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Vancouver Drydock - Water Lot Project

Environmental Noise Assessment

Prepared for:

Vancouver Drydock Co. Ltd.

2021-10-12

Prepared by:

BKL CONSULTANTS LTD.

File: 0579-21A-R2

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List of Abbreviations

Abbreviation/Acronym	Definition
%HA	Percentage of highly annoyed persons
ANSI	American National Standards Institute
BC	British Columbia
BKL	BKL Consultants Ltd.
dB	decibel
dBA	A-weighted decibel
EA	environmental assessment
EC	European Commission
Hz	hertz
km	kilometre
km/h	kilometres per hour
L_d	daytime (7 am to 7 pm) equivalent sound level
L_{den}	day-evening-night equivalent sound level
L_e	evening time (7 pm to 10 pm) equivalent sound level
L_{eq}	equivalent sound level
L_{LF}	low frequency sound level
L_n	nighttime (10 pm to 7 am) equivalent sound level
L_{Rden}	rated day-evening-night equivalent sound level
m	metre
the Port	Vancouver Fraser Port Authority
the Project	Vancouver Drydock - Water Lot Project
s	second
SWL	sound power level
TOR	Environmental Noise Assessment Terms of Reference
VD	Vancouver Drydock
VFPA	Vancouver Fraser Port Authority

Glossary

%HA - A descriptor for noise annoyance in a population derived from a dose-response relationship between the percentage of a population expressing high annoyance to long-term noise and the corresponding A-weighted day night sound level (L_{dn})

A-weighting – A standardized filter used to alter the sensitivity of a sound level meter with respect to frequency so that the instrument is less sensitive at low and high frequencies where the human ear is less sensitive. Also written as dBA.

Ambient/existing level – The pre-project noise or vibration level.

C-weighting – C-weighting provides a more discriminating measure of the low frequency sound pressures than provided by A-weighting. Unlike A-weighting, C-weighting retains its sensitivity to sounds between 100 and 1000 Hz. Also written as dBC.

Cumulative sound – The summation of individual sounds into a single total value related to the effect over time.

Day-evening-night equivalent sound level (L_{den}) – The sound exposure level for a 24-hour day calculated by logarithmically adding the sound exposure level obtained during the daytime (L_d) (7:00 am to 7:00 pm) (or 5 times the sound exposure for Saturdays and Sundays) to 5 times the sound exposure level obtained during the evening (L_e) (7:00 pm to 10:00 pm) and to 10 times the sound exposure level obtained during the nighttime (L_n) (10:00 pm to 7:00 am) to account for greater human sensitivity to weekend daytime, evening, and nighttime noise.

Decibel – The standard unit of measurement for sound pressure and sound power levels. It is the unit of level that denotes the ratio between two quantities that are proportional to pressure or power. The decibel is 10 times the logarithm of this ratio. Also written as dB.

Equivalent sound level – The steady level that would contain the same amount of energy as the actual time-varying level. Although it represents the average sound energy throughout a period of time, it is strongly influenced by the loudest events because they contain the majority of the sound energy.

Frequency – The number of times that a periodically occurring quantity repeats itself in one second.

Frequency spectrum – The distribution of frequency components of a noise or vibration signal.

Hertz – The unit of acoustic or vibration frequency representing the number of cycles per second.

Impulsive sound – Non-continuous sound characterized by brief bursts of sound pressure. The duration of a single burst of sound is usually less than one second.

Intermittent sound – Non-continuous or transient noise or vibration that occurs at regular or irregular time intervals with each occurrence lasting more than about five seconds.

Intervening terrain – The terrain in between the noise/vibration source and a sensitive receiver.

Low frequency sound level (L_{LF})– The equivalent sound level that is the sum of the 16, 31.5 and 63 Hz octave bands, with no frequency weighting.

Maximum sound level – The highest exponential time-averaged sound level, in decibels, that occurs during a stated time period, using a “slow” or “fast” time constant (see time constant).

Metric – Measurement parameter or descriptor.

Noise – Noise is unwanted sound, which carries no useful information and tends to interfere with the ability to receive and interpret useful sound.

Noise sensitive human receivers – A place occupied by humans with a high sensitivity to noise. These include residences, hospitals, schools, hotels, etc.

Octave bands – A standardized set of bands making up a frequency spectrum. The centre frequency of each octave band is twice that of the lower band frequency. The bands are centred at standardized frequencies.

Rated day-evening-night equivalent sound level (L_{Rden}) – The L_{den} with a 5 dB correction added for tonal noise (e.g., alarm noise), a 12 dB adjustment for highly impulsive noise (e.g., rail shunting), a 5 dB adjustment for regular impulsive noise (e.g., banging sounds) and a variable adjustment for low frequency noise.

Receiver/receptor – A stationary far-field position at which noise or vibration levels are specified.

Root mean square – The square root of the mean-square value of an oscillating waveform, where the mean-square value is obtained by squaring the value of amplitudes at each instant of time and then averaging these values over the sample time.

Single event noise – Results from the occurrence of a singular intermittent or impulsive noise event such as from a train whistling, a railcar shunting or a vehicular passby. Single event noise is commonly described by the SEL and the fast A-weighted sound pressure level.

Sound – The fluctuating motion of air or other elastic medium that can produce the sensation of sound when incident upon the ear.

Sound exposure level – Defined as the constant sound level that has the same amount of energy in one second as the original noise event. Abbreviated as SEL.

Time constant (slow, fast) – Used to describe the exponential time weighting of a signal. The standardised time periods are 1 second for slow and 0.125 seconds for fast exponential weightings.

Tonal sound – Sound characterized by a single frequency component or multiple distinct frequency components that are perceptually distinct from the total sound.

Total Noise – Results from a combination of multiple noise sources at multiple spatial locations and is typically described by a 24-hour equivalent sound level.

Executive Summary

BKL Consultants Ltd. (BKL) has conducted an environmental noise assessment for the Vancouver Drydock (VD) Water Lot Project (the Project) in North Vancouver. The Project involves a relocation of the existing Careen drydock and the addition of a floating pontoon and two new drydocks.

BKL's environmental noise assessment aimed to:

- evaluate existing noise conditions at potentially affected residential receivers within the community;
- construct a noise model to predict community noise levels in the existing noise environment and the future noise environment with the Project operating at full capacity;
- perform a noise impact assessment in compliance with the Project & Environmental Review Guidelines – Environmental Noise Assessment (the Guideline); and
- provide mitigation options where applicable.

BKL evaluated existing noise conditions by performing a week long noise measurement at a residential balcony overlooking the Project starting from late February 2021. The noise measurements captured various drydock activities including vessel arrivals, and ultra high pressure washing (UHP) which was identified as the loudest activity that would occur at Vancouver Drydock.

BKL developed a Cadna/A computer noise model to assess the existing and post Project noise levels using the measurement results, and information provided by Vancouver Drydock about expected operating times of various activities.

The Project noise predictions were based on the following main assumptions:

- UHP activities generally between 07:00 and 18:00 and for an average of 4 days every two weeks.
- General drydock activities are located along the pier and at each of the drydocks; and
- No change in road or rail movements to Vancouver Drydock expected as a result of the Project.

The noise model accounts for the following factors:

- The specific operation times (times of day, total annual operation time) for each noise source was included.
- A 5 dB penalty was applied to noise from alarms such as during gantry crane movements.

Based on these assumptions, BKL predicts that

- the total post Project annual average Rated day-evening-night equivalent sound level (L_{Rden}) would be 66 dBA at the loudest residential receiver.

- the increase in the annual average Rated Noise Level due to the Project, would be no more than 3 dB, resulting in a change in the percentage of highly annoyed persons (%HA) to be 3.8%.
- the highest low frequency noise level (L_{LF}) from UHP activities would be 75 dB.

The Guideline does not provide a quantitative criterion for acceptable changes in %HA, but the predicted result is less than the Health Canada criterion of 6.5%. At the most exposed residential locations, the predicted low frequency noise level from UHP activities is slightly above the L_{LF} 70 dB threshold where there is a likelihood of noise-induced rattles; however, there has not been any reported complaints about rattles.

Introduction

BKL Consultants Ltd. (BKL) has been retained by Vancouver Drydock Company Ltd. to provide an environmental noise impact assessment for the proposed Seaspan Water Lot Project (the Project).

Vancouver Drydock (VD) proposes to expand its existing drydock facilities in the City of North Vancouver by extending its water lease to permit the addition of two smaller drydocks. The existing land and water facilities are on Vancouver Fraser Port Authority land located at 203 East Esplanade, North Vancouver, BC and therefore a noise assessment is required in support of the permit application.

Existing operations have been ongoing for many years carrying out repair, maintenance and refitting of medium to large ships and barges. Figure 1 shows the two existing drydocks along with an artist's conception of the two smaller drydocks proposed to the west. The new drydocks will be used to service smaller vessels (e.g., fishboats) than are typically serviced on the 221 m Panamax and 131 m Careen drydocks. A new floating Pontoon will also be added, primarily to permit access to the new drydocks. The large drydock shown in Figure 1 is the "Panamax" and the smaller one to the west is the "Seaspan Careen"

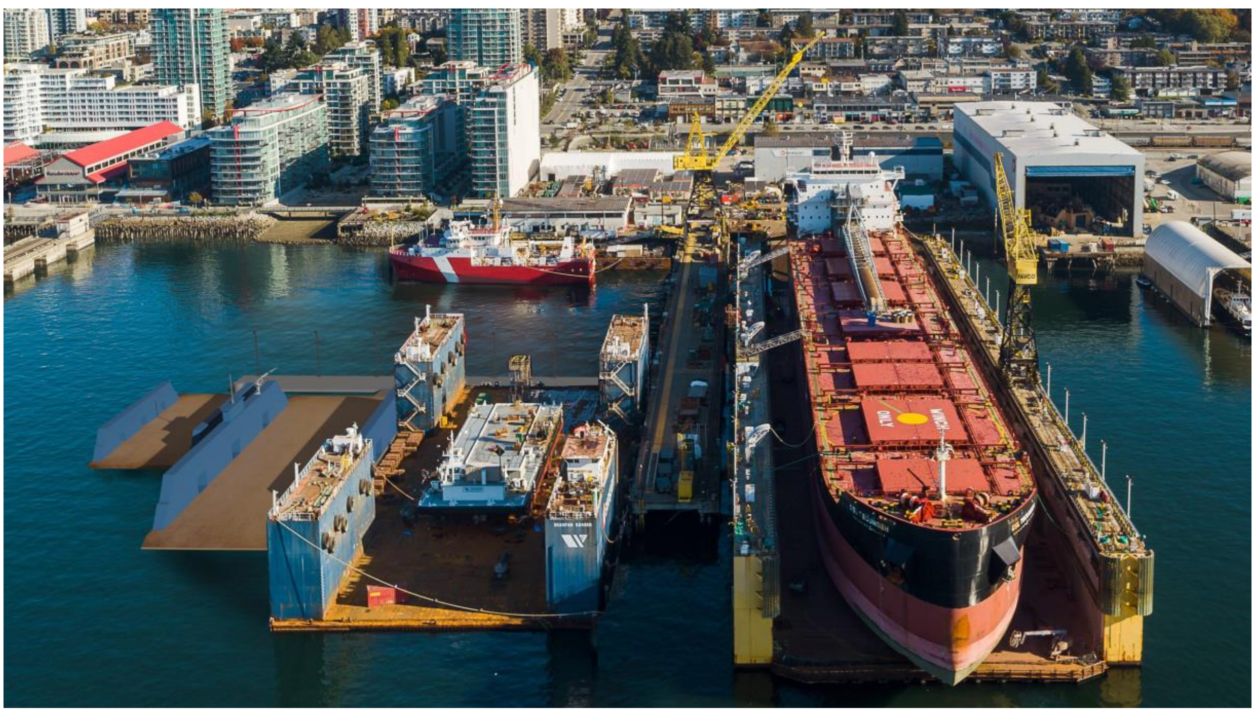


Figure 1: Aerial View of Proposed Expanded Drydock

The assessment methodology for the Project was developed by considering the requirements outlined in the Port's document, Project & Environmental Review Guidelines – Environmental Noise Assessment (PER) which was issued July 2015. The PER includes a noise screening procedure to determine whether an environmental noise assessment report is required for a Project. The completed screening worksheet, included in Appendix A, confirmed that a full noise assessment is required for this Project. The assessment methodology for the Project, including the noise monitoring procedure and noise modelling scenarios, were outlined in the Environmental Noise Assessment Terms of Reference document (TOR), dated February 28, 2021 and revised on March 12, 2021 in response to comments provided by the Port. The revised TOR is provided in Appendix B.

This report documents existing noise exposure levels at potentially affected residential receiver locations near the Project and the predicted noise climate following completion of the Project.

Relevant information regarding acoustic fundamentals and terminology is presented in Appendix C.

Project Description

Overview

The proposed locations of the new drydocks and pontoon are shown in Figure 2 and the nearest residential buildings, within The Pier development to the north and northwest, are shown in Figure 3.

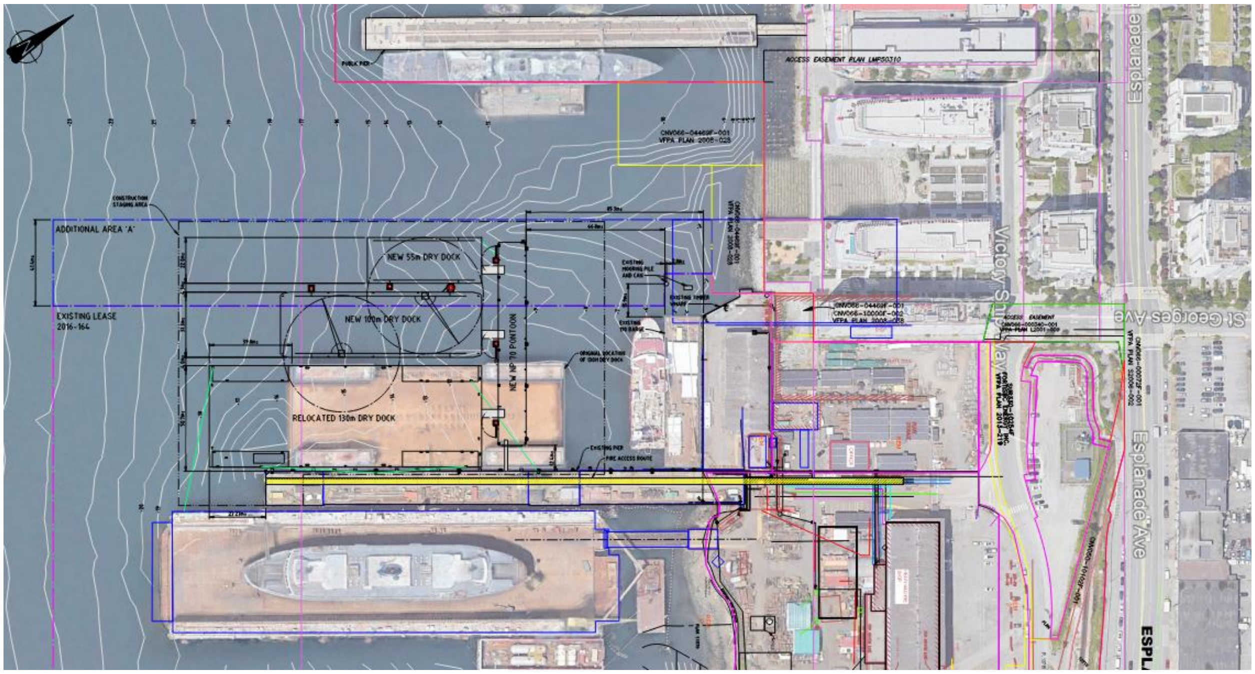


Figure 2: Indicative Drydock Expansion Layout

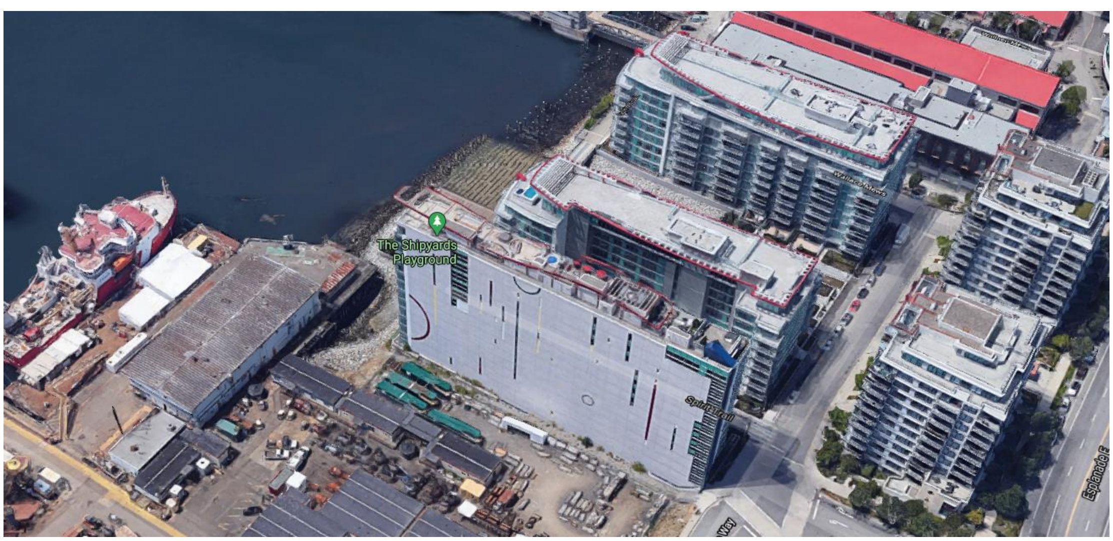


Figure 3: Nearest Residential Receptors

Operations in the onshore facilities and existing drydocks will not see any significant changes as a result of the Project. Any additional noise impact would result from work on vessels in the two new drydocks.

Existing Drydock Operations

The majority of work on drydocked vessels involves cleaning and painting of hulls and exterior top sides, the type of work that cannot be easily completed with the vessel in the water. Occasionally, sections of steel require replacement, which involves cutting out and replacing small areas of the hull or superstructure but the resultant noise is relatively short-lived. The most prevalent source of high noise levels is Ultra High Pressure Washing (UHP), which utilizes compressors to provide water under very high pressure via hoses to nozzles manned by specially trained personnel on portable man lifts. Noise from UHP work on vessels in the "Seaspan Careen" is clearly predominant over noise from similar work within the Panamax drydock since much of the UHP noise within the Panamax is contained by high wing walls that run along the entire length of the drydock. The Careen has lower wing walls with large openings mid-way along its length and there is a more direct and unimpeded sound transmission path through its open north end to residences immediately north of the Careen.

The UHP compressors for the Careen are located on its east side so noise propagation toward residences is generally shielded by whatever vessel is in that drydock (see Figure 4). The majority of the UHP noise occurs at the nozzles and where the water jets hit the steel hull or superstructure. UHP washing often involves simultaneous work from two or three man lifts working at various positions around a vessel (see Figure 5). Since some noise from some positions is likely to be shielded by the vessel itself and some positions are further from residences than others, total noise from UHP work is likely to be established primarily by one work location with only minor contributions from the other work locations.

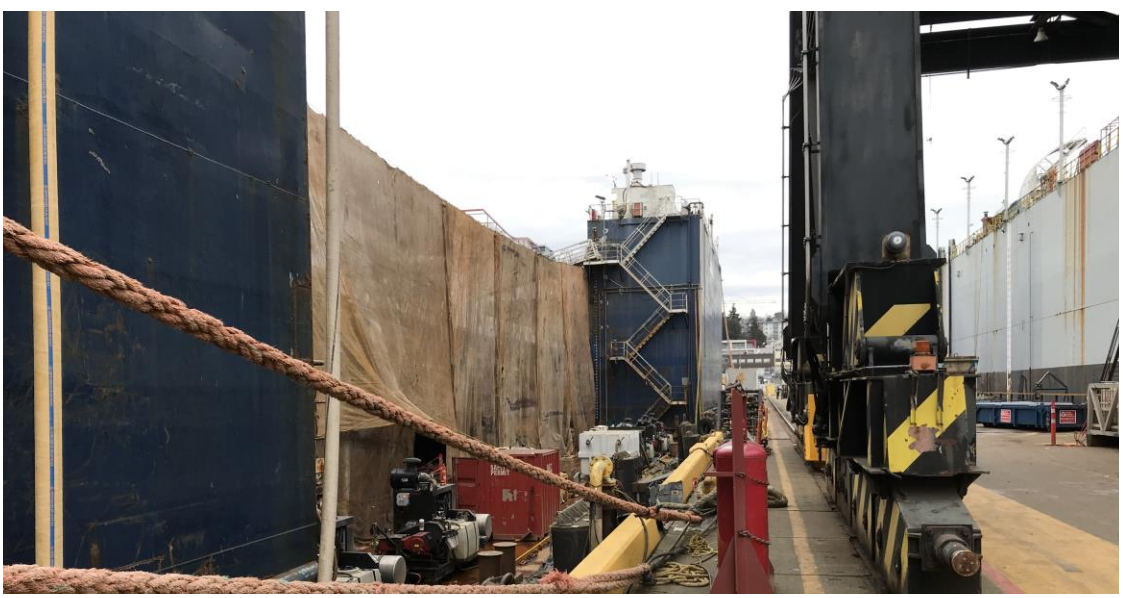


Figure 4: UHP Compressors on East Side of Seaspan Careen

Figure 5: Multiple UHP Man Lifts in Seaspan Careen

The duration of UHP work is project dependent. If only "spot blasting" is required, the duration is less than required for full paint removal. On average, roughly 3 to 5 days of UHP work is required on any given project and the average duration of a project (i.e., work on a given vessel) is about two weeks which equates to approximately 104 days per year. This would apply to both the Panamax and the Careen drydocks. Work within the existing drydocks is generally limited to a day shift plus a second shift (from 7:00 am to 10:45 pm) but the majority of UHP work is carried out by subcontractors that do not work past 6:00 pm. Work occurs less frequently on weekends since overtime rates apply.

Future Operations Following Project Completion

The proposed new drydocks will be used for smaller vessels such as fishboats and, because those projects are usually more cost-sensitive, overtime work would not often occur. Also, the amount/duration of UHP washing would likely be less on these smaller vessels. It would generally be limited to the day shift (7:00 am to 3:00 pm). At times, vessels will moor alongside the new pontoon if they arrive early for work in the drydock. Preparation work prior to drydocking or finishing touches following drydocking might also be carried out at this location. Typical activities would include: cleaning void spaces, mechanical prep, deck painting, etc., nothing that would generate a significant amount of noise. In fact, their presence could be beneficial in that they could partially shield noise originating within the Careen from residences to the north. The Project is not expected to result in any significant change in road, rail or marine traffic.

It is assumed that the new facilities will be fully utilized soon after they have been commissioned so only a single post-project scenario has been modelled, assuming full utilization. Furthermore, since overall noise levels at the potentially affected residential receptors will not be significantly affected by noise from nearby road or rail traffic, which could increase over time, a Future No-Project scenario has not been modelled.

Study Objectives

The objectives of this study were to:

- evaluate existing noise conditions at potentially affected residential receivers within the community,
- measure and model existing noise levels,
- modify the noise model to predict post-project levels,
- compare predicted post-project noise levels against existing noise levels,
- quantify the significance of any noise increases in terms of the rated annual average day-evening-night level (L_{Rden}) including any appropriate adjustments for time periods, tonal, impulsive and low frequency noise characteristics,
- assess the significance of any noise increases in terms of the predicted change in the percentage of individuals in the community that are likely to be "Highly Annoyed" (%HA), and
- provide mitigation options, if required, to minimize any significant noise impacts.

Construction noise assessment was not part of the current study. Construction noise management is addressed in the Project's Construction Environmental Management Plan.

Assessment Criteria

This noise assessment has been conducted to comply with the Port's *Project & Environmental Review Guidelines - Environmental Noise Assessment* (VFPA 2015, the Guidelines). It is understood that the Port's preference is to avoid any significant increase in total noise in residential communities due to the project.

The intent of the study is to predict the noise levels for two scenarios: the baseline scenario and the future scenario when the Project is operating at full capacity. As per the Guidelines, the model predicts the yearly average L_{Rden} total noise levels and accounts for:

- the tonal, impulsive and frequency characteristic of each noise source,
- how many days each activity occurs,
- the time of day each on-site activity occurs, and
- whether the activity occurs on weekends or weekdays.

Noise has been quantified using the rated annual average day-evening-night sound level, or L_{Rden}. The adjusted annual average equivalent sound level is the recommended metric to predict the long-term annoyance response of a community (ANSI 2005). The predicted L_{Rden} includes adjustments for evening, night and weekend noise and any necessary adjustments for tonal or impulsive noise as recommended by the ANSI standard. The purpose of applying these adjustments is to reflect the fact that people are more disturbed by noise during evenings, nights and weekends, compared to weekday daytime hours. Similarly, people are more disturbed by impulsive (e.g., railcar shunting), tonal (e.g., backup alarms on mobile equipment, vehicle horns) and excessive low frequency (e.g., some shipboard generators) noise sources, than they are by more neutral noise sources, like steady road traffic noise. The Guidelines also state that the Port will consider whether the post-project noise level exceeds 75 L_{Rden} dBA.

In addition to the L_{Rden}, the change in the percentage of highly annoyed individuals (%HA) between the baseline and the Post-Project year has been calculated. The Guidelines reference the %HA parameter, but do not provide criteria. Therefore, the Health Canada Guideline has been considered, which states that noise mitigation should be considered where the difference between the baseline %HA and the project %HA exceeds 6.5%.

The Port Guidelines also addresses low frequency noise, specifically stating that the Port will consider whether the post-project low-frequency level, which is defined as the logarithmic sum of the 16, 31.5 and 63 Hz octave bands, exceeds 70 dB L_{LF}.

In summary, the Guidelines indicate that mitigation will be considered following review of the application if the predicted noise impact exceeds the criteria indicated below in Table 1.

Table 1: PER Assessment Guideline Threshold Summary

Parameter	Value
Post Project noise environment, L_{Rden}	> 75 dBA
Increased community noise exposure in terms of increase in %HA	> 6.5% increase (Health Canada guideline)
Low frequency noise level, L_{LF}.	> 70 dB

Appendix C describes the metrics used in this assessment, including noise level adjustments.

Spatial and Temporal Boundaries

Spatial Boundaries

The study area (as shown in Figure 6 below) was defined to include the first row of residential buildings within "The Pier" development. These residences will be closest and most exposed to the new noise sources and, as illustrated by the 3-D view in Figure 3, they are well shielded from traffic noise to the north and rail noise to the east. The front row high-rise buildings within this development will also block noise transmission from the new drydocks to residential buildings to the north. The nearest buildings to the northeast, and east of the Project are commercial or industrial.

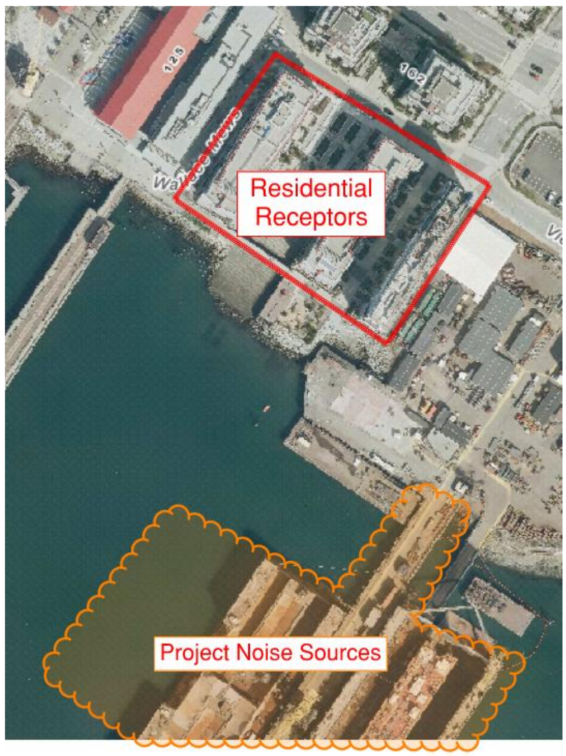


Figure 6: Study Area

Temporal Boundaries

The intent of the study is to predict noise levels for two scenarios: the baseline (existing) scenario and the future scenario when the Project is operating at full capacity. It is expected and assumed, that the new drydocks will be utilized at or near full capacity soon after their installation.

Noise associated with construction activities is excluded from this assessment.

Existing Environmental Conditions

Community Interaction

The Guidelines state "*the history of interaction between a tenant and the surrounding community concerning noise and other nuisance issues is useful in understanding the current level of acceptance*." Vancouver Drydock has provided a summary of noise-related complaints received within the past 5 years, which is shown in Appendix D. Out of a total of 8 complaints documented over this period, most were from residences within The Pier development and were likely related to UHP washing of vessels in the Careen drydock. One of the complaints resulted from UHP washing of a vessel's gantry cranes, which were above the height of the drydock wing walls. Another was due to an alarm on a mobile crane which was in use one night between 23:00 and 0:00 hours. That resident only heard the alarm noise once. There was also one complaint, on April 24, 2017, attributed to operation of a shipboard generator on a cargo ship berthed at the drydock location.

Baseline Noise Monitoring

Baseline noise measurements were carried out for one week beginning on Friday, February 26, 2021. The sound level meter was set up on the south facing balcony of a 5th-floor residence in the easternmost building within The Pier development (Trophy at the Pier). Figure 7 shows the monitoring location and Figure 8 shows a panoramic view from the balcony. The meter used meets the Type 1 specifications in ANSI S1.4 (ANSI 1983). The instrument was field-calibrated before and after the monitoring period using a Brüel & Kjær Type 4230 Calibrator. A detailed description of the monitoring site and time history graphs of the noise levels are contained in Appendix E.

Figure 7: Baseline Noise Monitoring Location

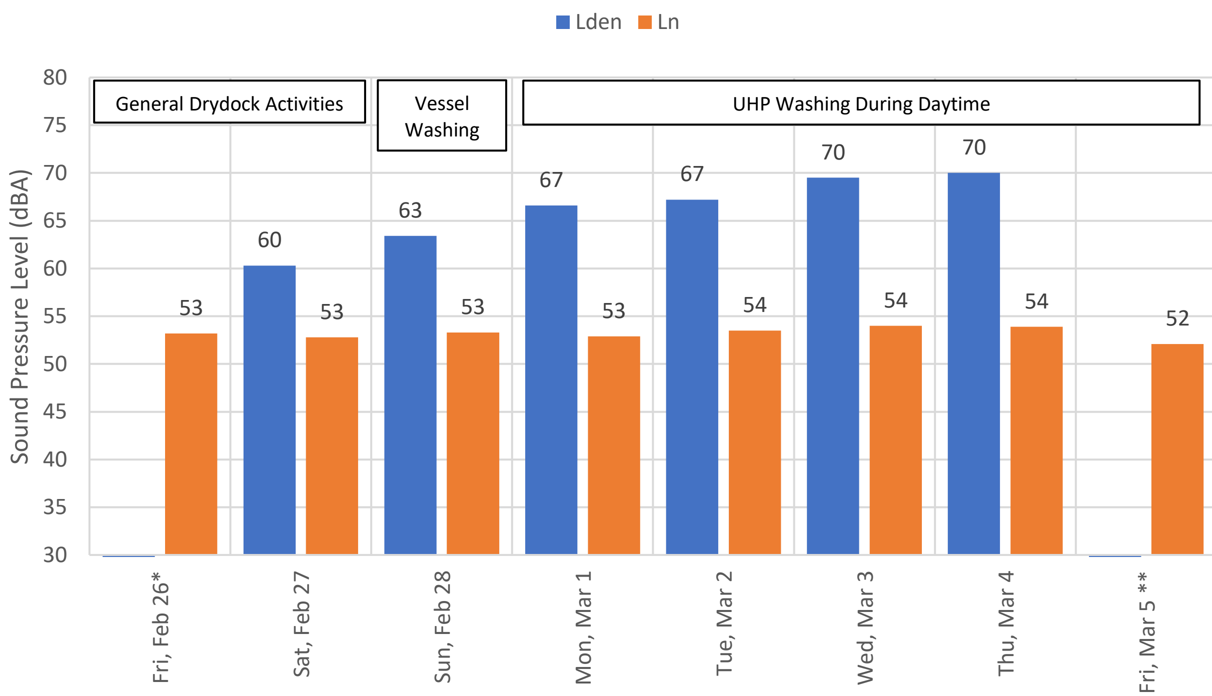
Figure 8: View from Baseline Monitoring Location toward Existing Drydocks

Table 2 summarizes the noise sources that were identified by listening to samples of the audio recording made during the baseline measurements. This list does not necessarily describe all measured noise sources, but it provides context to what is most subjectively noticeable. General drydock activities refers to events occurring within the drydock that can not be easily recognized but could include things like the moving and installation of parts, workers communicating, small machinery and tools operating, etc.

Table 2: Observed Noise Sources During Baseline Measurement

<table>
<tr><th>Date</th><th>Project Related Noise Sources</th><th>Non-Project Related Noise Sources</th></tr>
<tr><td>Friday, February 26</td><td>▪ general drydock activities
▪ gantry crane movement</td><td rowspan="8">▪ birds
▪ pedestrians along The Pier
▪ public playground at waterfront
▪ other Port activities or vessels
▪ HVAC from residential buildings
▪ distant road traffic
▪ distant rail traffic</td></tr>
<tr><td>Saturday, February 27</td><td>▪ general drydock activities
▪ gantry crane movement
▪ vessel arrival and tugs</td></tr>
<tr><td>Sunday, February 28</td><td>▪ general drydock activities
▪ low pressure washing of hull</td></tr>
<tr><td>Monday, March 1</td><td rowspan="5">▪ general drydock activities
▪ UHP</td></tr>
<tr><td>Tuesday, March 2</td></tr>
<tr><td>Wednesday, March 3</td></tr>
<tr><td>Thursday, March 4</td></tr>
<tr><td>Friday, March 5</td></tr>
</table>

The noise monitoring results are shown graphically in Figure 9. Maximum A-weighted noise levels (L_{AFmax}) attributable to UHP washing generally ranged from 65 dBA to 85 dBA at the monitoring location. The large difference in maximum noise levels depends on whether the part of a vessel's hull being washed is in a direct line of sight with the monitoring location and also on its distance from the monitoring location. Detailed histograms of maximum noise levels measured each day are shown in Appendix E. A representative octave band frequency spectrum for the UHP washing, is shown in Figure 10 and based on this spectrum, and the measurement results at the monitoring location, the Low-Frequency Noise Level (L_{LF}) generally ranges from 71 dB to 74 dB. This suggests that noise induced rattles could possibly be induced at the closest residential locations although there are no reports of this actually occurring. Low Frequency Noise Levels at more distant locations would be lower.



* *Ln* results from 22:00 to 23:59 only. *Lden* not applicable where full day data unavailable.

** *Ln* results from 00:00 to 07:00 only. *Lden* not applicable where full day data unavailable.

Figure 9: Plot of Daily Measured Noise Levels (dBA) and Dominant Noise Source

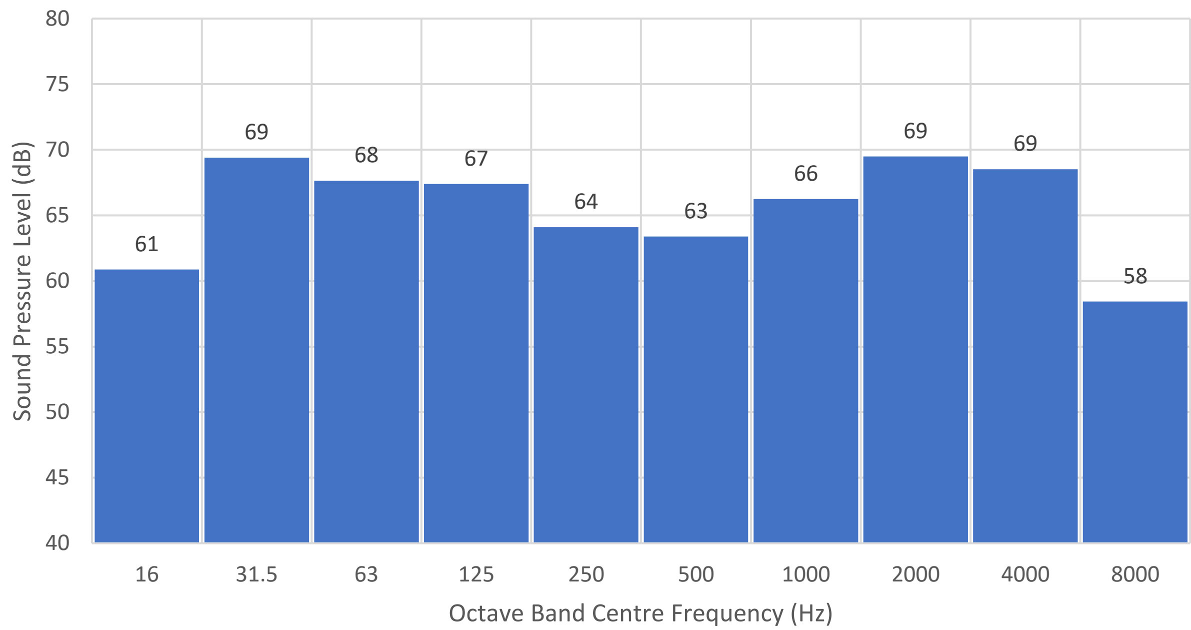


Figure 10: Representative Noise Spectrum During UHP Activities Measured on March 4

Acoustical Noise Modelling

In order to compare Future and Baseline noise levels, both metrics need to be normalized to an annual average level while incorporating adjustment factors as described in the Guidelines. Therefore, a 3D computer model was developed to calculate an annual average noise level for both scenarios. The acoustical model implements the internationally recommended ISO 9613-2 (1996) standard for predicting exterior sound propagation. Details of the Noise Modelling Methodology are shown in Appendix F.

Noise Source Locations

In order to reflect the varying locations of Project related noise sources throughout a typical year, sound sources in the model are spread over areas where they are likely to occur.

For general drydock activities, this area is assumed to be along the main pier and across all available drydocks in operation. For the purpose of noise modelling, a height of five metres above the drydock was assumed as an average height of the activities but it is understood that these could occur at any height from the bottom to the top of a vessel.

The gantry crane is limited to a single track along the pier and the alarm is used to warn pedestrians at ground level. Therefore, the gantry crane alarm is modelled as a line source spanning the entire length of its track and the alarm is assumed to be at a height of three metres above the pier.

The UHP noise occurs when the high pressure water exits the nozzle and strikes the hull of a vessel. Therefore, UHP noise is only a major contributor to noise at the residences when the side of the vessel facing the residence is washed. To model this effect, a vertical area source spanning a height of 10 metres was assumed over a representative vessel shape. The satellite image of the drydock already shows a vessel on the Panamax dock, and it was used as a reference for a representative vessel.

An overhead view of the noise sources for the existing scenario along with the nearest residences are shown in Figure 11. The addition of two drydocks with added UHP noise sources is shown in a 3D view of the future scenario in Figure 12.

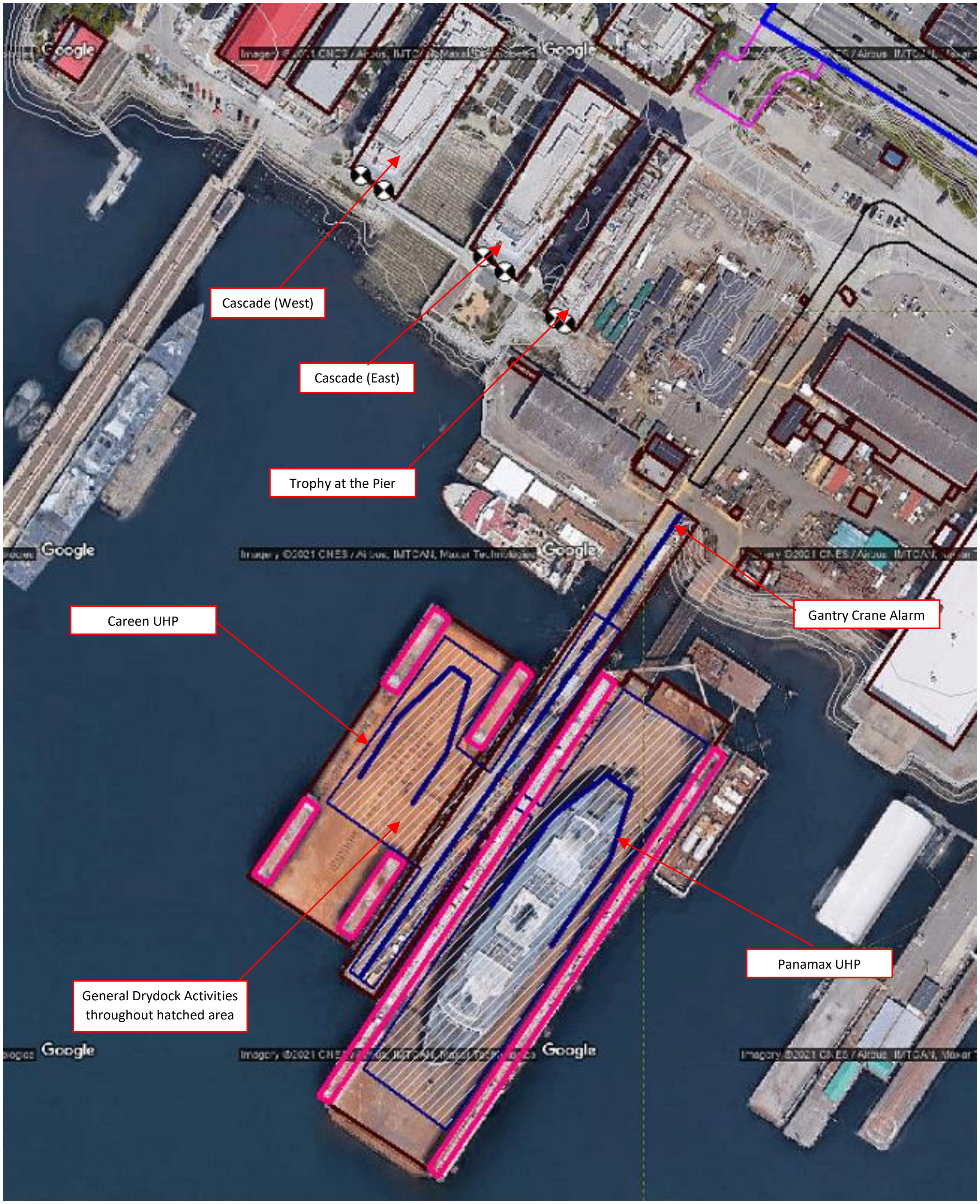


Figure 11: Baseline Noise Model Sources (in blue) and Nearest Residences

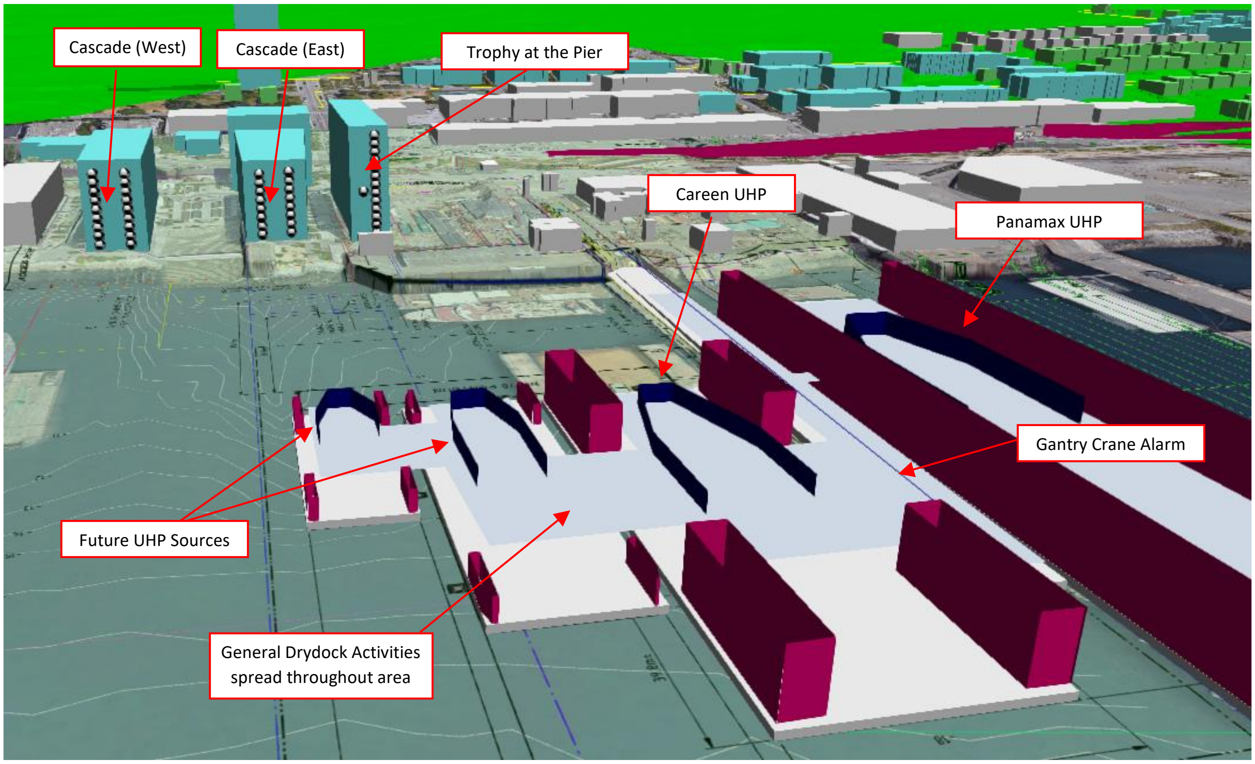


Figure 12: Future Noise Model Sources (in blue) and Nearest Residences

Calibration

In order to confirm accuracy of the noise model, the baseline scenario was compared against the baseline noise measurement results. The area noise source associated with general drydock activities was adjusted until the calculated L_{den} at the baseline location (5th floor of Trophy) was within 1 dB of the measured L_{den} for Saturday, February 26. There was no UHP activity on that day but the measured noise levels include vessels arriving at the dock.

Similarly, the UHP noise for both the Careen and Panamax were adjusted until the calculated result at the baseline location was within 1 dB of the measured equivalent noise level of all UHP activities measured from March 1 to 4.

The gantry crane alarm was only occasionally audible throughout the measurement. It was assumed to be at the northern end of the Careen drydock (as per the photo in Figure 8) and its level was adjusted to produce 56 dBA at the baseline monitoring location, which is consistent with measurement results.

Sound Level Adjustments

The required 5 dB evening time and 10 dB nighttime adjustments have been applied in the model to all noise that occurs during evening hours (7 pm to 10 pm) and nighttime hours (10 pm to 7 am) respectively.

In addition to the time period adjustments, noise source levels are adjusted to reflect the character of the noise source, specifically tonal, low frequency or impulsiveness characteristics.

Since the noise from UHP washing is neither tonal nor impulsive, no adjustments were required for tonality or impulsiveness.

The gantry crane alarms were modelled with a 5 dB penalty. None of the drydock noise that we noted in the baseline monitoring would be considered to be impulsive so no penalties for impulsiveness have been applied in the model.

It was also determined that a low frequency penalty did not need to be applied to UHP activities, as the difference between the Project A-weighted and the C-weighted was typically less than 10 dB.

Time scale adjustments were applied according to advice from Vancouver Drydock, and then normalized to an annual average. A summary of noise source adjustments is shown in Table 3.

Table 3: Noise Source Adjustments Included in Noise Model

Source	Calculated SWL from Measurement (dBA)	Noise Characteristic Adjustment Factors (dB)	Time Scaling Adjustments
Panamax and Careen UHP	133	-	4 days every two weeks
New 100 m drydock UHP	133	-	2.5 days every two weeks
New 55 m drydock UHP	133	-	2 days every two weeks
Gantry Crane Alarm	108	+5 tonal	5 minutes every hour
General Drydock Activities	113	-	Always operating

Receivers

The three residential towers of The Pier immediately adjacent to the Project comprise an estimated 47 waterfront residential units directly facing the Project. Specifically, there are an estimated 13 units at Trophy at the Pier, 16 units at Cascade at the Pier (East), and 18 at Cascade at the Pier (West) that face the waterfront. Calculations were performed for receivers on all levels assuming height differences of three metres per floor, as shown in Figure 13.

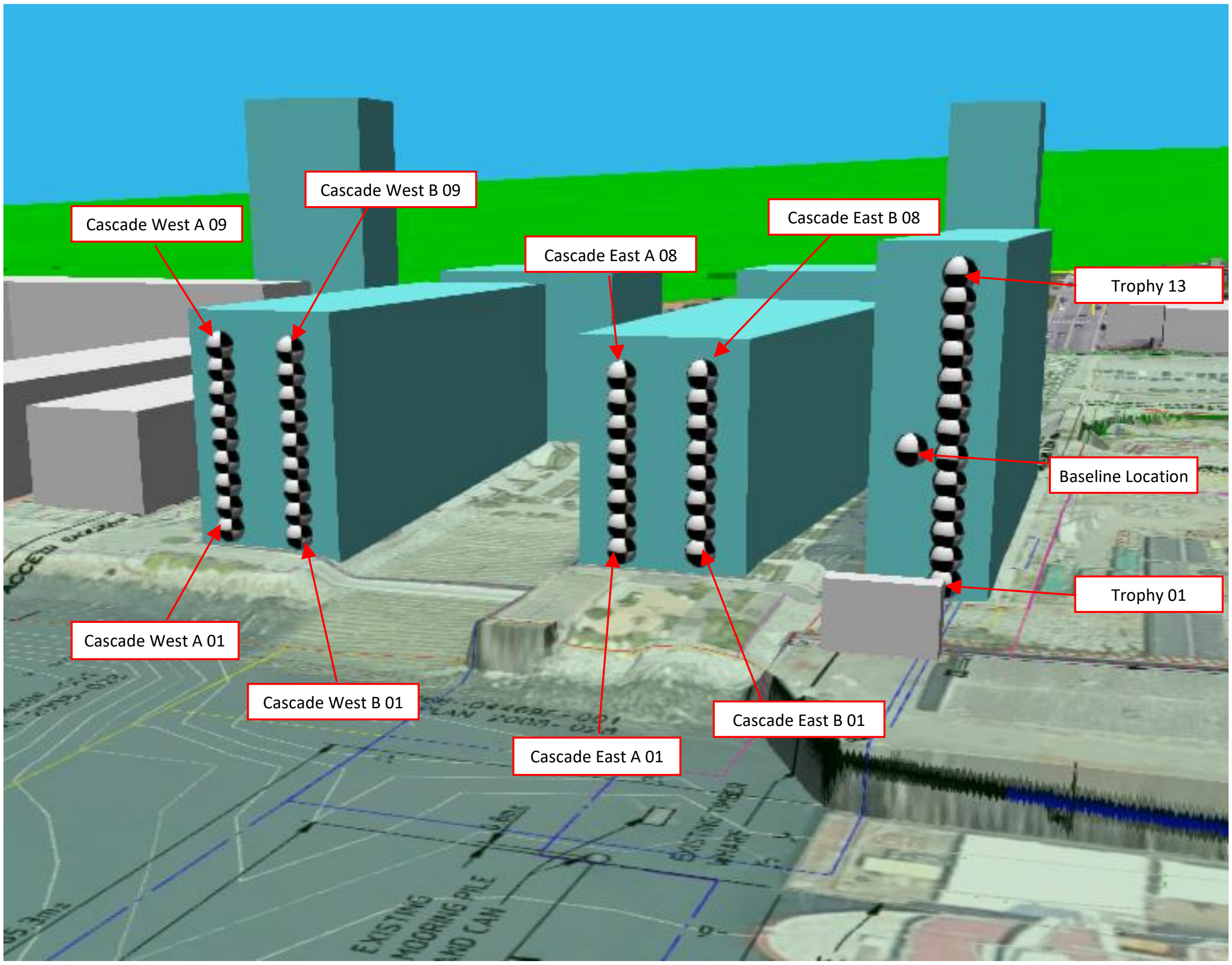


Figure 13: Receiver Locations at Nearest Residences

Limitations

For sound calculated using the ISO 9613 standard, the indicated accuracy is ± 3 dBA for source-to-receiver distances of up to 1,000 metres. Distances from the various drydock locations on the Project site to residential receivers at The Pier are less than 1,000 metres.

The sound power levels (*SWL*) for UHP operations were based on representative field measurements conducted by BKL on June 12, 2020.

Predicted Noise Levels

An excerpt of the full results showing the worst case predicted changes in the annual average rated noise level and the percent of highly annoyed persons at each assessed residential building is shown in Table 4. A full table of results at each receiver is shown in Appendix G.

Table 4: Summary of Worst Case Predicted Changes in Daily Noise Levels and %HA

Receiver	Baseline				Future				Change	
	L_{Rden} (dBA)	%HA	L_n (dBA)	L_{LF} (dB)	L_{Rden} (dBA)	%HA	L_n (dBA)	L_{LF} (dB)	L_{Rden} (dBA)	%HA
Trophy 05	65	14.6	53	74	66	16.1	53	74	1	1.5
Cascade East A 01	62	9.7	48	70	65	13.1	50	71	3	3.4
Cascade West A 01	60	7.6	47	69	63	11.4	49	71	3	3.8

The maximum predicted L_{Rden} does not exceed the Port's criterion of 75 dBA at any of the residences and the predicted change in %HA is below the 6.5% threshold.

An overhead noise contour map of the calculated L_{Rden} at a height of four metres above the ground or water for the future scenario is shown in Figure 14. This graphic shows that the predicted L_{Rden} beyond the three nearest residential units would also be below 75 dBA.

In general, there is a slight decrease in predicted future noise levels at the first three floors of the Trophy building. This is because the Careen drydock will be moving further away from the residence and the activity associated with the Careen is dominant at the lower portions of the Trophy Building. Along the upper floors of the Trophy building, there is only a marginal overall increase in noise levels as the reduction in noise from the Careen is offset by noise contributions from the new drydocks. At heights above the third floor, the wing walls of the new drydocks are not expected to provide any adequate shielding of noise.

The two Cascade buildings are predicted to show the highest changes in overall noise simply due to the closer proximity to noise sources with the addition of the drydocks.

The predicted future L_{LF} at the residences varies from 71 to 75 dB which suggests a slight likelihood of noise-induced rattles.

As the predicted low frequency noise is predicted to exceed 70 dB, a discussion of potential noise mitigation measures is described in the next section.

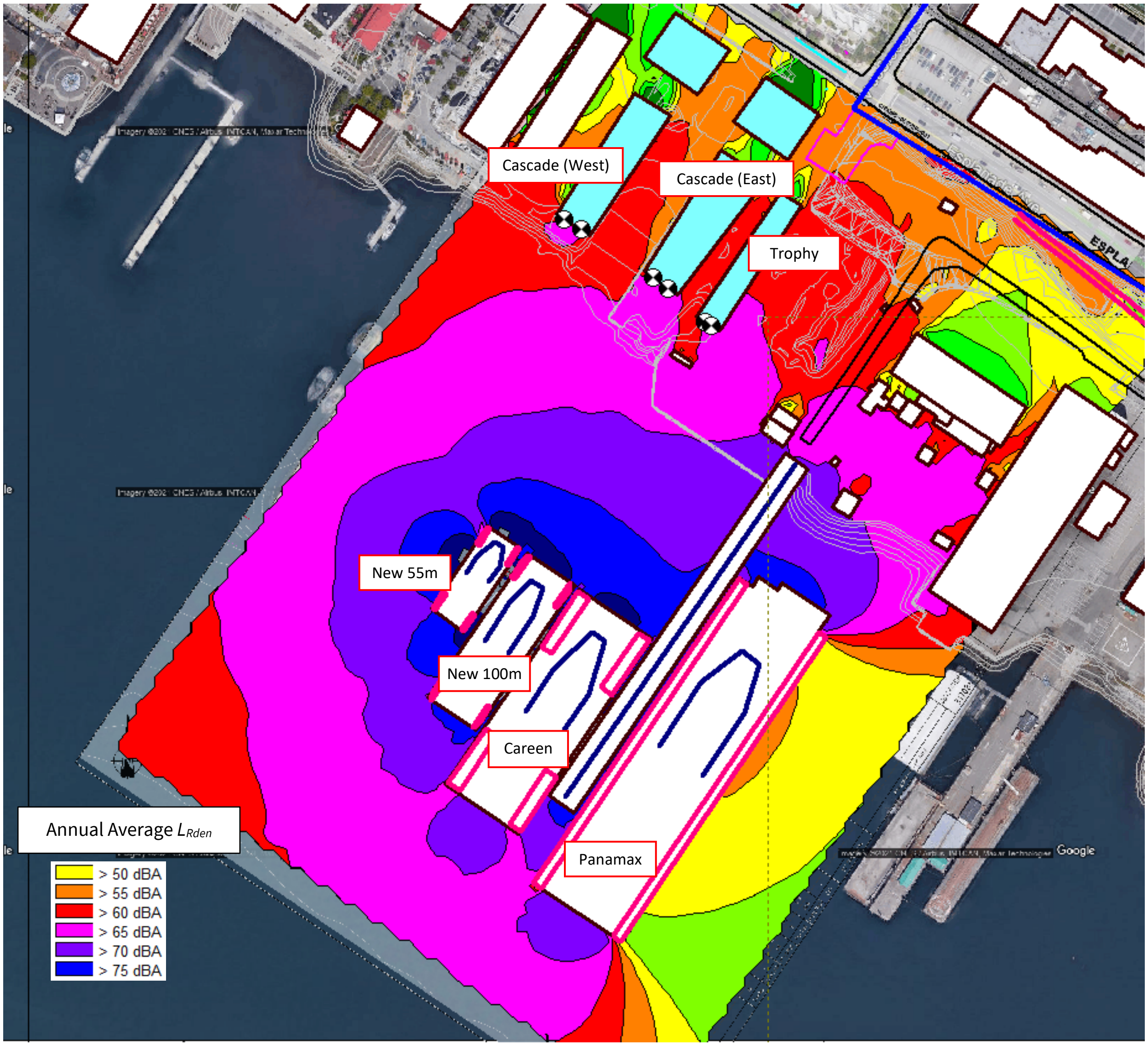


Figure 14: Representative Future Annual Average Noise Prediction

Potential Mitigation

Some of the noise from UHP washing will be contained by the wing walls of the new drydocks. The most unobstructed noise transmission paths to the residences will be through the open north ends of both drydocks. Both existing and future drydock operations generally require lightweight curtains to be strung across the open ends of the drydocks to contain dust and paint spray. The curtains presently in use are porous and have some openings so that they can withstand light to moderate wind pressure and so that they permit some degree of ventilation while fresh paint is drying as shown in Figure 15).

Figure 15: Existing Dust Control Curtains

If the curtains at the north end openings were non-porous, even lightweight material could provide some modest degree of sound attenuation. In order to withstand wind pressure, they could be suspended in overlapping strips, similar to the type of industrial vinyl strip doors shown in Figure 16. Since noise control is not required while paint is drying, it may be possible to partially withdraw the curtains to promote ventilation. If not, the curtains could stop short of the deck to permit some air flow without seriously compromising noise attenuation.

The density and material thickness of any potential mitigation materials would need to be evaluated to determine its effectiveness at attenuating low frequencies.

Figure 16: Typical Industrial Strip Door

Conclusions

This report documents existing noise levels at the nearest residential receivers to the Project and predicts future noise levels after completion. Baseline noise monitoring recorded noise from drydock activities observed between February 26 and March 4, 2021 including at least four days of UHP washing, which was identified as the loudest activity at the drydock. BKL developed a computer noise model to assess both existing and future annual average noise levels at all fronting residences at The Pier development.

The noise predictions were based on the following main assumptions:

- there will not be a substantial change in road or rail traffic near the Drydock over the duration of this Project upgrade
- Noise measured during February 26 without UHP activities is representative of typical drydock operations without UHP washing

The noise model accounts for the following factors:

- The specific operation times (times of day, hours per day, and total annual operation time) for each Drydock noise source.
- A 5 dB penalty applied to warning alarms that account for increased annoyance due to tonal sound.
- The general geography of the area including relevant buildings, terrain, etc.

Based on these assumptions, BKL predicts an increase in the Total Noise Level for the Future scenario of 3 dBA or less with the Project operating at full capacity. A small increase in noise level is to be expected given that, no activities are to be removed from the site and new activities are being added.

The dominant noise source in both the baseline and the future scenarios is predicted to be UHP noise at the existing Careen and new drydocks.

The change in the percentage of people highly annoyed by the overall noise environment is predicted to range from -1.1% to 3.8%, which is less than the Health Canada guideline of 6.5%.

The predicted low frequency noise at the nearest residences due to current UHP activities ranges from 69 to 74 dB; whereas future UHP activities is between 71 and 75 dB. This suggests a slight likelihood of noise-induced rattles (when the predicted low frequency noise level is above 70 dB).

A potential noise mitigation measure which would involve upgrading the existing dust curtains with a replacement that could provide some noise attenuation has been identified as a possible mitigation measure but its feasibility and effectiveness has not been evaluated in detail.

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Appendix A: PER Noise Assessment Worksheet

APPENDIX I – NOISE ASSESSMENT SCREENING WORKSHEET

This worksheet should be employed by one or more informed individuals representing the applicant in order to establish the potential to create noise impacts within surrounding areas. This screening procedure is opinion-based and largely qualitative in nature and involves completing a series of questions.

1. Complete this worksheet scoring each of the ten items.
2. Transfer the ten questionnaire scores into the Weighted Project Screening Scorecard provided as Appendix II – Noise Assessment Project Score.
3. Follow procedure in Appendix II

Question 1 – New Activity, Replacement or Expansion	3
Will the project involve only the replacement of existing equipment or activities or the expansion of a pre-existing facility or activity, or will it involve significant new noise sources or activities?	
• Replacement of Existing Equipment or Activities	Score 1 point
• Expansion of Existing Equipment or Activities	Score 3 points
• New Equipment or Activities	Score 5 points

Question 2 – Noise Levels Expected on Project Site	3
Based on experience with similar operations at the current location or elsewhere, or on your best judgment, do you expect that noise levels within the project site will be:	
• Very Low	Score 1 point
• Low	Score 2 points
• Moderate	Score 3 points
• High	Score 4 points
• Very High	Score 5 points

Question 3 - Presence of Undesirable Characteristics	3
Will any of the key activities/sources create ongoing noise which: (1). is clearly tonal (hums, whirs, whines), (2). is impulsive or has very rapid onset (bumps, bangs, material handling impacts, rail car shunting, compressed air release etc.), or (3). contains strong low-frequency content (e.g. large diesel engines, large fans or air compressors).	
• No	Score 0 points
• Yes, noise will contain one such characteristic	Score 3 points
• Yes, noise will contain two or three such characteristics	Score 5 points

Question 4 – Presence of High-Energy Impulsive Noise	0
Will any activities create ongoing noise which could be classified as "High-energy Impulsive"? Examples of such sources are limited in the port context but could include the industrial use of explosives or explosive circuit breakers.	
• No	Score 0 points
• Yes	Score 5 points

Question 5 – Hours/Days of Operation	2
Will the normal operating schedule be:	
• Day Shift only (5 days/week)	Score 1 point
• Day Shift only (7 days per week)	Score 2 points
• Day & Evening Shifts (5 days/week)	Score 2 points
• Day & Evening Shifts (7 days/week)	Score 3 points
• 24-hours per day (5 days /week)	Score 4 points
• 24-hours per day (7 days per week)	Score 5 points

Question 6 – Proximity to Noise-Sensitive Areas	4
How far is the nearest noise-sensitive land use (residences, schools, hospitals, passive parks etc.) from the property line of the project site?	
• More than 1,000 m	Score 0 points
• 500 to 1,000 m	Score 1 point
• 250 to 500 m	Score 2 points
• 125 to 250 m	Score 3 points
• 60 to 125 m	Score 4 points
• less than 60 m	Score 5 points

Question 7 – Presence of Noise Shielding or Reflection	3
Will buildings, structures and/or landforms partially or totally screen (that is, interrupt the line of sight and direct hearing) project noise sources from nearby noise receptors? Here consideration should be given to the relative elevations of the noise sources, the noise receivers (ground and upper floors) and the intervening buildings and/or landforms. Noise shielding effects are maximized when intervening buildings and/or landforms are higher and wider than both the noise source area and the noise receiver area. Alternatively, the project may involve construction of a building or other structure that, while not necessarily a significant source of noise itself, reflects noise from other sources towards adjacent noise-sensitive areas. This other noise may originate from project operations or from sources not related to the project, such as other port operations or transportation facilities related sources.	
• Substantial, continuous noise shielding	Score 0 points
• Substantial, but not total, screening	Score 1 point
• Intermittent shielding, e.g., row of smaller, non-adjoining buildings	Score 2 points
• Scattered shielding by objects, machinery, stockpiles	Score 3 points
• No shielding potential	Score 4 points
• No noise shielding and will reflect noise towards sensitive areas	Score 5 points

Question 8 – Baseline Noise Environment	2
How would you rate the baseline (pre-project) noise environment within the noise sensitive area nearest the project site?	
• Very noisy (near busy highway, busy port, airport, heavy industry)	Score 1 point
• Noisy (near busy arterial road, light industrial area, urban core)	Score 2 points
• Moderately noise (near collector road, suburban residential)	Score 3 points
• Quiet (suburban residential away from collector roads)	Score 4 points
• Very Quiet (rural residential, well away from industry or main roads)	Score 5 points

Question 9 – Population Potentially Exposed to Project Noise	5
Approximately how many residences or other noise sensitive land uses are located within 500 m of the project site's property line?	
• 5 or less	Score 1 point
• 5 to 15	Score 2 points
• 16 to 40	Score 3 points
• 41 to 100	Score 4 points
• more than 100	Score 5 points

Question 10 – Level of Community Concern about Noise	4
What level of concern (e.g., complaint history) currently exists among residents/users of adjacent noise sensitive lands regarding noise emissions from PMV lands in general and your project site in particular?	
• No history of concern or complaints	Score 1 point
• Minor concerns have been expressed	Score 2 points
• Unknown	Score 3 points
• Moderate level of concern, some complaints	Score 4 points
• High level of concern/organized complaints	Score 5 points

APPENDIX II – NOISE ASSESSMENT PROJECT SCORE

This worksheet should be used together with the questionnaire in Appendix I – Noise Assessment Screening Worksheet. For each of the ten questions, this worksheet applies a weighting factor that is reflective of the relative importance of that attribute in forecasting noise impact potential. The overall noise impact potential of the project is determined by tallying the weighted values of all response scores to obtain a *Total Weighted Project Score* as follows:

1. Complete the questionnaire as provided in Appendix I – Noise Assessment Screening Worksheet, scoring each of the ten items.
2. Transfer the ten questionnaire scores into the Weighted Project Screening Scorecard provided below.
3. Apply the *Importance Weighting* factor (multiplying the weighting factor by the questionnaire score) and determine a *Weighted Score* for each item.
4. Tally the *Weighted Scores* and determine the *Total Weighted Project Score*
5. Submit a completed project score worksheet as part of the PER project permit application

No.	Attribute of Project or Project Setting	Questionnaire Score (Appendix I)	Importance Weighting	Weighted Score
1	New Activity, Replacement or Expansion	3	1.2	3.6
2	Noise Levels Expected on Project Site	3	1.8	5.4
3	Presence of Undesirable Characteristics	3	1.6	4.8
4	Presence of High Energy Impulsiveness Noise	0	1.6	0
5	Hours/Days of Operation	2	1.2	2.4
6	Proximity to Noise Sensitive Areas	4	1.6	6.4
7	Presence of Noise Shielding or Reflection	3	1.8	5.4
8	Baseline Noise Environment	2	1.6	3.5
9	Population Potentially Exposed to Project Noise	5	1.0	5.0
10	Level of Community Concern About Noise	4	1.2	4.8
			Total Weighted Project Score :	41.3

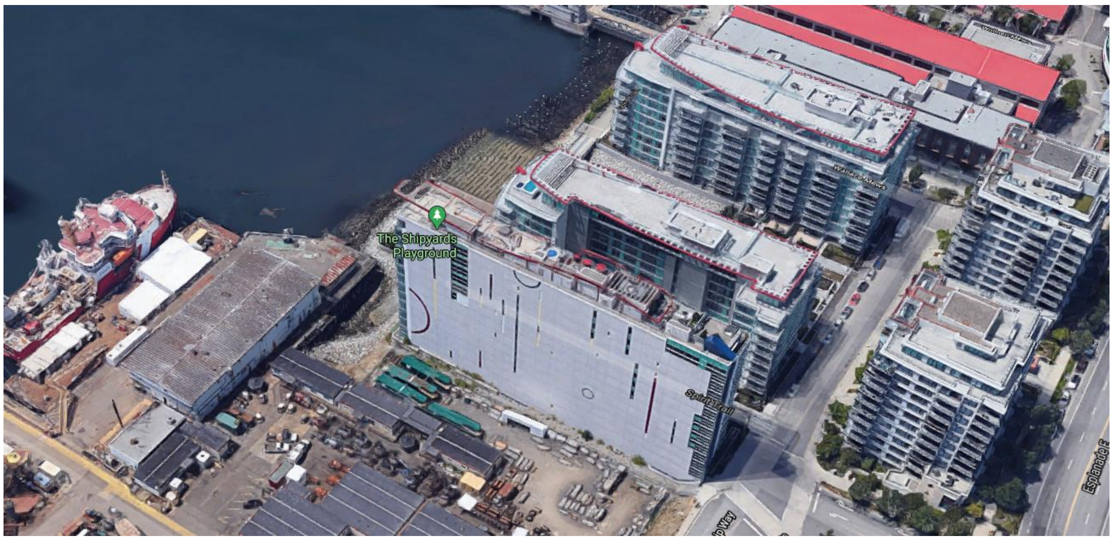
Appendix B: Noise Assessment Terms of Reference

It is understood that the Port of Vancouver's preference is to avoid any significant increase in total noise in residential communities due to the project. This will be assessed as follows:

1. The noise assessment will be conducted in compliance with the Port's Project & Environmental Review Guidelines - Environmental Noise Assessment (the Guideline). Any increases/decreases in noise levels are to be assessed relative to current total noise levels. The study area will consider the nearest residences within "The Pier" residential development, directly north and west of the drydocks. All notable sources of noise will be represented in the modelling as identified in 4 and 5 below.
2. Records of noise complaints received over the past five years, if available, will be reviewed in an effort to identify any specific receptor areas or noise sources of particular concern.
3. Existing baseline noise levels are currently being measured [as of February 28, 2021] on the balcony of one of the nearest apartments to the drydocks. Noise levels will be continuously monitored throughout an entire week during which, representative maintenance work will take place on a vessel in an existing drydock. The data will be organized to show average daily noise levels (L_{den}) during the weekday and weekend, as well as the nighttime equivalent noise levels (L_n) for comparison. Appropriate adjustments will be made for any tonal, impulsive or low frequency noise and supporting assumptions for any such adjustments will be fully documented and described in the assessment. Noise sources which create intermittent noise events displaying wide variations in noise levels over brief time periods, will also be identified and quantified in terms of their L_{eq} over a representative time period and their maximum noise levels (L_{AFmax}).
4. Best practice noise mapping techniques will be employed using our Cadna/A software to model major noise sources that contribute to the existing noise environment. Prominent sources of noise will be identified, labelled, and spatially presented in the model. The most significant noise source at the drydocks is expected to be high pressure washing of ship hulls. The modelling will be undertaken using standard empirical methodology, accounting for geometric spreading, atmospheric absorption, ground attenuation and receiver heights where appropriate. The noise model of existing conditions will be calibrated to agree with the measured baseline levels and will be used to predict the typical L_{den} and L_n values at locations other than the baseline measurement location.
5. In addition to modelling existing conditions, a future scenario will be modelled using the Cadna/A software. The future scenario will include existing drydock operations, plus new and more frequent activities attributable to the Project. Any new prominent noise sources will be identified, labelled, and spatially presented in the model. Both L_{den} and L_n values will be predicted. Where noise emission data for proposed equipment and activities are not available, BKL will conduct short-term noise measurements of those activities on site or will utilize the best available data from our extensive noise database or other references. Assumptions on annual operating hours for existing and future sources will be provided by Vancouver Drydock personnel. Noise data and assumed annual usage will be documented in an appendix to the

noise report. It is assumed that the new facilities will be fully utilized soon after they have been commissioned so only a single post-project scenario will be modelled, assuming full or nearly full utilization.

6. The south side of three residential buildings directly facing the drydock (Cascade East, Cascade West, and Trophy) is anticipated to be most affected by additional Project noise. These buildings were designed to protect against waterfront industrial noise, road and rail traffic noise from the north and from the east. As indicated in the photo below, the east wall of the east residential building does not have any exposure to residential units, only stairwells.



Existing and future drydock activities are not expected to significantly change the road and rail traffic in the neighbourhood; therefore, the selection of the noise receptors used for this study will be for those primarily affected by drydock related noise, such as the prominent high pressure washing of the ship's hulls. The Future No-Project scenario described in the Port's Guideline (in which only the increase in traffic volumes is considered) would not be relevant to the assessment of noise associated with drydock operations, and is therefore not included. Other residences which are farther away from the drydock and are currently very close to a major roadway are generally shielded from drydock noise by the three aforementioned buildings, and are considered too remote to include in this study.

7. The noise models of existing and future conditions will be used to predict any change in average L_{den} values due to the Project. The significance of any change in L_{den} attributable to the Project will be assessed by predicting any change in the percentage of the community that would be "highly annoyed" (%HA) as required by the Port's Guideline.

8. In addition to predicting any change in %HA, maximum noise levels (L_{AFmax}) associated with any highly intermittent noise will be reported and if they are expected to occur at night, the potential for sleep disturbance will be assessed.

9. If the results indicate that a significant noise increase may occur at one or more noise-sensitive locations, opportunities for noise mitigation will be identified, investigated and

discussed in the report. If practicable noise mitigation measures are identified, an additional post-project scenario, with mitigation, will be modeled and assessed.

10. The noise assessment report will list both the existing and new noise generating sources. Noise source locations and operating conditions will be noted, including distinguishing between day, evening, and night activities. Predicted noise levels, including ratings for time of day/week, tonality, impulsiveness, etc., will be presented using sound contour figures. The recommendations section of the report will indicate whether mitigation is recommended.

Appendix C: Introduction to Sound and Environmental Noise Assessment

General Noise Theory

The two principal components used to characterize sound are loudness (magnitude) and pitch (frequency). The basic unit for measuring magnitude is the decibel (dB), which represents a logarithmic ratio of the pressure fluctuations in air relative to a reference pressure. The basic unit for measuring pitch is the number of cycles per second, or hertz (Hz). Bass tones are low frequency and treble tones are high frequency. Audible sound occurs over a wide frequency range, from approximately 20 Hz to 20,000 Hz, but the human ear is less sensitive to low and very high frequency sounds than to sounds in the mid frequency range (500 to 4,000 Hz). A-weighting networks are commonly employed in sound level meters to simulate the frequency response of human hearing, and A-weighted sound levels are often designated dBA rather than dB.

If a continuous sound has an abrupt change in level of 3 dB it will generally be noticed, while the same change in level over an extended period of time will probably go unnoticed. A change of 6 dB is clearly noticeable subjectively and an increase of 10 dB is generally perceived as being twice as loud.

Basic Sound Metrics

While the decibel or A-weighted decibel is the basic unit used for noise measurement, other indices are also used to describe environmental noise. The equivalent sound level, abbreviated L_{eq}, is commonly used to indicate the average sound level over a period of time. The L_{eq} represents the steady level of sound that would contain the same amount of sound energy as the actual time-varying sound level. Although the L_{eq} is an average, it is strongly influenced by the loudest events occurring during the time period because these events contain most of the sound energy. Another common metric used is the L_{90}, which represents the sound level exceeded for 90 per cent of a time interval and is typically referred to as the background noise level.

The L_{eq} can be measured over any period of time using an integrating sound level meter. Some common time periods used are 24 hours, noted as the L_{eq24}, daytime hours (7 am to 7 pm), noted as the L_d, evening hours (7 pm to 11 pm), notes as the L_e, and night time hours (11 pm to 7 am), noted as the L_n. As the impact of noise on people is judged differently during the daytime, evening and nighttime, 24-hour noise metrics have been developed to reflect this.

The day-evening-night equivalent sound level (L_{den}) is one metric commonly used to represent community noise levels outside of the United States. It is derived from the L_d, L_e and L_n with a 5 dB penalty applied to the L_e, a 10 dB penalty applied to the L_n and a 5 dB penalty applied to the weekend L_d to account for increased sensitivity to evening, nighttime and weekend noise. In the United States, the day-night equivalent sound level (L_{dn}) is commonly used to represent community noise levels. It is derived from the L_d and L_n (i.e., eliminating the evening time period) with a 10 dB penalty applied to the L_n. ANSI Standard S12.9-2007 Part 5 *Sound Level Descriptors for Determination of Compatible Land*

Use states that although the L_{dn} and the L_{den} are not equal, their difference is typically insignificant for the purposes of studying annoyance.

ANSI S12.9-2005/Part 4 (2005) also recommends that adjustments be applied for certain sound characteristics to better predict long-term annoyance in the community. Relevant adjustments include a 5 dB adjustment for tonal noise (e.g., alarm noise), a 12 dB adjustment for highly impulsive noise (e.g., rail shunting), a 5 dB adjustment for regular impulsive noise (e.g., banging sounds) and a variable adjustment for low frequency noise (based on the received values in low frequency octave bands and the difference between the C-weighted and A-weighted sound pressure levels). With these factors taken into account, the day-evening-night level is referred to as the rated day-evening-night level, or L_{Rden}.

Appendix D: Record of Noise Complaints

Record No.	Date of Event	Date Reported	Description/Identification of Problem
19861	Friday, May 15, 2020	Friday, May 15, 2020 2:23:21 PM	Resident of 199 Victory Ship Way contacted the Seaspan ULC Environmental Manager to express concerns regarding noise generated at VDC over the past week.
19710	Tuesday, May 05, 2020	Wednesday, May 06, 2020 11:48:31 AM	Resident of 199 Victory Ship Way contacted the Seaspan ULC Environmental Manager to express concerns regarding noise generated on the Careen until 22:30 on 5 May 2020 and restarting 6 May 2020 at 07:00.
19616	Saturday, November 16, 2019	Wednesday, April 29, 2020 10:40:43 AM	Neighbour contacted Seaspan via email to complain about noise generated on 16 Nov 2019.
19614	Monday, August 05, 2019	Wednesday, April 29, 2020 10:20:42 AM	Stakeholder from the neighbouring condo (701 - 199 Victory Ship Way) contacted Seaspan regarding noise generated at VDC on 5/6 Aug 2019.
12462	Friday, November 02, 2018	Monday, November 05, 2018 2:11:41 PM	An interested party left a message on the VDC reception phone to complain about noise Thursday night / Friday morning. They live at 145 St Georges Ave, a few blocks from VDC and described the sound as being similar to a backup alarm going off for several hours.
12109	Monday, September 03, 2018	Tuesday, October 23, 2018 3:20:37 PM	Laurel completed an online form on the Port of Vancouver webpage regarding noise at VDC ... "Season drydock has been, what sounds like water blasting for almost a week including yesterday (Sunday) and this morning, holiday Monday September 3rd. These have been long days and have forced us inside with our doors closed due to the noise (can still hear it inside). Construction next door at the Cascade development isn't allowed on Sundays and holidays, why is Seaspan allowed to make ongoing, very loud noise on a long weekend? I have tried to access the noise monitoring page but it appears unavailable."
8154	Thursday, May 03, 2018	Monday, May 07, 2018 3:16:10 PM	Daryl Lawes received an email from Tyla Doyle on 6 May 2018 which stated ... "On Thursday, May 3 at approximately mid-day, there was excessive noise coming from the large fishing vessel. A worker was spraying the top spans and this was so noisy that I couldn't stay on my deck! I looked on Port of Vancouver's Noise Monitoring program website and saw that the reading was just above 75 db. I understand this noise monitor is situated back by the road (approximately 300 metres). We are about 100 metres from the noise origin so one can only imagine what the reading would be!"
251	Monday, April 24, 2017	Tuesday, April 25, 2017 3:22:07 PM	David Walker (E2nd, 604 500 1368) called to inquire about noise from the Ile de Batz.

Appendix E: Baseline Noise Measurement Results

Project ID:	0579-21A	Address:	5th Floor, 199 Victory Ship Way, North Vancouver
Start Date:	February 26, 2021	Instrument:	01dB DUO
Start Time:	16:00	Serial No:	10395
Duration:	7 days	Measured by:	Client

Location Description
The microphone was located on a 5th floor balcony overlooking Vancouver Drydock.

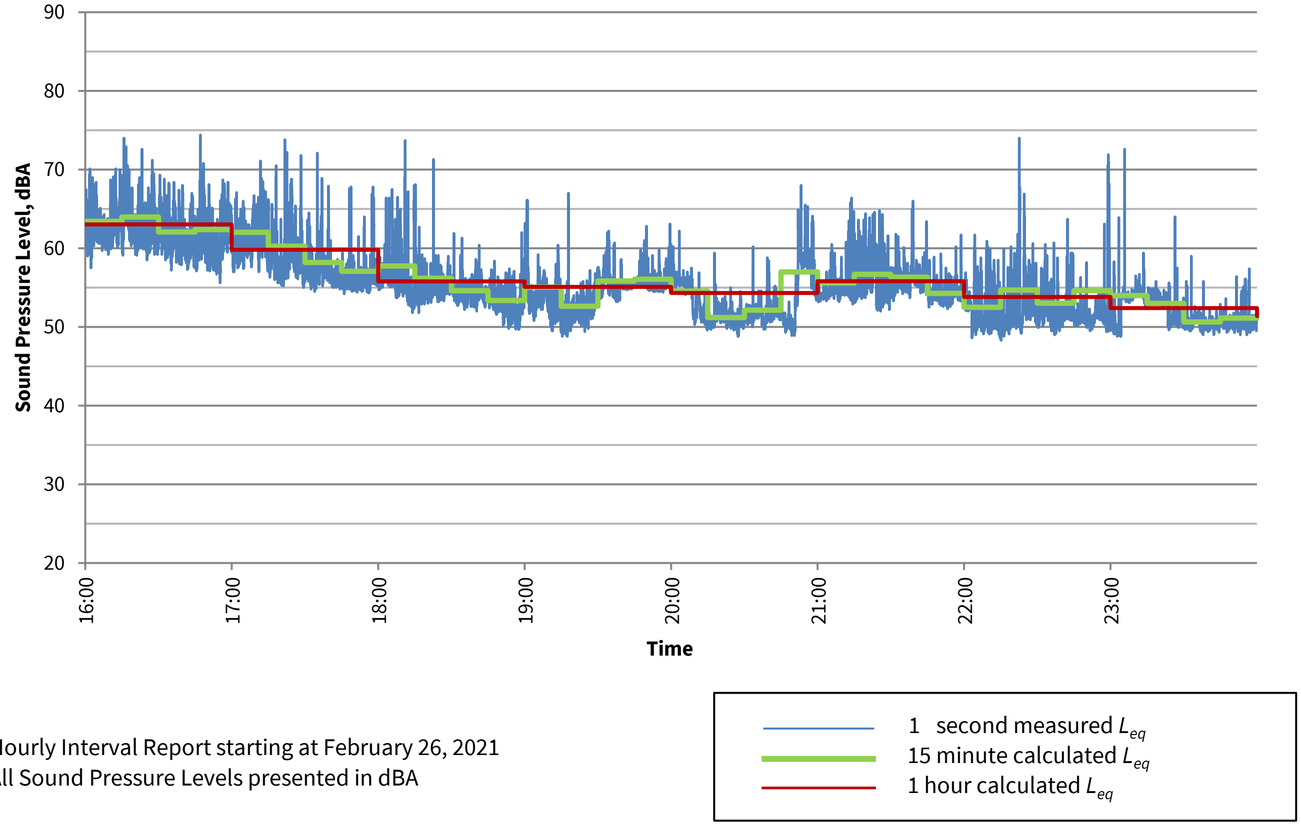
Ambient Noise Description
The dominant noise source was drydock activity. UHP activity was dominant from March 1-5.
Non project related noise sources include birds, general public along waterfront, and local HVAC equipment.

Environmental Conditions
The weather was generally clear or cloudy throughout the measurement period. A total of 28 mm of precipitation was recorded at a nearby weather station, but it did not contribute to overall noise levels.

Purpose of Monitoring Location
This monitoring location is representative of the worst case noise exposure for activities at Vancouver Drydock.

Baseline Noise Monitoring Detailed Results

The graph below shows the measured, and calculated time histories beginning on February 26, 2021

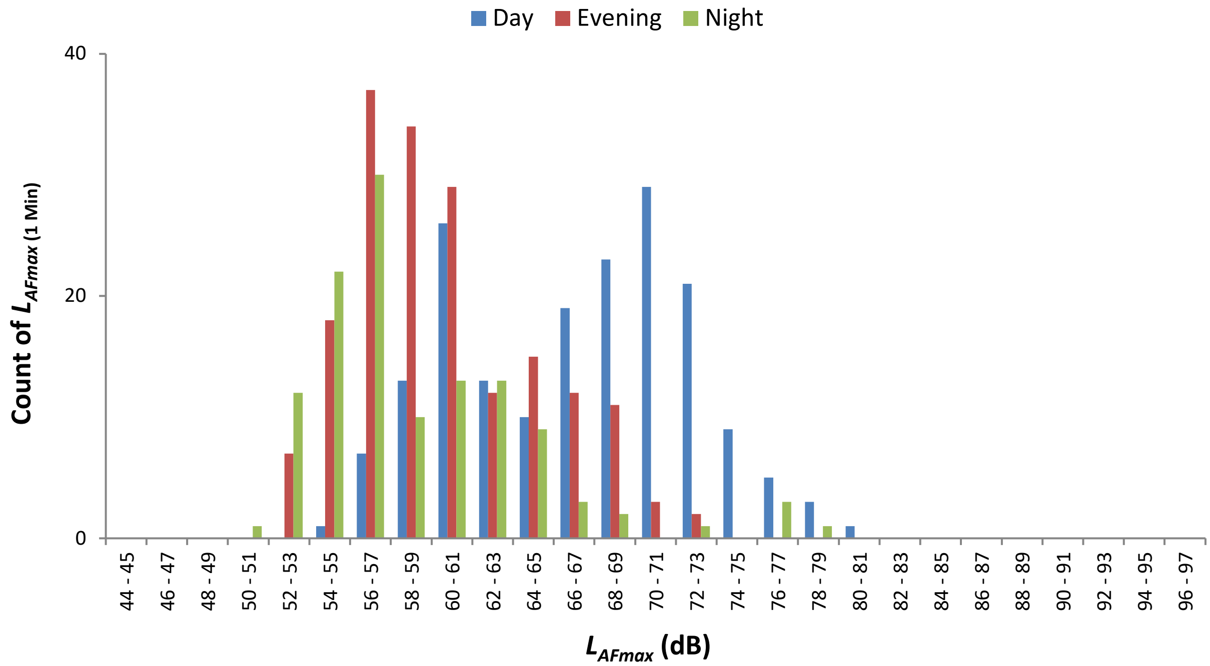


Hourly Interval Report starting at February 26, 2021
All Sound Pressure Levels presented in dBA

Date	Time	Duration	L_{eq}	L_{max}	L_{min}	L_1	L_5	L_{10}	L_{50}	L_{90}	L_{99}
Total	-	8:00:00	63	74	48	67	63	62	55	51	50
Feb 26	16:00:00	1:00:00	63	74	56	69	67	66	62	59	57
Feb 26	17:00:00	1:00:00	60	74	54	67	64	63	58	56	55
Feb 26	18:00:00	1:00:00	56	74	50	64	58	57	54	52	51
Feb 26	19:00:00	1:00:00	55	67	49	62	58	57	55	51	50
Feb 26	20:00:00	1:00:00	54	68	49	62	59	58	52	50	49
Feb 26	21:00:00	1:00:00	56	66	52	62	59	58	55	54	53
Feb 26	22:00:00	1:00:00	54	74	48	61	57	55	51	50	49
Feb 26	23:00:00	1:00:00	52	73	49	56	55	54	51	50	49

Vancouver Drydock - Maximum Sound Level Histogram

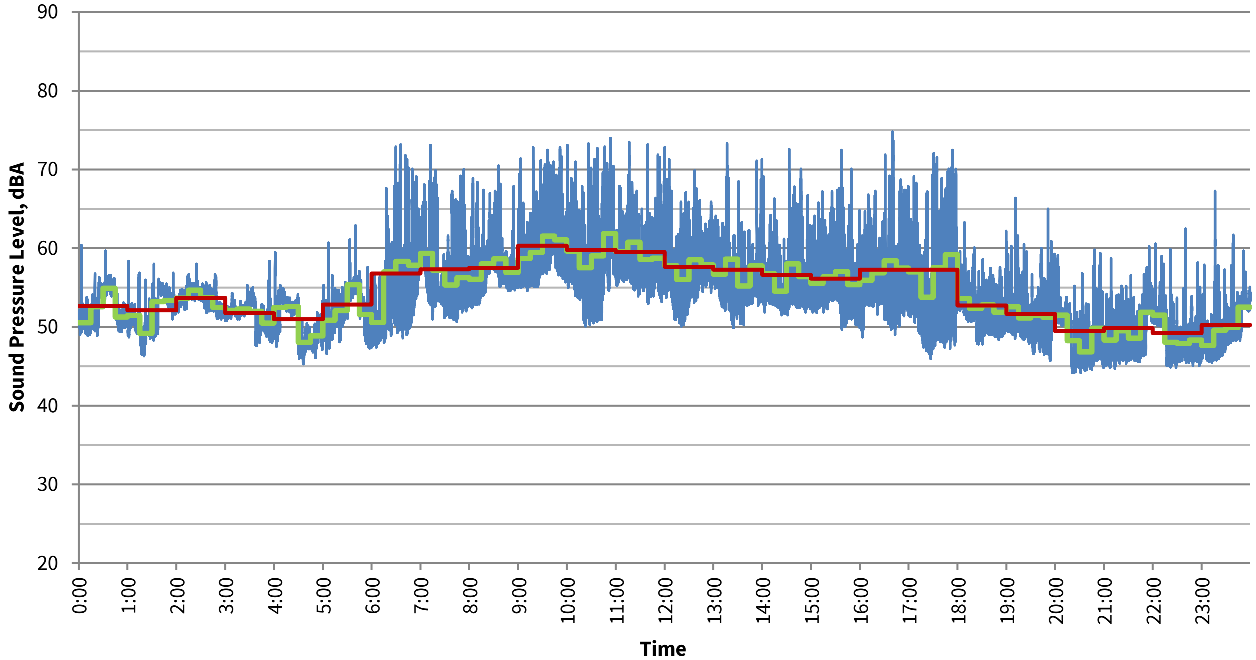
Histogram of 1 minute L_{AFmax} values on February 26th, 2021



	Count of 1 minute values		
L_{AFmax} (dB)	**Day**	**Evening**	**Night**
44 - 45	0	0	0
46 - 47	0	0	0
48 - 49	0	0	0
50 - 51	0	0	1
52 - 53	0	7	12
54 - 55	1	18	22
56 - 57	7	37	30
58 - 59	13	34	10
60 - 61	26	29	13
62 - 63	13	12	13
64 - 65	10	15	9
66 - 67	19	12	3
68 - 69	23	11	2
70 - 71	29	3	0
72 - 73	21	2	1
74 - 75	9	0	0
76 - 77	5	0	3
78 - 79	3	0	1
80 - 81	1	0	0
82 - 83	0	0	0
84 - 85	0	0	0
86 - 87	0	0	0
88 - 89	0	0	0
90 - 91	0	0	0
92 - 93	0	0	0
94 - 95	0	0	0
96 - 97	0	0	0

Baseline Noise Monitoring Detailed Results

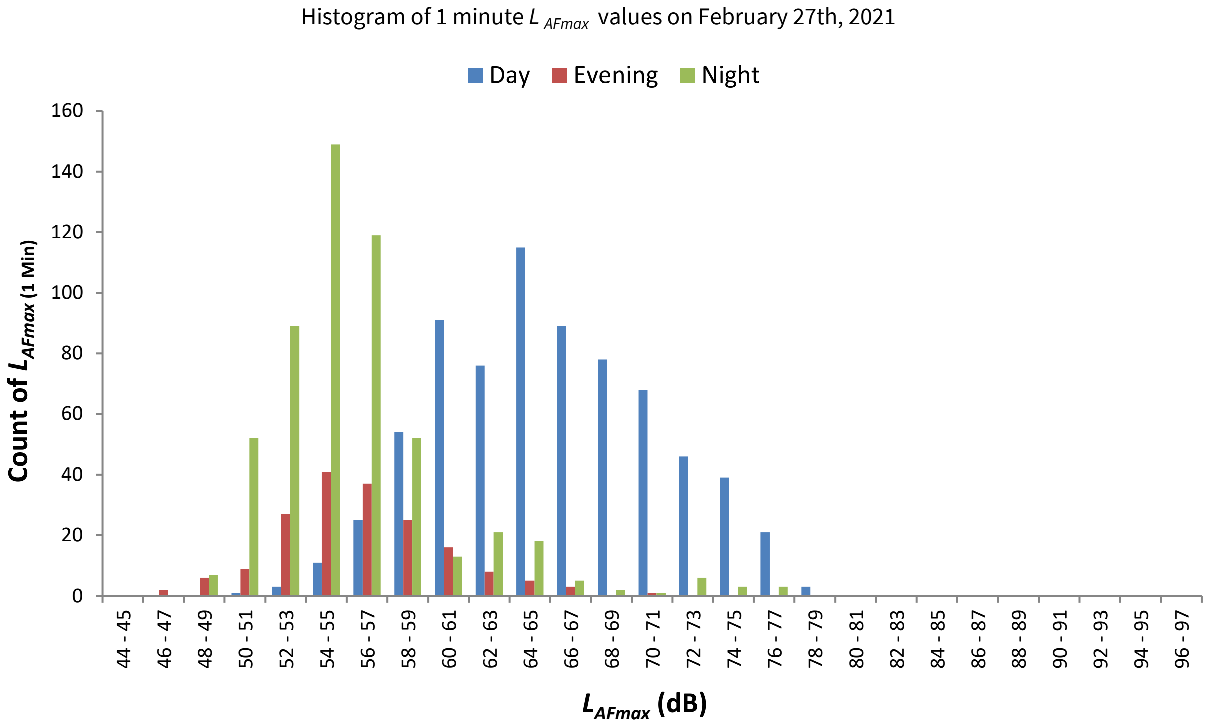
The graph below shows the measured, and calculated time histories beginning on February 27, 2021



Hourly Interval Report starting at February 27, 2021
All Sound Pressure Levels presented in dBA

Date	Time	Duration	L_{eq}	L_{max}	L_{min}	L_1	L_5	L_{10}	L_{50}	L_{90}	L_{99}
Total	-	24:00:00	56	75	44	66	60	59	53	48	46
Feb 27	0:00:00	1:00:00	53	60	49	56	56	55	51	50	49
Feb 27	1:00:00	1:00:00	52	58	46	56	55	55	51	49	47
Feb 27	2:00:00	1:00:00	54	58	51	56	55	55	54	52	51
Feb 27	3:00:00	1:00:00	52	58	48	54	54	53	52	49	48
Feb 27	4:00:00	1:00:00	51	60	45	55	54	54	50	47	46
Feb 27	5:00:00	1:00:00	53	63	47	59	56	55	52	49	48
Feb 27	6:00:00	1:00:00	57	73	47	68	61	59	53	49	48
Feb 27	7:00:00	1:00:00	57	73	51	67	62	60	54	52	51
Feb 27	8:00:00	1:00:00	58	71	52	65	61	59	57	54	53
Feb 27	9:00:00	1:00:00	60	73	55	69	65	62	58	56	55
Feb 27	10:00:00	1:00:00	60	74	50	69	65	63	57	52	51
Feb 27	11:00:00	1:00:00	60	74	53	68	64	62	58	55	54
Feb 27	12:00:00	1:00:00	58	73	50	66	62	60	56	53	51
Feb 27	13:00:00	1:00:00	57	73	50	68	62	59	55	52	51
Feb 27	14:00:00	1:00:00	57	73	52	66	61	59	54	53	52
Feb 27	15:00:00	1:00:00	56	73	50	65	60	58	54	52	51
Feb 27	16:00:00	1:00:00	57	75	49	67	62	60	55	52	50
Feb 27	17:00:00	1:00:00	57	73	46	68	63	60	53	49	47
Feb 27	18:00:00	1:00:00	53	63	48	58	56	55	52	50	49
Feb 27	19:00:00	1:00:00	52	66	46	58	55	54	51	48	47
Feb 27	20:00:00	1:00:00	49	60	44	56	52	52	48	45	45
Feb 27	21:00:00	1:00:00	50	60	45	56	54	53	49	46	45
Feb 27	22:00:00	1:00:00	49	63	45	55	52	51	48	46	45
Feb 27	23:00:00	1:00:00	50	67	46	56	54	53	49	47	46

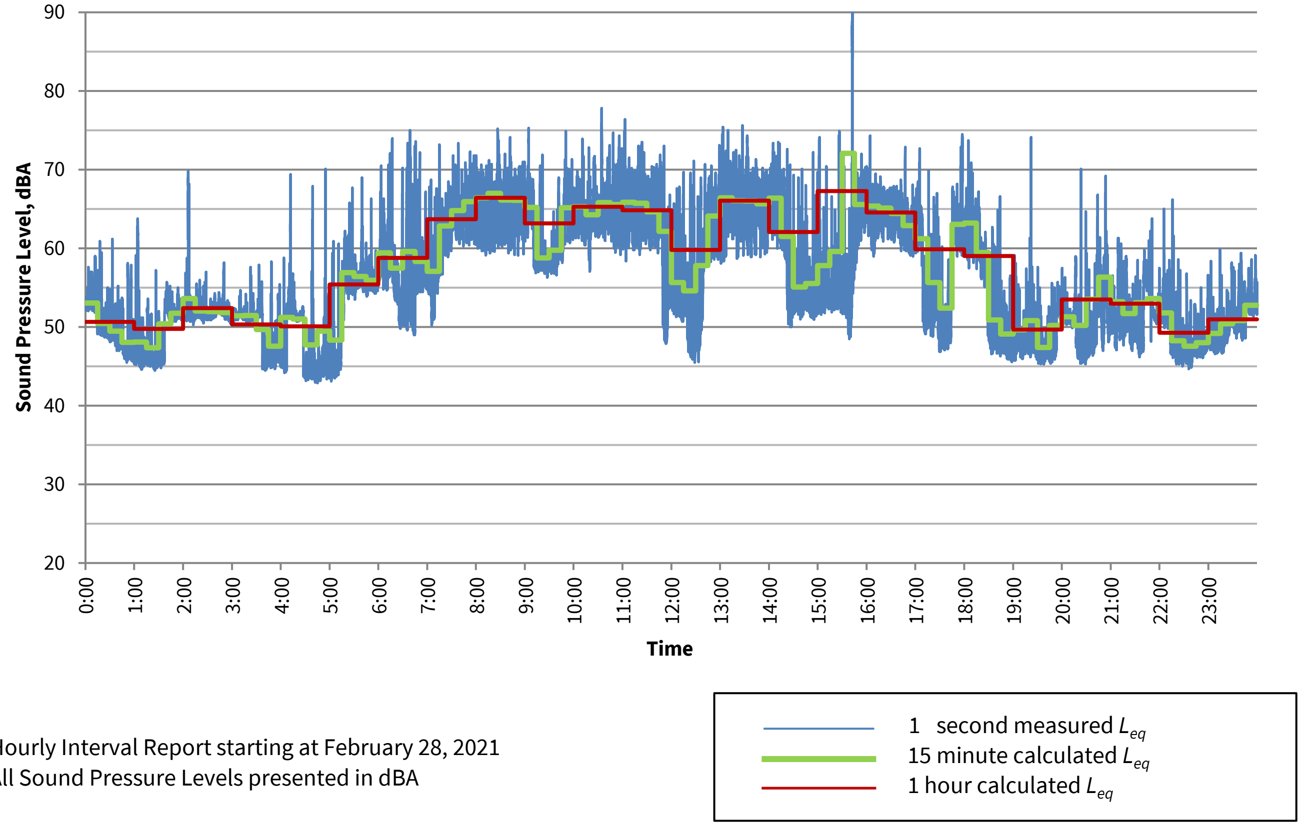
Vancouver Drydock - Maximum Sound Level Histogram



L_{AFmax} (dB)	Count of 1 minute values Day	Evening	Night
44 - 45	0	0	0
46 - 47	0	2	0
48 - 49	0	6	7
50 - 51	1	9	52
52 - 53	3	27	89
54 - 55	11	41	149
56 - 57	25	37	119
58 - 59	54	25	52
60 - 61	91	16	13
62 - 63	76	8	21
64 - 65	115	5	18
66 - 67	89	3	5
68 - 69	78	0	2
70 - 71	68	1	1
72 - 73	46	0	6
74 - 75	39	0	3
76 - 77	21	0	3
78 - 79	3	0	0
80 - 81	0	0	0
82 - 83	0	0	0
84 - 85	0	0	0
86 - 87	0	0	0
88 - 89	0	0	0
90 - 91	0	0	0
92 - 93	0	0	0
94 - 95	0	0	0
96 - 97	0	0	0

Baseline Noise Monitoring Detailed Results

The graph below shows the measured, and calculated time histories beginning on February 28, 2021

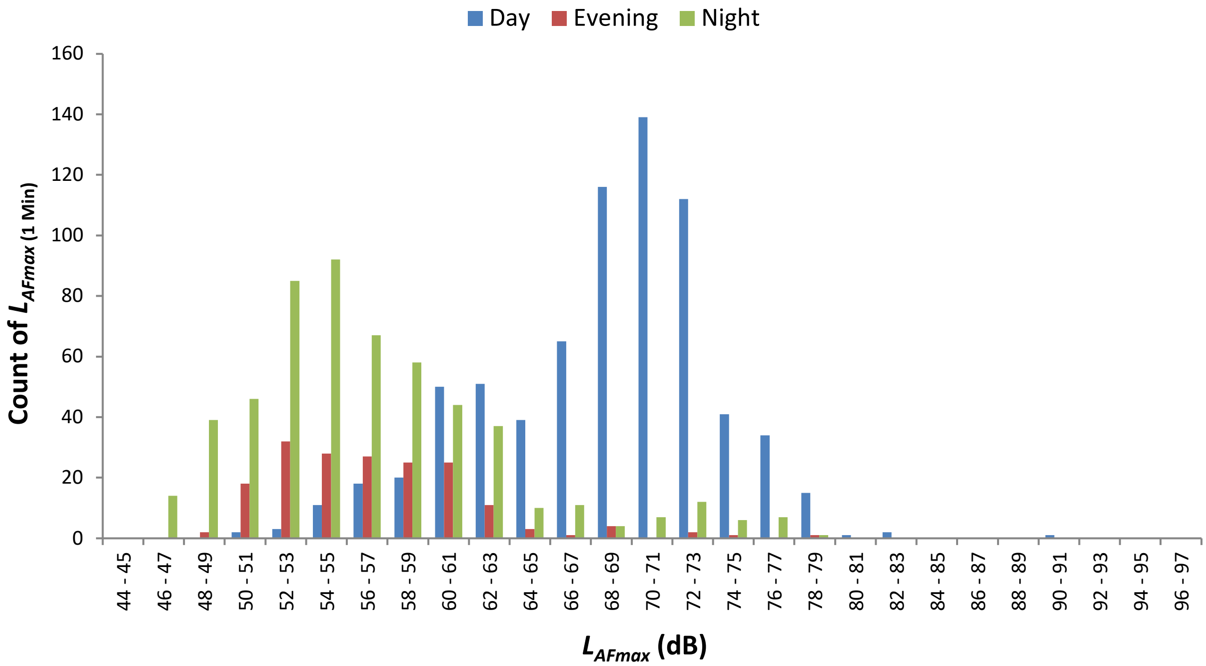


Hourly Interval Report starting at February 28, 2021
All Sound Pressure Levels presented in dBA

Date	Time	Duration	L_{eq}	L_{max}	L_{min}	L_1	L_5	L_{10}	L_{50}	L_{90}	L_{99}
Total	-	24:00:00	62	90	43	70	67	66	54	47	44
Feb 28	0:00:00	1:00:00	51	61	46	56	54	53	50	47	46
Feb 28	1:00:00	1:00:00	50	64	45	54	53	52	47	45	45
Feb 28	2:00:00	1:00:00	52	70	50	57	54	53	52	51	51
Feb 28	3:00:00	1:00:00	50	58	45	54	52	52	51	45	45
Feb 28	4:00:00	1:00:00	50	70	43	57	53	52	46	44	43
Feb 28	5:00:00	1:00:00	55	69	43	61	59	57	56	45	44
Feb 28	6:00:00	1:00:00	59	75	49	70	62	60	56	51	50
Feb 28	7:00:00	1:00:00	64	73	50	69	68	67	63	55	51
Feb 28	8:00:00	1:00:00	66	75	59	72	70	69	66	62	60
Feb 28	9:00:00	1:00:00	63	75	56	69	68	67	60	58	57
Feb 28	10:00:00	1:00:00	65	78	57	71	68	67	65	62	59
Feb 28	11:00:00	1:00:00	65	76	48	71	69	68	64	54	49
Feb 28	12:00:00	1:00:00	60	73	46	68	66	64	54	49	47
Feb 28	13:00:00	1:00:00	66	76	58	72	69	68	65	62	59
Feb 28	14:00:00	1:00:00	62	74	50	71	68	67	55	52	51
Feb 28	15:00:00	1:00:00	67	90	49	74	68	67	55	52	51
Feb 28	16:00:00	1:00:00	65	74	59	68	67	67	64	61	60
Feb 28	17:00:00	1:00:00	60	75	47	68	64	63	56	49	47
Feb 28	18:00:00	1:00:00	59	74	46	66	64	63	54	47	46
Feb 28	19:00:00	1:00:00	50	74	45	55	53	52	48	46	46
Feb 28	20:00:00	1:00:00	54	70	45	64	58	56	51	47	46
Feb 28	21:00:00	1:00:00	53	64	46	60	57	56	51	48	47
Feb 28	22:00:00	1:00:00	49	66	45	55	52	52	47	46	45
Feb 28	23:00:00	1:00:00	51	60	47	57	54	53	50	48	47

Vancouver Drydock - Maximum Sound Level Histogram

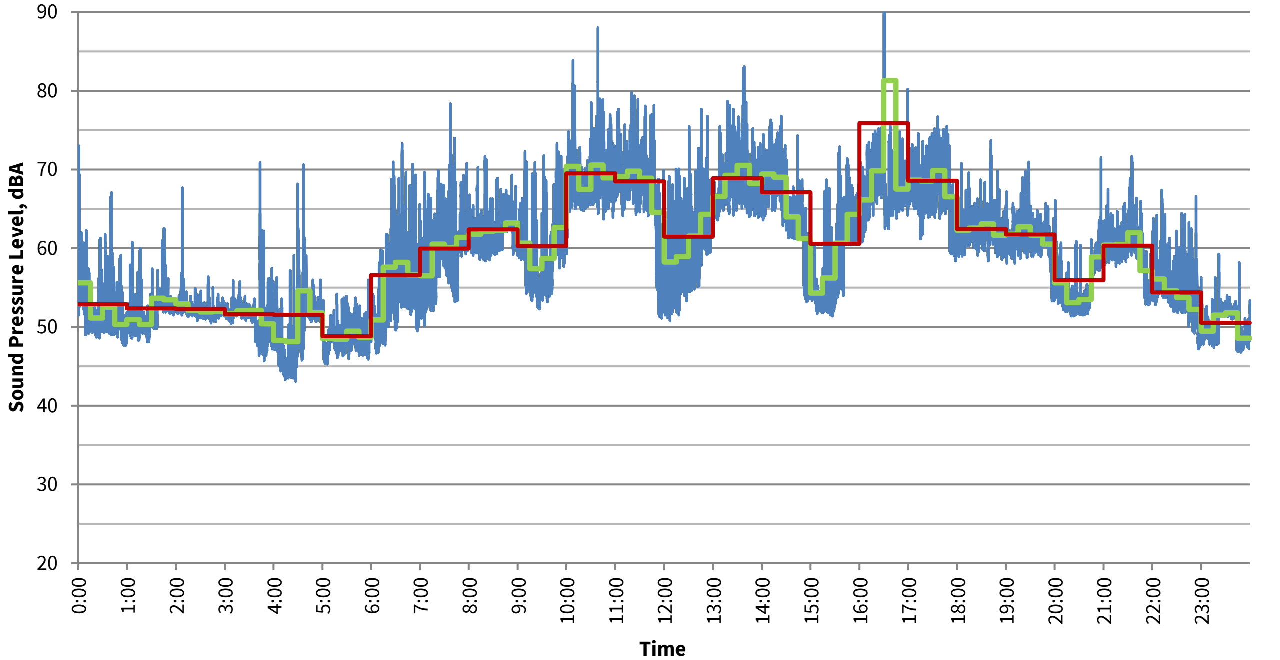
Histogram of 1 minute L_{AFmax} values on February 28th, 2021



	Count of 1 minute values		
L_{AFmax} (dB)	Day	Evening	Night
44 - 45	0	0	0
46 - 47	0	0	14
48 - 49	0	2	39
50 - 51	2	18	46
52 - 53	3	32	85
54 - 55	11	28	92
56 - 57	18	27	67
58 - 59	20	25	58
60 - 61	50	25	44
62 - 63	51	11	37
64 - 65	39	3	10
66 - 67	65	1	11
68 - 69	116	4	4
70 - 71	139	0	7
72 - 73	112	2	12
74 - 75	41	1	6
76 - 77	34	0	7
78 - 79	15	1	1
80 - 81	1	0	0
82 - 83	2	0	0
84 - 85	0	0	0
86 - 87	0	0	0
88 - 89	0	0	0
90 - 91	1	0	0
92 - 93	0	0	0
94 - 95	0	0	0
96 - 97	0	0	0

Baseline Noise Monitoring Detailed Results

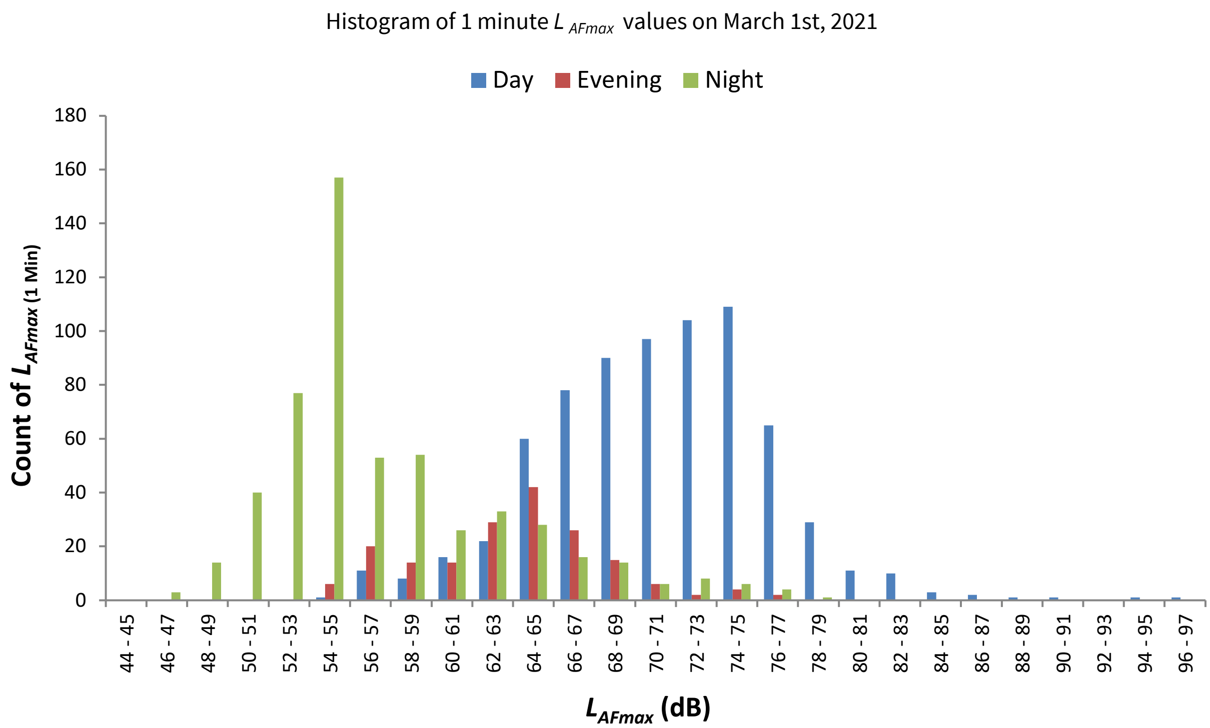
The graph below shows the measured, and calculated time histories beginning on March 1, 2021



Hourly Interval Report starting at March 1, 2021
All Sound Pressure Levels presented in dBA

Date	Time	Duration	L_{eq}	L_{max}	L_{min}	L_{1}	L_{5}	L_{10}	L_{50}	L_{90}	L_{99}
Total	-	24:00:00	66	95	43	73	70	68	58	49	46
Mar 1	0:00:00	1:00:00	53	73	48	61	56	54	51	49	48
Mar 1	1:00:00	1:00:00	52	63	48	60	56	54	51	49	49
Mar 1	2:00:00	1:00:00	52	68	51	55	53	53	52	51	51
Mar 1	3:00:00	1:00:00	52	71	46	57	53	53	52	48	47
Mar 1	4:00:00	1:00:00	52	71	43	59	55	53	50	44	44
Mar 1	5:00:00	1:00:00	49	56	45	53	52	51	48	47	46
Mar 1	6:00:00	1:00:00	57	73	47	67	61	59	54	49	47
Mar 1	7:00:00	1:00:00	60	78	50	67	64	63	58	54	52
Mar 1	8:00:00	1:00:00	62	72	58	67	65	64	62	60	59
Mar 1	9:00:00	1:00:00	60	73	52	69	65	63	59	54	53
Mar 1	10:00:00	1:00:00	70	88	59	77	73	71	68	66	62
Mar 1	11:00:00	1:00:00	69	80	51	76	72	71	68	56	52
Mar 1	12:00:00	1:00:00	61	78	51	69	67	65	59	54	52
Mar 1	13:00:00	1:00:00	69	83	64	78	73	71	68	65	64
Mar 1	14:00:00	1:00:00	67	77	53	74	72	71	65	55	54
Mar 1	15:00:00	1:00:00	61	73	51	70	66	64	56	53	52
Mar 1	16:00:00	1:00:00	76	95	61	93	73	71	67	64	62
Mar 1	17:00:00	1:00:00	69	77	58	74	72	71	68	62	60
Mar 1	18:00:00	1:00:00	62	74	58	67	64	64	62	60	59
Mar 1	19:00:00	1:00:00	62	71	53	66	64	64	62	59	54
Mar 1	20:00:00	1:00:00	56	72	51	62	60	59	54	52	52
Mar 1	21:00:00	1:00:00	60	72	53	66	63	62	60	54	53
Mar 1	22:00:00	1:00:00	54	67	47	60	57	56	54	51	48
Mar 1	23:00:00	1:00:00	51	59	47	54	53	52	50	48	47

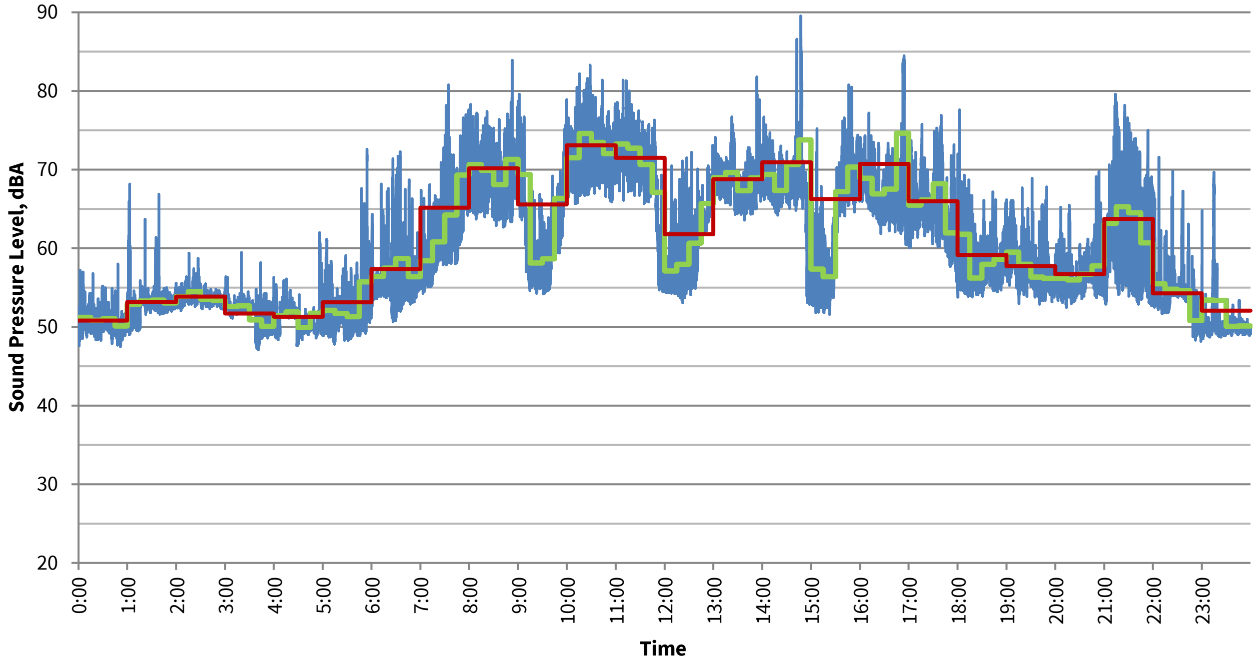
Vancouver Drydock - Maximum Sound Level Histogram



L_{AFmax} (dB)	Count of 1 minute values Day	Evening	Night
44 - 45	0	0	0
46 - 47	0	0	3
48 - 49	0	0	14
50 - 51	0	0	40
52 - 53	0	0	77
54 - 55	1	6	157
56 - 57	11	20	53
58 - 59	8	14	54
60 - 61	16	14	26
62 - 63	22	29	33
64 - 65	60	42	28
66 - 67	78	26	16
68 - 69	90	15	14
70 - 71	97	6	6
72 - 73	104	2	8
74 - 75	109	4	6
76 - 77	65	2	4
78 - 79	29	0	1
80 - 81	11	0	0
82 - 83	10	0	0
84 - 85	3	0	0
86 - 87	2	0	0
88 - 89	1	0	0
90 - 91	1	0	0
92 - 93	0	0	0
94 - 95	1	0	0
96 - 97	1	0	0

Baseline Noise Monitoring Detailed Results

The graph below shows the measured, and calculated time histories beginning on March 2, 2021

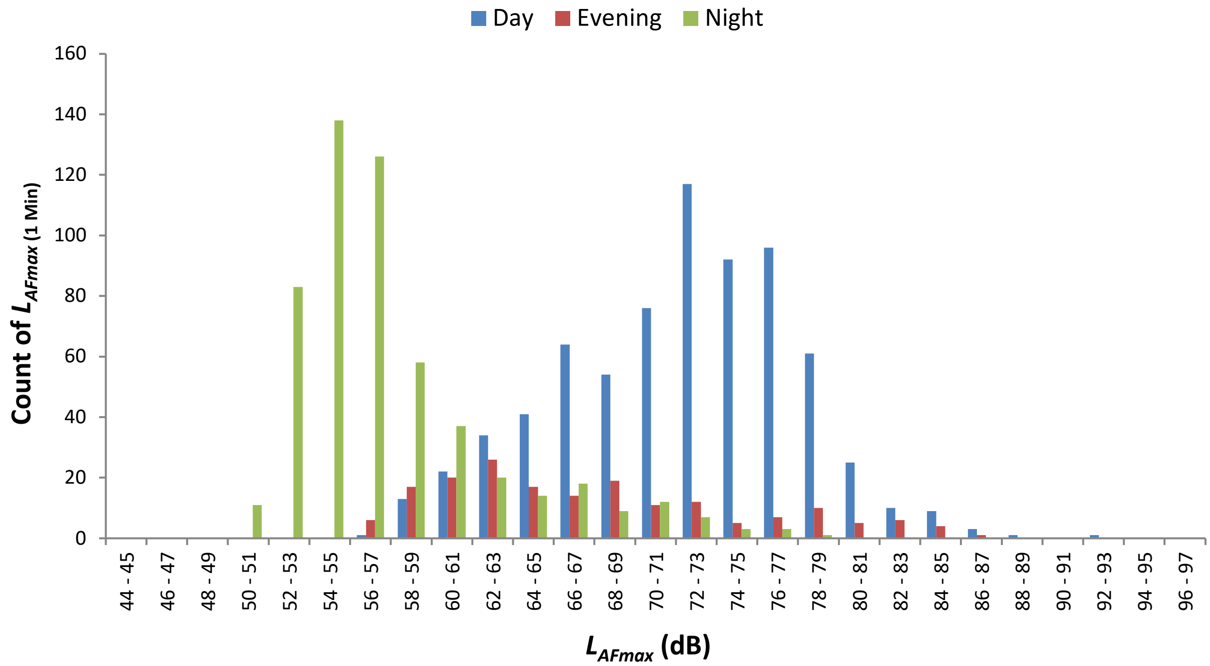


Hourly Interval Report starting at March 2, 2021
All Sound Pressure Levels presented in dBA

Date	Time	Duration	L_{eq}	L_{max}	L_{min}	L_1	L_5	L_{10}	L_{50}	L_{90}	L_{99}
Total	-	24:00:00	66	90	47	76	72	70	57	50	49
Mar 2	0:00:00	1:00:00	51	58	48	55	53	52	50	49	48
Mar 2	1:00:00	1:00:00	53	68	49	58	54	54	53	51	50
Mar 2	2:00:00	1:00:00	54	59	52	56	55	55	54	53	53
Mar 2	3:00:00	1:00:00	52	60	47	54	53	53	52	49	48
Mar 2	4:00:00	1:00:00	51	62	48	56	54	53	51	49	48
Mar 2	5:00:00	1:00:00	53	73	48	60	57	55	51	49	48
Mar 2	6:00:00	1:00:00	57	72	51	67	61	59	55	54	52
Mar 2	7:00:00	1:00:00	65	81	54	74	72	70	61	56	55
Mar 2	8:00:00	1:00:00	70	84	63	76	74	73	69	65	64
Mar 2	9:00:00	1:00:00	66	80	54	75	73	71	61	55	55
Mar 2	10:00:00	1:00:00	73	83	66	79	77	76	72	69	67
Mar 2	11:00:00	1:00:00	72	81	55	77	75	74	71	58	55
Mar 2	12:00:00	1:00:00	62	73	53	69	67	66	57	55	54
Mar 2	13:00:00	1:00:00	69	82	64	74	72	71	68	66	65
Mar 2	14:00:00	1:00:00	71	90	53	83	72	71	68	63	53
Mar 2	15:00:00	1:00:00	66	81	52	74	72	70	62	54	52
Mar 2	16:00:00	1:00:00	71	85	60	83	72	71	67	64	61
Mar 2	17:00:00	1:00:00	66	77	55	74	71	69	64	59	56
Mar 2	18:00:00	1:00:00	59	78	54	67	63	61	56	55	54
Mar 2	19:00:00	1:00:00	58	69	53	64	62	60	56	55	54
Mar 2	20:00:00	1:00:00	57	70	53	63	60	59	56	54	53
Mar 2	21:00:00	1:00:00	64	80	53	75	70	67	58	54	53
Mar 2	22:00:00	1:00:00	54	72	48	62	56	55	54	50	49
Mar 2	23:00:00	1:00:00	52	70	49	62	53	51	50	49	49

Vancouver Drydock - Maximum Sound Level Histogram

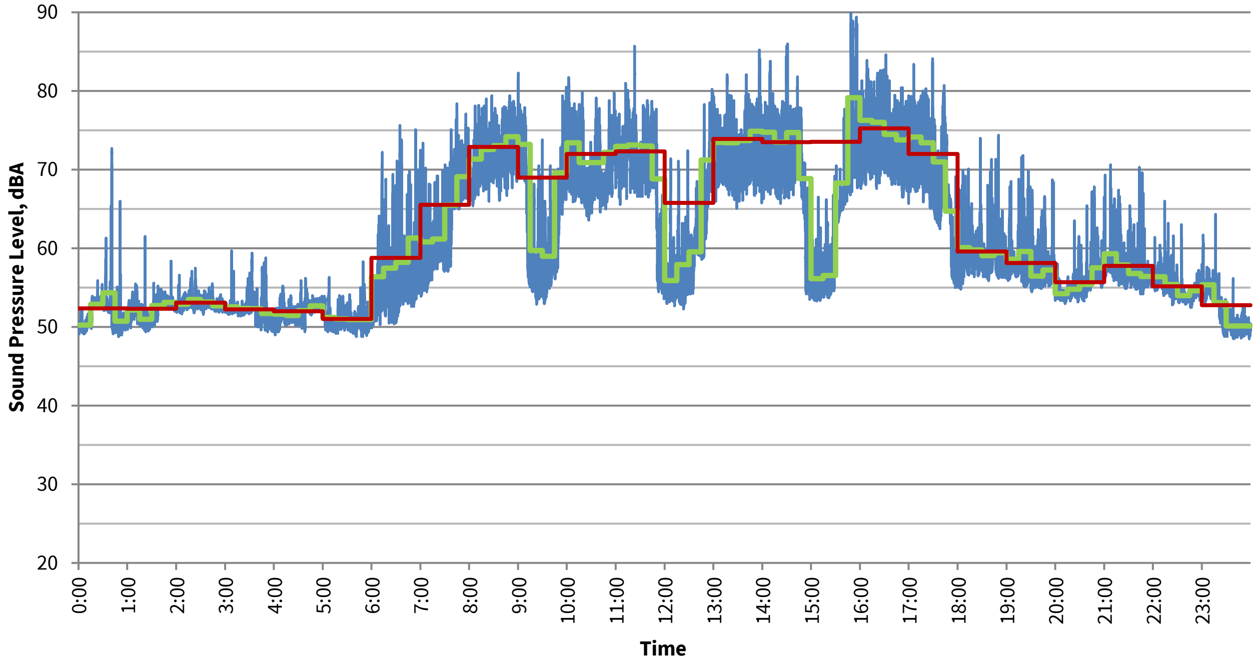
Histogram of 1 minute L_{AFmax} values on March 2nd, 2021

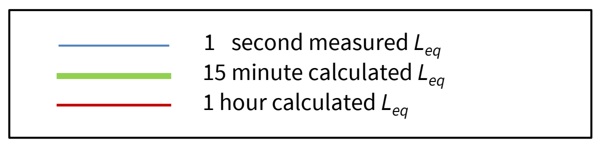


	Count of 1 minute values		
L_{AFmax} (dB)	Day	Evening	Night
44 - 45	0	0	0
46 - 47	0	0	0
48 - 49	0	0	0
50 - 51	0	0	11
52 - 53	0	0	83
54 - 55	0	0	138
56 - 57	1	6	126
58 - 59	13	17	58
60 - 61	22	20	37
62 - 63	34	26	20
64 - 65	41	17	14
66 - 67	64	14	18
68 - 69	54	19	9
70 - 71	76	11	12
72 - 73	117	12	7
74 - 75	92	5	3
76 - 77	96	7	3
78 - 79	61	10	1
80 - 81	25	5	0
82 - 83	10	6	0
84 - 85	9	4	0
86 - 87	3	1	0
88 - 89	1	0	0
90 - 91	0	0	0
92 - 93	1	0	0
94 - 95	0	0	0
96 - 97	0	0	0

Baseline Noise Monitoring Detailed Results

The graph below shows the measured, and calculated time histories beginning on March 3, 2021

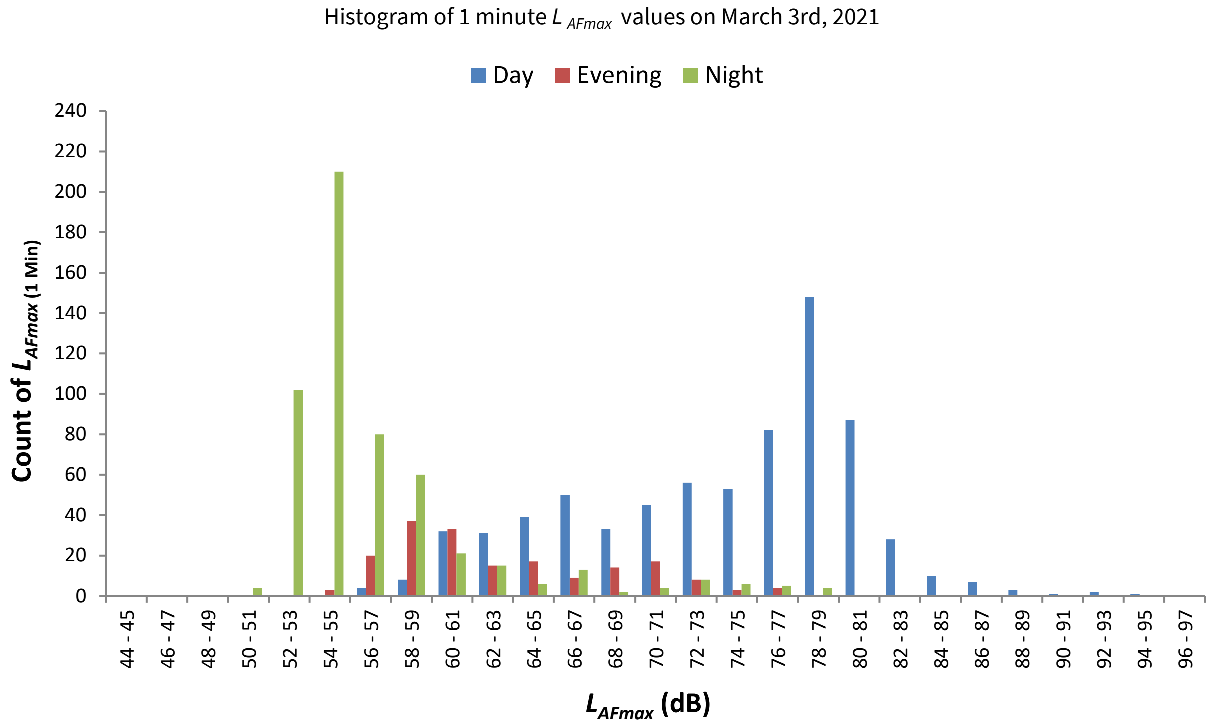




Hourly Interval Report starting at March 3, 2021
All Sound Pressure Levels presented in dBA

Date	Time	Duration	L_{eq}	L_{max}	L_{min}	L_1	L_5	L_{10}	L_{50}	L_{90}	L_{99}
Total	-	24:00:00	69	93	49	78	76	74	57	51	50
Mar 3	0:00:00	1:00:00	52	73	49	54	53	53	51	50	49
Mar 3	1:00:00	1:00:00	52	62	49	55	54	54	52	50	50
Mar 3	2:00:00	1:00:00	53	58	52	55	54	54	53	52	52
Mar 3	3:00:00	1:00:00	52	60	49	56	54	53	52	51	50
Mar 3	4:00:00	1:00:00	52	56	49	54	54	53	52	51	50
Mar 3	5:00:00	1:00:00	51	58	49	54	53	53	51	50	49
Mar 3	6:00:00	1:00:00	59	76	50	69	64	61	55	52	51
Mar 3	7:00:00	1:00:00	66	78	54	73	70	69	62	58	55
Mar 3	8:00:00	1:00:00	73	79	65	78	77	76	72	68	67
Mar 3	9:00:00	1:00:00	69	82	53	78	76	75	60	55	54
Mar 3	10:00:00	1:00:00	72	82	64	78	76	75	70	67	65
Mar 3	11:00:00	1:00:00	72	86	54	78	76	76	71	57	55
Mar 3	12:00:00	1:00:00	66	80	52	78	74	69	57	54	53
Mar 3	13:00:00	1:00:00	74	85	65	80	78	77	73	68	67
Mar 3	14:00:00	1:00:00	74	86	54	82	77	76	72	59	55
Mar 3	15:00:00	1:00:00	74	93	53	88	77	76	61	55	54
Mar 3	16:00:00	1:00:00	75	85	66	81	79	78	74	70	68
Mar 3	17:00:00	1:00:00	72	84	55	79	77	76	69	59	56
Mar 3	18:00:00	1:00:00	60	74	55	66	63	62	58	57	55
Mar 3	19:00:00	1:00:00	58	72	54	66	62	60	57	55	55
Mar 3	20:00:00	1:00:00	56	68	53	61	58	57	55	54	53
Mar 3	21:00:00	1:00:00	58	71	54	65	61	59	57	55	55
Mar 3	22:00:00	1:00:00	55	66	53	59	57	57	55	54	53
Mar 3	23:00:00	1:00:00	53	64	49	57	56	56	51	49	49

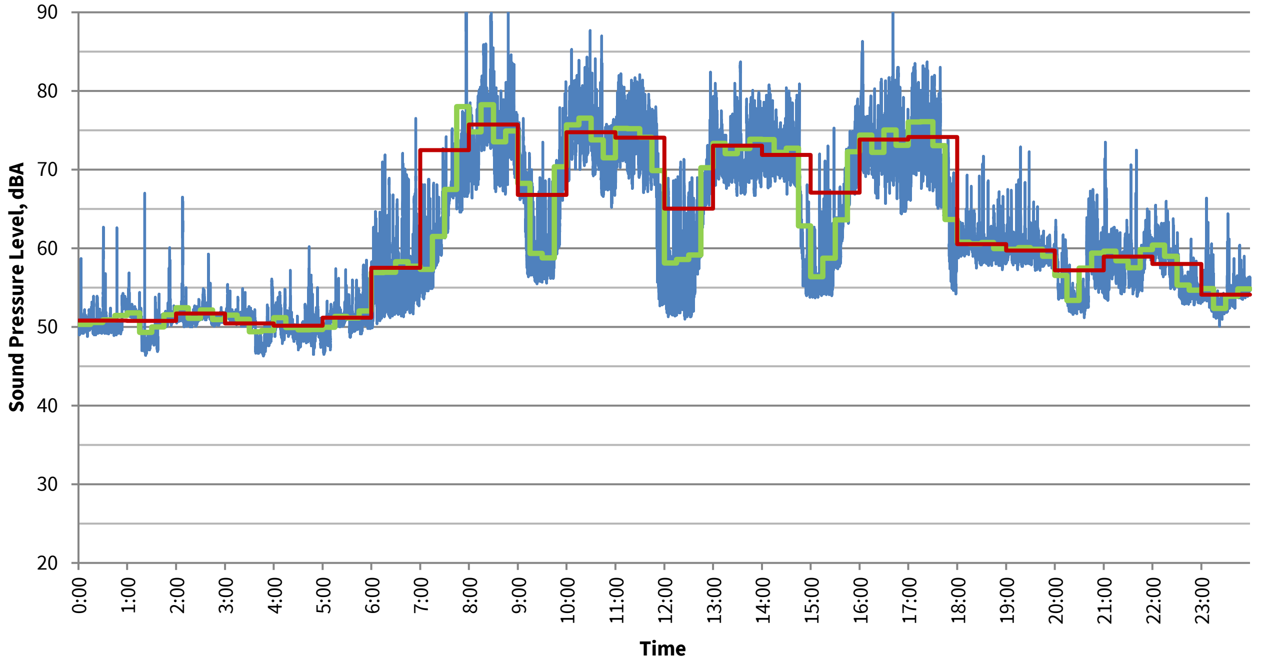
Vancouver Drydock - Maximum Sound Level Histogram



L_{AFmax} (dB)	Count of 1 minute values Day	Evening	Night
44 - 45	0	0	0
46 - 47	0	0	0
48 - 49	0	0	0
50 - 51	0	0	4
52 - 53	0	0	102
54 - 55	0	3	210
56 - 57	4	20	80
58 - 59	8	37	60
60 - 61	32	33	21
62 - 63	31	15	15
64 - 65	39	17	6
66 - 67	50	9	13
68 - 69	33	14	2
70 - 71	45	17	4
72 - 73	56	8	8
74 - 75	53	3	6
76 - 77	82	4	5
78 - 79	148	0	4
80 - 81	87	0	0
82 - 83	28	0	0
84 - 85	10	0	0
86 - 87	7	0	0
88 - 89	3	0	0
90 - 91	1	0	0
92 - 93	2	0	0
94 - 95	1	0	0
96 - 97	0	0	0

Baseline Noise Monitoring Detailed Results

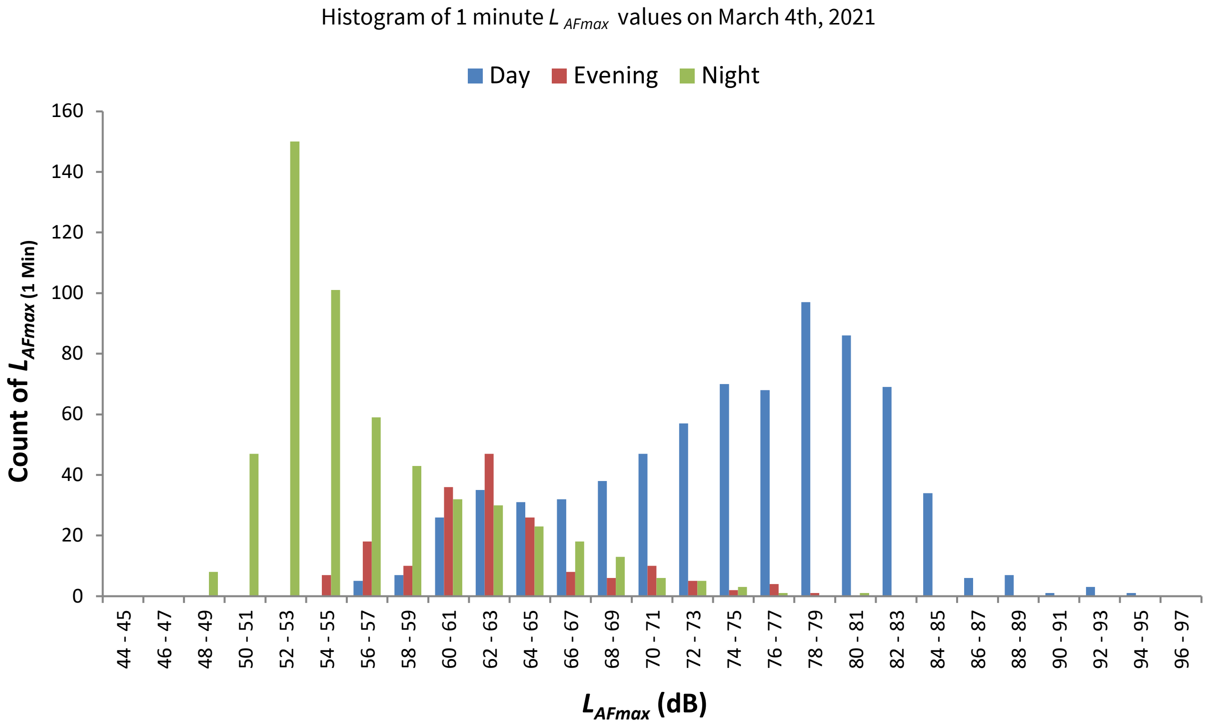
The graph below shows the measured, and calculated time histories beginning on March 4, 2021



Hourly Interval Report starting at March 4, 2021
All Sound Pressure Levels presented in dBA

Date	Time	Duration	L_{eq}	L_{max}	L_{min}	L_1	L_5	L_{10}	L_{50}	L_{90}	L_{99}
Total	-	24:00:00	70	92	46	79	76	74	58	50	48
Mar 4	0:00:00	1:00:00	51	63	49	54	53	53	50	50	49
Mar 4	1:00:00	1:00:00	51	67	46	54	52	52	51	48	47
Mar 4	2:00:00	1:00:00	52	67	50	56	53	52	51	51	50
Mar 4	3:00:00	1:00:00	50	56	46	55	52	52	51	47	47
Mar 4	4:00:00	1:00:00	50	60	47	54	53	52	50	48	47
Mar 4	5:00:00	1:00:00	51	59	47	56	53	53	51	49	47
Mar 4	6:00:00	1:00:00	58	77	50	67	62	60	55	52	51
Mar 4	7:00:00	1:00:00	72	92	54	87	73	71	63	56	55
Mar 4	8:00:00	1:00:00	76	91	66	83	80	79	74	70	68
Mar 4	9:00:00	1:00:00	67	81	56	76	73	71	60	57	56
Mar 4	10:00:00	1:00:00	75	88	65	81	79	77	74	70	67
Mar 4	11:00:00	1:00:00	74	82	53	80	78	77	74	56	53
Mar 4	12:00:00	1:00:00	65	82	51	75	71	69	57	52	52
Mar 4	13:00:00	1:00:00	73	84	67	79	77	76	72	69	68
Mar 4	14:00:00	1:00:00	72	81	54	78	76	75	71	56	54
Mar 4	15:00:00	1:00:00	67	79	54	76	74	72	59	55	54
Mar 4	16:00:00	1:00:00	74	90	64	81	78	76	72	69	65
Mar 4	17:00:00	1:00:00	74	84	54	82	80	78	71	59	55
Mar 4	18:00:00	1:00:00	61	72	57	67	63	62	60	59	58
Mar 4	19:00:00	1:00:00	60	73	57	63	62	61	59	58	58
Mar 4	20:00:00	1:00:00	57	68	51	64	62	60	55	53	52
Mar 4	21:00:00	1:00:00	59	74	53	65	62	61	58	56	54
Mar 4	22:00:00	1:00:00	58	66	53	63	62	61	57	54	53
Mar 4	23:00:00	1:00:00	54	66	50	58	56	55	54	52	52

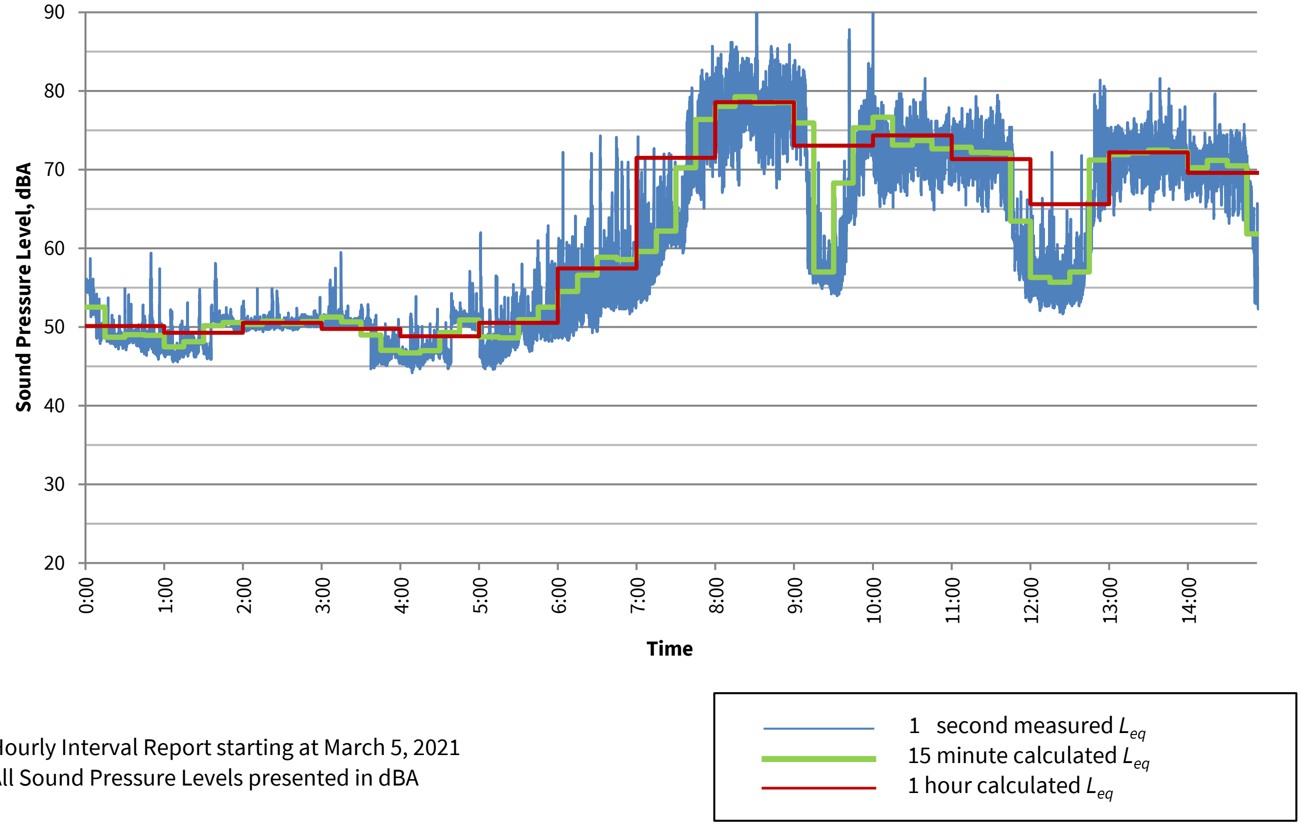
Vancouver Drydock - Maximum Sound Level Histogram



L_{AFmax} (dB)	Count of 1 minute values Day	Evening	Night
44 - 45	0	0	0
46 - 47	0	0	0
48 - 49	0	0	8
50 - 51	0	0	47
52 - 53	0	0	150
54 - 55	0	7	101
56 - 57	5	18	59
58 - 59	7	10	43
60 - 61	26	36	32
62 - 63	35	47	30
64 - 65	31	26	23
66 - 67	32	8	18
68 - 69	38	6	13
70 - 71	47	10	6
72 - 73	57	5	5
74 - 75	70	2	3
76 - 77	68	4	1
78 - 79	97	1	0
80 - 81	86	0	1
82 - 83	69	0	0
84 - 85	34	0	0
86 - 87	6	0	0
88 - 89	7	0	0
90 - 91	1	0	0
92 - 93	3	0	0
94 - 95	1	0	0
96 - 97	0	0	0

Baseline Noise Monitoring Detailed Results

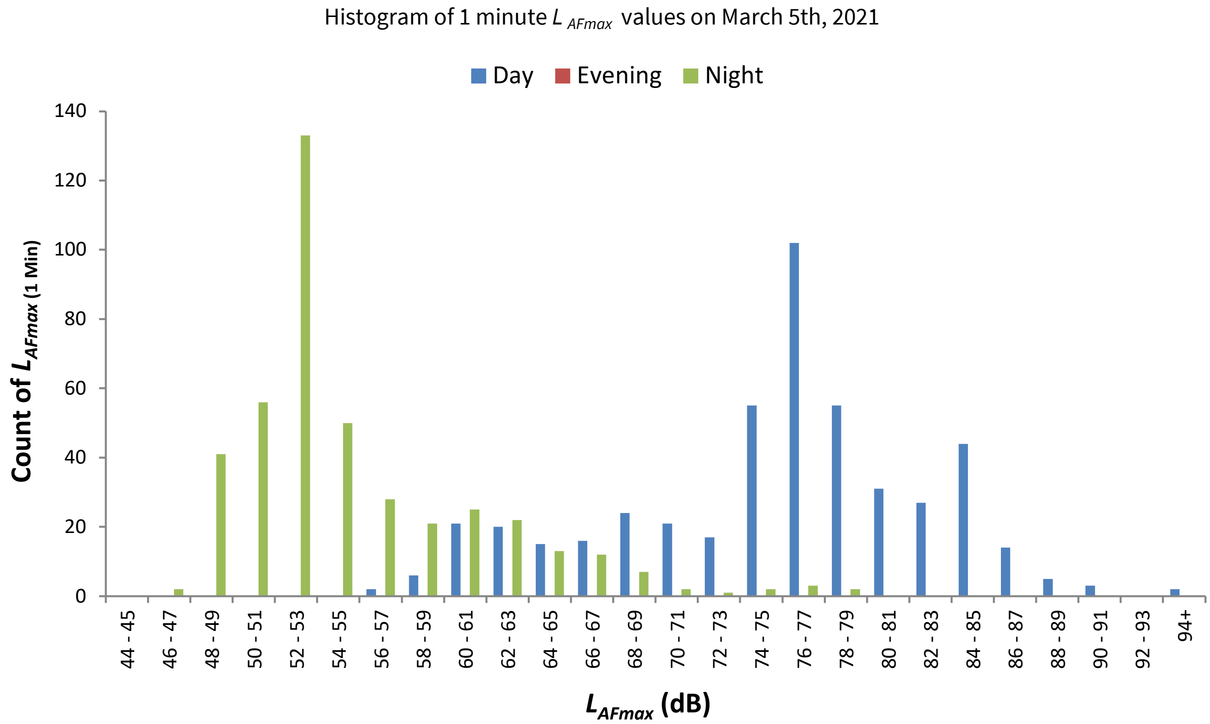
The graph below shows the measured, and calculated time histories beginning on March 5, 2021



Hourly Interval Report starting at March 5, 2021
All Sound Pressure Levels presented in dBA

Date	Time	Duration	L_{eq}	L_{max}	L_{min}	L_{1}	L_{5}	L_{10}	L_{50}	L_{90}	L_{99}
Total	-	24:00:00	71	104	44	81	78	75	56	47	46
Mar 5	0:00:00	1:00:00	50	59	46	56	55	53	49	47	47
Mar 5	1:00:00	1:00:00	49	58	46	54	51	51	48	47	46
Mar 5	2:00:00	1:00:00	51	55	49	53	51	51	50	50	50
Mar 5	3:00:00	1:00:00	50	60	45	54	52	51	50	46	45
Mar 5	4:00:00	1:00:00	49	57	44	53	52	51	47	46	45
Mar 5	5:00:00	1:00:00	51	63	45	58	55	53	49	46	45
Mar 5	6:00:00	1:00:00	57	74	48	69	61	59	54	50	49
Mar 5	7:00:00	1:00:00	72	86	53	81	78	77	63	56	54
Mar 5	8:00:00	1:00:00	79	91	67	85	83	81	78	73	69
Mar 5	9:00:00	1:00:00	73	88	54	82	80	78	64	56	55
Mar 5	10:00:00	1:00:00	74	104	65	78	76	75	72	69	67
Mar 5	11:00:00	1:00:00	71	80	53	77	75	74	71	58	54
Mar 5	12:00:00	1:00:00	66	81	52	76	73	71	56	54	53
Mar 5	13:00:00	1:00:00	72	82	64	77	75	74	72	69	67
Mar 5	14:00:00	1:00:00	70	80	52	75	73	72	69	55	53

Vancouver Drydock - Maximum Sound Level Histogram



Count of 1 minute values

L_{AFmax} (dB)	Day	Evening	Night
44 - 45	0	0	0
46 - 47	0	0	2
48 - 49	0	0	41
50 - 51	0	0	56
52 - 53	0	0	133
54 - 55	0	0	50
56 - 57	2	0	28
58 - 59	6	0	21
60 - 61	21	0	25
62 - 63	20	0	22
64 - 65	15	0	13
66 - 67	16	0	12
68 - 69	24	0	7
70 - 71	21	0	2
72 - 73	17	0	1
74 - 75	55	0	2
76 - 77	102	0	3
78 - 79	55	0	2
80 - 81	31	0	0
82 - 83	27	0	0
84 - 85	44	0	0
86 - 87	14	0	0
88 - 89	5	0	0
90 - 91	3	0	0
92 - 93	0	0	0
94+	2	0	0

Appendix F: Noise Modelling Methodology and Details

Acoustical Model

Noise levels at residential receiver locations have been predicted using the internationally recommended ISO 9613-2 (1996) standard, which is implemented in the outdoor sound propagation software Cadna/A version 2021. The *Good Practice Guide for Strategic Noise Mapping* (EC WG-AEN 2007) points out that this standard is recommended by the European Commission (EC) as current best practice to obtain accurate prediction results.

ISO 9613 describes a method for calculating the attenuation of sound during propagation outdoors in order to predict environmental noise levels at a distance from a variety of sources. It is the EC preferred standard for general industrial noise prediction. The method predicts the equivalent continuous A-weighted sound pressure level under meteorological conditions favourable for sound propagation. BKL used this method to predict noise propagation from the Project activities to the residential receptors.

Model calculations were performed in octave bands, considering ground cover, topography and shielding objects (see following sections). A temperature of 10°C and relative humidity of 80 per cent were used in the model settings to represent average weather conditions in Vancouver. A moderate temperature inversion was assumed to represent conditions favourable for sound propagation but not the absolute worst-case conditions.

Geometric Data

Topography

The intervening terrain has been modelled by directly importing ground contours provided by the City of North Vancouver.

The layout and dimensions of the Project terminal, its nearby facilities, and road and rail were taken from drawings provided by Vancouver Drydock. Residential building heights were estimated using field observations, and Google Earth.

Ground Surface

The acoustic properties of the ground surface can have a considerable effect on the propagation of noise. Flat non-porous surfaces, such as concrete, asphalt, buildings, calm water, etc., are highly reflective to noise, and according to ISO 9613-2 have a ground constant of G=0. Soft, porous surfaces, such as foliage, loam, soft grass, snow, etc., are highly absorptive to noise, and have a ground constant of G=1. The ISO standard does not use intermediate ground constants.

Highly reflective surfaces have been modelled in most areas as most of the surfaces near the site are considered to be acoustically hard, including nearby roadways and the water of Burrard Inlet.

Obstacles

The layout and dimensions of the Project's buildings and equipment were incorporated into the model based on drawings and details provided by Vancouver Drydock.

Orthophotos from Google Maps were used to identify other acoustically important objects or landmarks.

Noise Source Details

The table below describes the noise sources used in the noise model.

<table>
<tr><th rowspan="2">Description</th><th rowspan="2">ID</th><th rowspan="2">Hours per Time Period</th><th rowspan="2">Time Period</th><th rowspan="2">Model Source Type</th><th colspan="8">SWL (dBA) per Octave Band Frequency (Hz)</th><th rowspan="2">Total SWL (dBA)</th><th rowspan="2">Notes</th></tr>
<tr><th>63</th><th>125</th><th>250</th><th>500</th><th>1000</th><th>2000</th><th>4000</th><th>8000</th></tr>
<tr><td>Panamax UHP</td><td>UHP</td><td>11</td><td>Daytime</td><td>Vertical Area</td><td>125</td><td>119</td><td>115</td><td>116</td><td>120</td><td>125</td><td>129</td><td>128</td><td>133</td><td rowspan="3">Vertical Area around expected ship's hull location and height up to 10 m above drydock</td></tr>
<tr><td>Careen UHP</td><td>UHP</td><td>11</td><td>Daytime</td><td>Vertical Area</td><td>125</td><td>119</td><td>115</td><td>116</td><td>120</td><td>125</td><td>129</td><td>128</td><td>133</td></tr>
<tr><td>Future UHP</td><td>UHP</td><td>11</td><td>Daytime</td><td>Vertical Area</td><td>125</td><td>119</td><td>115</td><td>116</td><td>120</td><td>125</td><td>129</td><td>128</td><td>133</td></tr>
<tr><td rowspan="3">General Drydock Activity</td><td rowspan="3">Drydock</td><td>12</td><td>Daytime</td><td rowspan="3">Horizontal Area</td><td>123</td><td>119</td><td>109</td><td>108</td><td>107</td><td>106</td><td>97</td><td>85</td><td>113</td><td rowspan="3">Assume drydock activities are spread out along pier and each drydock.</td></tr>
<tr><td>3</td><td>Evening</td><td>116</td><td>112</td><td>102</td><td>101</td><td>100</td><td>99</td><td>90</td><td>78</td><td>105</td></tr>
<tr><td>9</td><td>Night</td><td>118</td><td>115</td><td>104</td><td>103</td><td>103</td><td>101</td><td>92</td><td>81</td><td>108</td></tr>
<tr><td>85T Gantry Crane</td><td>Gantry</td><td>1</td><td>Daytime</td><td>Line</td><td>-</td><td>-</td><td>-</td><td>-</td><td>106</td><td>102</td><td>92</td><td>-</td><td>108</td><td>Assume gantry moves along track 5 minutes every hour</td></tr>
</table>

Appendix G: Noise Modelling Detailed Results

As a general practice, noise results are presented as whole numbers. The detailed modelling results present results to one decimal point to illustrate slight differences predicted for different floor levels.

Receiver	Baseline				Future				Change	
	L_{Rden} (dBA)	%HA	L_n (dBA)	L_{LF} (dB)	L_{Rden} (dBA)	%HA	L_n (dBA)	L_{LF} (dB)	L_{Rden} (dBA)	%HA
Trophy 01	64.7	13.5	51.6	71.1	64	12.4	50.8	71.9	-0.7	-1.1
Trophy 02	65.2	14.1	52.4	71.4	64.4	13.0	51.6	72.3	-0.8	-1.1
Trophy 03	65.3	14.3	52.6	72.4	65.1	14.0	52.1	72.7	-0.2	-0.3
Trophy 04	65.4	14.6	52.8	73.6	66.2	16.0	52.5	73.2	0.8	1.4
Trophy 05	65.4	14.6	52.8	74.0	66.3	16.1	52.7	73.9	0.9	1.5
Trophy 06	65.5	14.6	52.9	74.1	66.3	16.1	52.7	74.4	0.8	1.5
Trophy 07	65.5	14.6	52.9	74.1	66.3	16.1	52.7	74.5	0.8	1.5
Trophy 08	65.5	14.7	53	74.2	66.3	16.0	52.7	74.5	0.8	1.3
Trophy 09	65.5	14.7	53.1	74.2	66.2	16.0	52.7	74.6	0.7	1.2
Trophy 10	65.5	14.7	53.1	74.3	66.2	16.0	52.7	74.6	0.7	1.2
Trophy 11	65.5	14.7	53.1	74.3	66.2	15.8	52.7	74.6	0.7	1.1
Trophy 12	65.5	14.7	53.1	74.3	66.2	15.8	52.7	74.7	0.7	1.1
Trophy 13	65.4	14.7	53	74.3	66.1	15.8	52.6	74.6	0.7	1.1
Cascade East A 01	61.9	9.7	48	70.0	64.5	13.1	49.5	70.7	2.6	3.4
Cascade East A 02	62.3	10.1	48.8	70.8	64.7	13.4	50.2	72.0	2.4	3.3
Cascade East A 03	62.6	10.5	49.3	71.4	64.8	13.7	50.5	72.7	2.2	3.2
Cascade East A 04	63.3	11.3	50.2	71.7	65.3	14.4	51	72.9	2	3.0
Cascade East A 05	63.4	11.6	50.7	71.9	65.4	14.4	51.3	73.1	2	2.9
Cascade East A 06	63.5	11.7	50.8	72.3	65.4	14.6	51.4	73.3	1.9	2.9
Cascade East A 07	63.6	11.7	50.9	72.5	65.4	14.5	51.5	73.5	1.8	2.7
Cascade East A 08	63.6	11.9	51	72.6	65.4	14.5	51.4	73.6	1.8	2.6
Cascade East B 01	62.7	10.6	48.4	70.0	64.8	13.5	49.7	70.9	2.1	2.9
Cascade East B 02	63	11.1	49.2	70.5	64.9	13.8	50.3	72.2	1.9	2.7
Cascade East B 03	63.3	11.5	49.9	71.5	65.2	14.2	50.7	72.9	1.9	2.7
Cascade East B 04	64	12.3	51	72.0	65.6	14.9	51.5	73.1	1.6	2.6
Cascade East B 05	64.1	12.4	51.3	72.4	65.7	15.0	51.7	73.3	1.6	2.5
Cascade East B 06	64.1	12.6	51.4	72.8	65.7	15.0	51.8	73.6	1.6	2.4
Cascade East B 07	64.1	12.6	51.4	72.9	65.7	15.0	51.8	73.8	1.6	2.4

Receiver	Baseline				Future				Change	
	L_{Rden} (dBA)	%HA	L_n (dBA)	L_{LF} (dB)	L_{Rden} (dBA)	%HA	L_n (dBA)	L_{LF} (dB)	L_{Rden} (dBA)	%HA
Cascade East B 08	64.2	12.6	51.5	73.0	65.6	14.8	51.8	73.8	1.4	2.2
Cascade West A 01	59.9	7.6	46.8	69.1	63.3	11.4	48.8	71.1	3.4	3.8
Cascade West A 02	60.1	7.7	47.3	69.2	63.4	11.5	49.1	71.2	3.3	3.8
Cascade West A 03	60.1	7.8	47.5	69.4	63.4	11.6	49.2	71.3	3.3	3.7
Cascade West A 04	60.4	8.1	48	69.8	63.5	11.7	49.4	71.5	3.1	3.6
Cascade West A 05	60.5	8.2	48.1	70.1	63.6	11.9	49.5	71.7	3.1	3.7
Cascade West A 06	60.6	8.2	48.2	70.2	63.6	11.9	49.5	71.8	3	3.6
Cascade West A 07	60.7	8.3	48.3	70.4	63.7	12.0	49.6	71.9	3	3.7
Cascade West A 08	60.8	8.4	48.4	70.5	63.7	12.0	49.7	72.0	2.9	3.6
Cascade West A 09	60.9	8.5	48.5	70.5	63.7	12.0	49.8	72.0	2.8	3.5
Cascade West B 01	60.3	8.0	46.5	69.1	63.4	11.6	48.8	71.3	3.1	3.6
Cascade West B 02	60.6	8.3	47.6	69.3	63.7	12.0	49.4	71.3	3.1	3.6
Cascade West B 03	60.7	8.4	47.9	69.5	63.7	12.0	49.5	71.6	3	3.6
Cascade West B 04	60.8	8.5	48.1	69.8	63.8	12.1	49.6	71.8	3	3.6
Cascade West B 05	61	8.8	48.5	70.4	63.9	12.3	49.8	72.0	2.9	3.5
Cascade West B 06	61.1	8.8	48.6	70.5	64	12.3	49.9	72.1	2.9	3.5
Cascade West B 07	61.2	8.9	48.7	70.7	64	12.4	49.9	72.2	2.8	3.5
Cascade West B 08	61.3	9.0	48.8	70.8	64	12.4	50	72.3	2.7	3.4
Cascade West B 09	61.4	9.1	48.9	70.8	64	12.5	50.1	72.3	2.6	3.4