in the "high-case" scenario.[254]

185. Thus far, then, VFPA has conceded that there will be more noise in the area of the terminal, and more "exceedance hours" in the marine shipping area, even its "most-realistic" scenario.

186. With respect to behavioural responses of Southern Residents to underwater noise, VFPA suggests that DFO approved of its approach to a behavioural response thresholds[255], when in fact DFO and the Panel were critical and called for a contextual approach.[256] VFPA states that its new model in Appendix IR2020-3-D includes contextual factors and takes a more conservative approach.[257] Drs. Scott and Val Veirs note that, while the 120 dB

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[249] *Ibid* at PDF p 16.
[250] *Veirs Report*, *supra* note 6 at PDF p 14.
[251] *IR2020-3*, *supra* note 180 at PDF p 18.
[252] *Ibid* at PDF p 20.
[253] *Ibid* at PDF pp 21-22.
[254] *Ibid*.
[255] *IR2020-3*, *supra* note 180 at PDF p 23.
[256] *Panel Report*, *supra* note 2 at PDF p 223.
[257] *IR2020-3*, *supra* note 180 at PDF p 22.

threshold that is conventionally used as a threshold for disturbance, there is no real behavioural science behind using it for Southern Resident Killer Whales, and as such it should be treated as simply a reference level that is helpful for making relative comparisons.[258]

187. Drs. Scott and Val Veirs state that evaluations of broadband noise must include energy in the Southern Residents' hearing range, noting that the band of frequencies they use for communication and echolocation is from approximately 10-50 kHz.[259] They state that the 120 dB threshold should be used to describe the aggregate acoustic effects of all anthropogenic noise sources that are contribution to a 120 dB level at the location of a Southern Resident, in light of the assumption that if the noise from all sources rises above this level, it will cause acoustic disturbance. Therefore no individual noise source should be permitted to cause the broadband noise from all sources to rise above 120 dB.[260]

188. As Drs. Scott and Val Veirs state in their review of VFPA's new evidence, "every incremental increase in noise for SRKWs at the wrong place and time – even if for an extra hour – reduces their access to food."[261] They further caution that "[w]here and when SRKWs overlap with container ship noise matters", and that these nuances are lost in VFPA's averaging of the Southern Residents' use of their habitat, noise levels, and ship location, and that the assumptions made are "less than precautionary".[262]

189. Drs. Scott and Val Veirs determined that VFPA's acoustic effects model was not appropriate, and that its analysis of noise from Mega-Max ships likely results in the model underestimating lost foraging time.[263]

190. VFPA concludes that, in its "most-realistic" scenario,

> [m]arine 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

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[258] *Veirs Report, supra* note 6 at p 13.
[259] *Ibid*.
[260] *Ibid* at p 14.
[261] *Ibid* at p 3.
[262] *Ibid*.
[263] *Ibid* at pp 12-15.

> affect other life functions, and the implementation of the proposed mitigation measures would further increase confidence in this conclusion.[264]

191. VFPA identifies four new proposed measures with respect to underwater noise from Project operations in and around the terminal: 1) delaying unberthing and departure when Southern Residents are present during daylight hours, 2) evaluating the potential effectiveness of technologies to reduce underwater noise associated with tugs and implementing them once feasible, 3) providing shore power connections for vessels, and 4) contractually requiring the terminal operator to require RBT2-bound container vessels to participate in applicable initiatives of the ECHO Program.[265] These measures are discussed in detail in the section below on adequacy of mitigation.

192. With respect to Project Related Shipping, VFPA maintains that its "realistic-case" scenario will not increase noise for the Southern Residents but concedes that "the high-case vessel scenarios could cause incremental effects" to the Southern Residents.[266] It cites this as the reason for identifying measures to "further reduce the potential for acoustic effects and strike risk".[267] As explained below, it has not proposed any new measures

193. VFPA concludes that "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."[268] As outlined below, the Conservation Coalition and their experts disagree, as does DFO.

194. VFPA has also newly added a commitment to a follow-up program on Project Related Shipping, which, as explained above, is an additional, separate requirement in CEAA 2012 from mitigation, and was previously missing. VFPA now states that it "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 that it has "identified potential

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[264] *IR2020-3, supra* note 180 at PDF p 18.
[265] *Ibid* at PDF p 24.
[266] *Ibid* at PDF p 28.
[267] *Ibid*.
[268] *Ibid* at PDF p 3.

contingency mitigation options that could be implemented if the effects exceed predictions."[269]

195. Drs. Scott and Val Veirs note that VFPA proposes to use modelling of only broadband noise levels when verifying underwater noise predictions as part of the follow-up program.[270] Their opinion is that all future modelling should instead incorporate the most sensitive hearing range of Southern Residents into evaluating potential acoustic impacts, and that field observations should be done to ensure that underwater noise does not exceed predictions.

196. As explained below, this new evidence should not alter the Panel's conclusions.

2. *VFPA's proposed mitigation for the Southern Residents is inadequate*

197. The Panel identified a lack of effective and mandatory mitigation, and VFPA's IR Responses have not resolved this problem. The Conservation Coalition has significant concerns about the proposed mitigation. These concerns are bolstered by the conclusions of their experts, Drs. Val and Scott Veirs, that the proposed mitigation is not sufficient to prevent the Project from jeopardizing the Southern Residents' recovery.[271] DFO's evidence similarly raises concerns about the adequacy of mitigation.

198. Specific concerns about the shortcomings of mitigation intended to address Project construction, operation and Project Related Shipping impacts are explained below. These specific concerns are in addition to the following overarching observations of the Conservation Coalition:

    a. The effectiveness of VFPA's proposed mitigation should be measured against not only its "most-realistic" but also its "high-case" scenario. The Southern Residents are SARA-listed and critically endangered, and this heightens the need for a precautionary approach, which CEAA 2012 requires regardless. Even if the "realistic case" scenario is used, the fact of larger vessels, even if there are not more vessels, will increase underwater noise.

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[269] *Ibid* at PDF p 30.

[270] *Veirs Report*, *supra* note 6 at p 16.

[271] *Ibid* at pp 4, 12, 17.

b. Most of what VFPA proposes as mitigation with respect to Project operations and Project Related Shipping does not meet the criteria for “mitigation” under CEAA 2012.

c. Measures proposed to reduce additional noise the Project would introduce do not account for the existing underwater noise problem. The acoustic environment in the Salish Sea already poses an imminent threat to Southern Resident survival and recovery. Incrementally increasing ocean noise before identifying a way address the existing unsustainable levels of noise could make it harder later to solve the cumulative problem, even if the measures taken now to offset the Project’s incremental contribution are effective in reducing the amount of additional noise from those new effects.

d. VFPA relies heavily on an existing initiative (ECHO) that is not tied to this Project and was only intended to reduce effects from the unsustainable status quo, not to excuse the addition of new impacts.

a) Mitigation for Project construction is inadequate

199. The effectiveness of VFPA’s proposed measures (limiting use of impact pile driving, avoiding certain activities during SRKW peak use season, using exclusion zones and stop-work procedures) depends heavily on successful detection of Southern Residents.

200. This was confirmed by the Panel, which found that “the ability of the mitigation measures to eliminate residual effects of construction noise on SRKW is highly dependent on the ability for SRKW to be detected within prescribed buffer zones.”[272]

201. DFO has also noted that the effectiveness of exclusion zones will depend on ability to detect Southern Resident presence, and that two of the three methods – tracking their approach, and visual detection by marine mammal observers – are unlikely to be as effective in winter, while the other method, passive acoustic monitoring, has other limitations including current gaps in coverage.[273] It suggests real-time acoustic detection, which is more reliable year-round but still requires monitoring, interpretation, and

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[272] *Panel Report*, *supra* note 2 at PDF p 227.

[273] *DFO Submissions*, *supra* note 77 at PDF pp 31-32.

validation to confirm killer whale presence.[274] DFO further cautions that VFPA has likely overestimated its modelled detection ranges for Southern Residents during construction and that it should remedy this by the placement of acoustic receivers.[275]

202. With respect to stop-work procedures, DFO cautions that it may be difficult to manage stopping some activities while continuing other noise-generating activities when the Southern Residents are nearby, as VFPA proposes to do, because the Southern Residents could quickly enter the reduced exclusion zone once they are in the area.[276]

203. A notable shortcoming in VFPA's construction mitigation plan is that it fails to account for recent changes in Southern Resident seasonal movement patterns. The Southern Residents are now highly likely to occur in and near the construction area from October to March compared to the data presented by VFPA.[277] DFO cautions that "there is a high likelihood of occurrence in areas within 20 km of the Project in May and October" and that "they are […] consistently observed in the winter [in the Salish Sea] including in the RBT2 construction area."[278] As a result there is considerable uncertainty as to whether VFPA's proposed construction mitigation measures will work, especially when the higher occurrence of Southern Residents in the Project area in winter is combined with the decreased ability to detect Southern Residents in winter, which DFO has noted.[279] The Veirs' Report recommends that the most high-risk construction activities, such as impact pile driving, should be limited to the month of April.[280]

b) Mitigation for Project operations is inadequate

204. VFPA has proposed four new measures it claims will mitigate noise from project operations: 1) delaying unberthing during the daytime when Southern Residents are detected, 2) evaluating quieter tugboat technology, 3) providing shore power connections for vessels, and 4) requiring vessels bound for the Project to participate in applicable

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[274] *Ibid* at PDF p 31.
[275] *Ibid* at PDF p 32.
[276] *Ibid*.
[277] *Veirs Report*, *supra* note 6 at pp 7 (Figure 2) and 8 (Figure 3); *DFO Submissions*, *ibid* at PDF p 29.
[278] *DFO Submissions*, *ibid*.
[279] *Ibid* at PDF pp 31-32.
[280] *Veirs Report*, *supra* note 6 at pp 7-8.

ECHO initiatives. The Conservation Coalition has concerns about each, and only considers the first and third to be actual mitigation.

205. First, VFPA proposes delaying container vessels from unberthing and departure during daylight hours when Southern Residents are present. It states that it "would establish methods to detect SRKW" prior to unberthing, which "would include […] both visual and acoustic detection data sources, and marine mammal observers."[281] In other words, the detection methods for this measure, the success of which depends on successful detection, have yet to be established. The detection challenge referred to above with respect to construction mitigation also applies to this proposal. Nevertheless, VFPA claims that this measure will reduce potential lost foraging time by 15% or 2.2 to 1.9 hours in the "most-realistic" scenario or 13% or 3.2 to 2.8 hours in the "high-case" scenario.[282] The Conservation Coalition assumes, since VFPA does not state otherwise, that VFPA's modelling of the effectiveness of this measure (based on which it predicts a 13-15% reduction in lost foraging time) optimistically assumes successful detection.[283]

206. Furthermore, VFPA is reducing the effectiveness of this measure by refusing to apply it at night. While VFPA proposes avoiding pile driving at night during construction "to ensure detection of all marine mammals within the prescribed buffer zone"[284], it has rejected recommendations, including from locally impacted Indigenous groups, to take a similarly precautionary approach to unberthing. VFPA does so on the basis that this would have "very limited benefit" because "there are so few SRKW transits near Roberts Bank at night" and it would reduce estimated lost foraging time by "only" 17 minutes per Southern Resident per year.[285] VFPA additionally rejected this suggestion because a measure for detection in the dark would be needed, such as passive acoustic monitoring, which would have a "substantial" cost in light of the "limited effectiveness, and small benefit", and therefore is not "economically feasible".[286] VFPA therefore proposes to only attempt detection and delay unberthing in the daytime, and to simply proceed with unberthing at

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[281] *IR2020-3*, *supra* note 180 at PDF p 24.
[282] *Ibid* at PDF p 25.
[283] *Ibid*.
[284] *Panel Report*, *supra* note 2 at PDF p 216.
[285] *IR2020-3*, *supra* note 180 at PDF p 24.
[286] *Ibid* at PDF pp 24-25.

nighttime, claiming “it would not be economically feasible or effective to detect SRKW and delay unberthing at night” using passive acoustic monitoring.[287]

207. The Conservation Coalition notes that VFPA has simply claimed, not demonstrated, that the cost of detection is unfeasible.

208. Further, contrary to VFPA’s assertions, the evidence of Drs. Scott and Val Veirs is that the Southern Residents forage in the relevant area during both day and night, and therefore measures related to both construction and operations should apply both day and night.[288] As described in the Veirs’ Report, VFPA concedes that unberthing reduces foraging time and increases collision risk during the day; clearly, it also has these effects at night.[289] Therefore, as these experts suggest, VFPA should either delay unberthing anytime Southern Residents may be in the area, day or night, and accomplish this by using passive acoustic monitoring and other methods day and night (which it should do regardless), or delay unberthing and departure until daylight hours.[290]

209. Similarly, DFO recommends that VFPA either implement passive acoustic monitoring or consider avoiding nighttime unberthing.[291]

210. VFPA’s second proposed measure is evaluating the potential effectiveness of technologies to reduce underwater noise associated with tug activities (e.g., electric tugs). VFPA would “continue monitoring development” and would implement quieter tugs “when feasible”.

211. VFPA does not provide a timeline, nor criteria for when this would be considered feasible, nor any other guarantee that this will ever actually be deemed feasible and implemented. As explained above, future studies are not mitigation. Therefore this proposal does not meet the standard for mitigation in CEAA 2012 as it is not a measure for “elimination, reduction, or control” of adverse effects.[292] As explained above, “vague hopes for future technology” are not mitigation.[293] DFO notes that VFPA cannot provide a “quantification

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[287] *Ibid* at PDF p 24.
[288] *Veirs Report*, *supra* note 6 at p 16.
[289] *Ibid* at p 15.
[290] *Ibid*.
[291] *DFO Submissions*, *supra* note 77 at PDF p 44.
[292] *CEAA 2012*, s 2(1), definition of “mitigation measures”.
[293] *Pembina*, *supra* note 30 at para 25.

of reduction of acoustic effects" from quieter tugs, and its opinion is that "at this time this measure cannot be relied on as mitigation for operational noise."[294]

212. VFPA should still pursue this research. Drs. Scott and Val Veirs suggest that the evaluation should pay particular attention to noise generated at the frequencies in the most sensitive hearing range of the Southern Residents.[295]

213. Third, VFPA proposes providing shore power connections for container vessels, which it says would reduce lost potential foraging time by 6.8 to 5.9 minutes in the "most-realistic" scenario or by 8.9 to 8.0 minutes in the "high-case" scenario.[296] The Conservation Coalition notes that this would have a smaller effect than the measures of pausing unberthing at night when Southern Residents are present, which VFPA dismissed based on limited effectiveness and small benefit, with a reduction in lost foraging time of 0.9 vs 17 minutes per Southern Resident per year.[297]

214. VFPA's fourth of four proposals is to contractually require the terminal operator to require RBT2-bound container vessels to participate in applicable initiatives of the ECHO Program (or a future equivalent program), to provide "greater confidence that RBT2 vessels will participate in the initiatives".[298] VFPA frames this in terms of "how reducing SRKW exposures to noise in the marine shipping area could mitigate acoustic effects from project operation at the terminal".[299]

215. VFPA claims, based on new modelling, that "the annual median SRKW exposures from project operation could be counterbalanced by reducing SRKW acoustic exposures in the marine shipping area" via "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".[300] A higher confidence interval would require higher participation: 30% participation over six months, or 36% for five months. VFPA assumed that RBT2-bound vessels would achieve a 95% participation rate (not 100%

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[294] *DFO Submissions*, *supra* note 77 at PDF p 44

[295] *Veirs Report*, *supra* note 6 at p 17.

[296] *IR2020-3*, *supra* note 180 at PDF p 26.

[297] *DFO Submissions*, *supra* note 77 at PDF pp 39-40; *IR2020-3*, *ibid* at PDF p 24.

[298] *IR2020-3*, *ibid* at PDF p 2.

[299] *Ibid* at PDF p 27.

[300] *Ibid*.

because sometimes safety requires non-compliance), based on the 2020 voluntary ECHO participation rate being 80%, and it claims that this additional participation by this subset of vessels would more than fully mitigate the increased noise from operations at the terminal.[301] VFPA further claims that this commitment would reduce potential increases in vessel strike risk for the Southern Residents.

216. VFPA claims that the increased participation rate resulting from this measure will balance out or offset increased noise from Project operations. The Conservation Coalition has identified several problems with this claim.

217. First, it is unclear whether this refers to making it mandatory for the vessels to carry out each of the initiatives (unless safety prevents it) or simply mandating greater participation in the voluntary program. The fact that VFPA says this would provide "greater confidence that RBT2 vessels will participate in the initiatives", as opposed to certainty, suggests that it may be the latter.[302]

218. Second, regardless, ECHO is not mitigation, as the Panel concluded.[303] As described on its website, ECHO is intended "to better understand and reduce the cumulative effects of shipping on whales throughout the southern coast of British Columbia."[304] Its "projects, educational initiatives and voluntary research trials" are "designed to provide a better understanding of the cumulative effects of marine shipping on whales, and inform the development and testing of potential threat-reduction solutions."[305]

219. ECHO is not intended to mitigate the potential effects of any particular proposed or new project. Instead it is intended to identify ways to lessen the effects of existing traffic, which effects are already unsustainable. VFPA is therefore attempting to pass off an initiative aimed at the status quo as mitigation for the Project's new, additional impacts in the terminal area. VFPA cannot use ECHO as cover to introduce new noise, or purport to assign part of it to address a new threat instead.

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[301] *Ibid*.
[302] *Ibid* at PDF p 2.
[303] *Panel Report*, *supra* note 2 at p 215.
[304] Port of Vancouver, "Enhancing Cetacean Habitat and Observation (ECHO) Program", online: <https://www.portvancouver.com/environmental-protection-at-the-port-of-vancouver/maintaining-healthy-ecosystems-throughout-our-jurisdiction/echo-program/>.
[305] *Ibid*.

220. VFPA also runs ECHO of its own volition, which means that the program could conceivably end at any time during the lifetime of the Project. VFPA does not address the fact that it is not obligated to continue the ECHO program and the possibility that this initiative could cease to exist. It does not suggest making a formal, let alone enforceable, commitment to continue the ECHO or an equivalent program for the life of the Project.

221. Third, it is unclear how a slowdown in parts of the marine shipping area for 5-6 months of the year can "counterbalance" year-round increased noise from Project operations, as VFPA suggests. Offsetting is not an accepted practice for mitigating underwater noise and VFPA is proposing an entirely novel and unproven approach.

222. DFO echoes this concern about using the concept of "offsetting" in this context, advising that "the concept of offsetting underwater noise is relatively new and in development." DFO states that "[t]he quantification of equivalency reductions in one location to offset noise inputs elsewhere is complicated and it is important to consider the biological meaningfulness of noise inputs and reductions over space and time."[306] In other words, lost foraging time near the terminal at a time when Southern Residents are present is still lost foraging time, regardless of what might be happening in the shipping lanes. DFO notes that it is still developing "the metrics and methods used to evaluate changes in underwater noise" and "the biological relevance to SRKW of noise increases and decreases over space and time"; until it has done this, DFO cannot fully comment on the appropriateness of VFPA's approach.[307]

223. Fourth, the ECHO initiatives described are insufficiently ambitious, as explained further below with respect to mitigation for Project-Related Shipping, and this measure is not anticipated to have a large impact. DFO identifies "key assumptions" in VFPA's analysis of the effectiveness of this measure, and it has characterized this measure as less likely to have an impact than the unberthing measure.[308] The Veirs' Report also identifies assumptions they characterize as "less than precautionary" in VFPA's modelling.[309]

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[306] *DFO Submissions*, *supra* note 77 at PDF p 45.

[307] *Ibid* at PDF pp 45-46.

[308] *Ibid* at PDF pp 44-45.

[309] *Veirs Report*, *supra* note 6 at p 3.

224. With respect to other measures beyond these four, VFPA states that "[t]he operations mitigation plan will be finalized prior to operation", and that it "will allow for consideration of additional feasible measures or technologies that may become available by that time", but for the time being VFPA proposes that its operations mitigation plan include the four measures above.[310]

225. VFPA notes that it will distribute educational materials, which the Panel specifically found not to be mitigation.[311] It notes that it will avoid dredging during the "SRKW peak use period" but does not suggest a formal commitment to this.[312]

226. Worthwhile potential measures are missing from VFPA's list. VFPA has rejected the idea of reducing the travelling speed of vessel assist tugs from 8 to 5 knots as "not effective", on the basis that the additional time spent travelling as a result would increase the probability of encountering a Southern Resident, thereby increasing potential lost foraging time.[313] As Drs. Scott and Val Veirs note, VFPA's conclusion on tugs is inconsistent with the logic behind vessel slowdowns generally, which VFPA is relying on as its main proposed method of addressing underwater noise. [314]

227. Simulations conducted by the Drs. Veirs and included in their Report indicates that measures to reduce the speed of vessel assist tugs would in fact reduce tug noise. Their simulation of a tug slowing from 8 to 5 knots showed that the lower speed reduced the sound exposure level by 3 dB, which they note is consistent with the 2.5-2.8 dB noise level reduction reported by ECHO resulting from the Haro Strait voluntary slowdown; the same physics supports reducing tug speed to reduce disturbance.[315] Rather than recommend a specific tug speed such as 5 knots, the Veirs' Report suggests that tugs, and all vessels classes, should slow down as much as safely possible (below a set maximum limit) to minimize their acoustic impact.

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[310] *IR2020-3, supra* note 180 at PDF p 24.
[311] *Ibid* at PDF p 27. *Panel Report, supra* note 2 at PDF pp 229-230.
[312] *IR2020-3, ibid* at pp 27-28.
[313] *Ibid* at PDF p 8.
[314] *Veirs Report, supra* note 6 at pp 15-16.
[315] *Ibid*.

228. VFPA has also rejected the Minister's idea of controlling the terminal's capacity as a method of reducing or limiting vessel transits, on the basis of its position that RBT2's terminal capacity will not affect overall container vessel calls at the Port of Vancouver.[316] It also states that limiting the Project's capacity would cause shipping companies to divert cargo to other Port of Vancouver container terminals or to other ports. Drs. Scott and Val Veirs' opinion is that, if true, diverting vessels to other terminals within the Port of Vancouver or other ports entirely would still be preferable for the Southern Residents given their use of the Fraser delta area, which includes increasingly frequent use between October and March.[317]

229. The Conservation Coalition's full comments on gaps in the draft conditions are included in part VI below.

c) Mitigation for Project Related Shipping is inadequate

230. VFPA has failed to propose any new measures to address underwater noise from Project Related Shipping.

231. VFPA claims that it has identified measures to "further reduce the potential for acoustic effects and strike risk".[318] However, it is not clear what VFPA has added to "further reduce" these effects, as neither of the two measures in its "marine shipping mitigation plan" are new, despite being referred to as "additional mitigation measures".[319]

232. VFPA continues to rely on measures that, as explained above, the Panel found were not mitigation and could not be relied upon to mitigate the Project's effects on the Southern Residents: 1) participation in regional and multi-stakeholder initiatives, including the Government of Canada's Oceans Protection Plan and Whales Initiative; 2) continuing the ECHO program, though it does not specify for how long, and 3) signing on to another five years of a SARA s. 11 Conservation Agreement concerning the Southern Residents (if the other parties agree).[320] These were presented to the Panel, which found that they are not mitigation, because they are not tied to the Project, do not have minimum standards, have

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[316] *IR2020-3, supra* note 180 at PDF p 6.
[317] *Veirs Report, supra* note 6 at pp 12-13.
[318] *IR2020-3, supra* note 180 at PDF p 28.
[319] *Ibid* at PDF pp 29-30.
[320] *Ibid* at PDF pp 29, 27.

no guarantee of permanence, are voluntary, and in the case of the regional initiatives and conservation agreement, they are not directly controlled by VFPA.[321] They therefore "cannot be relied upon to mitigate the effects of" Project Related Shipping."[322]

233. Further, the details of the ECHO measures VFPA proposes are of unknown effectiveness and/or are insufficiently stringent and do not guarantee any specific outcomes. With respect to the specific ECHO measures, the Conservation Coalition prefaces its comments by reminding the Agency that, as explained above, there is no guarantee of what ECHO will entail from year to year or even that ECHO will continue. ECHO is voluntary, and its measures are adjusted year-to-year, with no minimum requirement. VFPA does not propose or commit to any minimum stringency in the form of a maximum speed, or minimum speed reduction. Estimations of ECHO's benefits to date are based on findings of noise reduction of 2-3 dB based on speed adjustments and then modelling that predicts that this results in increased quiet time, as opposed to a biological assessment, observations, or analysis of the sufficiency of the measures to achieve any conservation goals. Targets are relative, and not determined by conservation benefit or to achieve specific goals but rather aimed at increasing participation year to year. ECHO is a worthwhile endeavour, but there is no standard of conservation benefit from ECHO.

234. As noted above with respect to mitigation for Project operations, the specific potential measures that VFPA describes for ECHO are insufficient, especially when contrasted with the proposed contingency measures, as they do not represent all feasible measures and are less ambitious and therefore presumably less effective than they could be.

235. With respect to speed, VFPA does not propose that ECHO slowdowns involve speeds below 14.5 knots except in two of its contingency measures.[323] It fails to mention its consultants' conclusion that "[r]esults for RBT2 container vessel with slow down speeds of 11 knots increased certainty in mitigating Project operation SRKW acoustic exposures", and that "[l]ikewise, speed reductions between 14.5 and 11 knots would add certainty in mitigating Project operation SRKW acoustic exposures above that predicted for 14.5 knot

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[321] *Panel Report*, *supra* note 2 at PDF pp 59, 91, 229-230.

[322] *Ibid* at PDF pp 229-230.

[323] *IR2020-3*, *supra* note 180 at PDF p 31.

reductions."[324] The Veirs' Report recommends that all vessels slow down by as much as is safely possible.[325] The Conservation Coalition therefore suggests that a speed limit of 11 knots or less would be preferable.

236. DFO's recent research has confirmed that speeds over 10 knots are likely to cause mortality in the event of a collision with a Southern Resident.[326] However, none of VFPA's proposed measures, even in the potential contingency measures, take this into account.

237. The Conservation Coalition is also concerned that VFPA has proposed some measures as contingency measures which could and should be in place immediately. For example, the proposed measures on Swiftsure Bank should be included up front and not merely as a potential contingency option. Recently published DFO research that VFPA cites in its IR Responses confirms that Swiftsure Bank has a high relative occurrence of Southern Residents, and is a key foraging area.[327] DFO's research further showed that the areas of high Southern Resident occurrence at Swiftsure Bank overlap with the shipping lanes, as they do in Haro Strait, and that the noise impact is even greater at Swiftsure Bank than at Haro Strait.[328] The eastern foreslope of Swiftsure Bank, an area where foraging behaviour dominates, was the area most impacted by large commercial vessel noise. DFO concluded that the Swiftsure Bank area, Haro Strait, coastal waters near the Fraser River and other locations in the Salish Sea have high Southern Resident occurrence from May to October, and therefore that "[m]arine spatial planning and conservation efforts that include these areas are likely to increase the success of threat mitigation actions."[329] The Conservation Coalition submits that the slowdown should therefore start west of Swiftsure Bank and should include inbound and outbound vessels.

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[324] Document #2083, "Appendix IR2020-3-F: Technical data report – Effectiveness of RBT2 container vessel slowdowns to mitigate SRKW acoustic exposures from project operation", (24 September 2022), at PDF p 382, online: <https://iaac-aeic.gc.ca/050/documents/p80054/141575E.pdf>.

[325] *Veirs Report*, *supra* note 6 at p 15.

[326] DFO, "Identification of Areas for Mitigation of Vessel-Related Threats to Survival and Recovery for Southern Resident Killer Whales", (June 2021), at PDF p 6, online: <https://waves-vagues.dfo-mpo.gc.ca/Library/40979817.pdf>.

[327] *Ibid*.

[328] *Ibid*.

[329] *Ibid* at PDF p 9.

238. With respect to timing, VFPA does not address the issue of Southern Resident presence year-round, which necessitates measures at all times of year that Southern Residents are present. DFO and Drs. Scott and Val Veirs caution in their Report that the Southern Residents' patterns of seasonal use of their habitat may be changing and that Southern Residents are consistently present in the Salish Sea in the winter months.[330] As a result, the May to September/October summer season can no longer be assumed to be the only or even primary time of year that protective measures are needed. Thus, the Veirs' Report recommends that conditions specifying times of year should go beyond May to October to include any month of the year when observations suggest the Southern Residents are present.[331]

239. The Conservation Coalition further notes that VFPA's evidence about ECHO's effectiveness is based on modelling rather than on observations of the Southern Residents themselves, such that its biological usefulness and effectiveness have not been demonstrated. As such it would not be precautionary to assume ECHO's effectiveness, especially if it alone is being relied on to mitigate effects of Project Related Shipping.

240. Other worthwhile potential measures are missing from VFPA's list. The Veirs' Report suggests that inbound arrivals on the outer shelf could be scheduled and staged in groups to increase quiet periods for Southern Residents as well as reducing the odds of spatiotemporal overlap with Southern Residents.[332]

241. Comments on specific draft conditions and gaps in the draft conditions are included in part VI below.

242. With respect to contingency measures, VFPA has provided a new list of contingency measures "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)."[333] VFPA is therefore proposing to only "mitigate" its most optimistic, or, "most-realistic" scenario at this time.

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[330] *Veirs Report*, *supra* note 6, at pp 6-7; *DFO Submissions*, *supra* note 77 at p 29.

[331] *Veirs Report*, *ibid* at pp 17-18.

[332] *Ibid* at p 21.

[333] *IR2020-3*, *supra* note 180 at PDF p 31.

243. The potential contingency options consist of four different vessel slowdown configurations that are comparatively more stringent due to their six month timeline and their inclusion of either additional areas beyond Haro Strait and Boundary Pass (Swiftsure Bank and potentially additional areas of Juan de Fuca Strait and/or the Strait of Georgia) or slower speeds (as low as 11 knots) or both; three of them would require 80% participation by other container vessels beyond RBT2-bound ones to work. VFPA states that some combination of these "more expansive measures" would be needed to mitigate its "high-case" vessel scenarios (though more still would be needed for its highest case of an additional 156 Mega-Max calls per year, as explained below), as well as to reduce sound levels in the relevant echolocation frequency bands for the Southern Residents.[334]

244. In other words, VFPA is saving for potential future contingency use not only measures for scenarios worse than its most optimistic one, but also holding in reserve measures that it considers necessary to reduce noise at relevant frequencies for Southern Residents. This is not precautionary, or appropriate for a SARA-listed species; it is unacceptable.

245. VFPA states that the contingency measures "are available today and have been proven to be effective in reducing underwater noise and potential acoustic effects on SRKW, despite longer transit times."[335] In other words, they are feasible (which Transport Canada echoes[336]) and believed to be effective, yet VFPA only proposes these as contingency measures to be implemented if underwater noise is higher than it predicts in the marine shipping area. The Conservation Coalition submits that both a precautionary approach and SARA s. 79(2) require taking all feasible measures and applying the more stringent option immediately. This is in part because it is possible that the most optimistic scenario will not transpire, and in part because, even if it does, the aim should be to more than mitigate the Project's effects, given the Southern Residents' perilous status and the fact that their survival is already threatened by the status quo. As explained above, the Panel also emphasized the need for a precautionary approach.[337]

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[334] *Ibid* at PDF pp 31-32.

[335] *Ibid* at PDF p 31.

[336] *Transport Canada Submissions*, *supra* note 224 at PDF p 6.

[337] *Panel Report*, *supra* note 2 at PDF p 39-40.

246. VFPA further concedes that still more measures, beyond its contingency measures, would be needed for its highest case of an additional 156 Mega-Max calls per year.[338] It does not even have a contingency plan prepared for its highest case scenario. This must be remedied.

247. DFO's evidence is similar to the Conservation Coalition's submissions with respect to inadequate mitigation for Project Related Shipping's effects. DFO echoes the Panel's findings that, without mandatory mitigation measures that reduce underwater noise from Project-Related Shipping, the Project will adversely affect the acoustic environment in Southern Resident critical habitat, and it therefore recommends that any potential approval include "enforceable conditions that hold the Proponent accountable to its updated underwater noise predictions and mitigations such that the Project will not result in increased underwater noise from container vessel shipping."[339] This standard of enforceability and accountability is not currently met by VFPA's proposals or the Proposed Draft Conditions.

248. With respect to the contingency mitigation measures, DFO again cautions that "[t]he concept of offsetting impacts of shipping related underwater noise is new" and that "there is significant uncertainty associated with underwater noise predictions and mitigations (e.g., additional vessel slowdowns) to offset effects of underwater noise" associated with potential increases in container vessel traffic.[340] Uncertainties include the mechanism for implementing additional slowdowns, compliance of vessels bound for other terminals, effectiveness of slowdowns to mitigate effects on the Southern Residents (due to further work being required to determine equivalency between detrimental effects of Project noise and benefits of measures), and "[t]he availability of underwater noise reduction measures to offset RBT2 while supporting existing commitments in relation to the Trans Mountain Expansion Project."[341] The Panel also previously noted that offsetting was "not the appropriate first line of corrective action" in the event of unforeseen effects.[342]

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[338] *IR2020-3*, *supra* note 180 at PDF p 32.

[339] *DFO Submissions*, *supra* note 77 at PDF p 43.

[340] *Ibid* at PDF p 46.

[341] *Ibid* at PDF pp 46-47.

[342] *Panel Report*, *supra* note 2 at PDF p 40.

249. With the point about existing commitments, DFO appears to be identifying the problem – raised above with respect to mitigation for Project operations – that will result if every new development purports to rely on the same vessel slowdown program as a means of addressing its contribution to the significant cumulative effects of underwater noise on the Southern Residents. Even if the ECHO measures were proven to be effective in addressing the pre-existing problem of unsustainable ocean noise in the Salish Sea, which DFO indicates is not currently the case, it may not be possible for the ECHO measures to maintain this effect with the addition of new sources of vessel noise to the Salish Sea. The benefits of the same slowdowns cannot be double-counted by Trans Mountain and the Project, let alone continue to be claimed by every new project, as VFPA's logic suggests.

250. Transport Canada's response to VFPA indicates its agreement with VFPA that Project Related Shipping will not increase underwater noise, after mitigation, but its explanation is faulty.[343] Transport Canada agrees based on: 1) the Agency's proposed draft conditions, including additional measures Transport Canada proposes; 2) Transport Canada's commitment to work with VFPA on implementing VFPA's contingency measures as required; 3) the Whales Initiative; and 4) VFPA's vessel forecast, which it accepts.

251. Transport Canada explains that its Whales Initiative includes "mandatory and voluntary measures" that include "vessel slowdowns, displacement of vessel traffic away from coastal foraging areas, the establishment of interim sanctuary zones, an increased approach distance on killer whales, slowing down when in the presence of whales, and disabling echosounders and underwater transducers when not in use."[344] Transport Canada states that "[t]hese measures, in concert with proposed mitigations under IR2020-3-E Underwater Noise Modelling of RBT2 Marine Shipping: Container Vessel Transit Exposure Model, and proposed conditions on limiting vessel noise, should serve to address any marginal increase in underwater vessel noise if vessel projections align with vessel forecasts."[345]

252. However, its reliance on the Whales Initiative, which it misrepresents, undermines Transport Canada's conclusion. First, the Whales Initiative is not mitigation, as the Panel

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[343] *Transport Canada Submissions, supra* note 224 at PDF p 6.

[344] *Ibid* at PDF p 7.

[345] *Ibid*.

found, as it is not tied to the Project.[346] Second, its listed measures are voluntary, or not applicable to container vessels, or both. The vessel slowdowns and displacement are voluntary ECHO measures. The other, government-initiated measures are also established annually, with no guarantees, year-to-year, and they do not apply to container vessels at all:

a. The annually-established mandatory interim sanctuary zones are not located in the shipping lanes, evident from the 2021 map, which is appended as Appendix 3.[347]

b. The mandatory approach distance does not apply to vessels in transit, such as container vessels.[348]

c. The slowdown in the presence of whales and the disabling of echosounders and underwater transducers when not in use are entirely voluntary and are not relevant to container vessels.[349]

253. Transport Canada's explanation is therefore misleading and should be disregarded.

254. DFO's comments, in contrast, do not accept VFPA's overall conclusion at this time.[350]

3. The Project will have significant adverse effects on the Southern Residents

255. As explained above, the Panel decided, consistent with policy, that significance of effects is determined based on their magnitude, spatial extent, frequency, duration, and reversibility.[351] It should also take into account "the ecological and social context of the environmental component" in question, such as a species being listed under SARA.[352]

256. In this case, the magnitude of the effects is debated, but the ecological context of the Southern Residents' critically endangered status combined with the spatial extent, frequency, duration, and irreversibility (during the indefinite lifetime of the Project) of the effects renders the Project's effects on the Southern Residents from Project construction

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[346] *Panel Report*, *supra* note 2 at PDF p 33.

[347] Order for the Protection of the Killer Whale (Orcinus orca) in the Waters of Southern British Columbia, 2021 (1 June 2021) C Gaz I, 2888, online: <https://www.gazette.gc.ca/rp-pr/p1/2021/2021-06-19/pdf/g1-15525.pdf> or <https://tc.canada.ca/en/interim-order-protection-killer-whale-orcinus-orca-waters-southern-british-columbia>.

[348] *Ibid* at s 2(2)(a).

[349] DFO, "2021 management measures to protect Southern Resident killer whales", online: <https://www.pac.dfo-mpo.gc.ca/fm-gp/mammals-mammiferes/whales-baleines/srkw-measures-mesures-ers-eng.html>.

[350] *DFO Submissions*, *supra* note 77, at pp 43, 46.

[351] *Panel Report*, *supra* note 2 at PDF p 39, relying upon *CEAA 2012 Policy*, *supra* note 40.

[352] *Panel Report*, *ibid* at PDF pp 39-40; *SARA Policy*, *supra* note 43.

and operations (including effects on Chinook salmon) and Project Related Shipping, and the cumulative effects with other current and future activities, significant.

257. The Panel found that the Project would have significant adverse environmental effects on the Southern Residents. It found that the Project's cumulative effects would further diminish prey availability in critical habitat, physically destroy a portion of critical habitat, further destroy the acoustic quality of critical habitat, and increase the risk of harm to individual whales from vessel strikes. VFPA's IR Responses should not alter these conclusions.

258. The evidence, taking into account the Panel's findings and VFPA's new IR Responses, as well as new comments from federal departments and the Conservation Coalition's experts, shows that the following is true even if VFPA is correct that overall vessel traffic at the Port of Vancouver would not increase:

   a. the Project, which is within Southern Resident critical habitat, would be entrenched as core commercial infrastructure, operating indefinitely, with more vessels calling at this location as opposed to other locations that are not in critical habitat;

   b. important habitat for the Southern Resident's most important prey, Chinook salmon, would be destroyed, thereby destroying Southern Resident critical habitat;

   c. a transition to larger ships which might otherwise result in a reduction in overall traffic would instead mean vessel trips remain at least as high;

   d. larger ships calling at the Project would be louder and therefore have greater impacts per ship on the Southern Residents;

   e. underwater noise would destroy critical habitat; and

   f. under any modelled scenario in the Project area there would be an increase in lost foraging time for the nutritionally stressed Southern Residents and an increase in the hours per year in which a behavioural disturbance threshold determined by VFPA will be exceeded (before taking into account VFPA's proposed "mitigation", which it claims will counter these increases).

259. The evidence also shows that VFPA's proposed "mitigation" for Project operations in IR2020-3 largely consists of things the Panel decided were not in fact "mitigation",

because they were voluntary or not tied to the Project. This is also true of all proposed measures for Project Related Shipping.

260. To survive and recover, the Southern Residents require existing conditions in the Salish Sea to improve. This means more Chinook and quieter seas. There is insufficient evidence that the measures proposed by VFPA would even address existing conditions, let alone account for increased stress from additional and/or louder vessels, the risk of vessel strikes, or the impacts to the Southern Residents that even temporary reductions in Chinook availability would cause.

261. The Veirs' Report concludes that the Project's impacts on the Southern Residents will be significant, taking VFPA's proposed mitigation into account.[353]

262. For the reasons below, VFPA's new evidence in IR2020-3 does not change the Panel's findings and its conclusion of significant adverse environmental effects.

a) Significant adverse effects on prey abundance

263. The effects on Chinook salmon that equate to significant adverse effects on the Southern Residents and their critical habitat are addressed above.

264. Impacts on Chinook salmon will adversely impact prey availability for the Southern Residents. Therefore, even setting aside Project Related Shipping, and regardless of the precise number of vessels that eventually call at the terminal during Project operations, or impacts of Project construction, the existence of the expanded terminal facility itself is likely to have significant adverse effects on the Southern Residents.

b) Significant adverse effects from Project construction

265. The Veirs' Report concludes that "[e]ven if the proposed mitigation measures are taken during construction of RBT2, the estimated lost foraging time is significant."[354]

266. As noted above, VFPA's analysis found that underwater noise during construction would result in "approximately 2 hours (1.2 h – 7.6 h) of potential lost foraging time per killer whale" over six years of in-water construction.[355] Drs. Scott and Val Veirs' evidence is that

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[353] *Veirs Report*, *supra* note 6 at p 4.

[354] *Ibid*.

[355] *IR2020-2.3*, *supra* note 209 at p 2.

"~2 hours/whale lost foraging time over 6 years of construction constitutes an adverse impact on SRKWs" and that VFPA's modeling would only be appropriately precautionary if they used the upper limit of lost foraging time, 7.6 hours per whale over six years.[356] Even using the mid-range value of 2 hours per whale over six years, the Veirs' Report states that this would equal more than 1 day per year for the entire population, and the upper value of 7.6 hours per whale equates to 4 days per year. This is a significant loss of foraging time for the population.[357]

267. The Veirs' Report also identifies potentially significant flaws in VFPA's modelling approach, the result of which is that it "underestimates the impacts on SRKW."[358] For example, VFPA failed to take into account recent science showing that female Southern Residents may have a greater avoidance response to noise than males. As such, there would be sex-based differences in the impacts of construction noise, and the only scenario that would allow for Southern Resident reproduction and recovery would be one that reduces noise impacts overall.[359] VFPA also used "one of the least precautionary assumptions" possible when modelling Southern Residents' location and direction of travel near the Project construction site, resulting in a model that does not accurately reflect the density distribution of Southern Residents at Roberts Bank.[360] The result is an underestimation of the probability that Southern Residents will approach the Project site close enough to be impacted by underwater noise.[361] Another non-precautionary assumption in VFPA's model is the assumption that Southern Residents will transit the Project area at a travelling speed, rather than a slower speed.[362]

268. Drs. Scott and Val Veirs are experts in bioacoustics and the behaviour of Southern Residents. In the Veirs' Report they opine that:

> [w]hen the current demographic condition and less predictable movements of the SRKWs are considered with the ongoing acoustic impacts in the Fraser River delta of

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[356] *Veirs Report*, *supra* note 6 at p 6.
[357] *Ibid*.
[358] *Ibid* at p 12.
[359] *Ibid* at p 5.
[360] *Ibid* at pp 8-12, Figures 4-6.
[361] *Ibid* at p 10.
[362] *Ibid* at pp 11-12.

> Deltaport operations, and the potential impacts of RBT2 over decades, we believe the construction impacts have the potential to jeopardize the recovery of the Southern Resident population.[363]

c) Significant adverse effects from Project operations and Project Related Shipping

269. The Panel found that the Project would have significant adverse effects and significant adverse cumulative effects on the Southern Residents due to underwater noise from both operations and Project Related Shipping. The proposed measures in VFPA's new IR Responses are not adequate to eliminate these adverse effects or render them non-significant. VFPA's new evidence in IR2020-3 confirms that the Project will increase underwater noise and lost foraging time. The Conservation Coalition, its experts, and DFO all disagree with VFPA's claims that its proposed "mitigation" will effectively cancel out these impacts. The Conservation Coalition submits, based on the evidence of its experts, that the Project will have significant adverse effects on the Southern Residents.[364]

270. VFPA concedes that there will be larger, and potentially more, ships at Roberts Bank even if the overall number of vessels at the Port of Vancouver is the same. This means an increase in vessels calling at a terminal within Southern Resident critical habitat. The Veirs' Report concludes that an increase in vessels at this location – in the Fraser River Delta, as opposed to at other terminals – increases the severity of effects on the Southern Residents.[365] The Project locks in, indefinitely, an expanded terminal which will maintain or increase, as opposed to alleviate, the unsustainable status quo conditions for Southern Residents in the Salish Sea. The anticipated industry-wide transition to larger ships might have resulted in an overall decrease in vessel numbers calling at Roberts Bank. Instead, with the Project, vessel transits are expected to remain at least as high as they are today, and with the increased noise associated with increased vessel size. Thus, noise in the vicinity of Roberts Bank will be increased over the lifetime of the Project – even if it may decrease at other Port of Vancouver locations not in critical habitat.

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[363] *Ibid* at p 4.

[364] *Ibid*.

[365] *Ibid* at pp 3-4, 12-23.

271. Further, the Proponent's new assessment may understate the Project's impacts. The Veirs' Report concludes that VFPA's acoustic effects model was not appropriate, and that its analysis of noise from Mega-Max ships likely underestimates lost foraging time.[366]

272. DFO's recent comments echo the Panel's finding that "an objective of net overall decrease in underwater noise by commercial vessel traffic" is necessary.[367] Drs. Scott and Val Veirs agree.[368] Consistent with DFO's Imminent Threat Assessment, which the Panel addressed, the Southern Residents' survival and recovery are already jeopardized by current conditions, including the current state of Chinook salmon and existing levels of ship source noise and disturbance in critical habitat.[369] The Southern Residents cannot tolerate increased threats; they require an improvement over status quo conditions if they are to recover from their current endangered status or even to survive over the long term.[370] As confirmed by the Veirs' Report, any additional impacts on prey availability or additional noise or disturbance will exacerbate the existing untenable conditions in the Salish Sea and will therefore be a significant adverse effect.[371]

273. The Panel found that, although the risk of vessel strikes risk is relatively small, a fatal vessel strike of even a single Southern Resident could have an irreversible and population level impact, due to the small size and social complexity of the Southern Resident population.[372] The Project's adverse effects could result in the death of one or more individual whales, with population level impacts. VFPA, however, has not proposed mitigation that would reduce this risk or reduce the likelihood of mortality in the event of a strike.

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[366] *Ibid* at pp 12-15.
[367] *DFO Submissions*, *supra* note 77 at PDF p 43.
[368] *Veirs Report*, *supra* note 6 at PDF p 5.
[369] *Imminent Threat Assessment*, *supra* note 206; Document #1605, "Expert Report of Scott Veirs", (10 April 2019), CCR Vol 2 Tab A, at PDF pp 10-13, [*2019 Veirs Report*], online: <https://ceaa-acee.gc.ca/050/documents/p80054/129296E.pdf>; Document #1798, "Review Panel Public Hearing Transcript", (23 May 2019), at pp 1873-1874, [*Public Hearing Transcript, May 23, 2019*], online: <https://iaac-aeic.gc.ca/050/documents/p80054/129949E.pdf>.
[370] *Public Hearing Transcript, May 23, 2019, ibid* at p 1874; *2019 Veirs Report, ibid* at PDF p 13; *Imminent Threat Assessment, ibid*.
[371] *Veirs Report*, *supra* note 6 at p 4.
[372] *Panel Report*, *supra* note 2 at PDF p 16.

274. While the precise amount of lost foraging time is uncertain in light of the varying projections of the number of vessels calling at the expanded terminal, all models show some increase in lost foraging time in the Project area due to vessel size and potentially vessel numbers. Because the Southern Residents already face an imminent threat to their survival for the very reason that they are nutritionally stressed, any decrease in foraging time constitutes a significant adverse effect.

275. The new evidence in IR2020-3 on proposed "mitigation" measures does not alter these conclusions. Drs. Scott and Val Veirs' opinion is that VFPA's proposed measures will not adequately protect the Southern Residents from the Project's adverse effects.[373] As such, underwater noise will increase both in the Project area from operations and in the marine shipping area, due to larger, louder vessels and due to more vessels calling specifically at Roberts Bank, even with the proposed mitigation.

276. While VFPA, as noted above, emphasizes that the Project's contribution appears smaller when one takes existing noise conditions into account, under CEAA 2012 the Minister must decide the significance of not only the Project's contribution but of the cumulative effects of the Project alongside existing and even future sources of underwater noise. The Southern Residents experience these effects cumulatively. The Conservation Coalition submits that, in light of the imminent threats to survival of the Southern Residents, which are largely due to the acoustic quality of critical habitat in the Salish Sea being already degraded to an unsustainable level, any increase in underwater noise is a significant adverse effect.

277. The Minister has before him a project that will affect a species whose survival and recovery is already in jeopardy. The evidence before the Minister is clear that existing conditions in the Salish Sea are already too much for the Southern Residents to handle. Any further pressure will contribute to and exacerbate an already untenable situation. Thus, any additional adverse effects on Southern Residents will be significant.

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[373] *Veirs Report*, *supra* note 6 at pp 4, 12.

4. *SARA requirements have not been met for the Southern Residents and their critical habitat*

278. The Conservation Coalition submits that the Project cannot be approved because SARA s. 79(2) and s. 77(1) requirements are not met with respect to the Southern Residents and their critical habitat, and these are clear preconditions to approval. They further submit that approval would be contrary to SARA because the Project would violate prohibitions under ss. 32 and 58 of SARA and because it does not appear to qualify for SARA permits, which would have to be granted after any CEAA 2012 approval in order for the Project to proceed.

a) SARA s. 79(2) requirements have not been met for the Southern Residents and their critical habitat

279. SARA s. 79(2), as interpreted by the Federal Court of Appeal, requires the decision-maker following an environmental assessment – whether it is the Governor in Council, as in the case that Court was deciding, or the Minister – not to approve a project "until <u>all</u> technically and economically feasible measures within the authority of the federal government were <u>in place</u>" [emphasis added].[374]

280. As explained above, s. 79(2) is not satisfied with respect to the Chinook salmon aspect of the Southern Residents' critical habitat.

281. This is also true of effects on the Southern Residents and the acoustic quality of their critical habitat. As summarized above, in the IRs VFPA identified additional measures with respect to underwater noise from Project operations only, and proposed no additional measures with respect to Project Related Shipping. The Conservation Coalition submits that the measures fall short of what s. 79(2) requires.

282. Subsection 79(2) of SARA requires the decision maker to ensure that all technically and economically feasible measures to avoid or lessen adverse impacts on listed species and their critical habitat are in place <u>before</u> an approval. Further, as confirmed by the Federal Court of Appeal, future or "inchoate" plans and commitments to address shipping noise do not satisfy s. 79(2), as they are not measures that will avoid or lessen effects; this is consistent with the Panel's conclusions about what constitutes mitigation. Therefore,

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[374] *Tsleil-Waututh, supra* note 14 at para 456.

proposals such as studying quieter tugs do not satisfy 79(2). Similarly, because "offsetting" of underwater noise is a novel and unproven concept, it cannot be relied upon.

283. Insofar as the Proponent suggests that voluntary measures or measures controlled by others such as the ECHO program, the Conservation Agreement, the Green Marine program, the Whales Initiative, the Oceans Protection Plan, or other regional initiatives will meet the requirements of s. 79(2)[375], this is contradicted by the requirement for the decision-maker to "ensure" that measures are in place. It is not possible to rely on such measures to discharge the duty in SARA to ensure measures to avoid or lessen the adverse effects of the Project on Southern Residents, because they are not mandatory, not tied to the Project, and/or not within VFPA's control. This is consistent with the Panel's finding that voluntary measures or measures controlled by others may not be achieved and "cannot be relied upon to mitigate the effects" in question.[376]

284. VFPA also falls short of s. 79(2) requirements by identifying measures it characterizes as feasible but relegating them to "potential contingency projects" and failing to implement them. Again, s. 79(2) requires that all feasible measures be in place before an approval. VFPA has identified measures that it states "are available today and have been proven to be effective in reducing underwater noise and potential acoustic effects on SRKW" – in other words, measures it claims are feasible and effective – yet it only proposes these as contingency measures, which would be implemented through its follow-up program if underwater noise is higher than it predicts in the marine shipping area.[377] Subsection 79(2) requires that these measures – which are more stringent options for vessel slowdowns in terms of location, speed, and duration – be put in place before the Project can be approved, not held in reserve to be used only if the effects are worse than expected.

b) SARA s. 77(1) requirements will not be met for the Southern Residents' critical habitat

285. Subsection 77(1) requirements have not been met either, for similar reasons to s. 79(2): based on the existing record, the Minister or Cabinet could not reasonably form an opinion

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[375] Document #2001, "From the Vancouver Fraser Port Authority to the Review Panel re: Updated Project Commitments", (July 5, 2019), at p 9, online: <https://www.ceaa-acee.gc.ca/050/documents/p80054/130776E.pdf>.

[376] *Panel Report*, *supra* note 2 at PDF pp 229-230.

[377] *IR2020-3*, *supra* note 180 at PDF p 31.

that all feasible measures will be taken to minimize the impact on critical habitat. This is true with respect to measures for underwater noise and measures for Chinook salmon, which are both part of critical habitat.

c) SARA permits and prohibitions

286. The Project's effects on the Southern Residents would violate one or more prohibitions under SARA (ss. 32 and 58), and the Project as proposed does not meet the standards for issuance of a SARA permit (ss. 73-74), such that even if the Minister or Cabinet approves it DFO may be unable to issue a SARA-compliant *Fisheries Act* authorization, without which the Project could not proceed.

287. As explained above, s. 32(1) of SARA prohibits killing, harm to, and harassment of any individual Southern Resident. Project construction, Project operations, and Project Related Shipping are likely to violate this provision through physical and acoustic disturbance, and the latter two carry the risk of violating it through a vessel strike.

288. Critical habitat destruction is also prohibited under s. 58(1) of SARA.[378] The Project would be constructed within the defined area of Southern Resident critical habitat, such that its construction would destroy a portion of critical habitat. Its effects on Chinook salmon and underwater noise, which are elements of critical habitat, would be effects on critical habitat. The Recovery Strategy also identifies physical and acoustic disturbance as an activity likely to destroy Southern Resident critical habitat.[379]

289. DFO stated before the Panel that construction of the terminal within critical habitat, the impacts to Chinook habitat due to the construction of the terminal, and the vessel noise resulting in lost foraging time would all constitute destruction of Southern Resident critical habitat.[380]

290. The Panel found DFO's advice to be "important" and it concluded that that the Project's effects on Chinook salmon "would result in the partial loss of legally defined critical habitat."[381] It further found that "acoustic disturbance from vessels in and of itself could be

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[378] *SARA*, s 58(1).

[379] *SRKW Recovery Strategy*, *supra* note 58 at PDF pp 64, 65.

[380] *Panel Report*, *supra* note 2 at PDF p 224; *Public Hearing Transcript, May 23, 2019*, *supra* note 369 at pp 1883, 1887-1888.

[381] *Panel Report*, *ibid* at PDF pp 228-229.

considered destruction of critical habitat."[382] The Panel concluded, with respect to synergistic effects of the Project and Project Related Shipping, that "the construction of the terminal and underwater noise generated by marine shipping associated with the Project would result in the destruction of SRKW critical habitat."[383]

291. A project that would violate prohibitions in SARA should not be approved under CEAA 2012. Such effects, contrary to one statute, cannot simply be "justified" under another.

292. Further, the Project would require a SARA-compliant *Fisheries Act* permit under ss. 73-74 of SARA. As noted above, DFO told the Panel that, "based on the imminent threat to their survival and recovery, declining populations and small cumulative impact to SRKW critical habitat, they were of the opinion that construction and footprint related impacts associated with the Project would likely require issuance of a SARA compliant *Fisheries Act* authorization"."[384] DFO now confirms that "[t]he construction and footprint-related impacts associated with the Project would require the Proponent to apply for a *Species at Risk Act* compliant *Fisheries Act* authorization".[385] DFO also states that "in assessing the application, DFO will consider all future implications of the Project on SRKW – including the construction footprint in critical habitat, Project operation, and Project-related marine shipping".[386]

293. The s. 73(3) permit requirements, again, are: (a) choosing the best of all reasonable alternatives for the activity, (b) taking "all feasible measures […] to minimize the impact of the activity on the species or its critical habitat", and (c) not jeopardizing the species' survival or recovery.

294. The failure to take all feasible measures as required by s. 73(3)(b) is addressed above in the discussion of s. 79(2).

295. With respect to the requirement in s. 73(3)(c), VFPA claims that, with its proposed measures, Project Related Shipping will not jeopardize the survival or recovery of the

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[382] *Ibid* at PDF p 229.
[383] *Ibid* at PDF p 230.
[384] *Ibid* at PDF p 224.
[385] *DFO Submissions*, *supra* note 77 at PDF p 42.
[386] *Ibid*.

Southern Residents.[387] However, the IR Responses did not address DFO's concerns about whether it could permit the Project. Drs. Scott and Val Veirs' opinion is that the Project will jeopardize survival and recovery[388], and DFO has outstanding concerns.

296. As noted above, DFO warned the Panel that it was uncertain that the s. 73(3) requirements for a SARA-compliant *Fisheries Act* permit could be met for the Project.[389]

297. DFO additionally states that it is "of the opinion that all effects on SRKW from the Project", including physical destruction from the terminal footprint as well as underwater noise from vessels, "should be fully addressed (i.e. not simply lessened) through the application of avoidance, mitigation and offset measures", due to "the low allowable harm that SRKW can bear without jeopardizing its recovery, given the imminent threat to its survival and recovery, declining small populations, and cumulative impacts to SRKW critical habitat."[390] DFO states that "to increase DFO confidence that the Project will not jeopardize the survival and recovery of SRKW" – which is a mandatory condition for issuance of an authorization under s. 73(3)(c) – the conditions should require full avoidance and mitigation of effects on SRKW from construction, operation, and Project-Related Marine Shipping.[391]

298. This is a high bar, which VFPA has not met in the IR Responses. DFO states that outstanding uncertainties with respect to contingency measures – discussed above with respect to mitigation – "will need to be further addressed" before it can make a decision on an authorization.[392] With respect to construction impacts, DFO has flagged that the detection plan and stop work procedures would require further discussion if VFPA were to apply for a SARA-compliant Fisheries Act authorization.[393] Overall, DFO advises that "there remains work to be done to finalize plans and improve the certainty regarding their

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[387] *IR2020-3, supra* note 180.

[388] *Veirs Report, supra* note 6 at pp 4, 12, 17.

[389] *Panel Report, supra* note 2 at PDF p 224.

[390] *DFO Submissions, supra* note 77 at PDF p 42.

[391] *Ibid*.

[392] *Ibid* at PDF p 47.

[393] *Ibid* at PDF p 32.

effectiveness", and that even with VFPA's new evidence, "uncertainties remain", and more detailed information would be needed for an authorization decision.[394]

299. Failure to meet these requirements set out by DFO is an obstacle to approval under CEAA 2012 for two reasons. First, jeopardy to the Southern Residents is indisputably a significant adverse effect, in addition to undermining the purpose of SARA, and it cannot be "justified" under CEAA 2012. Second, practically, there would be no practical purpose of the Minister or Cabinet approving something that DFO would not be able to authorize.

5. The significant adverse effects on the Southern Residents are not justified in the circumstances

300. The Project's significant adverse effects on the Southern Residents and their critical habitat cannot be justified in these circumstances, even taking the proposed mitigation in the IR Responses into account.

301. As described above, these effects will not be adequately or fully mitigated. The majority of the proposed measures do not even meet CEAA 2012's standards for reliable and mandatory mitigation measures. Overall, the evidence of Drs. Scott and Val Veirs and of DFO is that the proposed measures will fall short of preventing significant adverse effects on the Southern Residents. At this stage, with current noise levels and prey shortages already posing an imminent threat to the Southern Residents' very survival, they cannot tolerate any increase in underwater noise or decrease in Chinook salmon prey availability.

302. Therefore, even after mitigation, the effects that would be the subject of a justification decision include jeopardy to survival and recovery of this species, and the relevant circumstances include the Southern Residents being listed as endangered under SARA and already facing an imminent threat to their survival and recovery under current conditions.

303. VFPA claims that "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."[395] This claim is severely undermined by the significant problems with its proposed "mitigation", which is largely ineffective and is largely not actually mitigation. Any increase in underwater noise will necessarily jeopardize survival and recovery of the

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[394] *Ibid* at PDF p 47.

[395] *IR2020-3, supra* note 180 at PDF p 3.

Southern Residents, because they already face imminent threats to their survival and recovery, including from underwater noise – in addition to a lack of prey availability, which this Project will also exacerbate.

304. Further, SARA limits the Minister's or Governor in Council's discretion to deem significant adverse effects on the Southern Residents "justified". The concept of justification does not exist in SARA, and the Minister or Governor in Council cannot simply "justify" under CEAA 2012 effects that would violate provisions of SARA or would fail to meet the requirements of the permitting provisions, including by jeopardizing recovery or survival.

VI. The Impact Assessment Agency's Draft Potential Conditions

305. The Agency has prepared draft conditions for recommendation to the Minister for inclusion in a potential decision statement as binding conditions on Project approval.[396] The Conservation Coalition provides some overall observations of problems that appear throughout the Draft Potential Conditions as well as comments on specific conditions for fish and fish habitat and for marine mammals.

306. None of the suggested amendments or additions to the Draft Potential Conditions, if adopted, would change the Conservation Coalition's position outlined above with respect to the inadequacy of mitigation, the significance of adverse effects, the Minister's or Governor in Council's decision under CEAA 2012, or requirements under SARA.

307. The Conservation Coalition is concerned that many of the Draft Potential Conditions leave crucial measures to be developed at a later time by VFPA, and are insufficiently prescriptive (e.g. Conditions 7.6, 7.11, 8.2, 8.4, 8.6, 8.9). The conditions must require specifics, otherwise parties such as the Conservation Coalition cannot meaningfully assess how successful the conditions are likely to be, and the Minister or Governor in Council cannot be confident in their outcomes if they approve the Project.

308. Conditions must be as unambiguous as possible. For example, "relevant authorities" are defined in the Draft Potential Conditions as "federal and/or provincial and/or municipal authorities that are in possession of specialist or expert information or knowledge, or that

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[396] *Draft Potential Conditions*, *supra* note 4.

have a responsibility for the administration of a law or regulation, with respect to the subject matter of a condition set out in this document." Where conditions vaguely state that programs should be developed in consultation with "relevant authorities" (e.g. Conditions 2.1.7, 7.9, 7.12, 11.1, 14.3, 15.1.6, 16.4, 19.2, 19.6), they should specify which authorities, at minimum, must be included. The Agency has done this for some conditions and should do so throughout. In instances where a list is not intended to be exhaustive, the list can conclude the list with "and other relevant authorities"; as has been done by the Agency in some draft conditions.

309. As another example of the need for specificity, where conditions specify vague goals such as "reducing" mortality or "limiting" disturbance, they should, instead or as well, include quantitative measures, or at least detailed qualitative benchmarks, indicating how much reduction is necessary, how much something should be limited, etc. (e.g. Condition 7.10).

310. Every Project condition that applies to SARA-listed species must be drafted to clearly specify which SARA-listed species are covered, including by naming all those species. While there are 19 SARA-listed birds in the Project and Marine Shipping Area there are only conditions in relation to four of these species – barn owl, barn swallow, great blue heron, and western sandpiper. While it may be appropriate to take a representative species approach generally under CEAA 2012, section 79(2) of SARA requires a consideration of impacts to all SARA-listed species and requires measure to ensure all mitigation of all impacts on SARA-listed species.

311. Finally, while the Panel's recommendations addressed cumulative effects there is a general absence of conditions directed at cumulative effects. Given the highly developed state of the Fraser Estuary and the already degraded state of the Salish Sea, the Project is contributing to significant and challenging pre-existing problems that in many cases are already threatening species' survival and ecosystem collapse.

A. Part 2: General conditions

312. Condition 2.5: This condition leaves VFPA to determine crucial details of follow-up programs.

a. The condition leaves it to VFPA to determine thresholds for when further measures are needed (2.5.4) and what measures are to be implemented in the event that those thresholds are exceeded (2.5.5), and what the follow-up program needs to achieve before it can stop in these cases (2.5.6). These decisions should not be at VFPA's discretion, especially when they relate to SARA-listed species such as the critically endangered Southern Residents and their Chinook salmon prey.

b. Without specific requirements included in the conditions, it is not realistic to expect VFPA to identify a precautionary point at which it would "stop" the activities causing environmental damage in these cases (2.5.4).

c. This condition inappropriately focuses impacts only on "levels of environmental change relative to the baseline that are <u>caused by the Designated Project</u>", which ignores the reality of cumulative effects.

B. Part 7: Fish and fish habitat

313. <u>Condition 7.2:</u> This condition appears to require VFPA to either install a breach in the causeway if that is deemed feasible, or install a breach of the terminal if a breach of the causeway is not deemed feasible. As explained above, this would be inadequate to mitigate the disruption to juvenile salmon migration that will result from the Project. A single breach, 10 metres in diameter, will be insufficient to mitigate the loss of connectivity between the inter-causeway area and the area north of the causeway. This insufficiency is magnified by the fact that the four potential breach locations proposed by VFPA in IR2020-2.2 have highly differing abilities to restore connectivity to the inter-causeway area due to increasing tide height further from shore, making breaches closer to shore less effective. Condition 7.2 should instead require VFPA to construct multiple breaches, in series. For example, the Proponent should be required to construct and maintain three side-by-side culverts 10 metres in diameter at the terminal end, as well as one or more breaches of the causeway. This would reflect the expert evidence of salmon biologist David Scott, whose field work with breaches in other parts of the Fraser Estuary shows that breaches need to be multiple and as wide-open as possible to facilitate juvenile salmon migration.

314. <u>Condition 7.5</u>: This condition should spell out what happens if noise monitoring detects an exceedance, such as shut down of work or other immediate action to address the exceedance.

315. <u>Condition 7.11</u>: This offsetting condition is highly flawed.

a. The condition requires VFPA to develop any plans "prior to construction", but only requires it to implement any plans "during construction and operation". This undermines the effectiveness of this condition by potentially allowing adverse effects to occur before offsets are in place and functional, and it puts this condition offside the Federal Court of Appeal's interpretation of s. 79(2) of SARA, explained above, which requires measures to be in place before Project approval. At a minimum, the plans should be implemented prior to construction. However, there is a high degree of uncertainty regarding whether the offsetting plan proposed by VFPA will function as predicted, according to the expert evidence of salmon biologist David Scott. Therefore, this condition should require VFPA to demonstrate that the offsets are fully functional before Project construction and operations that will cause adverse effects to salmon take place. Given that VFPA has already identified offsetting initiatives, the condition as drafted is under-ambitious, and this amendment would not be overly onerous.

b. Sub-condition 7.11.3 requires VFPA to assess the projected benefits of offsetting measures, using more than one approach. This condition should prescribe the assessment approaches that VFPA must use, such as the more common approach of comparing "net overall habitat area". As explained above and in the Scott Report, the "multiple lines of inquiry" chosen by VFPA in the IRs are quite similar and are all based on a common assumption about relative productivity of habitats.[397] To highlight and compensate for the limitations of assumptions inherent in any approach or model, the approaches used to assess the offset plan should be different, and in the case of Roberts Bank which already suffers significant habitat loss, include "net overall habitat area" approach.

c. Given the uncertainty inherently associated with the of the out-of-kind offsetting proposed by VPFA, and the limited options for onsite restoration or offsetting, VFPA should be required to develop offsets covering a significantly larger area than that destroyed by the Project to account for the likelihood that some of the proposed offsets will not prove useful for the populations of Chinook salmon affected by the

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[397] *Scott Report*, *supra* note 5 at p 9.

Project. This is consistent with DFO’s recommendation that DFO’s opinion that “given the substantial habitat loss at Roberts Bank due to the Project footprint, additional onsite offsetting opportunities should be advanced and included in the final offsetting plan if they are feasible and beneficial to fish.”[398]

C. Part 8: Marine Mammals

316. Given their expertise in the area, the Conservation Coalition adopts the recommendations of Drs. Scott and Val Veirs regarding the proposed conditions as set out in their 2022 Report and as detailed below.

317. Condition 8.1.4: Drs. Scott and Val Veirs specifically recommend that for the estimated four pilings that will use impact and not vibratory methods, Reinhall or BOSS pilings are used, as they are preferable for reducing source levels during impact pile driving.

318. Condition 8.1.7: As suggested by Drs. Scott and Val Veirs, this condition should be amended to avoid the listed activities from September 30 through June 1, for periods beginning at any time that Southern Resident presence is confirmed in the Salish Sea and lasting until at least one to two weeks after the last confirmed observation. This will in turn make condition 8.2.7 more precautionary and less dependent on only marine mammal observers for its success by stipulating that all possible confirmation sources in the Salish Sea will be able to inform mitigation measures at the terminal, not only locally stationed marine mammal observers monitoring buffer zones. They further suggest that these activities be limited to the month of April, with the above precautions in place.

319. The above is further supported by DFO’s evidence, which states based on analysis of May to October only that “there is a high likelihood of [Southern Resident] occurrence in areas within 20 km of the Project in May and October”, and further states more broadly that Southern Residents are “consistently observed in the winter including in the RBT2 construction area.”[399]

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[398] *DFO Submissions*, *supra* note 77 at PDF p 16.

[399] *Ibid* at PDF pp 28-29.

320. Condition 8.1.8 and 8.22: The conditions related to dredging fail to incorporate VFPA's statement that it will avoid dredging during the "SRKW peak use period". This should be formalized, and the peak use period should be defined, in a condition.

321. Condition 8.2: Consistent with DFO's warnings with respect to the effectiveness of exclusion zones being dependent on successful detection of Southern Residents, and DFO's caution that there are gaps in passive acoustic monitoring, that the other methods of detection are unlikely to be as effective in winter as they are in summer, and that VFPA has likely overestimated its modelled detection ranges, VFPA should be required to adopt DFO's suggestion of "placing acoustic detection receivers much further away from the construction zone and at water depths that are in-line with where the whales may be located when calling (10-20m depth)" to allow for detection of Southern Residents before they enter a location where they can be impacted by construction noise.[400]

322. Condition 8.2.5: This should include validation of the exclusion zone for impulsive noise as well as continuous noise, as Drs. Scott and Val Veirs advise.

323. Condition 8.2.6: The expert evidence of Drs. Scott and Val Veirs is that the buffer zone for Southern Residents should be 3 km or more, which represents about 30 minutes of Southern Residents travelling at their mean speed of about 6 km per hour.

324. Condition 8.2.8: This condition should require that the stop-work procedures stop all noise-generating activities and not merely some when the Southern Residents are nearby, reflecting DFO's concern that the Southern Residents could move into the reduced exclusion zone if some activities continue.[401]

325. Condition 8.3: The weakness of the condition for vessels calling on the Project to participate in ECHO is that there is no condition or other guarantee that ECHO or a direct equivalent will continue for the life of the Project. Nor is there a condition or other guarantee as to what minimum standard ECHO will require of participants from year to year, as the program's specifics are announced each year for that year only, and could

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[400] *Ibid* at PDF pp 31-32.

[401] *Ibid* at PDF p 32.

theoretically be less stringent in one or more future years.[402] As drafted, the condition provides no guarantee of what participation in ECHO will entail in terms of specific measures from year to year.

326. The condition should therefore be amended to require that VFPA continue ECHO (or another equivalent future program developed in consultation with Fisheries and Oceans Canada and Transport Canada) for the lifetime of the Project. It must also be amended to require minimum annual ECHO program requirements (i.e., a slowdown to at least a specified speed, during specified months), so that there is a guarantee of minimum stringency, and so that innovation and improvement can occur with the guarantee that measures will never become less ambitious.

327. Alternatively, or additionally, rather than rely on ECHO, Condition 8.3 could simply require mandatory speed reductions (with exemptions to allow for safety designed in consultation with Transport Canada). Condition 8.4.3 indicates that VFPA can implement mandatory speed reductions; therefore, there is no need to rely on ECHO as the mechanism.

328. Regardless of whether or slowdowns and related measures are done through ECHO, the minimum requirements set out in the conditions should be more ambitious than what VFPA currently proposes, as set out in the expert report of Drs. Scott and Val Veirs, and described above.

329. With respect to time of year of slowdowns and related measures, Drs. Scott and Val Veirs have further cautioned that the Southern Residents' patterns of seasonal use of their habitat may be changing.[403] As a result, the May to September or October summer season can no longer be assumed to be the only or even primary time of year that protective measures are needed. Drs. Scott and Val Veirs recommend that conditions specifying times of year

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[402] See, for example, the following on slowdowns and lateral displacements, respectively, showing a year-to-year approach: Port of Vancouver, "2021 Haro Strait and Boundary Pass voluntary vessel slowdown", online: <https://www.portvancouver.com/environmental-protection-at-the-port-of-vancouver/maintaining-healthy-ecosystems-throughout-our-jurisdiction/echo-program/projects/haro-slowdown/>; Port of Vancouver, "2021 Strait of Juan de Fuca voluntary inshore lateral displacement", online: <https://www.portvancouver.com/environmental-protection-at-the-port-of-vancouver/maintaining-healthy-ecosystems-throughout-our-jurisdiction/echo-program/projects/lateraldisplacement/>.

[403] *Veirs Report*, *supra* note 6 at pp 6-7.

should therefore go beyond May to October to include any month of the year when observations or models suggest the Southern Residents may be present.[404] With respect to area, they advise that slowdowns should extend from Boundary Pass to the terminal and further north into and from Burrard Inlet, and that commercial traffic should be as far from the Fraser Delta as possible to avoid areas of higher Southern Resident density.

330. Condition 8.4: A noise budget is a valuable idea, and the Conservation Coalition supports the concept of setting a hard cap on underwater noise in Southern Resident critical habitat, at levels that do not destroy or otherwise impair critical habitat, which would necessarily be lower than current levels, which pose an imminent threat to survival and recovery. However, the use of a noise budget in this condition is fatally undermined by being proponent-determined, not determined based on the Southern Residents' actual needs, and by the absence of enforceability or any consequences for exceedance.

331. DFO has similarly noted the need for "enforceable conditions that hold the Proponent accountable" with respect to underwater noise in its comments.[405]

332. Condition 8.4.1: The noise budget to be established should be specified in the condition, not left to be determined by VFPA. As the Panel found, the Salish Sea is already too noisy for the Southern Residents.[406] The Project will increase noise to some degree under any interpretation of the evidence. The noise budget must reflect the fact that current conditions in the Salish Sea are already too loud for the Southern Residents, and it must go beyond ensuring "no net increase" from the Project to eliminate substantially more noise than the Project adds. It must be specified before approval, in the conditions, and it must be based on the Southern Residents' actual needs, keeping in mind that the status quo poses an imminent threat to their survival and recovery.

333. The expert report of Drs. Scott and Val Veirs explains that the current status and trajectory of the Southern Resident population requires an overall reduction of noise, or, a "more than

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[404] *Ibid* at pp 8, 17-18.

[405] *DFO Submissions*, *supra* note 77 at PDF p 43.

[406] *Panel Report*, *supra* note 2 at PDF p 132.

mitigate" budget, not just "no net increase".[407] DFO agrees that a net overall decrease is needed.[408]

334. Drs. Scott and Val Veirs further caution that no individual noise source should be permitted to cause noise at the location of a Southern Resident to rise above 120 dB, and they indicate that it could be precautionary to ensure that the broadband noise level received by foraging Southern Residents stays below 100 dB, and in the frequency bands relevant to the Southern Residents, below 50 dB for calls (near 1 kHZ) and below 40 dB for echolocation clicks (near 20-30 kHZ). The conditions should reflect this.

335. Condition 8.4.3: Rather than rely on this condition for additional measures only if monitoring reveals that VFPA is nearing exceedance of the noise budget, the conditions must require VFPA to take all feasible measures to reduce noise immediately, especially given that Transport Canada has deemed them feasible – though they cannot be relied on as effective at this time, as DFO has identified uncertainties and states that their effectiveness still needs to be evaluated.[409] Saving feasible measures for later is contrary to s. 79(2) of SARA and does not represent a precautionary approach to protecting the critically endangered Southern Residents.

336. This condition must also define "nearing exceedance" so that there is a clear trigger for backstop measures.

337. The backstop measures should be clearly spelled out in mandatory language in the sub-conditions. They could include, for example, a mandatory emergency backstop, such as limiting vessel calls, as per 8.4.3.3 – but with the number of vessels specified.

338. Condition 8.4.3.2: The reference to "offsets" falsely suggests that it is possible to "offset" underwater noise in Southern Resident critical habitat and should therefore be removed. DFO has stated in its response that "the concept of offsetting underwater noise is relatively new and in development", and that "[t]he quantification of equivalency reductions in one

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[407] *Veirs Report*, *supra* note 6 at p 21.
[408] *DFO Submissions*, *supra* note 77 at PDF p 43.
[409] *Transport Canada Submissions*, *supra* note 224 at PDF pp 6, 15; *DFO Submissions*, *ibid* at PDF pp 46-47.

location to offset noise inputs elsewhere is complicated and it is important to consider the biological meaningfulness of noise inputs and reductions over space and time." [410]

339. The Agency should amend the condition to specify the measures to which it refers.

340. Drs. Scott and Val Veirs have further suggested that this condition include consultation with the Canadian Coast Guard and/or Transport Canada about moving the shipping lanes and BC ferry routes away from the high-density Southern Resident usage areas within the Fraser delta and southern Strait of Georgia, given that this area is essential to Southern Resident foraging success for returning Fraser River salmon.

341. Condition 8.4.3.3: If a cap on vessel calls is an effective measure, which Drs. Scott and Val Veirs believe it is, there should be a condition for it to be automatically applied if VFPA is nearing exceedance of the noise budget. The benchmark for nearing exceedance must also be clearly defined.

342. Condition 8.4.4: This indicates that the Agency considers it possible VFPA will not be able to achieve the noise budget, in spite of Conditions 8.4.2 and 8.4.3. The Conservation Coalition reminds the Agency and the Minister that 1) underwater noise is already too high, and increases in noise are likely to constitute destruction of Southern Resident critical habitat, which is an offence under s. 58(1) of SARA, and that the Minister of Fisheries and Oceans will not be able to approve this Project if in her opinion it will jeopardize survival or recovery (which it will, as critical habitat is already too loud); and 2) effects of this kind on the SARA-listed Southern Residents are not justifiable under CEAA 2012. Failure with respect to noise budgets is not an acceptable outcome. Therefore, there must be a mandatory condition to achieve the noise budget, with an emergency backstop available if it appears that VFPA is "nearing exceedance."

343. Condition 8.5 and sub-conditions: This must be amended to require VFPA to not only evaluate but also implement measures before operations begin. It must also be amended to require VFPA to implement "all technically and economically feasible technologies", to comply with s. 79(2) of SARA.

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[410] *DFO Submissions*, *ibid* at PDF p 45.

344. <u>Condition 8.5.1</u>: Drs. Scott and Val Veirs suggest amending this measure to include assessment of to the underwater noise from electric tugs and design constraints to ensure that neither the electric motors nor operation with them would radiate additional noise in the frequencies where Southern Resident hearing is most sensitive (i.e. ~20 kHz).

345. <u>Condition 8.5.3</u>: This sub-condition is currently not drafted to require VFPA to actually implement technologies for quieter berthing, should its reviews indicate that it is feasible. The condition should be amended so that the Agency decides, based on VFPA's reviews and input from Transport Canada, when this technology is feasible and effective, and at that time can instruct VFPA to implement it, which VFPA is then required to do.

346. <u>Condition 8.6</u>: This condition is excessively open-ended. It must specify the outcomes it intends the procedures to achieve, and criteria for the procedures themselves.

347. Furthermore, as Drs. Scott and Val Veirs suggest, if VFPA does not attempt to detect Southern Residents at night, it must pause unberthing until daylight hours. This is consistent with DFO's advice that "an acoustic monitoring system be implemented if it is feasible" or alternatively VFPA "should explore avoidance of nighttime berthing."[411]

348. Therefore, this condition must explicitly require either the use of passive acoustic monitoring to detect Southern Residents at night and the avoidance of unberthing when they are present at night, or it must require avoidance of unberthing at night and postponement until daylight hours when visible marine mammal observation is more effective. The same could be done for berthing, not just unberthing, if incoming ships could anchor until daylight.

349. <u>Condition 8.9</u>: VFPA states that "the Minister can be confident that" additional actions will be taken under the follow-up program if the increase in sound exposure for SRKW is higher than expected under VFPA's "most-realistic" scenario, and that VFPA has "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."[412] However, despite the possibility that this

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[411] *Ibid* at PDF p 44.

[412] *IR2020-3*, *supra* note 180 at PDF pp 2-3.

scenario could occur, and despite VFPA’s apparent willingness to implement contingency mitigation in this scenario, this follow-up program condition contains no requirement for any action in the event that the follow-up program reveals that the increase in sound is higher than predicted, the noise budget is not being met, or technology implemented under 8.5 is not effective.

350. The Conservation Coalition submits that this condition must be amended to include how success or failure is to be measured in order to determine whether action is needed, as well as the action to be taken. DFO echoes this concern, recommending enforceable conditions that require additional mitigation measures to be implemented if underwater noise exceeds VFPA’s predictions for its “most-realistic” scenario.

351. Further, with respect to Condition 8.9, as Drs. Scott and Val Veirs suggest, VFPA should be required to verify the accuracy of underwater noise predictions that include not just broadband levels, as VFPA proposes, but also frequencies in the most sensitive hearing range of the Southern Residents.[413] All future modelling should incorporate the most sensitive hearing range of Southern Residents into evaluating potential acoustic impacts, and further, field observations should be done to ensure that underwater noise does not exceed predictions.

352. The Conservation Coalition does not object to the inclusion of Conditions 8.7-8.13 but reminds the Agency and the Minister that, in light of the meaning of mitigation as explained above, these are not considered mitigation under CEAA 2012 and they cannot satisfy the SARA s. 79(2) requirement. More specifically, these conditions include initiatives the Panel confirmed not to be mitigation (Condition 8.7 pamphlets, Condition 8.10 Conservation Agreement, Conditions 8.11-8.13 potential participation in regional initiatives by the federal government), initiatives that are follow-up programs (Condition 8.9), and initiatives that involve documentation as opposed to action (Condition 8.8).

353. With respect to regional initiatives, for the reasons explained above, these are not mitigation, including because they are not tied to the Project. They should nevertheless be pursued. The Conservation Coalition notes that the federal government has proposed

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[413] *Veirs Report*, *supra* note 6 at pp 13-15.

taking a regional approach to addressing ocean noise in the Salish Sea, and that this was reflected in the recommendations (not conditions) that accompanied the approval of the Trans Mountain Expansion Project. This regional approach has yet to materialize. If such an approach were taken and eventually resulted in binding and enforceable standards for noise in the Salish Sea, it would be a useful tool for addressing the cumulative noise problem. The Conservation Coalition submits that any approval of this Project by the Minister or Governor in Council must be accompanied by a three-year plan to implement a regional approach to underwater noise management in the Salish Sea by 2025, with short, medium, and long-term targets to reduce underwater noise below 2015 levels. This would be consistent with recommendations for Trans Mountain. The time limit is essential to ensure that this approach is actually taken within a useful timeline.

354. With respect to gaps and the need for additional conditions, Drs. Scott and Val Veirs recommend the addition of a condition reducing tugboat speed by as much as safely possible – an idea VFPA rejected and which is absent from the conditions. DFO similarly stated that, despite VFPA's position that the benefit would be small, this measure should "be implemented if feasible."[414]

355. Drs. Scott and Val Veirs further recommend staging inbound vessels on the outer shelf of Canada and anchoring temporarily within the Salish Sea to schedule their arrival in groups, timed to avoid spatiotemporal overlap with the Southern Residents, to create beneficial quiet periods and to reduce long-term average noise levels.

356. Finally, the Conservation Coalition submits that the conditions should require emergency response vessels with firefighting capabilities and emergency towing vessels, both capable of responding to container vessels of the size that would call at the Project, to be on standby on the shipping route, including at Sidney, BC, year-round. Container vessel fuel has the potential to cause a catastrophic spill in the event of an accident, and carries a fire risk.[415] In the recent case of the 2021 fire on the *Zim Kingston*, a much smaller container

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[414] *DFO Submissions*, *supra* note 77 at PDF p 44.

[415] Justine Hunter and Xiao Xu, "Misadventures of container ship MV ZIM Kingston highlight the risks of marine traffic off B.C.'s ecologically fragile coast", *The Globe and Mail* (29 October 2021), online: <https://www.theglobeandmail.com/canada/british-columbia/article-bad-luck-and-trouble-the-misadventures-of-the-mv-zim-kingston/>; Tim Robertson et al., "Vessel Drift and Response Analysis for the Strait of Juan de Fuca to the

vessel than those that would call at the Project (4253 TEU), two tugs with firefighting capabilities were coincidentally at a nearby dock and were able to prevent a large-scale environmental disaster.

VII. Conclusion

357. It is clear based on the record that the Project is likely to cause significant adverse environmental effects. These include significant adverse effects on the Fraser River estuary and estuary dependent species such as Chinook and chum salmon. The Project will also have significant adverse effects on the endangered Southern Residents. The significant adverse effects on Southern Residents include: further depleting availability of their primary prey, Chinook salmon; increasing physical and acoustic disturbance in critical habitat; further decreasing Southern Resident foraging time; and increasing the risk of a vessel strike.

358. It is also clear from the record that the significant adverse effects on Southern Residents and their critical habitat, including Chinook salmon prey, cannot be effectively mitigated as required under Canadian law for the Project to proceed.

359. Further, the Project could violate provisions of SARA, SARA requirements for measures to avoid or lessen the Project's effects on the Southern Residents and their critical habitat have not been met, and the Project may not qualify for a SARA-compliant *Fisheries Act* authorization.

360. The Project's effects cannot be justified in the circumstances. Significant adverse effects on federally protected endangered species cannot be justified under CEAA 2012.

All of which is respectfully submitted.

March 15, 2022

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Margot Venton

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Representatives for David Suzuki Foundation, Georgia Strait Alliance, Raincoast Conservation Foundation and Wilderness Committee

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Southern Strait of Georgia", (April 2021), at p ii, online: <https://www.sanjuanlio.com/wp-content/uploads/2021/04/Vessel-Drift-and-Response-Analysis-Inland-Waters-SJC-Apr21.pdf>.

Ecojustice Memo Re: RBT2 Final IR Responses and Draft Conditions

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This report was written in response to the request for my expert opinion, sent by Ecojustice on behalf of David Suzuki Foundation, Wilderness Committee, Raincoast Conservation Foundation, and Georgia Strait Alliance, to support their written submissions to the public comment period regarding the Vancouver Fraser Port Authority's Response to the Minister's Information Requests and the Draft Potential Conditions for the Roberts Bank Terminal 2 Project. The numbered headings represent the questions posed to me in the request for my opinion.

1. Please briefly explain your background, expertise, and qualifications, and append a copy of your curriculum vitae. Please also state that you provided an expert report to the Review Panel with respect to the T2 and append that report to your opinion.

I am David Scott, a fisheries biologist with particular expertise in salmon. I have been retained on behalf of the Raincoast Conservation Foundation, David Suzuki Foundation, Wilderness Committee, and Georgia Strait Alliance to assist them in the Roberts Bank Terminal 2 Project environmental assessment, particularly as it pertains to effects on juvenile Chinook salmon. My knowledge and experience regarding juvenile Chinook salmon use of the Lower Fraser River and estuary comes from studying juvenile salmon in this area for the past 10 years since 2012. My education includes a Bachelor of Science with High Honours in Biology from the University of Regina awarded in 2010. I then began studying juvenile salmon in the Lower Fraser River in 2012 when I began my master's degree studying Resource and Environmental Management at Simon Fraser University (SFU) under the supervision of well-known salmon ecologist Dr. Jonathon Moore. During my time at SFU I was involved with several research projects in the Lower Fraser River including my masters project which investigated the impacts of flood control infrastructure on juvenile salmon use of rearing habitats in the Lower Fraser with a particular focus on juvenile Chinook. In December 2014 I graduated with a Masters in Resource Management. In the fall of 2018, I began full time doctorate studies at the University of British Columbia under the supervision of Dr. Scott Hinch and my ongoing research continues to focus on improving our understanding of juvenile Chinook salmon use of the Fraser estuary.

Following the completion of my master's degree I was hired on contract by the Raincoast Conservation Foundation to provide written evidence for the National Energy Board joint review of the Trans Mountain Expansion project with a focus on potential risk to juvenile salmon in the Lower Fraser River and estuary. In 2016, as a contract employee with Raincoast, I led the beginning of a juvenile salmon research project in the Fraser estuary which has now completed six consecutive seasons. Raincoast's research involves repeated sampling of juvenile salmon habitats throughout the Fraser estuary including at Roberts Bank, with a sampling intensity of two sampling rounds at each site per month from April to July each year. This has resulted in a vast amount of time spent on the water in the Fraser estuary each year during the juvenile salmon outmigration and residency period, and as such I have acquired directly relevant and thorough knowledge of juvenile salmon usage patterns in this area. In 2017 I led a successful application to the Department of Fisheries and Oceans Canada (DFO) Coastal Restoration Fund and led Raincoast's 2.7-million-dollar restoration initiative to restore connectivity in the Fraser estuary by creating openings in structures such as jetties and causeways. From 2019 to 2021 Raincoast completed construction of three breaches of the Steveston Jetty, restoring migratory pathways for juvenile salmon on Sturgeon Bank. In 2022 Raincoast began work to breach the North Arm jetty, creating a 30-meter-wide breach to restore connectivity for juvenile salmon.

To date, I am an author on 10 peer reviewed scientific publications, four of which are directly related to the Fraser River estuary. I have also previously provided a written expert opinion report to the review panel for the Roberts Bank Terminal 2 project and responded to questions from the review panel regarding my expert opinion during the public hearing. That previous report, as well as a current copy of my curriculum vitae, are appended to this report.

2. Describe whether you have any relationship with David Suzuki Foundation, Wilderness Committee, Raincoast Conservation Foundation, or Georgia Strait Alliance that might affect your duty to be objective and impartial in providing your opinion.

Prior to agreeing to give an expert report in this proceeding I had previously been retained on contract by the Raincoast Conservation Foundation to provide written evidence for the National Energy Board joint review of the Trans Mountain Expansion project with a focus on potential risk to juvenile salmon in the Lower Fraser River and estuary. In 2016, as a contract employee with Raincoast, I led the beginning of a juvenile salmon research project in the Fraser estuary which is now in its fourth consecutive season. I continued to work with Raincoast on a full-time basis from 2016 until fall 2018 when I began my doctoral program in the Faculty of Forestry at the University of British Columbia. I continue to work with Raincoast on a part time basis helping to coordinate our Fraser estuary restoration project under the Fisheries and Oceans Canada Coastal Restoration Fund. My relationship with Raincoast in no way affects my ability to be impartial and objective in my review of the available scientific information in this opinion.

3. Please provide an updated version of section 1.3 of the expert report that you provided the Review Panel assessing T2 in April 2019, which is the section entitled "Current status of the five species of salmon that rely on the Fraser River estuary as habitat", that reflects any changes in their status.

Before the 1990's the Salish Sea supported a valuable recreational fishery for coho, and Chinook marine survival was strong. Over the past few decades Chinook, coho and steelhead have had consistently low returns in the Fraser and other parts of the Salish Sea. However, these trends have not been seen in other areas of Washington or B.C. This has led many to conclude that the problem is within the Salish Sea itself. In response, the Pacific Salmon Foundation together with Long Live the Kings in Washington launched an ambitious project, funding research across the Salish Sea investigating a variety of hypotheses into the decline in marine survival of Chinook and coho (marinesurvivalproject.org). Conversely, new research by Welch et al. (2021) points to a coastwide problem with marine survival for Chinook salmon related to poor ocean conditions. Regardless of the cause marine survival for Chinook salmon remains poor and shows no signs of improvement in the short term.

Various levels of government are responsible for protecting fish and their habitats, but DFO is the main authority responsible for managing Pacific salmon. In 2005, DFO published the Wild Salmon Policy to preserve and restore populations within the five commercially harvested species of wild Pacific salmon. While the majority of the policy has yet to be implemented, one initiative that has been carried out is the identification and establishment of individual Conservation Units (CUs), defined as "a group of wild salmon sufficiently isolated from other groups that, if extirpated, is very unlikely to recolonize naturally within an acceptable time frame" (DFO 2005). This classification recognizes and aims to protect the irreplaceable genetic and ecological diversity that is contained within thousands of BC's local streams and spawning populations (Holtby and Ciruna 2007). The Fraser River has 56 unique CUs of commercially managed salmon, including 16 in the Lower Fraser.

The Fraser River system produces the greatest number of Chinook salmon in Canada (Parken et al. 2008) and these Chinook make up the vast majority of Southern Resident Killer whale diets in their critical habitat (Hanson et al. 2010). In November 2018 the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) published a new summary of wildlife species assessments which included all Fraser River Chinook populations. They found that out of 16 Fraser River Chinook populations, half of them or 8 populations were listed as endangered, only 1 was listed as Not at Risk, and the remaining were listed as Threatened (3 populations), Special Concern (1 population) or Data Deficient (2 populations). Harrison River Fall ocean type Chinook salmon, which are the most reliant on the estuary of any Fraser Chinook population (DFO 1995; Chalifour et al. 2021), were listed as Threatened in this recent assessment, and have failed to reach their escapement target, which is the number of adults which reach spawning grounds, in eight of the last nine spawning years (Figure 1; CTC 2021). This trend has continued with Harrison Chinook continuing to have low numbers of returning adults in 2019, 2020 and 2021 well below the goal set by managers. Since the panel reviewed the evidence in May 2019, Fraser River salmon populations have faced another large impact from the Big Bar landslide (June 2019) which further stressed upper Fraser Chinook salmon populations which have continued to decline to very low spawner abundances.

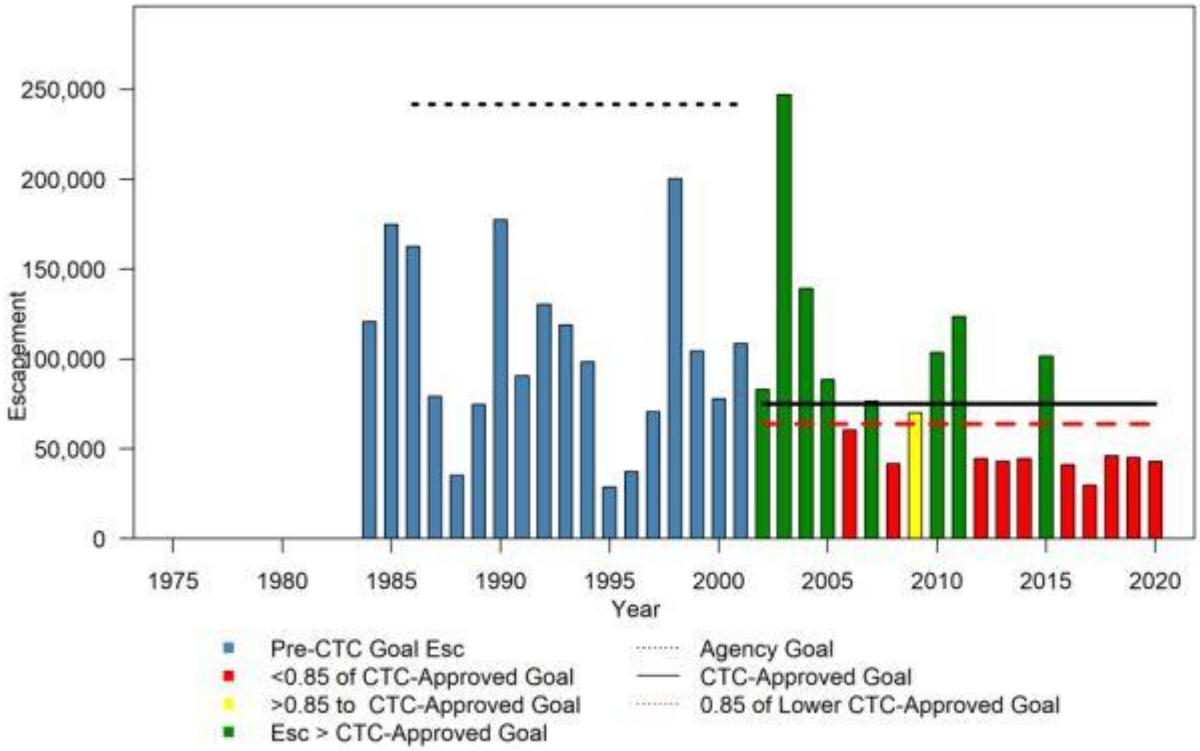

Figure 1. CTC (Chinook Technical Committee), 2021. Annual Report of Catch and Escapement For 2020, Pacific Salmon Commission Report, TCCHINOOK (21)-3. Vancouver, BC. Figure 2.33–Harrison River escapements of Chinook salmon, 1984–2020.

The Fraser estuary is particularly important for Chinook salmon with ocean type life histories, which migrate to the ocean during there first year of life and use estuary habitats for weeks to months before ocean entry (Levy and Northcote 1982, Chalifour et al. 2021). In the Fraser River there are only two populations of ocean type Chinook, the Lower Fraser population which represents the Harrison and Chilliwack Rivers, and the South Thompson population, which together make up the vast majority of Chinook returns to the Fraser River in recent years (CTC 2021). Recently Chalifour et al. (2021) showed that ocean type Chinook salmon from the Harrison River rely on the estuary for an average of 42 days and have high growth rates during this critical time before ocean entry. As growth during this period is thought to be a critical determinant of survival (Duffy and Beauchamp 2011), growth in the Fraser estuary is likely an important determinant of survival for these ocean type Chinook. Harrison River Chinook were recently listed as threatened by COSEWIC, therefore further impacts to these important habitats could further jeopardize the viability of this population. Recently, the Recovery Potential Assessment was published for Harrison Chinook which stated "*[t]he results from both the modelling and the threats assessment suggest that under model base case productivity, human-induced mortality and other sources of harm identified in the threats assessment should be significantly reduced from base case levels so as to not jeopardize recovery*" (DFO 2021, page 18). Conversely, South Thompson ocean type Chinook are the only population of Chinook salmon in the Fraser which is not currently listed as either Threatened or Endangered by COSEWIC, therefore avoiding impacts to that population is critical to ensure they do not also end up as a conservation concern.

4. **Within the bounds of your expertise, please provide your opinion on the following evidence from the VFPA, and indicate whether you agree or disagree with the VFPA's conclusions concerning salmon, and why:**
    a. **IR2020-1.1, "RBT2 Fish and fish habitat potential offsetting projects";**
    b. **IR2020-1.2, "RBT2 Proposed Fish and Fish Habitat Offsetting Plan";**
    c. **IR2020-2.1, "Avoidance and mitigation measures for project construction – Fish and fish habitat";**
    d. **IR2020-2.2, "Avoidance and Mitigation Measures for Project Construction – Juvenile Salmon".**

In March of 2020, the Impact Assessment Agency of Canada Federal Review Panel concluded that the Roberts Bank Terminal 2 expansion project would have significant adverse and cumulative effects to two populations of Fraser River Chinook salmon. This is due to the proposal's habitat-footprint in the Fraser Estuary and from the migration disruption of out-migrating juvenile salmon caused by the terminal's placement. Both the potential for migration disruption as well as the loss of habitat have been characterized by the review panel as a significant adverse impact to Chinook salmon therefore each should be considered and mitigated independently. The Proposed Fish and Fish Habitat Offsetting Plan IR2020-1.2 relies on two distinct components (habitat offset projects and breaches) both of which would need to function fully as intended to mitigate potential project impacts to juvenile Chinook salmon, yet both are faced with a high degree of uncertainty and rely on a variety of assumptions. As well, the reduction in project footprint proposed in IR2020-2.1 is very minor relative to the overall footprint and does not mitigate the increase in migration disruption caused by the expanded terminal footprint.

The offsetting plan relies on the successful implementation of a causeway or terminal breach to mitigate the impacts of migration disruption as well as the successful creation of a large area of offsetting habitat to mitigate the area of habitat lost by the project footprint. However, the size, design and number of breaches being proposed is unlikely to fully mitigate the migration disruption due to numerous factors including partial tidal connectivity, small size, lights only operating during daylight hours, and potential to clog. As well, although the VFPA proposes a large area of habitat offsetting, it fails to adequately compensate for the total area of lost habitat and is not able to replace lost habitat with similar in-kind habitat, therefore they rely on a productivity and relative value approach, which assumes that the habitat which they are creating is of more value than the habitat being lost. This also relies on the suite of offsetting habitat projects proposed in IR2020-1.1 achieving the level of productivity that it is predicted to despite VFPA's ongoing struggles with similar recent projects. Overall, it is highly unlikely that the proposed fish and fish habitat offsetting plan will mitigate the significant harm caused by the project to juvenile Chinook salmon productivity as further described below.

Migration Disruption

In their report the review panel (at page 187) concluded that the Project would have significant adverse impacts on migration of Chinook salmon, specifically that, "*terminal expansion would create a larger barrier to juvenile Chinook salmon wanting to migrate into the eelgrass beds on the south side of the shipping terminal. The Panel concludes that the Project will have an adverse residual effect on juvenile Chinook salmon due to migration disruption,* *coupled with minor adverse effects in the acoustic and light environments during construction and operations. This effect would be high in magnitude, local in extent, permanent in duration, and irreversible. The Panel concludes that this effect would be significant.*"

This finding of the review panel was further confirmed by recent field studies conducted for the VFPA's recent analysis (Phillips and Karpouzi 2021) which looked at improved field data relative to what was available during the project review period and found that juvenile Chinook densities were higher in spring on the north side of the causeway relative to the inter-causeway area.

Based on this data the VFPA conducted a modelling exercise which then predicted the additional migration disruption will result, illustrating: (IR2020-2.2 page 4) "*[t]he effect predicted by modelling is equivalent to a disruption of approximately 7% to 14% of the inter-causeway area proportion of juvenile Chinook salmon abundance that would have reached the inter-causeway area without the project in place, or approximately 2 to 4 kilograms per year (35 to 70 juvenile salmon per day).*"

In 2021 the Canadian Science Advisory Secretariat assessed the recovery potential for the Harrison River Chinook salmon population (DU2), which is currently listed as threatened by COSEWIC (Doutaz et al. 2021). They found that "*[b]ased on the assessed threats, over the next three generations it is expected that there will be a population level decline of 31-100% for DU 2".* They also found that *"Alleviating the multiple and complex threats to these DUs will be difficult, especially as many of the threats are exacerbated by climate change. It will be critical to ensure that efforts are appropriately coordinated through effective governance to successfully mitigate the cumulative impacts of these diverse threats*" (Doutaz et al. 2021).

They then go on to rate the current threat to this populations as High-Extreme and note in the comments from the threat workshop (Doutaz et al 2021, page 145) "*DU2 is particularly sensitive to the loss of estuarine and ephemeral habitats, predation by pinnipeds and pollution compared to other Fraser DUs, due to its reliance on coastal habitats in highly developed areas of both Canada and the US.*"

Therefore, it would seem that an impact of 7-14% per year on a population which currently has a High-Extreme threat rating and that is noted as particularly sensitive to loss of estuarine habitats would be significant and limit the potential for the population to recover.

In the offsetting plan (IR2020-2.2 page 5) the VFPA states that a "*breach at either the causeway or marine terminal location would provide for fish movement and therefore mitigate the potential for juvenile Chinook salmon migration disruption.*"

However, there are numerous factors which would impact the ability of the breaches to fully mitigate the migration disruption, including the width of the proposed breaches, the tidal connectivity of the proposed breaches, the length of the breaches and the method of breaching being proposed. The proposed breaches are too narrow to attract a significant amount of flow and therefore fish, are connected for only a portion of the tidal cycle due to their elevation and will be very long dark culverts which are unlikely to attract juvenile salmon passage. The narrow width and long distance also make it likely that the breaches would become clogged with debris further impeding juvenile salmon passage. Measures taken to prevent larger debris (logs) from becoming lodged in the breach such as a screen will likely become clogged with smaller debris such as eelgrass, further reducing the ability of juvenile salmon to pass through the culvert.

According to the VFPA (IR2020-2.2 page 8) "*Any of the four breach locations, each with illuminated culvert crossing structures, would allow juvenile Chinook salmon to move to and from the inter-causeway area. The marine terminal breach location would maintain the existing migration corridor for juvenile salmon (along the west side of the existing Roberts Bank terminals), while any of the three causeway breach locations would provide direct access from the north side of the causeway to the inter-causeway area.*"

The causeway breaches that they are proposing differ significantly and all are only connected for a small portion of the entire tidal cycle, while the terminal breach is connected for most of the tidal cycle it does not compensate for the ongoing migration disruption noted by VFPA: (IR2020-2.2 page 12) "*[t]he duration that a breach would have a minimum water depth of 0.5 m increases with distance of the breach location from shore, ranging from 9% at causeway location 1 to 86% at the marine terminal breach location (causeway location 3 is wetted 37% of the time). The minimum depth criterion was set at 0.5 m to accommodate juvenile Chinook salmon, which avoid movement into tidal channels when depths are shallower than 0.4 m (e.g., Hering et al. 2010). Empirical juvenile salmon data collected for the project in 2020 demonstrated greater density along the causeway at locations farther from shore.*"

Based on this information it is clear the breaches would vary considerably in their ability to allow fish passage and it appears that the VFPA has put very little consideration into the relative function of the proposed breaches.

The VFPA refers to work in the Squamish estuary, (IR2020-2.2 page 13) "*[t]he port authority is not aware of the existence of similarly-sized marine fish passage culverts, but notes a similar fish access upgrade has recently been implemented in a long, relatively narrow training berm in the Squamish River estuary specifically to improve juvenile Chinook salmon survival.*" However, based on personal communications with those conducting monitoring of the Squamish project they have seen that only 20% of juvenile salmon utilized the culverts (Stephanie Lingard, Personal Communication, January 2022), and as such they are now moving forward with a much more significant project to entirely remove the last 900 meters of the training berm (https://www.squamishchief.com/local-news/removal-of-the-squamish-spit-has-begun-5006558).

Another significant issue with the proposed breaches is that the long length of the culvert results in the need to illuminate the culverts to encourage fish passage. As the causeway is very wide, the breaches would rely on very long culverts (170 to 220 meters) (Table IR2020-2.2-1) which would not allow natural light and therefore would be unattractive to fish to continue moving through once they have entered.

The VFPA states (IR2020-2.2 page 10) "*[i]t was also determined during the early stages of concept development that either natural light penetration through an open crossing structure (bridge) or artificial lighting within a closed crossing structure (culvert) would be required to promote juvenile salmon passage through a breach. Based on this lighting requirement, concept designs for road and rail bridges included an open deck to allow for natural light penetration to the channel below, while the culvert design incorporated roof-mounted light fixtures to artificially illuminate the water column during daytime.*"

Additionally with respect to light, (IR2020-2.2 page 14) "*[t]he culvert concepts for the breaches integrate roof-mounted light fixtures with light level sensors to illuminate the water column during the daytime. Therefore, all four breach locations will provide light conditions conducive to juvenile salmon use. Low light levels within covered structures (e.g., culvert) can contribute to increased avoidance behaviour and deviation away from shaded areas during the daytime, leading to delay in juvenile salmon migration. At night, illuminated structures may cause juvenile salmon to congregate, thereby increasing the risk of predation, and therefore lights would be turned off at night (for review of the literature on lighting effects on juvenile salmon migration, see responses to IR5-18 and IR5-25 in CIAR Document #934).*"

During the juvenile salmon outmigration period the majority of the higher tides occur during the night when the lights in the culvert would not be illuminated, therefore even during the portion of the tidal cycle when the breach would be connected a much smaller portion of that time would the lights be illuminated. Instead, the terminal lights would be on which have the potential to disrupt juvenile salmon migration as noted by the VFPA, making it unlikely that juvenile salmon would use the breaches in the dark.

Overall, the VFPA concludes (IR2020-2.2 page 20) "*[w]ith a breach at any one of the four locations identified, the potential for minor project-related disruption of juvenile Chinook salmon migration will be mitigated effectively and additional mitigation for juvenile Chinook salmon migration disruption is not warranted.*" Despite this they also state (IR2020-2.2 page 8) "*[n]ot all juvenile salmon occupying habitats along the proposed widened causeway and marine terminal are expected to use a breach.*"

However, DFO also clearly does not agree that a single breach would be effective in mitigating the migration disruption, stating in their recent submission that (Ref # 2407 page 11) "*technical feasibility of any causeway breach should be determined, and a causeway breach should be implemented in addition to the marine terminal breach if feasible and beneficial to juvenile Chinook salmon*."

Overall, it is my professional opinion that it is highly unlikely that the scale, number and design of breaches being proposed will mitigate the project-related disruption of juvenile Chinook salmon migration caused by the project. To have a greater chance of effectively mitigating the migration disruption caused by the proposed expansion I would recommend a series of breaches in the causeway as well as the terminal breach at a minimum. I have recently led restoration efforts at the Steveston North Jetty in partnership with Fisheries and Oceans Canada, and we have created three 50-meter-wide breaches that are connected for the vast majority of the tidal cycle. We are now beginning work to create a series of three 30-meter-wide breaches in the North Arm jetty and have finished the initial breach this February 2022. Our monitoring has determined that all three breaches in the Steveston North jetty are utilized by juvenile salmon, demonstrating the need for multiple breaches at large scale to efficiently reconnect habitats through barriers of this scale. That is the scale and scope of breaches which would likely be necessary to fully mitigate the migration disruption caused by the expanded causeway and terminal.

Offsetting Plan

Offsetting ratio

The proposed offsetting plan also relies on several assumptions which create a high degree of uncertainty regarding its ability to offset losses related to the project. The VFPA states (IR2020-1.2 page 4) "*the project will result in a net gain in juvenile Chinook salmon habitat of 37.4 ha*" however the project results in a net loss of over 96 hectares of juvenile Chinook habitat, and it is only if the VFPAs relative habitat value approach is used that this value is obtained, which is not always clearly stated in the IR responses. As the VFPA is not able to compensate for the large area that will be lost due to the project footprint, they rely on the assumption that the habitat that will be created will be of higher value than the habitat lost by the project. In IR2020-1.2 the VFPA states that they have used multiple lines of inquiry, but they use three similar approaches, the productivity, footprint vs. non-footprint effects and relative value approach, to evaluating the net change in juvenile salmon habitat after the offsetting plan has been applied. These approaches all rely on similar assumptions including both that the offsetting projects will function fully as intended and that the habitats that are being created are of a higher value to juvenile Chinook salmon than those that are being lost.

Regarding the productivity approach, the VFPA (IR2020-1.2 page 2) states that "*[e]cosystem modelling,* ***supported by the review panel****, demonstrates that the new RBT2 terminal will indirectly increase marsh and eelgrass productivity in the biophysical local assessment area (LAA) due to changes behind the terminal in wave and current conditions, and that this habitat in turn will attract key species like juvenile Chinook salmon and Dungeness crab, resulting in 16 times more fish and fish habitat productivity than that lost due to the project footprint.*"

However, the review panel in their final report found that the project would result in significant and adverse impacts to juvenile Chinook salmon, which demonstrates that **the panel clearly does not support the results of the ecosystem modelling** presented by the VFPA and thus it should not have been further considered as a line of evidence when developing the offsetting plan. The relative value approach is similar and assigns an assumed value of productivity to the habitats that are being created and assumes that productivity is the only factor that determines the relative value of a habitat to juvenile Chinook in the estuary.

However, it is likely that juvenile chinook rely on a continuum of habitats during their estuary rearing period (Chalifour et al. 2019, Woo et al. 2019) and sand and mud flat and adjacent subtidal areas may provide important low tide refugees for juvenile salmon that cannot be appreciated using this approach. This is further noted by VFPA which states in (IR2020-2.2 page 4) "*[a]ided by the tides, juvenile salmon access productive habitats in the intertidal zone when the flats are inundated during flood tides. When the tidal flats are dry during ebb tides, juvenile salmon use turbid subtidal waters (influenced by the Fraser River plume) to seek refuge from visual predators.*"

The VFPA states (Appendix IR2020-1.2-D page 2): "*Additional analyses conducted at the request of DFO indicate that the project's proposed offsetting plan of 86 ha will conservatively result in a net gain in the productivity of fish and fish habitat by 1,773 tonnes (t) per year, even after accounting for uncertainty associated with the updated RB model and temporal lags. This conclusion is supported by an* ***alternate equivalency approach*** *that considered the relative* *importance to juvenile Chinook salmon of habitats in the biophysical LAA. This alternate equivalency approach demonstrates that the project's proposed offsetting plan will offset all impacts to juvenile Chinook salmon and will result in a net gain of 37.45 ha of juvenile Chinook salmon habitat.*"

The VFPA does not consider the common approach, the net change in overall habitat area, which demonstrates a net loss in juvenile salmon habitat if you look at the physical area of habitat lost relative to the total amount of compensation habitat. It is only using these approaches which rely on numerous assumptions which has a high degree of uncertainty, that a positive offsetting ratio emerges. According to *Table IR2020-1.2-D5* if simply the total net change in habitat from the project is considered the project results in a net loss of 96.21 hectares of juvenile Chinook salmon habitat, with a total loss 160.21 hectares even if the reduced footprint if considered, relative to just 64 hectares of proposed offsetting habitat, a ratio of 0.4:1.

In their Submission to Public Registry (Ref #2407 page 11) DFO found that "*[t]he Proponent suggests that while juvenile salmon access to the intercauseway area may be impeded, Project-related changes including offsetting north of the causeway, along with existing habitats, would be sufficient to support the productivity of juvenile Chinook.* ***It is unclear what evidence was used to support this assertion****. Given the steep decline of many Pacific salmon populations, it is important to ensure that the capacity of the ecosystem to support salmon is maintained and improved, such that it can support rebuilding stocks into the future*."

Offsetting Projects

According to DFO's "Policy for Applying Measures to Offset Adverse Effects on Fish and Fish Habitat Under the Fisheries Act" (DFO 2019) Principle 1, measures to offset should support fisheries management objectives and give priority to the restoration of degraded fish habitat. However, the VFPA is relying heavily on projects intended to create marsh habitat on sand and mud flat areas where it has never existed as opposed to attempting to restore once productive habitats. The VFPA plan relies heavily on the South Arm Jetty Tidal Marsh Project for a large portion of the overall hectares (30-40) of habitat offsets to be created however this is a project with a high degree of uncertainty regarding potential function, and which will inevitably become less productive over time due to sea level rise. This project is designed for an area which has never supported marsh growth historically as it is several kilometers westward of the historical marsh leading edge (Figure IR2020-1.1-1: Locations of offsetting projects currently being advanced for RBT2). Bradford 2017 states "*[t]he failure of offsets to deliver benefits is a risk not accounted for in the equivalency analysis. This risk includes catastrophic failures, or the deterioration of the offsetting measure over time….Offsets that are prone to complete failure are inconsistent with the principle of long-term self-sustaining benefits identified in Canada's offsetting policy (DFO 2013). Offset measures placed in high energy habitats (coastlines or rivers) are particularly vulnerable to such losses (Frissell and Nawa 1992; van Katwijk et al. 2009).*" As this project has potentially a high risk of failure it creates considerable uncertainty regarding the ability of the offsetting plan as a whole to accomplish the productivity gains predicted by the VFPA.

Although the Westham Island, Finn Slough and Tilbury Island projects do satisfy the primary principle of restoring degraded habitats, they fail to satisfy the guidelines of Principle 2 which states that with an "*"in-kind" approach to measures to offset, the fish and fish habitat that is adversely affected is replaced by the same quantity and quality of the same type of fish or fish* *habitat.*” These projects, as well as the habitat bank projects being used as part of the offsetting package, all have a focus on freshwater marsh habitat which is fundamentally different from the brackish and saline habitats which will be impacted by the project. As the offsite, out-of-kind approach has a much higher degree of uncertainty associated with its potential to mitigate impacts a much higher ratio of offsetting to lost habitat would be warranted.

In addition, the Semiahmoo Bay-Little Campbell River Enhancement Project (Section 3.6) may be of benefit to the local community, however it is unlikely to offer any benefit to the Chinook salmon populations which are predicted to be impacted by the project due to the location of the project many kilometers away from the Fraser River estuary. Juvenile salmon which have entered the highly saline waters of the Strait of Georgia are unlikely to re-enter brackish water of Boundary Bay and therefore this project is unlikely to provide any benefit to Fraser River Chinook populations being impacted by the proposed project.

Lastly the South Causeway Eelgrass Project is also likely to offer a lower benefit to juvenile Chinook than is currently being considered as part of the offsetting plan due to the project’s location on the South side of the BC Ferries terminal and causeway. The VFPA’s own field assessment has demonstrated the current Roberts Bank terminal results in a significant migration disruption to juvenile Chinook salmon (Phillips and Karpouzi 2021) and it is likely that the BC Ferries Terminal and Causeway further results in a migration disruption for juvenile Chinook at Roberts Bank. Therefore, while this particular project may succeed in producing dense native eelgrass habitat it is likely that a significant portion of the juvenile Chinook impacted by the proposed expansion will not be able to access this particular offsetting habitat.

The proposed offsetting projects are also not designed to mitigate the further disruption of natural processes at Roberts Bank which will further reduce the resilience of outer estuary habitats which exist today, and which are unlikely to be compensated for by static habitat creation projects built for today’s conditions. According to DFO’s “Policy for Applying Measures to Offset Adverse Effects on Fish and Fish Habitat Under the Fisheries Act” Principle 4, “*[m]easures to offset should generate self-sustaining benefits over the long term. Measures to offset should strive to generate self-sustaining benefits to fish and fish habitat conservation and protection. The benefits of the measures to offset fish and fish habitat should last at least as long as the adverse effects from the works, undertakings or activities being authorized*.” However, unless there is ongoing maintenance to keep pace with sea level rise these projects will not remain within the desired tide window that they are designed for which will result in the long-term loss of productivity of these projects due to sea level rise and coastal squeeze. This could lead to a reduction in productivity of up to 30% for juvenile Chinook across the entire estuary (Davis et al. 2021). Therefore, although the impacts of the project will last indefinitely, the potential benefits of the proposed offsetting projects are likely to decline significantly over time further reducing the habitat available to juvenile Chinook salmon in the Fraser estuary.

Success of Offsetting projects

The issue of offsetting projects is exacerbated by potential issues with onsite and offsite projects becoming fully productive over time and the need for long term adaptive management to accomplish this goal. As mentioned in my previous submissions, the VFPA has shown with recent offsetting projects the issues that can prevent these projects from functioning as intended. An example is the VFPA’s Roberts Bank east causeway habitat offsetting site, which after ten years of adaptive management has still failed to achieve its productivity assessments.

The VFPA (IR2020-1.1 page 41) states "*[t]hrough the port authority's long term monitoring program, it was identified that the components of the east causeway habitat offsetting site were not fulfilling objectives. These sites have subsequently been adaptively managed. Remediation efforts have been undertaken (as described in Section 7.2.1 below), and monitoring is currently underway.*"

This project was completed in 2010 yet as of the timing of writing of IR2020-1.1 (page 42) the VFPA stated "*[m]onitoring recently conducted in 2020 provides evidence of successful performance of the exclusion structures, increases in plant diversity, and the ongoing establishment of salt marshes but the continued presence of eelgrass wrack (potentially limiting salt marsh growth) and spread of invasive species in the upland riparian habitat is impacting performance. The port authority will be implementing the required remedial actions of invasive species removal and additional planting through this adaptive management approach.*"

This provides a great example of the challenges associated with creating offsetting habitats at the large scale proposed in the offsetting plan. This is one of the most recent offsetting projects undertaken by the VFPA and 11 years after completion it is still failing to meet the levels of productivity it was designed to provide. Despite the claims made by VFPA that the proposed onsite offsetting for RBT2 will not be impacted by the same issues it seems reasonable to expect that they will face similar challenges.

Regarding the proposed marsh creation projects, several ongoing issues which broadly impact marsh habitats in the Fraser estuary continue to occur at recent offsetting sites. Regarding the recent Glen Rose Tidal Marsh project the VFPA notes (IR2020-1.1 page 43) "*[m]arsh vegetation establishment has been slower at the other two sites (Glenrose Cannery and Gunderson Mudflat), especially at the latter and largest site as a result of herbivory impacts from Canada geese.*"

As well, in relation to their ongoing salt marsh restoration projects in Boundary Bay the VFPA states (IR2020-1.1 page 42) "*[d]ue to the high energy marine conditions, the Boundary Bay site has been affected by physical changes over the past five years, primarily ongoing accumulation of logs. However, marsh vegetation has re-established and the log removal conducted in 2014 has improved the overall productivity and value to fish and wildlife. The port authority continues to regularly monitor log accumulation at the salt marsh sites and these considerations will be evaluated during confirmatory monitoring to establish the habitat credit values at withdrawal, consistent with any of the other habitat bank sites. Furthermore, findings will be considered in the context of RBT2 offsetting projects that involve log removal (i.e., the Westham Island Canoe Pass Tidal Marsh Project and the Finn Slough Enhancement Project). This salt marsh restoration work demonstrates the resilience of salt marshes and ability of salt marsh vegetation to quickly recover following removal of log debris.*"

These are two key issues which will continue to impact the function of created marsh habitats in the Fraser estuary including the marsh projects being proposed by VFPA in the above statement. The problem of goose herbivory was again noted in another recent project, the New Brighton Shoreline Park Project, of which VFPA states (IR2020-1.1 pages 43-44) in "*Year 2 (2019), sparse vegetation coverage was noted in the high marsh area between 1.5 m GD and 2.0 m GD, and that some supplemental planting should be pursued. Salt marsh vegetation in the high* *marsh may be exposed to goose grazing during high tides, which is extremely challenging to fully address with fencing/ropes.*"

This observation was also recently made by Bradford et al. (2017): "*[r]ecent observations suggest that grazing by growing populations of Canada Geese are having a significant impact on vegetation of the Campbell and nearby estuaries (Dawe et al. 2011) an observation that serves to highlight the potential for large-scale environmental factors to overwhelm local efforts to create or restore habitats.*"

Given these stressors, there is a high degree of uncertainty regarding the potential productivity of the proposed offsetting projects and whether they will maintain the productivity of juvenile salmon in the Fraser River estuary.

Time Lags

The proposed offsetting plan also fails to consider time lag in a way the panel or the Minister can appreciate. Instead of giving a timeline on when these projects can be completed, the total amount of habitat created was discounted by a small percentage to account for a time lag which could be up to 12 years before habitats are constructed and functioning properly. Although the VFPA states that it has considered time lag in the offsetting plan, they instead have relied on their estimates of future productivity to compensate for losses to productivity which occur during the period between when the impacts occur and when the offsetting habitats become fully functional.

VFPA in IR2020-1.2 (page 5) state that as "*explained in Parts B and C, several examples of this conservative approach include assuming that it will take five years to build all offsetting projects (even when eelgrass transplanting, for example, will be productive after the first year), assuming that intertidal marsh offsetting projects require seven years to become fully functional (when it has been the port authority's experience that this is likely achieved in three to seven years), and, perhaps more notably, advancing 22 ha more conventional offsetting than is required to offset the effects of the project.*"

Therefore, according to a conservative approach, the VFPA is suggesting it could take 12 years before all the projects are fully productive, which is three full generations for the average ocean type Chinook in the Fraser River. Considering that Harrison River Chinook are designated as Threatened by COSEWIC, three full generations of reduced productivity may result in a serious impact which may not be easily compensated by potential future increases in productivity when offsetting projects eventually become productive, if they are even able to meet their productivity goals at all.

Appendix IR2020-1.2-D RBT2, "Proposed fish and fish habitat offsetting plan – additional technical analysis" states (at page 2) that "*[i]n response to DFO's comments on the draft IR2020-1.2 response, a total discounting of approximately 19.3% has been applied to account for potential uncertainty in the updated RB model and temporal lags. The 19.3% discounting is made up of four components: approximately 7.5% discounting to account for uncertainty in the updated RB model, and an additional of approximately 7.5%, 3.5%, and 0.8% discounting for temporal lags A, B, and C, respectively.*"

In terms of dealing with time lags related to offsetting in the productivity approach, temporal lags B and C are relevant. Appendix IR2020-1.2-D RBT2 (page 9) states: "*Temporal lag B refers to the time between construction of the proposed project and construction of offsetting habitats that comprise the project's proposed offsetting plan (described in IR2020-1.1). In their review of the draft IR2020-1.2 response, DFO commented that the time lag between project impacts and function of offsetting measures has not yet been identified and should be included in the account of potential time lag. To respond to this DFO comment, additional analysis was conducted to incorporate temporal lag B in the calculation of net gain in fish and fish habitat productivity from proposed offsetting presented in IR2020-1.2, as described below. Temporal lag B was considered equal to five years, and it was applied to the analysis of net changes in fish and fish habitat productivity. Temporal lag B of five years was considered appropriate given that the preliminary RBT2 offsetting construction schedule involves construction completion for all proposed offsetting projects within five years of RBT2 construction commencement.*"

Appendix IR2020-1.2-D RBT2 (pages 9-10) states that "*Temporal lag C refers to the time required for the offsetting measures that are part of the project's proposed offsetting plan to become fully functional……. The port authority stands by its original estimate that intertidal marsh will conservatively take five years to develop and mature based on experience and precedent (see Table IR7-28-1 in the response to IR7-28; CIAR Document #9346). However, given feedback from DFO, the port authority increased this to seven years. When temporal lag C was considered, net gains in fish and fish habitat productivity were discounted by approximately 18 t/year or 0.8% relative to the net gain in fish and fish habitat productivity of 2,197 t/year estimated in the draft IR2020-1.2.*"

Overall time lag for marsh offsetting projects appears to be calculated at 12 years, five years for construction and seven years to allow the project to come to full productivity, and for that a total of 4.3% of the total productivity predicted was discounted from the results of the productivity model. As previously noted, in 2021 the Canadian Science Advisory Secretariat assessed the recovery potential for the Harrison River Chinook salmon population (DU2), which is currently listed as threatened by COSEWIC (Doutaz et al. 2021). They found that "*[b]ased on the assessed threats, **over the next three generations** it is expected that there will be a **population level decline of 31-100% for DU 2**.*" This is the same time period of 12 years for which these significant habitat losses will be yet to fully compensated for, further stressing this population. Considering the potential for these time lags to be further exacerbated by offsetting projects failing to meet productivity goals within the 7-year time frame, a more conservative approach would be for the VFPA to construct and demonstrate the productivity of the offsetting before any of the project related impacts are allowed to occur. Considering the VFPA has identified and planned these projects well in advance of RBT2 and the VFPA has a habitat banking agreement, these projects could be a lot further along before the proposed construction is to occur.

5. **Specifically with respect to offsetting:**

IR2020-1.1 states that VFPA's "proposed offsetting projects […] more than counterbalance the residual effects of the RBT2 Project on fish and fish habitat" (page 1).

IR2020-1.2 concludes that the "offsetting proposed by the port authority fully offsets effects to juvenile Chinook salmon and counterbalances the effects of the project to fish and fish habitat", that "[p]otential effects to juvenile Chinook salmon have largely been

avoided…and have been more than offset", and that, with offsetting, T2 will result in net gains for juvenile Chinook salmon habitat (page 35).

What is your opinion, within the bounds of your expertise, on the validity of these conclusions and the evidence used to support them? Do you agree with the VFPA's conclusions? Why or why not?

It is my professional opinion that the VFPA's conclusions regarding changes in productivity associated with the project and offsetting plan are highly reliant on a number of assumptions which may or may not be accurate. Therefore, I believe that it is highly unlikely that the proposed offsetting plan will counterbalance effects on Chinook salmon as described below.

- The VFPA assumes that the creation of a single 10-meter-wide breach will fully mitigate the migration disruption caused by the expanded terminal footprint, which is highly unlikely due to several factors. A breach of such a small magnitude relative to the length of the disruption requires fish swim very close by to find the breach and it is likely only a small portion of out-migrating fish would find the breach. The breaches being proposed would only be connected during a portion of the tidal cycle therefore fish migrating at other times are unlikely to use the breach. The breach would also require juvenile salmon to enter a long dark culvert, which is to be mediated by the presence of lights in the culvert to illuminate passage, however these lights will be turned off during the night to reduce predation, when most high tides during the spring and summer outmigration season occur.
- The VFPA also relies highly on their assumptions of relative value of habitat types for their conclusions regarding offsetting ratio accomplished by their offsetting plan. In *Table IR2020-1.2-D4* it states that the relative value of the subtidal habitats impacted by the project is "Poor" which is given a relative value of only 0.05 while the relative value of high dense marsh that will be created is "High" or 1.0, however little justification is given for how these subjective values were determined. This approach fails to consider the importance of the timing and type of productivity associated with each habitat type found in the Fraser estuary and allows the proponent to assign a very low value to the area of habitat that they are removing and to assign a very high value to the habitats which they are creating or enhancing. However very little information exists currently regarding which habitat types are limiting for juvenile Chinook in the Fraser estuary, and regarding the importance of non-vegetated habitats such as sand and mud flats. While marsh areas certainly are highly important to juvenile salmon in the Fraser estuary, research from other areas has demonstrated that other habitat types such as sand and mud flats areas can also be of high value to juvenile salmon (Seitz et al. 2021) and that juvenile salmon rely on a continuum of habitats as they migrate through estuaries, which all play an important role prior to ocean entry (Woo et al. 2019). This point is further exemplified by the following excerpt from the "Roberts Bank Terminal 2 Follow-up Program; Juvenile Salmon Density Annual Data Report – 2020 report written by the VFPA (Phillips and Karpouzi 2021 page 34) which states "*[a]nalysis of Chinook body size presented in this report suggests that juvenile Chinook that enter Roberts Bank undergo a period of growth that allows them to transition to habitats away from the river mouth as the seasons progress. No differences were detected in mean body size of juvenile Chinook sampled in April in the control area, and north and south of the causeway. However, in May, juvenile Chinook sampled south of the causeway were found to be larger (by approximately 8 mm*

in mean fork length) than individuals north of the causeway and in the control area (Table 3-5)."

As size at ocean entry is a critical determinant of early marine survival, this additional growth which occurs for Chinook that are able to reach the inter-causeway area may be important to their future marine survival, and conversely those Chinook which do not reach the inter-causeway may have reduced survival.

Phillips and Karpouzi (2021 page 34) continues to state: *"Juvenile Chinook become tolerant of higher salinities as they increase in body size (Taylor 1990, McCormick 2006, Wong et al. 2019). Brackish marshes, such as those distributed in the control area and north of the causeway, tend to offer smaller juvenile Chinook less osmotically stressful and more sheltered habitat than the outer flats, including south of the causeway (Taylor 1990, Gregory and Levings 1998, Chalifour et al. 2019, 2020). The inter-causeway area is predominantly influenced by tidal exchanges and is characterized by higher salinities as indicated by higher salinity values measured during sampling in spring and summer 2020 (Table 3-12). Larger juveniles that are physiologically adapted to higher salinities are capable of transitioning to habitats away from the river mouth including in the inter-causeway area later in spring.*" This interpretation of their own field data demonstrates how juvenile Chinook rely on these Roberts Bank habitats as a continuum as they become larger and move further out into more saline waters. It is likely that the relative value of these outer estuary subtidal habitats can not be so simply assigned such a low value and the relative value approach should not be considered alone when evaluating the true compensation ratio being proposed by the VFPA.

- If the ratio of total area of offsetting habitats proposed relative to total area of habitat lost is considered an appropriate measure for evaluating the proposed offsetting plan, then the offsetting ratio proposed is much less than 1:1 which itself has been shown to be inadequate in accomplishing the goals of the No Net Loss policy. According to *Table IR2020-1.2-D5* if simply the total net change in habitat from the project is considered the project results in a net loss of 96.21 hectares of juvenile Chinook salmon habitat, with a total loss 160.21 hectares even if the reduced footprint if considered, relative to just 64 hectares of proposed offsetting habitat, a ratio of 0.4:1.
- The VFPA's conclusions also rely on the assumption that the offsetting habitat will function fully as intended despite a history of previous offsetting habitat failing to function as intended. The VFPA's plan relies highly on a large marsh creation project (Steveston North Jetty Marsh) which is located several kilometres beyond the natural marsh leading edge and is unlike any past compensation projects the VFPA has completed.
- These marsh creation projects may also not compensate for the impacts of the marine terminal as they are designed to replicate feeding areas only accessible at high tide, while the projects footprint impacts sub-tidal areas which juvenile Chinook can access for rearing and feeding at all tide levels and may represent important low tide refugia. While the VFPA offsetting plan may result in a net gain of overall productivity, it may not sufficiently compensate for the impacts of the projects as the offsetting projects are not like-for-like and they are not located in the same area or within the same salinity range. Therefore, while their offsetting plan may result in an increase in habitat available upstream and in other areas, the project may further result in a bottleneck downstream at Roberts Bank without sufficient outer estuary habitat remaining to support juvenile

salmon as they move through the mosaic of estuary habitats which support the various different types of prey items they must transition between as they grow larger before ocean entry.

We further request your opinion on the following points concerning the draft conditions:

6. **The appropriateness and effectiveness of the draft conditions for mitigating impacts on salmon;**
7. **Whether these draft conditions would be sufficiently to prevent T2 from contributing to cumulative effects on salmon (noting that this answer may depend on your opinion with respect to VFPA's conclusions about the possible magnitude of the effects);**

As described above in my responses to the proposed fish and fish habitat offsetting plan it is my opinion that the draft conditions are unlikely to effectively mitigate impacts on salmon and to prevent Terminal 2 from contributing to further significant adverse cumulative effects on juvenile Chinook salmon in the Fraser estuary.

In my opinion it is also unclear if the proposed offsetting plan satisfies the draft conditions. The draft conditions state "*9.2.3 - identify habitat suitable to be used as compensation for the lost wetland habitat referred to in 9.2.2, including by prioritizing wetlands within the local assessment area. For wetlands located outside the local assessment area, the Proponent shall favor sites located as close to the Designated Project as possible and that reflect equivalent wetland functions to those that are lost*." However, most of the offsetting projects being proposed or included from the habitat bank fail to satisfy this condition as they provide a completely different function for juvenile Chinook salmon, with very different salinity conditions and different potential prey items. The conditions also state "*9.2.4 - prioritize wetland restoration over enhancement and wetland enhancement over creation*," however a significant portion of the offsetting plan relies on the creation of new habitats which have a much higher possibility of failure.

8. **Any instances where in your opinion an existing condition can and should be strengthened, including an explanation of what the improved condition should require; and**

Condition 7.2 states that the Proponent "*shall install and maintain a breach to allow fish passage through either the existing and proposed widened areas of the causeway, if determined feasible pursuant to condition 7.1, or at the east end of the marine terminal identified on figure IR2020-2.2-1 (Canadian Impact Assessment Registry Reference Number 80054, Document Number 141672). The Proponent shall determine to the satisfaction of Fisheries and Oceans Canada which breach location to implement if both are technically and economically feasible.*"

This condition should be strengthened to remove the wording "if determined feasible pursuant to condition 7.1" as the VFPA has already stated that a breach of the causeway is technically feasible in IR2021-1.1. It should also be strengthened to require that the VFPA at the very least should implement both a causeway breach and a terminal breach to both mitigate for ongoing impacts to juvenile Chinook and potential further impacts as part of the proposed project. In my opinion it is very unlikely that a single breach would adequately compensate for the increased migration disruption caused by the increased project footprint, therefore further strengthening the conditions to require a series of breaches in the causeway as well as the terminal breach would provide the greatest potential to offset further impacts to juvenile Chinook caused by the proposed project.

The draft conditions could be improved in many places to strengthen the wording to protect Chinook salmon productivity. Draft condition 9.2.4, which requires VFPA to "*take into account time lags, technical limitations, and uncertainty when meeting the objective of no net loss as per the Federal Policy on Wetland Conservation on Federal Lands (Government of Canada, 1991)*" does not actually ensure that there is not a time lag between the timing of offsetting habitat functioning as intended and the timing of impacts to juvenile Chinook habitat. The condition should be strengthened to state that all offsite habitat offsetting projects should be demonstrated to function successfully before any impacts to juvenile Chinook salmon habitats can be authorized.

Additional feasible measures available to mitigate impacts on salmon that have not been included in the draft conditions.

As demonstrated by the far-reaching extent of VFPA's offsetting plan there are few further additional measures which can be implemented to mitigate the impacts of the proposed project on salmon habitat in this area due to the high degree of development and associated cumulative effects currently faced by salmon in this area. Currently, over 85% of floodplain habitats in the Lower Fraser River and estuary have already been lost or disconnected (Finn et al. 2021). Harrison River Chinook salmon, which are predicted to be significantly impacted by this project, were recently assessed as Threatened by COSEWIC, and have seen poor returns in 8 of the last 9 years (Figure 1; CTC 2021). Recent research conducted by our research group in the Fraser estuary (Chalifour et al. 2021) has shown that these Chinook rely on estuary habitats for an average of 6 weeks as juveniles and recent research by the VFPA (Phillips and Karpouzi 2021) has demonstrated that the current causeway and terminal are resulting in juvenile Chinook salmon failing to reach the inter-causeway area, an area of particularly high productivity. The research also noted that juvenile Chinook which were able to access the inter-causeway were significantly larger than those captured on the North side of the causeway, demonstrating its potential importance to these fish at this particular time during their early marine residence period.

Despite the potential introduction of a small breach in the marine terminal or the causeway, the extent of migration disruption is likely to increase due to the larger increase in the overall terminal footprint, and the location of the expansion further into deeper more saline waters. The terminal or causeway breaches will only be connected for a portion of the tidal cycle, and during the outmigration period the lights which are to be placed in the culverts to promote fish passage will be off for the majority of the time, providing little incentive for juvenile Chinook to follow along the causeway which is otherwise brightly illuminated during the evening. Although a small percentage of the juvenile Chinook migrating through the area may find the terminal breach, the remainder of the fish will have to navigate an even longer disruption and are therefore much more likely to be disrupted in their migration and fail to reach the inter-causeway area, further impacting their marine survival.

Conclusion

Despite the ongoing development of the offsetting plan and the potential for additional mitigation measures, significant risk remains to Chinook salmon.

DFO warned that "*[w]hile uncertainty regarding the effectiveness of offsets can be managed through appropriate planning and through conditions of a Fisheries Act authorization, it cannot be eliminated. DFO cautions that the development of an offsetting plan that is consistent with DFO policy will not remove all risks to fish and fish habitat*" (Ref #2407, page 24).

Overall, based upon the information provided in the IR responses, it is my opinion that the conditions as proposed, and the accompanying proposed offsetting plan are unlikely to prevent the significant adverse and cumulative impacts to juvenile Chinook salmon predicted by the review panel.

In their report, (at page 188) the panel concluded that "*the Project would result in a residual adverse effect and an adverse cumulative effect on ocean-type juvenile Chinook salmon populations from the Lower Fraser and South Thompson Rivers. The effects would be significant*."

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RAINCOAST
CONSERVATION FOUNDATION

April 2019

Debra Myles
Review Panel Manager, Roberts Bank Terminal 2 Project
c/o Canadian Environmental Assessment Agency
160 Elgin Street, 22nd Floor, Ottawa ON K1A 0H3

Dear Ms. Myles,

Re: Roberts Bank Terminal 2 Assessment

The Raincoast Conservation Foundation is concerned about the impacts of the proposed project on the marine environment and in particular on endangered marine species such as the Southern Resident Killer Whale. We have retained David Scott, a fisheries biologist with particular expertise in salmon, to review the proponent's responses to information requests in regards to the sufficiency and technical merit of the assessment as it pertains to Fraser River Chinook salmon. The potential for adverse effects on Chinook salmon marine survival is of direct significance due to their importance as prey items for endangered Southern Resident Killer Whales, their importance in commercial, recreational and First Nations fisheries, and their current declining status.

Please see attached for a review of the potential impacts of the project on juvenile Chinook salmon in the Fraser estuary and a discussion of the limitations of the Environmental Impact Statement and the proponent's responses to Information Requests in regard to their ability to predict potential impacts on juvenile Chinook productivity.

Sincerely,

Chris Genovali

Chris Genovali

Executive Director

Raincoast Conservation Foundation

Participant: David Scott

Organization (if applicable): Raincoast Conservation Foundation

Expertise:

I am David Scott a fisheries biologist, with particular expertise in salmon. I have been retained on behalf of the Raincoast Conservation Foundation to assist them in the Terminal 2 review, particularly as it pertains to effects on juvenile Chinook salmon. My knowledge and experience regarding juvenile Chinook use of the Lower Fraser River and estuary comes from studying juvenile salmon in this area for the past 7 years since 2012. My education includes a Bachelor of Science with High Honours in Biology from the University of Regina awarded in 2010. I then began studying juvenile salmon in the Lower Fraser River in 2012 when I began my Masters degree studying Resource and Environmental Management at Simon Fraser University under the supervision of well-known salmon ecologist Dr. Jonathon Moore. During my time at SFU I was involved with several research projects in the Lower Fraser River including my masters project which investigated the impacts of flood control infrastructure on juvenile salmon use of rearing habitats in the Lower Fraser with a particular focus on juvenile Chinook. In December 2014 I graduated with a Masters in Resource Management.

Following the completion of my degree I was hired on contract by the Raincoast Conservation Foundation to provide written evidence for the National Energy Board joint review of the Trans Mountain Expansion project with a focus on potential risk to juvenile salmon in the Lower Fraser River and estuary. In 2016, as a contract employee with Raincoast, I lead the beginning of a juvenile salmon research project in the Fraser estuary which is now in its fourth consecutive season. Our research involves repeated sampling of juvenile salmon habitats throughout the Fraser estuary including at Roberts Bank, with a sampling intensity of two sampling rounds at each site per month from April to July each year, typically consisting of 8 sampling rounds per site. This has resulted in a vast amount of time spent on the water in the Fraser estuary each year during the juvenile salmon outmigration and residency period, and as such I have acquired directly relevant and thorough knowledge of juvenile salmon usage patterns in this area. In 2017 I lead a successful application to the Coastal Restoration Fund and currently lead our 2.7-million-dollar restoration initiative to restore connectivity in the Fraser estuary by creating openings in structures such as jetties and causeways. In early 2019 we completed phase 1 construction of three breaches of the Steveston Jetty, restoring migratory pathways for juvenile salmon on Sturgeon Bank. In the fall of 2018, I began full time doctorate studies at the University of British Columbia under the supervision of Dr. Scott Hinch and my ongoing research will continue to focus on improving our understanding of juvenile Chinook use of the Fraser estuary.

I. The Fraser River estuary's role and condition in relation to salmon

1.1. The ecological importance of the Fraser River estuary, in particular for salmon.

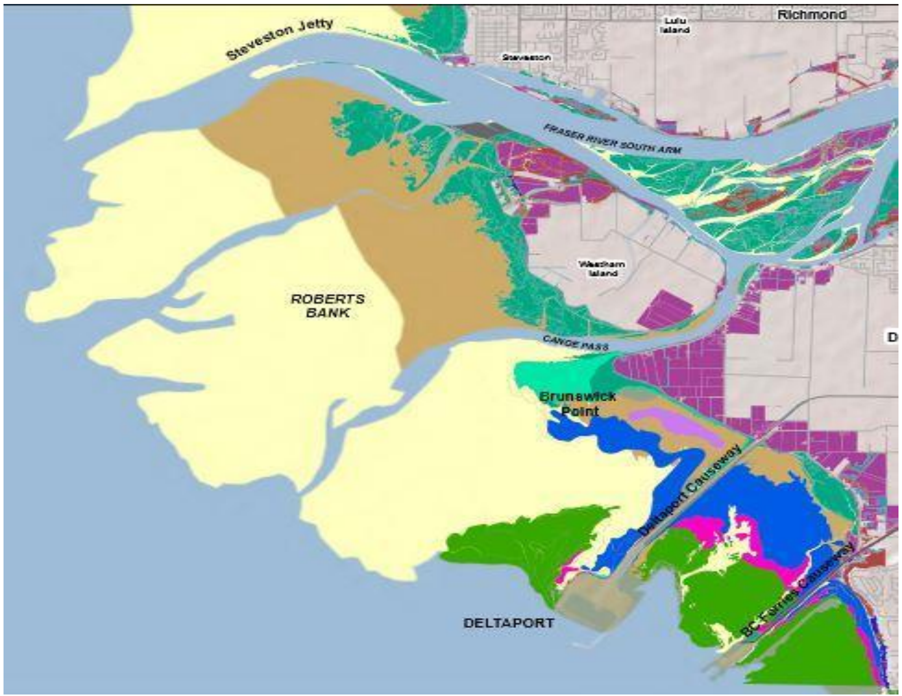
The Fraser River is one of the world's great rivers, running over 1300 km in length, with a watershed encompassing one quarter of British Columbia (Milliman 1980; Richardson et al. 2000). From the headwaters in the Rocky Mountains hundreds of tributaries combine as the river moves across British Columbia towards the ocean to deliver an enormous amount of freshwater (avg. 3,410 m^3 per second), and sediment (approximately 17 million tonnes/year), into the Lower Fraser and Salish Sea (Milliman 1980; McLean et al. 1999). As these streams combine the nature of the river changes, creating the diversity of habitats which salmon have adapted to thrive in. As a snowmelt driven system, spring brings a corresponding increase in river flows. In the Lower Fraser this results in a rise of several meters, temporarily connecting and creating habitats in the few areas where the river is unconstrained by dikes and armoring.

The salmon populations that exist in the Fraser today began to colonize the watershed after the last glaciers retreated between 9,500 and 9,000 years ago (Shaepe 2001). Since then salmon have spread throughout the watershed, evolving over time with the unique local conditions in each stream, using their homing ability to migrate back to their natal stream as adults (Taylor 1991). On European arrival, the Fraser was the most productive salmon river in the world, boasting populations of Chinook, chum, coho, pink and sockeye that were counted in the millions and originated from more than 1070 spawning populations distributed through the mainstem and tributaries (Slaney et al. 1996). Despite intense harvest and development pressures, the Fraser continues to support runs of all five economically important salmon species, producing over 50% of Canada’s wild Pacific salmon (Levy and Northcote 1982; Northcote and Atagi 1997; FRAP 1999). However most salmon populations from throughout the watershed have declined, resulting in greatly reduced abundances and strictly managed fisheries.

The Fraser was once the world’s most productive salmon basin, and still produces more salmon than any other river in British Columbia (Northcote & Atagi 1997), while also being the site of one of Canada’s largest cities (Vancouver) and most active port. All of the salmon that spawn in the Fraser watershed use the Lower Fraser and estuary as a migration corridor. Many further rely on the lower river, its tributaries and estuary for rearing, spawning and feeding. We define the Lower Fraser as the section of river flowing west from Hope, past Mission, through Metro Vancouver, and into the estuary where it meets the ocean. Despite the Lower Fraser watershed representing less than 5% of the total area of the entire Fraser Basin, this area supports more than half of the Fraser River’s chinook and chum, 65% of its coho, 80% of its pink and significant stocks of sockeye salmon (DFO 1995, 1996).

The lower river and delta below New Westminster empties directly into the southern Strait of Georgia via the North and Main arms, creating a fresh-saline mixing zone that is the estuary of the Fraser River. The inner estuary consists of the North Arm, which splits further around Sea Island into the North and Middle Arms, and the Main Arm which splits around the Woodward Island marsh complex into the Main Arm and Canoe Pass. The outer estuary is made up of Sturgeon and Roberts Bank, which are further divided by several jetties and causeways which alter the path of water, sediment and fish. These areas provide a variety of habitats including marsh, sand/mud flats, and eelgrass that differ in salinity, sediment type, and water depth, and in their ability to support salmon (Harrison et al 1999).

All Pacific salmon migrate through estuaries twice during there lifespan and many will reside for days to months during their downstream migrations (Weitkamp et al. 2014, Moore et al. 2016). Chinook and chum salmon which migrate downstream in there first year of life as fry are known to rear in estuaries from a few days up to a few months for some Chinook populations (Levings et al. 1989, Volk et al. 2010, Carr-Harris et al. 2015). In the Fraser estuary juvenile Chinook, chum and pink salmon have been shown to rear in high densities in marsh habitats (Levy and Northcote 1982), but very little information exists regarding there use of Roberts Bank. Today, much of the estuarine habitat in the Fraser has been lost, and numerous large barriers interrupt the movement of fish and disconnect ecosystems, with uncertain implications for salmon.



Source: Port Metro Vancouver

Figure 1. Habitat types in the Fraser estuary at Roberts Bank (sand flat, mud flat, eelgrass, intertidal marsh). From FREMP Backgrounder part 1, prepared by Northwest Hydraulic Consultants and GL Williams & Associates Ltd. 2009.

Figure 2. Port of Vancouver artist rendering of proposed terminal 2 in relation to existing Deltaport footprint in figure 1.

Chinook salmon populations from throughout the Fraser are vulnerable to impacts from changes to the estuary depending on population, CU, and life stage. Mature Chinook migrate through the Lower Fraser to their natal streams to spawn in three run timing groups spanning from February to November (DFO 1995). The Harrison River Chinook population (Lower Fraser River Fall CU) is one of the largest runs in North America, often making up the majority of Fraser chinook returns (CTC 2017; DFO 1995). This population has a unique life history that makes them most vulnerable to impacts of changes to habitat productivity in the estuary. Harrison River Chinook fry migrate downstream immediately after emergence to the Lower Fraser and estuary where they rear, feeding and growing primarily from April to June (can be up to 6 months) before ocean entry (DFO 1995; Levy and Northcote 1982; Murray and Rosenau 1989). This life history strategy of migrating to the ocean in the first year of life is called “ocean type”, whereas other Chinook which remain in freshwater for a full year before ocean entry are known as “stream type”. Ocean-type Chinook from throughout the watershed also utilize the Lower Fraser and estuary in the spring months as juveniles (DFO 1995). There are also three CUs of stream-type Chinook populations which occur in Lower Fraser tributaries where they are present as juveniles throughout the year (DFO 2013). Stream-type Chinook from upper and middle parts of the watershed are also present in the estuary from April to June during there migration to the ocean. The most vulnerable salmon populations to changes to habitat in the estuary are ocean-type Chinook due to their extensive use of Fraser estuary habitats as juveniles prior to ocean entry.

Research in the Fraser estuary and other estuary systems across the Pacific Northwest have demonstrated the importance of estuary rearing for juvenile Chinook salmon with “ocean type” life histories. In the Fraser, Levy and Northcote (1982) demonstrated high densities of Chinook rearing in tidal marsh channels, and hypothesized that growth in the estuary was greater than upstream freshwater habitats. Moore et al. (2016) described estuaries as important stop-over habitats for juvenile salmon and found that in the Skeena estuary 25% of juvenile Chinook salmon spent at least 33d in the estuary. Larger Chinook salmon resided in the estuary for longer durations, growing at an estimated 0.5 mm d-1, evidence that estuary residency provides growth opportunities (Moore et al. 2016). In the Columbia estuary McNatt et al. (2016) found many juvenile Chinook salmon remained in the marsh for 2–4 weeks and increased in length by 10–20 mm, with an average growth rate of 0.53 mm/d. The ability for juvenile Chinook to grow quickly during this estuary residence period is incredibly important as size at ocean entry is thought to be a major determining factor in early marine survival (Woodson et al. 2013). Based on these previous studies it seems likely that growth occurring in estuary habitats is important to the early marine survival of ocean-type Chinook in the Fraser River.

Investigations regarding juvenile Chinook use of Roberts Bank have been limited and did not occur until after construction of the original Deltaport causeway in 1969 (Greer et al. 1980; Levings et al. 1983; Trition 2004; Martel 2009; Archipelago 2014). Levy and Northcote (1982) sampled in the South Arm marshes of the estuary in 1979 and demonstrated high densities of juvenile salmon in tidal marsh channels, however recent studies conducted at Roberts Bank (Trition 2004; Martel 2009; Archipelago 2014) although documenting juvenile salmon presence, have captured relatively few juvenile salmon compared to the vast number emigrating from the river. Due to the presence of the terminal prior to any baseline studies it is difficult to interpret the relatively low number of juvenile salmon using the productive eelgrass beds of the inter-causeway area.

1.2. Current ecological condition of the Fraser River estuary, in particular in the context of its ability to function as salmon habitat and support healthy populations of wild salmon.

Prior to the arrival of Europeans, the Lower Fraser watershed was much different than it appears today. Nearly two-thirds of the land base of the Lower Fraser was forested, and the remainder comprised of wetlands and a large lake (Healey and Richardson 1996). European settlers arrived as early as 1850, and over the next one hundred years, the vast majority of the forest was harvested and cleared (Healey and Richardson 1996). Following this, the wetlands were drained to create farmland, and to protect developments from flooding, dikes were constructed. As the population grew on the floodplain so did the systems of dikes, cutting the river off from approximately 70% of the floodplain by the mid-20th century (Healey and Richardson 1996). Overall by the beginning of the 21st century, the forests and wetlands had been reduced to approximately one-tenth of the land base, with agricultural and urban land uses dominating the landscape (Healey and Richardson 1996).

The most recent assessment of the salmon resources of the Lower Fraser was conducted in 1997 as part of the Fraser River Action Plan, an initiative of the Habitat and Enhancement Branch of Fisheries and Oceans Canada. This review resulted in the Lower Fraser Valley Streams Strategic Review (PIBC 1997) and summary report, “Wild, Threatened, Endangered and Lost streams of the Lower Fraser Valley” and accompanying map (See Figure 2.1 below). Streams were evaluated based on whether they faced one or more of a number of stressors and classified as: wild (no stressors), threatened (one stressor), endangered (two or more stressors), or lost (culverted, paved over). Unsurprisingly, they found that very few streams can still be considered wild (<4%, no stressors), 20% were already lost (culverted or filled), 63% endangered (two or more stressors), and 13% threatened (one stressor) (Wild Streams Map, PIBC 1997).

Similar to much of the Lower Fraser watershed, the Fraser estuary has been considerably altered since the late nineteenth century. Dike construction, to permit agriculture and other developments and to prevent flooding, is estimated to be responsible for removing 70% of the estuary from use by fish, aquatic invertebrates and waterfowl (Hoos and Packman 1974). The mudflat and intertidal region of estuary delta is often the most ecologically important of these coastal habitats, yet protection of these areas in the Fraser estuary has been minimal (Elliott and Taylor 1989).

The various jetties and causeways constructed in the estuary have created significant barriers to fish migration and affected natural flow and sediment patterns (Harrison et al. 1999). This is particularly significant for certain species of juvenile salmon, which must now swim around these structures, exposing themselves to deep, saltier waters during a vulnerable juvenile stage of ocean entry when they would otherwise remain in the safer, nearshore areas. One such jetty, the Iona jetty, is also the source of an average of 557 million liters of partially treated sewage that is pumped directly into the estuary each day (Metro Vancouver 2013). Construction of the Roberts Bank coal port and container terminal removed significant amounts of habitat from the estuary, and coal dust is found in ever increasing concentrations in the surrounding mudflats (Johnson and Bustin 2006). Expansion of the coal port in 1980 was described by Fisheries and Oceans Scientist Dr. Levings (1985) as having “obliterated feeding areas, invertebrate communities, and possibly herring spawning areas from the local productions system”. Cumulatively, these human actions have likely severely reduced the ability of the estuary to support juvenile salmon and other species.

Climate change is already beginning to alter conditions in the Fraser estuary potentially placing further stressors on an ecosystem already suffering from an array of cumulative effects. Sea-level rise will likely lead to an increase in flood control structures and other infrastructure which contributes to coastal squeeze and the loss of coastal marsh habitats. Changes to the hydrology in the watershed are predicted to result in spring freshets which arrive earlier each year, altering salinities in the estuary during the juvenile Chinook residence period. We are already seeing changes to flows and temperatures in the Fraser River. Data series collected since 1953 indicate that spring freshet is arriving earlier and reaching half of its annual cumulative flow an average of nine days earlier than a century ago (Fraser Basin Council 2010; Figure 3.1). Low flows may create barriers to spawning salmon, and tributary streams that support juvenile coho may run dry during late summer. Summer mean water temperatures have increased over the past 50 years, equivalent to 2.2°C per century, and are predicted to rise another 1.9°C by 2080 (Morrison et al. 2002; Figure 3.2).

1.3. Current status of the five species of salmon that rely on the Fraser River estuary as habitat.

Before the 1990's the Salish Sea supported a valuable recreational fishery for coho, and Chinook marine survival was strong. Over the past few decades Chinook, coho and steelhead have had consistently low returns in the Fraser and other parts of the Salish Sea. However, these trends have not been seen in other areas of Washington or B.C. This has led many to conclude that the problem is within the Salish Sea itself. In response, the Pacific Salmon Foundation together with Long Live the Kings in Washington launched an ambitious project, funding research across the Salish Sea investigating a variety of hypotheses into the decline in marine survival of Chinook and coho (marinesurvivalproject.org). Conversely, new research by Welch et al. (2018) points to a coastwide problem with marine survival for Chinook salmon related to poor ocean conditions. Regardless of the cause marine survival for Chinook salmon remains poor and shows no signs of improvement in the short term.

Various levels of government are responsible for protecting fish and their habitats but Fisheries and Oceans Canada (DFO) is the main authority responsible for managing Pacific salmon. In 2005, DFO published the Wild Salmon Policy to preserve and restore populations within the five commercially harvested species of wild Pacific salmon. While the majority of the policy has yet to be implemented, one initiative that has been carried out is establishment of individual Conservation Units (CU's), defined as "a group of wild salmon sufficiently isolated from other groups that, if extirpated, is very unlikely to recolonize naturally within an acceptable time frame" (DFO 2005). This classification recognizes and aims to protect the irreplaceable genetic and ecological diversity that is contained within thousands of BC's local streams and spawning populations (Holtby and Ciruna 2007). The Fraser River has 56 unique CUs of commercially managed salmon, including 16 in the Lower Fraser. Chinook and sockeye salmon make up the majority of CUs in the Fraser and unfortunately recent assessments of Chinook in 2018 and Sockeye in 2017 have shown serious cause for concern with the majority of populations struggling.

The Fraser River system produces the greatest number of Chinook salmon in Canada (Parken et al. 2008) and these Chinook make up the vast majority of Southern Resident Killer whale diets in their critical habitat (Hanson et al. 2010). In 2016 a Canadian Science Advisory Secretariat review published by Fisheries and Oceans Canada concluded that the majority of Fraser River Chinook had declined over the past 12 to 15 years and that this was a significant cause for concern (DFO 2016, Attachment 1). In November 2018 COSEWIC published a new summary of wildlife species assessments which included all Fraser River Chinook populations. They found that out of 16 CU's, half of them or 8 populations were listed as endangered, only 1 was listed as Not at Risk, and the remaining were listed as Threatened (3 populations), Special Concern (1 population) or Data Deficient (2 populations) (COSEWIC 2018, Attachment 2). Harrison River Fall ocean type Chinook salmon, which are the most reliant on the estuary of any Fraser Chinook population (DFO 1995; Raincoast unpublished genetics data), were listed as Threatened in this recent assessment, and have failed to reach their escapement target in six of the last seven spawning years (Figure 1; CTC 2017, DFO 2018 Attachment 4). In 2018 Fraser River Chinook spawner abundance was poor across all populations including stream and ocean types, prompting new restrictions for Chinook fisheries in 2019 (DFO 2019 Attachment 4)

2. Effects of the Project on salmon and salmon habitat

2.1. Magnitude, geographic extent, temporal extent and reversibility of potential project effects on salmon.

The project has the potential to result in negative impacts to juvenile salmon and their habitats as a result of terminal placement and activities associated with terminal operations. In my opinion the greatest potential impact of this project is the cumulative impact of the existing terminal placement and the additional new terminal placement on juvenile salmon migration pathways in the estuary. There is also the potential for impacts to juvenile salmon behaviour and predation risk associated with anthropogenic lighting and noise from terminal operations. Lastly, there is the potential for changes to the Roberts Bank ecosystem and prey availability for juvenile Chinook which can not be properly characterized by the Roberts Bank ecosystem model based on flaws in its application as described below. Although the geographic extent of this impact is localised at Roberts Bank, there is little information available which can allow the proponent or the public to quantify the magnitude of these impacts on juvenile salmon survival during the critical estuary rearing and ocean entry phase of there life cycle. Juvenile salmon migrating southward from the mouth of the Fraser River may be exposed to highly saline waters as a result of the migration interruption created by the terminal, with unknown effects on their physiology and survival. Temporally, the effects of terminal placement are ongoing, permanent and irreversible, the construction of the new terminal further disrupts the migration pathway of juvenile salmon currently impacted by the existing causeway and terminal. This effect could only be reversed by the decommissioning and removal of the causeway and terminal. Alternatively, the causeway could be breached and openings created which could restore ecosystem connectivity and juvenile salmon migration pathways, however the impact of this type of action on the Roberts Bank ecosystem as a whole would require a thorough study.

2.2. Opinion on the Proponent's conclusions with respect to potential effects of the Project on salmon and salmon habitat.

It is my opinion that the information presented by the proponent in the EIS and supplementary information request responses is insufficient to justify their conclusions that the project will result in negligible adverse impacts to juvenile Chinook and chum VC's. The proponent's justification falls short due to four main issues; a) insufficient baseline data collection to properly characterize juvenile salmon use of Roberts Bank, b) flaws in the application of the Robert Bank ecosystem model c) lack of quantitative analysis of potential impacts of migration disruption, lighting and noise, and d) demonstrated ongoing lack of success in past habitat compensation activities.

a) Insufficient baseline data collection to properly characterize current juvenile salmon use of Roberts Bank and conduct a historical comparison

Current use of Roberts Bank

The field studies carried out by the proponent form the basis for their effect's assessment and the inputs for the ecosystem model; therefore, it is of the utmost importance that these data accurately represent use of Roberts Bank by juvenile Chinook salmon. In my professional opinion, for details discussed below, these studies fail to accurately characterize juvenile Chinook use of the Roberts Bank area. The proponent's field studies which relate to juvenile Chinook include the RBT2 Eelgrass Community Survey and the RBT2 Juvenile Salmon Surveys, which were conducted across 2012 and 2013. Due to their limited duration, lack of intensity, limited number of sites, and inefficient field methodology, the RBT2 Juvenile Salmon Surveys are wholly insufficient to accurately depict juvenile Chinook habitat preferences and abundance in the Roberts Bank ecosystem. Thus the parameters which have been used for the ecosystem model likely carry a high degree of uncertainty in there ability to make predictions about productivity.

The field studies conducted by the proponent had a very limited number of replicates, both spatially and temporally, that prevented them from detecting habitat preferences and likely lead to highly uncertain estimates of abundance for juvenile Chinook. The RBT2 Juvenile Salmon Survey (p. 40) states:

> "*No consistent seasonal or annual trends were observed in juvenile chinook abundance at individual sites or habitats, as numbers were overall fairly low and extremely variable*".

The assumption that juvenile Chinook do not exhibit habitat preferences between salt marsh, un-vegetated flats, and eelgrass is not supported by the literature, and instead seems to be an artifact of the limited field sampling conducted by the proponent. The RBT2 Eelgrass Fish Community Survey consisted of only 5 sites - 4 eelgrass sites and 1 reference site on the sandflat- and the RBT2 Juvenile Salmon Survey consisted mostly of shore tied sites and again appears to have had only one reference sandflat site. The likely reason they were unable to detect any habitat preferences is that there study had very limited replication both in the number of sites of each habitat and in the number of sampling occasions.

Along with being unable to detect habitat preferences the abundance estimates they have produced are unlikely to accurately represent juvenile Chinook use of Roberts Bank. Juvenile

Chinook abundance in the Fraser estuary is known to have a sharp peak in the spring and then drop off rapidly (Levy and Northcote 1982), however only one round of sampling was conducted during the spring season in each of the two sampling years. The results of their two years of spring sampling were highly variable:

> "*Juvenile chinook salmon abundance in the survey area was significantly higher in 2012 (4.1 ± 1.2 SE) than 2013 (0.5 ± 0.2 SE)*(RBT2 Juvenile Salmon Surveys p. 25)."

Due to the limited replication of their sampling protocol, it is difficult to know whether this represents a true difference in abundance or in outmigration timing, or is an artifact of the sampling methods. Based on the lack of replication, there is little confidence in the abundance estimates generated, which represent a mere snapshot versus an accurate or relative representation of juvenile Chinook abundance at Roberts Bank across the spring outmigration period. As outmigration abundance is determined by the strength of the spawning class in the previous year, juvenile Chinook abundance in the Lower Fraser and estuary varies considerably from year to year. The limited repetition of their sampling protocol both within and across years is insufficient to represent the long term average of juvenile Chinook abundance at Roberts Bank.

Based on this information which was provided as part of my initial review of the technical merit of the information provided, the review panel sent numerous information requests regarding the juvenile salmon surveys including IR05-17 - Juvenile Chinook Salmon Baseline.

In their response, VFPA does not provide any additional information regarding the justification of there sampling intensity, duration or number of sampling events to determine baseline information on juvenile Chinook abundance at Roberts Bank. Juvenile Chinook salmon and chum salmon abundance in the Fraser estuary has been shown to change rapidly throughout the spring and summer outmigration season (Levy and Northcote 1982), therefore repeated sampling is necessary to create an accurate representation.

Their response states *"No mismatches are identified between the actual sampling timing in relation to the period of juvenile salmon habitat occupation in the Project's local assessment area. Beach seines deployed for the Project using techniques and timing in a manner explained earlier in the response actually captured juvenile salmon. Therefore, field survey objectives (i.e., determination of seasonal abundance, distribution, and use by juvenile salmon of habitats, including eelgrass beds, in the local assessment area) were effectively achieved, and meet the overall need of informing the Project's effects assessment."*

Simply succeeding in capturing juvenile salmon does not give you any determination regarding the overall accuracy of your estimation. By sampling only once during the peak juvenile Chinook and chum outmigration period as VFPA indicated its sampling program was designed to do, they are unable to provide any estimation of variability in abundance over time and provide very little confidence in their estimation of overall juvenile Chinook biomass at Roberts Bank. Research conducted at Roberts Bank by Archipelago and GL Williams (2016) repeated their sampling across March, April and May and over 3 years post construction, with results demonstrating month to month and yearly variability in juvenile Chinook and chum salmon abundance.

For example, the Juvenile Salmon Survey (Section 4.1.7 of TDR MF-7 in Appendix AIR10-C of CEAR Document #388) in reference to the same data states: *"In 2012, the abundance of juvenile chum salmon at Roberts Bank causeway south and the BC Ferries Terminal varied by month (Figure 47; Table 36), with abundance at both locations being low in early March, higher at the BC Ferries Terminal in early April, and higher at the Roberts Bank causeway south site in early May."*

This variability is also demonstrated in the genetic data presented in the VFPA response to *IR5-19* in table *IR5-19-1* which demonstrates that not only does Chinook abundance vary from month to month within the summer season, the population of Chinook present in the estuary also varies over time. This table also demonstrates that in 2013 and 2014 juvenile Chinook abundance was highest in May, however VFPA field sampling as part of their Juvenile Salmon Surveys was conducted in June.

Therefore, the VFPA suggestion that their sampling did not mismatch peak abundance as they were successful in catching juvenile salmon is unsatisfactory, this data provides no estimation of error or indication of where on the curve of seasonal abundance there sampling occasion happened to occur. To properly estimate overall abundance in the study area, sampling intensity should be increased during peak outmigration timing and occur at regular intervals as demonstrated by Levy and Northcote (1982). Furthermore, as juvenile salmon abundance is variable across years with fluctuations in spawner abundance, sampling should be repeated across years in order to create an accurate representation of average juvenile Chinook and Chum salmon biomass at Roberts Bank.

The VFPA also further defend their choice of sampling technique by stating that *"These beach seining techniques continue to be used in the present by Raincoast Conservation Foundation to capture juvenile salmon as part of their Fraser River Estuary Juvenile Salmon project (Raincoast Conservation Foundation 2016)"* however Raincoast uses a small purse seine to sample habitats at Roberts Bank and only uses a beach seine in marsh channels where it can be deployed effectively.

<u>Inability to conduct a historical comparison</u>

The field studies also failed to make comparisons across years which could generate more accurate estimates of abundance and detect any changes in juvenile Chinook use of Roberts Bank over time. The Juvenile Salmon Surveys, although designed to complement the Eelgrass Community Survey, used a different methodology with a larger net and thus was not comparable across years. As juvenile chinook abundance varies significantly from year to year, a one-year study is unlikely to result in an accurate representation of long-term juvenile chinook use of the assessment area which could allow for an analysis of how the use of Roberts Bank by juvenile Chinook has changed over time. However, RBT2 Juvenile Salmon Survey Page 10 states:

> *"While CPUE data were reported in studies occurring pre-1983 (Greer et al. 1980, Gordon and Levings 1984), CPUE data from studies completed after the year 2000 was not available for comparison"*

Research that has been conducted since 2000 (Triton 2004; Martel 2009; Thurninger 2013 a,b) has all been done on behalf of the proponent. Catch per unit effort (CPUE) could have been calculated to standardize effort across sampling regimes and allow for a longer-term comparison. Based on the available information, it would appear that use of the Roberts Bank area by juvenile Chinook has decreased since the studies conducted in the 1980's;

> *Page 10: "because studies conducted pre-1983 were carried out prior to the expansion of Roberts Bank Port facilities on Pods 3 and 4 (Hemmera 2004, Figure 3) and modifications to the BC Ferry Terminal, data from these studies are less relevant for inter-annual comparisons than data from more recent studies"*

By avoiding comparisons of recent studies with historical data, the proponent is excluding any examination of how previous Port expansions may have impacted juvenile salmon use of the Roberts Bank area. A review of the potential impacts of the proposed expansion and investigation into juvenile salmonid use Roberts Bank would have been highly pertinent information. However, the proponent has conducted their studies in a way that precludes such analysis. The idea that studies conducted prior to the previous expansion are no longer valid creates a shifting baseline where conditions after each impact are taken as the new normal, while the cumulative impact of prior and proposed expansions is never truly evaluated.

b) Flaws in the application of the Robert Bank ecosystem model.

The output of the Roberts Bank ecosystem model was clearly used as a line of evidence to support the conclusions in the EIS for juvenile Chinook; however, this application of the model is flawed for several reasons. The model fails to incorporate a number of factors which have the potential to impact juvenile Chinook, and the field data used to develop several key input parameters is insufficient. The ecosystem model is also inappropriate to predict effects on juvenile Chinook as they only spend a portion of the year in the assessment area. As noted previously, the proponent stated:

> "….*the objective of the RB model was not to provide an assessment of Project impacts for each functional group at a fine temporal scale, but to estimate changes in productive potential, with and without the Project, at the ecosystem level*" (CEAR doc. #547, p. 99, lines 1914-1917).

The ecosystem productivity model is unable to incorporate several factors which have the potential to cause adverse effects on juvenile Chinook. The potential effects of the Project resulting from construction activities, noise, lighting and changes to migration pathways are only assessed qualitatively by the applicant, despite their potential to impact juvenile Chinook. EIS Section 13.6.3.6 p. 13-123 states:

> "*Discrepancy between ecosystem model and other lines of evidence attributed to inability of model to incorporate construction, acoustic, lighting, and migration mechanisms."*

The inability of the model to incorporate these factors cannot be interpreted as lack of risk to juvenile Chinook.

The proponent also states:

> *"….the* ***objective of the RB model was not to provide an assessment of Project impacts for each functional group at a fine temporal scale****, but to estimate changes in productive potential, with and without the Project, at the ecosystem level*"

(From the Vancouver Fraser Port Authority to the Review Panel re: Answers to preliminary technical questions submitted during the completeness phase from Fisheries and Oceans Canada, Natural Resources Canada, and Environment and Climate Change Canada, concerning the ecosystem modelling to support the Roberts Bank Terminal 2 Project environmental review (CEAR doc. #547, p. 99, lines 1914-1917).

Based on that statement, it would follow that the ecosystem productivity model should not be used as a line of evidence to conclude potential effects. However, based on EIS Section Table 13-12, it would appear that the ecosystem model *is* considered equal to other lines of evidence in the final conclusion.

The prediction of the ecosystem model is that juvenile Chinook will see an increase in productivity is based on the model's prediction that there will be a large increase in the productivity of macrofauna as a result of abiotic changes associated with the Project. However, the ecosystem model does not provide enough temporal clarity to accurately predict changes in juvenile Chinook productivity.

The ecosystem model predicts an increase in juvenile Chinook biomass of 16%:

> "*based on an increase in productivity on the tidal flats northwest of the Roberts Bank causeway*" EIS Appendix 10-C Roberts Bank Ecosystem Model Development And Key Run Section 3.7.2 Chinook Salmon Juvenile (p. 74).

However it is not known if the predicted 27% increase in macrofauna biomass (EIS Appendix 10-C Roberts Bank Ecosystem Model Development and Key Run Section 3.7.2 Chinook Salmon Juvenile p. 75) which drives this trend occurs at a time of year when it is relevant to juvenile Chinook. Juvenile Chinook peak in abundance at Roberts Bank in the spring and are completely absent from the area during the fall and winter, at least half of the year. The ecosystem model also describes several decreases in productivity associated with the project that have the potential to adversely impact juvenile Chinook at Roberts Bank. A decrease in Pacific herring productivity is predicted to occur (EIS Appendix 10-C Roberts Bank Ecosystem Model Development And Key Run Section 3.7.2 Chinook Salmon Juvenile P. 138).

Juvenile and immature Chinook are known to rely on larval and juvenile herring as prey. EIS Section 13.5.1.2 (p. 13-29) states:

> "*At Roberts Bank, major food items (for juvenile Chinook) change from spring to summer (i.e., epibenthic crustaceans and other invertebrates are more prevalent in spring, whereas fish such as Pacific herring are prevalent in later months)*"

Does this decrease in herring productivity not have a negative effect on juvenile Chinook? Juvenile salmon rely on these two different types of prey items at different times during their estuarine residence, therefore an increase in macrofauna may not be suitable to compensate for the loss of herring and other prey items at different times of the year.

The ecosystem model and EIS also fail to incorporate the predicted effects of climate change on the Roberts Bank ecosystem, despite being directed to do so in the EIS guidelines, adding considerable uncertainty to the description of future conditions with the project. EIS guidelines Section 10.1.5 Effects of the Environment on the Project (p. 26):

> *Longer-term environmental effects of potential future sea level rise and other changes to the climate on the project and surrounding ecosystems will also be assessed. This assessment will include a description of methodological approaches and climate data used as well as the scenarios and the assumptions made."*

EIS Section 13.5 (p. 13-20) states:

> *"Such variability is likely to be further amplified by climate change, where sea level rise is anticipated to cause a reduction in the intertidal mudflat area and an increase in marsh erosion in the foreseeable future."*

However, the EIS fails to capture these potential effects, as EIS Section 13.5 (p. 13-20) states:

> "*As such, in the absence of concrete predictions around changes in physical processes, for the purposes of this assessment, expected conditions are assumed to be the same as existing conditions"*

Sea level rise is predicted to result in decreases to freshwater and salt intertidal marsh and a decrease in the total area of tidal marshes (Craft et al. 2009). As the ecosystem model fails to incorporate sea-level rise, it fails to accurately characterize future conditions with the project. As tidal marshes are an extremely productive component of the Roberts Bank ecosystem, sea-level rise has the potential to result in adverse effect on the productivity of Roberts Bank. This has the potential to interact with the Project to decrease juvenile chinook productivity.

Overall there are many sources of uncertainty and significant assumptions in the ecosystem model which limit its ability to adequately predict the effects of the project on juvenile Chinook salmon. Due to these significant uncertainties it is my conclusion that the results of the ecosystem model should not be used as a line of evidence when evaluating the potential adverse effects of the project on juvenile Chinook salmon.

c) Lack of quantitative analysis of potential impacts of migration disruption, lighting and noise.

The EIS states that the effects of the project on juvenile Chinook will be minor; however, there is little quantitative evidence to support this conclusion. The balance of this conclusion appears to be based on the ecosystem productivity model and a qualitative assessment of other effects of the Project on juvenile Chinook, yet no explanation is provided regarding how these differing and opposing lines of evidence were weighed and incorporated into the final decision. It appears that in the absence of information, the effects of construction, acoustic disturbance, lighting and migration disruption are all assumed by the applicant to be minor. This is despite the fact that they were previously assumed to have an effect. Without quantitative evidence to analyze the potential effects there can be little confidence in the prediction that any effects will be minor.

Migration Disruption

The causeway and the terminal have the potential to impact juvenile Chinook migration, orientation and behaviour; however the magnitude of these effects is a question that has remained unresolved since the construction of the original terminal.

EIS Section 13.6.3.1 (p. 13-102) states:

> *"terminal placement (expected to disrupt juvenile migration, especially given remaining uncertainties around juvenile salmon movement patterns and residency times in the LAA)".*

The EIS Section 13.6.3.6 Summary of Marine Fish Productivity Changes Table 13-12 again states:

> "*Long-term minor decreases* [in juvenile Chinook productivity] *during operation due to change in lighting and migration disruption…*" yet no information is provided on why these effects were concluded to be minor.

Small juvenile Chinook may avoid moving around the terminal, as this would push them into deeper more saline waters, potentially exposing them to a higher risk of predation. The proponent has failed to perform the necessary field studies to support the conclusion that the effects on migration will be minor. It is scientifically indefensible to conclude that juvenile Chinook will not be adversely affected when it is unknown how they rely on habitat that has the potential to be impacted. This conclusion cannot be supported.

EIS section 13.8.1 (p. 13-141) states:

> *"quantification of this [*disruption to juvenile salmon migration*] effect is not available…"* with the footnote *"The Project would need to be in place in order to conduct studies evaluating potential changes in juvenile salmon migration"*.

However, a study of the existing effects from previous expansions could and should be undertaken. This issue has consistently been raised by panels that reviewed the previous expansions, and yet it still has failed to be quantified. In the Final Report of the Environmental Assessment Panel – Roberts Bank Expansion Project 1977 (80 pp.) states:

> *"(10) The existing Roberts Bank Port and ferry terminal causeways* ***could represent a significant interruptive effect*** *on the orientation of juvenile salmonids in their utilization of the intercauseway area, and* **this question warrants investigation**.".

Furthermore, the RBT2 Juvenile Salmon Surveys (p. 39) found that:

> "*juvenile Chinook salmon abundance was lower at locations in the Inter-causeway Area relative to other locations at Roberts Bank*".

It seems very probable that the effect of the existing causeway and terminal is to inhibit or alter juvenile Chinook movement at and around Roberts Bank. This represents a significant concern regarding potential effects to juvenile Chinook salmon. Despite this recommendation of the review panel nearly 40 years ago, the Port has not followed up with any research to answer this question. The overall size and orientation of the proposed expansion would further the movement barrier that was created by the initial causeway construction and no information exists on how this will impact juvenile Chinook and other salmon. Without further research into how the significantly increased barrier to movement affects juvenile salmon use of Roberts Bank, it is hard to understand how the EIS can conclude that there will not be significant adverse residual effects to juvenile Chinook.

It is presumable that before the construction of the original causeway, juvenile salmon navigated along the marsh and eelgrass nearshore areas of Roberts Bank, and experienced a gradient of salinity as they moved further out into the estuary. However, with the current footprint of Deltaport, juvenile Chinook must move from the brackish eelgrass habitats on the north side of the causeway into deeper saline waters if they hope to move into the intercauseway habitat. Expanding the footprint would only further this issue. While the intercauseway area may be a productive ecological zone, the proponent has not provided any evidence that juvenile Chinook will move into this area. What is the potential increase in predation associated with having to move through these deeper and illuminated waters? What incentive do juvenile Chinook have to move south around the Port to reach the intercauseway eelgrass? What is the incentive for juvenile Chinook to move into deeper waters if they are still in an estuary rearing phase? These questions need be resolved before further impacts to juvenile Chinook migration and behaviour can be properly assessed.

VFPA states *"Although a review of the literature yielded no evidence to suggest a causal link between causeway/terminal construction and fitness or predation consequences for juvenile salmon, because of the paucity of data on juvenile salmon movement patterns and residency in the LAA, the assessment conservatively concluded that migration disruption produced a minor adverse effect on productivity pre-mitigation."*

In their response to IR05-18 VFPA provides some information on juvenile Chinook movement patterns however they fail to provide any new specific reasoning for assessing the impacts on migration pathways as minor, and again discuss the lack of prior information which would be necessary to create an informed examination.

It appears that their conclusion is based solely on the assumption that there is some negative impact of terminal placement, yet they provide little evidence of how they concluded this effect to be minor.

They state *"Based on this assumption, terminal placement may encumber migration by increasing linear distance travelled and time spent in deeper waters, thereby increasing exposure and susceptibility to predators (e.g., Nightingale and Simenstad 2001, Ono et al. 2010)"*

Here they fail to discuss how changes in salinity experienced by juvenile salmon as a result of terminal placement may also lead to cumulative effects, as juvenile Chinook are forced to migrate from brackish waters through highly saline waters to go around the terminal, potentially with negative physiological consequences. This could further increase their vulnerability to predation or cause salinity stress, yet the magnitude of this effect is unknown and has not been discussed.

Light and Noise

The EIS lacks of a full evaluation of the potential effects of Project related noise and lighting on juvenile Chinook salmon behaviour. Underwater noise has the potential to effect juvenile Chinook salmon use of the Roberts Bank ecosystem by causing behavioural changes including avoidance behaviour. Changes to light and shading have the potential to increase susceptibility to predation and lower foraging success. Together these effects have the potential to adversely affect juvenile salmon productivity, and no information has been provided which would allow an accurate quantification of the magnitude of these effects.

While little research has been conducted on juvenile salmon sound sensitivity, Pacific herring have been shown to avoid noise produced by vessels (Schwarz and Greer 1984). A recent review by Robertis and Handegard (2012) looked at a number of reasons that vessels may elicit a behavioural response in fish and concluded:

> "*simple models of behaviour, for example those based on sound pressure level alone, cannot explain the observations of fish avoidance*".

However the EIS relies on a simple sound threshold which may not accurately predict juvenile Chinook avoidance behaviour and is not based on peer reviewed literature.

The conclusion that noise associated with shipping will not have an effect on juvenile Chinook is based on the threshold:

> "*sound levels generated by ship movements are not predicted to reach the behavioural threshold for salmon* (i.e., 90 dBht) (Nedwell et al. 2007)" (EIS Section 13.6.1.2 Changes in the Acoustic Environment p. 13-75).

Nedwell et al. (2007) states:

> "*On this basis, a method which is relatively simple to calculate and apply is proposed for estimating areas around a pile driving operation within which the two key auditory effects of noise will occur".*

This method may be summarised as:

> *"Provided animals are free to flee the noise, those within the area bounded by the 90 dBht level contour will strongly avoid the noise.*"

This standard which the proponent has chosen to use is inappropriate as it is based on a consultant's report which looked at the effect of pile driving noise (associated with the construction of wind farms) which creates very different types of noise than container ship operations. Pile driving creates short duration high intensity sounds as opposed to long duration low frequency noises produced by ships, which occur in the audible range for salmon (Schwarz and Greer 1984). The other significant problem with this standard is it provides no information on the minimum level of noise at which effects begin to occur, but instead is the level at which all individuals exhibit a strong response. Further justification for the use of this standard should be provided, and if possible it should be replaced.

Interestingly, Perry et al. (2012) investigated the use of a noise and light barrier to prevent juvenile Chinook salmon in the Sacramento River from entering a slough where survival was thought to be poor. They found that up to 40% of juvenile Chinook altered their behaviour to avoid the artificial barrier that they had created, depending on influence by the environment (Perry et al. 2012). Although the noise and light barrier they used certainly differs from that produced by the project this study clearly demonstrates that there is the potential for juvenile Chinook to alter their behaviour in the presence of noise and light. In recent studies of other fish species, the impacts of noise on behaviour and predation risk has been well documented. Studies on coral reef fish have documented increased risk of predation in the presence of boat noise (Simpson et al. 2016) and shown that noise reduces their ability to learn to avoid predators (Ferrari et al. 2018). A study of two species of goby found that in the presence of noise they had reduced spawning success (de Jong et al. 2018) and a study of bass found that in the presence of boat noise they exhibited reduced parental care leading to reduced fitness (Maxwell et al. 2018). Overall, there is an emerging body of research in the past few years which is beginning to document a much greater impact of noise on fish behaviour than previously anticipated.

The role of artificial lights in facilitating excessive predation by seals on juvenile salmon has been documented in BC (Yurk and Trites 2000). Lighting and shading have the potential to negatively affect juvenile Chinook, but again the magnitude of this effect has not and cannot be quantified. EIS Section 13.6.3.1 (p. 13-97)

> "*Changes in the light environment have the potential to influence Pacific salmon productivity in the LAA; however, since it was not possible to incorporate this mechanism into the ecosystem model, it is addressed qualitatively. Low light conditions, such as those brought about by structural shading, are not optimal for juvenile salmon, which depend upon light for prey capture and schooling (Nightingale and Simenstad 2001a). Increased predation on juvenile salmonids in low light (i.e., dawn or dusk) has been documented (Ginetz and Larkin 1976), and may be caused by a period of partial night blindness, since the process of dark adaptation takes as long as 50 minutes (Ali 1959), or by a loss of schooling ability (Ono et al. 2010).*"

Again, an effect on juvenile Chinook is predicted, and as there is no quantitative evidence provided on the potential magnitude of this affect, yet it is assumed in the EIS to be minor. Overall, little information is presented to support the conclusion that project related noise and light will not have an effect on juvenile Chinook, and more information should be provided and the uncertainty should be more directly acknowledged.

d) Demonstrated ongoing lack of success in past habitat compensation activities.

Habitat compensation has long been a tool used by proponents in the Lower Fraser and estuary to offset for habitat losses associated with development projects according to the no net less principal. However, while proponents are typically required by law to construct these offsetting habitats, there has been very limited requirements for follow up monitoring to determine the effectiveness of these efforts. Recently, a review conducted by Lievesley et al. (2017) surveyed compensation sites throughout the Lower Fraser which had been constructed between 1983 and 2010. They assessed sites based on both the area of habitat established and the proportion of native species relative to nearby reference sites and found that only 65% of sites achieved their intended area, and only 50% of sites were scored "good" for the proportion of native species established. Overall, they found that combining these two metrics only one third of past compensation sites achieved their intended function, and importantly they found that time since construction did not have a significant influence on the proportion of native species demonstrating a lack of improvement in the ability of proponents to build successful projects over three decades (Lievesley et al. 2017).

As the Port plans to offset habitat losses with tidal marsh creation, a detailed evaluation of the effectiveness of past compensation works should be presented. In their response to IR7-28 Marine Fish – Mitigation, Habitat Compensation the VFPA uses two examples of past compensation projects to demonstrate their ability to successfully complete compensation works. Both of the projects are admittedly failures as initially designed, with follow up work conducted to improve function.

Project 1 - BC Ferries - Following failed plantings in 1993 the ecosystem was eventually established and following sampling in 2015 was deemed to have naturally reached acceptable functional levels and no remedial action was taken.

Over time the constructed marsh had established successfully and transitioned (influenced by local patterns of inundation and oxygen availability) to closely resemble and function like salt marsh formed naturally nearby at the base of the BC Ferries causeway (Envirowest Consultants Inc. 2015)

The productivity and functionality of the project over the intervening 22 years is not discussed, and was likely less than predicted. As this is a compensation works, the impact on net productivity during the period of time prior to successful establishment is important.

Project 2 – Inter-causeway South Marsh – This project represents the most recent and nearby compensation works the VFPA has constructed ad included fish sampling over multiple years. Despite this being a recent project, which could build on decades of past experience, the project has mostly been a failure to date.

In 2010, as part of the east causeway habitat compensation for DP3, the VFPA constructed four lagoon marshes (behind barrier islands) and five open marsh benches along the south shoreline of the Roberts Bank causeway (see Figure IR7-28-1) to satisfy the requirements of the project's

DFO Fisheries Act Authorization (these compensation works are referenced in the context to this information request).

Establishment of marsh vegetation was poor in three of four lagoon marshes and in two of five open marsh benches; pickleweed was most frequently recorded (Archipelago and Williams 2016). Overall, constructed lagoon marshes and open marsh benches were determined to not function as intended (Archipelago and Williams 2016).

Not surprisingly this also failed in terms of increasing juvenile salmon abundance, and VFPA states: *"Juvenile chum and Chinook salmon were caught during each year of postconstruction sampling (i.e., 2011, 2012, 2015) in every constructed habitat type (i.e., open marsh bench, sand/silt, gravel/sand), and fish presence was similar to references sites (Archipelago and Williams 2016). Based on these results, Archipelago and Williams (2016) "concluded that, as juvenile chum and Chinook salmon have consistently been present in the inter-causeway area since the late 1970s, the DP3 habitat compensation area continues to provide habitat for outmigrating juvenile salmon"*

Based on these results, Archipelago and Williams (2016) found no significant increase in juvenile salmon use of the restored areas post construction, demonstrating the ineffectiveness of their approach.

Following six growing seasons of failure, further remediation and planting was conducted:

"Three months after planting in May 2017, the VFPA conducted a salt marsh assessment, which revealed that vegetation establishment was generally good. Plug survival exceeded 80% at five out of eight remedial locations, while at the remaining three locations, plug survival ranged from 50% to 70% (Golder Associates 2018)."

"Effectiveness of remedial habitat creation cannot be determined yet as long-term effectiveness monitoring is scheduled to begin in September 2018."

Thus, following seven years of underwhelming performance by their largest compensation to date, the VFPA has still yet to provide evidence that they are able to successfully complete compensation projects which meet their desired goals. This is critically important considering the currently declining status of Fraser Chinook populations, reduced productivity for any given period of time such as the 7 years which have elapsed here could lead to impacts on vulnerable populations.

Furthermore, lessons learned from these projects may not be informative for RBT2 compensation projects, as VFPA states in their response:

"The south side of the Roberts Bank causeway is primarily exposed to southerly and southeasterly winds in winter that generate the largest offshore waves; in contrast, extreme wind and wave conditions on the north side of the Roberts Bank causeway, where intertidal marsh creation is proposed for RBT2, are less intense and much less frequent (see EIS Appendix 9.5-A).

These projects demonstrate the VFPA's technical capability to undertake large-scale transplantation projects as well as commitment to long-term monitoring that allows for adaptive management and early remedial action if required to ensure transplant success.

In my opinion the Deltaport Third berth projects clearly demonstrate the limited success with which VFPAs habitat compensation projects have reached. Considering there is a significant difference between these habitats it seems likely that new challenges which will arise which will continue to limit the effectiveness of there habitat creation efforts.

In terms of compensating for time lags associated with habitat compensation VFPA states in their response to IR7-27:

"As a fundamental principle used in the development of the final Offsetting Plan during permitting, the VFPA will make all reasonable efforts to avoid and minimise time tags between the potential impacts and the functioning of the offsetting measures. The quantification of any remaining losses of fisheries productivity will be performed as an inherent component of the Offsetting Plan with provision for offsetting these losses."

Considering the current importance of juvenile Chinook salmon as prey items later in life for the SRKW, lost productivity in one out-migration cohort can unlikely be compensated for by increased productivity in future years due to further compensation actions.

2.3. Potential for the Project to exacerbate existing problems in the estuary and result in any cumulative adverse effects on salmon or salmon habitat.

The project will further exacerbate existing problems in the estuary and will result in additional cumulative adverse effects to an ecosystem which already faces a high degree of cumulative effects on salmon habitat. The project combined with the existing Deltaport causeway and terminal will further reduce ecosystem connectivity in the estuary and further disrupt juvenile salmon migration pathways. Migration pathways for juvenile salmon are already highly altered by multiple structures including the current Deltaport causeway and terminal and BC Ferries causeway at Roberts Bank, as well as the Steveston North Jetty, Iona Jetty, North Arm Jetty and Iona Causeway on Sturgeon Bank and Sea Island.

As the project is likely to result in adverse effects on juvenile Chinook, an assessment of cumulative effects should be conducted. Even though the EIS fails to accurately describe existing conditions experienced by juvenile Chinook in the assessment area, and fails to conduct a cumulative effects assessment, the EIS assumes the potential effects on juvenile Chinook to be negligible after mitigation. However, the EIS guidelines Section 12.1.1 Residual Environmental Effects (p. 31) states that:

> "*The residual effects, even if very small or deemed insignificant, will be described*."

Without an adequate assessment of project or cumulative effects, the effect of the project nor the potential effectiveness of mitigation cannot be quantified and are thus functionally unknown. The lack of a cumulative effect's assessment fails to provide the panel with sufficient information to properly evaluate the potential project effects in the context of the many other activities which adversely affect juvenile Chinook in the assessment area.

The proponent was directed to address cumulative effects on juvenile Chinook in the Regional Assessment Area, which is outlined as Hope to the estuary, with attention to be paid to the Cohen Commission Final Report (EIS Guidelines 12.2.1 Cumulative Effects Assessment p. 32). EISG 12.2.1 Cumulative Effects Assessment states that:

i) *This narrative discussion should include historical data, where available and applicable, to assist interested parties to understand the potential effects of the project and how they may be addressed.*

ii) *The EIS will describe the analysis of the total cumulative effect on a VC over the life of the project, including the incremental contribution of all current and proposed physical activities, in addition to that of the project. The EIS will include different forms of effects (e.g. synergistic, additive, induced, spatial or temporal) and identify impact pathways and trends.*

Despite this, the proponent has failed to describe previous cumulative effects on salmon and their habitats in the Lower Fraser. Cumulative effects to the Lower Fraser and estuary include, but are not limited to, the loss/alienation of at least 70% of floodplain and 70% of estuarine habitats which are now diked or armoured and converted to human uses, an array of pollutants discharged from sewage treatment plants and industrial activities, drastic recession of marsh across Sturgeon Bank, and trifurcation schemes with numerous jetties in the estuary, including the existing Roberts Bank Terminal causeway, which have altered the flow of water and sediment in the estuary, changing salinity gradients and the ability of juvenile salmon and other fishes to move throughout the estuary. These are only some of the cumulative changes to the Regional Assessment Area which the proponent failed to adequately represent. A full evaluation should be requested for the panel to be able to accurately understand the potential for significant cumulative effects on juvenile Chinook in the RAA.

2.4. Options for avoiding or mitigating the direct or cumulative effects of the Project on salmon or salmon habitat and the viability and the effectiveness of those options.

The options for avoiding the direct effect of the project on juvenile salmon and their habitats is limited due to the nature of the impacts. In my opinion the creation of habitat offsetting projects in other areas of the estuary, regardless of there success, will not directly compensate for the increased migration disruption at Roberts Bank. As previously discussed, the proponent has a dismal track record regarding the successful establishment of there compensation projects. Therefore, in my opinion the proposed mitigation works are limited both in their viability and effectiveness for compensating for direct and cumulative effects of the project on juvenile Chinook.

Viable options for avoiding the direct impact of migration disruption are limited but would involve allowing for the passage of juvenile salmon without the interruption created by the additional footprint of Terminal 2 and would ideally also compensate for the ongoing interruption created by the existing causeway and terminal. Passage for juvenile salmon could be allowed by creating openings in the causeway through the installation of a series of culverts or bridges to allow the movement of water and fish. In 2005, Northwest Hydraulic Consultants prepared a report analyzing the effectiveness of creating a 1m or 4m culvert opening in the causeway and found that they would have limited success (CEA Agency Registry Document #539). The choice to model such a small opening is perplexing as they undoubtedly would have little impact on a causeway which is over 3.5 km in length. Currently Fisheries and Oceans Canada has been working with Raincoast Conservation Foundation to address the presence of other barriers to juvenile salmon movement in the Fraser estuary through the Coastal Restoration Fund. Early in March 2019 three 50-meter-wide breaches were created in the Steveston North Jetty to allow for the passage of juvenile salmon following hydraulic modelling work which had demonstrated its potential effectiveness. In future years, projects being pursued include a breach of the McDonald Slough causeway with a minimum channel width of 9 meters for a causeway less than 1 km in length, and a 75-meter-wide breach of the North Arm jetty. These are the scale of breaches which should be investigated and which would have the potential to mitigate for the ongoing and cumulative impacts of the Deltaport causeway and terminal on juvenile chinook movement at Roberts Bank. The current investment by Fisheries and Oceans Canada in addressing barriers to juvenile salmon passage in the Fraser estuary demonstrates the importance of this issues and in the shared concern for the impacts of barriers such as these to juvenile salmon movement. Therefore, in my opinion the only viable option for mitigating these impacts is clearly the creation of significant breaches in the existing and expanded causeway.

3. Relationship with a party to this Hearing that might affect my duty to be objective and impartial.

3.1. Relationship with the Proponent, or with any federal government department participating in the Hearing, such as Fisheries and Oceans Canada prior to agreeing to give an expert report in this regulatory proceeding.

Prior to agreeing to give an expert report in this proceeding I had no relationship with the proponent or Fisheries and Oceans Canada. However in the time since the review began I have developed a positive working relationship with the Proponent's Habitat Enhancement Program team in relation to Raincoast's own restoration activities in the Fraser estuary. I have also developed a collaborative working relationship with Fisheries and Oceans Canada through our Coastal Restoration Fund project.

3.2. Relationship with the Organization, or with David Suzuki Foundation, Wilderness Committee, or Georgia Strait Alliance prior to agreeing to give an expert report in this regulatory proceeding.

Prior to agreeing to give an expert report in this proceeding I had previously been retained on contract by the Raincoast Conservation Foundation to provide written evidence for the National Energy Board joint review of the Trans Mountain Expansion project with a focus on potential risk to juvenile salmon in the Lower Fraser River and estuary. In 2016, as a contract employee with Raincoast, I lead the beginning of a juvenile salmon research project in the Fraser estuary which is now in its fourth consecutive season. I continued to work with Raincoast on a full-time basis from 2016 until fall 2018 when I began my doctoral program in the Faculty of Forestry at the University of British Columbia. I continue to work with Raincoast on a part time basis helping to coordinate our Fraser estuary restoration project under the Fisheries and Oceans Canada Coastal Restoration Fund. My relationship with Raincoast in no way affects my ability to be impartial and objective in my review of the available scientific information in my opinion.

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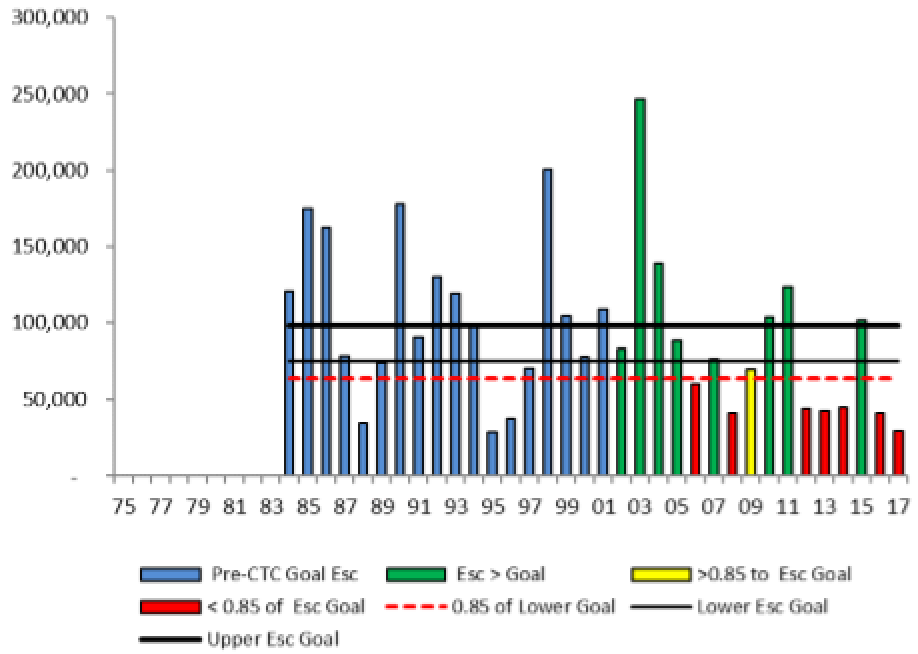

Figure 2.33.–Harrison River escapements of Chinook salmon, 1984–2017.

Figure 1. Harrison River escapements of Chinook salmon, 1984-2017, taken from the 2017 Pacific Salmon Commission Chinook Technical Committee report.

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Academic Background

Doctor of Philosophy in Forestry **Sept 2018 - present**

- Current student in the Pacific Salmon Ecology and Conservation Lab under Dr. Scott Hinch studying juvenile Chinook use of the Fraser estuary including outmigration timing, habitat preferences, physiological adaptation to saline water, and evaluating restoration effectiveness.

Masters of Resource Management: Simon Fraser University, Burnaby, BC Sept 2012 – Dec 2014

- Master's Research Project – Supervisor Dr. Jonathan W. Moore: *Flood mitigation structures transform tidal creeks from nurseries for native fish to non-native hotspots.* **GPA 3.97/4.33**

Bachelor of Science Honours: University of Regina, Regina, SK Sept 2006 – Oct 2010

- Honours Thesis – Supervisor Dr. Bjoern Wissel: *Quantifying Productivity and Respiration in a Urea Fertilization Experiment using O2 and CO2 Stable Isotopes.* **GPA 82.68/100**

Publications

Warkentin, L., Favaro, C., **Scott, D.**, Seifert, R., and Moore, J. W. 2018. Urban planning for fishes: untangling a new project's effects from old infrastructure and regional patterns. Canadian Journal of Fisheries and Aquatic Sciences, 999: 1-12.

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Work Experience

Biologist: Raincoast Conservation Foundation February 2015 – Present

- **Fraser Estuary Juvenile Salmon Research Project**: Raincoast has been conducting a field research program over the past two years in partnership with the Baum Lab from the University of Victoria to investigate juvenile Chinook salmon habitat preferences in the Fraser estuary. I have been responsible for leading or co-leading all aspects of the projects including our successful grant application to the Salish Sea Marine Survival Project in 2016, planning the field project including applying for permits, choosing and purchasing sampling equipment and determining field sites and methods. I have also been directly responsible for leading all data collection including organizing field crew and volunteers and conducting field research activities.

- **CEAA Review Roberts Bank Terminal 2**: Working on behalf of Raincoast, I am assisting Ecojustice in their participation in the CEAA review of this project. Working independently I produced a submission on the completeness of the Marine Shipping Addendum, a submission on the Sufficiency and Technical Merit of the Marine Shipping Addendum, and a submission on the Sufficiency and Technical Merit of the Environment Impact Statement, all as it pertains to potential effects on juvenile Chinook.
- **Lower Fraser River Salmon Habitat Outreach**: Over the past two years Raincoast has been working with conservation groups, First Nations, and other stakeholders towards creating a "Vision for Salmon Habitat" in the Lower Fraser. Working towards this goal I have been reaching out to and meeting with groups and individuals throughout the Lower Fraser Region; groups range from large and small ENGO's to stream keepers groups to First Nations to local governments and to concerned citizens. I have also drafted a report on the current state of salmon habitat in the Lower Fraser to support this initiative. To date, we have held the first in a series of workshops which I helped organize and facilitate. This successfully brought together members of the Kwantlen and Kwikwetlm First Nations along with other streamkeeper groups and local government representatives to work towards a collective vision.
- **NEB Review Trans Mountain Pipeline Expansion**: I worked with Toxicologist Kate Logan to co-produce a report submitted to the National Energy Board on the potential effects of a Trans Mountain pipeline rupture or tanker spill on salmon in the Lower Fraser River.

Nutrient Restoration Technician: British Columbia Conservation Foundation Sept – Oct 2014

- **Field Research**: Assisted B.C. Ministry of Environment staff with field work on nutrient restoration projects in Alouette and Wahleach Reservoirs. Duties included conducting stream spawner surveys of kokanee salmon including leading group of BCIT students, setting and retrieving gill nets, and identifying and processing freshwater fish including sexing and removing otoliths of salmonids.
- **Manuscript Preparation**: Lead collaboration with B.C. Ministry of Environment staff to produce a now published manuscript on the effect of their management efforts on nutrient dynamics in Alouette Lake. I lead all aspects of manuscript preparation including analysis, writing, submission and the review process.

University Research Experience

Masters Research: Simon Fraser University, Burnaby, B.C. Sept 2012 – Dec 2014

- **Masters Project**: Led field research project – designed and managed research project and crew consisting of two research and volunteer assistants; captured fish at field sites, tidal creeks and sloughs located throughout the lower Fraser Valley; identified freshwater fish species and juvenile salmon. Analysis – gained experience working with R software package to present and analyze data using various techniques. Research – gained experience in compiling primary literature and scientific writing while completing thesis and drafting manuscript for publication.
- **Snakehead Fish Project**: Worked with a team of researchers including a government scientist and geneticist to investigate the occurrence of a non-native snakehead fish discovered in a local pond. My duties including stable isotope analysis, working with Dr. Jon Moore on applying stable isotope tissue turnover model, writing manuscript and incorporating collaborators efforts and reviewers comments into now published manuscript. Worked with SFU Information Officer to draft press release, lead to >10 newspaper articles including Vancouver Sun, and recent CBC TV interview.

Research Assistant: Simon Fraser University, Burnaby, B.C. July 2012 – July 2014

- Lower Mainland Urban Stream Monitoring project: Assisted MSc Candidate Corinna Lichota in 2012 and 2013, and led research project in 2014. Collected physical data on streams and captured fish in small urban streams throughout the Lower Mainland using Backpack Electrofishing technique. Gained experience identifying freshwater fish and conducting stream research.

Research Assistant: University of Regina, Regina, S.K. Mar 2008 – Apr 2010

- Conducted field sampling of lakes throughout southern Saskatchewan under supervision of Dr. Bjoern Wissel. Duties included identification, enumeration and preparation for stable isotope analysis of zooplankton samples, preparation of various other types of samples for water chemistry and stable isotope analysis, and preparation of equipment for field season. Collected water chemistry data and water samples from lakes throughout southern Saskatchewan. Interpreted results from isotope analysis including using model to determine productivity to respiration ratios from dissolved oxygen saturations and isotope values.

Presentations

Scott, D., Chalifour, L., MacDuffee, M., and Baum, J. 2019. Variation in out-migration timing and estuary reliance of "ocean-type" Chinook salmon in the Fraser River estuary, BC. Pacific Ecology and Evolution Conference. Bamfield, British Columbia, February 2019.

Chalifour, L., **Scott, D.,** MacDuffee, M., and Baum, J. 2018. Juvenile Chinook salmon *(Oncorhynchus tshawytscha*) residency and early growth in the lower Fraser River estuary. Salish Sea Ecosystem Conference. Vancouver, B.C.

Scott, D., Chalifour, L., MacDuffee, M., and Baum, J. 2018. Characterizing juvenile Chinook salmon outmigration timing, size and population origin in the Fraser River estuary. Salish Sea Ecosystem Conference. Vancouver, B.C.

Scott, D. 2016. Flood control structures in tidal creeks associated with reduction in nursery potential for native fishes and creation of hot-spots for invasive species. Salish Sea Ecosystem Conference. Vancouver, B.C.

Scott, D. 2014. Impacts of small scale flood proofing barriers on fish communities in tidal creeks. Eco Evo Retreat. Brackendale, B.C., November 2014.

Hebert, A. S., **Scott, D.**, Harris, S., Weir, T. 2014. A Multi-Step approach To Restoring Anadromy in Alouette Reservoir (British Columbia): Understanding Nutrient Fluxes of Our Management Activities. Joint Aquatic Sciences Meeting. Portland, Oregon, May 2014.

Scott, D. 2014. Altering Connectivity in Tidal Creeks: Impacts of flood proofing on fish communities in Lower Fraser streams. Pacific Ecology and Evolution Conference. Bamfield, B.C., March 2014.

Scott, D. 2014. Altering Connectivity in Tidal Creeks: Impacts of flood proofing on fish communities in Lower Fraser streams. Inter-Departmental Ecology of Aquatic Systems. Simon Fraser University, Burnaby, British Columbia, January 2014.

Scott, D. 2013. Invasive Species CSI: The Case of the Snakehead. Pacific Ecology and Evolution Conference. Bamfield, British Columbia, March 2013.

Scott, D. 2013. Snakehead CSI. Inter-Departmental Ecology of Aquatic Systems. Simon Fraser University, Burnaby, British Columbia, January 2013.

Scott, D., Quiñones-Rivera, Z., Bogard, M., Leavitt, P.R., Wissel, B. 2010 Quantifying Productivity and Respiration in a Urea Fertilization Experiment using O2 and CO2 Stable Isotopes. Canadian Conference For Fisheries Research. Winnipeg, Manitoba, January 2010.

Awards

- national Science ad Engineering Research Council CGS – D Award, **2018**
- University of British Columbia Graduate Fellowship (Doctorate), **2018**
- Best Talk Award – Ecology and Evolution retreat, Brackendale, B.C. **2014**
- Coastal Zone Canada (BC) Association Graduate Fellowship in Coastal Studies. **2013**
- Simon Fraser University Graduate Fellowship (Masters), **2012**
- University of Regina Academic Silver Scholarship, **2009, 2008**
- University of Regina Wildlife Awareness Prize in Biology, **2009**
- NSERC-Undergraduate Student Research Award, **2009**

Teaching Experience

TA for Marine Invertebrate Zoology: Bamfield Marine Sciences Center, B.C. Summer 2014

- Coordinated field trips and field gear, operated various boats in marine environments, and assisted students with independent research projects.

TA for Ecology and Conservation of Coastal BC: SFU, Burnaby, B.C. Spring 2014

- Led tutorials which included coordinating paper discussions, field outings and marking assignments.

TA for REM 698: Simon Fraser University, Burnaby, B.C. Summer 2013 / 2014

- Twice planned and led four-day field trip, around B.C. for 25 new graduate students in the Resource and Environmental Management Program.

Supplemental Instructor: University of Regina, Regina, S.K. Fall 2009 – Winter 2010

- Duties included attending class, preparing material for and running three weekly study sessions for students as well as midterm and final review sessions for Biology and Statistics 100 courses.

Volunteer Experience

President – Still Creek Streamkeepers **2017 – present**

- Worked with a local stewardship group to start a streamkeepers group which carries out activities such as spawner surveys, water quality testing, and garbage cleanups, and meets monthly.

Chair of the PEEC Organizing Committee: Bamfield Marine Sciences Center, B.C. 2013 / 2014

- Gained experience working with a team to organize the Pacific Evolution and Ecology Conference.

Lab Assistant: Simon Fraser University, Burnaby, B.C. Jan. 2012 – Apr. 2012

- Volunteered with Dr. Anne Salomon's Coastal Marine Ecology and Conservation lab preparing various tissue samples for stable isotope analysis.

Certifications

- **Backpack Electrofishing Crew Supervisor – Vancouver Island University** July 2012
- **Marine Basic First Aid Certificate** April 2014
- **Boat Operation**
    - Small Vessel Operator Proficiency – **2014**
    - Restricted Operator Certificate – Marine – DSC – **2014**
    - Med A3 – Small Non-Pleasure Vessel Basic Safety – **2011**
    - Pleasure Craft Operator Card – **2003**
- **SCUBA**
    - PADI Advanced Open Water Diver Certification – **2011**

Fisheries and Oceans Canada Pêches et Océans Canada
Ecosystems and Oceans Science Sciences des écosystèmes et des océans

Pacific Region

Canadian Science Advisory Secretariat
Science Advisory Report 2016/042

INTEGRATED BIOLOGICAL STATUS OF SOUTHERN BRITISH COLUMBIA CHINOOK SALMON (*ONCORHYNCHUS TSHAWYTSCHA*) UNDER THE WILD SALMON POLICY

Chinook Salmon adult spawning phase. (Photo credit: Fisheries and Oceans Canada.)

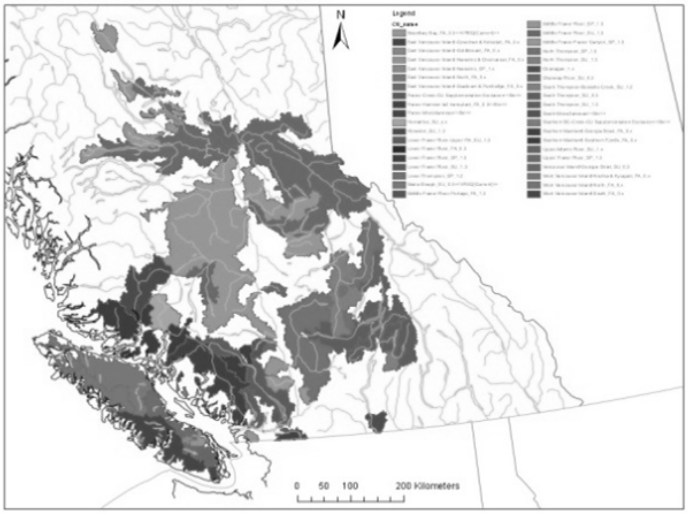

Figure 1. Map of southern BC showing the Chinook Conservation Units.

Context:

Canada's Wild Salmon Policy's (WSP) identifies six strategies for implementation. Strategy 1 is "Standardized monitoring of wild salmon status" and requires biological status assessments for all Pacific salmon conservation units (CUs). To conduct WSP status assessments, a toolkit comprised of a number of classes of indicators and metrics for status evaluation was completed in 2009. However, since a number of metrics can be used to evaluate biological status, it is possible that each metric can indicate a different status (Red, Amber, or Green). Therefore, status integration, which includes synthesis of CU status information across metrics into one or more status zones, and the provision of expert commentaries on the information used to assess status, is a useful final step in the status designation process. This report presents the application of WSP status integration conducted in a CSAS workshop. This workshop builds upon a previous application of WSP status integration techniques conducted for Fraser Sockeye CUs.

This Science Advisory Report is from the February 4-6, 2014 Assessment of Southern British Columbia Chinook Salmon Conservation Units, Benchmarks and Status. Additional publications from this meeting will be posted on the [Fisheries and Oceans Canada (DFO) Science Advisory Schedule](#) as they become available.

August 2016

SUMMARY

- A workshop entitled “Assessment of Southern British Columbia Chinook Salmon Conservation Units, Benchmarks and Status” was conducted to determine an integrated Wild Salmon Policy (WSP) status for each of the 35 southern BC Chinook Salmon Conservation Units (CU). The status integration method used was similar to that applied to Fraser Sockeye (Grant & Pestal 2013). A characteristic of southern BC Chinook Salmon CUs that is distinct from the Sockeye Salmon CUs assessed so far is the significant presence of hatchery-origin fish in addition to wild-origin fish in many of the CU area/watersheds.
- For this workshop, multi-page standardized data summaries were produced for each southern BC Chinook Salmon CU. The data used to generate these summaries had been previously reviewed through two Regional Peer Review processes.
- Participants were asked to determine a single WSP status zone from Red (poor status) to Amber (cautious status) to Green (healthy status) for the CU based on a combination of the information from the individual status metrics.
- Status evaluations were completed and consensus reached on an integrated WSP status designation for 15 of the 35 CUs. Of these, 11 were assigned a Red status, one was assigned a Red/Amber status, one was assigned an Amber status and two were assigned a Green status. For another nine of the 35 CUs, an integrated status evaluation was not possible based on the information presented at the workshop. For these CUs, the status designation is “data deficient” and this designation is not expected to change until more information becomes available. For the remaining 11 of the 35 CUs, status evaluations were not completed. Instead, the status of these CUs was classified as “to be determined”. These CUs are a component of units where the enhanced sites are predominant; consensus was not reached on how to derive a WSP status assessment for such units.
- In addition to providing final integrated status for each CU, the expert interpretation of the data summaries was documented in status commentaries. These commentaries provide the details underlying the final integrated status decisions. Status zones on their own do not provide an indication of which factors drive their designation, which would influence subsequent WSP strategies. The commentaries are an important source of information to inform management considerations.
- The designation of seven Fraser River CUs as Red and two others with a status of Amber is especially noteworthy. A review of all Chinook populations in BC carried out more than 30 years ago found compelling evidence of substantial declines in abundance in all geographic regions, except within the Fraser River watershed. The last 12 to 15 years have been a period during which most groups of Chinook within the Fraser River have declined in numbers, and the outlook for Chinook outside of the Fraser River has generally not shown sustained improvement since the earlier review.
- Integrated WSP status designations could not be developed for 20 of the 35 southern BC Chinook CUs based on the information and methods available to the workshop participants, which is very concerning. This highlights the need for additional work relating to information collection and assembly and for the development of a suitable method for status assessment when there is a significant contribution to recruitment and spawner abundance from enhanced sites.
- A proposal on the frequency of status re-assessments was agreed to: DFO staff should recalculate the individual status metrics annually, update the standardized data summaries,

and check for any substantial changes. If results from individual metrics indicate a change that could affect the overall status for the CU, a meeting would be convened to address the affected CUs only. A full re-assessment of all CUs would take place every four years.

INTRODUCTION

The goal of the Wild Salmon Policy (WSP) is to “restore and maintain healthy salmon populations and their habitats for the benefit and enjoyment of the people of Canada in perpetuity” (DFO 2005). In order to achieve this goal, the WSP outlines a number of strategies, including Strategy 1 (Standardized Monitoring of Wild Salmon Status), which is the subject of this Science Advisory Report (SAR). Action Steps for Strategy 1 include:

1. identification of CUs;
2. development of criteria to assess CUs and identification of benchmarks to represent biological status; and,
3. monitoring and assessment of CU status.

Work on these action steps has progressed since the WSP was published in 2005, with the following peer-reviewed milestones:

- method for the identification of Pacific salmon CUs (Holtby & Ciruna 2007);
- method for the assessment of Pacific salmon biological status under the WSP (Holt *et al.* 2009);
- technical background for WSP status assessments (Holt 2009; Porszt 2009; Holt 2010; Holt & Bradford 2011; Porszt *et al.* 2012);
- integration techniques for WSP status assessments of salmon CUs (Grant & Pestal 2013);
- revision of southern BC Chinook Conservation Unit assignments (DFO 2013).

Four classes of indicators have been recommended to evaluate WSP status of wild Pacific salmon: abundance, trends in abundance, distribution, and fishing mortality (Holt *et al.* 2009). Within each class of indicator, one or more metrics can be used for status assessments, and, for each metric, a lower benchmark and upper benchmark delineate the Red to Amber and Amber to Green status zones, respectively (Table 1). These biological benchmarks are specifically used for status assessments, and are not prescriptive for specific management actions. They are also designed to be more conservative than the criteria established by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), as required by the WSP.

Table 1. The three zones of biological status defined in the WSP (Grant & Pestal 2013).

Status	Definition
Red	“… established at a level of abundance high enough to ensure there is a substantial buffer between it and any level of abundance that could lead to a CU being considered at risk of extinction by COSEWIC”
Amber	“While a CU in the Amber zone should be at low risk of loss, there will be a degree of lost production. Still, this situation may result when CUs share risk factors with other, more productive units”
Green	“identif[ies] whether harvests are greater than the level expected to provide on an average annual basis, the maximum annual catch for a CU, given existing conditions…there would not be a high probability of losing the CU”

Since CU status evaluations can include more than one metric, it is possible that different metrics could each indicate a different WSP status zone from Red (poor status) to Green (healthy status). For example, the WSP recent trend in abundance metric could suggest a CU's status is poor, while conversely, the long-term trend metric could indicate the same CU's status is healthy. In cases where metric information is contradictory, provision of this metric-specific status information alone does not provide complete scientific advice to fisheries management. Instead, a final step that synthesizes all metric and status-related information into an integrated status for each CU, and provides expert commentary on this information, is necessary as inputs into subsequent implementation of WSP Strategy 4 (Integrated Strategic Planning) to prioritize assessment activities and management actions (Table 2. Guidance in the WSP on assessment actions and management considerations for CUs in each of three status zones (Grant & Pestal 2013).Table 2).

Table 2. Guidance in the WSP on assessment actions and management considerations for CUs in each of three status zones (Grant & Pestal 2013).

Status	**Assessment Actions**	**Management Considerations**
Red	"… a detailed analytical assessment will normally be triggered to examine impacts on the CU of fishing, habitat degradation, and other human factors, and evaluate restoration potential", "… detailed stock assessments will identify the reasons for the change in status". "CUs in the Red zone … will be identified as management priorities … the protection and restoration of these CUs will be primary drivers for harvest, habitat, and enhancement planning."	"Biological considerations will be the primary driver for the management of CUs with Red status". "The presence of a CU in the Red zone will initiate immediate consideration of ways to protect the fish, increase their abundance, and reduce the potential risk of loss".
Amber	"… a detailed analytical assessment may be required to input into Strategies 2 & 3.."	"Decisions about the conservation of CUs in the Amber zone will involve broader considerations of biological, social, and economic issues"; "involves a comparison of the benefits from restoring production versus the costs arising from limitations imposed on the use of other CUs to achieve that restoration"; "implies caution in the management of the CU"
Green	" a detailed analytical assessment of its biological status will not usually be needed"	"Social and economic considerations will tend to be the primary drivers for the management of CUs in the green zone, though ecosystem or other non-consumptive values could also be considered".

For Pacific Salmon CUs, WSP biological status integration methods have previously been developed and applied to Sockeye Salmon assessments (Grant & Pestal 2013). However, a characteristic of southern BC Chinook Salmon CUs that is distinct from the Sockeye Salmon CUs assessed so far is that many areas support substantial numbers of hatchery-origin fish in addition to wild-origin fish. Therefore, the guidelines developed for Sockeye Salmon are only partially applicable to the southern BC Chinook Salmon situation. In order to explore the applicability of the status integration techniques developed previously, and to provide WSP status assessments, a CSAS workshop entitled “Assessment of Southern British Columbia Chinook Salmon Conservation Units, Benchmarks and Status” was conducted to achieve these goals. This SAR summarizes the results from this CSAS workshop.

The objectives of the workshop were to:

1. Determine an integrated WSP status for each southern BC Chinook Salmon CU;
2. Indicate the effect on the status assessments of including, or excluding, enhanced Chinook Salmon contributions;
3. Provide advice on data and methods required for assessing the status of any CUs that are currently data deficient;
4. Include information specific to each CU on fishing mortality, where possible;
5. Provide advice on the appropriate frequency of status re-assessment, changes to monitoring variables that could invoke early re-assessment, and the appropriate timing for assessment relative to data availability; and
6. Identify and recommend data management approaches required to support recommended changes to re-assessment of CUs.

ASSESSMENT

Data

For this workshop, multi-page standardized data summaries were produced for each southern BC Chinook Salmon CU. The data used to generate these summaries had been previously reviewed through two CSAS Regional Peer Review processes[1,2]. These data summaries included the following:

- time series plots of spawner abundances (either relative indices or absolute abundances, where available);
- a table of absolute abundances relative to COSEWIC criteria D1 for small populations;
- a summary of overall data quality (as a percentage of spawner abundance);
- a summary of the categorization of enhancement activity level by census site[3];

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[1] Brown, G.S., Baillie, S.J., Thiess, M.E., Bailey, R.E., Candy, J.R., Parken, C.K., and Willis, D.M. 2014. Pre-COSEWIC Review of Southern British Columbia Chinook Salmon (*Oncorhynchus tshawytscha*) Conservation Units: Part I, Background. CSAS Working Paper 2012/P62. In revision.

[2] Brown, G.S., Baillie, S.J., Bailey, R.E., Candy, J.R., Holt, C.A, Parken, C.K., Pestal, G.P., Thiess, M.E., and Willis, D.M. 2014. Pre-COSEWIC Review of Southern British Columbia Chinook Salmon (*Oncorhynchus tshawytscha*) Conservation Units, Part II: Data, Analysis and Synthesis. CSAS Working Paper 2012/13 P23. In revision.

[3] The concepts of a “Total Unit” (TU) and an Enhancement Unit (EU) were introduced at the workshop. A Total Unit can be comprised of two components: the CU and an associated EU. The CU includes only census sites with low or unknown enhancement level activity in an attempt to be consistent with the WSP focus on ‘wild salmon’. The EU contains only census sites with moderate or high enhancement level activity. Although these concepts were introduced at the workshop, they were not endorsed by the participants and therefore are not considered to form a viable conceptual approach to this issue.

- a stacked bar plot illustrating the distribution of spawner abundance across sites within the CU;
- a whisker plot illustrating short term trends by census site within the CU;
- a table of spawner abundance by census site within the CU;
- status information for up to three WSP metrics: one metric for abundance relative to biological benchmarks, one metric for extent of decline in abundance, and two related metrics for short-term trend in abundance;
- where available, supplementary time series plots of natural log-transformed spawner abundance, generational average of spawner abundance, CWT indicator spawner abundance, total return, productivity (recruits/spawner by brood year), hatchery releases from within and outside the CU, exploitation rates and marine survival;
- retrospective (historical) time series of status for each WSP metric relative to established benchmarks (Holt *et al.* 2009).

Methods

Workshop participants were invited to attend based on their experience with different aspects of salmon assessment and included DFO staff from Science, Ecosystems Management and Fisheries Management sectors and external participants from First Nations organizations, the commercial and recreational fishing sectors, environmental non-governmental organizations, and academia. Participants were requested to join one of four pre-workshop seminars in order to review the data summary layout and to provide feedback to organizers on the workshop format. At the workshop, participants were assigned to one of six groups, each comprised of six or seven individuals. Their group assignment remained the same for the duration of the workshop. Individuals were assigned in order to provide a varied mix of views and expertise within each group.

Each of the 35 CUs (and their associated enhanced sites where applicable) was designated as an individual case study. The identity of the CU represented by a case study was not revealed to the participants during the initial assessment sessions. This “blind” approach was similar to that employed by Grant & Pestal (2013) during the Fraser Sockeye workshop. The 35 case studies were presented in seven sets over the first two days of the workshop. Participant groups were given 15 minutes, 30 minutes, one hour or 1.5 hours, depending on the set size and complexity, to discuss each set in a breakout session. At the end of each breakout session, back in a full participant plenary session, groups compared results and discussed their reasoning for their final integrated status designations. All of the 35 CUs were evaluated by at least some of the groups, and each group evaluated a representative number of CU types (different metrics and statuses). Late on the second day, the CU identity of each case study was revealed to the participants. The third day of the workshop was a full day of plenary discussion to reconcile group integrated status results allowing for use of knowledge of the identity of each CU.

Results

Final Integrated Status

By the end of the workshop, participants completed status evaluations and reached consensus on an integrated WSP status designation for 15 of the 35 CUs (Table 3 and Figure 2). The 15 southern BC Chinook CUs are ordered in Table 3 using their final integrated status, with CUs designated Red (poorest status) located at the top of the table to CUs designated Green (best status) at the bottom. Thirteen out of the 15 CUs were reconciled between groups in the post-reveal plenary session to a single WSP status zone. There was one CU where final integrated statuses included two status zones. The Lower Fraser River_FA_0.3 (CK-03) CU's integrated Green status was flagged as provisional by participants. Following the example of the Fraser Sockeye WSP status assessments (Grant & Pestal 2013), when some participants held divergent views, the status assignment was classified as "provisional". In this case, the short-term decline observed in recent years, despite decreasing exploitation rate, resulted in a provisional status designation to highlight the need for monitoring the trend.

For another nine of the 35 CUs, an integrated status evaluation was not possible based on the information presented at the workshop. For these CUs, the status designation is "data deficient" (DD). When preparing the data summaries, the workshop organizers identified five CUs as obviously data deficient (Table 3, Cases 31 to 35). The workshop participants supported this initial assessment and also designated an additional four CUs as data deficient. For all nine of these CUs, the status designation is not expected to change until more information is available.

South Thompson-Bessette Creek_SU_1.2 (CK-16) and Okanagan_1.x (CK-01) were designated as Red status. However, there was some concern expressed by the participants that the definition of these CUs might not be valid. The status of these CUs should be re-evaluated following a review of their CU definitions.

The remaining 11 of the 35 CUs (Table 4) presented a substantial challenge for the participants and ultimately, status evaluations could not be completed for them. Instead, the status of these CUs was classified as "to be determined" (TBD). These CUs are geographically proximate to predominantly enhanced sites, or data exist only for the enhanced sites geographically proximate to the CU (e.g. a CU may exist but no wild census sites have data of sufficient quality for assessment at this time). Consensus was not reached on how to derive a WSP status assessment for such combined wild and enhanced site units, or the CUs that spawn in the same area. A method to consider enhanced contribution by redefining the wild site versus enhanced site classification in the data summaries was proposed by the workshop organizers. However; there was consensus that a review of the proposed method was not within the scope of the workshop and should be the subject of a future review. Although there are no status evaluations provided for these 11 CUs, unlike the situation with the data deficient CUs, an integrated WSP status could be determined in some cases once a suitable method is developed to assess the status of enhanced sites and how they should be considered in status assessments of the CU.

Status Commentaries

In addition to documenting a final integrated status designation for each CU, the expert interpretation of the data summaries was recorded as status commentaries (Appendix B of the Research Document resulting from the workshop). These commentaries provide the details underlying the final integrated status decisions, which varied even amongst CUs with identical status designations. These details will be important when the results from Strategy 1 (Standardized Monitoring of Wild Salmon Status) are linked to Strategy 4 (Integrated Strategic Planning). Status zones on their own do not provide an indication of which factors drive their designation, which would influence subsequent WSP strategies. The commentaries are an important source of information to inform management considerations.

Table 3. Summary of completed integrated status evaluations for Southern BC Chinook Salmon CUs.

Integrated status evaluation completed at workshop

Integrated Status	Case #	CU ID	CU Name	Area
RED	1	CK-10	Middle Fraser River_SP_1.3	Fraser
RED	4	CK-18	North Thompson_SP_1.3	Fraser
RED	6	CK-19	North Thompson_SU_1.3	Fraser
RED	11	CK-09	Middle Fraser River-Portage_FA_1.3	Fraser
RED	24	CK-17	Lower Thompson_SP_1.2	Fraser
RED	25	CK-31	West Vancouver Island-South_FA_0.x	WCVI
RED	26	CK-12	Upper Fraser River_SP_1.3	Fraser
RED	29	CK-29	East Vancouver Island-North_FA_0.x	Inner SC
RED	30	CK-32	West Vancouver Island-Nootka & Kyuquot_FA_0.x	WCVI
RED*	3	CK-16	South Thompson-Bessette Creek_SU_1.2	Fraser
RED*	5	CK-01	Okanagan_1.x	Columbia
RED / AMBER	27	CK-14	South Thompson_SU_1.3	Fraser
AMBER	12	CK-11	Middle Fraser River_SU_1.3	Fraser
GREEN(p)	9	CK-03	Lower Fraser River_FA_0.3	Fraser
GREEN	2	CK-13	South Thompson_SU_0.3	Fraser

Integrated status evaluation not possible based on information presented at workshop

Integrated Status	Case #	CU ID	CU Name	Area
DD	7	CK-82	Upper Adams River_SU_x.x	Fraser
DD	8	CK-06	Lower Fraser River_SU_1.3	Fraser
DD	10	CK-05	Lower Fraser River-Upper Pitt_SU_1.3	Fraser
DD	28	CK-28	Southern Mainland-Southern Fjords_FA_0.x	Inner SC
DD	31	CK-08	Middle Fraser-Fraser Canyon_SP_1.3	Fraser
DD	32	CK-20	Southern Mainland-Georgia Strait_FA_0.x	Inner SC
DD	33	CK-34	Homathko_SU_x.x	Inner SC
DD	34	CK-23	East Vancouver Island-Nanaimo_SP_1.x	Inner SC
DD	35	CK-35	Klinaklini_SU_1.3	Inner SC

“(p)” means provisional, and identifies cases where some participants held divergent views.
“*” means that CU definition should be reviewed.

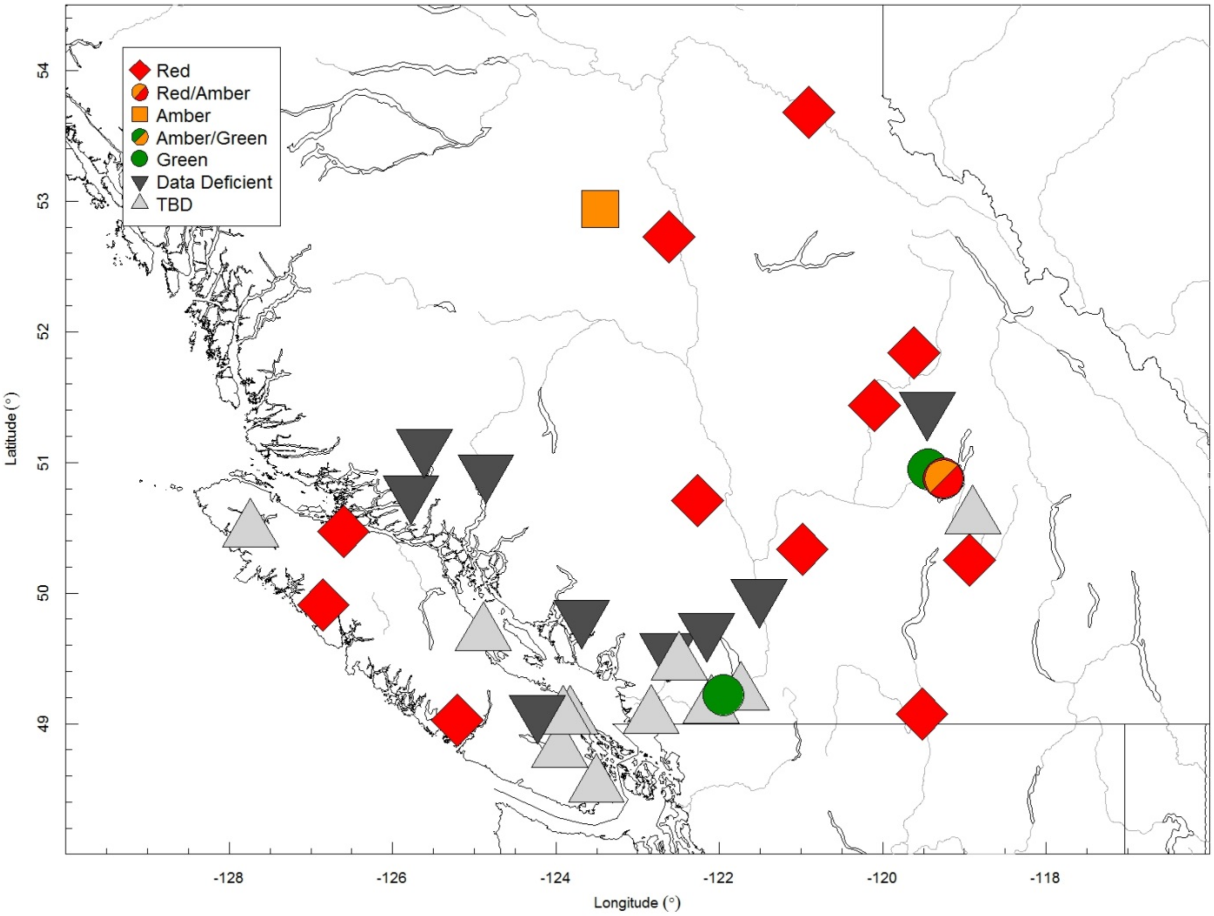

Figure 2. Map of southern BC summarizing workshop consensus on biological status of southern BC Chinook Salmon CUs.

Status Integration Approaches

The workshop organizers had prepared an initial set of guidelines for status integration (see Appendix E of the Proceedings resulting from the workshop). These guidelines were largely based on the recommendations in Grant and Pestal (2013). After the groups had completed several evaluations they reported that they were adopting patterns in their approach to status integration. Based on the feedback from participants, the guidelines were revised and are reported in Section 3 of the Research Document resulting from the workshop. In addition, the status deliberation notes and plenary discussions exposed some common themes to status integration approaches that were not explicitly endorsed as guidelines by the participants. These are also documented in Section 3 of the Research Document resulting from the workshop.

Table 4. Summary of incomplete integrated status evaluations for Southern BC Chinook Salmon CUs.

Integrated status evaluation not attempted at workshop due to unresolved methods

Integrated Status	Case #	CU ID	CU Name	Area
TBD**	13	CK-04	Lower Fraser River_SP_1.3	Fraser
TBD	14	CK-21	East Vancouver Island-Goldstream_FA_0.x	Inner SC
TBD	15	CK-33	West Vancouver Island-North_FA_0.x	WCVI
TBD	16	CK-22	East Vancouver Island-Cowichan & Koksilah_FA_0.x	Inner SC
TBD	17	CK-02	Boundary Bay_FA_0.3	Inner SC
TBD	18	CK-07	Maria Slough_SU_0.3	Fraser
TBD	19	CK-25	East Vancouver Island-Nanaimo & Chemainus_FA_0.x	Inner SC
TBD	20	CK-15	Shuswap River_SU_0.3	Fraser
TBD	21	CK-83	East Vancouver Island-Georgia Strait_SU_0.3	Inner SC
TBD	22	CK-27	East Vancouver Island-Qualicum & Puntledge_FA_0.x	Inner SC
TBD	23	CK-9008	Fraser-Harrison fall transplant_FA_0.3	Fraser

"**" means that CU status should be re-evaluated after review of enhancement level definition.

Sources of Uncertainty

- The standardized data summaries were prepared based on data that had been previously reviewed[1,2], however, these summaries are based largely on spawner data with a substantial but unquantified level of uncertainty.
- A period of apparent abundance increases occurred during the 1990s and early 2000s when major improvements were made in many BC escapement programs. These escapement estimation improvements typically resulted in immediate and noticeably higher annual estimates relative to earlier estimates. This suggests that apparent improvements in abundance could be related more to changes in survey and estimation methods than to genuine biological changes.
- Some of the abundance time series represent relative rather than absolute abundances. Relative abundances likely under-estimate true abundance (by unknown and variable amounts), so an indication of red zone status in relation to the WSP metric on absolute abundance may not be accurate.
- Some of the individual metrics display a pattern of changing status from one year to the next (e.g. red status one year followed by green status the next year and then returning to red). In this situation, the metric is not conveying meaningful results for determining integrated status and would typically be disregarded or given less weight in status deliberations.
- Information on the contribution of enhanced fish to the abundance of fish observed at "wild" sites is often limited; and as such, the actual wild contribution (which is key to the WSP CU definition) is often unknown. For the purposes of these status assessments, observations at wild sites are assumed to be comprised entirely of wild fish.
- The status evaluations developed at this workshop ultimately relied on the expert opinions of the participants and as such, are subject to the experience and opinions of the individuals involved. Because many of the evaluations are more subjective than objective, the

repeatability of these findings is uncertain. The status commentaries in Appendix B of the Research Document resulting from the workshop identify cases where participants were especially confident in their assessment, as well as cases where the status designations were particularly uncertain, which may be useful in developing approaches to quantifying this uncertainty in the future.

CONCLUSIONS AND ADVICE

Southern BC Chinook CUs Integrated Status

Integrated status designations were developed for 15 of the 35 southern BC Chinook CUs, and status commentaries were provided for all 35 CUs. In some cases, the commentaries provide more useful advice for management considerations than would be indicated by the mapping of the status zone to the management considerations in Table 2. These results address two of the six objectives for the workshop: “determine an integrated WSP status for each southern BC Chinook Salmon CU”, and “include information specific to each CU on fishing mortality, where possible”.

The majority of CUs for which an integrated status was developed occurred within the Fraser River watershed (11 of 15). This reflects the reduced prevalence of enhancement as a management intervention in that region. While seven of the Fraser River CUs were designated as Red, all four of the CUs that were assessed from other regions were also designated as Red. All adult and juvenile life history patterns known in southern BC Chinook are represented in the group of 11 Red status CUs. This suggests that declines in abundance shown by these CUs cover a broad geographic area and are not specific to any particular group of Chinook Salmon.

The designation of seven Fraser River CUs as Red and two others with a status of Amber is especially noteworthy. A review of all Chinook populations in BC carried out by Healey (1982) more than 30 years ago found compelling evidence of substantial declines in abundance in all geographic regions, except within the Fraser River watershed. Riddell *et al.* (2013) suggested that spawner abundances in most southern BC areas may have increased for a period in the 1990s and early 2000s. However, these apparent improvements in abundance could be related more to changes in survey and estimation methods than to genuine biological changes. Regardless of whether real abundance increases occurred in the 1990s, the last 12 to 15 years have been a period during which most groups of Chinook within the Fraser River have declined in numbers. The outlook for Chinook Salmon outside of the Fraser River has generally not shown sustained improvement since Healey’s (1982) review.

Recommendations

- Integrated status designations could not be developed for 20 of the 35 southern BC Chinook CUs based on the information and methods available to the workshop participants. This represents the majority of the southern BC Chinook CUs, or approximately 21% of the surveyed aggregate abundance, which is a concern. This highlights the need for additional work and relates to the objectives: “provide advice on data and methods required for assessing the status of any Conservation Units that are currently data deficient”, and “identify and recommend data management approaches required to support recommended changes to re-assessment of CUs”.
- In some cases, additional information relating to the data deficient CUs is in the possession of the Department, but has not yet been incorporated into the regional escapement data holdings where it would be accessible to analysts. If this information were incorporated, it is possible that some of the CUs would no longer be data deficient and status designations could be developed. This information includes escapement survey records held by local

offices in paper and electronic formats that have not been a priority for further analysis to date. The work necessary to locate and incorporate this information into the regional escapement data holdings could provide significant benefits for future status assessments.

- The workshop participants identified an issue where a Chinook population is known anecdotally to exist, but there are no escapement surveys recorded in the regional escapement data holdings. Examples of this are information from local traditional knowledge, data from non-DFO programs such as fish habitat surveys initiated for forestry purposes, and data from juvenile salmon surveys. Since the regional adult escapement data holdings provided the source information for initial CU definition, the absence of survey records meant that these populations were not included in the CU definitions. Thus it is possible that there are additional Chinook CUs yet to be defined. These would likely form additional CUs for the data deficient category. This issue could be addressed by incorporating the information on un-surveyed but known Chinook populations into the regional escapement data holdings as placeholder records.
- The amount of data filtered out due to data quality concerns prior to status assessments raises questions regarding the utility of temporally extensive, low-quality surveys and their role in the stock assessment program should be reviewed. If such data are not useful for status assessment, then they are of little value other than indicating fish presence which has proved useful only in identifying spawning sites for potential grouping within a CU.
- Aside from the data deficiency issue, the other issue which prevented integrated status designations relates to the workshop objective: "indicate the effect on the status assessments of including and excluding enhanced Chinook Salmon, where applicable". This was the only objective of the workshop that was not successfully addressed. The participants attempted to address this objective but the consensus was that given the methods and guidelines available to them, status designation was not possible for CUs that had a substantial contribution from enhanced sites. To resolve this issue for future assessments would require a specific project to develop a suitable method for status assessment for sites (or groups of sites) with significant enhancement contribution. In addition, guidance would need to be developed for considering the interaction between the CU and an associated enhanced contribution in the status assessment of the CU. The resulting proposed method and guidelines should then be subject to peer review. Once this work is complete, the southern BC Chinook CUs currently categorized with a status of To Be Determined should be re-assessed.

Status Integration Process

Again, similar to the approach taken for Fraser Sockeye Salmon CUs (Grant & Pestal 2013), expert opinion on status integration and associated commentaries were elicited through a combination of smaller breakout groups and full participant plenary sessions. The advantage of this approach was that it permitted independent small-group evaluation of a range of integration approaches and integrated status designations, which could then be consolidated in a plenary session with all participants. Although not highlighted in the results presented here, more often than not, the individual group results showed a similar status designation for a CU and the status reconciliation during the plenary session was rapid and not controversial. This provides some confidence that the integration process is more objective than subjective, and is repeatable.

Integration Guidelines

Now that two of these larger integration workshops have occurred, and a variety of CUs have been examined, it might be possible to prepare a more comprehensive set of integration guidelines for formal peer-review. Once accepted, these guidelines could allow for the completion of a preliminary status integration report for a collection of CUs by a small expert team. This report would then become the working paper to be reviewed via the more typical CSAS Regional Peer Review process. If this work were undertaken it would help to address the concern that the workshop format for WSP status assessment is onerous and is limiting the opportunity for status assessments.

Frequency of Re-Assessment

A key workshop objective was to "provide advice on the appropriate frequency of status re-assessment, changes in monitoring variables that could invoke early re-assessment, and appropriate timing for assessment relative to data availability". The following proposal on the frequency of status re-assessments was agreed on by participants in plenary session.

- DFO staff should recalculate the individual status metrics annually, update the standardized data summaries, and check for any substantial changes.
- A meeting would not be required to re-assess status of CUs unless results from individual metrics indicated a change that could affect the overall status for the CU.
- A shorter (and perhaps smaller) meeting would be convened to address the affected CUs only.
- A full re-assessment of all CUs would take place every four years (representing approximately once per generation for most Chinook CUs).
- Full re-assessment meetings would include representation from DFO and stakeholders, but could be shorter than the current workshop; the meeting could review a status assessment working paper, and could possibly be vetted through a CSAS Science Response process instead of a Regional Peer Review process.

SOURCES OF INFORMATION

This Science Advisory Report is from the February 4-6, 2014 Assessment of Southern British Columbia Chinook Salmon Conservation Units, Benchmarks and Status. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

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Aussi disponible en français :

MPO. 2016. État biologique intégré du saumon quinnat (oncorhynchus tshawytscha) du sud de la Colombie-Britannique en vertu de la politique concernant le saumon sauvage. Secr. can. de consult. sci. du MPO, Avis sci. 2016/042.

Summary of COSEWIC Wildlife Species Assessments, November 2018*

Wildlife species are sorted according to current status and then by common name.

Status	Common name (population)	Scientific name	Range of occurrence
Extirpated	Pygmy Short–horned Lizard	*Phrynosoma douglasii*	BC
Endangered	Brook Spike–primrose	*Epilobium torreyi*	BC
Endangered	Chinook Salmon (East Vancouver Island, Stream, Spring)	*Oncorhynchus tshawytscha*	BC Pacific_Ocean
Endangered	Chinook Salmon (Lower Fraser, Stream, Summer (Upper Pitt))	*Oncorhynchus tshawytscha*	BC Pacific_Ocean
Endangered	Chinook Salmon (Middle Fraser, Stream, Fall)	*Oncorhynchus tshawytscha*	BC Pacific_Ocean
Endangered	Chinook Salmon (Middle Fraser, Stream, Spring)	*Oncorhynchus tshawytscha*	BC Pacific_Ocean
Endangered	Chinook Salmon (North Thompson, Stream, Spring)	*Oncorhynchus tshawytscha*	BC Pacific_Ocean
Endangered	Chinook Salmon (North Thompson, Stream, Summer)	*Oncorhynchus tshawytscha*	BC Pacific_Ocean
Endangered	Chinook Salmon (South Thompson, Stream, Summer 1.2)	*Oncorhynchus tshawytscha*	BC Pacific_Ocean
Endangered	Chinook Salmon (Upper Fraser, Stream, Spring)	*Oncorhynchus tshawytscha*	BC Pacific_Ocean
Endangered	Hairy Valerian	*Valeriana edulis* ssp. *ciliata*	ON
Endangered	Nooksack Dace	*Rhinichthys cataractae*	BC
Endangered	Rainbow Smelt (Lake Utopia large–bodied population)	*Osmerus mordax*	NB
Endangered	Rainbow Smelt (Lake Utopia small–bodied population)	*Osmerus mordax*	NB
Endangered	Rapids Clubtail	*Phanogomphus quadricolor*	ON
Endangered	Ute Ladies'–tresses	*Spiranthes diluvialis*	BC
Threatened	Black Ash	*Fraxinus nigra*	MB ON QC NB PE NS NL
Threatened	Chinook Salmon (Lower Fraser, Ocean, Fall)	*Oncorhynchus tshawytscha*	BC Pacific_Ocean
Threatened	Chinook Salmon (Lower Fraser, Stream, Summer)	*Oncorhynchus tshawytscha*	BC Pacific_Ocean
Threatened	Chinook Salmon (Middle Fraser, Stream, Spring (MFR+GStr))	*Oncorhynchus tshawytscha*	BC Pacific_Ocean
Threatened	Chinook Salmon (Middle Fraser, Stream, Summer)	*Oncorhynchus tshawytscha*	BC Pacific_Ocean
Threatened	Lake Chub (Atlin Warm Springs populations)	*Couesius plumbeus*	BC
Threatened	Lake Chub (Liard Hot Springs populations)	*Couesius plumbeus*	BC
Threatened	Wood Turtle	*Glyptemys insculpta*	ON QC NB NS
Special Concern	American Bumble Bee	*Bombus pennsylvanicus*	ON QC
Special Concern	Chinook Salmon (Lower Fraser, Stream, Spring)	*Oncorhynchus tshawytscha*	BC Pacific_Ocean

Summary of COSEWIC Wildlife Species Assessments, November 2018*

Wildlife species are sorted according to current status and then by common name.

Status	Common name (population)	Scientific name	Range of occurrence
Special Concern	Greater Short–horned Lizard	*Phrynosoma hernandesi*	AB SK
Special Concern	Pale Yellow Dune Moth	*Copablepharon grandis*	AB SK MB
Special Concern	Polar Bear	*Ursus maritimus*	YT NT NU MB ON QC NL Arctic_Ocean
Special Concern	Pygmy Snaketail	*Ophiogomphus howei*	ON NB
Special Concern	Yellow Scarab Hunter Wasp	*Dielis pilipes*	BC
Special Concern	Yukon Draba	*Draba yukonensis*	YT
Not at Risk	Chinook Salmon (South Thompson, Ocean, Summer)	*Oncorhynchus tshawytscha*	BC Pacific_Ocean
Not at Risk	Roughhead Grenadier	*Macrourus berglax*	NU NB NS NL Arctic_Ocean Atlantic_Ocean
Data Deficient	Chinook Salmon (Southern Mainland, Ocean, Summer)	*Oncorhynchus tshawytscha*	BC Pacific_Ocean
Data Deficient	Chinook Salmon (Southern Mainland, Stream, Summer)	*Oncorhynchus tshawytscha*	BC Pacific_Ocean

*The assessments of Cryptic Paw Lichen (*Nephroma occultum*), White–rimmed Shingle Lichen (*Fuscopannaria leucosticta*), and Cobblestone Tiger Beetle (*Cicindela marginipennis*) were deferred. These wildlife species will be re-considered by COSEWIC at a later meeting.

PACIFIC SALMON COMMISSION
JOINT CHINOOK TECHNICAL COMMITTEE REPORT

ANNUAL REPORT OF CATCH AND ESCAPEMENT FOR 2017

REPORT TCCHINOOK (18)-02

July 19, 2018

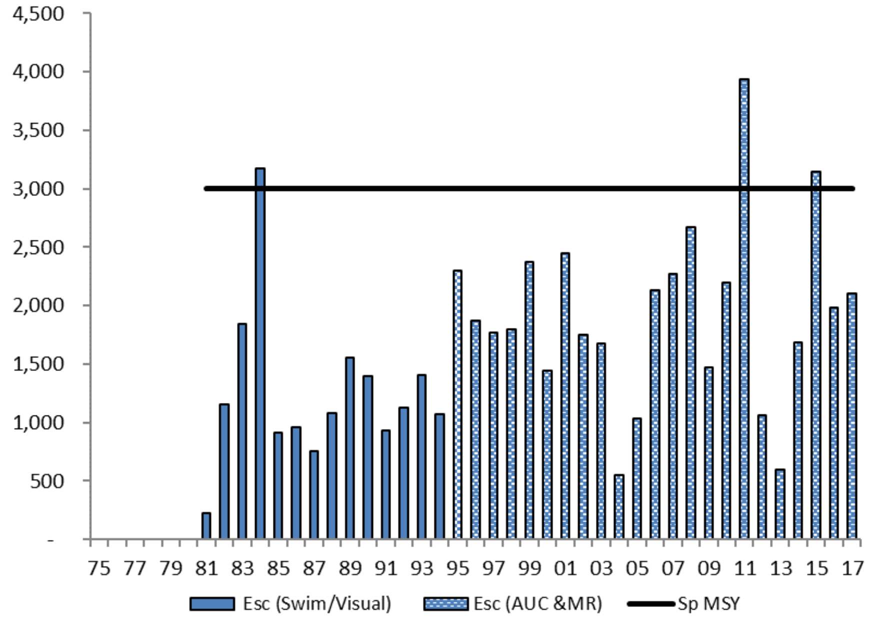

Figure 2.26.–Nanaimo River escapements of Chinook salmon, 1981–2017.

2.3.3.4 Fraser River Stocks

A large and diverse group of Chinook salmon spawning in Canada occurs in the Fraser River watershed, with many local populations (CTC 2002b; Candy et al. 2002).

Much of the knowledge about the status of Fraser Chinook salmon is based on spawner escapement data. Most of these data are from visual surveys, which are generally biased low, although many estimates are considered to be precise (Parken et al. 2003). Visual survey data are generated from aerial surveys and the escapement estimate is usually obtained by dividing the peak count by 0.65 (Farwell et al. 1999; Bailey et al. 2000). The CDFO continues to evaluate the accuracy and regularly updates estimates based on the peak count method through calibration studies on Middle Shuswap, Lower Chilcotin, Chilko and periodically Lower Shuswap. Escapement has also been estimated at several locations using MR methods; and direct counts at fences and using resistivity counters. Occasionally escapement estimates could not be determined for reasons including forest fires and extreme weather events that cause resistivity outages and cancellation of visual surveys. When this occurs, the missing estimate is infilled using the English method (English et al. 2007).

Currently, Fraser River Chinook are assessed as five stock groups for PSC management (Fraser Spring-Run 1.2, Fraser Spring-Run 1.3, Fraser Summer-Run 1.3, Fraser Summer-Run 0.3, and Fraser-Late), but are only represented by two stocks in the CTC Model (Fraser Early and Fraser Late). As part of the CTC Model Improvements program, the Fraser Early model stock is being separated into four model stocks to better represent population dynamics. The Fraser Late model stock is being separated into two stocks: natural (Harrison) and hatchery (Chilliwack).

The terminal run estimates in Appendix B6 include catch estimates derived from the Fraser run reconstruction model for CTC stocks only (English et al. 2007). Catches reported in Appendix A includes reported catches for all stocks, not just those for CTC stocks.

Within the Fraser, there are five current CWT-indicator stocks; Nicola River (Fraser Spring-Run 1.2), Lower Shuswap (Fraser Summer-Run 0.3), Middle Shuswap (Fraser Summer-Run 0.3), and Harrison River and Chilliwack River (Fraser Late). The Dome Creek CWT-indicator stock (Fraser Spring-Run 1.3) was discontinued in 2005.

Only the Harrison River has a CTC-approved escapement goal. For the remaining four stock groups, habitat-based models have been developed to estimate spawning capacity and the spawner abundance required to produce maximum sustained yield, S_{MSY} (Parken et al. 2006). In 2014, a Canadian Centre for Science Advice Pacific meeting examined the status and benchmarks for Southern BC Chinook conservation units (CUs), including Fraser. Benchmarks and status were accepted for non-enhanced CUs, but further work on enhanced CUs was required to evaluate status.

Escapements to the three stock groups with yearling smolt life history declined steeply from 2003 to 2009, and yearling smolts that entered the ocean in 2005 and 2007 experienced especially low survival. Recently, escapements have remained low and escapements to many of the stock groups failed to attain brood year levels. In contrast, escapements to the Fraser Summer-Run 0.3 increased during the 1990s and remained abundant until 2012, 2016, and-2017; when escapements were very low compared to levels observed over the previous decade.

For the Fraser late stock group, the Harrison River had very low escapements from 2012– 2017 (except 2015) with escapements more than 15% below the lower bound of the escapement goal (Figure 2.33). Escapement exceeded the upper bounds of the escapement goal in 2015 (101,516); however, was well below the lower bound of the escapement goal in 2014, 2016 and 2017 and the 2017 escapement estimate is the second lowest on record (Appendix Table B6).

2.3.3.4.1 Fraser River Spring Run: Age 1.3

The Fraser River spring run age-1.3 aggregate includes spring-run populations of the Mid- and Upper Fraser, North Thompson, and South Thompson, but excludes the Lower Thompson tributaries (CTC 2002b).

Escapements are typically estimated by expanded peak counts of spawners, holders and carcasses, surveyed from helicopters or on foot. Escapement decreased again in 2017 from levels observed in 2016 and was estimated at 8,154, which was lower than parental brood in 2012 and lower than base period values (Figure 2.27).

Escapement Goal Basis: There is currently no PSC-agreed escapement goal for this aggregate. Habitat-based estimates of S_{MSY} and other stock-recruitment reference points are available, but estimates of total escapement are needed to make them effective. Work is currently underway to estimate total escapements by developing factors that calibrate the visual survey indices to total escapements estimated by MR and electronic resistivity counter methods.

Agency Comments: The stock group has declined substantially over the last decade and is a stock of conservation concern.

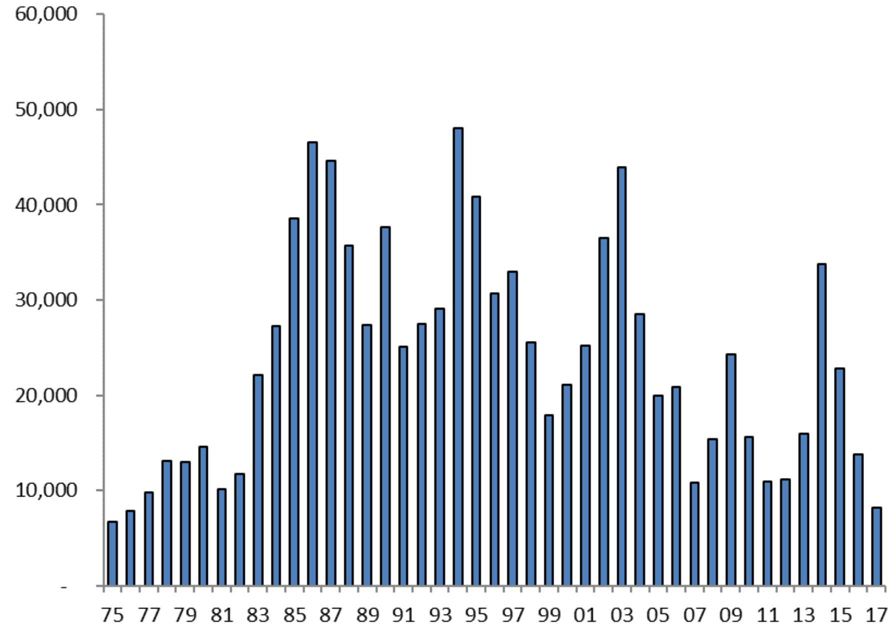

Figure 2.27.–Fraser River spring run age-1.3 stock group escapements of Chinook salmon, 1975–2017.

2.3.3.4.2 Fraser River Spring Run: Age 1.2

The Fraser Spring-run Age 1.2 stock group includes six smaller body size populations that spawn in the Lower Thompson River tributaries, Louis Creek of the North Thompson and the spring-run fish of Bessette Creek in the South Thompson (CTC 2002b). This stock group has an early maturation schedule for a stream-type life history, with an average generation time of 4.1 years (brood years 1985–1986), which results in smaller body size and lower fecundity compared to other stock groups.

Escapement Methodology: For the CTC time series, escapements are estimated visually using expanded peak counts of spawners, holders and carcasses in Spius Creek, Coldwater River, Louis Creek and Bessette Creek. Escapements to the Deadman and Bonaparte rivers are estimated by resistivity counter. Mark-recapture and calibrated visual surveys are used to estimate escapement to the Nicola River. Escapement decreased again in 2017 from levels observed in 2016 and was estimated at 5,105, which was lower than parental brood escapement in 2013 (Figure 2.28).

The Nicola River is the exploitation rate indicator stock for the Fraser Spring-run Age 1.2 stock group. Since 1995, high precision escapement estimates (by age and sex) have been generated using an MR program where Petersen disk tags are applied by angling and post-spawned carcasses are examined for the presence of marks. Estimates of escapement have been generated using pooled Petersen and stratified Darroch methods. The expanded peak count time series for the Nicola River is generally less than the MR estimates (Parken et al. 2003); therefore, the Nicola peak count series has been calibrated to the mark-recapture data and is used prior to 1995 in the Fraser Spring-run Age 1.2 aggregate time series (Figure 2.28 and

Figure 2.29).

The MR estimated escapement of 1,702 in 2017 is lower than the 2016 escapement and represents 49% of the 2013 parental brood. Since 1995 hatchery origin fish have averaged 25% of the spawning escapement.

Escapement Goal Basis: There is currently no PSC-agreed escapement goal for this aggregate. Habitat-based estimates of S_{MSY} and other stock-recruitment reference points are available for this stock group (Parken et al. 2006), but estimates of total escapement are needed to make them effective. Work is currently underway to estimate total escapements by developing factors that calibrate the visual survey indices to total escapements estimated by MR and electronic resistivity counter methods. Since 2004, the Nicola River escapements have been less than the median estimate of S_{MSY} (9,300; CV 21%).

Agency Comments: The stock group has declined substantially over the last decade and is a stock of conservation concern.

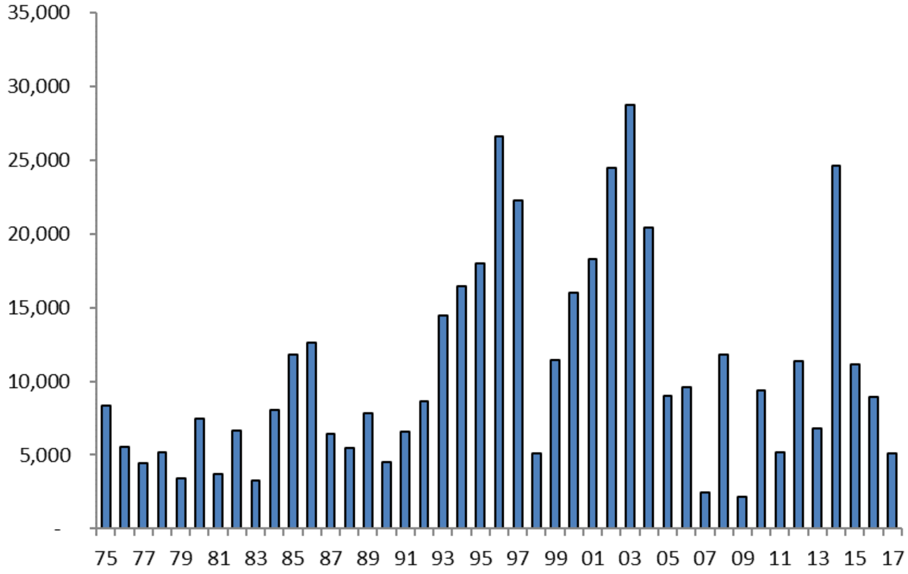

Figure 2.28.–Fraser River spring run age-1.2 stock group escapements of Chinook salmon, 1975–2017.

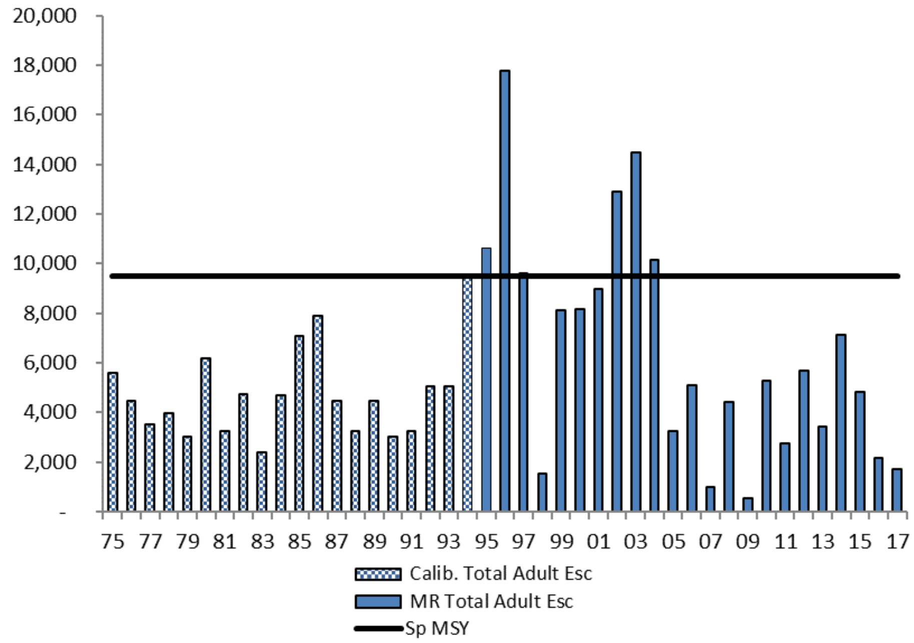

Figure 2.29.–Nicola River escapements of Chinook salmon, 1975–2017.

2.3.3.4.3 Fraser River Summer Run: Age 1.3

The Fraser River summer run age-1.3 aggregate includes 10 populations spawning in large rivers, mostly below the outlets of large lakes. These include the Nechako, Chilko, and Quesnel rivers in the Mid-Fraser and the Clearwater River in North Thompson watershed (CTC 2002b). The aggregate escapement was estimated at 6,459 in 2017, which is substantially lower from those observed in 2016 and in the parental brood in 2012. This is the lowest escapement on record for this aggregate (Figure 2.30).

Escapement Methodology: Escapements are estimated by expanded peak counts of spawners, holders and carcasses surveyed from helicopters. Surveys of the Stuart River and North Thompson River were discontinued in 2004 due to unreliable counting conditions and removed from the data series.

Escapement Goal Basis: There is currently no PSC-agreed escapement goal for the aggregate. Habitat-based estimates of S_{MSY} and other stock–recruitment reference points are available for this stock group, but estimates of total escapement are needed to make them effective. Work is currently underway to estimate total escapements by developing factors that calibrate the visual survey indices to total escapements estimated by MR and AUC methods.

Agency Comments: The stock group declined over the last decade and has been a conservation concern for several years. In 2017 it declined to the lowest level observed in 42 years.

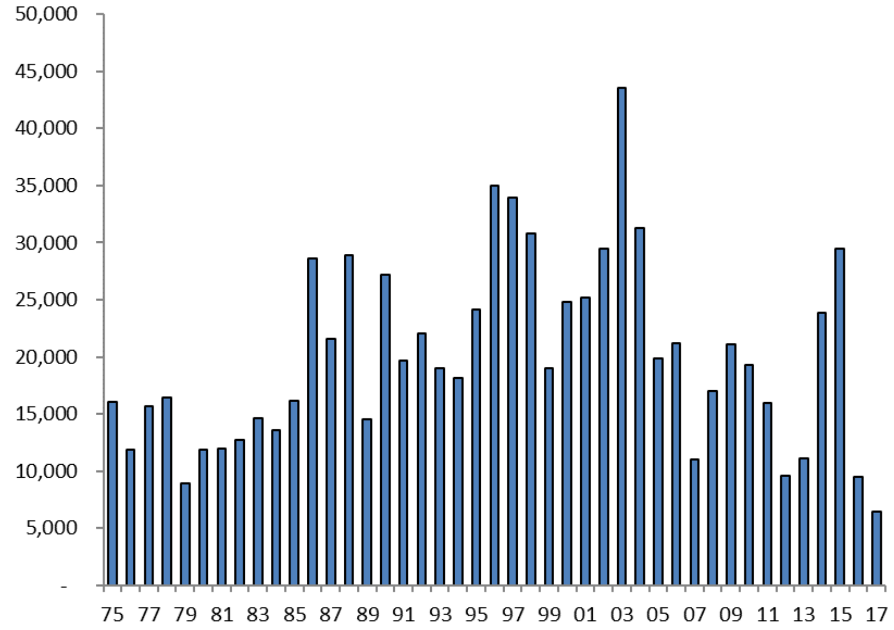

Figure 2.30.–Fraser River summer run age-1.3 stock group escapements of Chinook salmon, 1975–2017.

2.3.3.4.4 Fraser River Summer Run: Age 0.3

The Fraser Summer-Run Age 0.3 aggregate includes six populations spawning in the South Thompson watershed and one in the lower Fraser. These include the Middle Shuswap, Lower Shuswap, Lower Adams, Little River and the South Thompson River mainstem, in the BC interior, and Maria Slough in the lower Fraser (CTC 2002b). Escapements to this stock group were low in 2017, although there was some variation within the stocks in the aggregate. Escapements were estimated at 84,470 in 2017 (Figure 2.31).

Escapement Methodology: Escapements are estimated using peak count visual survey and mark-recapture methods. Since 2000 (with the exception of 2003), the Lower Shuswap River has been an exploitation rate indicator stock for the Fraser Summer-run Age 0.3 stock group, and an MR program provides high precision estimates of escapement by age and sex. Tags have been applied to live fish by seining and salmon carcasses were examined later for the presence of marks. In addition, there are multiple years of MR and CWT data for the Middle Shuswap River. The estimated escapement for Lower Shuswap in 2017 was 13,430 which is less than half of the parental brood (Appendix Table B6). Since 2000, hatchery-origin fish averaged 11% of the escapement (range: 4%-22%; Figure 2.32), and were estimated to be 12% of the escapement in 2017.

Escapement Goal Basis: There is currently no PSC-agreed escapement goal for the aggregate. Habitat-based estimates of S_{MSY} and other stock-recruitment reference points are available for this stock group (Parken et al. 2006), but estimates of total escapement are needed to make them effective. Work is currently underway to estimate total escapements by developing factors that calibrate the visual survey indices to total escapements estimated by MR methods and novel methods developed during the Sentinel Stocks Program. Peak count estimates for the Lower Shuswap River from 1975 to 1999, and for 2003 have been calibrated to mark-recapture equivalents. In the past two decades, with the exception of 2012 and 2016, Lower Shuswap River escapements have exceeded the median estimate of S_{MSY} (12,300; CV=17%).

Agency Comments: Escapements had been increasing for this stock group over the last decade and the stock group has been healthy and abundant, with the exception of the 2012 and 2016 escapement (the progeny of the 2012 brood year escapement).

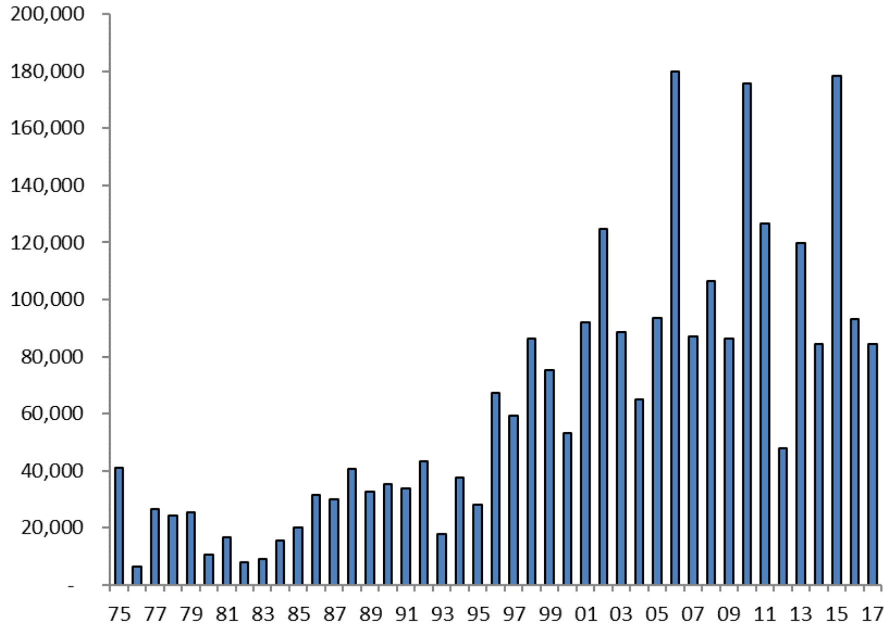

Figure 2.31.–Fraser River summer run age-0.3 stock group escapements of Chinook salmon, 1975–2017.

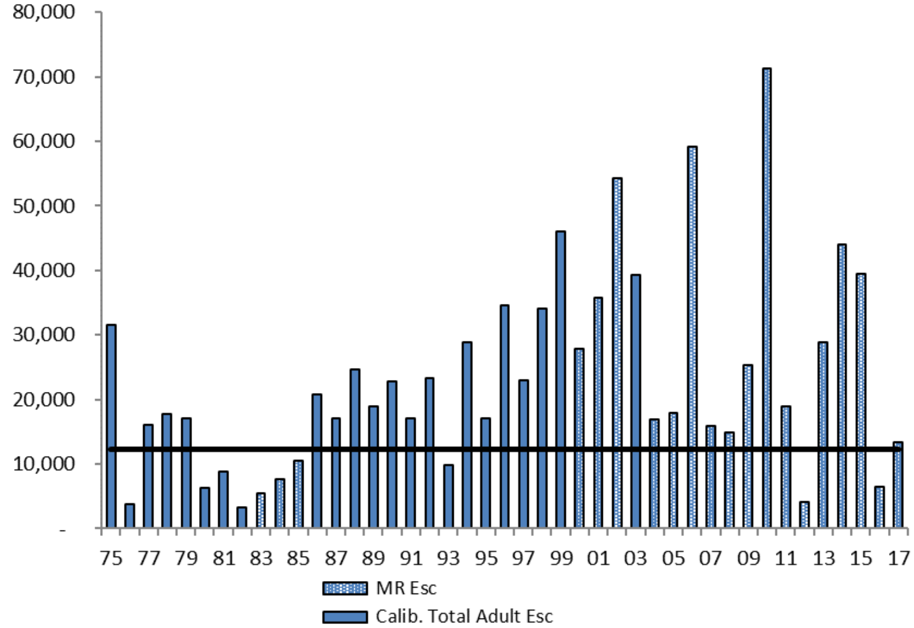

Figure 2.32.–Lower Shuswap River escapements of Chinook salmon, 1975–2017.
The visual escapement estimates have been calibrated with the mark–recapture estimates.

2.3.3.4.5 Fraser River Late Run (Harrison River)

Harrison River Chinook salmon are white-fleshed fish that return to spawn during the fall. They are unusual in that the fry migrate into the lower Fraser River and estuary shortly after emergence. This stock spends 2-4 years in the coastal marine environment before returning to spawn. When healthy, the Harrison River stock is one of the largest naturally spawning Chinook salmon populations in the world and makes important contributions to fisheries in southern BC, and Washington State. Spawning escapements to the Harrison River have varied widely from a low of 28,616 adults in 1995 to a high of 246,984 adults in 2003 (Figure 2.31). Escapements were more than 15% below the lower bound of the escapement goal from 2012–2017 (excluding 2015), the estimated escapement in 2017 was only 27,799 adult Chinook salmon (Figure 2.33).

Escapement Methodology: Since 1984, MR studies have been conducted annually on the Harrison River to obtain reliable estimates of spawning escapements.

Escapement Goal Basis: Due to their natural abundance and importance in numerous British Columbia and Washington State fisheries, Harrison River Chinook salmon were designated as an escapement indicator stock (i.e., ‘key stream’ indicator) to aid in fulfilling commitments under the 1985 Pacific Salmon Treaty. In 1986, an interim escapement goal for Harrison River Chinook salmon was established at 241,700 fish, based on doubling of the escapement estimate obtained from a MR program in 1984. In 2001, an escapement goal range was developed for Harrison Chinook salmon using a Ricker stock-recruit approach (CTC 2002b). The escapement goal range that was proposed was 75,100–98,500 (CV=15%) with the upper bound equal to the upper 75% confidence limit derived from a bootstrap procedure. This range was reviewed and accepted by the CTC. Escapements have fluctuated substantially with no apparent trend in the time series, until the recent period of poor returns. Average contribution of enhanced fish is 4%.

Agency Comments: The stock was identified as a conservation concern in 2016 due its low escapement in five of the past six years relative to the escapement goal.

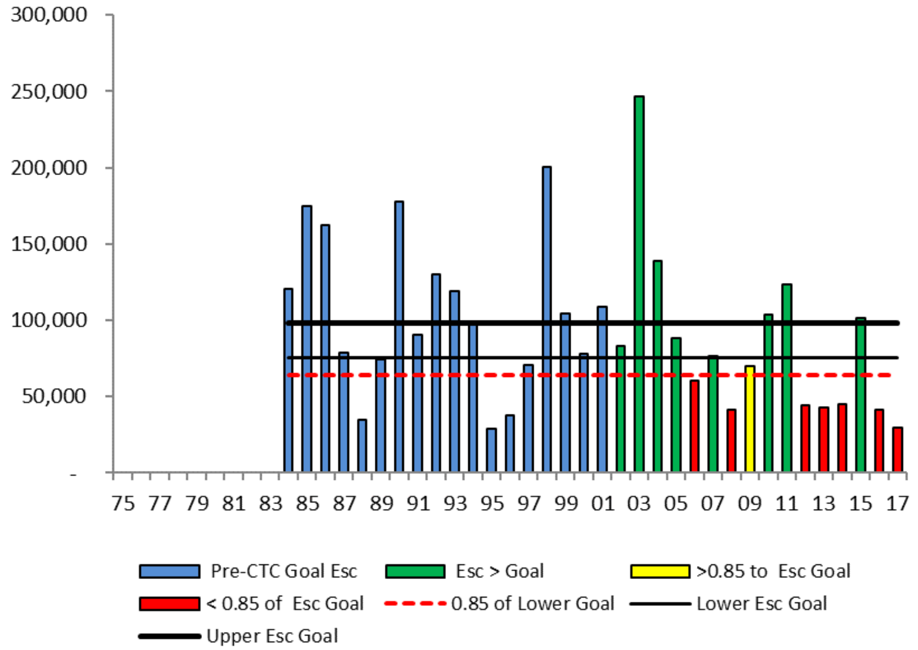

Figure 2.33.–Harrison River escapements of Chinook salmon, 1984–2017.

2.3.4 Puget Sound, Coastal Washington, Columbia River, and Coastal Oregon Stocks

The PSC escapement indicator stocks in Washington and Oregon are currently separated into four regional groups: Puget Sound, Washington Coastal, Columbia River, and North Oregon Coastal. Far north migrating Chinook salmon from the mid-Oregon Coast are currently being incorporated in the PSC Chinook model in this year's base period recalibration. There are currently no CTC-agreed escapement indicator stocks for the Mid-Oregon Coastal group, although there have been two proposed (the South Umpqua and Coquille). The indicator stocks include a variety of run timings and ocean distributions.

Biologically based escapement goals have been reviewed and accepted by the CTC for four fall stocks (Queets, Quillayute, Hoh, and Grays Harbor) and two spring/summer stocks (Queets and Hoh) in coastal Washington, four Columbia River stocks (Lewis, Upriver Brights, Deschutes, and Mid-Columbia Summers), and three far north migrating Oregon coastal stocks (Nehalem, Siletz, and Siuslaw).

2.3.4.1 Puget Sound

Puget Sound escapement indicator stocks include spring, summer/fall and fall Chinook salmon stocks from the Nooksack, Skagit, Stillaguamish, Snohomish, Lake Washington, and Green river systems. They tend to have a more local distribution than most coastal and Columbia River stocks and are caught primarily in WCVI AABM fisheries, and Canadian and US ISBM fisheries. Escapement for these stocks is defined as the total number of natural- and hatchery-origin fish spawning naturally on the spawning grounds.

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February 5, 2019

To First Nations and Stakeholders,

Re: 2019 Fraser River Chinook Conservation Measures

This letter is intended to communicate the Department's approach for developing fisheries management actions to address conservation concerns for Fraser River Chinook in 2019. Additional information is outlined below on the conservation concerns for these stocks, proposed management approaches for consideration, and timelines for decision making. The Department will be seeking feedback on the proposed management approaches in February to inform possible adjustments to early season fisheries beginning in **April 2019**.

Conservation concerns

In November 2018, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) released the results for an assessment of 16 southern BC Chinook designatable units (DUs). Of these units, 13 DUs originate in the Fraser River with 7 DUs assessed as *endangered*, 4 *threatened* and 1 *special concern;* Southern Thompson Ocean Summer Chinook were deemed *not at risk*. For the other 3 DUs outside the Fraser River, 1 DU (East Vancouver Island Stream Spring; Nanaimo River) was assessed as *endangered* and 2 Southern Mainland DUs were data deficient. Status information is summarized in **Appendix 1** and at (https://www.canada.ca/en/environment-climate-change/services/committee-status-endangered-wildlife/assessments/wildlife-species-assessment-summary-nov-2018.html. COSEWIC is expected to submit these assessments to the Government of Canada via the annual report which is anticipated in the Fall 2019. This annual report will initiate the formal process to consider whether or not to these DUs will be listed under the *Species at Risk Act* (SARA). COSEWIC assessment of the remaining southern BC Chinook populations is also planned for 2019 with an expected report on the status of these DUs in Fall 2020.

In 2018, spawner abundances of Fraser Chinook salmon declined substantially compared with the parental brood year abundance for 4 of 5 management units (**Table 1**). In addition, productivity of many of these populations was likely further impacted by observations of smaller size at age, reduced fecundity, and lower proportions of females in spawner surveys. These observations are consistent with broad coast-wide declines in Chinook survival, size at age, and fecundity that have been documented for many populations (see http://www.dfo-mpo.gc.ca/csas-sccs/Publications/ScR-RS/2018/2018_035-eng.html.)

Table 1: 2018 Spawner Abundance Relative to the Parental Brood Year and Recent Recruits per Spawner (R/S).

Management Unit	2018 Spawners	Brood Year (2013 or 2014) Spawners	% Change	Projected Recruits per Spawner (R/S) [C]
Spring 4_2	2,100	24,867	-92%	0.04-0.08[A]
Spring 5_2	8,399	15,947	-47%	0.6-0.9[A]
Summer 5_2	5,443	12,604	-57%	0.5-0.8[A]
Summer 4_1	46,543	84,700	-45%	0.85-0.93[A]
Fall 4_1 (Harrison)	46,094	44,686	3%	0.98[B]

[A] Several assumptions were used to project recruits to account for missing age data, missing age-specific exploitation rates, infilling for incomplete escapements, and missing information to determine total hatchery-origin escapement.

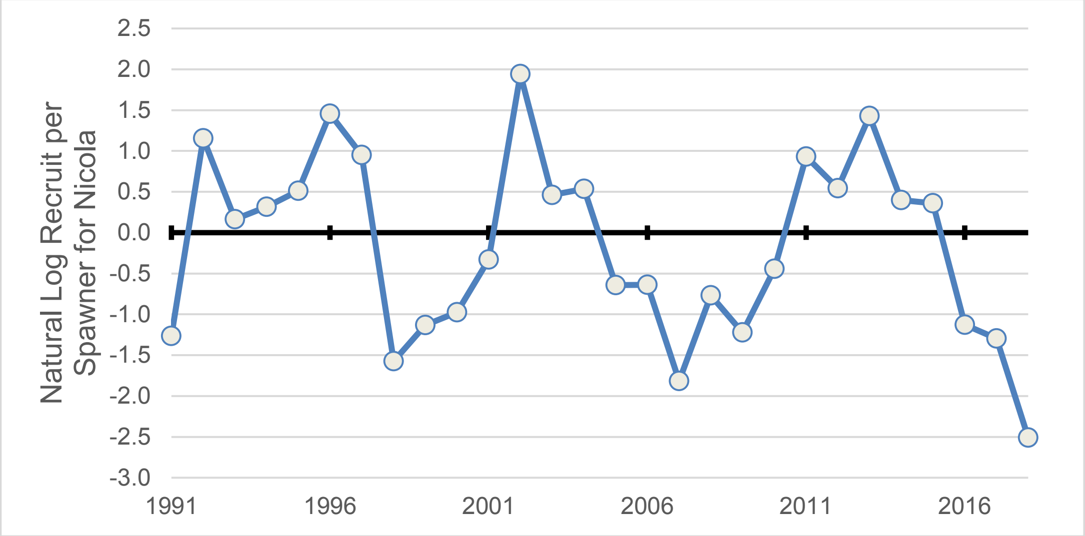
[B] Recruits and spawners reconstructed by cohort (brood year) using escapement goal methodology (Brown et al. 2001)

[C] Recruits represent the total number of adult offspring surviving to enter the fishery (i.e. pre-fishery abundance). Recruits are determined as catch plus spawners for the current year.

These declines in spawner abundance occurred even with additional fishery management actions implemented beginning in June of 2018 with the aim of reducing fishery mortality rates on Fraser Chinook salmon by 25-35%. An assessment of Coded-Wire Tag (CWT) data to determine fishery mortalities by fishery and location will be required to assess whether the target fishery reductions were achieved. This will take place when CWT data becomes available (March 2019).

The most serious declines in productivity have occurred for Spring 4_2 Chinook where projected R/S has declined to 0.04 to 0.08 R/S and the lowest on record since 1991. For every 100 parental spawners, between 4 and 8 adult recruits are projected to have returned before fishery removals (**Table 1**; **Figure 1**). When R/S is less than 1, populations will not replace themselves even in the absence of fishing mortality and spawner abundance will continue to decline; additional fishing mortality will increase declines in spawner abundance.

Figure 1: Time series of pre-fishery recruits per spawner for Spring 4_2 Chinook (Information for the Nicola River CWT indicator population).



Index values use a natural log scale where 0 equates to 1 recruit per spawner. Points below the x-axis (values less than 0) represent R/S less than 1 and will result in declining spawner abundance.

Recruits per spawner have also declined below 1 R/S for the Spring 5_2, Summer 5_2, Summer 4_1 and Fall 4_1 indicator populations; (see **Appendix 2**).

Southern Resident Killer Whales (SRKW) also continue to face threats to their survival and recovery and the Government is planning additional measures to strengthen protection of the species in 2019, these measures may have further implications for salmon fisheries. The seasonal distribution and movement patterns of SRKW are strongly associated with the availability of their preferred prey, Chinook salmon. The Department is working with a Technical Working Group to identify recommended approaches to support increased Chinook prey availability for SRKW.

Proposed Management Approaches

To address conservation concerns for Fraser River Chinook, the Department is proposing additional precautionary reductions in Canadian fishery mortalities. Proposed management objectives for each management unit are identified below

Table 2: Summary of Proposed Management Objectives

Management Unit	Management Objective	Considerations	Proposed CDN Fishery Mortality Range
Spring 4_2 Spring 5_2 Summer 5_2	Maximize the number of returning Chinook reaching spawning grounds by reducing Canadian fishery mortalities to the greatest extent possible.	Substantial reductions in fishery mortalities are required for Spring 4_2, Spring 5_2 and Summer 5_2 Chinook given their poor stock status, extremely poor productivity and expectations for continued declines in spawner abundance. Any fishery mortalities will worsen spawner declines unless productivity improves. New measures are anticipated to affect commercial, recreational and FSC fisheries.	The magnitude of reductions in CDN fishery mortalities will depend on the management measures implemented. Two scenarios are proposed that would aim to reduce total CDN fishery mortalities to less than 5% (see Scenario A below) or less than 10% (see Scenario B below). Recent CDN fishery mortalities averaged 14.5% (2013-2016) based on Spring 4_2 (Nicola) CWT indicator. Reducing fishery mortalities below 5% would require an overall 65% reduction.
Summer 4_1	Precautionary reduction in fishery mortalities similar to 2018 to protect co-migrating Fraser Chinook stocks of concern.	South Thompson Chinook were designated by COSEWIC as *Not At Risk*; however, productivity (R/S <1) and fecundity has declined for this group since 2015 and there are concerns for the Maria Slough conservation unit given that fewer than 20 spawners returned in 2018. In addition, the migration of Summer 4_1 Chinook overlaps with other Fraser Chinook stocks of conservation concern, particularly Summer 5_2 chinook. Additional reductions in commercial and recreational fishery harvest opportunities will also need to be considered to support priority access for FN FSC fisheries in the Fraser River given expectations for very limited FSC fishery opportunities in 2019.	Reducing CDN fishery mortalities to 20% or less is proposed. Recent fishery mortalities average 27.5% (2013-2016) based on the Lower Shuswap CWT indicator. Reducing fishery mortalities to 20% or less would require a 25% or greater reduction.

Fall 4_1	Fraser Fall 4_1 (Harrison) Chinook is the only Fraser management unit with an approved management objective. The management objective is to achieve the spawning escapement goal range of 75,100 to 98,500 spawners. A precautionary reduction in CDN fishery mortalities is proposed, similar to 2018.	Since 2012, the escapement goal has not been achieved, with the exception of 2015, and the COSEWIC stock status is *threatened*. Given declines in productivity (R/S < 1) and recent average fishery mortalities, spawner abundance may not reach the lower bound of the escapement goal range in 2019. Additional reductions in commercial and recreational impacts will need to be considered.	Reducing CDN fishery mortalities to 13% or less is proposed. Current fishery mortalities average 17% (2013-2016) based on the Harrison CWT indicator. Reducing fishery mortalities to 13% or less would require a 25% or greater reduction.

Note: Projected Canadian fishery mortalities used in **Table 2** are based on the average fishery mortalities for all Canadian fisheries from 2013 to 2016. **Appendix 3** shows where Fraser Chinook CWT indicator stocks have been encountered in BC fisheries and the corresponding average fishery mortalities (%) for the 2013-16 period.

Potential Fishery Scenarios

Achieving the proposed management objectives will require additional reductions in fisheries impacts in times and areas where Fraser Chinook are encountered in Northern and Southern BC, including commercial, recreational and First Nations fisheries. Fraser Spring 4_2 and Spring 5_2 Chinook return to spawn from early March through late July, with migration peaks in June through the lower Fraser River. Summer 5_2 Chinook have later timing and return to the Fraser River to spawn from late June to August with a peak in late July.

Two potential fishery scenarios are outlined below that provide examples of potential management actions that would be required for Fraser Spring 4_2, Spring 5_2 and Summer 5_2 Chinook to achieve less than 5% Canadian fishery mortalities (Scenario A) or less than 10% Canadian fishery mortalities (Scenario B). **These are initial scenarios for discussion purposes; alternative fishery scenarios and/or management actions contained within a scenario may be considered based on feedback received.**

Scenario A – This approach would target a high degree of protection for Fraser Spring 4_2, Spring 5_2 and Summer 5_2 Chinook, to permit as many fish as possible to pass through fisheries to spawning areas. This approach would aim to reduce total Canadian fishery mortalities to less than 5%. This would require commercial troll fisheries in Northern BC (Area F) and the West Coast of Vancouver Island (Area G) to remain closed through July (Area G) and to July 17 (Area F). Marine recreational Chinook fisheries along migration corridors in southern BC would be Chinook non-retention. Recreational fisheries in the Fraser River would remain closed to fishing for salmon into August, followed by no fishing for Chinook if there are openings for other species. First Nations FSC fisheries opportunities would be restricted to unplanned events or very limited communal fisheries. For fisheries following the Summer 5_2 migration, fishery measures would target reductions similar to 2018 for Summer 4_1 and Fall 4_1 Chinook with possible measures including:

- Measures to reduce removals in marine recreational fisheries (e.g. reduced daily/possession limit, hatchery-marked Chinook retention, size limit adjustments).
- Closures to salmon fishing or non-retention of Chinook salmon in Fraser River recreational fisheries.
- Possible reduction in harvest allocations in commercial troll fisheries.
- Consideration of retention of Chinook by-catch and/or limited Chinook-directed opportunities for FSC fisheries.

Scenario B – This approach would aim to reduce Canadian fishery mortalities to 10% or less for Fraser Spring 4_2, Spring 5_2 and Summer 5_2 Chinook. This would require commercial troll fisheries in Northern BC (Area F) and the West Coast of Vancouver Island (Area G) to remain closed through July (Area G) and to July 10 (Area F). Southern BC marine recreational Chinook fisheries would have reduced daily limits and/or hatchery-marked retention depending on time/location. Recreational fisheries in the Fraser River would remain closed to fishing for salmon through July until August 23. First Nations FSC fisheries would have management actions similar to 2018. For fisheries following the Summer 5_2 migration, fishery measures would target reductions similar to 2018 for Summer 4_1 and Fall 4_1.

Table 3: Summary Table of proposed management actions for Scenario A and B

Fishery	Scenario A	Scenario B
Commercial		
NBC AABM (Area F) Troll	Closed to July 17	Closed to July 10
WCVI AABM (Area G) Troll	Closed to August 1	Closed to August 1
Kamloops Lake Chinook Demonstration Fishery	Closed	Closed
Recreational		
NBC AABM	*No measures proposed for Fraser chinook*	*No measures proposed for Fraser chinook*
NBC ISBM	*No measures proposed for Fraser chinook*	*No measures proposed for Fraser chinook*
WCVI AABM (Areas 121 to 127)	a) Apr 1 to July 31, Chinook non-retention; b) Aug 1 to Dec 31, 2 Chinook/day.	*No measures proposed for Fraser chinook*
WCVI ISBM	*No measures proposed for Fraser chinook*	*No measures proposed for Fraser chinook*
Johnstone Strait (Area 12)	c) Apr 1 to July 31, Chinook non-retention; d) Aug 1 to Aug 29, 1 Chinook/day (with option for terminal fisheries); e) Aug 30 to Dec 31, 2 Chinook/day.	a) Apr 1 to August 29, 1 Chinook/day (with option for terminal fisheries). b) Aug 30 to Dec 31, 2 Chinook/day.
Strait of Georgia – North Areas 13 to 17, 28, portion of 29 (29-1 and 29-2)	a) Apr 1 to July 31, Chinook non-retention; b) Aug 1 to Aug 29, 1 Chinook/day (with option for terminal fisheries); c) Aug 30 to Dec 31, 2 Chinook/day.	d) Apr 1 to August 29, 1 Chinook/day (with option for terminal fisheries). e) Aug 30 to Dec 31, 2 Chinook/day.
Strait of Georgia – South and Juan de Fuca Areas 18 to 20, portions of Area 29 (29-3 to 29-5)	a) Apr 1 to July 31, Chinook non-retention; b) Aug 1 to Aug 29, 1 Chinook/day (with option for terminal fisheries); c) Aug 30 to Dec 31, 2 Chinook/day.	a) Apr 1 to July 31, 1 chinook/day; hatchery marked only b) Aug 1 to Aug 29, 1 Chinook/day (with option for terminal fisheries) c) Aug 30 to Dec 31, 2 Chinook/day.
Fraser River Tidal and Non Tidal and Sub area 29-6 to 29-10	a) Jan. 1 to August 23 , No fishing for salmon. Aug. 23 to Dec. 31, Chinook non-retention	a) Jan. 1 to August 23 , No fishing for salmon. b) Aug. Aug 23 to December 31, 1 Chinook/day
Freshwater Regions 3,5,7 &8	b) closed to fishing for salmon except in some areas where fisheries on other stocks or species may take place.	c) closed to fishing for salmon except in some areas where fisheries on other stocks or species may take place.

First Nations		
South Coast	a) Fishing to FSC communal allocations as in previous years; marine FSC Chinook fisheries are largely terminal and directed at local Chinook stocks. No measures proposed for SCA First Nations chinook fisheries.	A) Fishing to FSC communal allocations as in previous years; marine FSC Chinook fisheries are largely terminal and directed at local Chinook stocks. No measures proposed for SCA First Nations chinook fisheries.
Lower Fraser	a) Jan. 1 to Aug 10, very limited impacts on chinook in FSC fisheries b) After Aug. 10, targeted chinook fishing or bycatch during sockeye-directed opportunities.	a) Jan. 1 to Aug 10, limited chinook directed FSC fisheries with effort limitations extended to Aug. 10 or bycatch during sockeye-directed opportunities b) After Aug. 10, targeted chinook fishing or bycatch during sockeye-directed opportunities.
BC Interior - d/s of Thompson Confluence	a) Jan 1 to Aug 10, very limited impacts on chinook in communal FSC fisheries. Time or gear restrictions. b) After Aug. 10 limited selective chinook fishing or bycatch during sockeye-directed opportunities until. Later in August, targeted chinook fishing or by-catch during sockeye directed fishing. Low impact terminal harvests.	a) Jan 1 to Aug 10 limited communal FSC fisheries. Time or gear restrictions. b) After Aug 10, Directed chinook fishing or bycatch during sockeye-directed opportunities.
BC Interior - u/s of Thompson Confluence Note: the only chinook in the area are Spring 5_2 and Summer 5_2 chinook.	Fisheries in the area constrained by preferred gear type or fishing times. Discussion required to reduce overall catch.	Fisheries in the area constrained by preferred gear type or fishing times.

Appendix 4 outlines the specific fishery management measures that were implemented in 2018.

Process

The Department is seeking feedback from First Nations and stakeholders on the proposed fishery scenarios, or effective alternatives, and on the associated fishery management actions that best achieve the management objectives. The Department will consider feedback and evaluate expected outcomes for consistency with proposed management objectives, conservation and allocation priorities, support for effective implementation and fostering compliance, and consider potential impacts on fishery monitoring and stock assessment programs (e.g. CWT data). Any proposed measures will also be evaluated for compliance with new fishery reductions identified for Canadian and US Chinook indicator populations under the renewed provisions of the Pacific Salmon Treaty. The revised versions of Annex IV, Chapters 1, 2, 3, 5, and 6 (plus current text for Chapters 4, 7, and 8) have been posted at https://www.psc.org/publications/pacific-salmon-treaty/. Please note that Chapters 1, 2, 3, 5, and 6 are not yet formally in force, but the Parties have agreed to provisionally apply them as of January 1, 2019.

Given the early run timing of Fraser Chinook and potential importance of these stocks to SRKW in the early spring, the Department is considering adjustments to early season fisheries that occur between April and June 2019. Department staff will meet with First Nations and stakeholders through the **end of February** to discuss potential management scenarios and supporting information on consequences of potential early season actions to support decision making.

Fishery management measures later in the season (i.e. July 2019 and onward) will be considered as part of the process to develop the 2019/2020 Salmon Integrated Fisheries Management Plans. Further discussion with First Nations and advisory groups will take place during the consultation process to develop the 2019/20 salmon IFMPs.

If you wish to provide feedback, please do so in writing, by **March 1, 2019** to the DFO Pacific Salmon Management Team at DFO.PacificSalmonRMT-EGRSaumonduPacifique.MPO@dfo-mpo.gc.ca. Feedback received will be summarized by the Department and any recommendations on harvest planning will be provided to First Nations and the Departments advisory committees, including the Sport Fishing Advisory Board (SFAB), Commercial Salmon Advisory Board (SFAB), Marine Conservation Caucus (MCC) and Integrated Harvest Planning Committee (IHPC) for further consideration.

Yours sincerely,

J Grout

Jeff Grout
Regional Resource Manager, Salmon

Appendices (4):

1. Summary of Stock Status of Fraser River BC Chinook Designatable Units.
2. Trends in productivity (R/S) for Fraser Chinook management units.
3. Graphical representation of average Canadian total fishing mortalities for Fraser River Chinook CWT indicator populations for the 2013-2016 period.
4. Summary of 2018 fishery management measures.

Appendix 1: Stock Status of Fraser River BC Chinook Designatable Units.

Fishery Management Unit	**Designatable Unit**	***COSEWIC Assessment***	**CU and WSP Status** no colour = TBD gray = Data Deficient orange = red/amber	**Spawning Locations**
Spring 4_2 Chinook	DU14 BC South Thompson Stream Summer	*Endangered*	🟥 CK-16 STh Bessette Creek	Bessette Creek, Creighton Creek; Duteau Creek; Harris Creek
	DU15 BC Lower Thompson Stream Spring	*Not assessed*	🟥 CK-17 Lower Thompson Spring	Bonaparte River; Coldwater River; Deadman River; Louis Creek; Nicola River; Spius Creek
Spring 5_2 **Chinook**	DU3 BC Lower Fraser River Stream Spring	*Special Concern*	CK-04 LFR Spring	Birkenhead
	DU4 BC Lower Fraser River Stream Summer (Upper Pitt)	*Endangered*	▨ CK-05 LFR Upper Pitt	Pitt River-Upper
	DU7 BC Middle Fraser River Stream Spring	*Endangered*	▨ CK-08 FR Canyon-Nahatlatch	Anderson, Nahatlatch
	DU9 BC Middle Fraser River Stream Spring	*Threatened*	🟥 CK-10 MFR Spring	Cariboo River-upper; Chilako River; Chilcotin River upper; Chilcotin River-lower; Cottonwood River; Horsefly River; Narcosli Creek; Naver Creek; West Road River and others
	DU11 BC Upper Fraser River Stream Spring	*Endangered*	🟥 CK-12 UFR Spring	Bowron River; Dome Creek; East Twin Creek; Fraser River-above Tete Jaune; Forgetmenot Creek; Goat River; Holliday Creek; Holmes River; Horsey Creek; Humbug Creek; Kenneth Creek; McGregor River; McKale River; Morkill River; Nevin Creek; Ptarmigan Creek; Slim Creek; Small Creek; Snowshoe Creek; Swift Creek; Torpy River; Walker Creek; Wansa Creek; West Twin Creek; Willow River; and others
	DU16 BC North Thompson Stream Spring	*Endangered*	🟥 CK-18 NTHOM Spring	Albreda River; Blue River; Finn Creek; Lyon Creek; Mad River

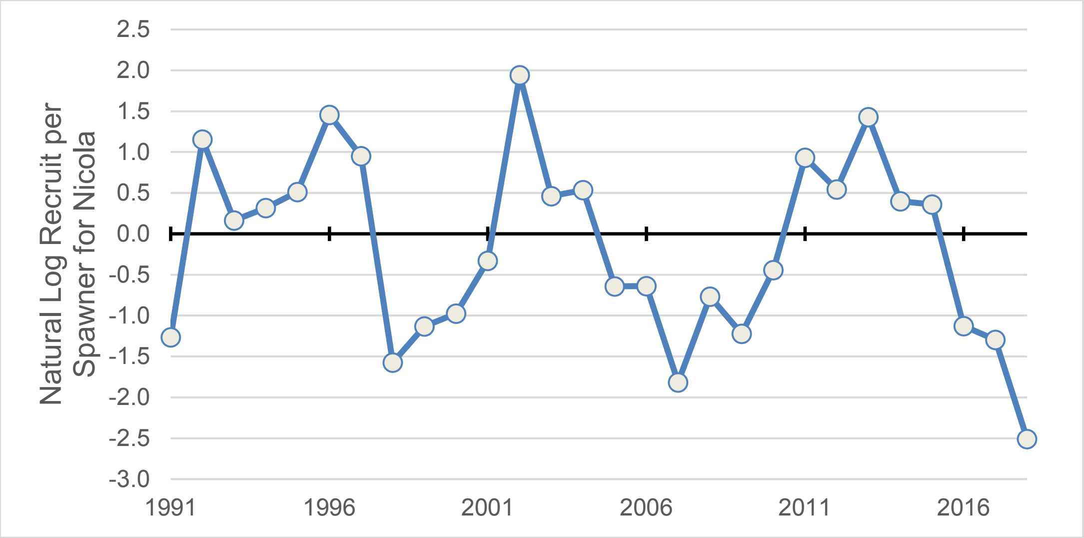
Summer 5_2 Chinook	DU5 BC Lower Fraser River Stream Summer	*Threatened*	**CK-06 LFR Summer**	Big Silver Creek; Chilliwack/Vedder River; Cogburn Creek; Douglas Creek; Green River; Lillooet River; Sloquet Creek; Tipella Cr.
	DU8BC Middle Fraser River Stream Fall	*Endangered*	CK-09 MFR Portage	Portage
	DU10 BC Middle Fraser River Stream Summer	*Threatened*	CK-11 MFR Summer	Bridge River; Cariboo River lower; Chilko River; Endako River; Kazchek Creek; Kuzkwa River; Nechako River; Quesnel River; Seton River; Stellako River; Stuart River; and others
	DU13 BC South Thompson Stream Summer	*Not assessed*	CK-14 STh Summer age 5_2	Eagle River; Salmon River
	DU17 BC North Thompson Stream Summer	*Endangered*	CK-19 NTHOM Summer	Barriere River; Clearwater River; Lemieux Creek; Mahood River; Mann Creek; North Thompson River; Raft River
Summer 41 Chinook	DU6 BC Lower Fraser River Ocean Summer	*Not assessed*	CK-07 Maria Slough Summer	Maria Slough
	DU12 BC South Thompson Ocean Summer	*Not At Risk*	CK-13 STh Summer age 4_1 CK-15 Shuswap River Summer	Adams River; Little River; South Thompson River; Lower Thompson River; Lower Shuswap, Middle Shuswap
Fraser Fall 4_1 Chinook	DU2 BC Lower Fraser River Ocean Fall	*Threatened*	CK-03 LFR Fall	Harrison
ECVI and Mainland Chinook	DU19 BC East Vancouver Island Stream Spring	*Endangered*	CK-23 East Vancouver Island – Nanaimo Spring	Nanaimo River - Upper

Appendix 2: Trends in productivity (R/S) for Fraser Chinook management units.

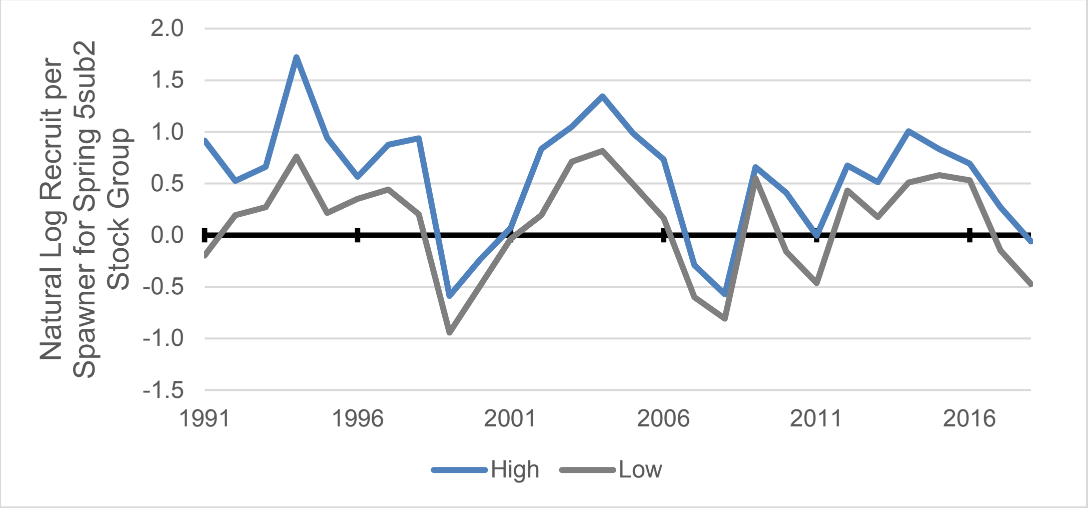
Notes:

1. For the Spring 4_2 and Summer 4_1 stocks, R/S estimates are shown for the CWT indicator stock, Nicola and Lower Shuswap, respectively.
2. For the Spring 5_2 and Summer 5_2 stocks, R/S series were generated using the CWT CYER data from Nicola and from Lower Shuswap to provide a range of R/S. This provides an index of recruitment but not a direct measure given assumptions (e.g. missing age data, missing age-specific exploitation rates, infilling for escapement, inability to measure total hatchery-origin escapement).
3. For the Fall 4_1, the R/S series was based on recruits and spawners reconstructed by cohort (brood year) using the established escapement goal methodology (Brown et al. 2001)

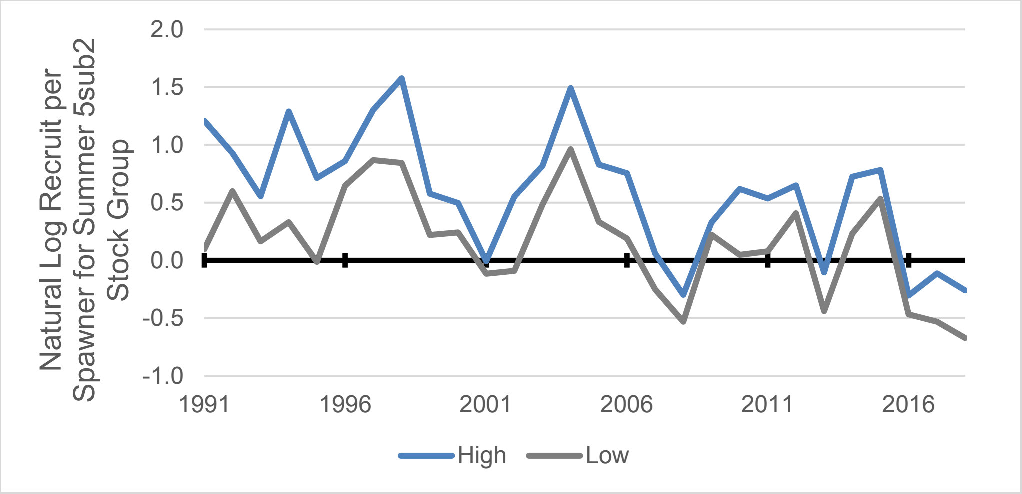
Spring 4_2 (Nicola Indicator)



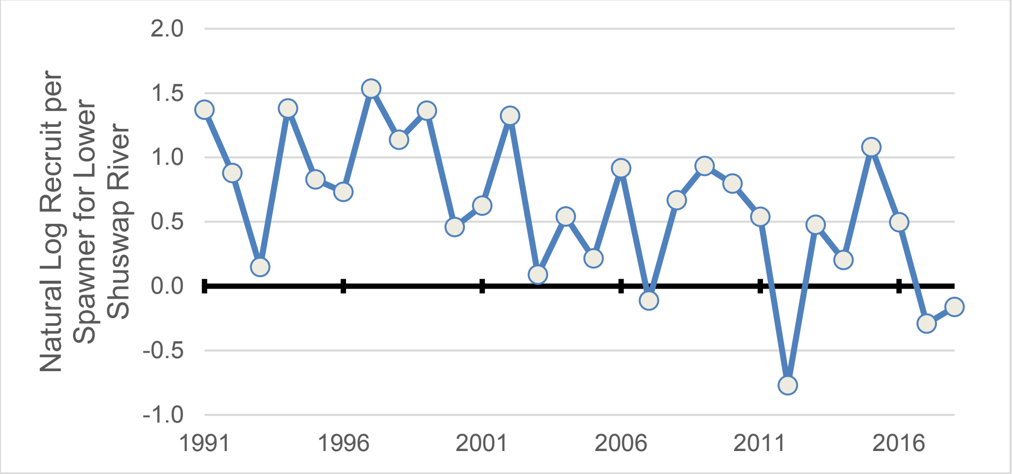
Spring 5_2



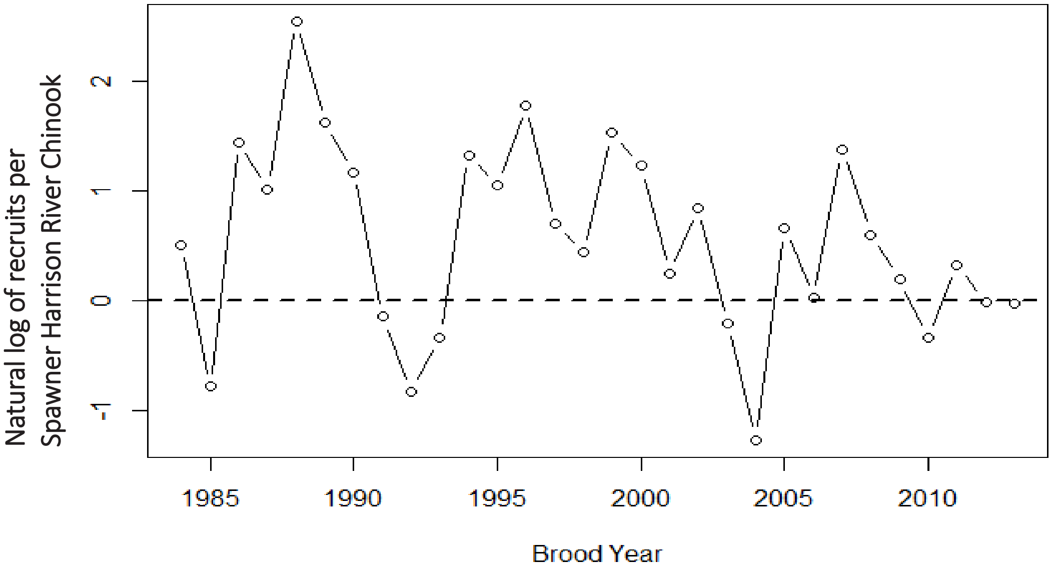
Summer 5_2



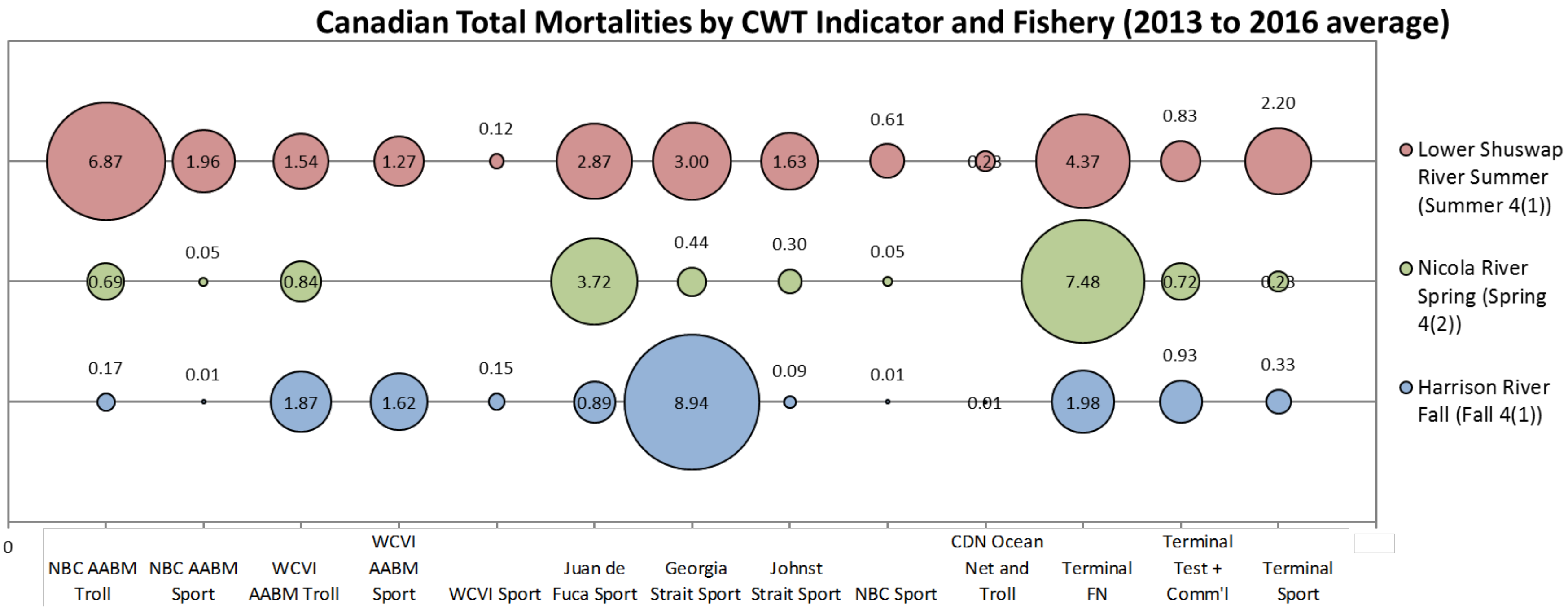
Summer 4_1 (Lower Shuswap indicator)



Fall 4_1 (Harrison indicator)



Appendix 3: Graphical representation of average Canadian total fishing mortalities for Fraser River Chinook CWT indicator populations for the 2013-2016 period.



Numbers in bubbles represent average number of Chinook fishery mortalities per 100 Chinook in the total run based on the hatchery CWT indicator stock. For example, CDN fishery mortalities for Nicola Chinook total 14.5% (sum of grey bubbles/100) and with US removals of 2.3% (not shown in figure); total fishery mortalities are 16.9% with remaining 83.1% of run going to spawning grounds

Appendix 4: Summary of 2018 fishery management measures.

FN0428-Conservation Measures for Northern and Southern BC Chinook Salmon and Southern Resident Killer Whales

(https://notices.dfo-mpo.gc.ca/fns-sap/index-eng.cfm?pg=view_notice&DOC_ID=208486&ID=all)

This notice provides information on planned conservation measures for Northern and Southern BC Chinook Salmon and Southern Resident Killer Whales that will be implemented beginning June 1, 2018.

Chinook Conservation Measures
To address Chinook conservation concerns, DFO is implementing a precautionary 25-35% reduction in exploitation rates for Chinook stocks of concern to support conservation and promote rebuilding. These additional reductions are planned to address conservation concerns for Nass River, Skeena River and many small wild Chinook populations in Northern BC; and, all Fraser River Chinook populations (including Spring 4(2), Spring 5(2), Summer 5(2), Summer 4(1) and Fall 4(1) populations) in Southern BC.

Additional Northern BC Chinook management measures are outlined below, followed by additional Southern BC Chinook management measures.

Northern Commercial Fisheries

Area F Troll - opening of AABM Chinook fishery delay to July 10 in addition to boundary changes. Refer to the subsequent Fishery Notice for details.

Northern Recreational Fisheries

Please note that possession limits for Chinook Salmon are twice the daily limit.

The recreational daily limits of Chinook Salmon are being reduced in North Coast tidal waters as follows:

Haida Gwaii:

Effective June 1, 2018 to July 9, 2018, the daily limit is one (1) Chinook per day in Areas 1, 2, 142, and that portion of Area 101 west of 131 degrees 40.0 minutes West longitude

North Coast:

Effective June 1, 2018 to June 15, 2018, the daily limit is one (1) Chinook per day in Areas 3 to 5, 103 to 105, Subarea 102-1, and that portion of Area 101 east of 131 degrees 40.0 minutes West longitude
Effective June 16, 2018 to July 9, 2018, there is zero (0) retention of Chinook Salmon in Areas 3 to 5, 103 to 105, Subarea 102-1, and that portion of Area 101 east of 131 degrees 40.0 minutes West longitude

Effective July 10, 2018 to July 31, 2018, the daily limit is one (1) Chinook per day in Areas 3 to 5, 103 to 105, Subarea 102-1, and that portion of Area 101 east of 131 degrees 40.0 minutes West longitude

Effective June 1, 2018 to July 31, 2018 the daily limit is one (1) Chinook per day in Areas 6 and 106

Variation Order Number: 2018-RFQ-0307

Management measures for northern BC non-tidal waters were previously announced in FN0372 issued May 8, 2018.

Southern BC Commercial Fisheries

Area G Troll:
There is no commercial fishery for AABM Chinook in June or July.

Area B Seine and Area H Troll:
Effective June 1 to September 30, 2018, there is no commercial salmon fishing in Subareas 20-3, 20-4 and that portion of Subarea 20-5 that lies west of 123 degrees 49.30 minutes west longitude (Otter Point).

Area B Seine and Area H Troll:
Effective June 1 to September 30, 2018 there is no commercial salmon fishing in Subareas 18-2, 18-4, 18-5 and 18-9.

Southern BC Recreational Fisheries:

Southern BC Inside Waters

Areas 13 to 18, 28 and 29 and Subareas 19-1 to 19-6 (except those portions listed below):

Effective June 1, 2018 until September 30, 2018, the daily limit for Chinook Salmon is one (1) per day in in Areas 13 to 17, 28 and 29 with the exception of those four areas listed below under the headings Strait of Georgia, Pender Island, Juan de Fuca and Fraser River mouth. Terminal fishing opportunities at full limits for Chinook may be considered in-season if abundance permits.

Effective October 1, 2018 until further notice, the daily limit for Chinook Salmon is two (2) per day in in Areas 13 to 19, 28 and 29.

Exceptions:

Strait of Georgia:
Note: this measure came into effect on May 7, 2018 as previously announced in FN0370 issued May 7, 2018.

Effective immediately until June 28, 2018 the daily limit for Chinook salmon is two (2) per day, of which only one may be greater than 67 cm in Subareas 18-1, 18-3, 18-6, 18-11, and 19-5.

Effective June 29, 2018 to July 31, 2018 the daily limit is two (2) Chinook salmon per day between both of which must be less than 85 cm in Subareas 18-1, 18-3, 18-6, 18-11, and 19-5.

Chinook salmon retained in these waters must have a fork length of at least 62cm.

Pender Island:
Effective June 1 to September 30, 2018 there is no fishing for finfish in Subareas 18-2, 18-4, 18-5 and 18-9.

Juan de Fuca (Subareas 19-1 to 19-4 and Area 20):
Effective June 1, 2018 to September 30, 2018 there is no fishing for finfish in Subareas 20-3, 20-4 and that portion of Subarea 20-5 that lies west of 123 degrees 49.30 minutes west longitude (Otter Point)

Effective June 1, 2018 until June 28, 2018 the daily limit for Chinook salmon is two (2) per day which may be wild or hatchery marked between 45 and 67 cm fork length or hatchery marked greater than 67 cm in Subareas 19-1 to 19-4 and 20-6 and 20-7 and that portion of Subarea 20-5 that lies east of 123 degrees 49.30 minutes west longitude (Otter Point).

Effective June 29, 2018 until July 31, 2018, the daily limit for Chinook salmon is two (2) Chinook per day which may be wild or hatchery marked between 45 and 85 cm or hatchery marked greater than 85 cm in Subareas 19-1 to 19-4 and 20-6 and 20-7 and that portion of Subarea 20-5 that lies east of 123 degrees 49.30 minutes west longitude (Otter Point).

Fraser River Mouth (Subareas 29-6, 29-7, 29-9 and 29-10):
Effective June 1, 2018 to September 30, 2018, there is no fishing for salmon in Subareas 29-7, 29-9 and 29-10.

Effective June 1, 2018 to July 31, 2018, there is no fishing for salmon in Subarea 29-6.

Effective August 1, 2018 to September 30, 2018, there is no retention of Chinook Salmon in Subarea 29-6.

Variation Order Number: 2018-RFQ-0307; 2018-RCT-0321

Appendix 2

David Scott M.R.M., BSc.
1917 Bayswater Street, Vancouver B.C. V6K 4A7
Tel: 604.817.6700; Email: scott24d@gmail.com

Academic Background

Doctor of Philosophy in Forestry **Sept 2018 - present**

- Current student in the Pacific Salmon Ecology and Conservation Lab under supervisor Dr. Scott Hinch, studying juvenile Chinook use of the Fraser estuary including outmigration timing, habitat preferences, physiological adaptation to saline water, and evaluating restoration effectiveness.

Masters of Resource Management: Simon Fraser University, Burnaby, BC **Sept 2012 – Dec 2014**

- Master's Research Project – Supervisor Dr. Jonathan W. Moore: *Flood mitigation structures transform tidal creeks from nurseries for native fish to non-native hotspots.*

Bachelor of Science Honours: University of Regina, Regina, SK **Sept 2006 – Oct 2010**

- Honours Thesis – Supervisor Dr. Bjoern Wissel: *Quantifying Productivity and Respiration in a Urea Fertilization Experiment using O2 and CO2 Stable Isotopes.*

Professional Experience

- **CEAA Review Roberts Bank Terminal 2 - 2016 - Ongoing**: Working as a fisheries biologist with specific expertise in salmon, I assisted Ecojustice in their participation in the CEAA review of this large marine container terminal proposed for the Fraser Estuary, BC. Working independently, I produced a submission on the completeness of the Marine Shipping Addendum, a submission on the Sufficiency and Technical Merit of the Marine Shipping Addendum, and a submission on the Sufficiency and Technical Merit of the Environment Impact Statement, all as it pertains to potential effects on juvenile Chinook salmon. I prepared a final written submission prior to the public hearings including responses to additional information and potential effectiveness of compensation projects. I also participated in the public hearings including answering questions from the review panel and asking questions of the proponent and other presenters. The review panel directly cited my submissions several times in their support of the evidence which I submitted in their final report.

Biologist: Raincoast Conservation Foundation February 2015 – Present

- **Tsawwassen First Nation Stewardship Program – 2020 – Ongoing:** Over the past year we have been working with the Tsawwassen First Nation to develop a stewardship program to guide their future resource and land management decisions. In the summer of 2020, I led a youth stewardship program in conjunction with TFN which ran two days each week and involved teaching a group of youths from their community about stewardship and field research. This included a blend of learning from community members and outside biologists such as myself and other guests that I organized. Over the winter of 2020-21 I have worked with the TFN Natural Resources Department on two major grant applications to potentially support an ongoing stewardship program which we are currently developing.
- **Fraser Estuary Juvenile Salmon Research and Restoration Project - 2016 - Ongoing**: Raincoast has been conducting a field research program over the past five to investigate juvenile Chinook salmon habitat preferences in the Fraser estuary. I have led Raincoast's connectivity restoration initiative which has included creating three breaches in the Steveston North jetty in the Fraser estuary. I have been responsible for leading or co-leading all aspects of the projects including our successful grant application to the Salish Sea Marine Survival Project in 2016 and Coastal Restoration Fund in 2017 for $2.7 million, planning the field project including applying for permits, choosing and purchasing sampling equipment, determining field sites and methods, and working with our project director and engineering and construction teams. I have also led all data collection including organizing field crew and volunteers and conducting field research activities. This also includes working with charter boat operators from the Tsawwassen First Nation which have guided us in the estuary since the inception of the project.

- **Lower Fraser River Salmon Habitat Outreach – 2015 - 2020**: Over the past five years Raincoast has been working with conservation groups, First Nations, and other stakeholders in the Lower Fraser. Working towards this goal I have met with groups and individuals throughout the region; groups range from large and small ENGO's to stream keepers' groups to First Nations to local governments and to concerned citizens. I helped author a report in 2020 titled "Toward a vision for salmon habitat in the Lower Fraser River" which provides background the current state of salmon habitat in the Lower Fraser and lays out our vision for the future of salmon habitat in this important region.
- **NEB Review Trans Mountain Pipeline Expansion** - **2015**: I was retained by Raincoast Conservation Foundation to aid in their preparation of a submission to the joint review panel. I worked with Toxicologist Kate Logan to co-produce a report submitted to the National Energy Board on the potential effects of a Trans Mountain pipeline rupture or tanker spill on salmon in the Lower Fraser River.

Nutrient Restoration Technician: British Columbia Conservation Foundation Sept – Oct 2014

- **Field Research**: Assisted B.C. Ministry of Environment staff with field work on nutrient restoration projects in Alouette and Wahleach Reservoirs. Duties included conducting stream spawner surveys of kokanee salmon including leading group of BCIT students, setting and retrieving gill nets, and identifying and processing freshwater fish including sexing and removing otoliths of salmonids.
- **Manuscript Preparation**: Lead collaboration with B.C. Ministry of Environment staff to produce a now published manuscript on the effect of their management efforts on nutrient dynamics in Alouette Lake. I lead all aspects of manuscript preparation including analysis, writing, submission and the review process.

University Research Experience

Masters Research: Simon Fraser University, Burnaby, B.C. Sept 2012 – Dec 2014

- **Masters Project**: Led field research project – designed and managed research project and crew consisting of two research and volunteer assistants; captured fish at field sites, tidal creeks and sloughs located throughout the lower Fraser Valley; identified freshwater fish species and juvenile salmon. Analysis – gained experience working with R software package to present and analyze data using various techniques. Research – gained experience in compiling primary literature and scientific writing while completing thesis and drafting manuscript for publication.
- **Snakehead Fish Project**: Worked with a team of researchers including a government scientist and geneticist to investigate the occurrence of a non-native snakehead fish discovered in a local pond. My duties including stable isotope analysis, working with Dr. Jon Moore on applying stable isotope tissue turnover model, writing manuscript and incorporating collaborators efforts and reviewers comments into now published manuscript. Worked with SFU Information Officer to draft press release, lead to >10 newspaper articles including Vancouver Sun, and recent CBC TV interview.

Research Assistant: Simon Fraser University, Burnaby, B.C. July 2012 – July 2014

- Lower Mainland Urban Stream Monitoring project: Assisted MSc Candidate Corinna Lichota in 2012 and 2013, and led research project in 2014. Collected physical data on streams and captured fish in small urban streams throughout the Lower Mainland using Backpack Electrofishing technique. Gained experience identifying freshwater fish and conducting stream research.

Research Assistant: University of Regina, Regina, S.K. Mar 2008 – Apr 2010

- Conducted field sampling of lakes throughout southern Saskatchewan under supervision of Dr. Bjoern Wissel. Duties included identification, enumeration and preparation for stable isotope analysis of zooplankton samples, preparation of various other types of samples for water chemistry and stable isotope analysis, and preparation of equipment for field season. Collected water chemistry data and water samples from lakes throughout southern Saskatchewan. Interpreted results from isotope analysis including using model to determine productivity to respiration ratios from dissolved oxygen saturations and isotope values.

Publications

Finn, R. J., Chalifour, L., Gergel, S. E., Hinch, S. G., **Scott, D. C.**, and Martin, T. G. 2021. Quantifying lost and inaccessible habitat for Pacific salmon in Canada's Lower Fraser River. *Ecosphere*, 12(7), e03646.

Kehoe, L. J., Lund, J., Chalifour, L., Asadian, Y., Balke, E., Boyd, S., Carlson, D., Casey, J. M., Connors, B. Cryer, N., Drever, M. D., Hinch, S., Levings, C., MacDuffee, M., McGregor, H., Richardson, J., **Scott, D. C.**, Stewart, D., Vennesland, R. G., Wilkinson, C. E., Zevit, P., Baum, J. K., and Martin, T. G. 2021. Conservation in heavily urbanized biodiverse regions requires urgent management action and attention to governance. *Conservation Science and Practice*, *3*(2), e310.

Chalifour, L., **Scott, D. C**., MacDuffee, M., Stark, S., Dower, J. F., Beacham, T. D., ... and Baum, J. K. 2021. Chinook salmon exhibit long-term rearing and early marine growth in the Fraser River, British Columbia, a large urban estuary. *Canadian Journal of Fisheries and Aquatic Sciences*, 78(5), 539-550.

Chalifour, L., **Scott, D. C.**, MacDuffee, M., Iacarella, J. C., Martin, T. G., and Baum, J. K. 2019. Habitat use by juvenile salmon, other migratory fish, and resident fish species underscores the importance of estuarine habitat mosaics. *Marine Ecology Progress Series*, 625: 145-162.

Scott, D. C., Chalifour, L., MacDuffee, M, Baum, J. K. and S.G. Hinch. 2019. Variation in Out-migration Timing and Estuary Reliance of "ocean-type" Chinook Salmon in the Fraser River Estuary, BC. NPAFC Technical Report No. 15, North Pacific Anadromous Fish Commission, Vancouver, B.C., Canada.

Chalifour, L., **Scott, D. C.**, MacDuffee, M, Dower, J. F., Beacham,T. D., and Baum, J. K. 2019. Characterizing Juvenile Chinook Salmon Residency and Early Growth in the Lower Fraser River Estuary. NPAFC Technical Report No. 15, North Pacific Anadromous Fish Commission, Vancouver, B.C., Canada.

Warkentin, L., Favaro, C., **Scott, D.**, Seifert, R., and Moore, J. W. 2018. Urban planning for fishes: untangling a new project's effects from old infrastructure and regional patterns. Canadian Journal of Fisheries and Aquatic Sciences, 999: 1-12.

Scott, D. C., Harris, S. L., Hebert, A. S., and van Poorten, B. T. 2017. Nutrient dynamics in a highly managed reservoir system: considering anadromous sockeye salmon (Oncorhynchus nerka) and nutrient restoration. *Lake and Reservoir Management*, 33(1): 14-22.

Scott, D. C., Arbeider, M., Gordon, J., and Moore, J. W. 2016. Flood control structures in tidal creeks associated with reduction in nursery potential for native fishes and creation of hotspots for invasive species. *Canadian Journal of Fisheries and Aquatic Sciences*, 73(7): 1138-1148.

Moore, J.W., Beakes, M.P., Nesbitt, H.K., Yeakel, J.D., Patterson, D.A., Thompson, L., Phillis, C.C., Braun, D., Favaro, C., **Scott, D.**, Carr-Harris, C., and Atlas, W. 2015. Emergent stability in a large free-flowing watershed. *Ecology*. 96: 340–347.

Gordon, J., Arbeider, M., **Scott, D.**, Wilson, S., and Moore, J. W. 2015. When the tides don't turn: Floodgates and hypoxic zones in the lower Fraser River, British Columbia, Canada. *Estuaries and Coasts*. 38 (6): 2337-2344

Scott, D., Moore, J., Herborg, L.M., Clarke Murray, C., and Serrao N.R. 2013. A non-native snakehead fish in British Columbia, Canada: Capture, genetics, isotopes, and policy consequences. *Management of Biological Invasions* 4(4): 265-271.

Presentations

Scott, D. C., MacDuffee, M., and Hinch, S. G. 2021. Potential factors influencing variation in early growth rates of juvenile Chinook salmon in the Fraser River, B.C. Canadian Conference For Fisheries Research, Vancouver BC, February 2022.

Scott, D. C., MacDuffee, M., Rondeau, E., Beacham, T., and Hinch, S. G. 2021. Hatchery and wild juvenile Chinook salmon show different habitat preferences in the Fraser estuary: insights from genetic analyses. Salmon Ocean Ecology Meeting, March 2021.

Scott, D. C., Chalifour, L., MacDuffee, M., and Hinch, S. G. 2020. Two years of juvenile Pacific salmon movement through `newly created breaches of a major barrier in the Fraser River estuary, British Columbia, Canada. American Fisheries Society Virtual Conference. September 2020.

Scott, D. C., L. Chalifour, J. Baum, M. MacDuffee, and S.G. Hinch. 2020. Movements and habitat use of juvenile salmon in the Fraser estuary. 14th annual Symposium on Salmon migrations, ecology and management. University of British Columbia. Vancouver, British Columbia. February 6, 2020.

Scott, D. C., M. MacDuffee, and S.G. Hinch. 2019. Juvenile Pacific salmon movement through newly created breaches of a major barrier in the Fraser River estuary, British Columbia, Canada. American Fisheries Society and The Wildlife Society Joint Workshop. Reno, Nevada, USA. October 1, 2019.

Scott, D. C., Chalifour, L., MacDuffee, M, Baum, J. K. and S.G. Hinch. 2019. Variation in Out-migration Timing and Estuary Reliance of "ocean-type" Chinook Salmon in the Fraser River Estuary, BC. North Pacific Anadromous Fish Commission Workshop, Portland, Oregon, USA, May 18, 2019.

Scott, D., Chalifour, L., MacDuffee, M., and Baum, J. 2018. Characterizing juvenile Chinook salmon outmigration timing, size and population origin in the Fraser River estuary. Salish Sea Ecosystem Conference. Vancouver, B.C.

Scott, D. 2016. Flood control structures in tidal creeks associated with reduction in nursery potential for native fishes and creation of hot-spots for invasive species. Salish Sea Ecosystem Conference. Vancouver, B.C.

Scott, D. 2014. Impacts of small scale flood proofing barriers on fish communities in tidal creeks. Eco Evo Retreat. Brackendale, B.C., November 2014.

Hebert, A. S., **Scott, D.**, Harris, S., Weir, T. 2014. A Multi-Step Approach To Restoring Anadromy in Alouette Reservoir (British Columbia): Understanding Nutrient Fluxes of Our Management Activities. Joint Aquatic Sciences Meeting. Portland, Oregon, May 2014.

Scott, D. 2014. Altering Connectivity in Tidal Creeks: Impacts of flood proofing on fish communities in Lower Fraser streams. Pacific Ecology and Evolution Conference. Bamfield, B.C., March 2014.

Scott, D. 2013. Invasive Species CSI: The Case of the Snakehead. Pacific Ecology and Evolution Conference. Bamfield, British Columbia, March 2013.

Scott, D., Quiñones-Rivera, Z., Bogard, M., Leavitt, P.R., Wissel, B. 2010 Quantifying Productivity and Respiration in a Urea Fertilization Experiment using O2 and CO2 Stable Isotopes. Canadian Conference For Fisheries Research. Winnipeg, Manitoba, January 2010.

Awards

- AWD 4848 – Mary and David Macaree Fellowship, Forestry Graduate Student Award, University of British Columbia, Fall-Winter **2019**.
- National Science and Engineering Research Council CGS – D Award, **2018**
- University of British Columbia Graduate Fellowship (Doctorate), **2018**
- Best Talk Award – Ecology and Evolution retreat, Brackendale, B.C. **2014**
- Coastal Zone Canada (BC) Association Graduate Fellowship in Coastal Studies. **2013**
- Simon Fraser University Graduate Fellowship (Masters), **2012**
- University of Regina Academic Silver Scholarship, **2009, 2008**
- University of Regina Wildlife Awareness Prize in Biology, **2009**
- NSERC-Undergraduate Student Research Award, **2009**

Conservation coalition review of "Agency conditions and VFPA responses to Minister's Information Requests"

Supplemental expert report prepared for the Impact Assessment Agency and the Minister of Environment and Climate Change

Prepared by:

Scott Veirs, PhD
Val Veirs, PhD
Beam Reach Marine Science & Sustainability (SPC)
Seattle, WA, USA

Prepared for:

David Suzuki Foundation
Wilderness Committee
Raincoast Conservation Foundation
Georgia Strait Alliance

March 4, 2022

General info

Background, expertise, and qualifications

I: Dr. Scott Veirs

Dr. Scott Veirs is an expert in marine bioacoustics, oceanography, and ecology of the Salish Sea. He specializes in the quantitative evaluation of acoustic impacts on marine mammals from individual and cumulative human activities.

Dr. Veirs was trained in environmental science as the first Earth Systems major at Stanford University and received a Masters and PhD in Oceanography from the University of Washington. For the last 20 years, his research has focused on killer whale bioacoustics and quantifying underwater noise pollution, particularly from commercial ships, in Washington and British Columbia. From 2005-2012 he organized bioacoustic field research projects for 50 undergraduates during which he observed the behavior of Southern Resident Killer Whales (SRKWs) over many seasons within their core summertime habitat (the central Salish Sea).

Currently, Dr. Veirs helps coordinate the Orcasound hydrophone network and chairs the Marine Mammals Work Group of the Puget Sound Ecosystem Monitoring Program (PSEMP). He is a member of the Acoustical Society of America and most recently presented research with his colleague, Dr. Val Veirs, at the fall, 2021, meeting of the Society in Seattle on real-time passive acoustic monitoring of SRKWs. Since January, 2019, he has served as Chair of the Marine Mammal Work Group which is currently developing a monitoring framework for underwater noise within the Puget Sound Vital Signs.

Further details regarding his educational background and professional experience are provided in Attachment A.

II: Dr. Val Veirs

Dr. Val Veirs has worked on underwater noise, orca vocalizations and echolocations, and ship noise for the past 20 years from his lab on San Juan Island. He maintains one of the hydrophones in the Orcasound network on the eastern shore of Haro Strait where he has listened to many container ships traveling to and from the Port of Vancouver, as well as the Southern Resident Killer Whales.

Dr. Veirs is retired from Colorado College where he was Professor of Physics and Director of Environmental Science. He has many related publications and workshop presentations. Further details regarding his educational background and professional experience are provided in Attachment B.

Relationship to funders

Do you have any relationship with David Suzuki Foundation, Wilderness Committee, Raincoast Conservation Foundation, or Georgia Strait Alliance that might affect your duty to be objective and impartial in providing your opinion?

No, we do not.

Do you have any relationship with VFPA, Fisheries and Oceans Canada, or Environment and Climate Change Canada?

Scott has served intermittently on the technical committees organized by the ECHO program, which is administered by the VFPA. As an organizational member of Orcasound, Beam Reach has received DFO funding as a subcontractor to Simon Fraser University for a transboundary collaborative effort to share open acoustic data, open source software, and machine learning models.

Opinion on Information Request Responses and Draft Conditions

The bioacoustic impacts of noise generally depend on received level, frequency overlap, and duration -- but are context-specific (Ellison et al. 2012). Noise from loud music may be desirable when you're going to a concert, but really stressful if you're trying to have a meeting. Orcas sometimes choose to surf the wake of a container ship, putting themselves very close to the noise from the ship, but they're not trying to accomplish an acoustic challenge like foraging at the same time. Thus, noise exposure when an orca is listening for faint communication cues or echoes (during foraging, for example) may be detrimental at very low levels compared to those that would evoke a response when they are in other behavioral states, like traveling or socializing.

The underwater soundscape of the Salish Sea is already too loud for SRKWs. The best available science (Holt 2008; Lacy et al. 2017) says reducing noise can dramatically increase foraging space. The proponent's models suggest orcas are losing ~20 days of foraging opportunities under current levels of vessel noise. As society struggles with the challenge of saving Chinook along the west coast, we must remember that *decreasing* noise when SRKWs are foraging increases their access to scarce salmon and is therefore equivalent to *instantly* bolstering their food supply. On the other hand, every incremental increase in noise for SRKWs at the wrong place and time -- even if for an extra hour -- reduces their access to food.

Where and when SRKWs overlap with container ship noise matters. Especially in the environmental impact assessment of noise from "incidental shipping," the spatio-temporal details of real whale-ship interactions are lost in the proponent's averaging of SRKW habitat use, noise levels, and ship tracks. The spatial and temporal averaging continues in their current response, and the proponent's assumptions within their acoustic effect modeling continue to be less than precautionary, just as we felt they were in Undertaking 20 (Document 80054, https://iaac-aeic.gc.ca/050/documents/p80054/129951E.pdf; see our 2019 report to the Review Panel, appended). The routes of Roberts Bank Terminal 2 (RBT2) container ships and SRKWs movements are juxtaposed, typically with overlap or only a few kilometers separation, in much of the Salish Sea (Strait of Juan de Fuca, Haro, and in the southern Strait of Georgia). Nevertheless, the proponent remains fixed on expanding capacity in the same river delta where J pod is seeking salmon with less predictable timing and increasing intensity.

For these overarching reasons and other detailed ones we present in this report, we disagree with the proponent's conclusions. We instead assert that the impacts on SRKWs of RBT2 construction and operation are significant. And we argue that the proposed mitigations are not sufficient to prevent the recovery of the SRKWs from being jeopardized by the RBT2 project.

Response to Information Requests

I: Mitigation during construction

- **In light of the most-recent scientific information about the endangered Southern Resident Killer Whale (SRKW) population, we disagree with the proponent's conclusions**.

Even if the proposed mitigation measures are taken during construction of RBT2, the estimated lost foraging time is significant. Additionally, other potential acoustic impacts during the construction phase remain of concern to us, especially given recent changes in SRKW movement patterns -- specifically an increased use of the southern Strait of Georgia during fall/winter relative to spring/summer (Olson et al. 2018; Canadian Science Advisory Secretariat 2021). Unexpected shifts in SRKW movements continue to be observed this winter (2022) with real-time observations by sighting and listening networks in Washington showing that J pod is again exhibiting the "new normal" pattern of relatively high occurrence in the inland habitat near the Fraser River during winter months (Oct-Mar), and reduced use of during spring months (Shields, Lindell, and Woodruff 2018).

When the current demographic condition and less predictable movements of the SRKWs are considered with the ongoing acoustic impacts in the Fraser River delta of Deltaport operations, and the potential impacts of RBT2 over decades, we believe the construction impacts have the potential to jeopardize the recovery of the SRKW population. We base our opinion on three basic observations or recent publications which are not fully considered in the response of the proponent or the draft conditions:

First, during the RBT2 review process, the SRKW population has continued to fail to recover (Figure 1, from the Puget Sound Vital Signs https://vitalsigns.pugetsoundinfo.wa.gov/VitalSignIndicator/Detail/32 and based on census data from the Center for Whale Research). We missed by a long shot a 2020 U.S. recovery plan goal of "95 individual Southern Resident Killer Whales, which would represent a 1 percent annual average growth rate from 2010 to 2020."

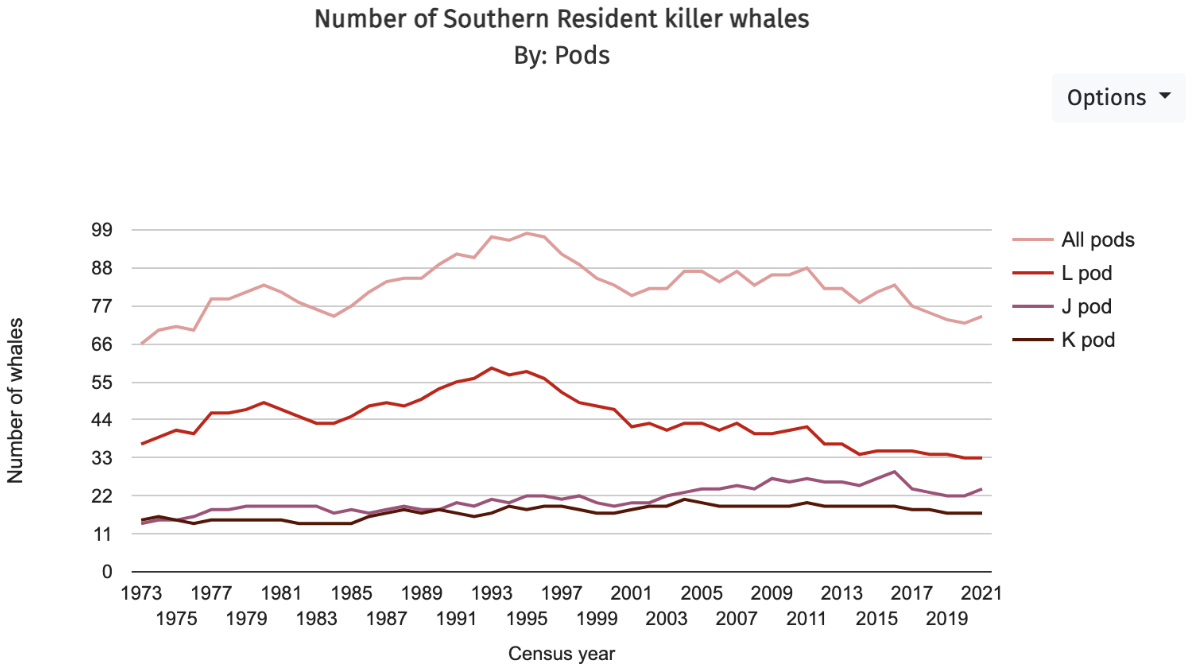


Figure 1: SRKW Population History

The population of L pod has reached an all-time low. K pod continues to decline. As of March 2, 2022, two out of three expecting females in J pod have lost their pregnancies. Overall, the population's demographic situation has worsened, in part due to the loss of more reproductive or post-reproductive females, like L47 in September, 2021 (age 47). The loss of such a grandmother can mean a decrease in survival rate for weaned grand offspring of 5-30%, depending on their age -- the "grandmother effect" (Nattrass et al. 2019).

Secondly, we think it is likely that females have a greater avoidance response to vessel noise than males. This was suggested recently as a possible mechanism to explain observations of females transitioning to non-foraging behavioral states during close approaches of whale watching vessels (Holt et al., 2021). If correct, it would mean lost foraging time may be underestimated by the construction impact models which do not account for sex differences, and may miss negative consequences for reproductive processes like fetal growth during pregnancy, lactation after calving, or missed opportunities to benefit from the grandmother effect. Only a precautionary approach that *reduces* noise impacts dramatically (e.g. by 10 dB per decade) is likely to lead to more successful reproductive outcomes among the few remaining reproductive females and improved survival in the SRKW population. Aspiring to "no net increase" in noise from any given development project is not a cumulative recipe for success across the Salish Sea region, or their range.

Finally, in the latest analysis by the proponents there remains an increased bioacoustic impact. They conclude that "approximately 2 hours (1.2 h – 7.6 h) of potential lost foraging time per killer whale over the entire six years of in-water construction" (IR2020-2.3 at page 2). Additionally, there are new uncertainties that cause us to project that SRKW recovery could be jeopardized, even upon successful implementation of the proposed mitigation measures.

Based on the previous two points (about their demographic precariousness and foraging disruption by noise), we judge that ~2 hours/whale lost foraging time over 6 years of construction constitutes an adverse impact on SRKWs. New uncertainties in the bioacoustic modeling methodology that we discuss in the next section suggest the modeling would be appropriately precautionary only if they were to use the proponent's *upper* limit of lost foraging time (7.6 hours/whale over six years) instead of the approximate mean (2 hours/whale). Also, we find the proponent's unit of hours/whale less informative than if we convert to days lost for the population (~75 whales): 2 hours/whale over 6 years is equivalent to more than 1 day per year for the population; 7.6 hours/whale converts to almost 4 days/year.

While the whole population losing 1-4 days of foraging per year is significant, it is also worth asking what happens if something goes really wrong. We must at least briefly consider the population consequences of a mitigation failure, especially a worst-case scenario. For example, if an MMO fell asleep or a stop work order was accidentally not followed and a lactating female SRKW was present near the center of an exclusion zone as impact-pile driving began, might that animal suffer a temporary threshold shift (short-term deafness) that results in her being unable to hear an on-coming vessel in time to avoid being struck and killed by a vessel, just as J34 apparently was just north of RBT2 site (off Vancouver and Sechelt, BC).[1] Such an accident could remove a breeding age female and shortly thereafter her calf with catastrophic consequences for the SRKW population.

- **New uncertainties within the acoustic effects models leave us unconvinced that the proposed measures will be effective at protecting SRKWs during RBT2 construction.**

One emerging source of uncertainty is whether the SRKW movement patterns have changed significantly during the environmental assessment process. This issue was first raised by recent data from DFO that showed a higher likelihood of SRKW presence at Roberts Bank in September recently (DFO, 2021) than would be expected from the long-term historic means used in the proponent's models (including most-recent data that are ~5 years old now). An even more recent example of this change is 2021 opportunistic sightings of SRKWs within the Salish Sea (Figure 2) that show occurrence was the *opposite* of the seasonal habitat use statistics used by the proponent.

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[1] This hypotheses regarding the death of J34 in December, 2016, should be confirmed or denied as part of the RBT2 assessment. This should include the publication by DFO of the full necropsy report and supporting data. After more than 5 years all that has been released is this 2-paragraph synopsis -- https://www.pac.dfo-mpo.gc.ca/fm-gp/species-especes/mammals-mammiferes/j34-eng.html

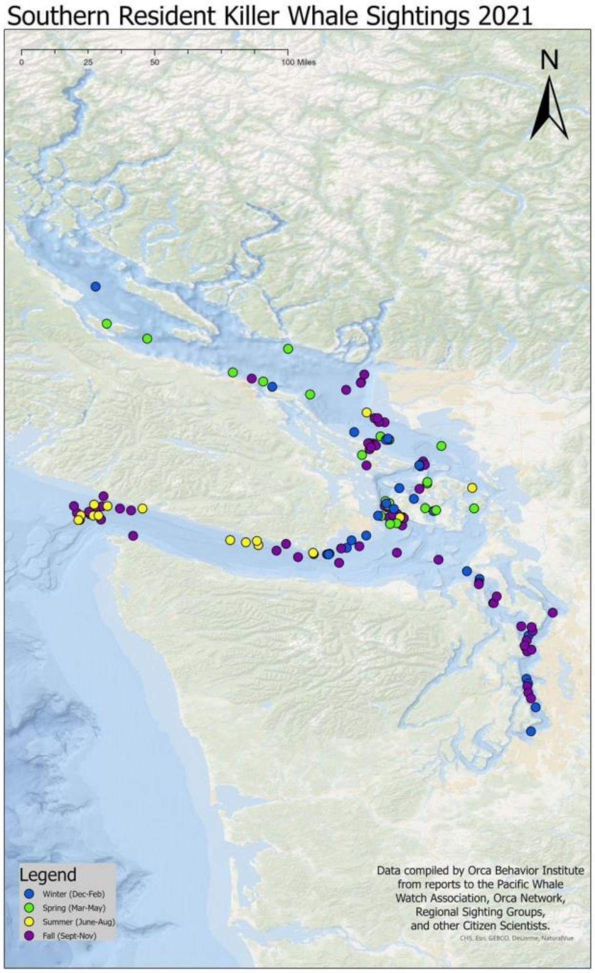

Figure 2: SRKW Sightings by season in 2021 (Orca Behavior Institute)

SRKW pods occurred in the southern Strait of Georgia on more sighting-days in fall and winter (purple and blue dots) than in spring and summer (green and yellow dots). We are concerned that this emerging usage pattern could cause a significant departure from the proponent's 16-year average of "~19 days in winter (November to April)" (Appendix IR2020-2.3-E, page 8, https://iaac-aeic.gc.ca/050/documents/p80054/141573E.pdf) upon which some of the construction mitigation measures are based. All pods frequented the delta in September 2021 and at least two pods (J and L) occupied the southern Strait of Georgia in winter 2021-22.

Specifically, this new movement pattern calls into question the optimal timing for the noisiest construction activities described under mitigation evaluation (Section 2.4.4, Appendix IR2020-2.3-E, p. 28), i.e. any time between Oct. 1 - Feb 29 (Figure 3, reproduced from Appendix IR2020-2.3-E, p. 13). Beyond these shifts in September occurrence, based on the last ~5 years observations (2017-2022), we now expect J-Pod to occur regularly in the Salish Sea in January through March, and expect them hardly at all in April, May, and June. This is a very different seasonal pattern than the historical averages suggest and the proponents rely upon. Thus, to take a more precautionary approach, we recommend that impact-pile driving and other construction activities that cause higher-risk in-water noise be limited to the month of April (or at least the Mar-May period).

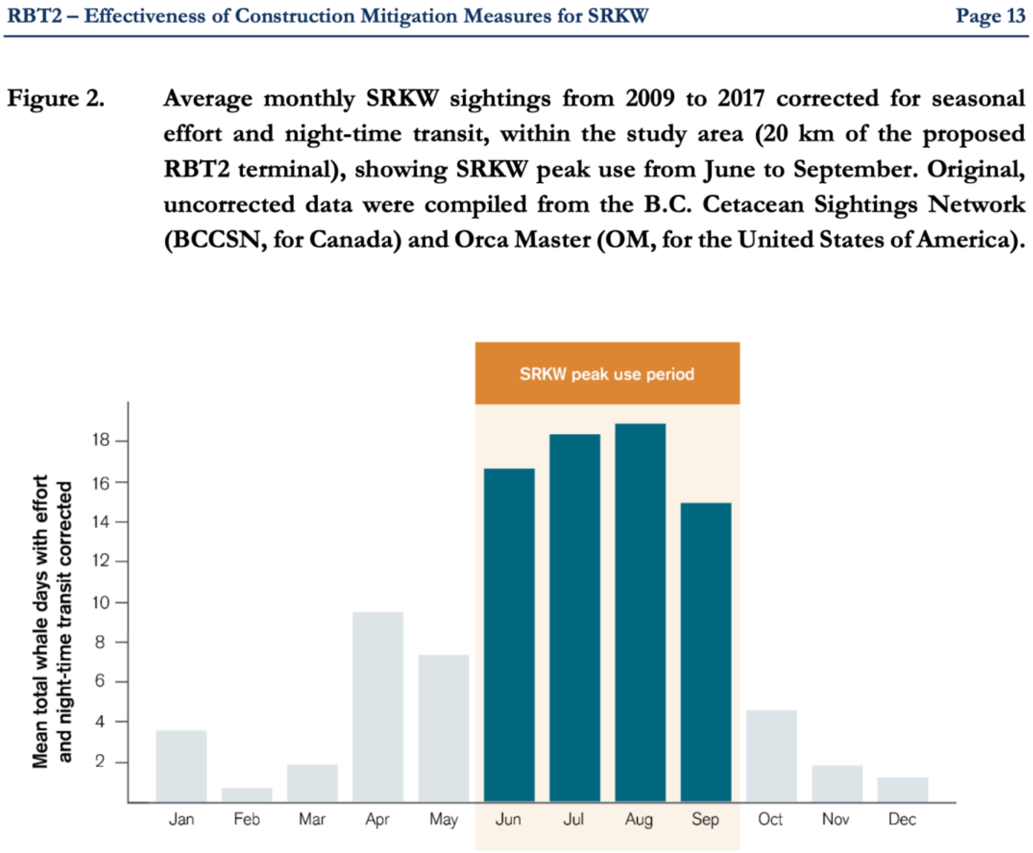

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Figure 2. **Average monthly SRKW sightings from 2009 to 2017 corrected for seasonal effort and night-time transit, within the study area (20 km of the proposed RBT2 terminal), showing SRKW peak use from June to September. Original, uncorrected data were compiled from the B.C. Cetacean Sightings Network (BCCSN, for Canada) and Orca Master (OM, for the United States of America).**

Figure 3: Historic seasonality of monthly SRKW occurrence. In more recent years, the “new normal” for J pod occurrence within the study area has minima in April and May, rather than winter months (Nov-Mar).

Related to this, we recommend that stop work measures based on SRKW presence within the Salish Sea be a planned mitigation measure year-round, rather than a contingency plan with an ambiguous cessation area. Section 5 of the proponent’s construction response (IR2020-2.3, p 12, https://iaac-aeic.gc.ca/050/documents/p80054/141572E.pdf) states (bold emphasis ours): “Although we have high confidence in the planned mitigation measures, we recognize that **unexpected issues can arise**; in this event, our contingency plan is to extend temporary stop-work measures (issued as part of planned mitigation) until SRKW leave the area.”

A second source of uncertainty are key assumptions of the new models, including SRKW transit speed and the “polygon strip” used to estimate the closest point of approach (CPA) of SRKWs to the proposed pile driving activities (Figure 4, adapted from, Appendix IR2020-2.3-E at p 10; PDF p.177, https://iaac-aeic.gc.ca/050/documents/p80054/141573E.pdf). We believe that this rectangular region, oriented by the proponents orthogonal to the terminal face, is one of the least precautionary assumptions that could be made in characterizing CPA. By simultaneously assuming that SRKWs forage through the construction site parallel to shore and the berthing face, and including transits through the polygon associated with SRKWs traveling to/from Active Pass in a fan-shaped distribution, the proponents bias the first step of the pseudo-code implemented to calculate potential lost foraging time (Appendix IR2020-2.3-E at p 28; PDF p.195).

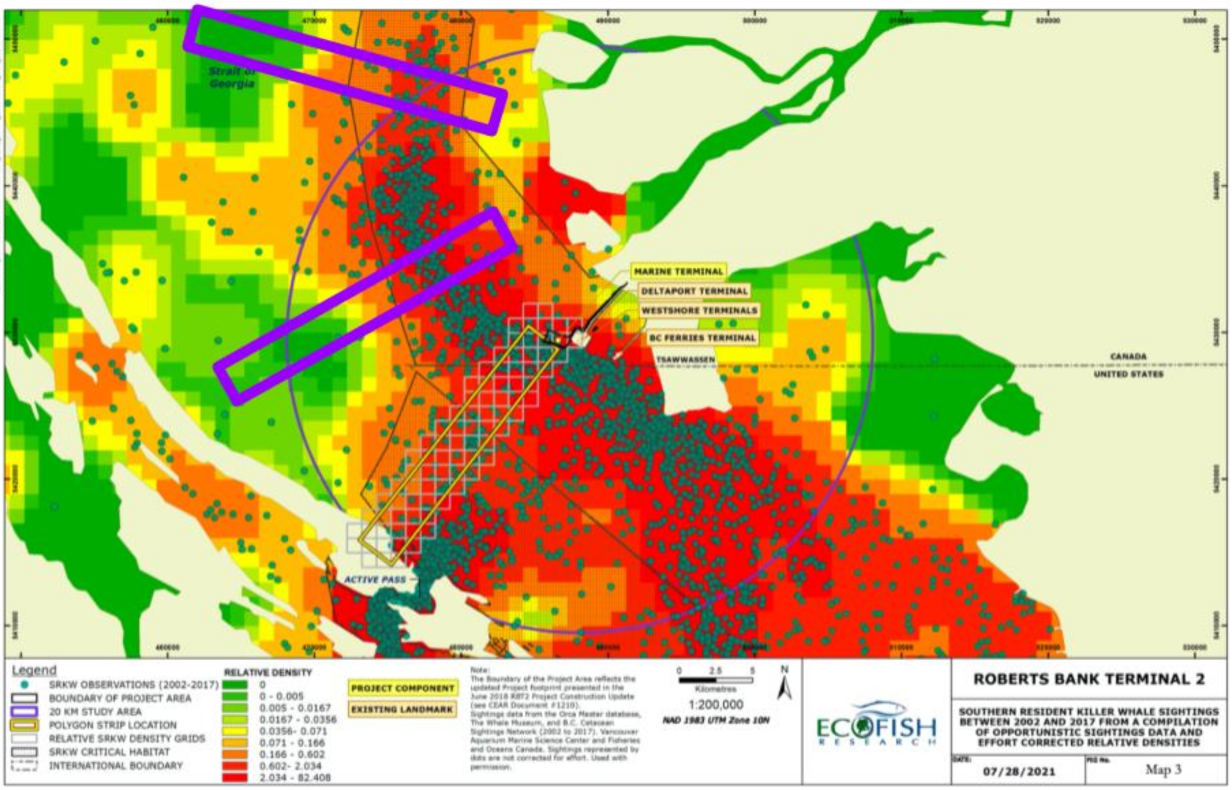

Figure 4: SRKW sighting density map with purple sampling “strips” that could have been used to generate a more accurate probability distribution of SRKW transits of the RBT2 terminal site as a function of distance offshore from the Fraser River delta and proposed berth face. The proponent’s sampling strip is the yellow rectangular region.

It would be more precautionary to assume that orthogonal to the berthing face, the foraging activity of SRKWs is distributed spatially as Figure 4 depicts it north of the fan-shaped travel corridors associated with Active and Boundary Passes. This could be accomplished by orienting the strip orthogonal to the shoreline offshore from the south or north arms of the Fraser river mouth (see purple rectangles in Figure 4 that we have added to the proponent’s Map 3). The SRKW density distribution obtained from either purple box would be similar and oceanographically and ecologically expected: the closer you are to the bathymetric face of the Fraser River delta, the more likely it is that the SRKWs will occur.

In contrast, the proponent’s sampling strip results in a distribution with a dip at intermediate ranges and elevated density at high ranges (Figure 5, from Appendix IR2020-2.3-E at p 15; PDF p. 182).

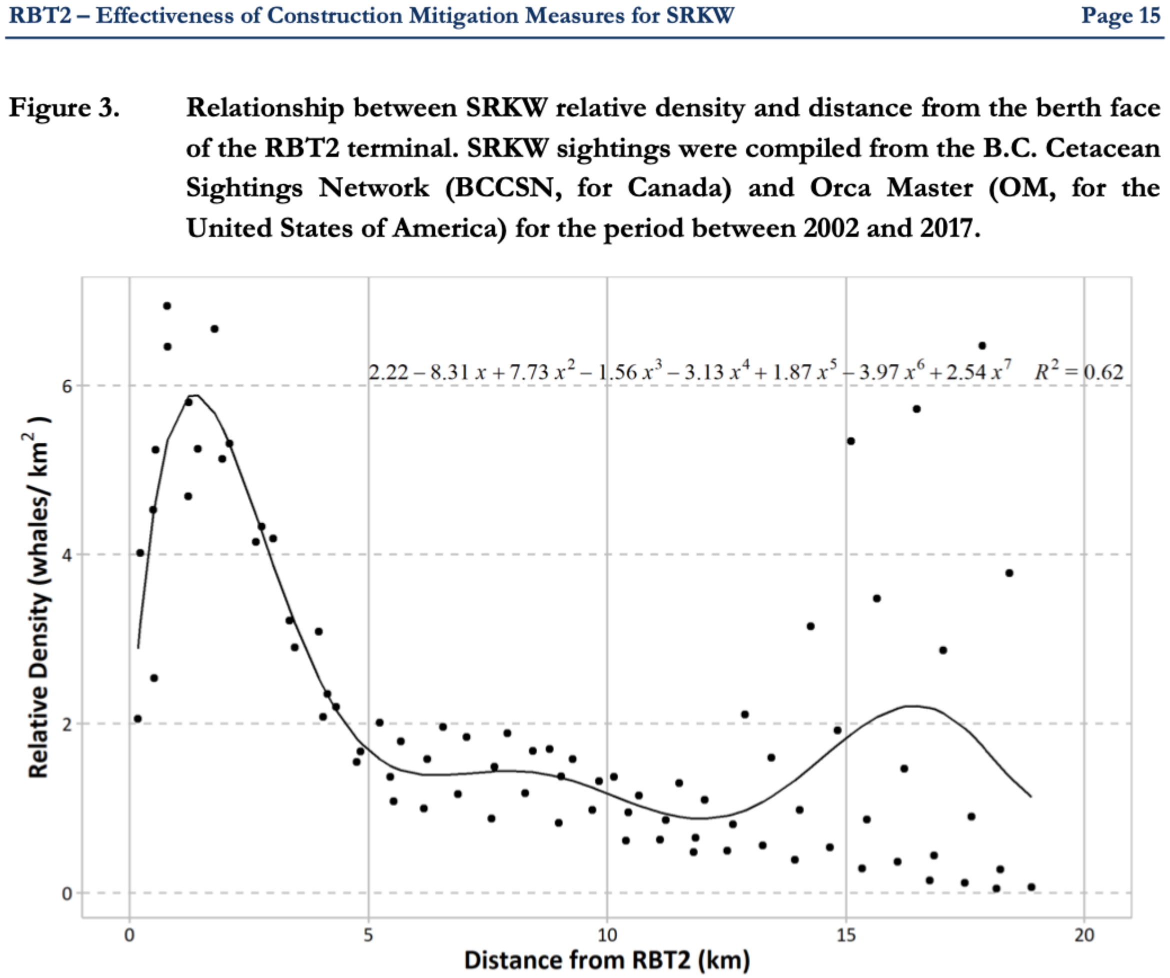

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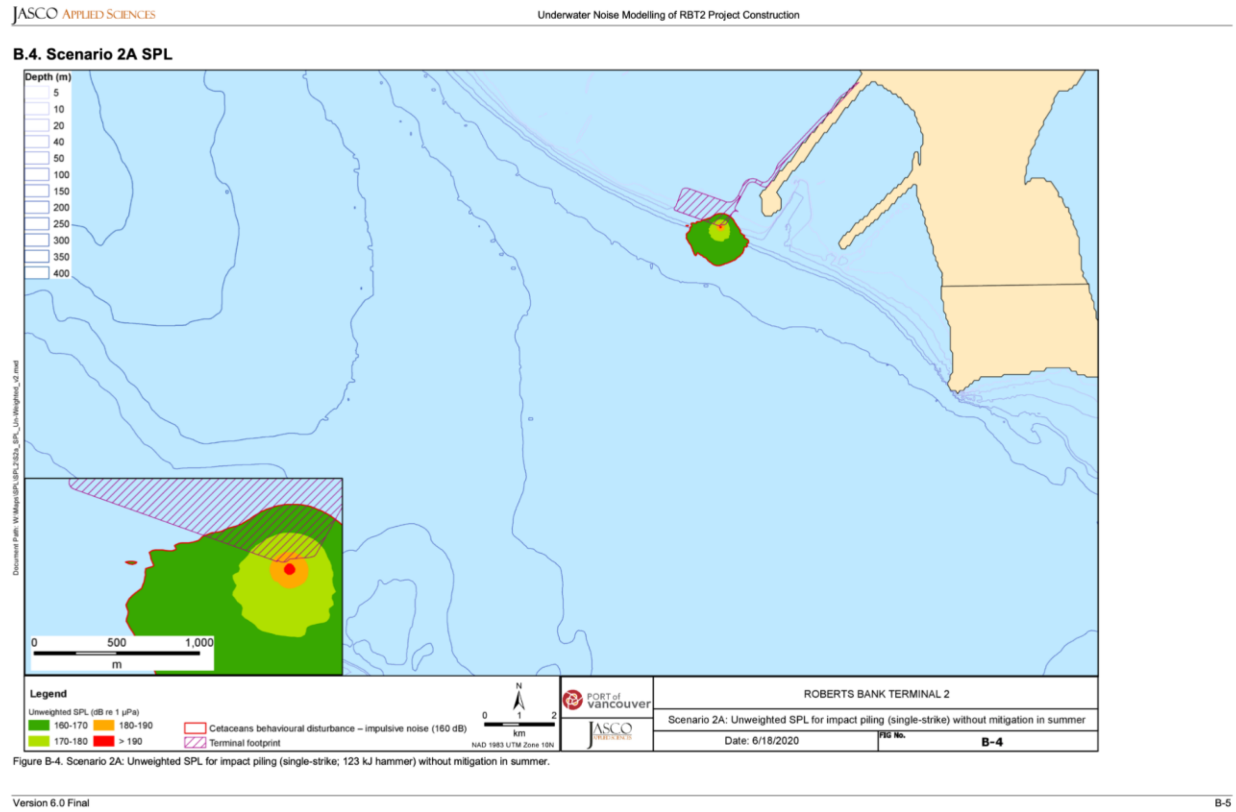
Figure 3. **Relationship between SRKW relative density and distance from the berth face of the RBT2 terminal. SRKW sightings were compiled from the B.C. Cetacean Sightings Network (BCCSN, for Canada) and Orca Master (OM, for the United States of America) for the period between 2002 and 2017.**

Figure 5: SRKW relative density as a function of range from the RBT2 berth face.

This assumption results in an underestimation of the probability that SRKWs will transit the noise field at close ranges (i.e. 0-3 km). Possibly even more dangerous is the additional assumption that the density of SRKWs is not maximum at the berth face. While the proponent fits a 7th-order polynomial to the observations that decreases from a maximum of ~6 whales/km2 at 1.5 km range to half of that at the berth face (Figure 5), it would be much more precautionary to assume that the maximum observed density in either purple strip in Figure 4 represents the SRKW density at the berth face. Furthermore such an approach would be logical because the nearshore SRKW density distribution maxima follow the bathymetric face of the delta -- the same bathymetric feature on which the RBT2 berth would be perched.

It is critically important to be conservative in estimating this distribution because the noise intensity offshore from the berth face decreases roughly as the square of the range. During the summer months when the sound speed profile limits propagation more, the 160 dB isopleths extend 1-2 km from the berth face (Figure 6, reproduced from Figure B-4 from [Appendix IR2020-2.3-C](https://iaac-aeic.gc.ca/050/documents/p80054/141573E.pdf) at p B-5 (PDF p 104), https://iaac-aeic.gc.ca/050/documents/p80054/141573E.pdf).



JASCO Applied Sciences Underwater Noise Modelling of RBT2 Project Construction

B.4. Scenario 2A SPL

Figure B-4. Scenario 2A: Unweighted SPL for impact piling (single-strike; 123 kJ hammer) without mitigation in summer.

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Figure 6: An example of noise isopleths with a hemi-circular distribution, in this case extending just a couple kilometers away from the berth face. Note the position of the berth face on the outer bathymetric edge of the Fraser River delta.

In other cases, the noise field that could cause behavioral change (e.g. away from foraging) during construction activities may extend much further offshore; the proponents state that under the current assumptions, “the largest exclusion zone (>7 km)” may be necessary for “5 of the 58 months of in-water construction.” ([Appendix IR2020-2.3](https://iaac-aeic.gc.ca/050/documents/p80054/141572E.pdf), pg. 8, https://iaac-aeic.gc.ca/050/documents/p80054/141572E.pdf). In such situations, estimating the probability of a nearshore transit by SRKWs accurately is even more important because of how much steeper the noise level gradients are within the first few km from the berth face.

This first step in the pseudo-code of the Monte Carlo simulation also underpins the potential lost foraging time computations. Additionally, even as the new models assume conservatively that all transits during construction and operation consist of SRKWs in a foraging behavioral state (which we applaud), the speed used to model the exposure to noise for SRKWs moving through the noise field is based on the traveling behavioral state. It would have been more precautionary to assume a slower speed through the modeled noise field during foraging than the mean speed of traveling SKRWs: 5.75 km/hr (Williams and Noren, 2009).

For both of these reasons, we are concerned that the most-recent bioacoustic modeling underestimates the impacts on SRKW. This concern fits within the pattern we identified in Undertaking 20: bioacoustic model assumptions shifting from precautionary to less-and-less conservative (see Question 1 of our 2019 report to the Review Panel, appended).

Pending a reassessment of the SRKW density function in the acoustic effects modeling, we recommend a radial buffer beyond the exclusion zone for a particular activity of at least +3 kilometers, or about half of an hour of SRKW traveling at their mean speed of ~6 km/hr. Based on the proponent's estimate that "effective range of PAM system (~6 km) and MMO NOAA protocols (up to 6 km)" and typical exclusion zone radii for RBT2 activities, we think that reliable detection within this increased buffer will be feasible.

We are glad to see that Reinhall (http://www.marinecontech.com/) pilings are mentioned specifically (IR-2.3 appendices, (Appendix IR2020-2.3-E, page 8, https://iaac-aeic.gc.ca/050/documents/p80054/141572E.pdf)). This newer type of double-walled pile may reduce source levels by up to 20 dB re 1 uPa @1m during impact pile driving. We recommend that such pilings be used for the (estimated four) pilings that will be driven via impact hammering instead of vibratory methods.

II: Mitigation during operation and marine shipping incidental to the project

- **We believe that the combination of the acoustic impacts due to terminal operations after RBT2 expansion and the impacts of other shipping activities at the mouth of the Fraser River is likely to further jeopardize the recovery of the SRKW, even after the proposed mitigation measures.**

The SRKW continue to frequent this estuary searching for returning Chinook salmon upon which they are critically dependent. The proponent hints at a scenario which we feel would be most precautionary given the current precarious demographic situation faced by the SRKWs (IR2020-3, https://iaac-aeic.gc.ca/050/documents/p80054/141574E.pdf, pg.6):

> 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. Limiting terminal capacity is unnecessary in view of the measures that would be able to mitigate potential effects to SRKW (Appendix IR2020-3-B, pg. 6, https://iaac-aeic.gc.ca/050/documents/p80054/141574E.pdf)).

Since we disagree that the proposed measures will adequately protect SRKWs, we posit that it would definitely help the SRKW if some of the shipping projected for Vancouver, especially the terminal in the Fraser delta, were diverted instead to ports outside of the Salish Sea (or at least outside the delta). This would be the ultimate lateral offset, especially for J pod in recent years when they have shifted to frequenting the Fraser not only during the summer season (Jun-Sep), but also increasingly through the fall and winter months (Oct-Mar).

III: Acoustic Modeling:

- **The acoustic effects model is not appropriate, in part because it assumes noise above 1 kHz does not have any behavioural effect.**
- **Broadband evaluations must include energy in the hearing range of the SRKW.**

While it is conventional to use the 120 dB broadband level as a threshold of disturbance, there is no real behavioural science behind applying this number for killer whales. The only peer-reviewed direct observation of underwater noise correlating with change of behaviour in SRKW is the discovery that the source level (loudness) used by orcas increases as the broadband noise around those orcas increases (Holt et al. 2009). However, the 120 dB broadband level does give a reference level that is helpful for making relative comparisons (Richardson et al. 1995).

It must be noted that SRKW are relatively insensitive to noise with frequencies less than about 1 kHz. Hence, the 120 dB ‘broadband threshold’ is actually affecting SRKW because of the acoustic power at the high frequencies used for communication and echolocation, especially where SRKW hearing is most sensitive (Figure 7). Most of the acoustic energy, measured in dB, that is emitted by large ships is in the ‘low frequency’ regime, with peak noise power well below 1000 Hz. Noise at these low frequencies is not within the hearing range of the SRKW. But, ship noise extends well into the frequency ranges where SRKWs hear well, communicate, and echolocate (Veirs, Veirs, and Wood 2016).

A frequency band ~10-50 kHz approximately (Figure 7) is the band of frequencies that the SRKW use for communication and for echolocation. It is noise in this frequency region that affects the ability of SRKW to communicate with their conspecifics and to use echolocation clicks to find the salmon prey that they desperately need. The use of the 120 dB broadband threshold of disturbance is predicated on the assumption that broadband noise has high frequency components that affect SRKW behaviour.

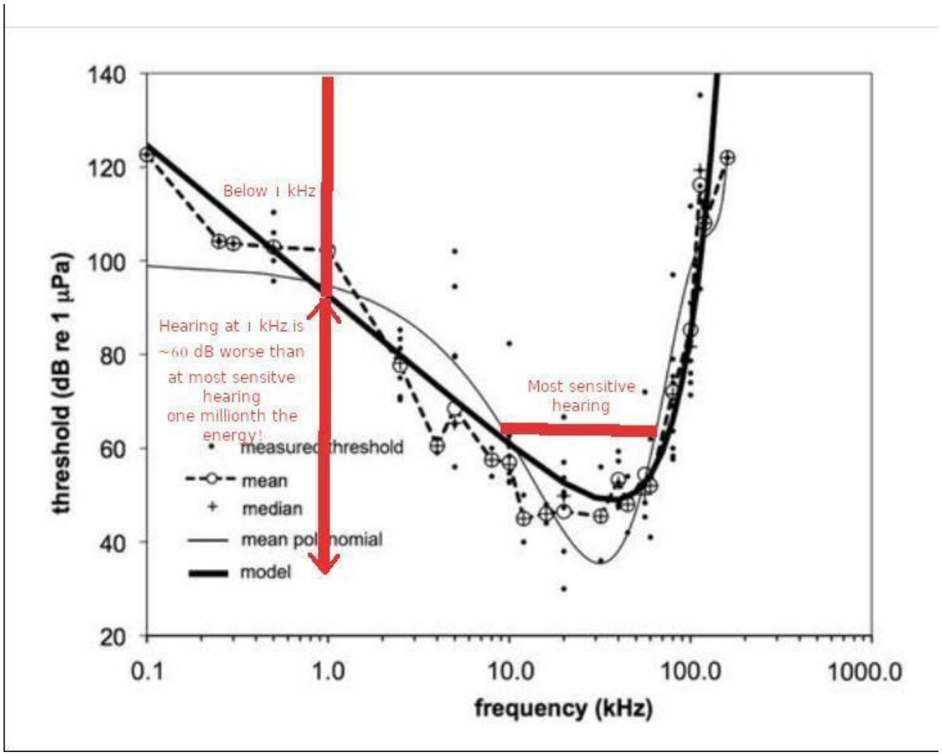

Figure 7: Killer whale audiogram showing their most sensitive hearing range (20-80 kHz). Red annotations are added for this report and also illustrate that at frequencies below 1 kHz, SRKW hearing is a million times worse than their peak sensitivity (Branstetter et al. 2017).

Thus, it is inaccurate for the proponents to state "Consequently, vessel size has a greater influence on echolocation click masking thresholds (above 1 kHz) than on behavioural response thresholds (which are dominated by noise below 1 kHz)." (Appendix IR2020-3-A, pg. 311, https://iaac-aeic.gc.ca/050/documents/p80054/141574E.pdf). Behavioural response evaluations must include the portions of acoustic energy that SRKW can hear and hence respond to, with needed assumptions spelled out.

Wherever possible the "120 dB as a threshold of disturbance" should be used as a threshold describing the aggregate acoustic effects of all anthropogenic noise sources that happen to be contributing to 120 dB level at the location of a SRKW. The assumption we all are working under is that when the noise level, from all sources, rises above 120 dB, this will cause acoustic disturbance which is in turn caused by acoustic energy that the SRKWs can hear. No individual noise source should be permitted to cause the 'ambient' noise at the location of a SRKW to rise above 120 dB without specific authorization. ('Ambient' here means the broadband noise from all other sources.)

The proponents predict that Mega-Max container ships will not radiate increased *broadband levels* of underwater noise. But, their modeled source level frequency spectra show that the Mega-Max ships will be 5-10 dB more intense at frequencies precisely in the frequency range where the SRKW hear best. It is essential that all comparisons between the acoustic impacts of

Mega-Max ships and other container ships incorporate this difference in high-frequency emissions (see Attachment C).

We conclude that the proponent’s analysis of noise from Mega-Max ships likely results in the acoustic effects model underestimating lost foraging time. Also, any additional lost foraging time is a severe threat to the recovery and even survival of the SRKW since they are so centered on the adult Chinook salmon that are, in smaller and smaller numbers, returning into the delta of the Fraser River.

IV: Unberthing:

- **Unberthing should be delayed anytime, day or night, that SRKW are in the area.**
- **Slower tugs are less impactful than fast tugs.**

Unberthing should be delayed anytime SRKW may be in the area, day or night. If efforts to detect SRKW at night are not pursued, then unberthing should be disallowed until daylight hours. As the proponent reports, unberthing creates lost foraging time and collision risk during the day. Clearly, it also has these effects at night. Monitoring via passive acoustics and video (visual and thermal IR) should be a part of all marine mammal observer efforts, day and night.

The conclusion, summarized below, that faster tugs create a smaller acoustic disturbance seems to be incorrect.

> “We evaluated the effectiveness of a vessel-assist tug traveling at 5 knots rather than the typical 8 knots….. 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 traveling tug overlaps a transiting SRKW” (IR2020-3, pg. 28 https://iaac-aeic.gc.ca/050/documents/p80054/141574E.pdf)

In a simple Monte Carlo simulation that we developed, a tug goes back and forth between two locations sometimes at 5 kts and sometimes at 8 kts leaving each station on the hour. The model suggests that it is actually better from a sound exposure level (SEL) perspective for the tug to go at the slower speed (by 3 dB SEL; see Attachment D).

Related to this, we note that the fundamental assumption behind the ECHO program’s multi-year vessel slowdown is that slower vessels have smaller acoustic impacts on the SRKW. Here is a quote from IR2020-3, page 1, https://iaac-aeic.gc.ca/050/documents/p80054/141574E.pdf, “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).”

The 3 dB difference predicted by our model is consistent with the 2.5-2.8 dB noise level reduction reported by ECHO due to the Haro Strait voluntary slowdown. If slowing commercial ships in Haro Strait works, then the same physics supports our model calculation that slower tugs will cause less disturbance than an equal number of faster tugs.

As a general rule, all classes of vessels should slow *as much as possible* to minimize their acoustic impact on SRKWs. In the case of tugs un/berthing container ships, an optimal mitigation plan would stipulate not a fixed speed limit (e.g. 5 knots), but even lower minimum speeds for the tugs during each of their activities: the guidance should be to use the lowest speed possible (below a set limit) at which they can still accomplish their functions safely. For any given source level, the lower your speed, the more likely the noise level received by a SRKW will be below the natural background noise levels.

V: Day/Night and Seasonal Southern Resident Killer Whale Foraging Issues

- **The SRKW may visit the Port of Vancouver area in either day or night.**
- **The SRKW have been changing their seasonal visitation behaviour.**
- **Ships and tugs should avoid common paths that SRKW use where possible.**

The study makes errors in two ways with respect to timing of noise sources. First, SRKW forage both in the daylight and at night. They operate acoustically. Underwater in the Salish Sea, most visible sight is absorbed at depths of 10 meters or less, so day or night makes little difference to echolocating SRKWs. Hence, the proponents must make efforts both day and night to minimize their noise impacts when SRKW may be present. This should apply both to the construction and to the operations stages of the project.

Second, the SRKW have been showing up less frequently in recent years and have spread their visits out throughout the year. Hence, slowdowns or re-routing etc must be carried out in any month of the year when observations or models suggest the SRKW may be present.

All future modeling should incorporate the most sensitive hearing range of the SRKW into evaluating potential acoustic impacts on these whales. In contrast, the proponents propose to model only broadband levels when estimating SRKW exposures to noise:

> *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). (IR2020-3, pg. 30)*

Field observations must be carried out operationally to assure that sound sources do not exceed the predicted levels. This should apply both to the construction and the operations phases of RBT2.

VI: New technologies:

Shore power:

> Provide shore power connections for container vessels (IR2020-3, pg. 26, https://iaac-aeic.gc.ca/050/documents/p80054/141574E.pdf)

This is a good idea and the proponent should charge a fee to any container ship that does not come equipped with this capability and connect up and use it. Include this requirement in Section 4 (pg. 26): “Contractually require the terminal operator to require RBT2-bound contain er vessels to participate in applicable initiatives of the ECHO Program (or equivalent)"

Electric tugs:

> 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. (IR2020-3, pg. 25, https://iaac-aeic.gc.ca/050/documents/p80054/141574E.pdf)

This is a good idea with careful attention to noise generated in the most sensitive hearing range of the SRKW.

Opinion on draft conditions

We comment on the relevant portion of the draft conditions (pages 23-28).

Many of the draft conditions are appropriate, but others need to be strengthened in order to constitute effective mitigation measures. Overall, we find the draft conditions to be too ambiguous or general for us to fully assess their effectiveness.

Thus, we remain concerned that even if all these conditions are met, they will be insufficient to prevent RBT2 from contributing to cumulative effects that jeopardize the recovery of the SRKW population.

Measures to be strengthened or questioned:

Measure 8.1.7 (avoid, from June 1 or the date Southern Resident Killer Whale (Orcinus orca) are confirmed by marine mammal observers to be present in the Salish Sea, whichever is later, to September 30:") should probably read "or a subsequent date." This is because in the "new normal" movement patterns of the SRKWs, it is likely they will be observed months prior to June 1 in any given year, especially in Jan-Mar relative to Apr-Jun.

Additionally, given recent changes in wintertime use of the southern Strait of Georgia, the same sub-measures should be taken during the winter months (Sep 30 - June 1), beginning whenever SRKWs are confirmed and extending 1 week after the last confirmed observation within the Salish Sea. An additional measure could be for a second week after the last sighting to intensify monitoring by the RBT2 MMOs per measure 8.2.7.2

Such wintertime avoidance periods would complement measure 8.2.6 by stipulating that all possible confirmation sources within the Salish Sea will be able to inform the mitigation measures at RBT2, rather than just the local MMOs monitoring the exclusion or SRKW buffer zones. The rationale is similar to 8.2.7.5, but adds the more precautionary approach of avoiding high-risk acoustic activities when the probability of SRKW entering the exclusion zones is much higher than when SRKWs have not been observed for >1 week. This would establish a much higher "standard of care" for SRKWs than the minimum-30-minute stop work period applied to marine mammals in general within measure 8.2.8.3.

Measure 8.2: Why is this plan not to be developed in consultation with other stakeholders (in addition to Indigenous groups)?

Measure 8.2.3 may have a typo. Is “when carrying each” meant to be “when carrying out each”?

Measure 8.2.5: Why is validation applied only for “continuous noise” sources when impulsive noise have higher source levels, and are therefore more likely to cause temporary or permanent threshold shifts at any particular range within (or potentially beyond) the exclusion zone.

Measure 8.3 should include expansion of the ECHO program. The ECHO program should be extended from Boundary Pass to RBT2 and further north into and from Burrard Inlet. This expansion should also ensure that the commercial traffic lanes are moved as far from the Fraser Delta as possible (i.e. at least as far as the red line in Figure 9). Ideally all RBT2 vessel traffic that traverses SRKW foraging habitat near the Delta, including persistent noise sources like tugs, should also be laterally offset similarly whenever possible. Minimal lateral offsets might be accomplished through the existing traffic separation schemes, but a great opportunity lies in devising a new scheme that avoids as much as possible the high-density SRKW areas (see Figure 4).

Currently, ships moving between the current terminal and Burrard Inlet pollute almost the entire delta with noise at close range. For example, Figure 8 shows a recent example of a container ship movement between Deltaport and an anchorage in Burrard inlet.

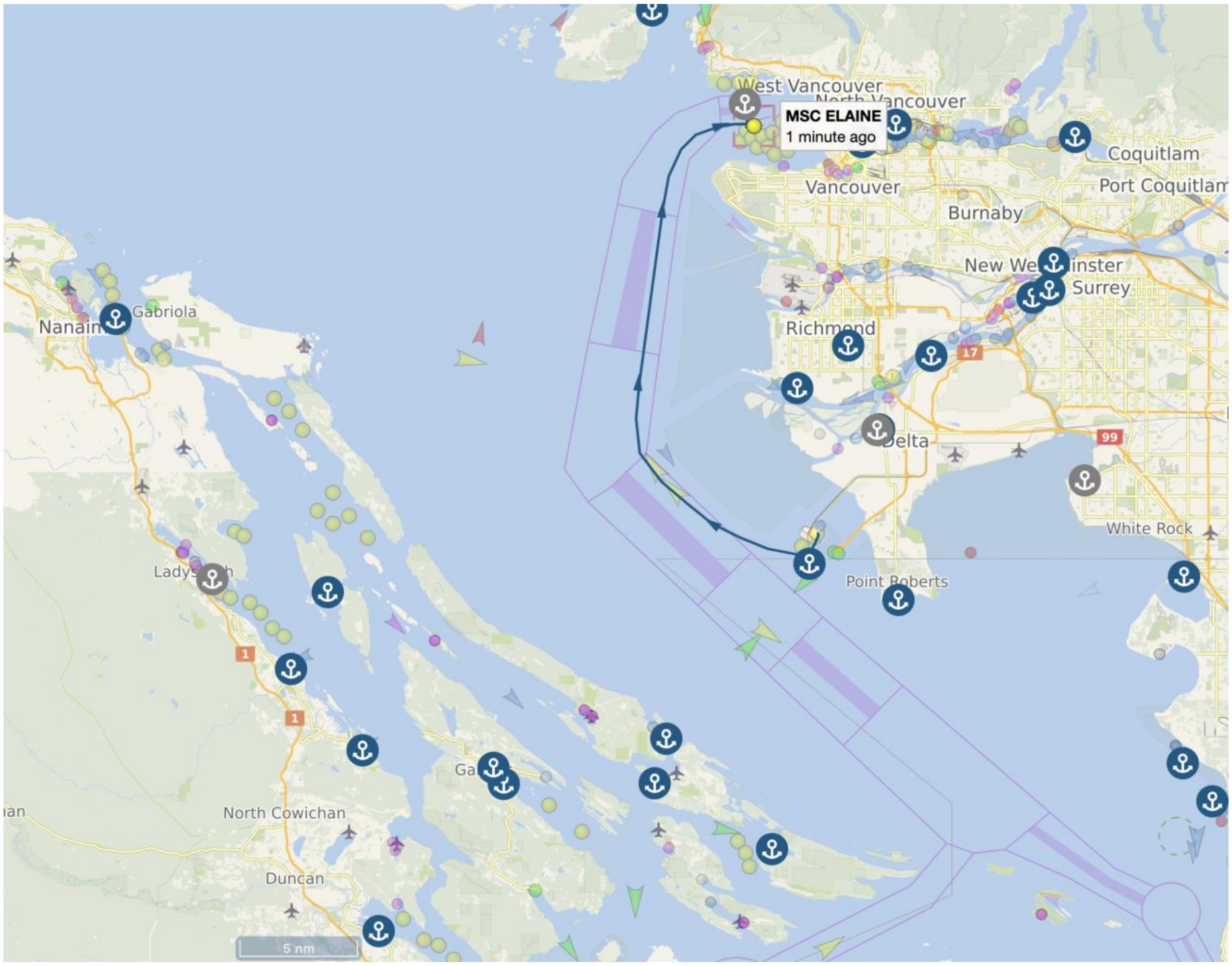

Figure 8: An example container ship transit from Deltaport to Burrard Inlet.
(Screen grab from vesselfinder.com in February, 2022.)

If we overlay the effort-corrected density of SRKW occurrence (Figure 4) on Figure 8, we can see in the resulting Figure 9 that these container ship transits are almost exactly in the worst possible place from the SRKW's perspective. The example transit (black curve) from Deltaport to an anchorage in Burrard Inlet, within the existing northbound shipping lane (pink boundary lines and solid pink separation zones), aligns almost exactly with the highest-density use of the Fraser delta region by SRKWs (orange/red shading and gray circle SRKW observation points).

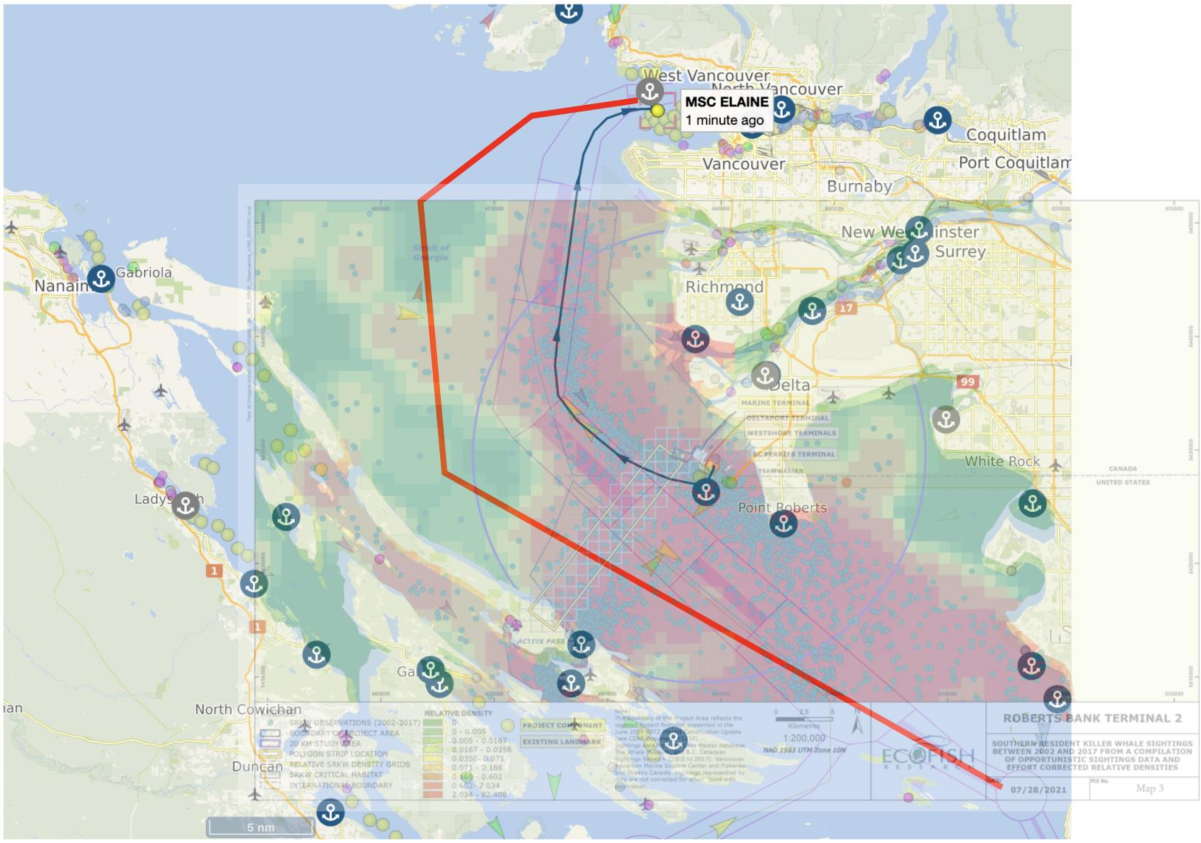

Figure 9: an overlay of Figures 4 & 8. The red annotation indicates a proposed re-orientation of the commercial shipping lanes to avoid proximity to the Fraser delta face and highest-density SRKW areas.

Similarly, the current traffic lanes and separation scheme could be shifted (e.g. per our added bold red line) so that turning circles are centered in the lowest SRKW density areas, and the lanes are laterally offset much further from the high-density SRKW areas that coincide with the bathymetric slope at the outer edge of the delta. Ideally the Twassen-Nanaimo ferry route would be similarly shifted, and both ferry and container ship traffic would approach and depart their terminals via routes oriented orthogonal to the delta face.

Measure 8.3.2 refers to the risk of fatal vessel strikes of SRKWs. To properly assess the effectiveness of mitigating this risk, this measure should include formal publication of the complete and final necropsy results for the SRKW J34 that stranded near Sechelt in December, 2016, to determine or constrain as much as possible what type of vessel struck and killed the whale. To date only a single-page initial necropsy report has been published by DFO and it is no longer publicly accessible via the (now broken) link on the U.S./NOAA SRKW site's strandings section -- https://www.fisheries.noaa.gov/west-coast/endangered-species-conservation/southern-resident-killer-whale-recovery-planning-and#strandings

Measure 8.4.1

A budget to limit actual lost foraging time to what was modeled is only a precursor to achieving “no net increase” in acoustic impacts to SRKWs throughout RBT2 construction and operation. Given the current trajectory of the SRKW population and demographics, there should be a “more than mitigate” budget to ensure that when SRKWs are foraging in the vicinity, both construction and Deltaport/ RBT2 operations and other ECHO noise mitigations reduce acoustic impacts below what they would have been without RBT2 construction and operation. Such a budget could quantify the contingencies that are described qualitatively in measure 8.4.4.

Measure 8.4.3.2 should include consultation with the Canadian Coast Guard and/or Transport Canada about moving the shipping lanes and BC ferry routes away from the high-density SRKW usage areas within the Fraser delta and southern Strait of Georgia. This sub-region of SRKW critical habitat in Canada and the U.S, so essential to SRKW foraging success with returning Fraser salmon, is unfortunately where both the Tsawwassen ferry and Robert’s Bank container ship terminals were located, historically. Short of correcting that unfortunate lack of ecological forethought by re-locating the terminals elsewhere (e.g. the southern or northern edges of the delta), the impacts of their ship traffic could be mitigated most effectively and continuously through such decisive operational adjustments.

Measure 8.5.1 should include assessment of the underwater noise from electric tugs and design constraints that ensure that neither the electric motors or the operation with them radiate additional noise in the frequencies where SRKW hearing is most-sensitive (i.e. ~20 kHz).

Measure 8.6 could also be applied to unberthing activities at night, e.g. when SRKWs are known to be within the Salish Sea, delay unberthing until daylight hours when visible marine mammal observation is effective.

Measure 8.6 could also apply to berthing activities. For example, if SRKWs are known to be within the Salish Sea, an incoming ship at night could be sent to anchor (e.g in Burrard Inlet) until daylight hours when it could commence berthing.

Feasible measures to add

We respectfully suggest that the proponent could consider the following feasible measures that have not yet been included in the draft conditions:

1. Lateral offset of the commercial shipping lanes as far as possible from the current terminals of the delta and the densest SRKW habitat use areas in the delta (eastward into the Strait of Georgia closer to the Gulf Islands).
2. Re-routing of the BC ferries coming to/from Tsawwassen as far as possible from the densest SRKW habitat use areas in the delta.
3. Moving the entire shipping, coal, passenger ferry terminal complex from Robert’s Bank to the south side of the delta, or at the least construct new containership capacity some place other than the central delta of the Fraser.

Condition 8.4.3.2

Offsets for underwater noise may be possible for SRKW, but in most cases meaningful offsets (that improve acoustic habitat where and when SRKWs are present) will require Federal coordination between the RBT2 project, ECHO, and other vessel traffic noise sources and management agencies in Canada, and possibly also the U.S. Here are a few examples of measures that could result in the most significant reductions in vessel noise for SRKWs:

1. Collaborate with the U.S. to implement a voluntary slow down near Swiftsure Bank for all inbound traffic, not just outbound traffic.
2. Collaborate with BC Ferries to move the Tsawwassen-Nanaimo run further offshore from the SRKW foraging area in the Fraser delta (Figure 10). Additionally, BC Ferries could shift capacity to Horseshoe Bay, thereby reducing the number of BC ferry transits of the Fraser delta and acoustic impacts (e.g. with smaller, slower ferries) within the nearby SRKW foraging areas, especially in the summer months.

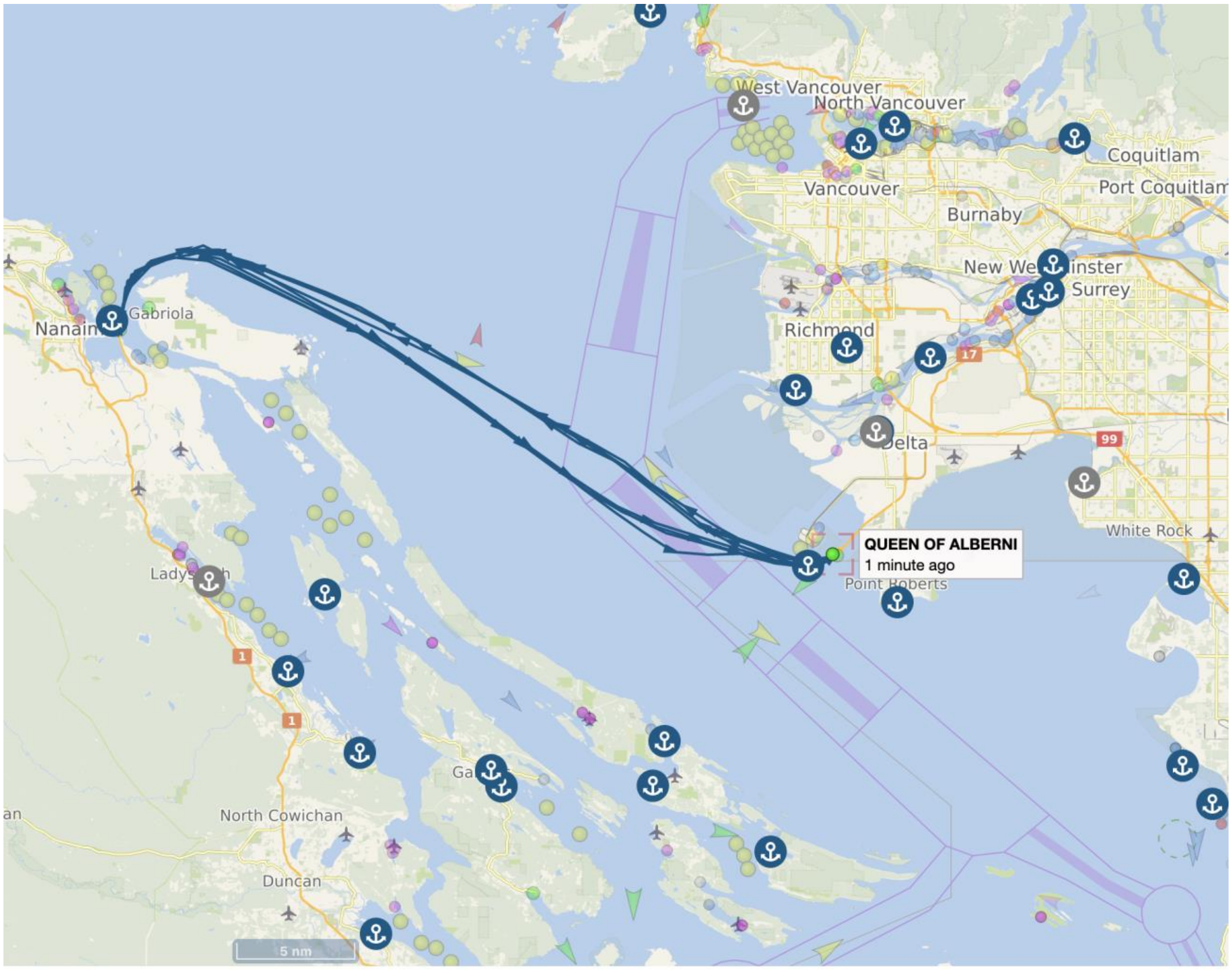

Figure 10: Screen grab from VesselFinder.com showing typical BC ferry tracks between Tsawwassen and Nanaimo..

3. Given the experience gained during the COVID pandemic with staging inbound vessels on the outer shelf of BC/Canada and WA/USA and anchoring ships temporarily within the Salish Sea, work to schedule arriving container ships in temporal groups, ideally timed to avoid spatiotemporal overlap with SRKWs. Even if SRKWs have not been recently located, such grouping could leaving "quiet periods" that benefit all soniferous species in the Salish Sea and could dramatically reduce long-term average noise levels.

VI: Concluding thoughts:

If you listen to the live Orcasound hydrophones, you'll hear speeding boats and transiting ships raise the natural noise levels in Haro Strait by ~20 dB. From the SRKW's perspective, that's more than a 100-fold increase in acoustic intensity -- for a few minutes by boats and for at least a half-hour by ships.

In the best of the whales' worlds, no vessel -- boat or ship -- would raise noise levels above the natural levels (at any of the frequencies that matter to the SRKW). A precautionary approach to developing an expanded terminal on Roberts Bank would definitively **more than mitigate** the impacts from the current and existing terminal, as well as the future terminal operations. Based on our analyses of the Haro Strait soundscape, such an approach would ideally ensure that every container ship is engineered and operated so that the broadband level received by *foraging* SRKWs stays below 100 dB. In the bands relevant to SRKWs, the received spectrum levels should stay below 50 dB re 1 uPa^2/Hz for calls (near 1 kHz) and below 40 dB re 1 uPa^2/Hz for echolocation clicks (near 20-30 kHZ).

Keeping received broadband levels in the core summertime habitat below 100 dB would be a substantial and expensive challenge -- if not an impossible one -- for most existing ships because in most cases it would require a reduction of 20-30 dB from current, typical received levels. That degree of reduction will require more than slow downs and lateral offsets. It would only be possible through strategic combinations of permanent ship quieting technologies and operational strategies -- like re-routing, convoys, and dramatic slow downs.

By dramatic slow downs, we mean that every class of vessel should slow down as much as possible while still maintaining safe navigation and operations. Ideally, every ship would reduce it's noise impacts during this critical time in the recovery of SRKWs -- whether they are involved in the RBT2 project, the ECHO program, the emerging Quiet Sound program in Washington (USA), or any vessel noise mitigations schemes for SRKWs we implement within the Salish Sea and the rest of their critical habitat.

We remain concerned about the adverse impacts of the project. Voluntary slow downs and lateral offsets are temporary and will only get us ⅓ or at best ½ of the way to where we believe SRKWs need noise levels to be.

Through transboundary cooperation and open collaboration, we believe it could be possible to manage ship noise regionally within the Salish Sea and SRKW critical habitat to **much more than mitigate** the impacts of RBT2 construction and operation. However, what the proponent has offered thus far does not attain that high bar. New development must be paired with reductions in current and on-going impacts of Deltaport and other VFPA container ship terminals, as well as decreases for U.S. ports and shipping, as well as for vessel classes other than container ships. Ultimately, we must affect dramatic (e.g. 10-30 dB per ship) reductions in received noise levels and thereby *increase* foraging time for the SRKWs, as much and as rapidly as possible.

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Appendices

Attachment A: CV for Scott Veirs

Scott R. Veirs

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Education

Sep 1998 – Jun 2003	**University of Washington Seattle** PhD, Oceanography Seattle, WA, USA
Sep 1995 – Jun 1997	**University of Washington Seattle** MSc, Oceanography Seattle, WA, USA
Sep 1988 – Jun 1992	**Stanford University** BS, Earth Systems Palo Alto, CA, USA

Research & Work Experience

Jun 2003 - present	**President** Beam Reach Marine Science & Sustainability
Sep 1998 – Jun 2003	**Research Assistant, Teaching Assistant** University of Washington Seattle, School of Oceanography
Sep 1997 – Jun 1998	**Research Assistant, Teaching Assistant** San Francisco State University, Oceanography Department
Jun 1995 – Jun 1997	**Research Assistant, Teaching Assistant** University of Washington Seattle, School of Oceanography

Public service

2017-present	**Coordinator, Orcasound** Hydrophone network and open-source software project
2018-present	**Chair, Marine Mammal Work Group** Puget Sound Ecosystem Monitoring Program (PSEMP)
2020	**Session Chair, Salish Sea Ecosystem Conference** Trophic energy flow in the Salish Sea: Part IV (Marine Mammals)

Peer-reviewed publication highlights

S Veirs, V Veirs, R Williams, M Jasny, J Wood. A key to quieter seas: half of ship noise comes from 15% of the fleet. PeerJ Preprints 6, e26525v1, 12, 2018.

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Richard E Thomson, Steven F Mihály, Alexander B Rabinovich, Russell E McDuff, Scott R Veirs, Frederick R Stahr: *Constrained circulation at Endeavour Ridge facilitates colonization by vent larvae*. Nature 08/2003; 424(6948):545-9.

Thesis

Scott R Veirs: *Heat flux and hydrography at a submarine volcano: Observations and models of the Main Endeavour vent field in the northeast Pacific*. 06/2003, Degree: PhD, Supervisor: Russel McDuff

Public presentations

2018-2020	**Guest lecturer, UW Oceanography, Marine Pollution** Trophic energy flow in the Salish Sea: Part IV (Marine Mammals)

Publications

John Calambokidis and Scott Veirs. *Overview of baleen whale feeding behavior and prey in the Salish Sea*. Salish Sea Ecosystem Conference, 2020.

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Attachment B: CV for Val Veirs

Val Veirs

EDUCATION

Case Institute of Technology

Cleveland, Ohio, June 1964, BS (Physics)

Illinois Institute of Technology

Chicago, Illinois, June 1969, Ph.D.

(Physics)

PUBLICATIONS and RECENT PRESENTATIONS

Proposed metrics for the management of underwater noise for southern resident killer whales. Coastal Ocean Report Series, Heise et. al., Technical Report · August 2017 DOI: 10.25317/CORI20172

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Quiet time for orcas: noise reduction strategies that can assist killer whales in their foraging and communication,Val Veirs, Orcasound Hydrophone Network,Scott Veirs, Beam Reach, Lauren McWhinnie, Patrick O'Hara, & Gregory O'Hagan, NEMES (Noise Exposure to the Marine Environment from Ships), Salish Sea Ecosytem Conference, April 6, 2018

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Detection & classification of SRKW calls through human & machine learning, in real-time, Val Veirs and Scott Veirs, Beam Reach, SPC, Data Workshop, Organized by ONC/Merdian | 21-22 Nov 2019 | Victoria, BC

Real-time detection and classification of underwater soundscape signals via a convolutional autoencoder, Val Veirs and Scott Veirs, Beamreach SPC, Acoustical Society of America meeting, Nov 29, 2022, Seattle WA

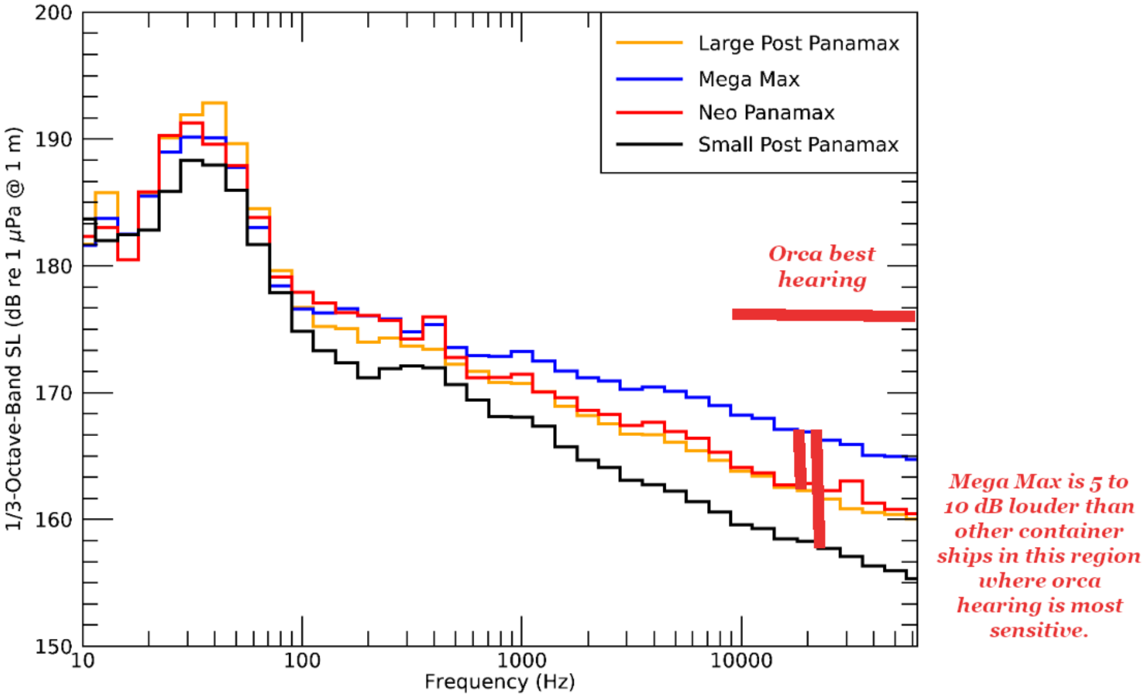
POSITIONS – (Last 30 years)

2012-Present	Researcher with Beam Reach SPC
2005-2012	Faculty Member, Beam Reach Marine Science and Sustainability School
2003-2010	Member of Board of Directors of the Whale Museum (President 2005---2010) - Friday Harbor, WA
2008-2016	Member of Board of Directors of the San Juan Nature Institute (Vice President 2005-2010, President 2010-2016) - Friday Harbor, WA
1995-1998	Director of Environmental Science at Colorado College
1992-1993	Professor of Physics, University of Indiana - in Malaysia
1988-1992	Chair, Department of Physics, Colorado College
1987-Present	Professor of Physics, Colorado College (currently Emeritus)
1985 (Spring)	Lectures in Artificial Intelligence, Guadalajara and Mexico City, Mexico
1984 (Fall)	Visiting Faculty in Artificial Intelligence, Yale University

Attachment C: **Mega Max source level model**

The modeled distances and areas where SRKW disturbance will occur should account for the fact that, based on the proponent's estimates (Figure C1), Mega Max vessels are louder than average container ships in the frequency range where the SRKW are most sensitive. Specifically, the graph shows that the Mega Max vessel source ⅓-octave levels are predicted to be 5-10 dB higher than conventional vessels in the most sensitive hearing range of the SRKW (10,000-30,000 Hz).

A simple model with spherical spreading and high frequency absorption tells us that when an average container ship creates disturbance (120 dB threshold) out to a distance of 800 meters and over an area of 200 hectares, a Mega Max vessel will cause disturbance out to a distance of 1300 m and over an area of 500 hectares. This will be so even though the Mega Max radiates less power at 30 Hz than smaller classes of container ships. The excess high-frequency noise levels expected from Mega Max vessels has serious potential impacts for SRKWs and should be incorporated in all the acoustic modeling.



Orca best hearing

Mega Max is 5 to 10 dB louder than other container ships in this region where orca hearing is most sensitive.

Figure 3. Container vessel source level estimates by size class, in decidecade frequency bands, scaled to a reference speed of 19 knots. Source level data extend to a maximum frequency of 63.1 kHz.

Figure C1: ⅓-octave power spectra for different size classes of container ships. (Adapted from Appendix IR2020-3-E, pg 311, https://iaac-aeic.gc.ca/050/documents/p80054/141574E.pdf with red annotations for this report.)

Attachment D: Fast vs slow tugs noise model

We created a Monte Carlo model that simulates two different scenarios of tugs shuttling between two locations as SRKWs pass nearby. In one scenario, tugs go back and forth each hour on the hour between two stations (tug basin or berth face and a container ship) at slow speed (5 kts) and in the other they also leave on the hour but go faster (8 kts).

In the model, a SRKW swims from one side of the large square domain (10x10 km) to the other side at a speed of 4 kts. The square domain is centered on the point at the middle of the line between the two tug stations. The model calculates the sound exposure level (SEL) experienced by the whale. Three different whale paths are modeled. One midway between the two end-points of the tug paths and perpendicular to them. In a second, the whale swims parallel to the tug paths 1000 m away and in the third, the whale swims perpendicular to the tug paths but 1000 meters beyond one end of the tug paths. A thousand runs are made with random start times for the whales and the average SELs per whale transit are reported.

The results are as follows:

Table: SEL experienced by orca passing through domain with tug noise (two stations 1km apart)	**Tug speed = 5kts**	**Tug speed = 8 kts**
Whale crosses between the two tug stations	139	141
Whale parallels the tug at range of 1000 m	132	134
Whale crosses perpendicular to the tug path 1000 meters beyond one tug station	129	132

SEL is calculated by adding the acoustic power received by the whale multiplied by 60 seconds for each minute that the whale takes to cross from one side of the 10km square to the other. In each case, the SRKW, in traveling near the tugs, experiences 3 dB less sound energy when the tugs run at 5 kts compared to 8 kts.

Model is available in Colab at this URL -- https://colab.research.google.com/drive/1DJUM85gh4M3v4z6xS3hj1Td0w_Yr1sRz

Appendix 1

Potential acoustic and cumulative impacts of the Roberts Bank Terminal 2 (RBT2) project, especially related to southern resident killer whales (SRKWs)

Prepared for the Review Panel of the Canadian Environmental Assessment Agency

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Prepared for:

David Suzuki Foundation
and
Wilderness Committee

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Table of contents (and scope of work)

Describe your qualifications

1. About the author

1. Please describe your education and training and provide an explanation of your expertise in relation to the issue of marine mammals and marine mammal habitat, and in particular southern resident killer whales. Please also provide a copy of your current curriculum vitae.

Dr. Scott Veirs is an expert in marine bioacoustics, oceanography, and ecology of the Salish Sea. He specializes in the quantitative evaluation of acoustic impacts on marine mammals from individual and cumulative human activities.

Dr. Veirs was trained in environmental science as the first Earth Systems major at Stanford University and received a Masters and PhD in Oceanography from the University of Washington. For the last 15 years, his research has focused on quantifying underwater noise pollution, particularly from commercial ships, in Washington and British Columbia. From 2005-2012 he organized bioacoustic field research projects for 50 undergraduates during which he observed the behavior of southern resident killer whales over many seasons within their core summertime habitat (the central Salish Sea).

Currently, Dr. Veirs coordinates the Orcasound hydrophone network and serves as Chair of the Marine Mammals Work Group of the Puget Sound Ecosystem Monitoring Project. He is a member of the Acoustical Society of America and most recently presented research with his colleague, Dr. Val Veirs, at the fall, 2018, meeting of the Society in Victoria on computing natural versus anthropogenic noise statistics in killer whale critical habitat. In January, 2019, he was elected Chair of the Marine Mammal Work Group which is part of the Puget Sound Ecosystem Monitoring Program.

Further details regarding his educational background and professional experience are provided in Attachment A.

Acoustic impacts of the Project, particularly on Southern Resident Killer Whales

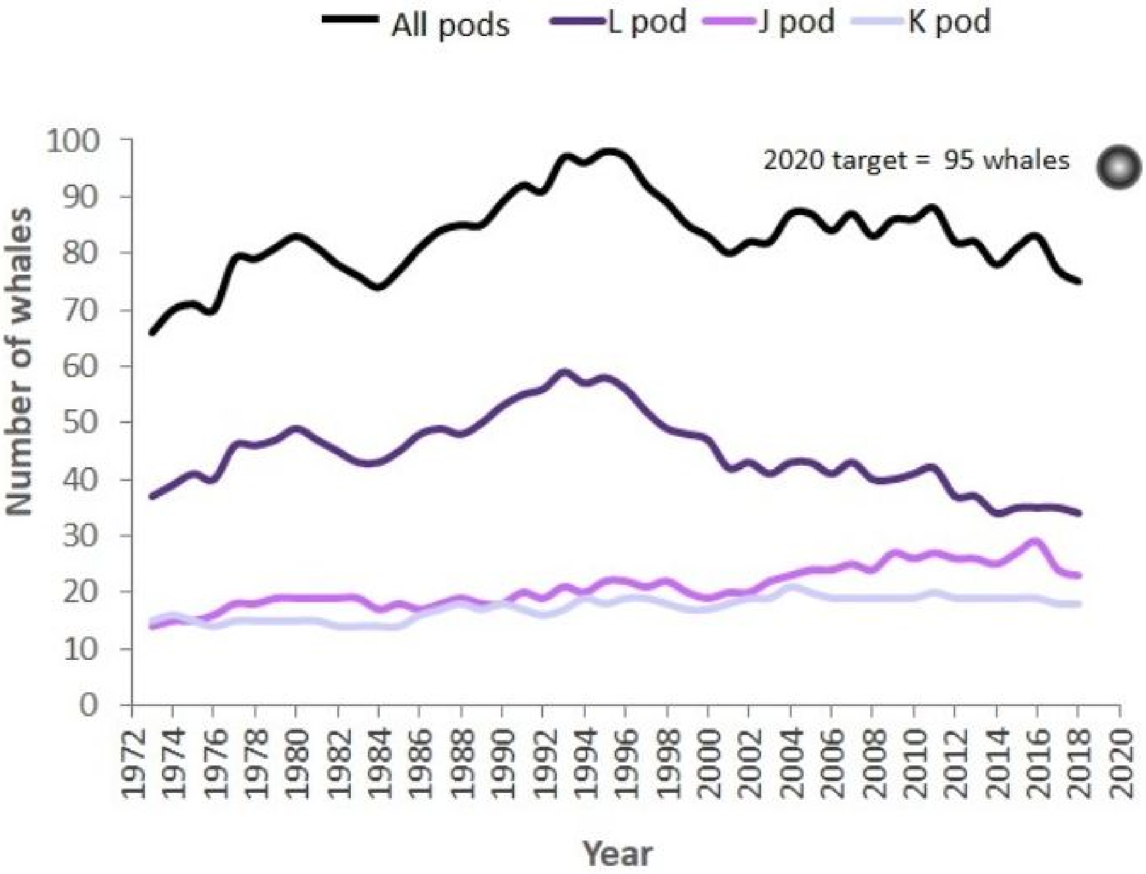
2. Please describe the current status of the Southern Resident Killer Whale population.

As of 2019, the SRKW population is increasingly bound towards extinction with many individuals currently starving. Some experts are calling this "the last generation."

The current status of the Southern Resident killer whale (SRKW) population is tenuous, at best. These salmon-eating orcas remain endangered on both sides of the U.S./Canada border and are struggling to obtain sufficient quantities of their preferred prey, Chinook salmon. Not only are many runs of Chinook extirpated or endangered within the SRKW's range -- from northern California to Haida Gwaii -- but also their access to scarce Chinook is reduced by noise and physical disturbance from vessels (commercial ships, recreational boats, and whale watching boats). Added to these risk factors is the bioaccumulation of persistent chemical pollutants in their blubber. When orcas starve (due reduced salmon supply or access), the lipid-soluble contaminants are mobilized during metabolism of fat reserves, resulting in suppression of their immune systems and increased vulnerability to disease and catastrophic events, like oil or fuel spills.

The SRKWs are listed as endangered both in Canada (under the Species at Risk Act) and in the U.S. (under the Endangered Species Act). These listings were triggered by declines in the population that occured in the late 1990s and early 2000s, especially in the size of L pod. (See figure below from the Puget Sound Partnership's orca vital sign which shows SRKW census data provided by the Center for Whale Research.)

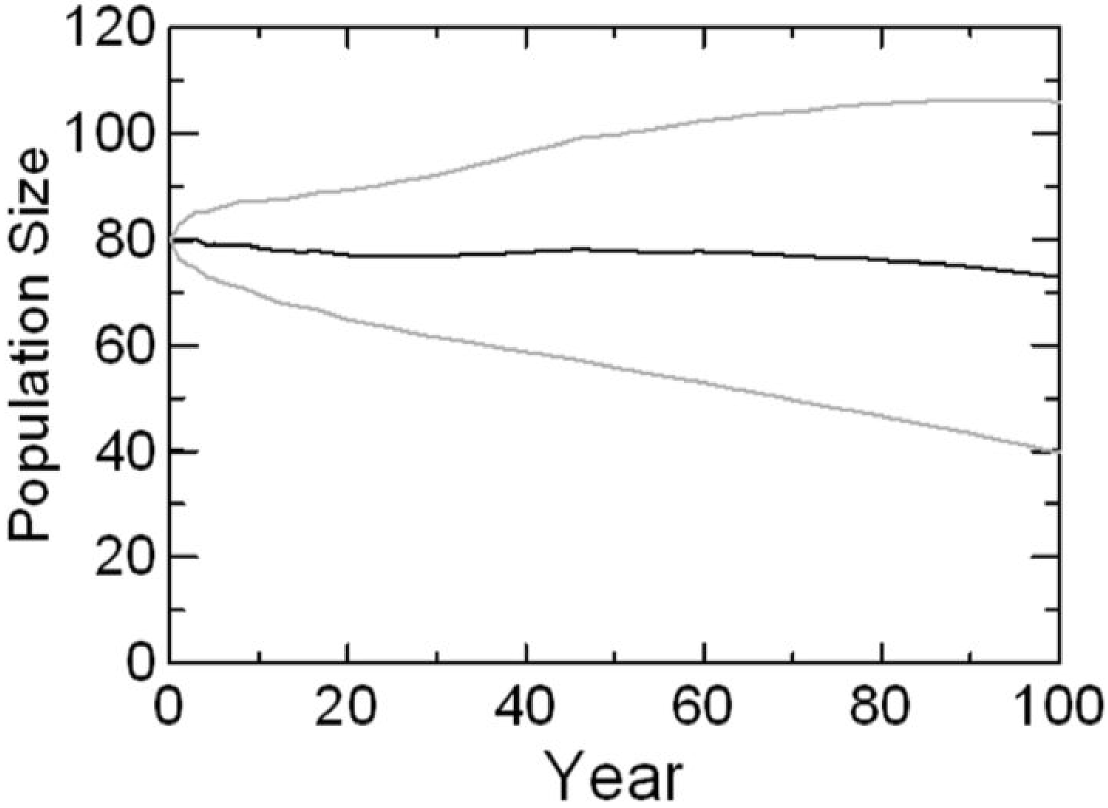
1972-2018



Source: July 1 census, Center for Whale Research

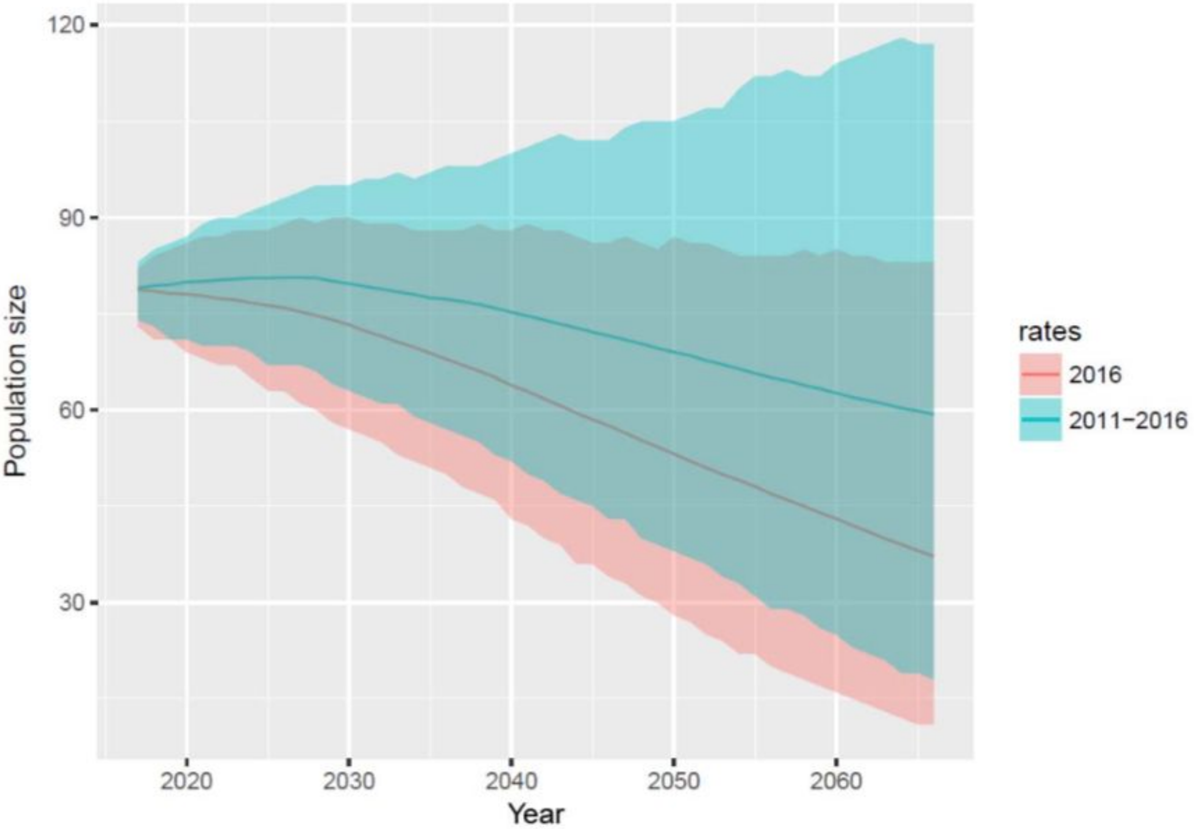
The total SRKW population reached a 33-year low of 75 whales in 2018. The U.S. recovery goal of an annual average growth rate of +2.3% (over 30 years) has only been met in 6 of the 13 years since the population was declared endangered in the U.S. Instead of the desired long-term growth, there has been a long-term decline since 1995 when the total population peaked at 98 animals. More recently, there has been a net loss in *each of three pods* since 2011, resulting in the annual average growth rate of the *total* population between 2011 and 2018 being -2.0%. Because of these recent declines, we are far from meeting the population goal of 95 animals by 2020 which was set by the Puget Sound Partnership in 2011 (and would have represented a 1.0% annual average growth rate from 2010 to 2020).

The most-recent peer-reviewed population viability analysis provided a 100-year forecast of the SRKW population starting in 2015 and using reproductive rates observed during 1976-2014 (Lacy et al., 2017). The study concluded that under current levels of salmon supply, vessel disturbance, and toxic chemical burdens, the SRKW population will not recover, but instead will most likely remain near its current size. The good news was that with a 15% increase in salmon supply and a 50% reduction in vessel noise (to increase hunting efficiency and therefore access to salmon), the population could achieve the recovery goal: a growth rate of +2.3%. The bad news was that any increased impacts (like fewer fish or more noise pollution) beyond the current levels would result in the slow decline of the population towards extinction. These optimistic and pessimistic possible outcomes fall above and below the status quo population projection (black line) and within bounds of the population simulations (grey lines), as depicted below (Figure 1 of Lacy et al., 2017).



Unfortunately, very worrisome recent changes have occured in the condition of the SRKW population. First, the birth rate has decreased (no births in 2017 or 2018, and thus far only one birth in 2019). Second, demographically important females have been lost. Since 2014, the population has lost nearly 20% of females that are of reproductive age (10-42 years old). In early 2017, the oldest female in this matriarchal species died at an estimated age of 105 years -- representing a loss of leadership and experience for finding food. A third concern is an elevated level of unsuccessful pregnancies, likely a manifestation of a lack of adequate food for reproductive females. Finally, there is growing evidence of deteriorating body condition from drone-based observations (Fearnbach et al., 2018). Multiple individual animals are starving.

These changes mean that the vital rates used by Lacy et al. (2017) may be overly-optimistic. The most-recent status review in the U.S. (NMFS, 2016) included a 50-year forecast of SRKW population based on reproductive rates from 2011-2016 (blue region in their Figure 3.1 shown below) -- a time period when the reproductive rates were lower than the the longer-term mean rates. Over the long haul, the median population simulation declines dramatically under the 2011-2016 conditions (blue line). If the reproductive rates from the single poor year of 2016 are used, the decline is immediate and precipitous (red line).



The December 2016 status review stated that this most-pessimistic projection “provides information on what could happen if poor reproduction continues” (NMFS, 2016). Regrettably, SRKW reproduction in 2017 and 2018 was even worse than in 2016.

As I will explore further in this report, based on the biological observations made during the RBT2 environmental assessment process, the SRKW population is now firmly “in the red zone” (notice that all of the simulations in the red-shaded zone above indicate long-term decline). If we want to prevent the extinction of the SRKWs we must make bold reductions in our human impacts on this iconic and endangered species. An incremental increase or even no-net-increase in human impacts will not be sufficient to save them.

3. Please describe the current state of the acoustic environment in the Salish Sea.

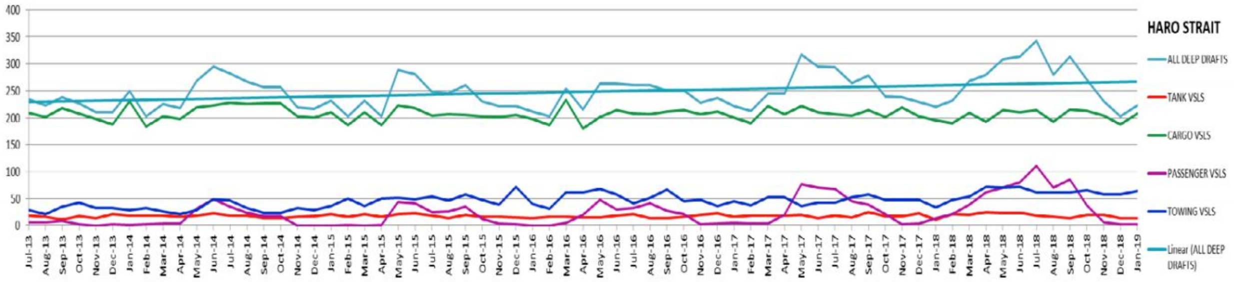
The acoustic environment of the Salish Sea is highly polluted, the dominant noise source is ships, and container ships are the most-intense polluters.

Since the end of the age of sail, the Salish Sea has become an urban estuary with shipping lanes and common boat routes that overlap in space and time with SRKW critical habitat. The growth of human population in Washington and British Columbia to now nearly 8 million people has driven a wide range of activities that have impacted the local ocean. Mining, logging, and agriculture affected the freshwater habitats of salmon while the marine environment was impacted directly by the harvest of marine life -- from the extirpation of humpback whales and culling of pinnipeds to the overfishing of salmon, bottom fish, and forage fish. Today, some old impacts have been reduced to varying extents: forestry is becoming more sustainable, humpbacks are beginning to return, fishing pressure has been reduced, and some river habitats are under repair.

However, human population growth around the Salish Sea continues and coincident demand for natural resources, products, and space is driving new developments -- each with new impacts, many of which affect the marine acoustic environment. Some types of development, like pile driving to build a new pier, can affect the acoustic environment with noise that is intense, but of limited duration. Impact pile driving is a local example of *acute noise pollution*. In contrast, vessel noise is less intense at the source, but much more continuous and common. Ship noise is a local example of *chronic noise pollution.*

In the modern era, commercial shipping is the dominant source of chronic noise pollution in the acoustic environment -- both in the open oceans (Hildebrand, 2009) and within the Salish Sea. While the killer whales first experienced only a few ferries, fishing boats, and tugs towing log booms, today the main source of noise in the acoustic environment of the Salish sea is the commercial shipping sector -- a wide variety motorized vessels related to the transportation of natural resources, products, and people.

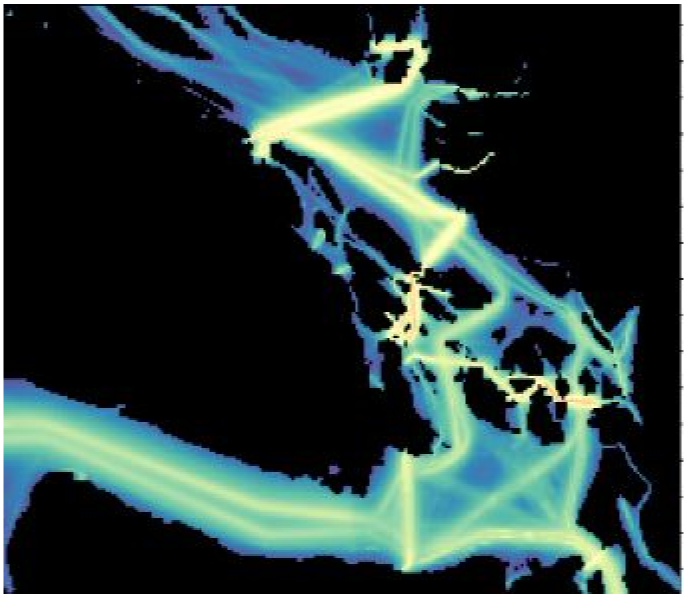
Ships dominate the soundscape in the core summertime habitat of the SRKWs, an area known as Haro Strait. On average about 20 ships/day (Veirs & Veirs, 2006) or 1 ship/hour (Erbe et al., 2012) transit Haro Strait, each typically elevating the background noise levels for at least a half hour. This current amount of traffic has been growing for a century, though there is shorter-term variance driven by economic and operational dynamics of the many classes of ships that use the Strait. A recent example of the traffic levels in Haro Strait (2013 through 2018) is *PSHSC passageline plot* shown below:



During the RBT2 EIS process (2013-2019), passenger (cruise) ships and tug/tow traffic have been growing while cargo and tanker traffic have held steady.

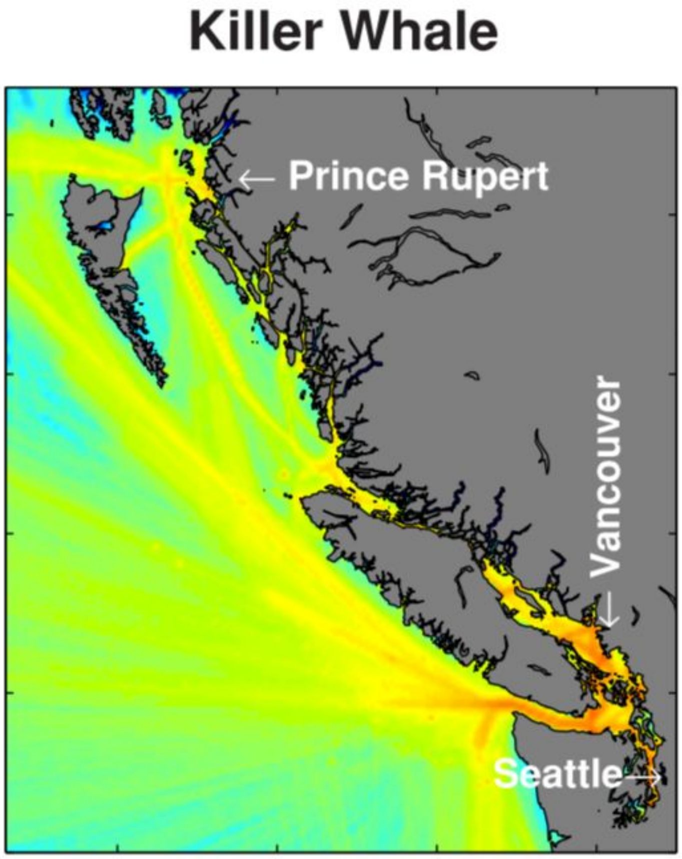
An analysis of Haro Strait traffic (~1,600 unique ships making ~2,800 isolated transits in 2011-2013) characterizes the modern fleet that dominates the acoustic environment of the southern Salish Sea (Veirs et al., 2016). Table 2 of that paper indicates that the most common types of ships are bulk carriers (34%) and container ships (18%). Tugs and cargo ships each make up about 10% of the traffic, while vehicle carriers, tankers, military, and fishing vessels are each about 2-7% of the total. The final ~5% of traffic consists of passenger vessels (cruise ships and ferries), miscellaneous, pleasure craft (recreational boats >20 m long), and research vessels.

A helpful visualization of the regional cumulative impact from this commercial traffic and other vessel movements is the monthly average sound pressure level for July as calculated by a cumulative vessel noise model (MacGillivray et al., 2016) that accounts for a wide range of vessels (including most ship classes, whale watching boats, and recreational boats), as well as the amount of time they spend in the region and their source level. The warmer colors represent higher levels of underwater noise and land is black.



This modeled acoustic overview of the southern Salish Sea highlights where on-average vessel noise dominates (due to intensity and/or persistence) during the summer. Summer is the season when SRKWs are most commonly present in the same area, seeking salmon returning to Salish Sea rivers, especially the Fraser (Hanson et al., 2010). You can see common vessel routes in light yellow-green -- both the commercial ships in the shipping channels and boat traffic between popular ports. Brighter yellows and orange delineate more prevalent sources, primarily ferries and tugs.

A similar modeling effort and visualization compared ship noise energy levels in the Canadian part of this region with the rest of coastal British Columbia (see figure below from Erbe et al., 2014). They adjusted the noise levels according to how SRKWs hear (using audiograms from captive killer whales) to show that -- from the perspective of southern resident killer whales -- the southern Salish Sea is the most-polluted acoustic environment in all of coastal British Columbia.



These independent visualizations make it clear that the acoustic environment of the Salish Sea is already highly polluted. Most of the southern Salish Sea, including the area associated with noise impacts from the proposed RBT2 project (the “regional model area”), is currently of poor “acoustic environmental quality” if judged by the European noise standards (annual mean ⅓-octave band levels at 63 and 125 Hz; Erbe et al., 2014).

A hopeful observation is that half of the ship noise pollution in Haro Strait is caused by only 15% of the fleet (Veirs et al., in review, 2018). This means that if the most intense sources in each class of ship were retrofitted with quieting technologies or replaced with ships that have less than median source spectra for their class, then the regional noise levels could be dramatically (and permanently) reduced.

Container ships bound to/from ports in Canada or Washington State are responsible for much of the noise pollution in the southern Salish Sea. Not only do they make up about 20% of the traffic within the summertime critical habitat of SRKWs (northbound in Haro Strait), but also they are the class of ships that moves the fastest (mean speed over ground of 19.2 +/- 1.9 knots) and has the most intense source levels (Veirs et al., 2016).

4. Please describe the relationship between the acoustic environment and marine mammals such as the Southern Resident Killer Whales and their habitat.

Hearing is at least as important to killer whales as vision is to us. An acoustic environment with low noise levels is important for many SRKW vital functions, including foraging, communication, and navigation.

Sound is the medium of choice in the oceans; light is comparatively useless. While sea water is nearly transparent to sound, the water molecules quickly scatter and absorb light. This causes the oceans to be dark at depths of just a few hundred meters -- even in crystal clear waters at noon on a sunny day.

In the Salish Sea, underwater visibility is greatly reduced. Not only do suspended sediments from rivers and beaches make the water murky, but so do plankton -- microscopic plants and animals that drift with the tides. Consequently, it is rare for a SCUBA diver to be able to see more than 10 meters in the Salish Sea. And during the spring bloom -- the annual explosion of phytoplankton growth -- sometimes you can’t see your hand in front of your face.

Remarkably, even such murky water is nearly transparent to sound. Sound attenuation is so low in salt water that low-frequency calls of baleen whales can travel 1000s of kilometers across the entire Pacific ocean and still be audible. This means that on a quiet day underwater in Haro Strait, SRKWs can communicate at ranges of tens of kilometers and use their echolocation clicks at the surface to locate salmon swimming 100-200 meters beneath them. Unfortunately, it also means that typical ship noise is audible to many types of marine mammals, including toothed whales like SRKWs -- at ranges up to 30 kilometers (see Fig. 3 above from Erbe et al., 2014).

The very low attenuation of sound in the sea has driven the evolution of killer whales into apex predators that are acoustic virtuosos. They make a wide range of signals (calls, whistles, and clicks) and they emit these sounds almost all the time, typically calling many times per minute during all behavior states except resting. They also have incredible hearing abilities that enable them to sense or explore their environment with exquisite resolution. Whale watchers commonly observe SRKWs coordinate navigation acoustically, with a whole pod simultaneously changing direction despite being spread out beyond sight of one another. Toothed whales can emit extremely intense echolocation clicks and then listen for nuances in the echoes that enable them to not only locate fish that are too far away to be seen, but probably also discern their size and species.

Since the glaciers retreated from the Salish Sea ~10,000 years ago and Pacific salmon returned to the rivers of the Cascade and coastal mountain ranges, southern resident killer whales have interacted with humans and used sound to hunt, communicate, and navigate. When humans used the canoe for transportation and through the age of sail that brought Vancouver and colonists to the Salish Sea, only natural sources of noise affected the relationship of killer whales and their acoustic environment. Earthquakes, breaking waves, lightning, and rain storms were likely the most intense and predominant sources in the geophony (non-biological natural sounds in a soundscape) for the SRKWs then, as they are now. Calving and cracking ice would have been common during deglaciation. The biophony (sounds made by life) back then were also probably similar to what we commonly hear underwater in the modern Salish Sea: the low-frequency calls of other cetaceans, predominantly humpback and minke whales; high-frequency clicks and whistles from other Pacific white-sided dolphins and Dall’s or harbor porpoises; the underwater barks and roars of sea lions and seals; the grunts and hums of soniferous fish; and the snaps and pops made by invertebrates, likely including snapping shrimp and sea urchins.

All of these natural and human noises are environmental cues for marine organisms, especially those that have exquisite sonic systems, like SRKWs. Examples of cues that may be important to SRKWs are: the distant calls from Bigg’s (mammal-eating) killer whales; sounds made by potential prey, like grunts from bottom fish; sounds of their prey pursuing or consuming its prey (e.g. salmon foraging for herring); the sound of a distant high-speed vessel that is on a collision course; or the first faint pings from military mid-frequency sonar that could cause acoustic injury if not avoided.

Very little is known about the role of such environmental cues in the acoustic ecology of the Salish Sea. Such cues are often faint and thus may be inaudible even in low levels of anthropogenic noise. The importance of detecting faint environmental cues may be the most profound reason that extended periods of quiet may be important in marine soundscapes. Importantly, such acoustic cues have not been considered in the environmental assessment of the Project's impacts on SRKWs; the only signals that have been considered are those emitted by the SRKWs themselves.

Combinations of experiments and models suggest that SRKWs are able to accomplish amazing acoustic feats in a natural soundscape (at low background noise levels, without any anthropogenic noise pollution). In addition to being able to communicate with each other at ranges of up to 16 km (Miller et al., 2006), killer whales can echolocate an adult Chinook salmon at a range of 100 meters easily (Au et al., 2004), and possibly at 400+ meters (Holt, 2008). They may also be able to use their echolocation to determine the spatial orientation of a salmon at such ranges, and even discriminate the species of salmon (Au et al., 2010) before or during pursuit of a target.

5. Please describe how physical and acoustic disturbance from vessels affects marine mammals such as Southern Resident Killer Whales and their habitat.

It's already too loud for SRKWs. The interference of noise with communication and echolocation signals can cause SRKWs to forage less efficiently. Reducing current noise levels to ensure scarce salmon are accessible may be as important to SRKW recovery in the short-term as boosting salmon abundance is in the long-term.

Disturbance from vessels can hinder important marine mammal activities, like hunting, communicating, and navigating. Vessels can affect marine mammals, including SRKWs, in two main ways. Both mechanisms can also affect marine mammal habitat.

The first way is physical disturbance. Vessels can get so close that the whales react when they become aware of the vessel (either visually -- below or above water, acoustically, or otherwise). A minor example is an animal changing its behavior when it is surprised (e.g. a harbor seal plunging into the water after noticing a kayaker quietly paddling nearby). An extreme example of physical disturbance is contact, which does happen occasionally -- even with killer whales (Williams and O'Hara, 2010) -- when an animal collides with a stationary vessel or is struck by a moving vessels or its propeller). Vessels can also affect habitat through physical disturbance (e.g. a ship wake disturbing surf smelt on a beach).

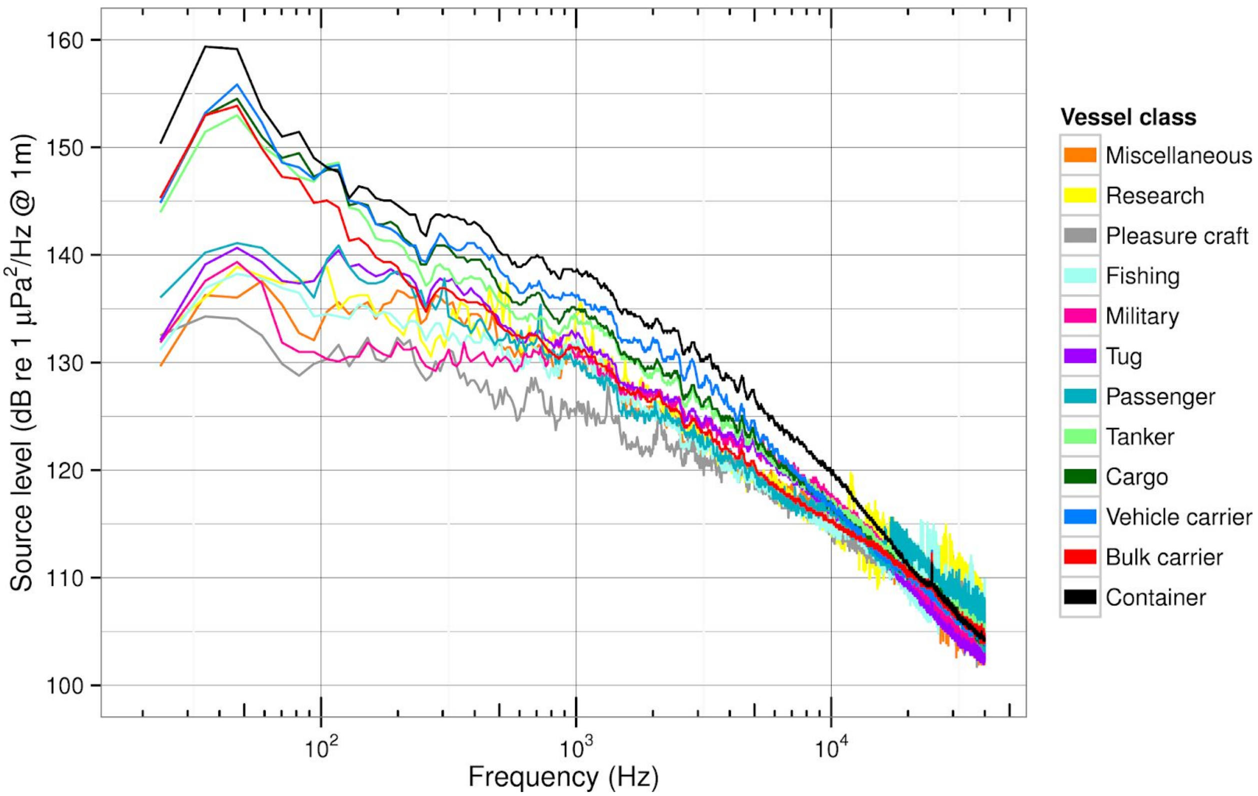
The second way is acoustic disturbance. Vessel noise can affect marine mammals and/or their habitat. For acoustic disturbance of a marine mammal to occur, the animal must be sensitive to at least some of the frequencies of noise emitted by the vessel, and the received level of the noise must be above or near the hearing threshold of the animal. Furthermore, the position of the animal must overlap in space and time with the noise from the vessel noise. Even if a marine mammal species of concern isn't present when the noise pollution occurs, its habitat can be damaged by the sound because many other types of marine life are sensitive to vessel noise, including larvae, invertebrates, and fish (e.g. Slabbekoorn et al., 2018).

The frequencies of ship noise overlap with SRKW signals and the hearing ranges of most marine mammals

The advent of the motorized vessel surely marked the beginning of significant anthrophony (sounds made by humans) in the acoustic ecology of the Salish Sea. Prior to that human vessels probably only radiated low-intensity, intermittent noise from paddles and creaking ropes, footsteps on hulls, or anchor chain clanking around a windlass.

In contrast, a vibrating steam or combustion engine mounted rigidly to a hull is a source of *continuous* low-frequency underwater noise. The shaft and bearings that transmit the engine's power to the propeller can generate intense noise (e.g. periodic squeaks), especially if they are not maintained. But the propeller itself is often the dominant source of noise from a motorized vessel, due to a process called cavitation -- the formation of underwater voids in low-pressure zones around the propeller that collapse violently as they move back into the higher-pressure zones. Cavitation creates surprisingly-intense continuous noise over a wide range of frequencies (50-100,000 Hz; Ross, 1976; Gray & Greeley, 1980; Arveson & Vendittis, 2000), including those where most marine life signals and listens.

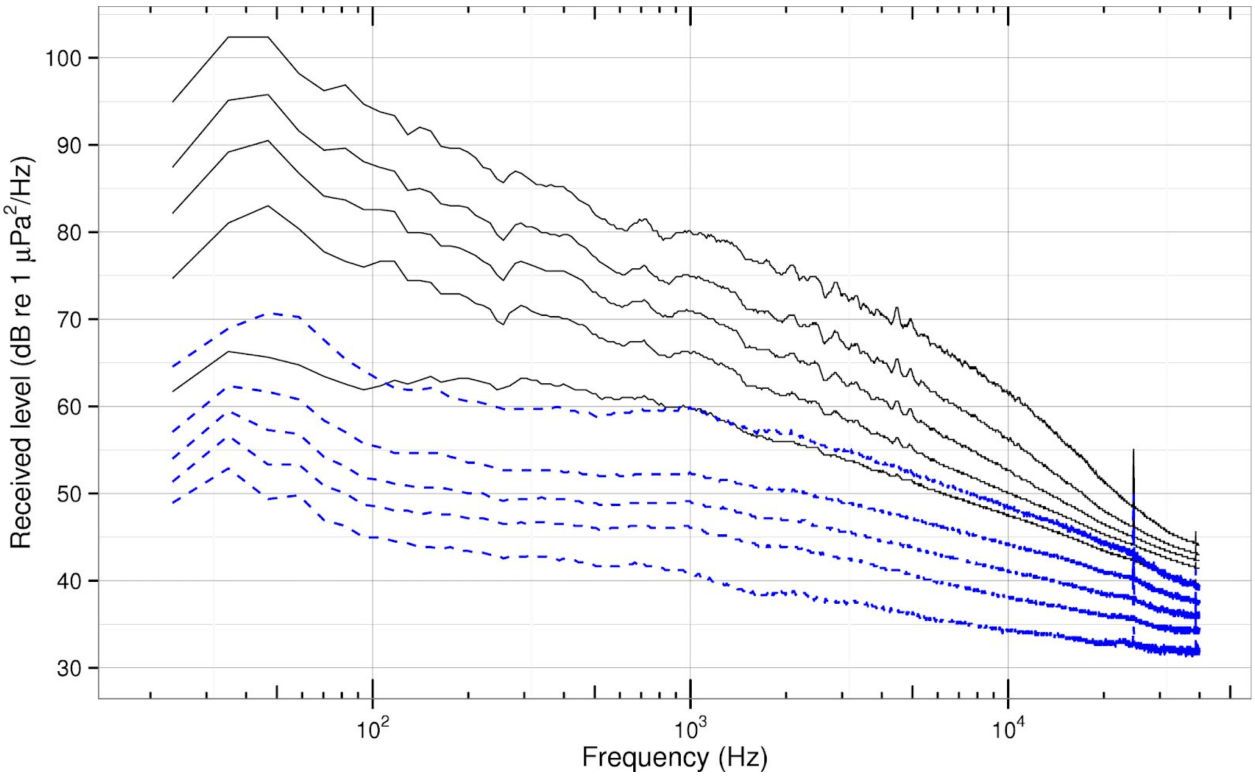
These primary sources of vessel noise combine to generate a spectrum of noise -- a complex pattern of different amounts of acoustic power at different frequencies. The source spectrum for most ships has a peak near 50 Hz with a steep drop in power at lower frequencies and a more gradual (5-15 dB/decade) decrease in power at higher frequencies. Here is a plot of the median source spectrum for a variety of ship classes observed in Haro Strait (from Veirs et al., 2016) that shows this overall pattern:



A similar pattern is apparent in other measurements of noise from ships that interact with the Port of Vancouver. For example, figure 4 of MacGillavry et al. (2016) shows peak power near 50 Hz for most ship classes at typical transit speeds, though they use ⅓-octave bands so the peak is not as prominent.

For cetaceans with low-frequency calls like humpback whales, the combined noise from cavitation and hull-borne machine vibration that peaks near 50 Hz is the most likely to interfere. For high-frequency specialists like dolphins and porpoises, the cavitation noise may be the most impactful, particularly at close ranges to vessels. For southern resident killer whales, both the upper low-frequency noise and lower high-frequency noise from ships at typical ranges to whales in the Salish Sea overlaps with their signals and hearing sensitivity. At ranges greater than ~10 km, another property of sea water -- frequency-dependent absorption -- tends to reduce cavitation noise above 10 kHz to background levels.

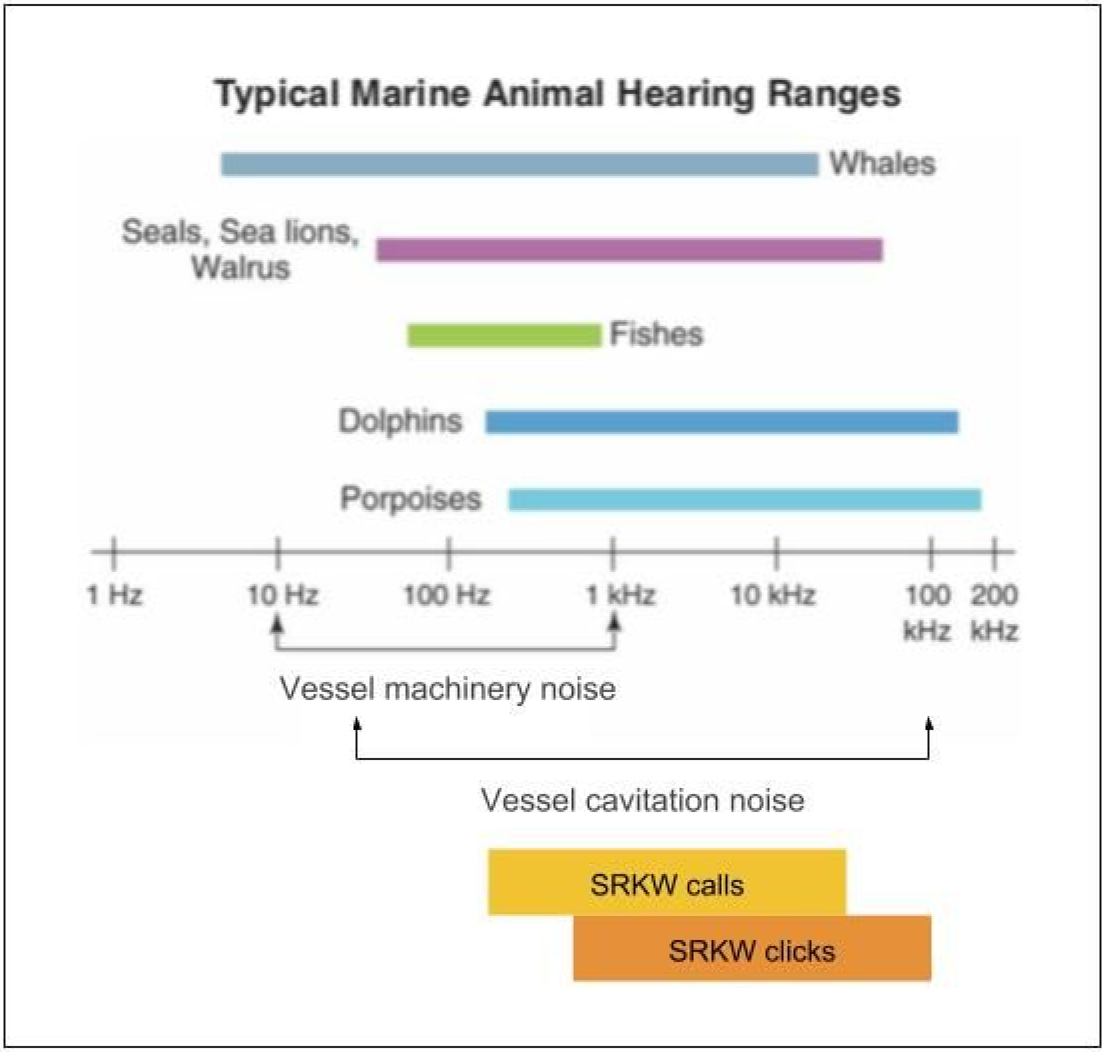
Most of the Salish Sea, however, consists of basins and channels that are rarely wider than ~10km, so both low- and high-frequency noise from vessels in the central shipping lanes reaches the shorelines. The following figure from Veirs et al. (2016) presents noise spectra from measurements made near the shoreline in Haro Strait, within the core summertime habitat of the SRKWs. The spectra of noise received when ships are transiting in the northbound shipping lane a couple kilometers away (solid black lines; 5, 25, 50, 75, and 95% percentiles) are elevated at all frequencies above the background noise levels (dashed blue lines; same percentiles) when ships and boats are not present.



Even at the highest frequencies measured (10,000-40,000 Hz), the median (central, 50% percentile) received ship noise is ~6-11 dB above the median background level. This means that not all the high frequency noise generated by the ship has been absorbed by the time it reaches a killer whale foraging along the west side of San Juan Island. At lower frequencies, in the range used by SRKWs for communication calls (200 - 20,000 Hz), the median ship noise level that reaches the nearshore habitat of the SRKWs is elevated 20-30 dB above the median background level.

Thus, in an urban estuary like the Salish Sea, there is overlap between the frequencies of ship noise, SRKW hearing sensitivity, and SRKW signals. With shipping lanes in major channels throughout SRKW critical habitat, the distances between ships and animals are often too short to absorb high-frequency component of cavitation noise. While most shorelines are less than 5 kilometers of a shipping lane, it is also worth remembering that most of the Salish Sea is less than 300 meters deep, so any animals or habitats located beneath the shipping lanes experience the emitted noise at ranges of less than 300 meters.

The following figure (adapted from Southall et al., 2018) illustrates this frequency overlap between close-range vessel noise and the signals emitted by Salish Sea marine life. The frequency ranges for SRKW signals are indicated for calls (yellow) and clicks (orange) relative to the frequency ranges for ship noise (machinery and cavitation).



The critical habitat of SRKWs overlaps with the spatial extent of mean monthly ship noise

The maps in this report illustrate the general spatial overlap between SRKW critical habitat and the spatial extent of mean monthly vessel noise modeled by the proponents. Most foraging areas commonly used by the SRKWs (e.g. Ashe et al., 2010) lie within 1-5 km of commercial shipping lanes.

The annual migratory movements of SRKWs overlap with the temporal distribution of ships

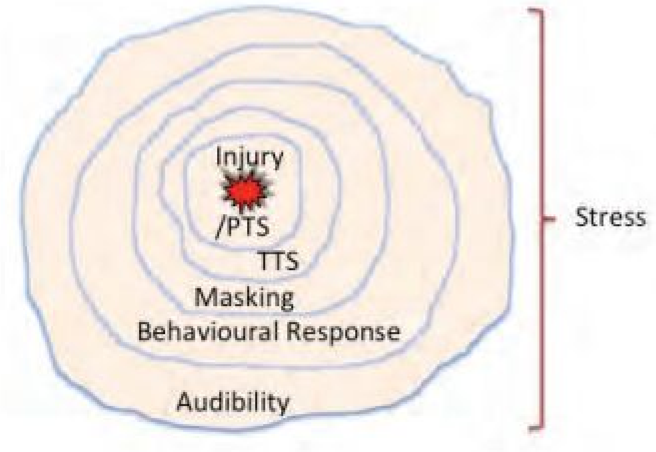
While there are temporal patterns unique to each class of ship, there is generally a high level of ship traffic throughout the year in the Salish Sea. Similarly, though the annual migratory patterns have been shifting to some extent in recent years, it is still generally true that the SRKWs are “resident” within the southern Salish Sea during the summers, and migrate along the outer coasts of the western U.S. and British Columbia during the other seasons.

Potential acoustic impacts of ship noise on SRKWs

Thus, we have generally satisfied the criteria for an effect of ship noise on SRKWs, other marine mammals, and their habitats: the signal and noise overlap in frequency, time, and space. This allows us to continue, assessing in much greater detail the potential acoustic impacts of ship noise on SRKWs.

General framework for bioacoustic impact assessment

The general framework for such bioacoustic impact assessments is illustrated by this diagram (Figure 1 of Erbe, 2013):



For a source emitting noise at a constant level (at the red center of the diagram), there are potential zones of bioacoustic impact around it that become less severe as the distance between the source and a receiver increases. Closest to the source is a zone where permanent deafening can occur (PTS = permanent threshold shift). Next is a zone of temporary hearing loss (TTS = temporary threshold shift), followed by zones where signals can be masked (drowned out by noise to the point of being unrecognizable) and behavior may be altered. Finally, there is a zone of audibility beyond which the receiver cannot hear the sound source. In all of these zones, including the outermost zone of audibility, the emitted sound (noise source) could induce physiological stress.

Many variables can change the extent of these zones over time. They shrink if the source becomes less intense. They also shrink if the species has less sensitive hearing at the frequencies emitted by the source.

Perhaps most importantly, recent research indicates that the extent of the behavioral response zones, and sometimes also the masking zone, can change dramatically depending on the context of the noise exposure (Ellison et al., 2012). Context may be behavioral; for example, a resident killer whale is more likely to change behavior upon noise exposure when they are foraging than when they are traveling. The context may also by physical; for example, the degree of masking may depend on the orientation of a whale to the noise source, if that animal has hearing sensitivity that varies with the direction of the incoming sound.

Key bioacoustic impacts of ship noise on SRKWs

The typical noise levels from container ships received by SRKWs are not high enough to cause injury (acoustic trauma) or deafening (a permanent threshold shift). Similarly, temporary deafening is unlikely (NOAA, 2018). So, the key impacts to SRKWs of ship noise are masking of signals that are important to SRKWs -- calls, clicks, and environmental cues -- and behavioral changes. The environmental impact assessment of the Project focuses primarily on these two types of bioacoustic impact. The potential impacts of stress due to noise exposure remain unexplored, yet noise (and vessel disturbance) may play a role in SRKW endocrinology (Ayres et al., 2012) and we know that noise pollution can raise stress hormone levels in other cetaceans, like the North Atlantic Right whale (Rolland et al., 2012).

The Project proponents go to heroic efforts to refine the general spatio-temporal overlap described in this report and ultimately understand more specifically where and when SRKWs are likely to experience various levels of noise impacts from typical ships. The key finding of the Population Consequence of Disturbance Model was that **existing conditions** were predicted to "reduce the total number of minutes of foraging by 19.1 days (27,507 minutes) per animal per year" within the focused model area.

The Salish Sea is already too loud for SRKWs

Those 19.1 days of lost foraging time are something the SRKWs cannot currently afford. That key finding by the Proponent and its manifestation in PCOD simulations (figure included below) that indicate that the probability of decline is near 50% adds to our understanding that the Salish Sea is already too loud for SRKWs.

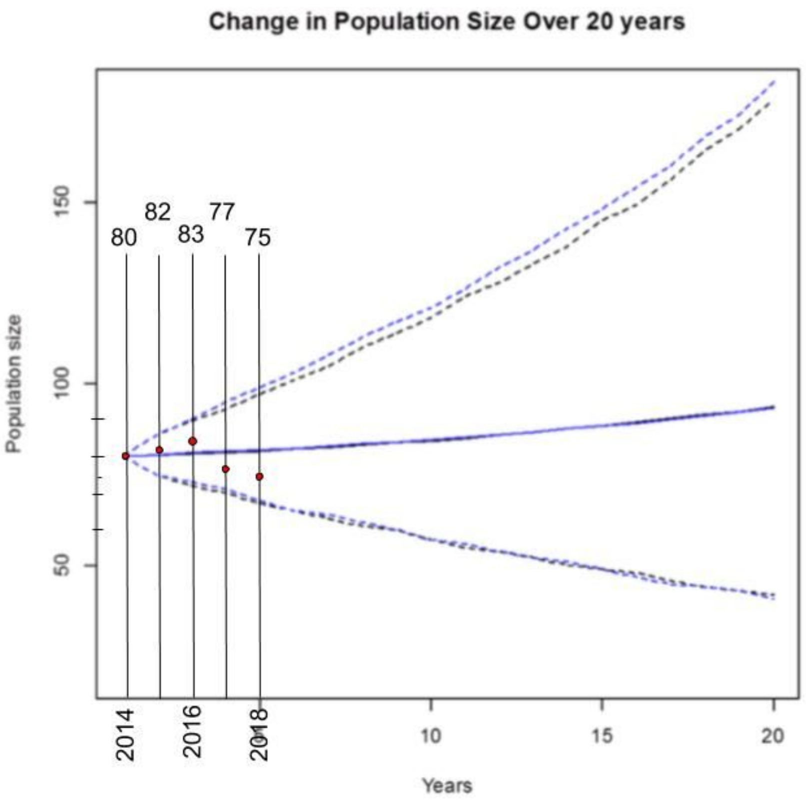
Other, independent studies have come similarly concluded that ship noise and vessel disturbance is having a detrimental impact on SRKWs. Holt (2008) found that a large container ship (MV Hanjin Marseilles) at a range of 442 m was predicted to reduce echolocation from 400 m in quiet Haro Strait conditions to only 60 m. That's a decrease of 85%. Williams et al. (2014) concluded that current levels of noise caused SRKWs to lose 62% of communication space while noise from busy ship traffic increased the loss to 97%.

For a apex predator that forages for scarce Chinook through a combination of echolocation clicks and social calls (some of which may coordinate foraging), such losses aren't tolerable. A

85% decrease in echolocation range and a 62% loss of communication space from current noise conditions indicates the profound need for us to decrease noise levels from the status quo.

To illustrate the consequence of failing to take bold action to get more Chinook in SRKW mouths, I have overlain Figure 5 of the SRKW PCOD Model (Appendix 14-C) with the census totals for the SRKW population from the Center for Whale Research overlaid for the ~5 years since the model was run:

Figure 5 **Estimates of Population Size (solid lines) Under Existing Conditions Based on the Effects of Disturbance in the LSA Over the Course of a Year and Assuming 3D Prey Search. Dashed lines are the 95% CI.**



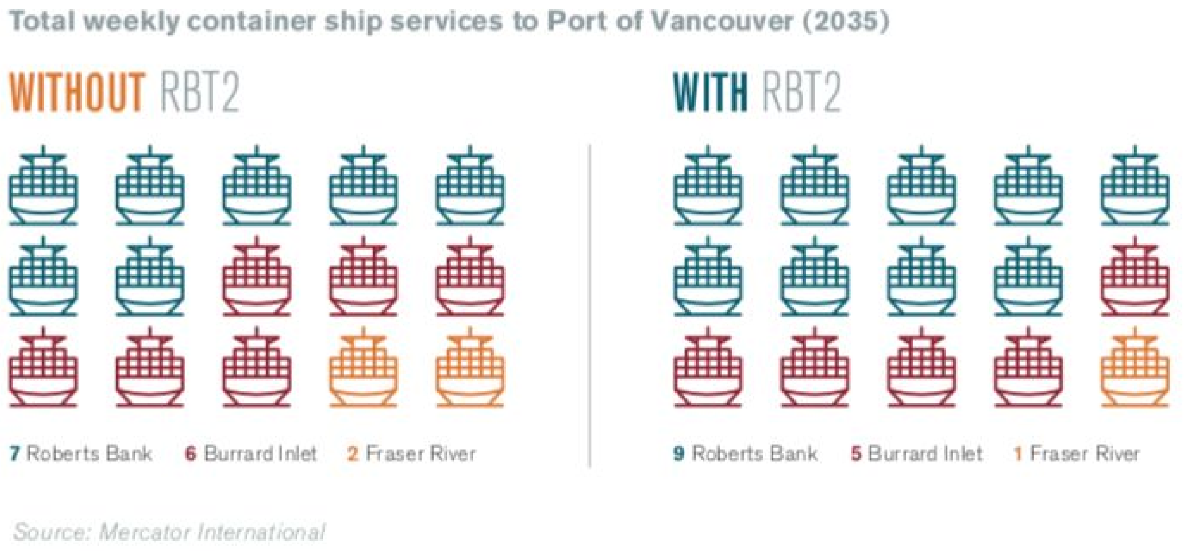
Each red dot represents the total number of SRKWs from 2014 through 2018. The recent and overall decreases should sound set off conservation alarm bells. It is time to run a scenario in which we more than mitigate current noise levels and begin recovering relevant salmon stocks. If we succeed, the PCOD simulations will reduce the probability of extinction from where it is now (~50%) to something more tolerable to a society that values wilderness icons, like <5%.

6. How will Project-related shipping affect the acoustic environment in the Salish Sea, and how will it affect marine species, such as the Southern Resident Killer Whales, and their Habitat?

Given the polluted status of the modern acoustic environment in the Project area, a modeling effort to predict increases in noise from the project isn't needed. **Any noise added by Project activities will worsen the current, unacceptably poor status of the acoustic environment.**

After the most-vigorous modeling effort to date, the Project documents conclude that not only would an increase in long-term mean noise levels occur as expected, but the increased noise could have significant impacts on SRKWs. As expected, the increase in noise from scenario S1 (status quo) to S2 in the focused model resulted in an "increase of 74 low-severity (5.0% increase) and 26 moderate- severity (4.2% increase) behavioural responses per year per SRKW individual". Overall, the PCOD scenario which included RBT2 and incremental vessel traffic associated with RBT2, in addition to existing and expected conditions (S2), increased the foraging time lost by approximately 5.3% resulting in 20.1 days lost in the FMA. That is essentially another day of lost foraging for a species that has already lost too much foraging time.

In the Container Vessel Call Forecast Study (Mercator 2018) and Ship Traffic Information Sheet (Document 1362), the proponents suggest that in the long-term (2035) predicted shifts in the container shipping industry to larger ships (>15,000 TEU) could result in a re-distribution of traffic between Vancouver ports. The re-distribution is depicted in this graphic in which each ship icon represents a weekly container ship service:



Whether or not the RBT2 is built, the number of services still totals 15. Because of the projected continuation of a decadal shift in the industry to larger ships (which are in essence a permanent convoy of smaller ships) the 2018 study suggests that the total annual container ship calls at Roberts Bank terminals would decrease between 2030 and 2035 (from 520 calls to either 364 without RBT2, or 468 with RBT2).

The Mercator report (2018) also predicts that the total annual calls in 2035 may be about the same as the current status quo (based on the total annual calls in 2017). As I mentioned in the previous section, the status quo noise levels are already too noisy. No net increase in ship noise (based on number of calls) in 2035 is not sufficient mitigation at this point, especially since in the interim (e.g. in 2030) the number of calls are predicted to be higher than in 2035 -- representing a net increase in ship noise.

Even if the number of calls remains the same in 2035 as it was in 2017, I continue to have doubts about the methods used in the EIS for estimating the increased source level of noise emitted by the larger (>15,000 TEU) containships. (See my attached comments regarding the EIS and Addendum.) The same number of calls with higher-than-predicted source levels could mean that was expected to result in no-net-increase actually is a net increase in ship noise.

Finally, the graphic above suggests to me that without the RBT2, the total calls of container ships to the Fraser River delta would decrease (with obvious associated reductions in environmental impacts) . With RBT2 there are 9 services to Roberts Bank in 2035; without RBT2 there are 7. If we include services to the Fraser River facility (which obviously must traverse the nearshore environment of the delta, as well as a portion of the lower Fraser River), there are 10 total services affecting the delta environment with RBT2 (10 = 9 to Roberts Bank and 1 to the Fraser facility); without RBT2 there are 9 (=7+2).

7. Please describe the magnitude and geographic extent of the acoustic impacts of Project-related shipping.

In their Underwater Noise Exposure and Acoustic Masking Study (Appendix 14-B), the Proponents estimate that noise from a large container ship “starts to reduce echolocation detection distance at ~2.5 km, which is 1 km further than when it starts to reduce call masking detection distance.” If we assume this is accurate (at least for the larger, more intense ships), then echolocation space of SRKWs is being decreased over much of their critical habitat. Given that the shipping lanes (including the traffic separation zone) are often a few kilometers across (between the outer edges of the lanes), echolocation could be decreased throughout any channels in SRKW critical habitat that host a central shipping lands and are less than 8 kilometers across (8 = 2.5 + 3 + 2.5). The geographic extent of call masking might encompass all such channels that are less than 5 km across.

8. Will the acoustic impacts of Project-related shipping be temporary, ongoing, or permanent?

The acoustic impacts of Project-related shipping will be ongoing as long as RBT2 ships transit SRKW habitat at their current source levels. The good news about underwater noise pollution is that it goes away nearly instantaneously when you quiet the source.

It is possible (but unlikely) that the impacts could turn out to be temporary. For example, the SRKW habitat could change; they could cease using the Salish Sea and therefore no longer overlap with RBT2 ships in space or time. Alternatively, the ships could be re-routed away from SRKW habitat and therefore alleviate ongoing impacts. And finally, impacts could be reduced over time through mitigation methods (ideally through permanent ship quieting technologies).

In one sense, the impacts of the Project-related shipping could be permanent. If noise from RBT2 container ships causes detrimental shifts in SRKW demography or accelerates the population's decline, the impacts on the population could be very long-lasting, or even lead to extinction (which is permanent).

9. What, if any, are the options to mitigate the impacts of Project-related shipping, including the impacts on the Southern Resident Killer Whales and their habitat? What is your opinion of the viability of these options and their likely effectiveness?

The Project will definitely increase noise in the region's marine acoustic environment. The good news is that ship quieting technologies and techniques exist that could "more-than-mitigate" the impacts of the current noise levels, including any added by the Project.

Building on a CSAS review to which I contributed and a related publication (Williams et al., 2019), I consider 11 mitigation measures below and rank them according to their likelihood to reduce sound exposure levels experienced by SRKWs ("effectiveness"). For each of the mitigation actions and measures, the uncertainties and limitations as well as the actions to address any uncertainties and limitations are listed (in the first table). Next, I assess combinations of these mitigation scenarios and rank them (in the second table) to evaluate the pragmatic combination of measures most likely to reduce noise exposure levels within SRKW habitat.

I used the following criteria to rank the status of noise management options.

1. Higher rankings were assigned to mitigation options likely to reduce global, rather than only local noise levels. In practice, this means I gave higher rankings to permanent removals or retrofits than to temporary operational mitigation methods (e.g., local speed limits). All other things being equal, this approach would allow Canada to make long-lasting improvements in acoustic habitat quality for SRKW, while also making progress toward international targets to reduce shipping noise globally.
2. Higher rankings were assigned to mitigation measures that are likely to be implemented quickly, thereby facilitating SRKW recovery as soon as possible. I assume that measures affecting a small fraction of the fleet would be implemented faster than actions that would require fleet-wide changes and/or 100% compliance.
3. Higher rankings were assigned to mitigation options that lend themselves to time- and area-based management tools, to allow adaptive management of mitigation measures targeted on SRKW habitat as policy-makers refine SRKW conservation objectives. For example, spatially explicit management tools could prioritize noise mitigation in areas that SRKW use preferentially for feeding.

Ranking of single management options

In the table below, I rank noise management options based on their overall effectiveness in minimizing impacts of ship noise on SRKWs and other marine life. In addition to noting logistical constraints, uncertainties, and limits for each management option, I summarize what options could cause a 3 dB decrease in broadband noise levels, equivalent to halving the radiated power of the fleet that frequents the SRKW habitat. For example, a 3 dB reduction could be accomplished by removing ships that make up the 15% of the modern fleet that have the most intense source levels. (I call these ships “gross polluters” following the nomenclature under the California smog emissions standards for cars, in which a small proportion of agents cause a disproportionately large input to the pollutant.)

To gauge whether a noise mitigation measure is likely to cause a relatively large or small reduction in noise, I use a 3 dB placeholder value for a meaningful noise reduction. This 3 dB value is a placeholder until policy makers specify the level of risk they are willing to tolerate in light of SRKW recovery, but it happens to match nicely with two related processes. At a local scale, we are facing industrial development that may easily double traffic of large ships in the Salish Sea (Gaydos et al. 2015), which—all other things being equal—would theoretically cause a 3 dB increase in noise levels. A reduction of 3 dB would be required to offset these future inputs without causing a net increase in noise. Secondly, we note a recent pledge by Okeanos and a later endorsement by the International Whaling Commission (IWC Scientific Committee 2016) to reduce the inputs from individual ships. These international groups call for efforts to “reduce the contributions of shipping to ambient noise energy in the 10-300 Hz band by 3 dB in 10 years and by 10 dB in 30 years relative to current levels” (Wright 2008).

Rank (1= best)	Management option	Actions to get -3dB	Logistics	Uncertainties & limits
1	Remove noisiest ships in fleet	Remove “gross polluters” (see text). Could cause reductions >3 dB.	15% of fleet affected	Can noisiest ships be removed? If removed and replaced, are noisiest ships replaced with mean or minimum noise level?
2	Retrofit noisiest ships in fleet	Reduce noisiest ships to below 175.4 dB	43% of fleet affected	Key retrofit actions are more effective at the design phase
3	Retrofit all ships in the fleet	Retrofit all ships so source level reduced by 3 dB for each ship	100% affected	Key retrofit actions are more effective at the design phase. Large industry disruption/cost for modest return.
4	Modify ship design	All new ships use best practices to reduce source level by 3-5 dB	1% increase in manufacturing costs	Applies to all new builds.
5	Remove and replace	Replace noisiest ships with ones with 3-5 dB lower source level	Combines options 1 and 4	May be challenges with ensuring SL of replacements meets reduction target
6	Speed limit	All ships must respect speed limit of 11.8 knots	83% of fleet affected; VTSS & Coast Guards monitor only for speeders. Reduces lethal risk of ship	Collateral impacts (e.g., navigational safety, oil spill risk).

			strikes for baleen whales.	Local, not global. Longer exposure to lower levels may be a concern, depending on noise metric specified in policy.
7	Convoy (grouping ships together)	Convoys (e.g. at 11.8 knot speed limit)	Could affect only fast ships, or certain classes; major impacts on stevedores and pilots	May be risk implications for collision and oil spill associated.
8	Real time ship traffic control (rerouting, slowing, or rescheduling) to avoid SRKWs	Area to be avoided only when SRKWs are present. Requires real-time monitoring and flexibility (on some time scale) for pilots/ships to adapt.	Unknown fraction of ships affected some unknown proportion of time. Depending on % of ships affected, less effective than “Remove” scenario (Ranked #1)	May displace oil spill / ship strike risks. Real-time monitoring may not be 100% effective.
9	Re-route ships (permanent)	Permanent change in shipping lane.	All ships affected 100% of the time. Depending on class of ships affected, may become equivalent to “Remove” scenario (Ranked #1)	Will habitats shift? Will this displace oil spill risk?
10	Reduce speed for all ships	All ships slow down 3 knots from current speed	100% affected; VTSS & Coast Guards monitor all; Citizen scientists could monitor AIS; Pilots Association	Local, not global; hard to enforce Longer exposure to lower levels is a concern
11	Move lanes sideways	Shipping lanes shifted 1-4 km from current	Coast Guard/IMO	Constrained by geography in Haro and

		position		Rosario Straits and Swiftsure Bank. May involve major disruption for <3 dB effect

Slowing ships to reduce noise may have a variety of additional costs and benefits. Slowing ships down generally reduces noise levels, but it may also lower the risk of ship strike in baleen whales and possibly SRKW (Hatch et al. 2008). Slowing ships could also change navigational risks. A vessel traffic risk assessment conducted in Puget Sound during 2010 showed a 27% reduction in the risk of incidents (i.e., collisions and/or oil spills) when container ships were slowed to 17 knots from their mean speed of ~19 knots (Van Dorp & Merrick 2014).

Given the uncertainties and limitations of some scenarios, many of which rely on model predictions because they have never been implemented, I would advise Canada to take a multi-pronged approach to reach aspirational (~10 dB) noise reduction targets and to include a precautionary buffer to allow for imperfect compliance. The pragmatic, multi-pronged approach outlined here could guide a synthesis of multiple mitigation measures. This multi-pronged approach will (a) allow for aspirational reductions >3 dB in magnitude (i.e., thereby acknowledging that biologically relevant targets are not yet known and may require mitigation >3 dB); and (b) buffer against imperfect compliance rates, while still achieving a 3 dB reduction. For example, an 11.8 kt speed limit (3 dB reduction), removal of gross polluters (3 dB), retrofitting noisy ships (3 dB), and managing large ship traffic in a convoy approach could collectively result in a reduction >10 dB. This multi-pronged approach would allow Canada to exceed the IWC's most ambitious pledge -- a 10 dB reduction over 30 years (IWC Scientific Committee 2016).

Together, these two ranking tables could guide future models to predict population consequences of increased noise levels, or various mitigation scenarios, to SRKW. Some of these scenarios could explore how Canada could more-than-mitigate the impacts of the Project and dramatically and permanently reduce modern ship noise levels.

Ranking table of combinations of management options

Rank (1 is best)	Management option	Achievable noise reduction (dB)	Logistics	Uncertainties & limits
4	Convoy with 11.8 knot speed limit	3 dB for 50% of time at Lime Kiln	Pilots Association, VTSS, Coast Guard	Compliance, safety, and enforcement
3	Removal of gross	6 dB	Remove "gross	Logistical

	polluters + retrofit for remaining		polluters” to reduce source level by >3 dB and retrofit rest of fleet to reduce source level by 3 dB for each ship	constraints with respect to time, resources, and industry responsiveness
2	Removal+retrofit+ slow all by 3 knots	9 dB	Logistics from #3 plus VTSS & Coast Guards monitor all; Citizen scientists could monitor AIS; Pilots Association	Compliance and enforcement with respect to the speed reduction
1	Removal+retrofit+ convoy at a speed to get >4 dB	>10 dB	Logistics from #3 plus convoy approach could impact only fast ships, or certain classes	Convoy coordination

10. How will Project construction affect the Southern Resident Killer Whales and their Habitat?

Any construction project that involves impact or vibratory pile driving has the potential to have short- and long-term impacts on nearby marine mammals, including SRKWs, and their habitat. The worst case scenario would be the exposure of a SRKW to high-intensity construction noise that could cause permanent or temporary deafening. The more likely impacts, however, would involve fish (which could have cumulative effects for the SRKWs, e.g. if herring and/or salmon are killed) or possibly an increase in local noise that could impact SRKW foraging and communication efficiency if they are hunting for Fraser River adult Chinook during the construction phase.

11. What are the options to mitigate the impacts of Project construction on the acoustic environment, including the impacts on the Southern Resident Killer Whales and their habitat?

If Canadians are really interested in helping the SRKWs recover, they should expand shipping capacity somewhere else. And ideally they should also move the existing persistent sources of noise and chemical pollution out of the active delta of Fraser river. The Fraser delta and estuary is the nearshore habitat where the SRKW’s primary summer prey -- Chinook salmon -- return as adults and rear as juveniles.

According to the history prepared by the proponents (section 2.1-2.2), the ecological importance of this nearshore environment was not a consideration back in the 1950s when the location was chosen for a major ferry terminal. In a rush to restore ferry service after a labor strike, the location was selected based on four factors: shortness of the route; proximity to the Massey tunnel; land that was already cleared and level; and the relatively short causeway length needed to reach water deep enough for the ferries. So, a ferry terminal was constructed *within* the estuary and delta.

While other areas were considered for a coal terminal, one was added just north of the ferry terminal in the 1960s. Though alternate locations like Boundary Bay were considered and impacts on marine life were considered (but not formally assessed), the current location was preferred for “remoteness from densely populated areas to minimize impacts from occasional air, water, or noise pollution.” As a point of reference, just as the coal terminal was being finished in 1970, the capture industry reached its zenith -- removing 15 killer whales from the Salish Sea that year.

In 1979, a proposal to expand the coal terminal was rejected because “the potential impacts on the Fraser River Estuary were too great.” The panel articulated that their primary concern was protection of the valuable Fraser River salmon fishery, highlighting that there was not sufficient estuarine habitat required to support juvenile salmonids. Nevertheless, a reduced expansion of the coal terminal was eventually allowed. Ironically, enough extra space opened up over time in the coal terminal to allow container shipping infrastructure to move in (first to pod 4 in 1995, then pod 3 in 2000) and eventually expand itself (by adding the third berth in ~2010).

Thus, the current Roberts Bank shipping terminal is located only a few kilometers from the southernmost channel of the Fraser River -- where inbound adult salmon approaching via the Strait of Juan de Fuca naturally enter the river. Extending to the northeast from the existing terminal, the new terminal (RBT2) would be even closer to the nearest river mouth (and the adjacent Alaksen National Wildlife Area). The decadal advancement of Canadian development is poised to continue -- towards the central delta of the river that feeds the SRKWs.

The importance of this geographic area (the Fraser River delta) is emphasized in the Canadian delineation of critical habitat for SRKWs in the following map (Figure 1 of CSAS, 2017). Note the arc of the critical habitat north from Point Roberts around the delta towards west Vancouver. In contrast, the marine areas on the sides of the delta (Burrard Inlet on the north and Boundary Bay on the south) are not designated as critical habitat for SRKWs.

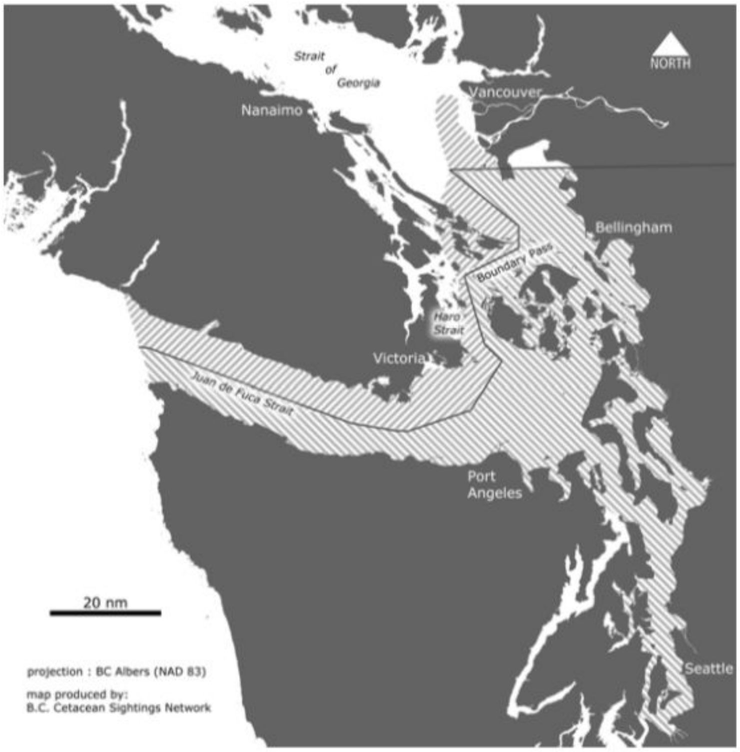
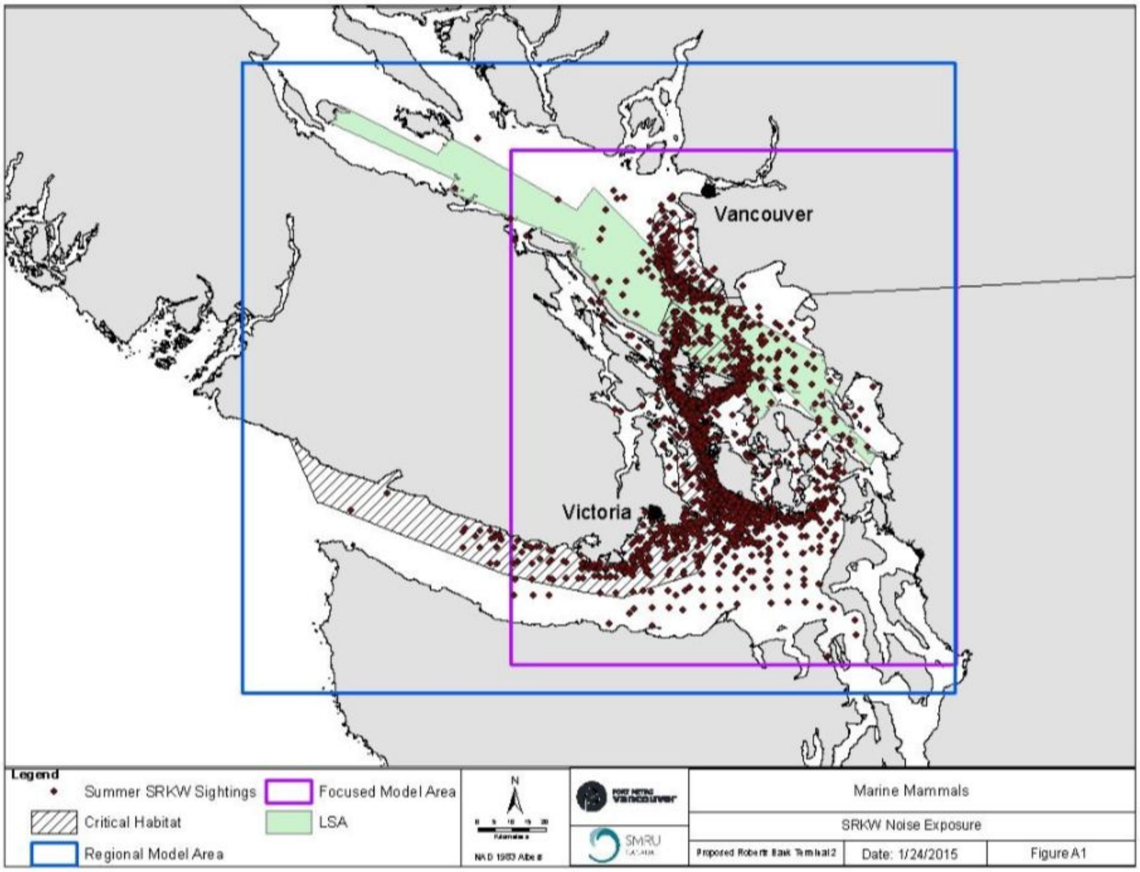


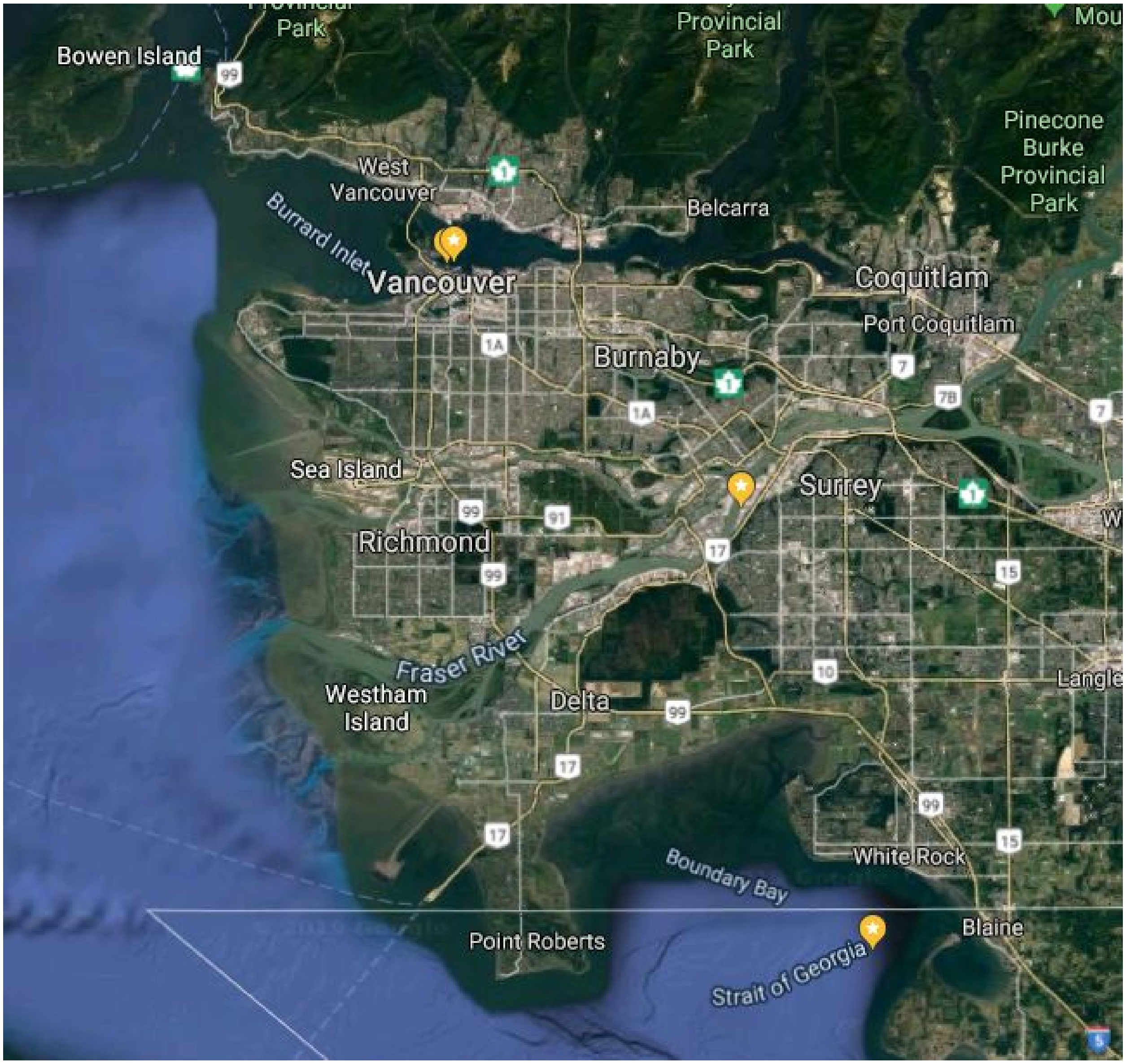
Figure 1. Southern Resident Killer Whale Critical Habitat in Canada and the United States. The hatched area in US waters depicts the approximate Critical Habitat under the US Endangered Species Act

Another indication that the Fraser river mouth is important to the SRKWs, and not necessarily the outer edges of the delta, is Figure A1 (from Appendix 14-B) below. The highest density of summer SRKW sighting locations extends from the Strait of Juan de Fuca through Haro Strait, the Gulf Islands, and Boundary Pass to the mouth of the Fraser. Sightings on the outer edges of the delta are rare to non-existent. The most parsimonious ecological explanation for this pattern is that the SRKWs are foraging on adult Chinook as they return to the Fraser River.

Figure A 1 **Summer SRKW Sightings Locations, SRKW Critical Habitat, Regional Model Area, Focused Model Area, and LSA**



A precautionary approach to more than mitigating the potential impacts of increased (and extant) ships on SRKWs and on salmon in the Fraser delta would be to move all shipping terminals *outside* of the delta. Looking at the satellite map (below) from the SRKW's and Chinook salmon's perspective, Vancouver Harbour looks like much better location for shipping and coal terminals than the active Fraser delta. That harbour is well north of the modern Fraser River mouth and adjacent to the mooring area for commercial ships in Burrard Inlet. In that vicinity there is already substantial shipping infrastructure (Vanterm and Centerm) which could be expanded dramatically to accommodate both RBT2 and RBT1.



Alternatively, the containership (and coal) terminals could be moved to the south side of the Fraser Delta, on the far side of Point Roberts, within Boundary Bay. Positioned near White Rock, as far as possible from the Fraser river mouth but still in Canada, it might have the least impact on the nearby marine and estuarine environments.

There is evidence that such a move to restore natural habitat within the delta would benefit salmon, including Fraser Chinook upon which SRKWs depend in the summertime. For example, one peer-reviewed assessment of coal port impacts on juvenile salmon (including Chinook) emphasized that the “recent construction for expansion of the port has obliterated feeding areas, invertebrate communities, and possibly herring habitat from the local production system” (Levings, 1985).

Relocating the present-day terminals would also reduce impacts on the SRKWs -- both acoustic (e.g. the ships, their tending tugs) and cumulative. If the Tswassen ferry terminal was also relocated, it could dramatically reduce the risk that a SRKW is struck by a vessel, as may have happened in the death of J-34 in the southern Strait of Georgia (the immediate vicinity of the Project). To optimally reduce SRKW strike risks (and reduce noise and other ferry impacts) near the Fraser river mouth, it would be prudent to route all Nanaimo-bound traffic through Horseshoe Bay and make a new ferry terminal (based e.g. in White Rock?) serve only travellers bound to/from Sidney and the southern Gulf Islands.

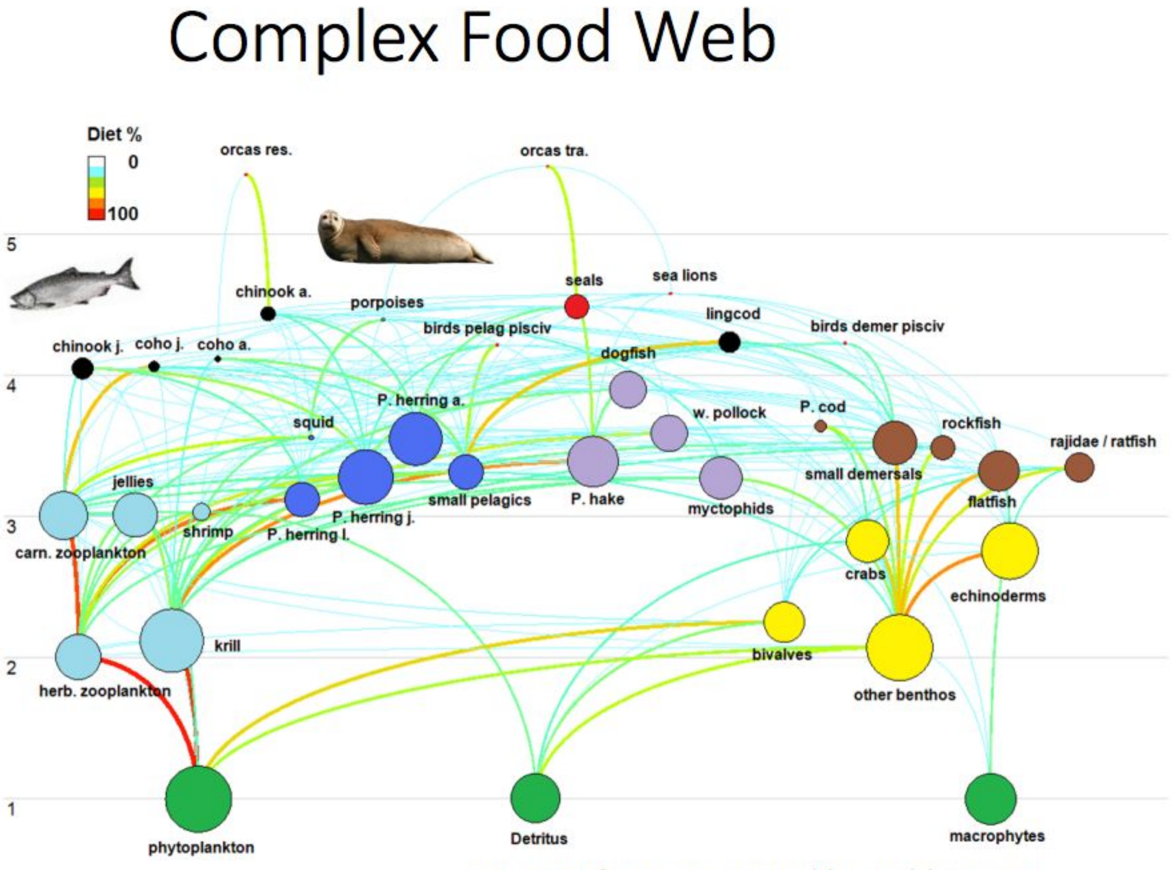
Cumulative effects of the Project, particularly on Southern Resident Killer Whales

12. Please describe the cumulative effects of the Project-related shipping in combination with other human activity on the Salish Sea, including the cumulative effects on the Southern Resident Killer Whales and their habitat.

I have two main concerns regarding cumulative effects of the Project and other human activities within the Salish Sea. The first relates to the strong ecological connection between SRKWs (and other marine mammals), adult and juvenile Chinook salmon, and Pacific herring. The second involves vessel strikes on SRKWs, and the possible roles of ships and/or ship noise in those strikes.

Pacific herring connections to Chinook salmon and SRKWs

The RBT2 Project could have a wide range of cumulative effects on the food web in the Strait of Georgia -- which is wonderfully complex, as depicted in this diagram (adapted by WDFW from Priekshot et al., 2012):



Complex Food Web

Source: Strait of Georgia ecosystem model – D. Preikshot & I. Perry, Fisheries and Oceans Canada

The population dynamics of SRKWs (abbreviated as “orcas res.” in the food web diagram) are driven primarily by abundance of Chinook along the west coasts of the U.S. and British Columbia (Ford et al., 2010). During the spring and summer, adult Chinook returning to the Fraser River are the most important component of the SRKW’s diet (Hanson et al., 2010). Human fishers often troll for those adult Chinook using herring plugs, which I take as anecdotal evidence that returning Chinook prey upon herring. The food web diagram verifies this trophic connection among many others between both adult and juvenile Chinook (“chinook a.” and “chinook j.” in the diagram) and adult and juvenile herring (P. herring a.” and “P. herring j.” in the diagram). So, the condition of returning adult Chinook probably depends upon the availability of at least adult herring, and possibly also juvenile herring, along the Chinook migration route.

A different, but possibly more important connection between Chinook and herring is that herring predators, like harbor seals (the red dot in the food web), sea lions, and birds may switch from eating herring to consuming juvenile salmon when herring are scarce. In the region of the Project, just south of the Fraser River mouth, the Cherry Point herring population used to be the largest in Washington State. Historically, Cherry Point herring spawned from the north end of Bellingham Bay north to the Canadian border (Point Roberts). For reasons that are not yet clear, the Cherry Point stock is only at about 10% of its historic size. Because of this local shortage the nearshore environment at the mouth of the Fraser is likely a habitat in which out-migrating Fraser Chinook smolts face elevated levels of natural predation.

All this means that any impacts of the Project on herring (or eel grass to which the herring attach their eggs when they spawn each spring) could have ecosystem effects which matter to the SRKWs (and other marine mammals who prey upon adult Chinook). Potential impacts of the Project on herring include: disturbance during construction (e.g. by pile emplacement); destruction of eelgrass beds during construction; and on-going disturbance by ship and tug noise near RBT2. There is emerging evidence that displacement of herring can be caused by underwater noise (e.g. Slotte et al., 2004).

Also related to these connections is a trend of transient (Bigg's) killer whales recently occupying the Salish Sea more than in the past, while there are fewer SRKWs (Shields et. al. 2018). Hence, SRKW's may not be necessarily always be controlling, and the impacts of ship's presence and noise on transient killer whales should not be ignored, especially given the complex ecological connections between residents and transients. For example, Bigg's killer whales prey mainly upon harbor seals while harbor seals prey upon not only salmon (adults and juveniles) and their prey (e.g. herring), but also key predators of juvenile salmon (like hake).

Vessel strikes of SRKWs, and the potential role of ships and/or ship noise

Because the RBT2 will bring an increase in ship traffic or at least an increase in the size of ships frequenting the habitat of the SRKWs, I am concerned about the possible increased cumulative risk of ship strike on the SRKW population, especially given its current precarious condition. A deadly strike of another reproductive female could hasten the extinction of the SRKWs.

Since 2012, two SRKWs have been killed by something that caused "blunt force trauma." In the case of J34 who stranded at Sechelt, B.C., in 2016, it is most-likely that he was killed somewhere in the southern Strait of Georgia -- an area where vessel traffic is high and where SRKWs forage for Chinook. Public opinion suggested that a vessel was probably the cause of the trauma. The necropsy report, though not yet formally released, basically reported that J34 was struck on the upper left side hard enough to have fractured his skull. In the case of L112, who stranded in 2012, the trauma was similar as was the setting: she was most-likely killed near the Columbia River mouth -- an area where vessel traffic is high and where SRKWs are known to forage for Chinook.

Williams et. al. (2010) reports that 3-4 whales are struck per year in Canadian and US inland waters. Furthermore, Williams et. al. quantifies the increased probability of ship strike as shipping traffic changes. Also, in multiple cases of killer whale strikes since observations began in Johnstone Strait (Helena Symonds, pers. comm.) ship propellers have caused severe injury or fatalities. Multiple examples of killer whale dorsal fins being severed or deformed suggest strikes by ships, rather than by boats. In the case of A21, a Northern Resident Killer Whale, we know that it was hit by the Comox ferry and did not survive (Ford et al., 2000).

While serious injuries to SRKWs from collisions with vessels are probably rare events, there is a disturbing trend of two individuals suffering from blunt force trauma in the last 7 years. It is possible we should expect such strikes to become more common if we continue to increase vessel traffic in the region -- from recreational boats to ferries and container ships. The cumulative impact of such vessel interactions may be complex; perhaps the persistent noise from ships makes it increasingly difficult for SRKWs to pick up on acoustic environmental cues -- like the buzz of an oncoming speed boat that normally could be avoided (under low background noise conditions).

13. What, if any, are the options to mitigate the cumulative effects on the Southern Residents and their habitat? What is your opinion of the viability of these options and their likely effectiveness?

In an ideal world, we would have an accurate ecosystem model of the Salish Sea integrated with PCOD models for all species that respond to important habitat characteristics like underwater noise. With such integrated models we could assess assess cumulative impacts on species of concern more easily and with greater confidence. We could also test the efficacy across of potential conservation actions across an ecosystem, rather than for individual species. Unfortunately, such models are only emerging now and are not yet integrated.

Given this state of affairs, I would like to offer a list of questions which arose during my assessment of the RBT2 Project, and especially the modeling of the population consequences of acoustic disturbance for SRKWs. While the proponents state they attempted to keep the PCOD model “simple,” it still is complicated and within it are many assumptions and scientific uncertainties related to the complex bioacoustics of SRKWs and ship noise.

General questions about the RBT2 SRKW PCOD model:

- Why have the proponents not run a “more than mitigate” scenario (e.g. RBT2 goes forward and ships add noise, but other sources of noise in the SRKW habitat are dramatically lowered by a mitigation strategy like the slow-down of all ships, including new RBT2 ships)?
- A 50% chance of decline should be unacceptable. What reduction in noise exposure would generate less than a 5% chance of decline?
- Are vital rates in year N a function of vital rates in year N-1?
- Is the assumption of Chinook supply being constant reasonable? Have runs been done with better/worse Chinook supply? (How sensitive is the PCOD model to Chinook supply? Is it over-optimistic about prey-switching?)

- When the proponents write that “Therefore, while the model itself is robust, the results should be interpreted in the larger context of the limitations...” what does “robust” here mean? If the authors are saying that the results don’t change much with different scenarios, then they need to expand their scenarios. For example, they could run a scenario with much less shipping and see how the model responds.

Finally, the Project proponents rightly identify the limitations of using a monthly average of noise levels as an input for an SRKW PCOD model. They state that using an averaging time scale of minutes for a couple of days of representative acoustic data is important because “behavioural response and masking are driven by noise extremes, not averages.” I would even shorter time scales may be appropriate for estimating the statistical distribution of low-severity and moderate-severity behavioural responses and acoustic masking (for SRKW signals in ship noise) because there are significant variations of ship noise on time scales of seconds or even milliseconds (e.g. the “clattering” that is characteristic of many cavitating propellers) and because the SRKW signals also have a time scale of seconds (calls, whistles) or milliseconds (echolocation clicks and their echoes).

Do you have any relationship with a party to this litigation that might affect your duty to be objective and impartial?

14. Before agreeing to give an expert report in this regulatory proceeding, did you have a relationship with the Proponent, or with any federal government department participating in the Hearing, such as Fisheries and Oceans Canada?

I have had a working/financial relationship with DFO. I sub-contracted with Oceans Initiative to help produce a CSAS report regarding ship noise mitigation. That sub-contract included me traveling to Vancouver to present the results of our research at the 2017 CSAS meeting.

15. Before agreeing to give an expert report in this regulatory proceeding, did you have a relationship with the David Suzuki Foundation and Wilderness Committee, or with Raincoast Conservation Foundation or Georgia Strait Alliance? Please explain.

I've not had working/financial relationships with Georgia Strait Alliance. I worked under contract for the Rainforest Conservation Foundation from Oct 2018 - Jan 2019, preparing a report regarding potential threats of the Trans-mountain pipeline extension to SRKWs that they filed in a hearing about the project, but my agreement to provide a report to the RBT2 panel was signed a couple years before working with the Rainforest Conservation Foundation. I have had a relationship with the David Suzuki Foundation and Wilderness Committee through this RBT2 review process, including the agreement to provide an expert report to this regulatory proceeding, and to work on previous stages of the environmental review of the RBT2 project.

Conclusions

The SRKW are one the most-studied marine mammal populations in the world. For almost 40 years, we know identified every individual, so know both the current population and many demographic parameters. We have categorized their calls and we know a lot about how they move throughout the year and what they eat.

Yet we are just beginning to understand how they use sound for complex essential tasks like foraging and how such endeavors are affected by ship noise, as well as other potential impacts of human human activities. We don't know for what any of their calls are used. We have no measurements of the intensity or directivity of their clicks (assuming instead that they are the same as those of NRKWs or similar to other dolphins). We don't know how well their main prey, Chinook salmon, senses sound pressure or particle motion. We can only infer how they hear (assuming key acoustic parameters like critical ratios, directivity index, and avoidance of masking in anisotropic noise). And we do not yet fully understand the importance of quiet time to SRKWs and the acoustic ecology of the Salish Sea.

The Project proponents have demonstrated that they are willing to make great efforts for new development to have no net increase in impacts on the SRKW population. Canada has slowed ships and demonstrated decreases in ship noise levels, but has not invested in studying how the SRKWs respond to such mitigation. Within the RBT2 assessment, great efforts have been made to measure ship noise, predict increases from the status quo under various development scenarios, and model the loss of communication and echolocation space from the remaining noise.

Despite these valiant efforts, we are struggling to decide as a society that we are unwilling to lose them. Perhaps individuals who have decided that too much would be lost lack the tools to communicate why. Or perhaps we all lack the wisdom to know exactly what -- beyond direct economic value -- would really be lost if our regional icons go extinct.

In the face of scientific uncertainty about SRKWs and our impacts on their complex marine ecosystem, we should take a precautionary approach. We should quiet their waters before adding more ships. We should ensure they have abundant, non-toxic salmon to eat and are on the road to recovery before we make their lives more difficult.

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Attachments

Attachment A: C.V. for Dr. Scott Veirs

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Education

Sep 1998 – Jun 2003	**University of Washington Seattle** PhD, Oceanography Seattle, USA
Sep 1995 – Jun 1997	**University of Washington Seattle** MSc, Oceanography Seattle, USA
Sep 1988 – Jun 1992	**Stanford University** BS, Earth Systems Palo Alto, USA

Thesis

Scott R Veirs: *Heat flux and hydrography at a submarine volcano: Observations and models of the Main Endeavour vent field in the northeast Pacific*. 06/2003, Degree: PhD, Supervisor: Russell McDuff

Research Experience

Jun 2003 – present	**Principal Investigator** Beam Reach, Killer whale bioacoustics Seattle, WA, USA
Jun 1995 – Jun 2003	**Research Assistant, Teaching Assistant** University of Washington Seattle, School of Oceanography

Skills & Activities

Skills	Marine Sciences, Marine Mammal Research, Environmental Sustainability, Underwater Noise, Acoustics, Environmental Science, Oceanography, Open Science, Hydrophones, Sound, Whales, Audio, Marine Biology
Scientific Memberships	Acoustical Society of America
Interests	Open Science

Publication Highlights

Scott R. Veirs, Val Veirs, Jason D. Wood: *Ship noise extends to frequencies used for echolocation by endangered killer whales*. PeerJ 02/2016; 4(3)., DOI:10.7717/peerj.1657

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Attachment B: Addendum gap report

Beam Reach
Marine Science & Sustainability School

Contract Report

For David Suzuki Foundation and Wilderness Committee via
EcoJustice

Acoustic & cumulative effects of the Roberts Bank Terminal 2 Project on Southern Resident Killer Whales

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Dr. Scott R. Veirs

Contact:
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October 27, 2016

Contents

1 Scope of work

The overall scope of work is to review the sufficiency (completeness) and technical merit of the Shipping Addendum and additional related information provided by the Port on April 8, 2016. My review focuses on the assessment of acoustic and cumulative impacts on Southern Resident Killer whales (SRKWs).

2 Were completeness comments addressed?

On February 24, 2016, the CEAA requested additional information in a letter to the Port of Metro Vancouver. On April 8, 2016, the Port (now the Vancouver Fraser Port Authority) responded with additional information. I've reviewed the table of comments I provided in December, 2015, regarding completeness of the Addendum and determined whether or not each comment was addressed in the February 24 letter from the CEAA and/or the April 8 response from the Port. For all comments relevant to the SRKWs I found that my concerns about completeness were not addressed within either document.

3 Assessment of the Shipping Addendum & related information

3.1 Overview

While the Addendum and related EIS documents state that existing ship noise levels are high and modeled behavioral responses and acoustic masking are significant, it downplays the potential (low- to moderate-severity) acoustic impacts of RBT2 by citing the PCOD prediction of no change to vital rates of SRKWs. It notes that the PCOD confidence intervals are large and that ship noise could be limiting SRKW recovery through reductions in foraging success. Furthermore it notes that cumulative acoustic impacts of current noise levels have not been assessed because noise from boats (i.e. whale watching vessels) is not included in the noise models.

However, in determining the significance of acoustic disturbance from the project to SRKWs, the EIS (in section 14.9.2.1) emphasizes that the ship calls associated with the project are small compared to the existing traffic (260 ship calls per year out of 12,706 total commercial marine vessels transiting the waters near Roberts Bank in 2030). This leads to the both Addendum and EIS concluding that "acoustic disturbance from Project operation over and above existing conditions is unlikely to affect individual SRKWs such that the survival or recovery of the species is jeopardised."

Where will our marine species end up if all projects take this approach? A sustainable, responsible terminal development would incorporate sufficient mitigation to incrementally reduce ecological impacts on marine life. Instead, this project proposes to increase the impacts, but only a bit. This is the mechanism – one more small cut – that underlies the notion of environmental death by a thousand cuts.

Overall, the impact assessment effort is admirable in this project. I believe there is an earnest effort to improve the accuracy of the assessment through refining its models, as well as their underlying assumptions and the parameterizing data. The modeling of acoustic impacts and effects, in particular, is advanced and innovative, but consequently so complex and novel that a second extension of the October, 2016, comment deadline would be required for me to fully understand and critique the methodology.

The biggest shortcoming of the acoustic assessment – in the Addendum for the RAA, as well as in the EIS for the LAA – is the averaging of noise levels over irrelevant time scales. In key parts of the methodology, averages are computed over a year or a month, rather than a shorter period appropriate to the impact being assessed. I note specific instances of this weakness in the notes I have provided below on both the acoustic and cumulative impacts on SRKWs.

One specific, overarching concern with the entire EIS and its Addendum is that the project lifetime appears to be underestimated. The modeled scenarios in both the EIS and Addendum extend only to 2030, whereas the project lifetime has been stated to be at least 40 years. (Page 17 of the EIS Executive summary notes: "Once the Project was operational, and subject to ongoing availability and functioning of the terminal, Port Metro Vancouver would make regular payments to the infrastructure developer [to maintain RBT2] over a period of up to 40 years.") If RBT2 begins operations as early as 2020, it would thus be expected to continue operating at least until 2060. With this in mind, it is appropriate to use the 2016 Ocean Shipping forecast to estimate shipping traffic and ship size distributions over the full lifetime of the project. This latest shipping forecast expects that container ships will exceed 400 m LOA and 20,000 TEU (with drafts that could still be accommodated by the RBT2), and even mentions the possibility of 24,000 TEU ships being berthed by the Port of Metro Vancouver under "careful management." These projections indicate that the acoustic model assumptions are not conservative enough and that model scenarios should be extended (beyond the insufficient temporal boundary of the EIS) to at least the 2050 conditions characterized by the 2016 forecast – and possibly projected conditions in 2060. Would consideration of this latest forecast change the worst case scenarios explored in the EIS and Addendum?

To supplement these general problems, I list below the strengths and weaknesses of the assessment of first the acoustic, and then the cumulative impacts on SRKWs.

3.2 Potential acoustic impacts on SRKWs

3.2.1 Weakness: Use available data to validate projected spectrum source levels for largest container ships

[Reference Addendum section 7.6.2.2]

Regarding Triple-E class contain ships the Addendum (Section 7.6.7.1) states erroneously that there is an "absence of source level measurements for this class of vessel." Figure 7 of McKenna et al. (2013) indicates that they have source spectra for at least 3 container ships that are 350-400 m long.

The Addendum should use the most-recent published, peer-reviewed data to verify the assumption that adding 1.67 dB will accurately adjust spectrum levels from the measured representative ship (338 m) to a Triple-E class (367 m) ship. New Panamax container ships are 335-397 m long and carry up to 15,000 Twenty-foot Equivalent Units (TEU); Triple-E ships are of similar length, but carry up to 18,000 TEU. The class of the largest ships measured by McKenna et al. (2013) should be ascertained and utilized.

3.2.2 Weakness: Clarify the distribution or derivation of source spectra for container ships

[Reference Addendum section 7.6.2.2]

Container ship source levels have a wide range of broadband values distributed about the mean. McKenna et al. (2013) reports a range of ±15 dB. Therefore, the louder ships likely to be in the distribution should be used to evaluate the likely most severe impacts (e.g. on SRKWs). A ship that is 15 dB louder than the average ship produces about 30 times the acoustic power underwater.

The Addendum should include a clear characterization of the distribution of container ship source spectra. The derivation of the "conservative" source level estimates for model and representative ships is not clear in section 7.6.2.2 or the references it makes (to Section 7.6.3.1 and Appendix 7.6-A).

Some clarification is offered on page 6 of another technical document (Appendix 9.8-B: RBT2 – Vessel Traffic Underwater Noise Study), but it is not sufficient for me to determine the actual 1/3-octave band source levels that were finally utilized in the acoustic models. It is disconcerting that the derivation apparently involved extrapolation both at low (<50 Hz) and high (>8,000 Hz) frequencies. Thus, I am left unable to assess the assertion that the acoustic models are using a "conservative" estimate of the (largest) container ship source level.

3.2.3 Weakness: Ambient noise measurements are contaminated with low-frequency pseudo-noise

[Reference Addendum section 7.6.4.1]

Some noise measurements incorporated into the Addendum (and EIS) were made when tidal current flowing past the cable which supported the hydrophone was strong enough to cause noise at frequencies that overlap with ship noise. Such "pseudo-noise" can bias key measurements that the acoustic assessment relies upon.

The Addendum should re-assess sound pressure level statistics, particularly at low-frequency (<200 Hz). If it is not possible to re-acquire ambient noise recordings using a mooring design that does not introduce pseudo-noise associated with tidal currents, then the acknowledged contamination of at least some of the acoustic records by pseudo-noise should shift analysis away from annual or monthly means and towards assessing ship and background levels only during low-velocity tidal periods, e.g. via the methods of Bassett et al. (2012). Such an approach will make the acoustic models more accurate.

3.2.4 Weakness: Fill gaps in VTOSS data to match spatial resolution with appropriate time scales

[Reference Addendum section 7.6.7.1]

The Addendum acknowledges gaps in the VTOSS data. These should be filled with gap-free ship track data (e.g archived AIS data from 2012, possibly supplemented with data from more recent years). While VTOSS data errors may average out over months, they could cause inaccuracies in assessments of SPL averages over shorter time scales (as requested elsewhere in these comments).

3.2.5 Weakness: Use best available science when estimating source level of largest container ships

[Reference Addendum section 7.6.7.1]

McKenna et al. (2013) reports that ship length is the second most predictive covariate of broadband and octave-band source level and her Fig. 4 suggests slope is about 0.015 dB/m of LOA (for broadband levels between 20 and 1,000 Hz). In opposition to this, the Addendum states that there is no relationship between merchant ship length and source level, citing the much older study by Scrimger and Heitmeyer (1991).

The Addendum should include recent peer-reviewed literature when justifying the estimation of Triple E-Class source levels. It should use existing data (e.g. McKenna et al., 2013) to assess whether scaling container ship noise by vessel length works for existing source level measurements of different sized container ships.

3.2.6 Weakness: Single source level applied to all sizes of container ships

[Reference: 103688E.pdf, pages 7.6.6-7.6.7, sections 7.6.3.1; technical reports]

The noise models applied a single source level to all sizes of container ships after citing Scrimger and Heitmeyer (1991) regarding correlation of ship source level with ship type, rather than ship size. It is difficult to ascertain from the Addendum and related documents what actual source level was used. I had to dig all the way back into an EIS technical document (RBT2-Ship-Sound-Signature-Analysis-Study-TDR1.pdf) to begin to understand what actual source levels were used to characterize container ship noise. There I found a comparison of two different measurements of three container ships (from TWMBR and AMAR data sets) that implies that the broadband source levels determined from the AMAR data were 206, 203.9, and 200.5 dB re 1 μPa @ 1 m. These levels greatly exceed other estimates for individual container ships in the peer-reviewed literature (Veirs et al., 2016, McKenna et al., 2013, Bassett et al., 2012). As an aside, this constitutes evidence that the AMAR recordings are contaminated with low-frequency noise.

Containship source spectrum levels vary by 10-15 dB re 1 μPa^2/Hz @1 m while mean broadband source levels have a standard deviation of $pm4$ dB re 1 μPa @ 1 m (Veirs et al., 2016). A truly conservative methodology would: take the upper bound of the variation around the mean or the 95% quantile spectrum levels to characterize the current container ships frequenting the Port; extrapolate it upward adjustment (e.g by 1.67 dB) to the maximum size class of container ship expected at RBT2; and then further extrapolate to the length of the largest ships projected to utilize the Port in 20150 (per the 2016 shipping forecast).

3.2.7 Weakness: Monthly average sound pressure levels aren't relevant to assessing effects on SRKWs

[Reference: 103688E.pdf, pages 7.6.6-7.6.7, sections 7.6.3.1, 7.6.5.1]

The relevant time scale for assessing behavioral change due to a change in average SPL should be similar to the duration of an organism's exposure to the ship's noise – e.g minutes for a typical passing ship, not days or months. This has recently been articulated in draft guidance from NOAA (2013): "Overall dB rms levels should be based on short enough time windows to capture temporal variation in sound levels."

The Addendum and related information fail to provide statistics that summarize acoustic environment at shorter (e.g. 1-minute) time scales. Instead it offers only monthly or seasonal averages of SPL (which are not relevant to many potential effects on marine organisms). When assessing the change due to +1.5 additional container ships per day, summary statistics should include daily metrics like those quantified in the main EIS Appendix 14-B (e.g. % reduction in daily "quiet" time), or even shorter-time-scale means for those species that have brief-duration behaviors linked to vital rates (like SRKW foraging encounters).

When a SRKW is echolocating and/or calling while in pursuit of a Chinook salmon, the relevant time scale for averaging the ambient noise levels is seconds or minutes, not months or seasons. A monthly average SPL may greatly underestimate the relevant level and therefore the masking potential of ship noise.

3.2.8 Weakness: Baseline distribution of vessel sizes not provided

Table 4-3 (EIS Addendum 4.2.1.1) or a new table should present current vessel size distributions (e.g. 2012 data) in addition to the projected distributions for 2025 and 2030.

Section 17.3.2 requires "description of the types and sizes of vessels currently operating in the region." The size distribution of the shipping traffic (at least the container ships) currently associated with PMV terminals is important for referencing potential increased effects of the Project. Without this information it is impossible to correlate vessel size with potential effects (e.g. due to not only underwater noise, but also wakes, oil spill risks, etc.).

As I mentioned in the overview, a new table should also be expanded to include vessel sizes and size distributions not just for 2025 and 2030, but for the project lifetime – at least out to 2050, the latest year included in the 2016 shipping forecast.

3.2.9 Strength: The terminal expansion is sited in an area of chronic underwater noise pollution

While the location of the proposed terminal expansion is problematically within habitat of the SRKWs and the acoustic impacts of the associated shipping traffic may be significant, an advantage of the proposed site is that it already polluted acoustically. Extant sources of underwater noise include ships associated with the adjacent coal terminal and extant container terminal, nearby Tsawwassen ferries (berthed or in transit), and the shipping lanes in the Strait of Georgia (center of traffic separation zone 6 km away; near edge of northbound lanes 3 km away).

Table 8 of "RBT2 – Ambient Noise Measurements" shows that the long-term mean received sound pressure levels at Roberts Bank are about 120 dB re 1 μPa compared to 110 dB re 1 μPa in Haro Strait.

3.2.10 Weakness: Movement data does not allow assessment of Rosario Strait as alternative route to mitigate risks for SRKWs

Table 4-2 (EIS Addendum section 4.1.1) should include any 2012 movement data for segment F (through Rosario) for all vessel classes. The number of container ships movements through Segment B (Haro Strait) in 2012 should be broken down for each PMV terminal by: (a) inbound for a PMV terminal directly from the Pacific, (b) bound for a PMV terminal from Puget Sound, (c) bound for Puget Sound from a PMV terminal, (d) outbound from a PMV terminal directly to the Pacific.

Section 4.1.1 mentions the historic routing of container traffic between Vancouver and Puget Sound via Rosario Strait. The requested information is needed to determine whether Haro Strait traffic and associated effects could be mitigated by re-activating Rosario Strait transits. Section 17.2.2 specifically calls for "alternatives considered, such as different routing, frequency and vessel types." The relevance of such information is implied in Addendum section 4.2.1.6 for projected RBT2 traffic (but not current traffic): "almost 100% of the ship calls will also visit one of the PNW U.S. ports of Seattle or Tacoma as part of their voyage. This accounts for one additional movement through Segment C for each such voyage with a total of 780 movements through Segment C and 520 non-Project associated movements through Segment G."

In presenting projected vessel calls and movements through 2030 WorleyParsons Canada (2011) note such direct transits to/from U.S. ports, but do specify the routes taken.

> "Deltaport in 2010 had a split service that called twice at the terminal: the first call to discharge import containers and the second call to load export containers. Between the Deltaport calls, the vessel visited a U.S. Pacific Northwest port. The split service adds 52 vessel calls and 104 movements for 2010. Although unusual, this practice was assumed to persist at Deltaport in all projection years so as not to understate potential ship movements. The ship movements in the summary table reflect this service."

The route taken during these historic movements should be included, in part to understand the feasibility of mitigating impacts on SRKWs by avoiding their core summertime habitat in Haro Strait.

3.3 Potential cumulative impacts on SRKWs

3.3.1 Weakness: Fuel spill risks in the Fraser River delta and SRKW critical habitat

Increasing shipping traffic in or near the Fraser River Delta, as opposed to other terminals, poses potential cumulative impacts on SRKWs. In addition to direct ecological impacts of the new terminal during construction (to the seabed northwest of the coal terminal) and acoustic impacts of the additional ships (discussed previously), the additional traffic would raise likelihood of a bunker fuel spill that could disperse into the Delta.

The new terminal would be located 5.5 km offshore of the current adjacent Delta shoreline which includes habitat for juvenile salmon and other species which ultimately feed the SRKWs. The southern arm of the Fraser River meets the Strait of Georgia 6 km north of the proposed terminal site. In a spill scenario with southerly wind, a rising tide, and minimal seasonal outflow, the wind-driven and estuarine circulation in the area could hypothetically carry fuel up-river into the Fraser Delta where subsequent tidal exchange could disperse it throughout the lower Delta, including the Alasken National Wildlife Area, South Arm Marshes, and Deas Island Park. The time of year when this risk would be highest would be during a strong rising tide in early spring (February-April) – when wintertime southerlies are still prevalent, the Fraser's spring freshet has not begun in earnest (Davenne and Masson, 2001), salmon smolt out-migration is underway for Fraser Chinook, and herring are spawning in nearshore environments of the Salish Sea (see Table 13-4 of the EIS).

If expansion were shifted to Cen-Term or VanTerm, and/or traffic re-routed to Johnstone Strait and Discovery Passage, risks would shift away from Delta and SRKW critical habitat (as defined in the U.S.). Rosario has fewer protected areas and was used historically for container ships transiting between Vancouver and Puget Sound ports (Addendum page 4-3 to 4-4).

Another alternative that could reduce such risks to the Fraser River Delta is to create a terminal in Boundary Bay. Such a site would be more likely to contain a spill beyond the Delta, especially in the prevailing southerly winter winds. Any reductions in risks to the Delta would need to be weighed against the likely impacts to Boundary Bay ecosystems, including the local herring habitat. Additionally, the relative importance to SRKWs of the Delta versus Boundary Bay would need to be assessed, though the current Canadian critical habitat map does not include the Bay (Fisheries and Oceans Canada, 2011).

3.3.2 Weakness: Potential air pollution impacts not assessed for SRKWs

Air quality impact modeling should include a 3-dimensional puff model parameterized with wind data. This would allow estimation of increased exposure of SRKWs breathing ship exhaust at the sea surface. Plumes from ships and the associated air pollution near the sea surface are commonly observed near shipping lanes, including at the proposed site of the new terminal.

3.3.3 Weakness: Wave model predictions should be validated to confidently predict impacts on forage fish, including those in food chain that supports SRKWs

The wave height model seems unrealistic (from diver's perspective). The largest amplitude modeled surface waves are substantially lower than are commonly observed as ship wakes arrive at the shorelines of the Salish Sea. This discrepancy should be resolved by validating the model with field data.

If additional container ships are randomly distributed (i.e. not grouped with existing ship traffic), the projected increase of +1.5 ships/day means 3 extra daily disturbances year round in the nearshore environment (e.g. to forage fish eggs). The potential impact on forage fish that feed SRKW prey, and the cumulative effect on SRKWs themselves, should be assessed using new versions of the wave height models – ones that have been validated. The resulting wave height predictions should then be used as inputs to an ecological model that examines the effect of nearshore disturbance on forage fish, juvenile and adult salmon that prey upon them, and the SRKWs that consume the adult salmon.

3.3.4 Weakness: Temporal distribution of ships not specified in models

[Reference Addendum section 7.6.5.1]

Worst case models should assume that additional ships are distributed at extremes: either evenly spaced between or coincident with current and projected non-RBT2 traffic. For example, assume that the +1.5 additional ships per day will cause 3 new ship wakes to impact shorelines in two extreme ways: (a) wakes arriving at the shoreline in the middle of periods which would otherwise have been calm; and (b) wakes arriving simultaneous to existing or projected non-RBT2 wakes, thereby increasing their impact.

How were the additional 260 RBT2 ships distributed temporally in each Addendum model?

3.3.5 Strength: Mitigation of construction noise which could affect SRKW hearing and therefore cause cumulative effects during operation

Section 14.7.1.1 summarizes mitigation plans during construction, including marine mammal monitoring in buffer areas by observers and hydrophones. To prevent the inadvertent exposure of SRKWs to construction noise, and possible temporary or permanent thresholds shifts in their hearing that could cause cumulative effects (e.g. reduced foraging or communication success of SRKWs during and near RBT2 operations), construction and such monitoring should take place during daylight hours when visibility is sufficient, and ideally outside of the summer months when SRKWs are most prevalent in the LAA.

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Attachment C: Sufficiency report

Roberts Bank Terminal 2 Project Environmental Impact Statement

Comments on sufficiency of Information Requests

Participant: Dr. Scott Veirs

Organization (if applicable): Beam Reach Marine Science & Sustainability (SPC)

SCOPE OF WORK

Determine if gaps have been addressed and there is now sufficient information on shipping noise impacts and cumulative effects to proceed to hearing.

Do the Proponent's responses to IR Packages 1-13, when considered in combination with the EIS, the Marine Shipping Addendum, and other information contain sufficient information to allow the review panel to conduct a technical review of the Project?

General Comments

Expertise

I am Dr. Scott Veirs a marine biologist and oceanographer, with expertise in underwater acoustics including the impact of ocean noise on marine mammals. I have been retained on behalf of the Western Canada Wilderness Committee and David Suzuki Foundation to assist them in the Roberts Bank Terminal 2 review.

Overview

I find that the majority of the Information Request Packages that I have reviewed (see appended list) provide sufficient information to proceed with a hearing. However, there are a few Packages that are insufficient. I have briefly highlighted the insufficient packages in this Overview section and subsequently provide notes on each within my detailed comments.

Highlighted insufficiencies regarding acoustic impacts on SRKWs

- My main concern with respect to acoustic impacts on SRKWs is with IR04. In the most relevant sections (IR04-11 and -13), it would be helpful if the Proponent could further explain how "ship source level measurements presented in McKenna et al. (2013) would predict a smaller, less conservative adjustment of +0.5 dB for a Triple-E class container ship," ideally by providing a plot which indicates where the reference ship lies in the distribution of the McKenna data. I am also interested in knowing whether the Proponent could provide their own estimates of source levels for containerships that have been measured (more recently than the McKenna data) with the ECHO underwater listening stations in order to (a) verify that the power law of Ross (1976) provides accurate estimates of modern, local, extant containship source levels prior to using it to project source levels of larger, future ships, and/or (b) refute the extrapolated values I have derived for such larger, future ships using the median data of McKenna (2013). Without clarity on how the +1.67 dB estimate was derived, it is difficult to be sure that the noise modeling is as conservative and precautionary as the Proponent asserts.
- IR01-05 should provide more information about the historic (and potential future) use of Rosario Strait in trans-border-bound containership traffic. The Panel's consideration of possible mitigation measures (primarily for acoustic impacts in Haro Strait) could benefit from additional data on the logistics and costs for pilots (both U.S. and Canadian) when Rosario Strait was used for trans-border-bound containership traffic, as well as further details about the routes taken, the nature of the "one-way passage restrictions," and any incidents that occurred due to the slightly less-wide Strait. (The narrowest point in Rosario is ~2.7 km vs 3.6 km in Haro/Boundary.) Also, the Proponent's Table IR1-05-03 indicates that re-activation of trans-border-bound traffic in Rosario Strait would involve <u>all</u> containership traffic (because all ships are bound for ports in both Puget Sound and Vancouver), thereby potentially <u>halving</u> the noise impacts in Haro Strait where SRKW foraging is relatively concentrated during the summertime.

Highlighted insufficiencies regarding cumulative impacts on SRKWs

- Within IR5-15, 26, and 27 there is insufficient information about the relative sensitivity of herring and eulachon. To verify the assumption that herring are "controlling" -- more sensitive to noise than other fish species -- it would be valuable to ask the Musqueam: are the herring more 'skittish' than they observe the eulachon to be in response to noise?
- IR5 - 32 and 41 fail to provide the best available information regarding transient killer whale occupancy of the Salish Sea which may cause some cumulative effects on southern residents to be underestimated or missed.

I end this overview of my comments by pointing out that I believe there are still gaps existing related to my comments on completeness in 2015 and 2016 (beyond what has been provided through the Information Requests of the Panel). To illustrate this, I've provided a checklist of incompleteness I indicated, along with some notes regarding progress I am observing towards completeness. Thus far, however, only one box is checked out of nine...

Insufficiencies in the Information Request Responses

My detailed comments for each Package are provided below. They often follow relevant quotes and/or figures from the Proponent's response.

Package IR-1

IR1-05 Marine Shipping: movements

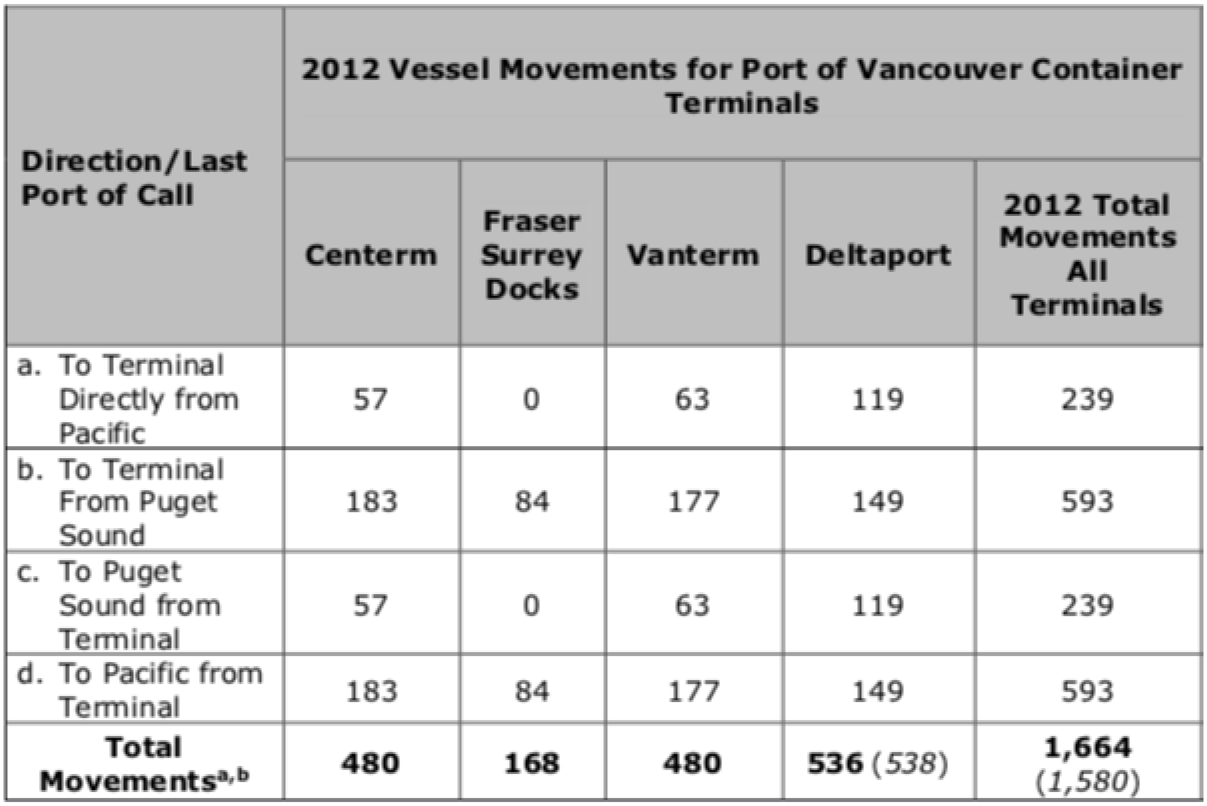
- "Rosario Strait route has not been used by trans-border-bound container vessels for approximately 10 years."
- Prior to 2010, how were these trans-border container ships handled? Were there pilot stations in other locations (e.g. Pt. Roberts? Or just Seattle?), or was the cost of having both a Canadian and U.S. pilot aboard just part of doing that business? Why did the change in routing occur?

- "Passage by container ships through Rosario Strait to, or from, Canadian terminals would require dual pilots (one Canadian and one American) to be on board for the entire voyage since this route does not pass the normal pilot stations at Victoria and Port Angeles… This re-routing would increase shipping costs significantly."
- The proposed RBT2 would be located only ~2 km from the U.S./Canadian border. Is it possible that VFPA container ships bound for Puget Sound could have a U.S. pilot handle those 2 km? Or could Canadian tugs handle the ship until it at the border and a U.S. pilot is aboard? Alternatively could a Canadian pilot go the first 2 km and then be replaced with by a U.S. pilot?
- For northbound traffic, could a U.S. pilot board the vessel in Seattle or Tacoma, and then follow a cost-effective procedure to safely cross the final 2 km to the RBT2 facility?
- What would be the change in cost for the Canadian and U.S. Pilot Associations (and the affected shipping line) if such a whale-benefiting mitigation were to be implemented?

- "Rosario Strait is very narrow and includes one-way passage restrictions."
- Please specify whether the constrictions were a problem when Rosario Strait was used by containerships (before 2010?), the beams and lengths of those ships, and the nature of the one-way passage restrictions.
- The length, beam, and draft of the New Generation IIB (20,000 TEU) container ship are expected to be 450, 61.5, and 16.5 meters, respectively. In comparison, large containerships that likely used Rosario historically were Panamax or New Panamax ships which both have length, beam, and draft of 366, 49, and 15.2 meters. The changes in beam would only be ~12.5 meters in a channel kilometers across. And the increase in draft would be only 1.3 meters.

- The narrowest point is 2.7 km (between Decator and Cypress Islands)In comparison, the narrowest part of Haro Strait and Boundary Pass is 3.6 km (between Turn Point and Rum Island). The bulk of Rosario Strait is about 5 km wide, which is comparable to the width of many restrictions along the Haro-Boundary route (e.g. Sidney to Henry, Moresby to Stuart, South Pender to Stuart, Saturna to Skipjack, or East Point to Patos).

- Table IR1-05-03 (extract below) indicates that *all* container ships that visit Deltaport also visit Puget Sound ports. I also note that Fraser Surrey Dock traffic only goes “counter-clockwise” (entering Puget Sound first, then Canadian waters, before returning to the Pacific), likely due to a shipping service which imports first to the U.S. and then exports from Canada.
- This means that if all ships used Rosario Strait, then containership traffic in Haro Strait could be halved.
- Furthermore, if incentives could cause more lines to visit Puget Sound first and then Vancouver, then most Haro Strait traffic would be southbound -- effectively shifting the noise sources laterally ~2 km further away from key SRKW foraging areas along the west side of San Juan Island.
- Even if this pattern was only followed during the summer (when SRKWs frequent Haro Strait and Boundary Pass) or even only when SRKWs were present in Haro, it seems like an important mitigation option to consider further.
- Note the consistent symmetry in this extract from Table IR1-05-03:



Direction/Last Port of Call	**2012 Vessel Movements for Port of Vancouver Container Terminals**				
	Centerm	**Fraser Surrey Docks**	**Vanterm**	**Deltaport**	**2012 Total Movements All Terminals**
a. To Terminal Directly from Pacific	57	0	63	119	239
b. To Terminal From Puget Sound	183	84	177	149	593
c. To Puget Sound from Terminal	57	0	63	119	239
d. To Pacific from Terminal	183	84	177	149	593
Total Movements[a,b]	**480**	**168**	**480**	**536** (*538*)	**1,664** (*1,580*)

Package IR-3 Ecosystem Model

IR3-05 Exchange with Adjacent Ecosystems

- Reviewed, but no comments on in/sufficiency

Package IR-4

IR4-01 Vessel Traffic Projections: container ship sizes

- Reviewed, but no comments on in/sufficiency

IR4-02 Vessel Traffic Projections: air pollution and wake/wave effects

- Reviewed, but no comments on in/sufficiency

IR4-03 Vessel Traffic Projections: George Massey Bridge/Tunnel

- Reviewed, but no comments on in/sufficiency

IR4-04 Vessel Traffic Projections: segment G details

- Reviewed, but no comments on in/sufficiency

IR4-05 Vessel Traffic Projections: small vessels

- Reviewed, but no comments on in/sufficiency

IR4-06 Vessel Traffic Projections: Fraser-Surrey coal/bulk dock

- Reviewed, but no comments on in/sufficiency

IR4-07 Vessel Traffic Projections: non/peak traffic at various facilities

- Reviewed, but no comments on in/sufficiency

IR4-08 Vessel Traffic Projections: tug & ferry movement details

- Reviewed, but no comments on in/sufficiency

IR4-09 Vessel Traffic Projections: vessel movement for excluded projects

- Reviewed, but no comments on in/sufficiency

IR4-10 Underwater noise: ECHO program

- Reviewed, but no comments on in/sufficiency

IR4-11 Underwater noise: estimating Triple-E-class ship source levels

The response states "...ship source level measurements presented in McKenna et al. (2013) would predict a smaller, less conservative adjustment of +0.5 dB for a Triple-E class container ship."

However, figure 3 from McKenna et al., 2013, depicts median values for repeat-transit container ships with lengths up to 350 meters:

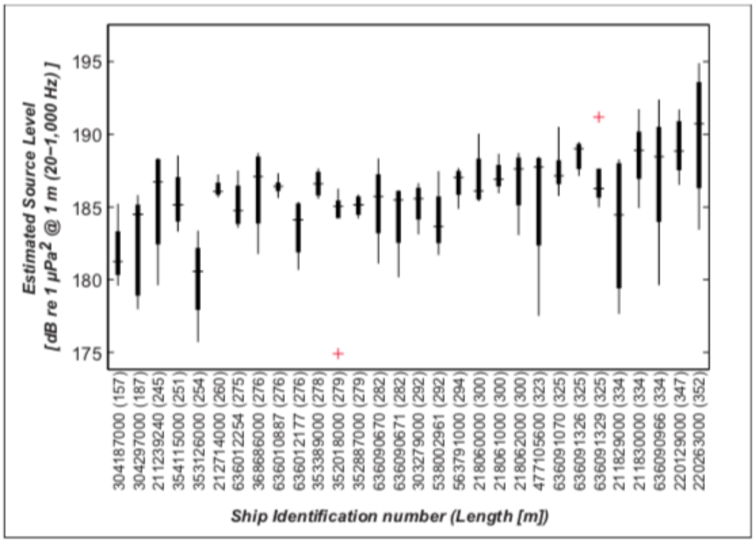


Figure 3 | Variability individual container ship estimated SL from ships that transited on four or more different occasions. Boxes bound the 25th and 75th percentiles with the horizontal line at the median. Ends of the vertical whiskers are the highest and lowest values of the data set that are within 1.5 times the inter-quartile range of the box edges. The plus signs represent data outside the range of the whiskers.

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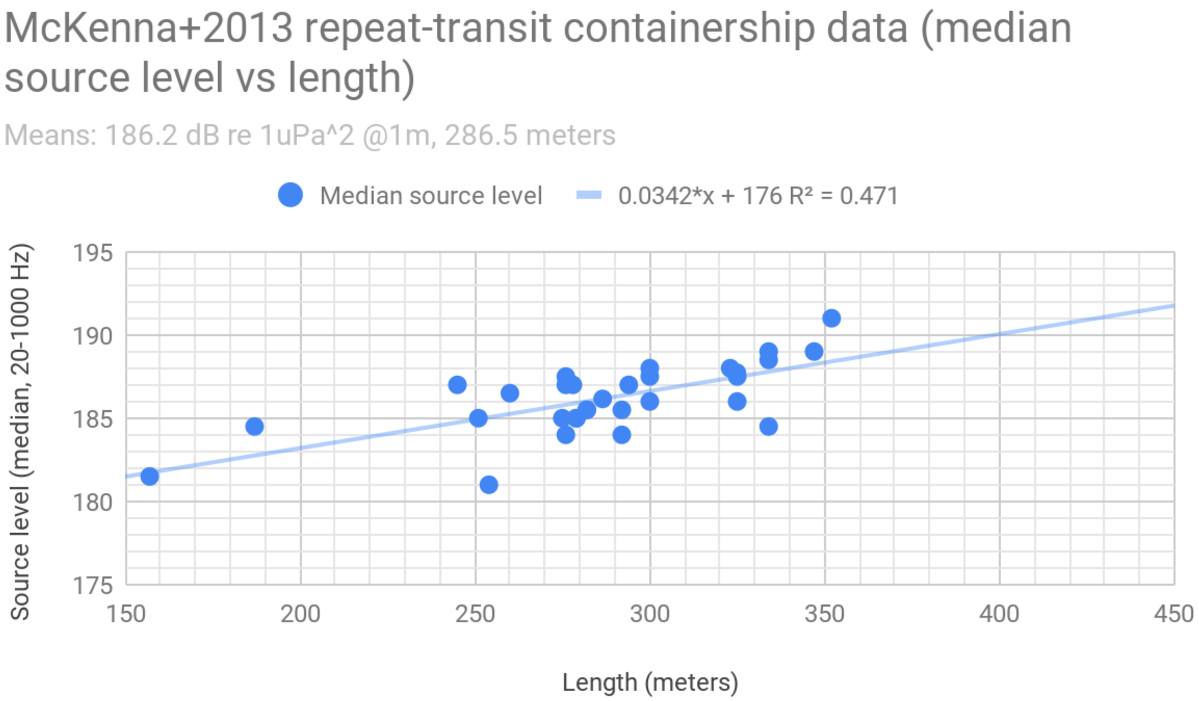
These data are median source levels derived from multiple measurements made during at least 4 distinct transits of the same ship. If we plot the median values versus the associated ship's length, we see a linear relationship with a slope of +3 dB per +100 meters:


McKenna+2013 repeat-transit containership data (median source level vs length)

Means: 186.2 dB re 1uPa^2 @1m, 286.5 meters

The best-fit trend line to these data (20-1000 Hz median band levels) indicate that a 400-meter-long containership (length of a Triple-E class vessel specified in the response by the Proponent) would be expected to have a source level of 190.0 dB re 1uPa^2 @1m, which is +3.8 dB above the overall mean value for this data set (186.2 dB re 1uPa^2 @1m). Even if the mean of vessels with lengths of 300-350 m (187.7 dB) is used as the reference, the estimated source level of a Triple-E (400 m long) vessel would be +2.3 dB.

Thus, I understand neither how the value of +0.5 dB was computed, nor how the Proponent's adjustment of +1.67 dB can be considered conservative and precautionary. The decibel scale is logarithmic, so an adjustment of ~2.3 or 3.8 dB is distinct enough from +1.67 that a re-assessment of the conservativeness of the noise modeling is warranted, even after considering the Proponent's response regarding key model assumptions being precautionary.

The Response cites this document as +1.67 dB adjustment being "probably the best information available" -- CEAR Document #959 From Fisheries and Oceans Canada to the Review Panel re: Response to Information Requests issued by the Review Panel on April 5, 2017 (See Reference Document 951).

I have reviewed the CEAR document #959 and see that it makes no use of available modern data (e.g. the linear plot of modern containership medians that I have provided). The DFO response to the Panel states: "There is a link between SL and vessel length and the Proponent is assuming a second-power law dependency as suggested by Ross (1976) to scale the SL from an observed container vessel to the anticipated Triple E-class container ships expected in the future. Assuming that these larger ships will be about 21% longer than the present one, the second-power law indicates that this will increase the SL of these vessels by 1.67 dB."

IR4-12 Underwater noise: berthed container ship source level

- Reviewed, but no comments on in/sufficiency

IR4-13 Underwater noise: source level of 22-24,000 TEU vessels

- Using the Proponent's lengths for these larger capacity vessels (430 and 450 meters, respectively), the length-vs-source-level regression of McKenna+2013 data suggests the source levels for the bigger ships would be 191.0 and 192.0 dB re 1 uPa @1m, respectively. If the same extrapolation method that was used to estimate the Triple-E class source level was applied to these larger ships, the expected additional level above the measured mean source level (for ships up to 267m long) would be +4.3 or +5.8 dB. Since a 3 dB increase is equivalent to a doubling of acoustic intensity and a 6 dB increase indicates that a quadrupling of intensity, these would be much more impactful ships that thus further call into question how conservative we should take the noise modeling results to be.
- The response states: "The forecast of these larger vessel classes calling at RBT2 after 2030 is dependent on global market and trade conditions, and thus, is speculative."
- In assessing the longest-term environmental impacts of the project, we should assume the worst case (noise) scenario. That scenario is much larger ships with proportionally higher source levels -- possibly 200-400% of the intensity of the Triple-E class (if my linear extrapolation is accurate) -- likely outweighing any benefit of needing fewer voyages due to the larger ships' increased capacity (only 120-131% higher than the Triple-E capacity of 18,340 TEUs).

IR4-14 Underwater noise: small vessel noise contribution (table)

- Reviewed, but no comments on in/sufficiency

IR4-15 Underwater noise: impact pile driving

- Reviewed, but no comments on in/sufficiency

Package IR-5

IR5-01

- Reviewed, but no comments on in/sufficiency

IR5-01a Anchorage clarifications and maps/tables

- Reviewed, but no comments on in/sufficiency

IR5-15

- Claim: “Because eulachon do not have a swim bladder (Phleger 1998, Bone and Moore 2008), they are considered less sensitive to underwater noise than Pacific herring. Therefore, the assessment of underwater noise-related effects on Pacific herring is considered conservative.”

IR5-26

- (pg. 276) “Atlantic herring would react to underwater noise that exceeds 165 dB (i.e., 90 dB above the species’ hearing threshold of 75 dB). Thus, 90 dBht was determined to be the loudness level above which behavioural effects would manifest regardless of species.”
- (pg. 277) Musqueam First Nation assertion that eulachon are skittish suggests that eulachon may respond at the 90 dBht (herring) level where behavioural effects manifest. An audiogram and then a dBth (eulachon) calculation is needed to assess eulachon response.

IR5 - 27

- The proponents again claim here that herring are controlling over eulachon. Have the Musqueam have noticed if the herring are ‘skittish’ as they say eulachon are... That might help understand if herring really are controlling.

IR5 - 32

- Insufficient information provided
- (pg. 432) The “use of SRKW as the representative species for transient killer whales provides a more conservative assessment, as transient killer whales occur less frequently than SRKW in the local assessment area.”
- Recent studies show that more transient (Bigg’s) killer whales have recently occupied the Salish Sea more than in the past, while there are fewer SRKWs (Shields et. al. 2018). Hence, SRKW’s may not be controlling and the impacts of ship’s presence and noise on transient killer whales should not be ignored, especially given the complex ecological connections between residents and transients. For example, Bigg’s killer whales prey mainly upon harbor seals while harbor seals prey upon not only salmon (adults and juveniles) and their prey (e.g. herring), but also key predators of juvenile salmon (like hake).

IR5-40

- Reviewed, but no comments on in/sufficiency

IR5-41

- Insufficient information provided

- Williams et. al. (2010) reports that 3-4 whales are struck per year in Canadian and US inland waters. Furthermore, Williams et. al. quantifies the increased probability of ship strike as shipping traffic changes.
- Also, in multiple cases of killer whale strikes since observations began in Johnstone Strait (Helena Symonds, pers. comm.) ship propellers have caused severe injury or fatalities. Multiple examples of killer whale dorsal fins being severed or deformed suggest strikes by ships, rather than boats.
- The results of Williams et al. (2010) and other observations of ship strikes, particularly of resident killer whales, should be collated and incorporated.

IR5-42 through 52

- Reviewed, but no comments on in/sufficiency

Package IR-6 Air Quality

Package IR-7 through 10

- Potentially relevant, but not yet reviewed

Package IR-11

IR11-01

- Reviewed, but no comments on in/sufficiency

IR11-02 through 10

- Potentially relevant, but not yet reviewed

IR11-12

- Potentially relevant, but not yet reviewed

Package IR-12

IR12-05 In-air noise

- Potentially relevant, but not yet reviewed

Package IR-13 Mitigation Measures

IR13-30 Mitigation measures

- Reviewed, but no comments on in/sufficiency

Insufficiencies in “other information”

- Potentially relevant, but not yet reviewed

Were 2015 and 2016 SRKW noise and cumulative impact gaps identified by SV sufficiently filled?

2015 completeness requests

- ☐ Size distribution of 2012 ships (at least containerships)
- ☑ Vessel movement breakdown by source & destination
- ☐ Noise statistics on time scales that are relevant to SRKW behavior
- ☐ Use all available data to verify that extrapolating SL by length is accurate
- ☐ Use all available data to verify that 1.67 is an accurate way to adjust spectrum levels (from 338 to 367m)
- ☐ Show distribution of container ship spectra along with “representative” spectrum (338m ship)
- ☐ Ensure noise (RMS) values are not contaminated by low frequency tidal pseudo-noise
- ☐ Use ship movement data (AIS, not only VTOSS) with resolution that matches acoustic averaging period (seconds or minutes, not months)
- ☐ Consider impacts on Bigg’s whales, and ecosystem interactions with SRKWs and their prey
- ☐ Assess acoustic impacts on humpback signals (echolocation and communication)
- ☐ Clarify how additional 260 transits were distributed temporally

NOTES related to my completeness requests:

Re size distributions: I see from here this projection of sizes for 2025-2035, but not (yet) the 2012 distribution:

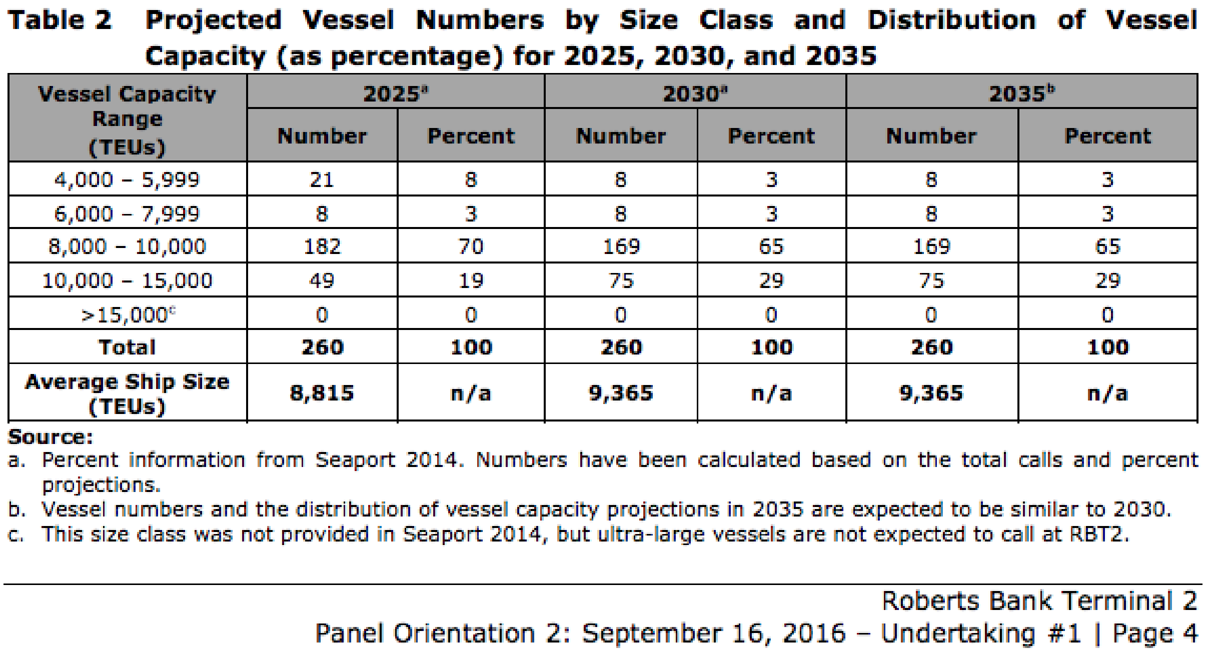


Table 2 Projected Vessel Numbers by Size Class and Distribution of Vessel Capacity (as percentage) for 2025, 2030, and 2035

Vessel Capacity Range (TEUs)	2025[a]		2030[a]		2035[b]	
	Number	Percent	Number	Percent	Number	Percent
4,000 – 5,999	21	8	8	3	8	3
6,000 – 7,999	8	3	8	3	8	3
8,000 – 10,000	182	70	169	65	169	65
10,000 – 15,000	49	19	75	29	75	29
>15,000[c]	0	0	0	0	0	0
Total	**260**	**100**	**260**	**100**	**260**	**100**
Average Ship Size (TEUs)	**8,815**	**n/a**	**9,365**	**n/a**	**9,365**	**n/a**

Source:

a. Percent information from Seaport 2014. Numbers have been calculated based on the total calls and percent projections.

b. Vessel numbers and the distribution of vessel capacity projections in 2035 are expected to be similar to 2030.

c. This size class was not provided in Seaport 2014, but ultra-large vessels are not expected to call at RBT2.

Roberts Bank Terminal 2
Panel Orientation 2: September 16, 2016 – Undertaking #1 | Page 4

References

Shields, M.W., Lindell, J., Woodruff, J., 2018. Declining spring usage of core habitat by endangered fish-eating killer whales reflects decreased availability of their primary prey. Pacific Conservation Biology 24, 189. https://doi.org/10.1071/PC17041

Williams, R., O'Hara, P., 2010. Modelling ship strike risk to fin, humpback and killer whales in British Columbia, Canada. Journal of Cetacean Research and Management 11, 1–8.

Appendix 2

Conservation coalition review of VRPA response to Undertaking # 20 – Underwater noise

Supplemental expert report prepared for the Review Panel of the Canadian Environmental Assessment Agency

Prepared by:

Scott Veirs, PhD
President, Beam Reach Marine Science & Sustainability
Seattle, WA, USA

Prepared for:

David Suzuki Foundation
and
Wilderness Committee

June 21, 2019

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Describe your qualifications

About the author

Please describe your education and training and provide an explanation of your expertise in relation to the issue of marine mammals and marine mammal habitat, and in particular southern resident killer whales. Please also provide a copy of your current curriculum vitae.

Dr. Scott Veirs is an expert in marine bioacoustics, oceanography, and ecology of the Salish Sea. He specializes in the quantitative evaluation of acoustic impacts on marine mammals from individual and cumulative human activities.

Dr. Veirs was trained in environmental science as the first Earth Systems major at Stanford University and received a Masters and PhD in Oceanography from the University of Washington. For the last 15 years, his research has focused on quantifying underwater noise pollution, particularly from commercial ships, in Washington and British Columbia. From 2005-2012 he organized bioacoustic field research projects for 50 undergraduates during which he observed the behavior of southern resident killer whales over many seasons within their core summertime habitat (the central Salish Sea).

Currently, Dr. Veirs coordinates the Orcasound hydrophone network and serves as Chair of the Marine Mammals Work Group of the Puget Sound Ecosystem Monitoring Project. He is a member of the Acoustical Society of America and most recently presented research with his colleague, Dr. Val Veirs, at the fall, 2018, meeting of the Society in Victoria on computing natural versus anthropogenic noise statistics in killer whale critical habitat. In January, 2019, he was elected Chair of the Marine Mammal Work Group which is part of the Puget Sound Ecosystem Monitoring Program.

Further details regarding his educational background and professional experience are provided in Attachment A.

Question to be addressed

1. What is your opinion of the approach taken by the Port in responding to the Panel's question?

My overall opinion of the approach taken by the Port in the response in Undertaking 20 (and the closely-related precursor CEAR 1362) is that it has caused increased confusion and complexity, and may now underestimate the acoustic and cumulative impacts of the project on Southern Resident Killer Whales (SRKWs). While the bulk of the bioacoustic modeling in Undertaking 20 is still viable, the assumptions have shifted from precautionary to less-and-less conservative. Simultaneously, it is becoming increasingly difficult for me to ascertain and track all the assumptions embodied by each new acoustic modeling effort, and to assess the degree to which the new assumptions have also been used to revise results from previous acoustic modeling efforts. Finally, there are also still information gaps (some of them newly arisen from the new approach) that preclude me from making a thorough assessment of cumulative impacts on SRKWs.

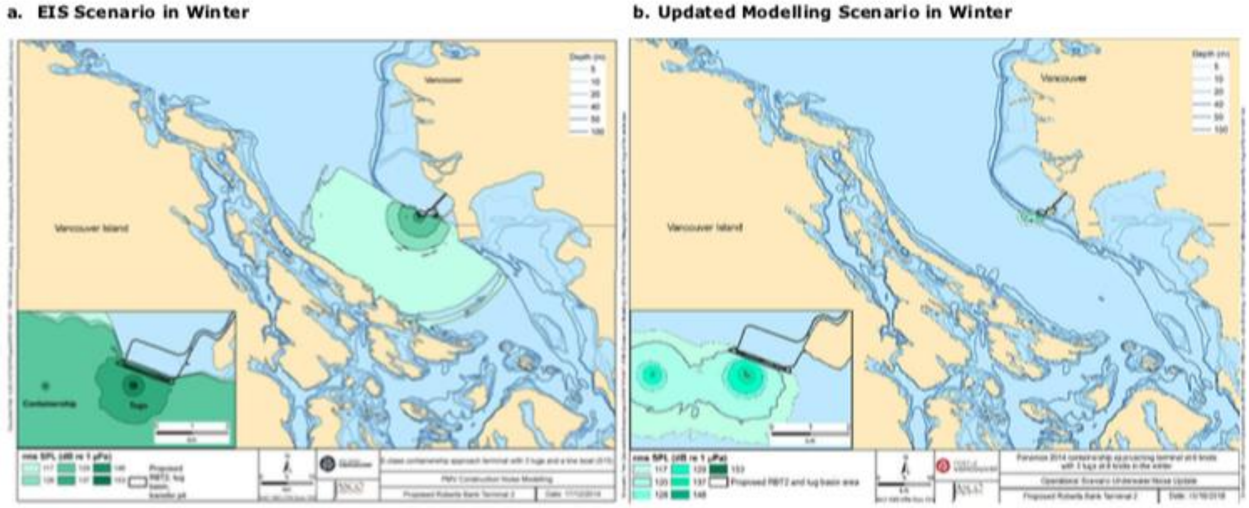
Acoustic models shift from precautionary to less than conservative

Here is the progression of acoustic modeling approaches, as I have perceived it:

1. The original noise modeling in the EIS was relatively conservative, as described in the introduction to Undertaking 20: "Underwater noise modelling of 260 annual 18,000 TEU (twenty-foot equivalent unit) capacity Mega-Max class container vessels calls to the RBT2 terminal with support from three tugs and a line boat." (NOTE: The Mega-Max ship class as depicted by the Port (e.g. Figure UT36-1) has a capacity of 18,000-24,000 TEUs, so the modeling could have been maximally precautionary if it assumed that in 25-50 years container ships will be in the upper end of the range, near 24,000 TEU.)
2. The 2018 modeling was less conservative, using a 9,600 TEU ship in the models and 2014 projections of traffic levels in 2030, leading to "substantially smaller underwater noise footprints."
3. The latest (2019) noise modeling (presented in Undertaking 20) is no longer conservative. It used actual measurements of the average container ship size class expected i.e., (Neo-Panamax, 13,000 TEU). This effort also resulted in "substantially smaller annual incremental increases in underwater noise."

It makes good sense that the increase in noise levels and associated impacts are "substantially smaller" because each revised assumption is much less conservative. In addition to the assumption of a much smaller container ship (13,000 instead of 18,000 TEUs), the most dramatic change is the assumption of summer rather than winter propagation conditions, justified by a limited survey of the seasonal use of the Fraser delta by SRKWs. (Noise propagates more efficiently in winter near the mouth of the Fraser, primarily because the Fraser outflow is relatively low and wind-driven vertical mixing is intensified. This leads to more-vertical, less-complex sound speed profiles and modeled noise impacts that have a broader spatial extent than during summertime oceanographic conditions.) Aggregate source levels are further lowered by assuming that one less boat would attend ships during berthing, while the tug speed remains reduced from 12 to 8 knots (see CEAR 1362, page 4), and the model still uses a mean sound pressure level rather than the most intense 2-minutes from a 30-minute sample.

All together, these model adjustments dramatically reduce the predicted acoustic footprint of the ship approach and berthing process. A noise impact that previously extended 10s of kilometers across the southern Strait of Georgia (from the terminal to Active Pass) is suddenly reduced to a radius of just a few kilometers (and is so imperceptible at full scale that an inset is now required), as can be seen here (in this portion of Figure 1 of CEAR 1362 from the "MEMO: Summary of Underwater Noise Modelling Report and Implications for Southern Resident Killer Whales" which introduces the JASCO noise modeling study (Warner et al., 2018) that underpins and is referenced by Undertaking 20):


a. EIS Scenario in Winter

b. Updated Modelling Scenario in Winter

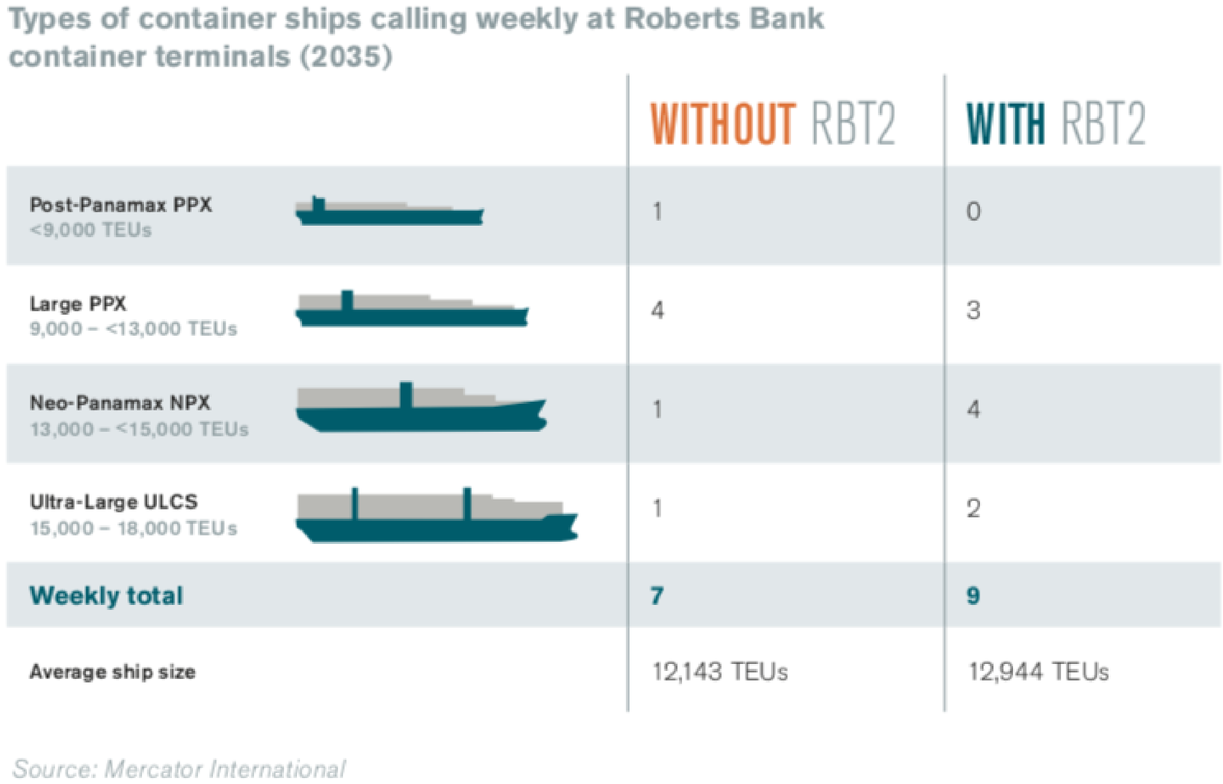
Growth projections are confusing: calls vs TEUs vs services & ship size

One common refrain from the proponent during the Panel Review hearings since the publishing of the Mercator report has been that there will be fewer container ships calling upon the Port of Vancouver in 2035 than called in 2017. An early manifestation of this within the proponent's documents can be found on PDF page 102 of the Mercator report (the Mercator Study; CEAR Document #1362), where the VFPA states in the ship traffic information sheet that "the 2018 study forecasts fewer overall ship calls to the Port of Vancouver in 2035 than there were in 2017."

This assertion has led to confusion (including during the hearings, for both the Review Panel and myself) because at first glance it makes it seem like the project -- a proposed expansion of the Roberts Bank terminal -- would somehow reduce acoustic and cumulative impacts for SRKWs relative to the current status quo. As Madame Chair of the Review Panel rightly pointed out during the marine mammal hearing, *the extra containers aren't flying themselves from the Pacific into Vancouver*, so what's going on?

Indeed, the whole premise of the RBT2 project is to increase the VFPA capacity (to import or export more containers) to accommodate projected growth in the shipping industry. If we accept that there won't be additional movements of VFPA container ships, then we must conclude that future ships will have to be larger (at least in breadth and draft, if not also in length), and therefore should be expected to have higher source levels of underwater radiated noise.

The expected increase in ship capacity is apparent in the following figures from the proponent. The first is from the last page of the Mercator report and is specific to weekly services at "Roberts Bank container terminals" --

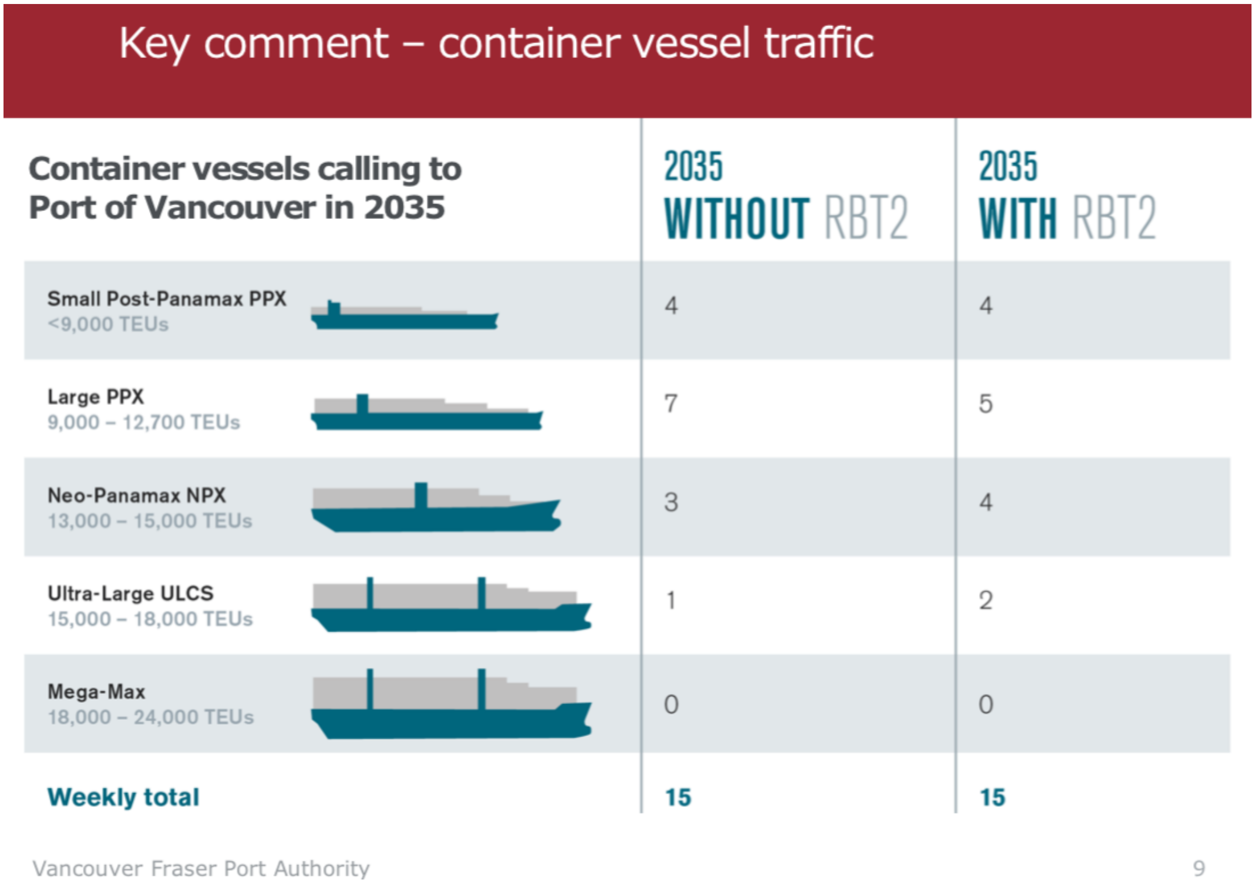


Types of container ships calling weekly at Roberts Bank container terminals (2035)

	WITHOUT RBT2	WITH RBT2
Post-Panamax PPX <9,000 TEUs	1	0
Large PPX 9,000 – <13,000 TEUs	4	3
Neo-Panamax NPX 13,000 – <15,000 TEUs	1	4
Ultra-Large ULCS 15,000 – 18,000 TEUs	1	2
Weekly total	**7**	**9**
Average ship size	12,143 TEUs	12,944 TEUs

Source: Mercator International

-- while the second was utilized in the VFPA presentation to the panel related to marine mammal impacts (and also in Figure UT36-1) and characterizes all services to all VFPA facilities --



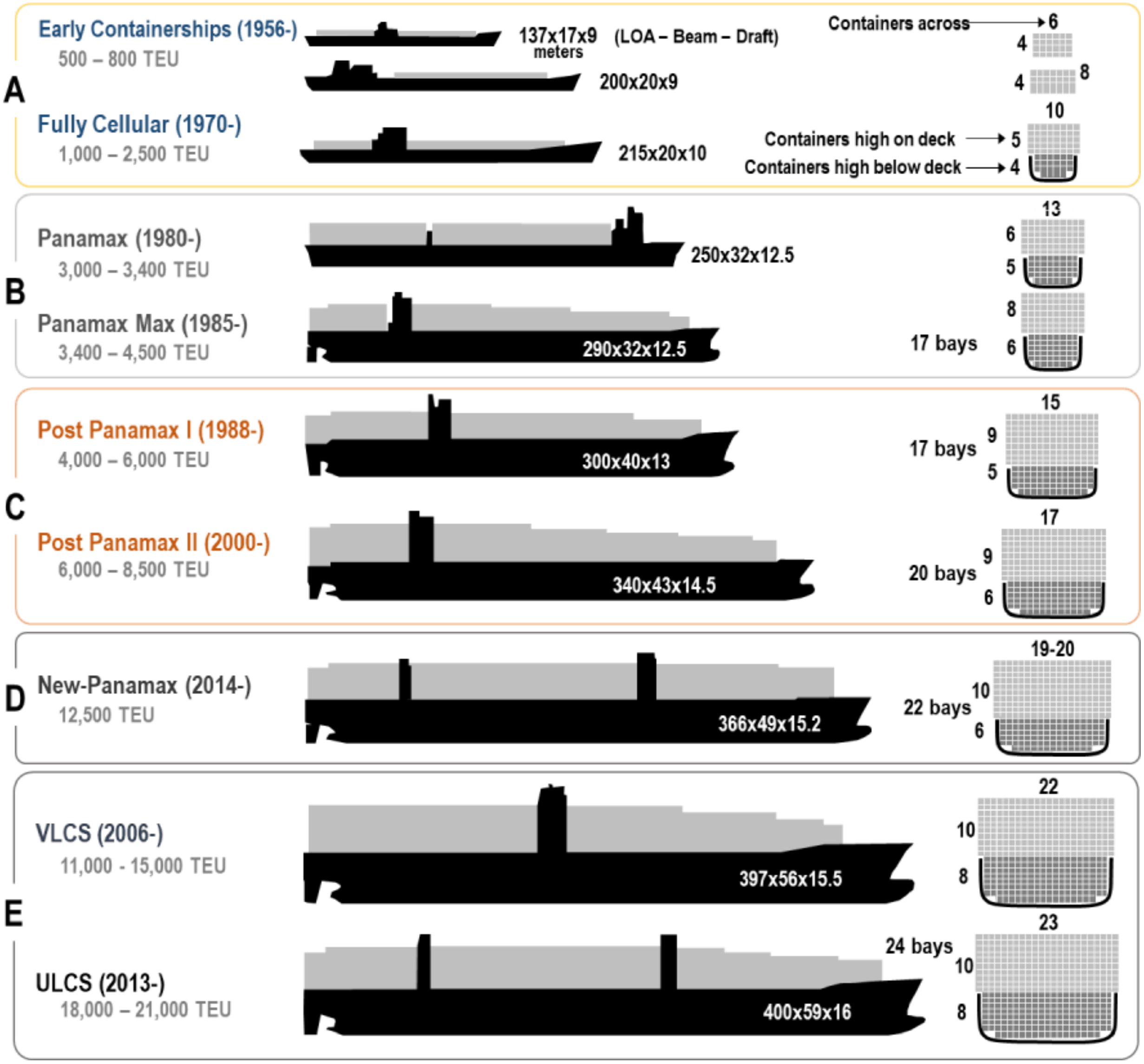
Key comment – container vessel traffic

Container vessels calling to Port of Vancouver in 2035	2035 WITHOUT RBT2	2035 WITH RBT2
Small Post-Panamax PPX <9,000 TEUs	4	4
Large PPX 9,000 – 12,700 TEUs	7	5
Neo-Panamax NPX 13,000 – 15,000 TEUs	3	4
Ultra-Large ULCS 15,000 – 18,000 TEUs	1	2
Mega-Max 18,000 – 24,000 TEUs	0	0
Weekly total	**15**	**15**

Vancouver Fraser Port Authority 9

Both graphics are misleading, but the second one is especially so, because they fail to explain how the larger ships carry so many more containers. While the diagrams indicate graphically that additional containers can be accommodated by increasing the ship length or by adding another layer of containers (known as a “bay”), the side-only view without any textual information about the ship beam fails to convey that containers can also be added by increasing the breadth (beam) of the ship. The second figure depicts the Mega-Max class (18,000-24,000 TEU) ships for which the RBT2 wharf was designed, but fails to depict how they increase in size (as they must) in order to accommodate up to 6,000 more containers. There appear to be more bays and no increase in length, but are they also wider? Any additional increase in the displacement of the ship will also increase its draft, thereby necessitating a berth in deeper water, and generally require a more powerful or efficient propulsion system to maintain typical container ship speeds.

In my opinion a diagram like the following one (from worldshipping.org) would be more helpful (and less misleading) --



Source: http://www.worldshipping.org/about-the-industry/liner-ships/container-ship-design

Growth projections are confounded with model revisions: altered baselines & new scenarios

In the end, the VFPA is still basing their assessment on a projected expansion of container capacity (TEUs) in Vancouver. Clear characterization of the projected shipping and mitigation of any associated impacts (e.g. from more ships and/or bigger ships) should be the foundation of the assessment of any proposal to increase terminal capacity. Instead, the proponent has modified the noise and impact model assumptions in one part of SRKW critical habitat to be less precautionary, and in the process confused whether or not assumptions in other parts of critical habitat have changed.

Under the assertion that the RBT2 project is the current embodiment of that projected growth in containers moving through any/all Ports of Vancouver, I disagree that the increased container capacity will result in “very little difference” in underwater noise. The proponents own modeling of a reasonable, conservative scenario (the “S2” scenario in the EIS/Addendum) in which the impact from the expected growth in TEUs/year was added to the status quo impact of 19 days resulted in ~20 days of lost foraging per year for the SRKWs. Thus an incremental loss was clearly associated “with” the project in the EIS and Addendum, and incremental losses still remain after the latest model revisions.

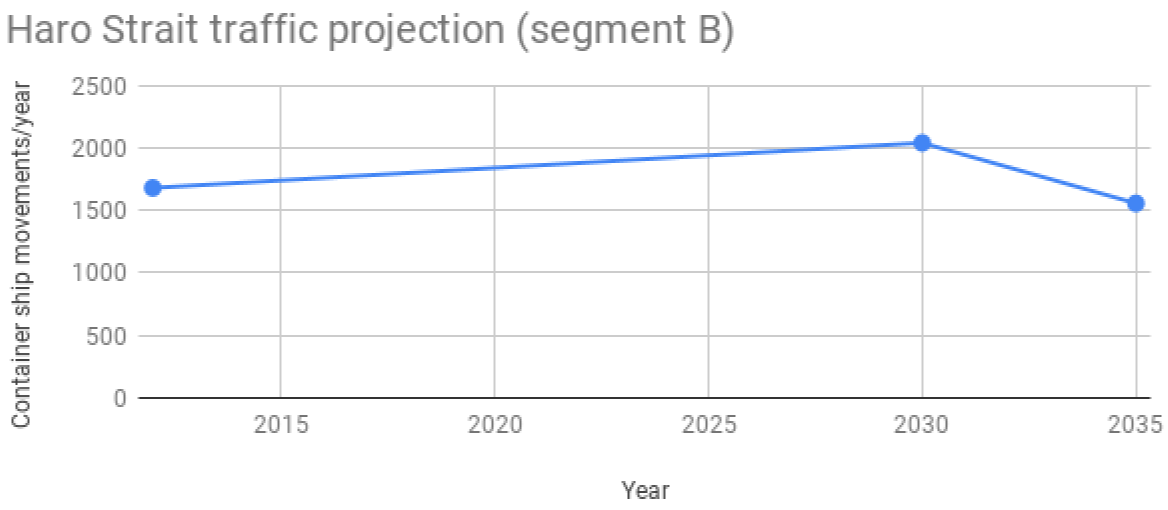
In the post-Mercator documents and oral arguments, we are being asked to forget about those lost 20 days and instead focus on what fractions of days might not be lost near the terminal and the Fraser delta environment under two different distributions of about the same number of ships (1526 in 2030 per the original EIS/Addendum versus a total of 1560 in 2035 in the post-Mercator projection [ref. Table in Figure UT35-A1]). This change attempts to present the panel with a new version of “with” or “without” RBT2 -- considering 2 possible redistributions of the increased TEUs within the Port’s various terminals. Nevermind the previous approach of comparing the 2012 status quo with an assessment of various scenarios of future direct and cumulative impacts (including the movement of ships to and from the VPFA Navigational Jurisdiction Area).

We must remain cognizant that the VPFA is still projecting growth in total TEUs -- even as the projected number of movements in 2030 decreases relative to 2017 -- and plans to accommodate it at RBT2 or some combination of its other facilities. So, *any* proposal to increase capacity must be associated with impacts of the added VPFA ships -- no matter the terminal(s) they service -- and wherever those ships or facilities affect critical habitat. Instead of expressing the still-significant impacts as tiny percentages, I believe the proponent should be considering how to “more than mitigate” the potential impacts of increasing shipping capacity in and around the Fraser delta and the Salish Sea.

2. Based on Port’s new analysis, is it possible to assess the differential impacts of larger vessels as they transit through the entirety of Southern Resident Critical Habitat?

A key concern I raised during the hearing process is whether the changing assumptions about the number of movements and size classes of ships *near the terminal* (described in CEAR 1362, page 2 as: during the Operation Phase; during approach/departure and berthing/unberthing activities; within VFPA jurisdiction“) have or could affect the earlier acoustic modeling done *in the broader regions of SRKW critical habitat* (e.g. the “regional model area” or the full “focused model area”). I believe I was assured that the answer was no, but I’m still uncertain, primarily because I don’t understand the evolution of the traffic projections, e.g for segment B (Haro Strait).

In pursuit of confirmation in the proponent’s written submissions, I have graphed the traffic projection based on Doc 1899 (UT35-A1) for Segment B (Haro Strait):



Where the number of ship movements/year is derived from the following table:

Pre-Mercator projection:						
Year	**Non-RBT2 container ships**		**RBT2 container ships**		**Total movements through Haro**	**Haro movements per day**
	movements	calls	movements	calls		
2012	1684	842	0	0	1684	4.6
2030	1526	763	520	260	2046	5.6
Change	-158	-79	520	260	362	1.0
Post-Mercator projection, w/o RBT2:						
Year	**Non-RB container ships**		**RBT1 container ships**		**Total movements through Haro**	**Haro movements per day**
	movements	calls	movements	calls		
2035	832	416	728	364	1560	4.3
Post-Mercator projection, with RBT2:						
Year	**Non-RB container ships**		**RBT1+2 container ships**		**Total movements through Haro**	**Haro movements per day**
	movements	calls	movements	calls		
2035	624	312	936	468	1560	4.3
Change	-208	-104	208	104	0	0.0

This graph helps me understand the number of movements through Haro, but I can no longer see how it is possible to assess whether the overall noise modeling effort is accurate, or the degree to which it is precautionary. I'm particularly concerned by the last two points made in CEAR 1362 (page 4) regarding the "more representative Project operation assumptions included in this updated modelling study":

1. "Reducing the assumed size of container ships calling at the RBT2 terminal from 18,000 TEU Triple-E (398 metres in length) to an average size of 9,600-TEU Panamax (338 metres in length);

2. Reducing the number of support vessels involved in berthing operations from three tugs and a line boat to three tugs only to reflect requirements for the average container ship;
3. Reducing tug transit speeds from 12 to 8 knots, based on consultation with local tug operators;
4. Modelling berthing operations using the 30-minute average support tug source levels, in addition to the conservative highest two-minute support tug source levels used in the EIS;
5. Including an expected conditions scenario in 2023 with increases in vessel traffic at existing Westshore and Deltaport terminals between 2012 and 2030 (based on expected increases in traffic documented in the response to IR4-09 (CEAR Document #1051); and
6. Updating the horizon year for existing (2015) and expected (2023) conditions, which were assessed in the EIS to be 2012 and 2018, respectively."

I'm particularly concerned that the last two assumptions may have been applied to the estimation of direct acoustic and cumulative impacts not only in the area near the terminal, but in broader areas of SRKW critical habitat. However, the short time period allocated for understanding the extent of the noise modeling revisions makes resolution of these concerns impossible.

3. Do you agree with the Port's suggestion that there will be very little difference in total underwater noise with or without the Project?

I disagree. The project *still increases noise* significantly and SRKWs can't tolerate further incremental impacts.

Undertaking 20 concludes that there the "annual average incremental contribution of Project terminal underwater noise" will increase if RBT2 is built by 1.8 dB re 1 μPa (at the Roberts Bank receiver station). I think any increase in noise where the SRKWs forage is very significant. That's still a positive number, and any increase is not a "little difference" or otherwise insignificant to the current population of SRKWs. So, no, I do not agree with the Port's suggestion.

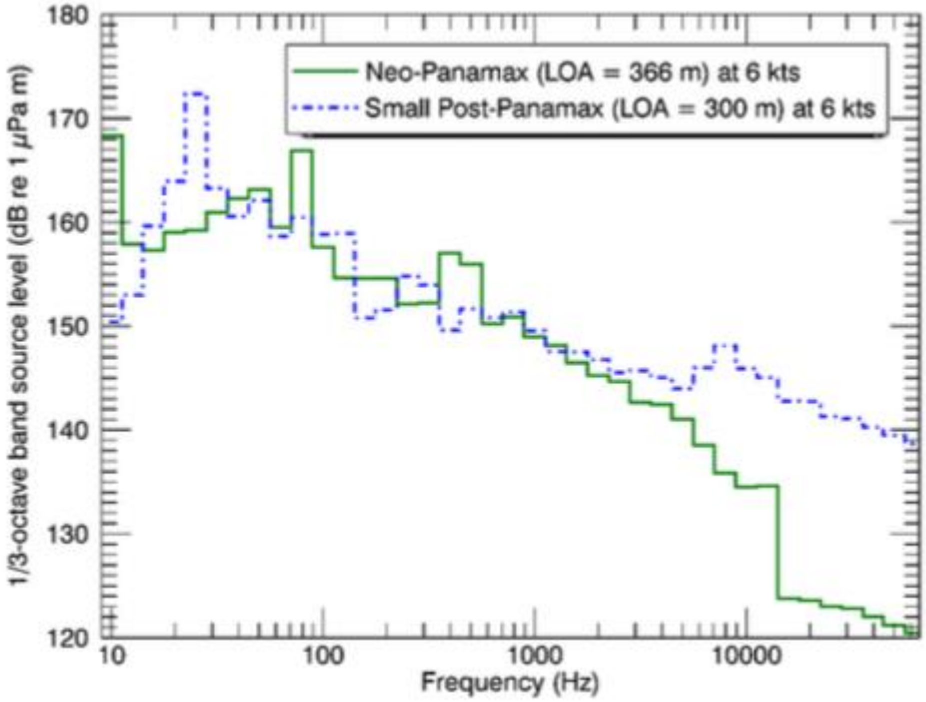
Importantly, the proponent also confirmed in their response to my questions during the hearings that the overall acoustic impacts of RBT2 on SRKW would include additional lost foraging opportunities. On page 6 of Appendix A in Undertaking 20, the proponents state that predictions of acoustic disturbance to SRKWs are still positive (1.4 hours/whale/year).

Despite the confusion about shifting distributions of traffic and the recent adjustments to the models that assess impacts near the proposed terminal, the overall message from the EIS/Addendum persists: it is already too loud for SRKWs (under **existing conditions** within the focused model area SRKWs are losing 19.1 foraging days/whale every year) and increases in traffic associated with VFPA expansions will make things worse for them (e.g. increasing the annual loss to 20.1 days/whale for the RBT2 scenario S2).

As I write this, none of the 3 SRKW pods have not been sighted within the Salish Sea for more than 6 weeks. The 2019 Fraser River salmon returns have further faltered, in part due to the incremental impacts of projects like RBT2 that directly and cumulatively impact the Fraser river and delta. When they do return in pursuit of scarce Chinook, the increased noise impedes the efficiency of their foraging and other vital activities.

The noise model takes a less than precautionary approach, in part due to the assumed 13,000 TEU ship size and the use of limited source level measurements to characterize the source levels for that type of ship (rather than the average of a larger sample of measurements, utilizing available peer-reviewed data).

With reference to these ⅓-octave source spectra (Figure 1 of Undertaking 20, shown below), the proponent states that the 13,000 TEU ships "do not emit higher levels of underwater radiated noise, despite their larger size."



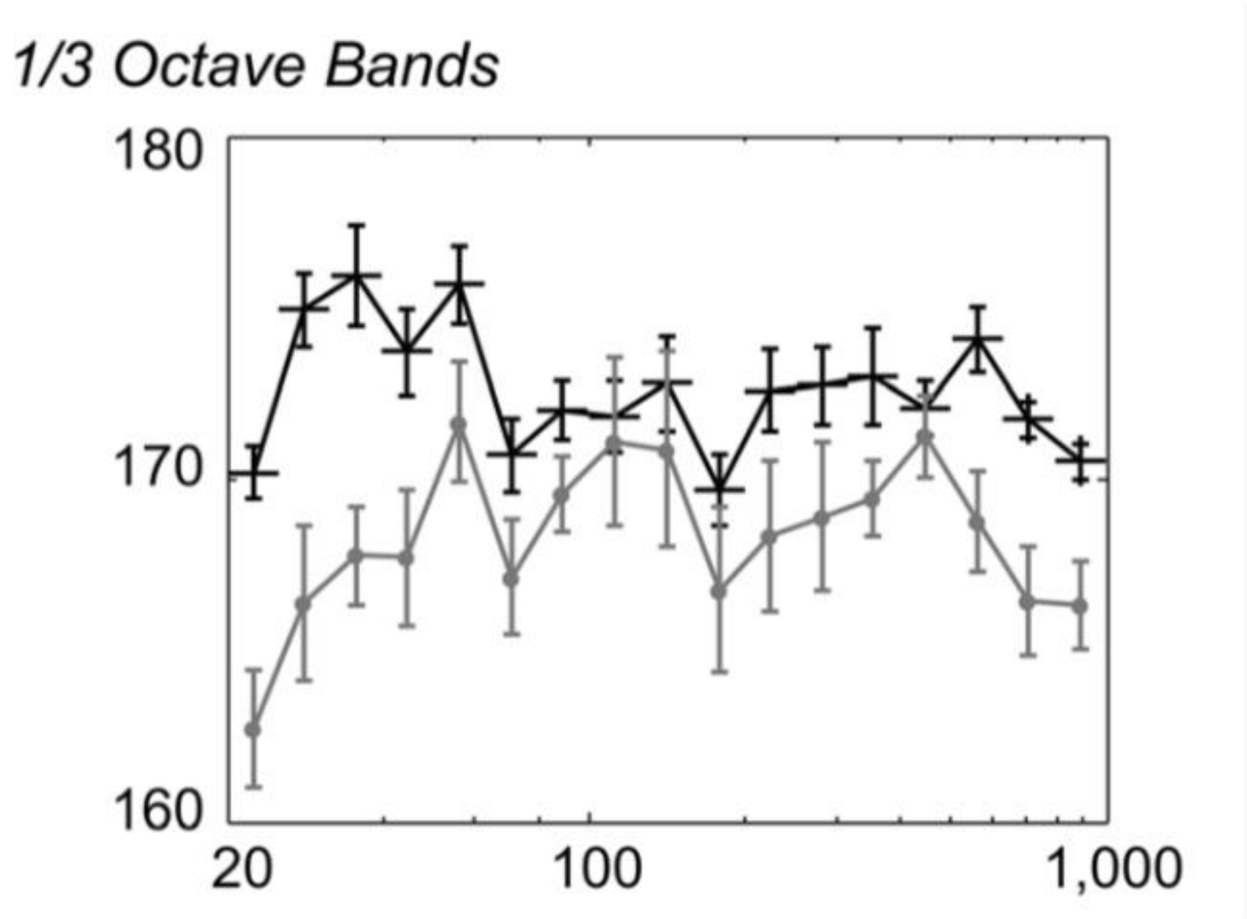
This is a surprising and problematic claim for a variety of reasons, including:

1. There is general agreement in the acoustic literature that radiated noise increases in proportion to the size of the ship (e.g. the Ross law that the proponents used in their original modeling effort).
2. The ⅓ octave levels of the larger ship (in green) **are indeed higher** than the smaller ship at some frequencies -- especially at 10 Hz where they are almost 20 dB (re 1 μPa at 1 m) more intense (with potential acoustic consequences for baleen whales,

like humpbacks). They are also ~5 dB (re 1 μPa^2 at 1 m) higher at 400-500 Hz, frequencies that are important to SRKW communication signals.

3. The field measurements were made from **only 9 measurements** and Undertaking 20 does not indicate how many unique container ships were measured. In any case, this is a small sample size compared to existing estimates of source levels for this size class that are available in the literature. Of course, because the original source levels (based on speeds of <15 knots) are confidential, it is not possible for us to assess whether they are likely to be representative of the global container ship fleet that presumably may call at the Port of Vancouver between now and 2035.
4. It is not clear under what conditions the smaller ships were measured. Were their speeds during measurement also <15 knots? The relatively elevated levels at high frequencies suggest that cavitation was more fully developed for the smaller ship, which could bias the overall spectra to be higher (upon adjustment to a 6 knot speed).
5. Making computational adjustments for speeds is likely to misrepresent the actual spectra, whether the adjustment is upward (to speeds where cavitation is much more likely) or downward (to speeds where cavitation may not be occurring, though it could have been at the measurement speed). It would be better to use measurements made at the speed of interest (i.e. 6, 8, or 12 knots for berthing; or 19 or ~14-15 knots for containerships in Haro Strait, at speed or slowed, respectively).

To demonstrate the proponent is not using all available data and illustrate another way in which the revised modeling is less than precautionary, here is a comparable plot from a study of modern containerships (see figure below from McKenna, 2012, in which the darker line with + symbols represents containerships) in southern California which averaged 6 ships with lengths of 294-298 m (the vertical axis is ⅓-octave band levels; the horizontal axis is the frequency of the ship noise in Hz):



Note that the peak power levels near 30 Hz is about 175 dB (re 1 μPa^2 at 1 m). In comparison, the proponent's supposedly conservative source levels are *much* lower, near 160 dB (re 1 μPa^2 at 1 m). The difference is even larger at 1,000 Hz: 170 for the California container ships and only 150 dB (re 1 μPa^2 at 1 m) for the Canadian samples. These decibel differences of 15-20 dB cannot be reasonably explained by the modeled reduction in speed from cruising to 6 knots and therefore suggest that the proponent's measured but sill assumed source levels -- the most important parameter in the revised noise modeling -- are a potentially *vast* underestimate of the likely radiated noise for current and future containerships.

A much more prudent and precautionary use of the ECHO underwater listening stations would be to continue to characterize the source spectra of modern containerships that frequent the VFPA facilities. Over time, we could not only obtain a more reasonable average spectra for existing ships, but also experimental data describing how noise levels vary with speed (instead of estimating noise reduction at slower speeds), loading, hull and propeller types, and other physical aspects of larger containerships. Thus informed, a truly precautionary modeling effort could be undertaken with a more believable prediction of the number, size, and radiated noise levels of the containerships that may ply the Salish Sea in future decades of this century.

4. Do you agree with the Report’s conclusion on page 6 of the Overview of Updated Underwater Noise Modelling for Terminal Operations, that if the Project goes ahead there will be no impacts on Southern Resident Killer Whales?

No, I don’t agree. The direct acoustic impacts on the SRKWs near the RBT2 were reduced through this latest modeling effort, but the changes in number of hours of noise and lost foraging time are both still positive.

In their letter to the Review Panel explaining the most-recent shifts in modeling assumptions (Warner et al. 2018 - CEAR #1363), the proponents wrote that in their previous efforts, “the overly conservative assumptions resulted in an overestimate of underwater noise levels due to Project operation.” I would now argue that the opposite is true: the most-recent approach to modeling noise impacts on SRKWs is now most-likely underestimating both the peak underwater noise levels the whales will experience decades from now and the resulting biological impacts they will suffer (from both behavioral response to the increased noise and lost communication and echolocation space).

Table 1 of Undertaking 20 indicates that a Mega-Max (18,000 TEU) class container ship requires 3 tugs and a line boat, while only 3 tugs are needed for the smaller (13,000 TEU) Neo-Panamax and (9,600 TEU) Large Post-Panamax classes. The 2018 and 2019 model revisions also slow the tugs from 12 to 8 knots, dramatically reducing their modeled underwater noise source levels. These changing assumptions may be leading us to the most ”realistic” modeled impacts, but they also represent a trend during this review process towards a less-and-less precautionary approach, including the adoption of model assumptions that can no longer be definitively considered conservative.

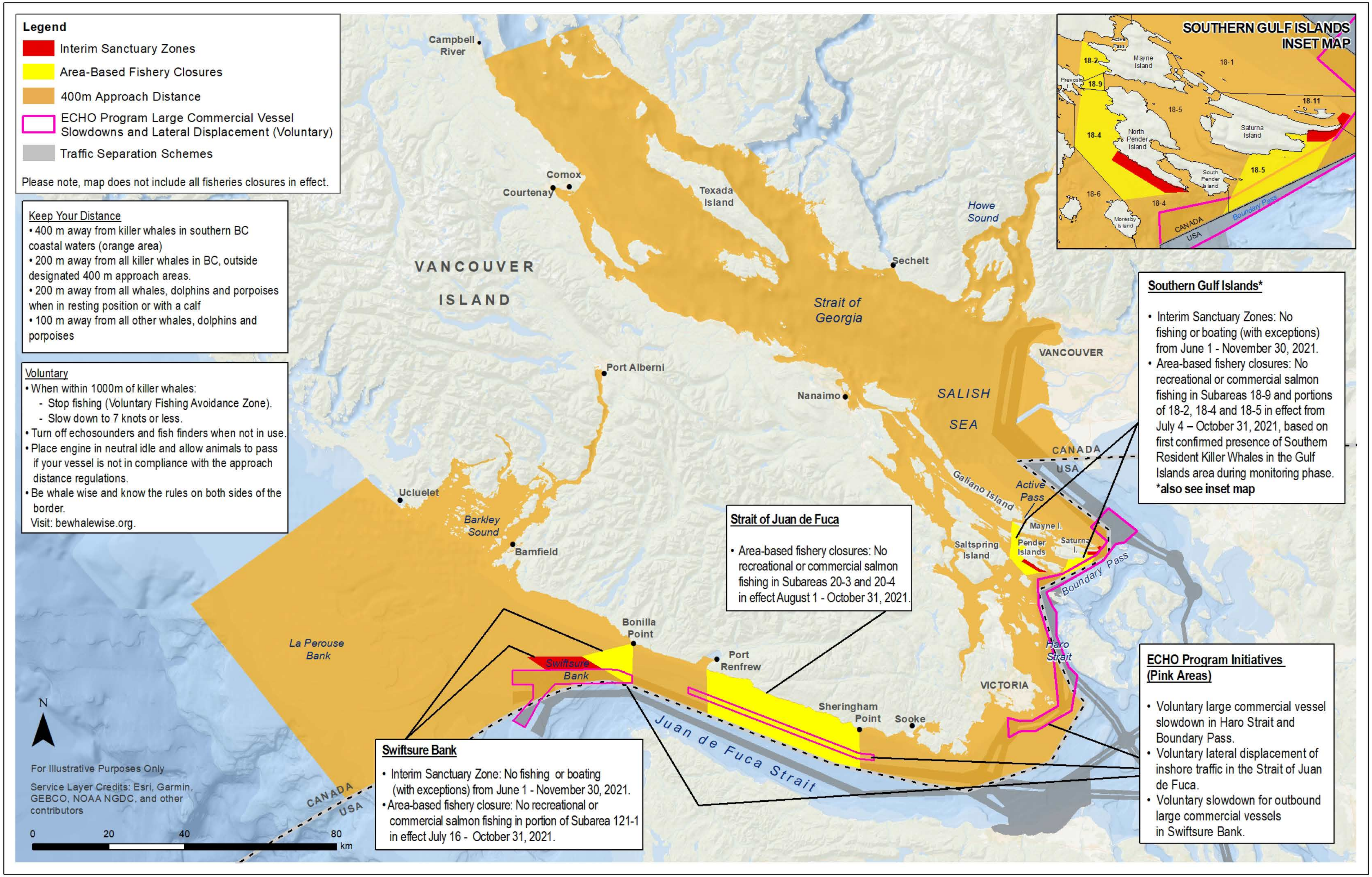
- The hours of lost foraging time for SRKWs also still represent an impact -- “Previous predictions of acoustic disturbance to SRKW in the EIS (i.e. approximately 3.5 hours per whale per year, EIS Appendix 14-B) are reduced to less than 1.4 hours per whale per year (or 0.016% of the year) above acoustic disturbance predicted to occur to SRKW during expected conditions (i.e. 2035 without RBT2).”

5. In your opinion, will the Project, as described in the Port’s new evidence, contribute to the cumulative threats with which the Southern Residents currently contend in their critical habitat in the Salish Sea?

In order to assess cumulative impacts on the SRKWs, it is important to know the extent to which impacts could be displaced to less sensitive ecological areas. For example, Undertaking 35 indicates that "The incremental increase of 208 movements at Roberts Bank terminals to/from RBT2 will result from 104 movements being redistributed from both a Burrard Inlet container terminal and the Fraser River container terminal." Unfortunately, Undertaking 35 doesn't specify the proportion of movements from Burrard Inlet (which is on the outer edge of the Fraser delta) versus from Fraser River terminal. It is also ambiguous whether the "Fraser River terminal" is the in-river Fraser Surrey docks, the existing RBT container ship facilities (Deltaport) in the nearshore environment of the central delta, or some combination of both.

- If the proponents no longer anticipate needing to accommodate Mega-Max class (18,000-24,000 TEU) ships, and instead are basing their noise models on an average container ship size class i.e., (Neo-Panamax, 13,000 TEU), should the project be downsized proportionally -- thereby reducing the environmental impacts associated with the larger ships (e.g. less draft means less dredging and smaller gantry cranes; less length means a smaller expansion; lower displacement means fewer tugs)? According to Table 1 of Undertaking 20, the expected length is reduced by 34 meters (from 400 to 366).

The overall suggestion of Undertaking 20 is that in-delta nearshore cumulative impacts would be dramatically reduced if RBT2 isn't built. That's a small step in the direction I recommended in my full expert opinion: towards moving ships from the center of the delta to its outer edges over the long-haul.



Legend

- 🟥 Interim Sanctuary Zones
- 🟨 Area-Based Fishery Closures
- 🟧 400m Approach Distance
- ☐ ECHO Program Large Commercial Vessel Slowdowns and Lateral Displacement (Voluntary)
- ▨ Traffic Separation Schemes

Please note, map does not include all fisheries closures in effect.

Keep Your Distance

- 400 m away from killer whales in southern BC coastal waters (orange area)
- 200 m away from all killer whales in BC, outside designated 400 m approach areas.
- 200 m away from all whales, dolphins and porpoises when in resting position or with a calf
- 100 m away from all other whales, dolphins and porpoises

Voluntary

- When within 1000m of killer whales:
  - Stop fishing (Voluntary Fishing Avoidance Zone).
  - Slow down to 7 knots or less.
- Turn off echosounders and fish finders when not in use.
- Place engine in neutral idle and allow animals to pass if your vessel is not in compliance with the approach distance regulations.
- Be whale wise and know the rules on both sides of the border.

Visit: bewhalewise.org.

Southern Gulf Islands*

- Interim Sanctuary Zones: No fishing or boating (with exceptions) from June 1 - November 30, 2021.
- Area-based fishery closures: No recreational or commercial salmon fishing in Subareas 18-9 and portions of 18-2, 18-4 and 18-5 in effect from July 4 – October 31, 2021, based on first confirmed presence of Southern Resident Killer Whales in the Gulf Islands area during monitoring phase.

***also see inset map**

Strait of Juan de Fuca

- Area-based fishery closures: No recreational or commercial salmon fishing in Subareas 20-3 and 20-4 in effect August 1 - October 31, 2021.

Swiftsure Bank

- Interim Sanctuary Zone: No fishing or boating (with exceptions) from June 1 - November 30, 2021.
- Area-based fishery closure: No recreational or commercial salmon fishing in portion of Subarea 121-1 in effect July 16 - October 31, 2021.

ECHO Program Initiatives (Pink Areas)

- Voluntary large commercial vessel slowdown in Haro Strait and Boundary Pass.
- Voluntary lateral displacement of inshore traffic in the Strait of Juan de Fuca.
- Voluntary slowdown for outbound large commercial vessels in Swiftsure Bank.

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Overview of 2021 management measures to protect Southern Resident Killer Whales