November 20, 2017

Jocelyne Beaudet  
Panel Chair, Roberts Bank Terminal 2 Project  
C/O Debra Myles Panel Manager, Roberts Bank Terminal 2 Project  
Canadian Environmental Assessment Agency  
22nd Floor, Place Bell  
160 Elgin Street  
Ottawa, ON K1A 0H3

Dear Mme. Beaudet,

From the Vancouver Fraser Port Authority re: Information Requests from the Review Panel for the Roberts Bank Terminal 2 Project Environmental Assessment: Responses (Select Responses from Packages 6 and 7 – November 20, 2017 Submission)

The Vancouver Fraser Port Authority (VFPA) is pleased to submit to the Review Panel selected responses to Information Request Packages 6 and 7 related to the Roberts Bank Terminal 2 Project Environmental Impact Statement.

We are making available the document Information Requests from the Review Panel for the Roberts Bank Terminal 2 Project Environmental Assessment: Responses (Select Responses from Packages 6 and 7 – November 20, 2017 Submission) which addresses the information requests IR6-08, IR7-01, -02, -08, -36, and -39.

Compilation of Panel Information Requests and Vancouver Fraser Port Authority Responses, which combine all available responses to the Review Panel’s Information Requests, will be updated shortly.

Yours sincerely,

[Original signed by]

Cliff Stewart, P.Eng., ICD.D  
Vice President, Infrastructure

cc Debra Myles, Panel Manager, Roberts Bank Terminal 2 Project  
Douw Steyn, Panel Member  
David Levy, Panel Member  
Michael Shepard, BC Environmental Assessment Office

Encl. (1)  
1. Information Requests from the Review Panel for the Roberts Bank Terminal 2 Project Environmental Assessment: Responses (Select Responses from Packages 6, and 7 – November 20, 2017 Submission)
IR6-08 Air Quality – WRF-NMM and CALMET Modelling: Hourly Hodographs

Information Source(s)

EIS Volume 2: Appendix 9.2-A, Appendix C, Section 2.6.1, Figure 2-45

Context

In Appendix C of Appendix 9.2-A of the EIS, there was no indication of the CALMET model fields’ ability to capture strong diurnal variation of wind speed and direction that characterize the sea-breeze conditions frequently seen in the Lower Fraser Valley, and which have been shown to be associated with pollutant recirculation, and associated degraded air quality.

It appears that Figure 2-45 (1500 PDT on August 2, 2010) of Appendix C of Appendix 9.2-A depicts a wind field during the afternoon sea-breeze phase of the well-known land/sea-breeze cycle. These conditions are responsible for regional (100 kilometres) scale horizontal recirculation of pollutants in this region. More information is required on the ability of CALMET modelled wind fields to properly capture the land/sea breeze cycle in this region. This information is required in order to assess the ability of the CALMET/CALPUF modelling system to capture wind structures that dominate the dispersion of pollutants in the local study area.

Information Request

Provide information in the form of hourly hodographs for up to five selected days to confirm that the NMM-WRF CALMET modelling system adequately captures the land/sea-breeze cycle in the region.

VFPA Response

Clarification

As clarification, Figure 2-43 of Appendix C in EIS Appendix 9.2-A (not Figure 2-45 as stated in the context section of IR6-08) depicts a CALMET wind field under unstable conditions during the afternoon sea-breeze phase on August 2, 2010 at 1500 PDT.

Provide information in the form of hourly hodographs for up to five selected days to confirm that the NMM-WRF CALMET modelling system adequately captures the land/sea-breeze cycle in the region.

As requested, hourly hodographs are provided to confirm that the NMM-WRF CALMET modelling system adequately captures the land/sea-breeze cycle in the region. Wind speed and direction data were extracted in 1-hour increments from the CALMET model at the east end of the causeway on five days to produce daily hodographs. Figures IR6-08-1 to IR6-08-5 include hodographs to illustrate daily changes during spring to summer 2010 when the land/sea-breeze cycle is most predominant. The dates selected include May 11, June 12, June 16, July 4, and August 20, as representative of the spring/summer period. The graphed
hours for each extracted point are labelled\(^1\) to clearly show the wind speed and direction for each hour over 24 hours.

**Figure IR6-08-1**  
**Hodograph for May 11, 2010 Showing Daily Land/Sea-breeze Cycle**

![Hodograph for May 11, 2010](image1)

**Figure IR6-08-2**  
**Hodograph for June 12, 2010 Showing Daily Land/Sea-breeze Cycle**

![Hodograph for June 12, 2010](image2)

\(^1\) The wind speed scale is indicated by blue numbers. The hourly wind speed and direction are indicated by the green line and dots, and the corresponding hours are shown by green numbers, in 4-hour increments.
Figure IR6-08-3  Hodograph for June 16, 2010 Showing Daily Land/Sea-breeze Cycle

Figure IR6-08-4  Hodograph for July 4, 2010 Showing Daily Land/Sea-breeze Cycle
These hodographs, based on the NMM-WRF CALMET data, illustrate the daily land/sea-breeze cycle: winds from the east (land breeze) in the morning hours, winds from the west (sea breeze) in the afternoon, and winds from the east (land breeze) during the evening to complete the land/sea-breeze cycle.

These hodographs, showing a similar sea-breeze cycle on each representative day, confirm that the NMM-WRF CALMET modelling system adequately captures the daily land/sea-breeze cycle in the region.
IR7-01 Atmospheric Noise – Modelling Using Worst-Case Meteorological Conditions

Information Source(s)

EIS Volume 2: Section 9.3.12; Appendix 9.3-A, Table 3-5

TDR Upland Noise and Vibration - Effects of Meteorological Conditions on Sound Propagation from Roberts Bank Terminals (CEAR Doc#986)

EIS Volume 4: Section 27.6.3.2; Section 27.6.3.4

Proponent Response to Information Request Package 3 (CEAR Doc#984): Preamble to IR3-25 to IR3-46

Context

In Appendix 9.3-A of the EIS, the Proponent acknowledged that meteorological conditions such as wind speed, wind direction and temperature stratification have an important influence on noise propagation in the atmosphere. In its technical data report on the effects of meteorological conditions on sound propagation (CEAR Doc#986), the Proponent examined some of these effects, and highlighted that enhanced noise propagation can occur:

- in downwind directions;
- in light wind conditions;
- under temperature inversions; and
- under low level jets (giving sea breezes as an example).

Further, it was emphasized that sound propagating over water may undergo modest amplification.

In Appendix 9.3-A of the EIS, the Proponent indicated that it used the LfU-Bayern (1999) noise modelling approach, which only accounts for wind direction effects. As a result, noise from the proposed Project may be greater than predicted since the LfU-Bayern approach does not account for the numerous meteorological conditions that could result in enhanced noise propagation, as described in CEAR Doc#986.

Alternatively, the CONCAWE model can explicitly treat temperature inversion and other meteorological conditions. As stated by the Proponent in Section 2.3.3.4 of Appendix 9.3-A of the EIS, the CONCAWE method was not used in the model because it is based on empirical sound propagation data collected exclusively over land, and because the Pasquill Stability Categories were similarly developed in relation to ground surfaces rather than water surfaces. However, the CONCAWE model can be operated with measured or estimated temperature profile data valid for overwater surfaces.

In Section 9.3.12 of the EIS, the Proponent indicated that it is not known whether low level jets actually occur within the local study area. However, it is possible that recently published
literature may provide information such that the influence of low level jets on noise propagation could be included in the noise assessment of the Project.

Because the noise modelling is based on a meteorological data set that is limited in terms of capturing important meteorological conditions (such as temperature inversions and low level jets) and their seasonality, further information regarding the worst-case meteorological conditions and the resultant noise levels at the seven sites identified by the Proponent in the upland study area is required.

**Information Request**

Provide a brief summary of relevant and available literature regarding existing measurement and modelling studies of the atmospheric boundary layer in near-coastal parts of the Lower Fraser Valley that could be applied to the local study area for the proposed Project. The review should include studies that investigated sea breezes and temperature inversions.

Based on results of the literature review, construct a representative meteorological data set to be used as input to the CONCAWE model. The data set should be designed to capture a reasonable worst-case scenario for enhanced noise propagation (i.e. downwind conditions, light winds, temperature inversions, low level jets, and overwater propagation) from the Project to the seven sites located in the upland study area for the Project. The data set should also account for seasonal dependence of meteorological conditions. Provide a tabulation of the data set used to represent the worst-case scenario.

Provide an analysis of the frequency of occurrence by season of these worst-case meteorological conditions that result in enhanced sound propagation.

Run the CONCAWE model using the representative atmospheric data set to develop an assessment of worst-case noise levels at the seven noise measurement sites in the upland study area for the Project during both construction and operation. The worst-case meteorological conditions should include all worst-case conditions acting simultaneously, and all physically realistic combinations of such conditions. The Proponent is to follow the revised activities for Project construction as presented in CEAR Doc#984.

Present the results of the CONCAWE model run in tables similar to Table 3-11 and Table 3-21 of Appendix 9.3-A of the EIS that summarize $L_d$, $L_n$, $L_{dn}$ and $L_{max}$ at the seven noise measurement sites in the upland study area during construction and operation of the Project under different combinations of the worst-case meteorological conditions. Provide a discussion of the results to accompany these tables.

**VFPA Response**

**Clarification**

This information request asks for updated noise modelling of $L_d$, $L_n$, $L_{dn}$, and $L_{max}$ at the seven noise measurement sites in the upland study area. However, these parameters (associated with continuous noise) were measured at, and predicted for, only sites 3, 4, and 5. Initial measurements of ground-borne vibration were taken at sites 1 and 2, and low frequency noise at sites 6 and 7 (as shown in Table 2-1 of EIS Appendix 9.3-A). The assessment focuses on predicted noise levels at sites 3, 4, and 5 as representative of the areas within the local assessment area (LAA) that are expected to receive the highest levels of Project-related noise in the future, as discussed in Section 9.3.6.3 of Appendix 9.3-A of the EIS. This response
provides the requested information for sites 3, 4, and 5, where the indicators $L_d$, $L_n$, and $Ldn$ were assessed.

The $L_{\text{max}}$ parameter represents the highest measured value over a designated time period and relates only to the measurements of existing conditions in Appendix 9.3-A of the EIS. Model scenarios cannot refine activity sufficiently to enable prediction of $L_{\text{max}}$ in 1 or 10 minute increments, or link short term event data represented by $L_{\text{max}}$ to specific meteorological conditions, so this parameter is not addressed in this response.

1. Provide a brief summary of relevant and available literature regarding existing measurement and modelling studies of the atmospheric boundary layer in near-coastal parts of the Lower Fraser Valley that could be applied to the local study area for the proposed Project. The review should include studies that investigated sea breezes and temperature inversions.

The following provides a detailed summary of relevant literature. The reference list is provided at the end of this response.

Overview – Refraction of Sound Rays in Surface Layer

In the Project region, the atmospheric boundary layer tends to be on the order of hundreds of metres high. Noticeable modifications to sound levels are only expected within the lowest 100 metres (approximately) of the atmospheric boundary layer, which is called the ‘surface layer’ (Stull 1988). This response will limit the discussion to the surface layer.

When sound waves travel horizontal distances of several kilometres between source and receiver, as would be the case with noise from the RBT2 terminal, the sound waves are substantially attenuated in the atmosphere due to geometric spreading and atmospheric absorption (Crocker 2007). Under these conditions, the main concern of worst-case atmospheric conditions is downward bending (refraction) of sound waves, which can limit the sound waves to the surface layer, resulting in increased noise propagation (Crocker 2007).

Sound can be generated across a broad, multidirectional wave front, or it can be very directional, depending on the nature of the sound source. The nature of spatial propagation of sound, and how sound is perceived or measured, results in only the portion of a sound wave that is on the direct path from source to receiver being heard. This is evaluated by defining or modelling sound as a ‘ray’ between the source and receiver of the sound. When substantial downward refraction of sound rays is occurring within the surface layer, additional rays that would otherwise propagate away from the surface will reach the receptor, resulting in amplification of the sound.

Effect of Atmospheric Conditions on Downward Refraction

Downward refraction of sound rays in the atmosphere occurs when the speed of sound propagation increases with height (Crocker 2007). The speed of sound depends on several atmospheric parameters, but only temperature and wind speed have sufficient vertical variability to cause measurably strong downward bending of sound waves within the atmospheric surface layer to cause sound amplification (Crocker 2007).
As described in Section 2.1.5 of the RBT2 Technical Data Report: Effects of Meteorological Conditions on Sound Propagation from Roberts Bank Terminals (‘RBT2 Meteorological Report’; CEAR Document #9861), under conditions that enhance downward refraction and over a hard reflecting surface, such as water, a maximum reduction in attenuation of 3 decibels (dB) would be possible. For example, a sound source of 50 A-weighted decibels (dBA) that attenuates to 40 dBA at a distance over land, a neutral atmospheric surface, would attenuate to 43 dBA at the same distance over water.

Temperature Variation

Downward refraction occurs when temperatures increase substantially with height above the ground within the atmospheric surface layer (Crocker 2007). Such atmospheric conditions are called ‘stable’, because the colder air near the ground has higher density than the air aloft and, therefore, vertical exchange of air is suppressed. The main mechanism creating stability is nighttime cooling at the surface, particularly under cloudless conditions. Because of the stability, air further aloft cools less rapidly, creating a positive temperature gradient from the surface upwards such that sound rays are refracted downward (Stull 1988). The meteorological modelling discussed further below suggests that stable nighttime conditions are common in the entire region, including the Project site.

Refraction of sound waves can also occur at substantially higher altitude, for instance at the temperature inversion at the top of the convective boundary layer or the capping inversion that frequently occurs over mountain valleys roughly at ridge height of the surrounding mountains (Whiteman 2000, McKendy and Lundgren 2000). In the lower Fraser Valley, these conditions occur at heights of many hundreds of metres up to approximately one kilometre above the surface (van der Kamp and McKendy 2010). However, under these atmospheric conditions, the change in attenuation is negligible because of the strong attenuation over the longer vertical distance travelled by the downward bent sound rays. Furthermore, such conditions are less likely to occur at the Project site, which is located at the mouth of the Fraser River over 35 kilometres from the mountain ridges to the north and south.

Wind Speed Variation

Downward refraction of sound also occurs in the direction of wind flow when wind speeds increase substantially with height above the ground (Crocker 2007). Wind speed is always zero right on the ground. Therefore, strong winds at relatively low altitudes cause a substantial increase of wind speed from the ground up. Section 2.2.2 of the RBT2 Meteorological Report (CEAR Document #986) defines ‘strong winds blowing at relatively low altitudes’ as ‘low level jets’. Different meteorological conditions that can cause low level jets are inertial oscillations and land-sea breezes, described in the following paragraphs.

Inertial Oscillations

Community members at Roberts Bank have reported sudden gusts of wind that amplify sound from the Roberts Bank terminals. These low-level jets are most likely inertial oscillations. Inertial oscillations are mostly expected in large flat terrain, which might explain the apparent lack of literature on inertial oscillations in the lower Fraser Valley. A mechanism explaining inertial oscillations was first proposed by Blackadar (1957), and Stull (1988) provides the mathematical description of the mechanism. The larger scale pressure differences in the atmosphere cause strong winds at higher elevation in the atmosphere. Under fair weather conditions during the daytime, turbulence from the surface heating slows down these winds throughout the entire atmospheric boundary layer. In the evening, the surface layer becomes stable and winds in the atmospheric boundary layer above the surface layer can speed up. These winds tend to oscillate in direction and speed because of Earth’s rotation, which imposes a perpendicular force on the motion (except near the equator). This is similar to a pendulum performing oscillations caused by its inertia and the gravitational force acting at an angle to the motion of the pendulum.

Inertial oscillations are expected to occur in a shallow layer of strong winds on the order of about one hundred metres deep that occur detached from the surface at altitudes of up to several hundred metres above the ground. Banta et al. (2002), for example, reported observations of inertial oscillations over Kansas. Other investigations, however, have called into question the prevalence of such idealised inertial oscillations and suggested that, in practice, inertial oscillations are weak, sporadic, and often occur substantially above the surface layer, for example Lundquist (2003).

On the rare occasion when inertial oscillations occur sufficiently close to the ground and with the wind direction from the noise sources towards the receptors, they can contribute to sound level amplification. However, typically inertial oscillations occur under stable nighttime conditions and weak surface winds, when noise is already substantially less attenuated, according to the existing models, than under other meteorological conditions, regardless of the presence of inertial oscillations. Therefore, information on the frequency of such events is not required to ensure modelling of noise propagation considers worst-case meteorological conditions.

Land-sea Breezes

At nighttime, because the heat capacity is lower for solid ground than for water, the energy loss from land causes a faster drop in temperature over land than over water. That implies that near the Project site right at the water, the faster temperature drop occurs over the land surface in the lower Fraser Valley. The build-up of colder air above the land surface eventually causes a decreasing pressure gradient from land towards the water, and creates a subsequent land breeze of colder air from the lower Fraser Valley towards the Strait of Georgia (Stull 1988).

Because land breezes generally blow from the receptors on land towards the sound source over water, they are less likely to be associated with worst-case meteorological conditions for sound propagation than their daytime equivalent, the sea breeze. Sea breezes can carry
sound from a noise source over the water towards the receptors on land. While they are typically hundreds of metres deep, the wind speed maximum occurs roughly 100 metres above the ground (Steyn 1998, 2003). Hence, under sea breeze conditions, a substantial wind speed gradient exists near the surface that can amplify sound levels.

Other Temperature Gradient Effects

The lower Fraser Valley is characterised by additional land surface complexities beyond the land-sea interface (McKendry and Lundgren 2000). Additional horizontal temperature gradients and subsequent pressure gradients are caused by the following (Whiteman 2000):

- Slope flows over steep complex terrain to the north and southeast of the lower Fraser Valley;
- Valley flows in tributary valleys particularly in the north shore mountains and for the lower Fraser Valley as a whole; and
- Plain-mountain wind systems for the larger-scale terrain gradient between the Pacific Ocean and the mountains in B.C. and Washington State.

To the extent that these flows reach the Project site in Delta, they can interact with the sea or land breeze. In most cases, the interaction would be an enhancement to, but indistinguishable from, the sea or land breeze. For instance, daytime up-valley flows into the lower Fraser Valley could enhance the sea breeze at the Project site.

In summary, worst-case meteorological conditions for noise propagation are those with strongly increasing temperature and wind speed (from source towards receptor) within the surface layer. These are most likely associated with sea breezes (potentially enhanced by other complex terrain flows in the lower Fraser Valley) during the daytime. At nighttime, these conditions occur when the atmosphere is stable and larger-scale winds aloft drag air within the surface layer or cause sporadic bursts of inertial oscillations. An analysis of the frequencies of these sea-breeze and stable nighttime conditions with winds blowing from the source to the receptors is provided below.

2. Based on results of the literature review, construct a representative meteorological data set to be used as input to the CONCAWE model. The data set should be designed to capture a reasonable worst-case scenario for enhanced noise propagation (i.e. downwind conditions, light winds, temperature inversions, low level jets, and overwater propagation) from the Project to the seven sites located in the upland study area for the Project. The data set should also account for seasonal dependence of meteorological conditions. Provide a tabulation of the data set used to represent the worst-case scenario.

Overview of CONCAWE Approach

The CONCAWE model estimates sound levels under six different meteorological categories (table on page 21 in CONCAWE (1981)). The purpose of the meteorological categories is to calculate a factor, referred to as K4, which is applied to the sound-level estimates to account for meteorological influence. Category 4 has assumed zero meteorological influence. Empirical correction curves were derived for the other five categories. These curves show sound-level corrections as a function of acoustic frequency and distance from the noise source. They were
derived from field data collected for sound from petrochemical plants propagating over a land surface. Generally, meteorological categories 1 to 3 are associated with noise reductions and categories 5 to 6 are associated with sound enhancement, relative to category 4.

Available meteorological data for the field study on which the CONCAWE model was based included wind speed and direction, daytime incoming solar radiation, and cloud cover. In a first step, that data were used to identify atmospheric Pasquill stability classes from A (very unstable) to F (stable) (table on page 20 in CONCAWE (1981)). In a second step, strength and direction of the wind components relative to the downwind direction from noise source to receptor were categorised. In the third step, these wind component categories were combined with Pasquill stability classes and assigned to one of the six meteorological categories (table on page 21 in CONCAWE (1981)).

A limitation of the CONCAWE meteorological categories is that they combine meteorological observations that are associated with very different meteorological conditions into the same category. For instance, meteorological category 6 could include a variety of conditions including the following: fully developed strong sea breezes straight from the noise source to the receptor (stability class C and \(v>3.0\) m/s); a typical winter storm under rainy and overcast conditions (stability class D and \(v>3.0\) m/s); or nighttime or otherwise stable conditions with sufficiently strong onshore winds to suppress a land breeze (stability class F and \(v>0.5\) m/s).

**Worst-case Meteorological Conditions for Sound Propagation at Roberts Bank**

To estimate CONCAWE calculation input data representing Pasquill stability classes for the Project site, solar radiation observations were required. These observations were unavailable from area meteorological stations, and therefore, another approach was necessary to derive information on Pasquill stability classes. Instead, output from a CALMET model run over the Project region for the year 2011 was utilised. CALMET was run using as input 1) observations from several meteorological stations in the region and 2) output from the atmospheric mesoscale Weather Research and Forecast (WRF) model. CALMET output included Pasquill stability classes and wind speed and direction at a 2.5-km grid resolution. This output was bilinearly interpolated to the location of the noise source to provide the best representation of atmospheric conditions at the location of noise generation and for much of the over-water distance travelled towards the receptors. Wind vectors were rotated relative to the downwind direction from noise source to each receptor for each of the three main receptors sites.

For every hour of the year 2011, the wind component categories and Pasquill stability classes determined from the CALMET output were assigned to their respective meteorological categories. Finally, the frequencies of occurrence for each meteorological category were determined for each of the three receptor sites 3, 4, and 5 (Figure 2-3 in Appendix 9.3-A of the EIS) to provide all potential stability classes prior to focusing on the worst-case conditions. The results are shown in Table IR7-01-1 below.
Table IR7-01-1 Frequencies of Occurrence of CONCAWE Meteorological Categories at Sites 3, 4, and 5 based on CALMET Output for Calendar Year 2011

<table>
<thead>
<tr>
<th>Meteorological Category</th>
<th>Frequency of Occurrence (in %)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Site 3</td>
</tr>
<tr>
<td>1</td>
<td>0.7</td>
</tr>
<tr>
<td>2</td>
<td>17.2</td>
</tr>
<tr>
<td>3</td>
<td>21.2</td>
</tr>
<tr>
<td>4</td>
<td>19.2</td>
</tr>
<tr>
<td>5</td>
<td>23.0</td>
</tr>
<tr>
<td>6</td>
<td>18.6</td>
</tr>
</tbody>
</table>

The class that represents the ‘worst-case’ meteorological condition from a CONCAWE perspective for noise propagation is category 6. As described above, this category can represent more than the ‘sea-breeze’ condition, which is known to be the ‘worst-case’ meteorological condition from the ISO 9613 model perspective (receptor downwind of sound source).

The data set that was developed considered the location of all receptors used in the noise and vibration study. However, the EIS did not include the modelling of future noise levels at sites 1, 2, 6, or 7. Sites 1 and 2 were used to assess Project-related ground-borne vibration and sites 6 and 7 were used to assess Project-related low frequency noise. As such, the design of the data set focused on capturing meteorological conditions at sites 3, 4, and 5, as these sites represent residential locations that in the future are expected to receive the highest levels of Project noise.

3. Provide an analysis of the frequency of occurrence by season of these worst-case meteorological conditions that result in enhanced sound propagation.

A climatology of sea breezes was presented in Steyn and Faulkner (1986) based on a ten-year observational record. The statistics presented in this study can be expected to provide a good representation of current conditions. Data from Table 2.2 in Steyn and Faulkner (1986) at Vancouver International Airport (representative of the Project site) were incorporated in Table IR7-01-2 below and used to derive a rough estimate of the overall frequency of sea breeze conditions by month and annually. Sea breezes are a daytime occurrence.
### Table IR7-01-2

Frequencies of Occurrence of Sea Breezes at Vancouver International Airport based on Data Presented in Steyn and Faulkner (1986)

<table>
<thead>
<tr>
<th></th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Annual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean frequency of occurrence (days)</td>
<td>3.2</td>
<td>4.1</td>
<td>6.9</td>
<td>7.7</td>
<td>9.4</td>
<td>8.5</td>
<td>11.5</td>
<td>11.0</td>
<td>8.9</td>
<td>8.7</td>
<td>3.8</td>
<td>2.2</td>
<td>-</td>
</tr>
<tr>
<td>Mean daily duration (hours)</td>
<td>4.9</td>
<td>6.7</td>
<td>8.1</td>
<td>8.6</td>
<td>9.0</td>
<td>8.3</td>
<td>7.9</td>
<td>8.3</td>
<td>8.9</td>
<td>7.2</td>
<td>5.5</td>
<td>4.1</td>
<td>-</td>
</tr>
<tr>
<td>Total average sea-breeze hours</td>
<td>15.7</td>
<td>27.5</td>
<td>55.9</td>
<td>66.2</td>
<td>84.6</td>
<td>70.6</td>
<td>90.9</td>
<td>91.3</td>
<td>79.2</td>
<td>62.6</td>
<td>20.9</td>
<td>9.0</td>
<td>674.3</td>
</tr>
<tr>
<td>Total hours per period</td>
<td>744</td>
<td>672</td>
<td>744</td>
<td>720</td>
<td>744</td>
<td>720</td>
<td>744</td>
<td>720</td>
<td>744</td>
<td>720</td>
<td>744</td>
<td>8760</td>
<td></td>
</tr>
<tr>
<td>Mean frequency of occurrence (%)</td>
<td>2.1</td>
<td>4.1</td>
<td>7.5</td>
<td>9.2</td>
<td>11.4</td>
<td>9.8</td>
<td>12.2</td>
<td>12.3</td>
<td>11.0</td>
<td>8.4</td>
<td>2.9</td>
<td>1.2</td>
<td>7.7</td>
</tr>
</tbody>
</table>
Relative to all hours in a given month, the frequency of sea breezes varies from a minimum of 1.2% in December to a maximum of 12.3% in August. Based on the ten-year observational data set in Steyn and Faulkner (1986) and the criteria for sea breeze identification applied by the authors, sea breezes occur in approximately 7.7% of all hours in a calendar year.

Table 2.2 in Steyn and Faulkner (1986) indicates that monthly mean sea breeze wind speeds varied between 2.5 m/s and 3.6 m/s, and the most frequent wind directions were from 210° to 240° (roughly southwesterly) at the coast. The wind component from noise source to receptors at the Project site is therefore less than +3 m/s most of the time. Because sea breezes occur under stability classes A, B, and C, according to the table on page 21 in CONCAWE (1981), sea breezes are assigned to meteorological categories 4 and 5 most of the time, and category 6 occasionally. Following the categorisation in the CONCAWE model, occasionally occurring sea breezes in category 6 are the worst-case meteorological conditions. Sea breezes occur less than 10% of the time.

Worst-case scenarios are therefore best represented by applying meteorological category 6 for every hour of the year, although in reality they occur less than 20% of the time over the course of a calendar year as shown in Table IR7-01-1. Table IR7-01-3 below shows the frequency of occurrence of the six meteorological conditions further broken down by season.
Table IR7-01-3  Frequencies of Occurrence of CONCAWE Meteorological Categories at Sites 3, 4, and 5 based on CALMET Output for Calendar Year 2011 Broken Down by Season

<table>
<thead>
<tr>
<th>Meteorological Category</th>
<th>Frequencies (in %)</th>
<th>Winter&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Spring&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Summer&lt;sup&gt;c&lt;/sup&gt;</th>
<th>Fall&lt;sup&gt;d&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Site 3</td>
<td>Site 4</td>
<td>Site 5</td>
<td>Site 3</td>
<td>Site 4</td>
</tr>
<tr>
<td>1</td>
<td>1.7</td>
<td>2.2</td>
<td>2.3</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>2</td>
<td>33.4</td>
<td>33.4</td>
<td>38.7</td>
<td>13.3</td>
<td>14.7</td>
</tr>
<tr>
<td>3</td>
<td>22.7</td>
<td>22.1</td>
<td>18.5</td>
<td>16.8</td>
<td>20.3</td>
</tr>
<tr>
<td>4</td>
<td>11.7</td>
<td>12.2</td>
<td>14.2</td>
<td>19.2</td>
<td>19.2</td>
</tr>
<tr>
<td>5</td>
<td>14.5</td>
<td>14.6</td>
<td>10.5</td>
<td>26.7</td>
<td>19.6</td>
</tr>
<tr>
<td>6</td>
<td>16.0</td>
<td>15.4</td>
<td>15.9</td>
<td>23.4</td>
<td>25.6</td>
</tr>
</tbody>
</table>

Notes:
- a. Winter includes the months of December, January, and February
- b. Spring includes the months of March, April, and May
- c. Summer includes the months of June, July, and August
- d. Fall includes the months of September, October, and November
4. **Run the CONCAWE model using the representative atmospheric data set to develop an assessment of worst-case noise levels at the seven noise measurement sites in the upland study area for the Project during both construction and operation. The worst-case meteorological conditions should include all worst-case conditions acting simultaneously, and all physically realistic combinations of such conditions. The Proponent is to follow the revised activities for Project construction as presented in CEAR Doc#984.**

Present the results of the CONCAWE model run in tables similar to Table 3-11 and Table 3-21 of Appendix 9.3-A of the EIS that summarize \( L_d \), \( L_n \), \( L_{dn} \) and \( L_{max} \) at the seven noise measurement sites in the upland study area during construction and operation of the Project under different combinations of the worst-case meteorological conditions. Provide a discussion of the results to accompany these tables.

**Project Operation**

The CadnaA model used in the EIS to forecast noise levels under future conditions with Project operation has been revised to account for the influence of meteorology on sound propagation according to the CONCAWE method (CONCAWE 1981). Sound propagation factors other than those considered by CONCAWE (e.g., distance) were still calculated according to the ISO 9613 standard (ISO 1996), as they were in the EIS. The ISO 9613 meteorological correction factor was replaced and calculated according to the CONCAWE method. The CONCAWE method was used to develop noise level predictions for the case of all sound propagation occurring under CONCAWE meteorological category 6; the category that would result in worst-case Project noise levels.

This revised approach only applies to noise from the sources in the CadnaA model that represent marine terminals and rail traffic. The EIS approach calculates road traffic noise as linear noise sources according to the NMPB-Routes 96 standard (Sétra 1997). The CONCAWE method does not include linear sources. The NMPB model does, however, allow for road traffic noise to be calculated under both neutral and downwind meteorological conditions. Conditions where downwind propagation occurs 100% of the year were used for the traffic portion of the model runs, which is equivalent to conditions included in CONCAWE meteorological class 6.

**Table IR7-01-4** presents noise levels at sites 3, 4, and 5 for CONCAWE meteorological category 6 (worst-case meteorological conditions). Provided for comparison are the noise levels presented in the EIS which are for annual average meteorological conditions according to the LfU-Bayern standard (LfU-Bayern 1999). All noise levels are for future conditions with Project operation.
Table IR7-01-4  Noise Levels at Sites 3, 4, and 5 (Future Conditions with Project Operation) for CONCAWE Meteorological Category 6 Compared to EIS Annual Average

<table>
<thead>
<tr>
<th>Site</th>
<th>ISO 9613 CONCAWE Meteorological Category 6</th>
<th>ISO 9613 EIS - LfU-Bayern Annual Average Windrose</th>
<th>Noise Level Differences between CONCAWE minus LfU-Bayern (EIS)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L_d (dBA)</td>
<td>L_n (dBA)</td>
<td>L_dn (dBA)</td>
</tr>
<tr>
<td>3</td>
<td>57.5</td>
<td>54.1</td>
<td>61.2</td>
</tr>
<tr>
<td>4</td>
<td>54.3</td>
<td>52.2</td>
<td>59.0</td>
</tr>
<tr>
<td>5</td>
<td>56.3</td>
<td>55.1</td>
<td>61.7</td>
</tr>
</tbody>
</table>

Table IR7-01-4 shows that noise levels at the three sites are from 2.4 to 5.7 dBA higher for CONCAWE Meteorological Category 6 (reflecting worst-case meteorological conditions) when compared to annual average noise levels according to LfU-Bayern.

**Construction Noise**

The calculations of Project construction noise levels have been revised to consider sound propagation under ISO 9613 with CONCAWE meteorological category 6 (i.e., ‘worst-case’ meteorological conditions). Project construction noise levels are based on the Project construction activities described in Section 4.4.1 of the EIS, and detailed in Appendix 4-E and 4-F of the EIS. The VFPA will respond to the Panel under separate cover with regard to the changes to the environmental assessment that result from the changes to the RBT2 Project Description, as per the Panel’s direction in letters dated July 17, 2017 (CEAR Document #9952) and October 3, 2017 (CEAR Document #10693). However, the changes to the Project Description include removal of key noise sources, such as activity associated with the intermediate transfer pit and marine vibro-replacement; these changes would have the effect of reducing construction noise. The information provided below is therefore considered conservative in this context.

Table IR7-01-5 presents revised construction noise levels, calculated using the CONCAWE method, at sites 3, 4, and 5. The corresponding table in the EIS is Table 9.3-18. Table IR7-01-6 compares the CONCAWE based results to the corresponding levels in Table 9.3-18 of the EIS.

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2 CEAR Document #995 From the Review Panel to the Vancouver Fraser Port Authority re: Requirements for information pertaining to changes to the Roberts Bank Terminal 2 Project.

3 CEAR Document #1069 From the Review Panel to the Vancouver Fraser Port Authority re: Response to the Vancouver Fraser Port Authority’s plan for the presentation of the revised information (See Reference Document # 1054).
### Table IR7-01-5  Construction Noise Levels under CONCAWE Meteorological Category 6

<table>
<thead>
<tr>
<th>Site</th>
<th>Annual Average Expected L_d (dBA)</th>
<th>Project Construction Phase L_d (dBA)</th>
<th>Project-related Increase (dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Range</td>
<td>Avg.</td>
</tr>
<tr>
<td>3</td>
<td>51.9</td>
<td>51.9 – 58.0</td>
<td>54.1</td>
</tr>
<tr>
<td>4</td>
<td>48.4</td>
<td>48.4 – 56.3</td>
<td>51.7</td>
</tr>
<tr>
<td>5</td>
<td>52.3</td>
<td>52.3 – 53.9</td>
<td>53.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Site</th>
<th>Annual Average Expected L_n (dBA)</th>
<th>Project Construction Phase L_n (dBA)</th>
<th>Project-related Increase (dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Range</td>
<td>Avg.</td>
</tr>
<tr>
<td>3</td>
<td>51.5</td>
<td>51.5 – 57.9</td>
<td>53.3</td>
</tr>
<tr>
<td>4</td>
<td>44.5</td>
<td>44.5 – 55.9</td>
<td>48.9</td>
</tr>
<tr>
<td>5</td>
<td>48.5</td>
<td>48.5 – 51.3</td>
<td>49.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Site</th>
<th>Annual Average Expected L_dn (dBA)</th>
<th>Project Construction Phase L_dn (dBA)</th>
<th>Project-related Increase (dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Range</td>
<td>Avg.</td>
</tr>
<tr>
<td>3</td>
<td>58.0</td>
<td>58.0 – 64.3</td>
<td>59.9</td>
</tr>
<tr>
<td>4</td>
<td>51.7</td>
<td>51.7 – 62.4</td>
<td>55.9</td>
</tr>
<tr>
<td>5</td>
<td>55.7</td>
<td>55.7 – 58.1</td>
<td>56.8</td>
</tr>
</tbody>
</table>

### Table IR7-01-6  Comparison of Project Related Increases from Construction Noise under CONCAWE Meteorological Category 6 and EIS ISO 9613 Methods

<table>
<thead>
<tr>
<th>Site</th>
<th>CONCAWE Project-related Construction Increase L_d (dBA)</th>
<th>EIS Project-related Construction Increase L_d (dBA)</th>
<th>Noise Level Differences between CONCAWE and EIS Construction Increases L_d</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0.0 – 6.1</td>
<td>2.2</td>
<td>0.0 – 1.9</td>
</tr>
<tr>
<td>4</td>
<td>0.0 – 7.9</td>
<td>3.3</td>
<td>0.0 – 2.6</td>
</tr>
<tr>
<td>5</td>
<td>0.0 – 1.6</td>
<td>0.7</td>
<td>0.0 – 0.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Site</th>
<th>CONCAWE Project-related Construction Increase L_n (dBA)</th>
<th>EIS Project-related Construction Increase L_n (dBA)</th>
<th>Noise Level Differences between CONCAWE and EIS Construction Increases L_n</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0.0 – 6.4</td>
<td>1.8</td>
<td>0.0 – 2.0</td>
</tr>
<tr>
<td>4</td>
<td>0.0 – 11.4</td>
<td>4.4</td>
<td>0.0 – 4.8</td>
</tr>
<tr>
<td>5</td>
<td>0.0 – 2.8</td>
<td>1.1</td>
<td>0.0 – 0.6</td>
</tr>
</tbody>
</table>
As shown in **Table IR7-01-6**, the CONCAWE based results show increases of up to 6.6 dBA (at site 4) relative to the noise levels in Table 9.3-18 of the EIS. The construction noise level ranges cover a five and a half-year period and the ‘worst-case’ sound propagation conditions (i.e., CONCAWE meteorological category 6) are forecast to occur for less than 20% of that time. Furthermore, these estimated maximum construction noise levels assume that the ‘worst-case’ sound propagation conditions would occur at the same time as maximum Project construction noise emissions. While there is no way to quantify this at this stage of construction planning, the variable nature of site activity is such that it is considered highly unlikely that such concurrence would happen 20% of the time.

**Conclusions**

**Summary of Model Outputs**

Recalculation of predicted noise levels using the CONCAWE method indicates that sound levels may increase by up to 5.7 dBA for the operation phase, and by up to 6.6 dBA for the construction phase, under ‘worst-case’ meteorological conditions, which are predicted to occur less than 20% of the time. The actual degree of sound level increases will depend on the level of site activity and the amount of ambient sound at those times when the category 6 meteorological condition occurs. The analysis presented herein applies worst-case meteorological conditions to annual average operation phase and construction phase noise levels, but actual levels will vary day-to-day and throughout the year.

**Conservativism and Limitations**

The predictions for sound levels, using the CONCAWE method, during the construction phase are considered highly conservative given that some noise emitting construction activities will be removed in the updated Project Description\(^4\). The predictions in the EIS are also considered conservative in this context.

Predictions for both the construction and operation phase are also considered conservative because the analysis for this response applied a more conservative attenuation factor than in typical CONCAWE applications. Uncertainty exists in the use of CONCAWE-based noise predictions, as the method suggests that hard surfaces, such as propagation over water or

\(^4\) An updated Project Description will be prepared, as per the Panel’s direction in letters of July 17, 2017 (CEAR Document #995) and October 3, 2017 (CEAR Document #1069).
concrete, use an arbitrary attenuation of -3 dBA (three dBA less attenuation than neutral conditions) for downwind conditions. However, the CONCAWE method does not account for partial attenuation over varying ground types. So the change in attenuation over water to land for the Project could not be evaluated using the CONCAWE method. To account for this, the calculations conducted for this CONCAWE-based exercise used the category 6 attenuation factor (or 100% downwind/sea breeze equivalent) for the entire source-to-receptor distance, which resulted in attenuation of up to -6 or -7 dBA (6 or 7 dBA less attenuation than neutral conditions) depending on distance and acoustic frequency. This is expected to result in higher sound levels than a strict application of the suggested CONCAWE factors for the applicable ground conditions.

Due to the limitations described above, using the CONCAWE method results in noise level predictions that are limited in accuracy and applicability to assessing Project-related effects from noise. The CONCAWE method has not been adopted by international standards organisations, such as CSA (Canadian Standard Organisation), ISO (International Organization for Standardization), or ANSI (American National Standards Institute). The limitations of the CONCAWE method with respect to modelling sound propagation over water, and therefore limitations in assessing Project-related effects from noise, are described in Section 2.3.3.4 of Appendix 9.3-A of the EIS.

References


**IR7-02 Atmospheric Noise – Transient Vessels**

**Information Source(s)**

Marine Shipping Addendum: Section 7.4.5.1; Table 7.4-1; Figure 7.4-3; Figure 7.4-4

EIS Volume 2: Section 9.3.6.3; Table 9.3-4; Figure 9.3-4

**Context**

In Section 7.4.5.1 of the Marine Shipping Addendum, the Proponent stated that no data are available regarding the noise levels or frequency of container ship-related transient noise events such as from ship horns or other signals. The Proponent stated that if the rate of occurrence of transient noise events is assumed to increase in proportion to vessel movements, then such occurrences would also be expected to increase by 9 to 12%. The Proponent further indicated that the rates of occurrence of transient events are not expected to be perceptible. As described in Table 9.3-4 of the EIS, perceptibility is based on noise level increases; therefore, it is unclear how the Proponent determined whether transient events would be perceptible since there was no information provided regarding noise levels for such events.

In Section 9.3.6.3 of the EIS, the Proponent indicated that noise from ships in transit was excluded from the model because no data were available regarding their noise emissions. Some participants in the environmental assessment have expressed concern regarding the transient noise from container ships. However, the Proponent also stated that during the July noise measurement period, residents reported that one of the ships berthed at Deltaport Terminal caused higher-than-usual noise levels.

Information is required to predict the noise levels from transient noise events from container ships at receptor locations within the marine shipping area and the upland study area.

**Information Request**

Based on the existing Roberts Bank terminals, describe the frequency of occurrence of transient noise events from a container ship while transiting the marine shipping area and while at berth.

Provide information on the $L_{\text{max}}$ of transient noise events from container ships, and describe the noise levels at various setback distances. Present the results in a figure similar to Figure 7.4-3 of the Marine Shipping Addendum.

Assuming neutral meteorological conditions, describe the $L_{\text{max}}$ of transient noise events from a container ship at berth, and a container ship transiting the Marine Shipping Area at the following locations:

- sites in the upland study area as denoted by Figure 9.3-4 of the EIS; and
• on land within the local study area as described in Table 7.4-1 of the Marine Shipping Addendum.

Provide a figure similar to Figure 7.4-4 of the Marine Shipping Addendum that identifies the following contour lines along the shipping routes for Segments A and B:

• perceptibility of noise level increases due to transient noise events from a container ship; and
• outdoor noise level of 60 dBA Lmax.

VFPA Response

**Based on the existing Roberts Bank terminals, describe the frequency of occurrence of transient noise events from a container ship while transiting the marine shipping area and while at berth.**

**Clarification**

Transient noise events from container ships include the following:

• Ship pass-bys – Although engine noise from container ships is continuous while in transit, the noise may be received as transient at a stationary noise receptor, as the passing ship approaches, passes by, and recedes from the receptor;
• Ship horn soundings – short blasts of a ship’s horn under certain navigational circumstances; and
• Ship anchor movements – metal-on-metal noise as the chain from the ship’s anchor passes through an opening in the ship’s hull while the anchor is being lowered or raised.

For the purposes of this response, ship pass-bys are the only relevant transient noise from container ships. The rationale for exclusion of ship horns and anchorage activities as part of this response is provided below.

The following rules from the document *Consolidation, Collision Regulations, C.R.C., c. 146*\(^1\) provide regulations governing the circumstances under which marine vessels are required to sound their horns:

• **Rule 34 Manoeuvring and Warning Signals – International** describes situations under which a vessel would be required to sound its horn;
• **Rule 35 Sound Signals in Restricted Visibility – International** describes various types of horn sounding procedures for vessels when they are moving or at anchorage in or near an area of restricted visibility;
• **Rule 36 Signals to Attract Attention**; and
• **Rule 37 Distress Signals**.

As most ship-to-ship communication is done over VHF (very high frequency) radio at the discretion of the vessel master and as required by Canadian Coast Guard vessel traffic services requirements (under Radio Aids to Navigation), none of the circumstances described in these rules are expected to occur regularly or predictably as part of RBT2 Project operation (approaching or departing the berth), or marine shipping associated with the Project (ships in transit outside of VFPA jurisdiction). While certain situations may arise occasionally, such as restricted visibility (due to fog, mist, or falling snow), that will require container ships to sound their horns to avoid collisions when approaching or departing the berth, these activities are not considered to be part of normal berthing operations of RBT2 so were not included in the scope of assessment of effects of the Project, or in this response. Similarly, as described in Section 4.4.2.1 of the EIS, there are no plans or foreseen terminal operating requirements for off-terminal anchoring of container ships waiting for a berth at the new marine terminal. Additional information on anchorage is provided in the response to IR5-01 (CEAR Document #1078\(^2\)), which clarifies that neither the construction phase nor the operation phase of RBT2 will require new anchorages.

**Frequency of Occurrence of Transient Noise Events**

As described in Section 4.4.2.1 of the EIS, the RBT2 Project is estimated to receive 260 container ship calls per year when the terminal reaches its 2.4 million vessel TEU (twenty-foot equivalent) design capacity. This will result in 520 Project-associated container ship movements per year (one call equals two movements—one inbound and one outbound), or on average approximately three pass-bys, and associated noise, every two days at a given receptor point along the shipping route. As explained below, whether or not the noise from a vessel pass-by is perceptible at a receptor point depends on the setback distance from the noise source.

*Provide information on the \(L_{\text{max}}\) of transient noise events from container ships, and describe the noise levels at various setback distances. Present the results in a figure similar to Figure 7.4-3 of the Marine Shipping Addendum.*

Figure 7.4-3 of the Marine Shipping Addendum (reproduced as **Figure IR7-02-1** below for ease of reference) provides \(L_{\text{max}}\) levels for container ship pass-bys at various setback distances at 40% and 80% engine load. Given that no additional sources of transient noise were identified in response to this information request, no modifications to the figure were necessary.

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\(^2\) CEAR Document #1078 From the Vancouver Fraser Port Authority to the Review Panel re: Responses to Information Requests IR4-33, IR5-01, IR5-12, IR5-15, IR5-16, IR5-23, IR5-24, IR5-32, IR5-33, IR5-34, IR5-35, IR5-36, IR6-26, IR7-03, and IR7-05 (See Reference Documents #946, #975, #991, and #1000).
Assuming neutral meteorological conditions, describe the $L_{\text{max}}$ of transient noise events from a container ship at berth, and a container ship transiting the Marine Shipping Area at the following locations: sites in the upland study area as denoted by Figure 9.3-4 of the EIS; and on land within the local study area as described in Table 7.4-1 of the Marine Shipping Addendum.

As discussed in the Section 7.3 of the Marine Shipping Addendum, container ship pass-bys are not expected to be audible beyond 4 km from the source. Consequently, under neutral meteorological conditions container ship pass-bys are not expected to be audible at sites 3, 4, and 5 as they are set back more than 5.5 km from the container ship arrival and departure routes, shown on Figure 4-1 of the Marine Shipping Addendum.

Provide a figure similar to Figure 7.4-4 of the Marine Shipping Addendum that identifies the following contour lines along the shipping routes for Segments A and B: perceptibility of noise level increases due to transient noise events from a container ship; and outdoor noise level of 60 dBA $L_{\text{max}}$.

Figure 7.4-4 of the Marine Shipping Addendum provides sound level contour lines showing the setback distances at which container ship noise pass-bys in Segment B (where vessel engine load is assumed to be at 40%) are estimated to result in maximum ship noise levels of 35 and 45 dBA (A-weighted decibels). These sound contour lines correspond to estimated background noise levels for the daytime (7:00 a.m. to 10:00 p.m., 45 dBA) and nighttime (10:00 p.m. to 7:00 a.m., 35 dBA) in the local study area of the atmospheric noise effects.
assessment (Section 7.4 of the Marine Shipping Addendum). As such, these contour lines provide estimates of the approximate setback distances at which maximum noise levels during container ship pass-bys would be perceptible (i.e., distinguishable from background noise).

Figure IR7-02-A1 in **Appendix IR7-02-A** updates EIS Figure 7.4-4 to provide a contour line corresponding to the setback distance at which the maximum noise levels during container ship pass-bys in Segments A and B, under 40% engine load, would reach 60 dBA. The setback distance is approximately 130 m from the source, and not anticipated to overlap with land, or areas with land-based receptors, at any point along the shipping routes in Segments A or B, as shown on Figure IR7-02-A1 in **Appendix IR7-02-A**. In Segments C, D, E, F, and G, land is further from the shipping lanes than in Segments A or B; therefore, the 60 dBA maximum noise level from ship pass-bys is also not anticipated to interact with land-based receptors in these areas.

**Appendices**

Appendix IR7-02-A  Supporting Figure
APPENDIX IR7-02-A
SUPPORTING FIGURE
Legend:
- BOUNDARY OF PROJECT AREA
- MARINE SHIPPING AREA AND SEGMENTS
- PILOT STATION
- ROBTS ASSOCIATED INBOUND SHIPPING ROUTE
- ROBTS ASSOCIATED OUTBOUND SHIPPING ROUTE
- U.S.A.-CANADA BORDER

Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community.

ROBERTS BANK TERMINAL 2
VEssel Pass-by Noise Level
OF 60 DBA IN MARINE SHIPPING
AREA SEGMENTS A AND B

DATE: 11/07/2017
PHN No: IR7-02-A1
IR7-08 Atmospheric Noise – Clarification, Traffic Forecasts

Information Source(s)

EIS Volume 1: Appendix 4-D

EIS Volume 2: Section 9.3.10.1; Table 9.3-23

Context

Table 9.3-23 of Section 9.3.10.1 of the EIS presented the forecast traffic and rail volumes on Deltaport Way and the Roberts Bank Rail Corridor. The Proponent indicated that the values in this table were based on Appendix 4-D of the EIS. However, it is unclear how the values for the following columns of Table 9.3-23 of the EIS were derived:

- Deltaport Way annual average daily traffic; and
- Deltaport Way percentage (%) heavy vehicles.

Information is required to determine how the values presented in Table 9.3-23 of the EIS were derived.

Information Request

Provide a description of how the information presented in Appendix 4-D of the EIS was used to derive the values presented in Table 9.3-23 of the EIS.

VFPA Response

The following two data sources were used to derive the annual average daily traffic volumes (AADT) and percentages of heavy vehicles on Deltaport Way in Table 9.3-23 of the EIS:

- Appendix 4-D of the EIS, Table 12; and
- Tsawwassen First Nation Community Development: Transportation Impact Assessment (Bunt & Associates 2011), Exhibits 5.4 and 6.4.

Table 12 of EIS Appendix 4-D provides inbound and outbound total vehicle movements (passenger/service vehicles and container trucks) for the growth scenario of 4.8 million (M) twenty-foot equivalent units (TEUs) through the existing Deltaport Terminal, and the proposed RBT2 terminal. The 4.8 M TEU scenario corresponds to future conditions with Project operation. Vehicle movements are provided for each hour of the day such that it is possible to calculate the AADT and percentage heavy vehicles that would be arriving at and departing the Roberts Bank causeway via Deltaport Way.

Exhibits 5.4 and 6.4 in Bunt & Associates (2011) provide projected AM and PM peak traffic volumes on Deltaport Way for 2031. The traffic volumes take into account the Tsawwassen...
First Nation Land Use Plan which includes up to nearly 3,500 additional homes, a 1.2 million square foot shopping centre, and a 575,000 square-foot mall.

The traffic data from EIS Appendix 4-D and Bunt & Associates (2011) were combined to provide total traffic volumes on Deltaport Way for the temporal cases that are considered in EIS Table 9.3-23 (i.e., future conditions with the Project and future conditions with the Project and other reasonably foreseeable projects and activities). Data from EIS Appendix 4-D provides Project-related truck traffic for the on-causeway portion of Deltaport Way. These volumes were used in the assessment of future cumulative changes to noise levels (EIS Section 9.3.10) for the off-causeway portion of Deltaport Way, and are shown in Table 9.3-22 for ‘incremental road traffic associated with RBT2’.

Annual average daily traffic projections, based on the AM/PM peak traffic data in Bunt & Associates (2011), were estimated using the formula:

\[ AADT = AM\ Peak \times 8 \]

References

**IR7-36 Outdoor Recreation – Baseline and Effects Assessment**

**Information Source(s)**

EIS Guidelines: Section 9.1.8

EIS Volume 4: Section 24.2; Appendix 18-A; Appendix 18-B

**Context**

The Updated Guidelines for the Preparation of the Environmental Impact Statement stated that, with respect to Indigenous groups potentially affected by the proposed Project, the EIS will include recreational uses of the Project area.

The Proponent, in Section 24.2 of the EIS, reported that Indigenous groups were consulted in the preparation of the outdoor recreation effects assessment. Only Tsawwassen First Nation and Musqueam First Nation provided comments to the Proponent on outdoor recreation for its preparation of the EIS. This information is found in Appendices 18-A and 18-B. There was no specific information reported in the EIS about potential Project effects on outdoor recreational activities undertaken by other Indigenous groups.

**Information Request**

Provide information about the outdoor recreational activities of Indigenous groups - other than Tsawwassen First Nation and Musqueam First Nation - in the outdoor recreation local assessment area and the regional assessment area. For each relevant recreational activity, include information about the level of use, frequency of activity and number of users. Evaluate any potential effects from the proposed Project on those outdoor recreational activities.

**VFPA Response**

*Provide information about the outdoor recreational activities of Indigenous groups - other than Tsawwassen First Nation and Musqueam First Nation - in the outdoor recreation local assessment area and the regional assessment area. For each relevant recreational activity, include information about the level of use, frequency of activity and number of users.*

Other than information on outdoor recreational activities carried out by Tsawwassen First Nation, no other outdoor recreation activities carried out specifically by other Aboriginal groups in the local and regional assessment areas (LAA and RAA) were identified through the preparation of the EIS or the Additional Information to the EIS – WSÁNEĆ Nation (AIEIS), which incorporates WSÁNEĆ Nation Aboriginal groups. In accordance with section 9.1.8 of the Updated EIS Guidelines, various processes were applied to obtain information on outdoor recreational activities from Aboriginal groups for the EIS and the AIEIS, as described below.
**Review of Secondary Information Sources**

Identification and review of available secondary sources on outdoor recreational activities within the LAA/RAA for the general Aboriginal population, as well as specific Aboriginal groups was undertaken. No specific publicly-available information on outdoor recreational activities for the Aboriginal population or specific Aboriginal groups was identified.

**Interviews**

Interviews were held with representatives of Tsleil-Waututh Nation to gather information on outdoor recreational activities in the LAA/RAA. No outdoor recreational activities in the LAA/RAA were identified by Tsleil-Waututh Nation representatives through these interviews.

Interviews were requested by the VFPA with all WSÁNEĆ groups involved in the AIEIS to gather information on marine commercial use and outdoor recreation activities as part of the AIEIS data collection program for existing conditions. Tseycum First Nation and Malahat Nation accepted the invitation for this interview. The interviews included questions regarding outdoor recreational use in the LAA/RAA. No outdoor recreational activities within the LAA/RAA were identified by Tseycum First Nation or Malahat Nation during this interview.

**Written Requests for Information**

Written requests for information on outdoor recreational use in the LAA were sent to Métis Nation B.C., Semiahmoo First Nation, and Lyackson First Nation. No information was received back from these Aboriginal groups on outdoor recreational activities in the LAA/RAA.

**Meetings and Workshops**

Meetings and workshops were held with the following Aboriginal groups to present and obtain input on initial EIS findings for the existing conditions (including outdoor recreation existing conditions), preliminary Project effects assessment results, and proposed mitigation measures (including those pertaining to outdoor recreation). Table IR7-36-1 below summarises these engagement activities.
### Table IR7-36-1  Additional Engagement Activities with Aboriginal Groups on Outdoor Recreation Activities in the LAA/RAA

<table>
<thead>
<tr>
<th>Aboriginal Group</th>
<th>Engagement Method and Date</th>
<th>Engagement Summary</th>
</tr>
</thead>
</table>
| Tsawwassen First Nation  
Tsleil-Waututh Nation  
Musqueam First Nation  
Hwlitsum  
Stz’uminus First Nation  
Lyackson First Nation  
Cowichan Tribes  
Penelakut Tribes  
Métis Nation B.C. | EIS Working Group Meetings¹:  
• May 27, 2014  
• June 17, 2014 | No information or input received from Aboriginal groups on outdoor recreational activities in the LAA/RAA, Project effects, or mitigation measures. |
| Tsawwassen First Nation  
Tsleil-Waututh Nation  
Semiahmoo First Nation  
Musqueam First Nation  
Lake Cowichan First Nation  
Lyackson First Nation  
Métis Nation B.C.  
Hwlitsum | EIS Technical Workshops – Valued Component Identification:  
• June 2014  
• July 2014 |  |
| Tsawwassen First Nation  
Tsleil-Waututh Nation  
Semiahmoo First Nation  
Musqueam First Nation  
Lake Cowichan First Nation  
Lyackson First Nation  
Métis Nation B.C.  
Hwlitsum | EIS Technical Workshops – EIS Preliminary Results:  
• October 2014 (four meetings) |  |
| Tsawwassen First Nation  
Musqueam First Nation | Review and comment on First Nations Community Assessments:  
• January 2015 |  |
| Cowichan Tribes  
Halalt First Nation  
Penelakut Tribes  
Stz’uminus First Nation | Technical Workshops – Review of Draft EIS:  
• October 2014  
• November 2014 |  |

¹ Working group meetings were also held on February 25, 2014 and April 15, 2014; however, content did not pertain directly to the outdoor recreation valued component.
As indicated in EIS Section 24.2.1 and in the response to Information Request #27 (IR-7.31.15-27 of CEAR Document #3142), while certain Aboriginal traditional cultural activities such as canoeing, hunting, fishing, and gathering may be viewed as having recreational benefit or attributes, these activities are pursued for traditional purposes. Descriptions of these and other traditional cultural activities by Aboriginal groups and potential Project effects on these and other cultural activities are described in EIS Section 32.2 and AIEIS Section 7.0 (and not EIS Section 24.0 (Outdoor Recreation Effects Assessment) and AIEIS Section 4.0 (Outdoor Recreation Effects Assessment)).

No outdoor recreational activities occurring in the LAA/RAA (that were not identified as pursued for traditional purposes) were identified by Aboriginal groups through implementation of secondary and primary data collection and engagement processes for EIS and AIEIS as described above (with the exception of outdoor recreation activities carried out by

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2 CEAR Document #314 From Port Metro Vancouver to the Canadian Environmental Assessment Agency re: Completeness Review - Responses to Additional Information Requirements (See reference document # 271) for the Environmental Impact Statement.
Tsawwassen First Nation Members as described in in EIS Sections 24.5.4.3 and 24.5.5 as well as EIS Appendix 18-A).

**Evaluate any potential effects from the proposed Project on those outdoor recreational activities.**

As described in the response to IR-7.31.15-27 (CEAR Document #314), based on the information received on outdoor recreational activities by Aboriginal groups, the outdoor recreation existing conditions identified in EIS Section 24.5 and AIEIS Section 4.0 are presented for, and assumed to be reflective of, the general population, which includes members of Aboriginal groups who may engage in these outdoor recreational activities in the LAA.

A minor potential effect of the Project was identified for changes in recreational crab harvesting area use, access, and displacement from the area of the Project terminal footprint and proposed expanded navigational closure areas, prohibiting recreational crab harvesting in these areas during construction and operations, as indicated in EIS Section 24.6.5.2. The identified Project effect on recreational crab harvesting would affect members of the general population who may engage in these outdoor recreational activities in the LAA. No recreational seafood harvesting activities connected with specific Aboriginal groups were identified through the above data collection and consultation and engagement process.
IR7-39 Outdoor Recreation – Beach Access, Clarification

Information Source(s)

EIS Volume 4: Section 24.5.4.3; Figure 24.4

CEAR Doc #654

Context

In Section 24.5.4.3 of the EIS, the Proponent indicated that the south side of the Roberts Bank causeway (east facing, inter-causeway side), is a popular place for dog walking and bonfires. The area is used both by Tsawwassen First Nation members and the broader community.

According to Metro Vancouver in CEAR Doc #654, the public presently has access to a beach along the existing Roberts Bank causeway.

Information Request

Indicate if the public will be restricted from accessing the beach and shoreline along the causeway (east facing, inter-causeway side) during construction or operation of the proposed Project.

VFPA Response

Public access to the beach and shoreline along the causeway is not expected to be restricted during Project construction or operations.