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MEMORANDUM

DATE:	2021-09-22	**RWDI Reference No.:** 2104113
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FROM:	Matthew Johnston, P.Eng. Ben Coulson, P.Eng., MASc Laura Dailyde, P.Eng., PMP	**EMAIL:** matthew.johnston@rwdi.com **EMAIL:** ben.coulson@rwdi.com **EMAIL:** laura.dailyde@rwdi.com
RE:	**Pitt Meadows Road and Rail Improvements Project Noise and Vibration Assessment Summary – Peer Review** **City of Pitt Meadows** Pitt Meadows, BC	

The following memorandum summarizes the findings of a peer review conducted by RWDI for the 2020 BKL Consultants Ltd. (BKL) report entitled "Pitt Meadows Road and Rail Improvements – Environmental Noise and Vibration Assessment" (i.e., the "Study"). BKL prepared the Study for the Vancouver Fraser Port Authority (VFPA) in order to assess the potential effects from noise and vibration associated with the proposed Pitt Meadows Road and Rail Improvements Project (i.e., the "Project") located in Pitt Meadows roughly between Kennedy Road and Golden Ears Way.

Noise and vibration terminology within this memo is consistent with the Study unless otherwise stated. Please refer to the Study for noise and vibration terminology definitions.

BACKGROUND

Key information about the Project based on the information presented in the Study includes:

- Approximately 5 km of new siding track and a new rail bridge over Katzie Slough, with two options for the track location:
  - a North Build option where the siding is on the north side of the existing tracks, and
  - a North/South Build option where the siding is on the south side of the existing tracks from approximately Kennedy Road to Harris Road and then transitions to the north side from approximately Harris Road to Golden Ears Way.
- Addition of a two-lane overpass at Kennedy Road and a four-lane underpass at Harris Road
- Rail traffic will approximately double by 2030 with or without the Project

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- Vancouver Intermodal Facility (VIF) rail yard and train building activity will increase in proportion to the projected freight rail through traffic increase.
- Train building will extend an addition 120 m west of Harris Road
- New switches near Kennedy Road, Harris Road, and Golden Ears Way

The Study only considered noise from existing rail operations as well as operational changes due to the project, it did not consider noise and vibration associated with construction or decommissioning phases.

The primary findings of the Study are as follows:

- For noise, the existing noise environment is loud, with noise levels that exceed the sleep disturbance and speech interference criteria by large amounts in many areas. There are nine dwellings recommended for mitigation for the North Build scenario and two dwellings for the North/South Build scenario.
- For vibration, levels are expected to be the same with or without the Project. No mitigation is recommended for vibration except where new switches are proposed for crossovers to access the new sidings. Vibration levels will increase near these locations due to rail discontinuities, resulting in potential impacts at one dwelling for the North Build scenario and five dwellings for the North/South Build scenario.

This review focused on the following key aspects of the Study which included:

1. Application of noise and vibration standards and applicable criteria, including;
   1.1. noise criteria
   1.2. vibration criteria
2. Modelling techniques and assumptions, including:
   2.1. noise model and assumptions;
   2.2. vibration model and assumptions;
3. Assessment of existing and future noise, including:
   3.1. special noise characteristics (impulsive and/or tonal noise);
   3.2. low frequency noise (LFN);
   3.3. Potential for health effects from noise;
4. Assessment of existing and future ground-borne vibration; and,
5. Potential additional concerns.

RESULTS / FINDINGS

The findings from RWDI's review of the Study are provided in this section.

1. Application of noise and vibration standards and applicable criteria

The assessment criteria enacted for the Study are based on the following:

- Health Canada's Guidance for Evaluating Human Health Impacts in Environmental Assessment: NOISE (HC, 2017) for noise; and
- U.S. Federal Transit Administration (FTA)'s Transit Noise and Vibration Impact Assessment Manual (FTA, 2018) for vibration.

The two documents summarized above are appropriate for this Study. Given the nature of the project and presence of potential Environmental Assessment triggers, there is an expectation for input from the railway's approval authority in addition to Health Canada. Hence, guidance on resolving noise and vibration issues from the Canadian Transportation Agency (CTA) should also have been considered including:

- "Guidelines for the Resolution of Complaints Concerning Railway Noise and Vibration", October 20, 2008.
- "Railway Noise Measurement and Reporting Methodology", August 2011.
- "Noise and Vibration from Idling Locomotives", March 2016.

The above documents are available from the CTA's website at www.cta.gc.ca.

1.1 Noise criteria

Noise criteria was extracted from the HC Guideline and a summary is provided in Table 1 along with comments from RWDI. The Study included evaluating the potential for adverse effects associated with speech interference, sleep disturbance, and expected community annoyance consistent with the HC Guideline.

Table 1: Summary of Noise Criteria Used for BKL Study

Potential Effect	Threshold (Metric)	Action if Exceeded	RWDI Comment
Speech Interference	55 dBA (L_d)	discuss severity	Within the Study, the severity is quantified but there appears to be no meaningful discussion around the potential health risk to the community and a follow-up strategy required to minimize the health risk. According to the Health Canada Guideline, "The prediction of potential impacts is necessary to understand the nature, extent and severity of human health effects that may occur due to noise generated during various stages of the proposed project. These calculations also serve to evaluate the feasibility of the project Proponent's planned mitigation measures reducing human health effects and weather a specific mitigation measure is expected to achieve the desired result." The results in the Study focus on the number of additional receptors to exceed the criteria for the future with-Project scenario when compared to the future without-Project scenario. This approach is appropriate for a relative change assessment, but considering this indicator is a limiting absolute noise level, this approach does not adequately assess the risk to human health. Considering the threshold is a limiting absolute noise level and the dominant noise contributions are from the corridor, it is reasonable to expect a rigorous assessment within the Health Canada guidance framework where noise levels are in excess of documented health risk targets. Mitigation may be recommended when exceeding this threshold, depending on the outcome of a comprehensive health assessment.
Sleep Disturbance	40 dBA (L_n)	discuss severity	See comment above in Speech Interference section. According to the World Health Organization (WHO, 1999), sleep disturbance is a major effect of environmental noise. It may cause primary effects during sleep, and secondary effects that can be assessed the day after night-time noise exposure. Uninterrupted sleep is a prerequisite for good physiological and mental functioning.
	72 dBA (L_{Fmax})	discuss severity	See comment above in Speech Interference section. The 72 dBA (L_{Fmax}) threshold is based on meeting the target indoor sound level with a **closed window**. As stated in the HC Guideline (Section 5.2), Health Canada recognizes that in many cases, people will want to keep their windows at least

Potential Effect	Threshold (Metric)	Action if Exceeded	RWDI Comment
			partially open. The equivalent threshold with a partially **open window** is **60 dBA (L_{Fmax})**. It is not clear based on a review of the Study why the criteria assumed closed windows.
High Annoyance	75 dBA (L_{dn})	apply mitigation	Health Canada indicates that mitigation of project noise be applied if it exceeds an L_{dn} of 75 dBA, even if the change in %HA does not exceed 6.5%. The Study recommends mitigation only for the additional receptors to exceed 75 dBA (L_{dn}) when comparing the future with-Project and without-Project scenarios. Considering this indicator is a limiting absolute noise level, feasible mitigation should be investigated for all dwellings which exceed 75 dBA (L_{dn}) due to the corridor.
	6.5% (Change in %HA)	consider mitigation	Health Canada notes that this is only one indicator of noise-related human health effects and that all possible human health endpoints be considered.
	70 dB L_{LF}	consider mitigation	It is important to point out that if this 70 dB "rattle criterion" is exceeded, Health Canada may suggest the implementation of feasible mitigation measures. There is evidence that noise-induced rattles are very annoying, and this annoyance may be independent of the number or duration of events. These criteria should be evaluated for individual train pass-by events. The Study recommends to consider mitigation only for the additional receptors to exceed 70 dB (L_{LF}) when comparing the future with-Project and without-Project scenarios. Considering this indicator is a limiting absolute noise level, it is reasonable to expect that a proper health assessment would include a discussion regarding potential health risks for all receptors in excess of the "rattle criterion". As mentioned in the Study, mitigation should be considered.

Based on the HC guidance and reviews of similar assessments, Health Canada holds the view that certain community reactions to project-related noise represent potential indicators of adverse health; that is, if the noise is experienced over a long period of time, it could potentially increase one's risk of developing health effects. In the context of noise exposure, two of the most common community reactions are **complaints** and **annoyance** (HC, Section 5.4).

The potential for annoyance is covered in Table 1 above. Considering complaints are a key indicator of health effects, it should be noted that thresholds for complaint were not included in the Study. A summary of these thresholds is provided in Table 2.

Table 2: Summary of Complaint Thresholds According to Health Canada

Potential Effect	Threshold (Metric)	Expected Community Response
Complaints	55 dBA (L_{dn})	sporadic complaints
	62 dBA (L_{dn})	widespread complaints
	75 dBA (L_{dn})	complaints can be expected to include strong appeals to authorities to stop noise

Health Canada states that reliance on noise complaints may only provide a partial indication of a noise problem and when possible, the estimated magnitude of complaints should be supplemented with other measures, such as the calculated change in the percentage of highly annoyed (%HA) in an average community and/or estimated impacts on sleep.

Based on an overall review of the criteria presented within the Study, there may be a disproportionate significance given to annoyance criteria. In Section 5.4 of their guideline, HC indicates that all measures of potential health effects should be considered in conjunction when evaluating the potential for adverse health conditions and Section 6.4 indicates such end points be considered in the warranting of mitigation to minimize human health impacts due to project noise.

1.2 Vibration criteria

Section 4.2 of the Study describes the origin of the vibration criteria. Within this section, The FTA manual is referenced. The criteria are set at 103 VdB ($RMS_{1s,\ max}$) and with a 3 dB increase over background. The Study indicates that a reference velocity of 10^{-6} mm/s (or 1 nm/s) was used. This value is not a reference velocity consistent with the FTA manual. Within the FTA manual, a reference velocity of $1x10^{-6}$ in/s (US) is used uniformly for discussion and comparison purposes, although the existence of other reference velocities (e.g., $1x10^{-8}$ m/s International) is acknowledged and noted as a potential communication issue. Although the value used in the Study is common in other jurisdictions, it does not explain the deviation from the standard reference velocity presented in the FTA manual which is cited.

Although this reference velocity is not consistent with the FTA manual, the criteria can be compared to predicted results as long as the monitored values are also utilizing the same reference velocity. The challenge that this deviation from the FTA manual presents to readers is that the criteria levels provided (in VdB) do not align with the criteria levels provided in the Vibration Impact Analysis (Section 6) portion of the FTA manual.

The Study focuses on the effects of freight train locomotive pass-by events only. The criteria presented are consistent with the 'occasional' events category as defined by the FTA manual (Table 6-2). The 'occasional' events criterion is defined at 30-70 events per day. Based on forecasted traffic levels provided in the Study for 2017, and 2021 monitoring conducted by RWDI, existing freight train locomotive pass-by events appear to be fewer than 30 per day. The existing frequency category may therefore be considered 'infrequent'. However, the 2030 forecasted traffic is predicted to fall within the 'occasional' events category. The Study did not make it clear that the criteria was chosen based on the future forecasted event frequency.

Further, the criteria presented in the FTA manual for 'infrequent' events equates to 108 VdB (re 1 nm/s). This criterion is higher than for occasional events because community response to vibration correlates with the frequency of events. As events become more frequent, the FTA criteria become stricter. In this case, there may be receptors in the existing scenario that meet the 'infrequent' event criterion but would exceed a future 'occasional' event criterion as events get more frequent. This example demonstrates the importance of considering the change in both level and frequency of events.

2. Modelling techniques and assumptions

The following section summarizes comments related to modelling assumptions included in the Study.

2.1 Noise model and assumptions

Noise modelling was completed using Cadna/A modelling software. Cadna/A is a computer software program that is capable of implementing a variety of noise propagation models for predicting impacts from rail activity and is an industry standard for such a study. The SRM II (1996) calculation methodology, a Dutch noise model, within Cadna/A was chosen for the purposes of this Study. Generally, a North American model would typically be utilized for a project like this, such as the Cadna/A implementation of the U.S. FTA/FRA algorithms. There are differences between European and North American trains including in sound emissions and track types. Given the potential for such differences, it would be expected that a detailed rationale is provided to support this modelling decision. No such discussion or rationale was included.

Upon reviewing the noise contour results, it was found that there are areas within the 100 m modelling domain that indicate notable sound levels extend to a farther distance, i.e., the contours are clipped near the domain boundary. Typically, when reviewing noise contours, it is ideal to see propagation to the extent where there is an adequate amount of change shown so that the reader has a good sense as to the extent of the impacts. As well, it is ideal to have contours extend as far out where impacts may be generally comparable to the expected background sound levels. As shown in Figure 1 below, the Study included areas (particularity on the western portion of the corridor, close to the VIF) where

there are few contour changes and sound levels are still greater than 65 dBA (L_{dn}). An expanded assessment boundary would have created a more complete picture to the extent of potential health effects within the City of Pitt Meadows. Based on reviewing the contour maps, expanding the assessment boundary would likely demonstrate that there are more dwellings which experience noise levels in excess of HC criteria (i.e. have the potential to cause health effects) than indicated in the Study.

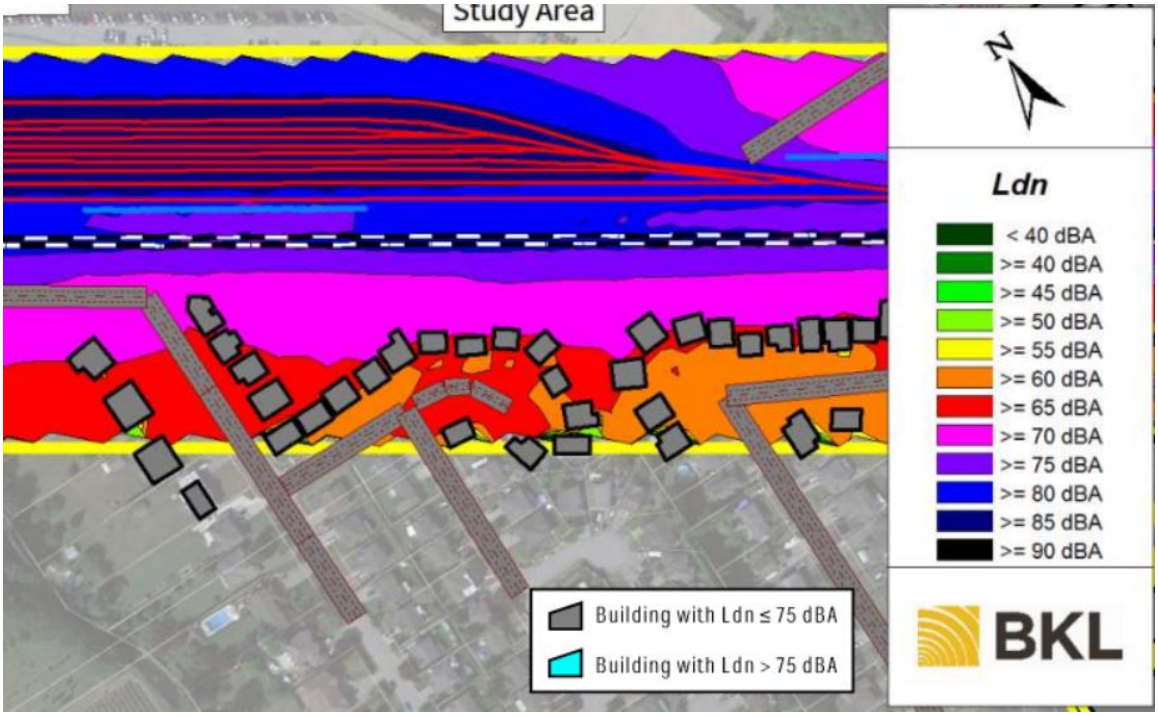

Figure 1 BKL Report Contour Map Sample (Snippet from Figure 8-1)

It appears that the Study only considered the future noise and vibration levels due to the Project's rail traffic and road sources. However, the HC Guidelines indicate that any additional background sound should normally also be considered, or at least it be clearly stated that it is not. In many similar instances, Health Canada has required that the cumulative future noise levels be considered, including for the evaluation of mitigation, since health effects will be tied to total exposure not just the influence of one source type.

Within the Study, the Cadna/A model described as being calibrated with monitored data for various train activities such as shunting, train building, rail whistle and rail crossing signals. It's unclear from the Study if the model was calibrated to train pass-by events and/or any overall average sound metrics.

The Study alludes to using a ground absorption factor within Cadna/A of either 0 (hard ground) or 1 (soft ground) because the International Organization of Standardization (ISO) standard doesn't use intermediate factors. Cadna/A is however capable of using intermediate ground absorption factors for areas that are in between soft and hard ground. For the suburban area where there is a lot of concrete, a ground absorption factor of 0 is appropriate and conservative. Where there is soft ground (rural area along the west of the assessed corridor), a ground absorption factor of 1 may result in predicted noise being overly attenuated over distance compared to reality. A ground absorption factor less than 1 may be more appropriate.

Train traffic volumes used for modelling by BKL are provided in Table 3 as well as actual train counts by RWDI based on 2021 noise and vibration monitoring.

Table 3: Existing Traffic Levels

Date	Harris Road Crossing (Trains Per 24-hr period)	
	Freight	Commuter
BKL Study (2019)	28	10
RWDI Observed (2021) [1]	13 – 24 (average day is 18)	6 [2]

Note: [1] Based on monitoring conducted by RWDI between the period of July 15 and August 3, 2021. [2] Weekdays only. West Coast Express has reduced number of trains per day.

Based on 2021 monitoring by RWDI, it was found that train volumes are consistently below the inputs used within the Study. It is unknown if rail traffic volumes may be suppressed in the summer of 2021 due to network changes. It is not clear if the values presented in the Study represent the daily number of trains counted during the 2019 one-week monitoring period. If the actual traffic volume is closer to 18 trains and not 28 trains, the future 2030 forecast volume (approximately 60 trains) will be triple the current volume.

It is possible that 28 trains per day is the current capacity of the corridor. However, this appears to contradict that future forecasted traffic volumes will double with or without the Project.

2.2 Vibration model and assumptions

For the purposes of this Study, a model was developed using the FTA algorithm. The FTA algorithm is an industry standard for assessing rail vibration in North America and is appropriate here.

The Study assumes 'normal' soil conditions for the model. Information to support this assumption should be provided based on knowledge of specific ground conditions. An investigation of subsurface conditions through reviewing borehole records, for example, may be helpful but may not be practical (or cost effective) on the scale necessary to evaluate vibration propagation changes. Where such

ground conditions are unknown, it would be more typical to use 'worst-case' soil conditions in order to generate conservative results. This approach is consistent with CTA, FTA, and HC guidelines.

The receiver reduction factors appear to be applied appropriately according to the FTA manual. One discrepancy is that within Table 6-12 of the FTA manual, a 3-4 storey masonry building results in a recommended 10 dB reduction; however, within the Study, a 12 dB reduction was applied to the Keystone building which was described as a '3-4 storey masonry building'. It is unclear why there is a discrepancy here from the FTA manual.

3. Assessment of existing and future noise

The following section summarizes any comments specific to the results of the noise assessment included in the Study.

According to the Study, two adjustments were made while calculating the L_{dn} metric. A +10 dB adjustment was applied to the nighttime average sound level as well as a +5 dB adjustment to the weekend daytime average sound level. The +10 dB adjustment for the nighttime average sound level is necessary and part of the computation of the L_{dn} metric. However, the +5 dB adjustment for weekend daytime hours is unusual and it is not clear why it was applied. It results in a higher L_{dn} then normal and is therefore conservative and a positive aspect. The origin of this adjustment is unknown but penalizes a period where there is an expectation of quiet, so it is logical.

According to HC, a +10 dB adjustment should be added to baseline levels in quiet rural areas to account for the expected heightened sensitivity to noise. This +10 dB adjustment also applies to the predicted project noise levels for all phases of the project. There are properties on the west side of the corridor that are in a more rural setting. A rationale for why this adjustment was not applied should be presented.

L_{Fmax} freight pass-by levels presented in Table 6-1 of the Study are based on the average of six freight pass-by events. There is no indication of how these six events were chosen.

3.1 Special noise characteristics (Impulsive and/or tonal noise)

To account for impulsive or tonal noise within the study area, sounds level adjustments were applied to predicted results as follows:

- A +5 dB regular impulsive adjustment is applied to all VIF rail yard activity and train building activity between Harris Road and Golden Ears Way.
- A +5 dB tonal adjustment is applied to the rail whistling at Kennedy Road crossing and the rail crossing signal at Harris Road crossing.

According to the HC Guideline, the sound sources which are identified as highly impulsive in ISO 1996-1:2003 (ISO, 2003) are the "metal impacts in rail-yard shunting operations." Hence, there is an expectation that the impulsive adjustment should be +12 dB adjustment. The noise due to the engine and motion of the rail cars during shunting is separate from the impact noise and is thus a separate component with a 0 dB adjustment. A rationale that supports the +5 dB adjustment instead of the highly impulsive adjustment of +12 dB should be provided for VIF shunting operations.

The primary activity for impulsive noise is around train building. The Study indicates that train building currently occurs on the north track along the 1.8 km stretch between Harris Road and Golden Ears Way. With the future project, train building will occur on the new north siding track and extend an additional 120 m west of Harris road with the potential to affect more residences. The Study mentions that the increased activity will be proportional to the projected rail traffic increase. The forecasted increase between 2019 and 2030 is roughly two times. The Study should confirm that the train building time is doubled for the future with- and without- Project scenarios.

3.2 Low Frequency Noise (LFN)

In Table 8-1 of the Study, LFN levels as high as 88 dB are presented (L_{LF}) which is well above the 70 dB threshold. The Study expects this "rattle" criterion to be exceeded at 117 dwellings with- or without-Project. According to Health Canada and the criteria section of the Study, feasible mitigation measures should be considered. There was however no consideration given within the Study to the effectivity or feasibility of mitigation.

3.3 Potential for health effects from noise

The key findings of the Study revolve around the long-term high annoyance indicator which is demonstrated by a change in %HA greater than 6.5% and/or an absolute L_{dn} value greater than 75 dBA. The Study identified no instances where a residence had a future with-Project L_{dn} less than 75 dBA but expected a change in %HA greater than 6.5%. The Study only recommends mitigation for instances where dwellings are predicted to exceed L_{dn} 75 dBA for the future with-Project if the future without-Project scenario is not already predicted to exceed 75 dBA (L_{dn}). In total, the Study is recommending mitigation for nine dwellings for the North Build scenario and two dwellings for the North/South Build scenario. There are twenty-four (24) dwellings where the 75 dBA (L_{dn}) is predicted to be exceeded due to rail operations and no mitigation is recommended. The Study appears to suggest that because the existing noise environment is so loud, mitigation is only warranted where the proposed Project additions notably increase the levels over criteria. However, Health Canada indicates that mitigation of project noise be applied if it exceeds an L_{dn} of 75 dBA, even if the change in %HA does not exceed 6.5%. It is typical for this threshold to be considered absolute (i.e. a limiting absolute noise level) and mitigation would be recommended at a minimum to all residences predicted to

exceed 75 dBA (L_{dn}). The application of this threshold within the Study appears to be a deviation from the HC Guideline.

In addition to findings around the long-term high annoyance indicator, a significant number of homes are predicted to experience speech interference and sleep disturbance. If the sleep disturbance criteria for events (72 dBA - L_{Fmax}) was to be adjusted to allow for windows partially open, the resulting number of homes that are predicted to exceed sleep disturbance criteria would increase notably.

The HC Guideline expresses that the severity of impacts be considered with respect to suggested speech comprehension and sleep disturbance criteria. However, the Study does not discuss the potential health effects related to these issues and appears to dismiss them since the existing levels are already loud. The HC Guideline implies that a Project should intend to reduce environmental noise levels to meet these criteria, and their application on other Projects has indicated that such metrics should also consider the combined influence of the Project and future community noise levels so that health effects can be properly considered. Therefore, additional mitigation should be considered within the study area based on all applicable criteria and minimizing the noise impact to affected residences. Note that the number of affected residences is expected to increase with a larger assessment boundary.

Upon a close review of the results (Appendix E), there is an instance where the 2030 future noise level with Project is expected to increase the L_{dn} from 72 dBA to 75 dBA compared to the without-Project scenario which results in only a 5.2% increase in %HA (dwelling DI-45). This residence does not trigger mitigation because it is assumed that it only rounds up to 75 dBA. This residence in particular is expected to have an overall L_{dn} which is predicted to be negligibly different than the absolute threshold which triggers mitigation and is experiencing a noticeable change (+3 dB) when compared to the without-Project scenario. In addition, this receptor is predicted to exceed speech interference and sleep disturbance thresholds as well low frequency noise “rattle” criteria. The results of the Study indicate significant noise concerns on many fronts but fails to trigger mitigation consideration based on the limited application of the Study’s criteria to warrant mitigation. Other areas where mitigation may be triggered would become apparent with a more rigorous mitigation decision framework that better matches the HC guidance.

Based on the contour maps provided in the Study (Figures 8-1 to 8-8), another significant number of residences are predicted to be above the threshold where widespread complaints can be expected (62 dBA - L_{dn}) and some (as documented) are above the threshold where complaints can be expected to include strong appeals to authorities to stop noise (75 dBA - L_{dn}). As mentioned above, complaints, like annoyance, are a key indicator of potential human health effects.

Where levels are extensive and significant, such as in this case, mitigation measures commonly include a communications plan and a complaint management system, consistent with HC Guidelines. Neither

of these considerations are identified in the Study. Note that this communication plan and complaint management system would be separate from that already in place by the CTA.

As dictated by the HC Guideline, the Study should have considered the severity of community health effects associated with all criteria. Such an approach would be expected to result in more expansive mitigation measures than those noted. The levels provided would be expected to raise concerns amongst Health Canada and CTA reviewers.

4. Assessment of existing and future ground-borne vibration

The assessment of vibration found that future with- and without-Project vibration levels are not expected to change since freight and commuter rail through traffic will remain on the existing tracks, rail traffic will be the same, and average rail speeds are not expected to change. Hence, no vibration impact is predicted for most receivers in the study area.

The Study states that there is no impact when the following conditions are achieved:

1. The existing vibration levels are above the threshold;
2. There is not a significant increase in the number of events; and
3. The increase in the vibration level between the existing and the future scenarios is less than 3 dB.

However, the following concerns are noted with respect to these no impact provisions, respectively:

1. If existing vibration levels are above threshold, it does not make them acceptable. As documented above, if the existing vibration criteria for freight pass-by events should be 108 VdB (re 1 nm/s) it is unclear how many dwellings exceed this criterion for the existing conditions. But increase in forecasted 2030 volumes would increase the event frequency so the future criteria would become 103 VdB. It could be argued that any dwellings that are currently below 108 VdB but predicted to exceed the future criteria of 103 VdB are experiencing an impact because the levels were previously acceptable but will become unacceptable due to increased frequency. This example demonstrates how increased frequency in events results in more significant impacts.
2. There is not a significant increase when comparing with- and without-Project. According to the FTA manual (Table 6-5), approximately doubling the number of events is required for a significant increase. However, there is a significant increase in traffic forecasted when comparing existing traffic and the with-Project scenario. This change will be significant for residents and should be addressed, particularly given the preceding example.
3. Agreed that the increase in vibration level is expected to be less than 3 dB.

Feasible mitigation should be considered at dwellings that are currently not in excess of the FTA threshold but are predicted to be for the with-Project scenario threshold.

The Study's recommendation to investigate potential mitigation solutions where new switches are proposed for crossovers is appropriate and is the minimum that should be considered.

5. Potential additional concerns

Two potential areas of concern for the Project that were not included in the Study include construction and maintenance activities. HC Guidelines are clear that construction and decommissioning are activities that should be considered for their noise impact and provides a very detailed process to assessing these activities in Section 6.3.1.

Further, the omission of a communications protocol or complaint resolution is notable. It is important that there is strong and consistent communication with the public regarding what to expect and for how long, and to provide an avenue and process by which complaints can be documented and resolved. Experience has demonstrated that these are key aspects for consideration by both the CTA and Health Canada.

CONCLUSIONS / RECOMMENDATIONS

The findings of the peer review are summarized below. The key findings of RWDI's review are summarized as follows:

- The severity of health effects associated with speech interference, sleep disturbance and low frequency noise should be discussed and evaluated. Existing conditions should be considered when assessing the potential for investigating mitigation to minimize such effects.
- Since the 70 dB "rattle criterion" is exceeded, Health Canada may suggest the implementation of feasible mitigation measures. There is evidence that noise-induced rattles are very annoying, and this annoyance may be independent of the number or duration of events.
- It is typical for the 75 dBA (L_{dn}) threshold to be considered absolute and mitigation would be recommended at a minimum to all residences predicted to exceed it. This application of this threshold within the Study appears to be a deviation from the HC guideline.
- Beyond the dwellings where the L_{dn} is expected to exceed 75 dBA, additional mitigation should have been considered within the study area to minimize the effects associated with other health effect criteria such as speech interference, sleep disturbance and low frequency noise.
- A significant number of residences are predicted to be above the threshold where widespread complaints can be expected (62 dBA - L_{dn}) and some (as documented) are above the threshold where complaints can be expected to include strong appeals to authorities to stop noise (75 dBA - L_{dn}). A community communication plan and complaint resolution process should be recommended as part of a mitigation plan.
- Feasible mitigation for vibration should be considered at dwellings that are currently not in excess of the FTA threshold for 'infrequent' event activity but are predicted to be for 'occasional' event activity for the with- and without-Project scenario threshold.

The secondary findings are summarized as follows:

- Given the potential for Environmental Assessment triggers, the Canadian Transportation Agency guidelines should be considered in addition to Health Canada and the U.S. FTA.
- Health Canada complaint criteria should be part of the Study, and mitigation should be considered where such criteria are exceeded.
- The sleep disturbance criterion (72 dBA L_{Fmax}) assumes a closed window which may be appropriate for some seasons but Health Canada recognizes that in many cases, people will want to keep their windows at least partially open. The equivalent criteria is 60 dBA (L_{Fmax}) with a partially open window. The criteria based on a closed window was not an assumption that was clearly discussed in the Study and does not seem appropriate.
- The reference velocity (re 1nm/s) used to calculate VdB is not standard within the FTA manual referenced. The result of this deviation from the FTA manual is that the criteria levels provided

(in VdB) do not align with the criteria levels provided in the Vibration Impact Analysis (Section 6) portion of the FTA manual. This change could be confusing for readers.

- The criteria presented for the Study is for occasional freight locomotive pass-by events (i.e. 30-70 events per day; 103 VdB threshold) per the FTA manual (with re 1 nm/s). This event frequency is consistent with future forecasted freight traffic and does not appear to be consistent with existing traffic levels. Existing freight traffic volumes equate to infrequent events (i.e. less than 30 per day; 108 VdB threshold). This shift to a stricter criterion due to changes in event frequency was not acknowledged in the Study and demonstrates the need for more careful consideration.
- A Dutch propagation model (SRM II) was chosen to predict rail propagation. Generally, a North American rail model such as U.S. FTA/FRA would be chosen. Evidence as to why the chosen model is representative of North American rail noise propagation should be provided.
- An expanded assessment boundary for noise modelling would have created a more complete picture to the extent of potential health effects within the City of Pitt Meadows. Although the worst-case receptors are captured within the chosen assessed boundary, the magnitude of the existing and future issues is not represented. Expanding the assessment boundary would likely demonstrate that there are more dwellings which experience noise levels in excess of HC criteria (i.e. have the potential to cause health effects) than indicated in the Study.
- It's unclear from the Study if the model was calibrated to measured train pass-by events and/or any overall measured average sound metrics.
- The Study does not appear to address that future sound levels only consider rail and road traffic and not the cumulative change in all other noise sources. A clear rationale should be provided as to why cumulative sound levels were not considered.
- There seems to be a discrepancy between the traffic volume used within the Study and actual traffic volumes based on RWDI's 2021 monitoring program. The Study includes 28 trains per day while RWDI counted on average 18 trains per day. If the baseline rail volumes are over-stated, the change to the future expansion conditions may be under-stated.
- For vibration modelling, where ground conditions are unknown, it would be more typical to use 'worst-case' soil conditions to generate conservative results.
- Table 6-12 of the FTA manual, a 3-4 storey masonry building results in a recommended 10 dB reduction; however, within the Study, a 12 dB reduction was applied to the Keystone building which was described as a '3-4 storey masonry building'. It is unclear why there is a discrepancy here from the FTA manual.
- L_{Fmax} freight pass-by noise levels and RMS vibration levels presented in Table 6-1 of the Study are based on the average of six freight pass-by events from a single day over the entire monitoring period. There is no indication of how these six events were chosen.
- A noise adjustment of +5 dB to account for impulsive noise for VIF rail yard activity and train building was applied; however, this activity may be considered highly impulsive which carries a +12 dB adjustment during the activity.

- The Study did not appear to confirm that the train building time is doubled for the future with- and without- Project scenarios.Sound and vibration effects from all phases of the Project should be considered, including construction, maintenance, and decommissioning. It is important that there is strong and consistent communication with the public regarding what to expect and for how long.

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