APPENDIX P

Noise Impact Assessment

FIBRECO

Fibreco Export Terminal Enhancement
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APPENDIX P
Noise Impact Assessment - Executive Summary

BKL Consultants Ltd. (BKL) has conducted an environmental noise assessment for the proposed Fibreco Terminal Enhancement Project (the Project) in the North Shore Trade Area of the Vancouver Fraser Port Authority (VFPA). The Project includes the expansion of Fibreco's existing facility to replace wood chip operations with grain operations.

The Project will include the following key changes and improvements:

- Elimination of wood chip operations
- Elimination of barge import and export
- Modifications to rail yard and rail car unloading shed
- New dumper baghouse dust collector
- New railcar indexers
- New conveyor systems for grain operations and improved material handling
- New silo storage for grain products
- Modifications to existing wood pellet silo feed conveyor system
- Modifications to existing berth and ship-loader

This report documents existing community noise levels near the Project and the predicted noise climate following completion of the Project. The assessment was prepared in accordance with the Environmental Noise Assessment Terms of Reference provided to VFPA on November 26, 2015.

The objectives of this study were to review existing conditions at nearby noise sensitive receptors, perform site measurements of significant Fibreco noise sources, construct a noise model to predict community noise levels in the existing noise environment and the future noise environment with the Project, and to provide mitigation options where applicable. This study does not address potential short-term construction noise effects. BKL assessed existing community noise levels using noise measurement data collected in 2012 by BKL in the Norgate residential community and by conducting noise measurements recently at Bodwell High School. Noise data was collected for a period of one week and was used to characterize the existing community noise environment and assist in establishing the existing noise levels at potentially affected receptors. BKL developed a Cadna/A computer noise model to assess existing and future noise levels at all nearby residences.

The model includes noise sources from Fibreco, local road traffic, and CN railway operations. The Project noise predictions were based on the following main assumptions:

- Wood chip operations will be completely eliminated
- Barge import and export will be completely eliminated
- Unloaded railcars will no longer roll freely down the slope and impact stationary cars
- CN service efficiency will improve since they will be able to deliver and retrieve more cars at a time, resulting in fewer shunting impacts per car serviced
- Shipboard generator noise emissions will increase in proportion to the proposed throughput increase

BKL accounted for the following factors when developing its noise model:

- CN servicing noise (spotting and pulling cars) on Fibreco rail tracks was considered Fibreco generated noise
- A 12 dB highly impulsive noise penalty was applied to impact noise from empty railcars free rolling down a gradual slope and impacting parked railcars
- A 5 dB regular impulsive noise penalty was applied to front end loaders moving rail cars
- A 5 dB tonal noise penalty was applied to backup alarms from mobile equipment
- A 12 dB highly impulsive noise penalty was applied to CN servicing noise due to shunting impacts

Based on these assumptions, BKL predicts a 0 to 2 dBA increase in Fibreco-generated noise throughout the surrounding community once the Project is at full capacity. However, future total noise levels with and without the Project are predicted to remain the same throughout the surrounding community, which shows that Fibreco is not the dominant source in the community. Total noise levels are predicted to remain unchanged in the future relative to existing noise levels, except for a slight decrease in one residential area due to train whistle cessation with the future Philip Avenue Overpass being constructed.

Although the Total Noise is not predicted to increase with the Project in 2020, noise mitigation could be considered to reduce the dominant Fibreco noise sources where practical. There are a number of noise mitigation strategies, such as fan silencers and noise barriers, which could be investigated to minimize Project noise levels using best available techniques not entailing excessive cost.

FIBRECO TERMINAL ENHANCEMENT PROJECT

ENVIRONMENTAL NOISE ASSESSMENT

PREPARED FOR:

FIBRECO

FIBRECO

JULY 2016

REVISION 0

BKL
Consultants in Acoustics

FIBRECO TERMINAL ENHANCEMENT PROJECT

ENVIRONMENTAL NOISE ASSESSMENT

PREPARED FOR:

FIBRECO

FIBRECO

JULY 2016

REVISION 0

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EXECUTIVE SUMMARY

BKL Consultants Ltd. (BKL) has conducted an environmental noise assessment for the proposed Fibreco Terminal Enhancement Project (the Project) in the North Shore Trade Area of the Vancouver Fraser Port Authority (VFPA). The Project includes the expansion of Fibreco's existing facility to replace wood chip operations with grain operations. The Project will include the following key changes and improvements:

- Elimination of wood chip operations;
- Elimination of barge import and export;
- Modifications to rail yard and rail car unloading shed;
- New dumper baghouse dust collector;
- New railcar indexers;
- New conveyor systems for grain operations and improved material handling;
- New silo storage for grain products;
- Modifications to existing wood pellet silo feed conveyor system; and
- Modifications to existing berth and ship-loader.

This report documents existing community noise levels near the Project and the predicted noise climate following completion of the Project. The assessment was prepared in accordance with the Environmental Noise Assessment Terms of Reference provided to VFPA on November 26, 2015.

The objectives of this study were to review existing conditions at nearby noise sensitive receptors, perform site measurements of significant Fibreco noise sources, construct a noise model to predict community noise levels in the existing noise environment and the future noise environment with the Project, and to provide mitigation options where applicable. This study does not address potential short-term construction noise effects.

BKL assessed existing community noise levels using noise measurement data collected in 2012 by BKL in the Norgate residential community and by conducting noise measurements recently at Bodwell High School. Noise data was collected for a period of one week and was used to characterize the existing community noise environment and assist in establishing the existing noise levels at potentially affected receptors.

BKL developed a Cadna/A computer noise model to assess existing and future noise levels at all nearby residences. The model includes noise sources from Fibreco, local road traffic, and CN railway operations.

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

- Wood chip operations will be completely eliminated.
- Barge import and export will be completely eliminated.
- Unloaded railcars will no longer roll freely down the slope and impact stationary cars.
- CN service efficiency will improve since they will be able to deliver and retrieve more cars at a time, resulting in fewer shunting impacts per car serviced.

- Shipboard generator noise emissions will increase in proportion to the proposed throughput increase.

BKL accounted for the following factors when developing its noise model:

- CN servicing noise (spotting and pulling cars) on Fibreco rail tracks was considered Fibreco-generated noise.
- A 12 dB highly impulsive noise penalty was applied to impact noise from empty railcars free rolling down a gradual slope and impacting parked railcars.
- A 5 dB regular impulsive noise penalty was applied to front end loaders moving rail cars.
- A 5 dB tonal noise penalty was applied to backup alarms from mobile equipment.
- A 12 dB highly impulsive noise penalty was applied to CN servicing noise due to shunting impacts.

Based on these assumptions, BKL predicts a 0 to 2 dBA increase in Fibreco-generated noise throughout the surrounding community once the Project is at full capacity. However, future total noise levels with and without the Project are predicted to remain the same throughout the surrounding community, which shows that Fibreco is not the dominant source in the community. Total noise levels are predicted to remain unchanged in the future relative to existing noise levels, except for a slight decrease in one residential area due to train whistle cessation once the future Philip Avenue Overpass is constructed.

Although the Total Noise is not predicted to increase with the Project in 2020, noise mitigation could be considered to reduce the dominant Fibreco noise sources where practical. There are a number of noise mitigation strategies, such as fan silencers and noise barriers, which could be investigated to minimize Project noise levels using best available techniques not entailing excessive cost.

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List of Abbreviations and Acronyms

Abbreviation/Acronym	Definition
ANSI	American National Standards Institute
BC	British Columbia
BKL	BKL Consultants Ltd.
CFM	cubic feet per minute
CN	Canadian National Railway
dB	decibel
dBA	A-weighted decibel
dBZ	decibel with no frequency weighting (zero weighting)
EC	European Commission
EU	European Union
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_n	nighttime (10 pm to 7 am) equivalent sound level
m	metre
MMTPA	million metric tonnes per annum
MT	metric tonne
MTPA	metric tonnes per annum
the Project	Fibreco Terminal Enhancement Project
VFPA	Vancouver Fraser Port Authority
s	second
SWL	sound power level

1 INTRODUCTION

BKL Consultants Ltd. (BKL) has been retained by Fibreco to provide an environmental noise impact assessment for the proposed Fibreco Terminal Enhancement Project (the Project). The current report provides a detailed assessment of environmental noise attributable to the Project based on the latest available information.

The Project includes the expansion of Fibreco's existing facility to increase wood pellet handling capacity and replace wood chip operations with grain operations. The Project will include the following key changes and improvements:

- Elimination of wood chip operations;
- Elimination of barge import and export;
- Modifications to rail yard and rail car unloading shed;
- New dumper baghouse dust collector;
- New railcar indexers;
- New conveyor systems for grain operations and improved material handling;
- New silo storage for grain products;
- Modifications to existing wood pellet silo feed conveyor system; and
- Modifications to existing berth and ship-loader.

The Vancouver Fraser Port Authority's (VFPA) goal for tenant-led projects such as this is to assess future noise levels and provide mitigation such that noise will not exceed existing noise levels. Therefore, a combination of measurements and modelling has been used to predict whether Fibreco-generated noise has the potential to increase community noise levels relative to those in recent years.

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

Relevant information regarding acoustics fundamentals and terminology is presented in Appendix A.

2 PROJECT DESCRIPTION

The Fibreco terminal is located on the north shore of Burrard Inlet, at 1209 McKeen Avenue, North Vancouver, BC, partially within VFPA lands. It is serviced by CN Rail. Figure 2.1 shows its location on Burrard Inlet, and Figure 2.2 shows a plan view of the nearby roadways and residences to the north.

Figure 2.1: Fibreco Terminal Location on Burrard Inlet

Figure 2.2: Fibreco Terminal next to Nearby Industry, Roadways and Residences

Currently, the Fibreco terminal operates 24 hours per day and 354 days per year, handling wood chips and pellets. This involves the unloading of rail deliveries, storing of products and loading of barges and deep sea vessels. Upon completion of the Project, wood chip operations will be completely eliminated and replaced by grain products while wood pellet operations will continue and increase in capacity. Barge import and export operations will also be eliminated as all products will be imported by rail and exported by vessels only. The terminal is expected to operate at its maximum throughput by 2020.

Table 2.1 below shows the existing and future anticipated maximum throughput for each product:

Table 2.1: Summary of Existing and Future Annual Throughput

Commodity	Annual Throughput [MMTPA]	
	2015	2020
Wood Chips	0.4	0
Wood Pellets	1.3	1.0
Grain Products	0	2.0
Total	**1.7**	**3.0**

The Project will include the installation and operation of the following key assets:

- Rail yard track work improvements to increase the storage capacity for railcars;
- New rail indexers to increase railcar unloading efficiency;
- New storage silos for grain products;
- New conveyor network to accommodate the handling of grain products and transferring to and from the grain silos;
- Modifications to the existing wood pellet silo feed conveyor system to increase throughput capacity and improve safety, maintainability and dust control; and
- Modifications to the existing berth and ship loader to allow for larger vessels and a higher ship loading rate.

Of the additions listed above, only some are expected to produce noise during operation that will be significant relative to other existing sources at Fibreco. These include the delivery and pickup of additional railcars, railcar unloading and ship loading operations, and conveyors.

3 STUDY OBJECTIVES

In accordance with the Environmental Noise Assessment Terms of Reference provided to VFPA on November 26, 2015, the objectives of this study were to

- evaluate existing noise conditions at potentially affected residential receptors within the Norgate community and at Bodwell High School;
- perform site measurements of Fibreco significant noise sources and CN delivery and pickup noise;

- construct a noise model for the purpose of predicting community noise levels in 2015 and noise levels with and without the Project in the year 2020;
- compare predicted noise levels with and without the Project;
- quantify the significance of any noise increases in terms of the annual average day-evening-night level (L_{den}) including any appropriate adjustments for tonal or impulsive noise; and
- provide mitigation options to address significant noise effects where necessary.

Construction noise assessment was not part of the current study.

4 ASSESSMENT CRITERIA

4.1 VFPA Noise Criteria

It is understood that VFPA's goal for tenant-led projects such as this is to demonstrate that annual average future noise levels will not exceed existing noise levels and that terminal operators incorporate continuous improvements to reduce noise impacts to the community. The noise criteria objective would be met if the Total Noise level (i.e., including all Project and non-Project noise sources) in the neighbouring noise-sensitive land uses (e.g., residential communities and schools) does not increase.

Noise has been quantified using the annual average day-evening-night sound level, or L_{den}. 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_{den} 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, and to impulsive (e.g., railcar shunting), tonal (e.g., backup alarms on mobile equipment, rail squeal) and excessive low frequency noise sources (e.g., some shipboard generators) compared to a more neutral noise source like steady road traffic noise.

Fibreco-generated noise is defined as noise that can be controlled by Fibreco (i.e., Fibreco rail activities, mobile equipment, product handling equipment, and mechanical equipment), and CN noise associated with collection and delivery of railcars to Fibreco (although the timing of these activities is controlled by CN). It does not include CN-generated rail noise along the main line.

In this study, the first two rows of residences at the south side of the Norgate community and Bodwell School were considered. For analysis purposes, residences were organized into groups of houses plus Bodwell School. Although BKL predicted noise levels for each residence and school, noise modelling results are presented in this report as average values for each group.

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

4.2 Noise Mitigation Criteria

If the noise impact assessment criteria are exceeded at any receptors, noise mitigation options using the Best Available Techniques Not Entailing Excessive Cost (BATNEEC) approach can be investigated to avoid significant adverse effects. The interpretation of excessive cost will depend on the significance of the noise impact.

The BATNEEC approach involves the assessment of all factors that contribute to the resulting noise impact, such as whether or not:

- the quietest available equipment is being used;
- the site layout has been optimized to minimize the noise impact, e.g., through the use of natural screens such as buildings, open doors facing away from residences, distance attenuation, etc.;
- site procedures have been optimized to minimize the noise impact, e.g., keeping doors closed, conducting noisy procedures indoors;
- hours of operation for noisy procedures have been optimized to minimize the noise impact and/or restrict them to specific hours so that the community knows when to expect particularly annoying noise events;
- other aspects of site operations are being conducted in the most noise conscious manner; and
- additional noise enclosures or barriers are used to minimize the noise impact.

5 SPATIAL AND TEMPORAL BOUNDARIES

5.1 Spatial Boundaries

The study area (see Appendix D – Figure D1) covers all noise sensitive receptor locations that could potentially be affected by the proposed Project including residences in the Norgate community and Bodwell High School. Fibreco-generated noise received outside of this area is likely to be masked by other community noise sources.

5.1.1 Inventory of Noise Sensitive Receptors

Two types of noise sensitive receptors have been identified: residential and educational.

The land use in the Norgate community is entirely single-family residential. Noise levels were predicted at 60 receivers within Groups A and B (see Appendix D). This represents the first two rows of receivers at the south side of the community. Receiver Groups A and B were subdivided into two rows. For example, receivers in the first row of housing in Group A, in the south, fronting Fibreco, were labelled A1, and the second-row receivers were labelled A2.

In addition to the Norgate community, one receiver was added at Bodwell High School east of Fibreco to consider the impact on the school building. The school is located within a comprehensive development zone.

5.2 Temporal Boundaries

Noise predictions have been completed for a series of scenarios chosen to best represent the current and future noise environments, taking into account the Project and anticipated future growth in road and rail traffic. The proposed scenarios, as established in the Environmental Noise Assessment Terms of Reference provided to VFPA on November 26, 2015, are listed and described in Table 6.1.

Table 6.1: Noise Modelling Scenarios

Scenario No.	Noise Scenario	Total Throughput	Description
1	2015 Pre-Project	1.7 MMTPA (60 railcars per day)	This is the scenario that existed in 2015 prior to the Project works and the Philip Avenue Overpass project. This is based on recent information available on traffic and rail volumes and on-site noise measurements of Fibreco operations.
2	2020 Without Project	1.7 MMTPA (60 railcars per day)	This scenario includes the anticipated 2020 rail and road traffic volumes with the Philip Avenue Overpass, and current Fibreco operations at maximum capacity.
3	2020 With Project	3.0 MMTPA (84 railcars per day)	The same as Scenario 2, 2020 without-Project, but this scenario accounts for the change in noise associated with the Project and its increased capacity.

6 EXISTING ENVIRONMENTAL CONDITIONS

6.1 Baseline Noise Monitoring

BKL assessed existing baseline noise levels using noise measurement data collected in 2012 at three sites in the nearby Norgate residential community. In addition, a weeklong measurement was performed at Bodwell High School in October of 2015. Measurements were conducted using Brüel & Kjær Type 2250 and Larson Davis 820 and 824 sound level meters, all of which meet the Type 1 specifications in ANSI S1.4:1983. The microphones were field calibrated before and after each monitoring period using a Brüel & Kjær Type 4230 Calibrator.

BKL studied noise data to characterize the existing community noise environment and assist in establishing the pre-Project noise exposure levels at potentially affected receptors. These levels are summarized in Table 5.1. The L_{den} values incorporate adjustments for evening, night, and weekend noise but not for annoying characteristics from tones, impulses, or low frequency noise. The monitoring locations are shown in Figure 5.1 on the following page.

Information regarding acoustic terminology and noise level adjustments can be found in Appendix A and Appendix B.

Table 5.1: Summary of Baseline Noise Data

Maplewood (2012)	Wednesday May 23	Thursday May 24	Friday May 25	Saturday May 26	Sunday May 27
L_d	55	55	53	53	57
L_e	50	51	49	50	48
L_n	47	47	47	49	44
L_{den}	56	56	55	58	60

Beechwood (2012)	**Wednesday May 23-24**	**Thursday May 24-25**	**Friday May 25-26**	**Saturday May 26-27**	**Sunday May 27-28**
L_d	55	55	-	-	-
L_e	49	51	-	-	-
L_n	47	48	-	-	-
L_{den}	56	56	-	-	-
Pinewood (2012)	**Wednesday May 23-24**	**Thursday May 24-25**	**Friday May 25-26**	**Saturday May 26-27**	**Sunday May 27-28**
L_d	55	56	55	55	59
L_e	51	52	47	51	44
L_n	50	50	51	51	50
L_{den}	58	58	58	60	62
Bodwell (2015)	**Wednesday Oct 14-15**	**Thursday Oct 15-16**	**Friday Oct 16-17**	**Saturday Oct 17-18**	**Sunday Oct 18-19**
L_d	60	60	64	60	61
L_e	57	55	61	53	51
L_n	52	53	54	49	51
L_{den}	61	61	64	63	64

The purpose of the baseline noise analysis was to provide some insight into existing (pre-Project) noise levels within potentially affected communities. Fibreco is not the only contributor to existing noise levels in nearby communities. As such, the measured noise levels include other nearby industries; road, rail, air and marine traffic; and local activities at or near the monitoring sites.

Analysis of data revealed that the dominant noise sources measured at the Norgate baseline sites were road traffic on Welch Street and West 1st Street, aircraft and rail activity (pass-bys, whistling, shunting and wheel squeal). The dominant noise sources measured at Bodwell High School were Fibreco and Vancouver Shipyards activities, rail activity (passbys and rail squeal), and traffic on Welch Street and West 1st Street. Noise levels were highest during daytime hours and lowest during nighttime hours. Weekend noise levels at Bodwell High School were higher than weekday noise levels.

Figure 5.1: Baseline Noise Measurement Locations

7 NOISE MODELLING METHODOLOGY

7.1 Acoustical Model

Transportation and industrial noise levels have been predicted using the internationally recommended ISO 9613-2 (1996), Dutch SRM II (1996) and NMPB-Routes-2008 (2009a, 2009b) standards implemented in the outdoor sound propagation software Cadna/A version 4.5. The *Good Practice Guide for Strategic Noise Mapping* (EC WG-AEN 2007) points out that these standards (or previous versions) are recommended by the European Commission (EC) as current best practice to obtain accurate prediction results. BKL follows best practices described in the *Good Practice Guide on Port Area Noise Mapping and Management* (NoMEPorts 2008).

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 mechanical equipment and rail operations within Fibreco.

NMPB-Routes-2008 is the new version of the current European Union (EU) preferred road traffic noise prediction model. It specifies octave band sound power levels for roadways, dependant on traffic volumes, average travel speed, percentage of heavy vehicles (i.e., trucks, buses), road gradient and a flow conditions factor (continuous, accelerating, decelerating). BKL has found that this model provides a high level of agreement with traffic noise measurements conducted in British Columbia. BKL used this method to predict noise emission and propagation for all road traffic.

The Dutch SRM II is the EC preferred rail prediction model. It calculates levels in octave bands and splits the source into as many as five sub-sources, located at different heights depending on the type of train specified. BKL used this method to predict noise emission and propagation from CN Rail through-traffic.

The noise model used one order of sound reflection. Based on experimentation with the noise model, higher orders of reflection were found to be insignificant and were therefore not modelled.

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.[1] A moderate temperature inversion was assumed to represent conditions favourable for sound propagation but not absolute worst-case conditions.

7.2 Geometric Data

7.2.1 Topography

The intervening terrain has been modelled by directly importing ground contours from the District of North Vancouver's GIS website.

7.2.2 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 (1996) 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, for example, at the Fibreco facility, such surfaces include nearby roadways and the surface of Burrard Inlet. The ground surfaces of the residential and Spirit Trail areas have been modelled as absorptive.

7.2.3 Obstacles

The layout and dimensions of Fibreco's buildings and equipment were incorporated into the model based on drawings and details provided by Fibreco, CWA Engineers, Hatch Mott Macdonald, and observations and measurements made by BKL on site.

Orthophotos from Google Maps were used to identify other acoustically important objects or landmarks. Residential building heights were estimated using field observations and Google Street View and were otherwise assumed to be five metres high.

[1] Variations in temperature and humidity have little effect on the overall noise propagation and hence the model predictions will represent a much wider range of weather conditions.

Currently, there is a wooden wall along the east and south sides of the property for dust control. The wall is approximately 8.5 metres high and is constructed from wood planks. Although there are visible gaps between the wood planks, this wall will provide some sound attenuation for sources directly behind the wall. In the future, with the elimination of wood chip operations, the dust control wall will be removed.

7.3 Fibreco Noise Sources

To measure noise from rail activity (including unloading, shunting, empty car impact, and CN spotting and pulling), BKL measured sound pressure levels at the Fibreco site in most of the operational areas. These measurements were used to predict the sound power levels (*SWLs*) of the rail operations that have the potential to affect the noise level at nearby and distant receptors. The future rail track alignment was provided by Hatch Mott Macdonald.

*SWL*s for items of equipment and operations that are part of the Project were estimated based on information provided by Fibreco, CWA, extrapolation of the data measured on site and other measurements of similar equipment conducted by BKL.

BKL did not include any alarm buzzers in the model (3 short bursts which sound every 5 minutes when CN trains arrive on site) since they are not a dominant source relative to the continuous noise generated on site and because Fibreco has never received complaints due to alarm noise.

The following sections outline the noise sources implemented in the noise modelling. Detailed noise source tables can be found in Appendix C. Figure 6.1 shows some of these noise sources as modelled in Cadna/A. Locations of pre- and post-Project noise sources are shown in Figures D2 and D3 in Appendix D.

Figure 6.1: 3-D View of Cadna/A Noise Model

7.3.1 Ventilation Fans

The most significant ventilation fans at Fibreco are the baghouse dust collector fans and pellet shed exhaust fans. Fan sound power levels in BKL's noise model were calibrated to BKL measurements performed on site. Existing fan noise and operation times are not expected to change with the Project. In the future, a new baghouse fan will be installed at the dumper.

7.3.2 Conveyor System (including Ship Loader)

The existing conveyor systems along with the associated drive motors were modelled as line sources and point sources respectively. Locations and geometry were based on site observations and available site drawings.

The future new and modified conveyor systems and associated drive motors were modelled in a similar way based on detailed drawings from CWA Engineers. The per-metre sound power levels were calculated based on measurements performed on existing Fibreco conveyors on site and applied to all conveyors. Similarly, drive motors were modelled based on measurement data and scaled according to power rating differences.

7.3.3 Railcar Unloader (Dumper)

The existing railcar unloader is exposed with railcars entering from the south and exiting to the north. Wood pellets are unloaded through the bottom opening of railcars and the process does not generate significant noise. Wood chips are unloaded by rotating the entire railcar. The motors involved are the main noise sources for this operation and they are modelled as point sources near the dumper. These sources were calibrated to measurements taken on site at the dumper.

In the future, wood chip operations will be eliminated completely. Hence, railcars will only be unloaded through the bottom opening and the rail unloader is not expected to generate significant noise.

7.3.4 Rolling Impacts and Shunting from Unloading

Currently, emptied wood chip railcars are released from the north side of dumper to roll down a gradual slope and impact parked railcars. For every track that the emptied rail cars are directed to, the first two rail cars are pulled by a front end loader to the end of the track where the brakes are applied before other railcars are free rolled down the same track. The number of impacts is assumed to be approximately 80% of the total number of wood chip railcars unloaded, which equates to 6400 impacts per year. This operation only occurs during wood chip unloading where railcars are disconnected before being rotated and dumped.

Empty railcar impact noise was modelled as line sources on tracks 4 to 8 (since the impacts occur at various locations all along the tracks). The sources are calibrated to measurements taken previously by BKL of empty railcar impacts. A 12 dB highly impulsive sound penalty was added to these sources.

In the future, wood chip operations will be eliminated completely and empty railcars will not be disconnected and released to roll down the slope. Hence, rolling railcar impacts will also be eliminated.

7.3.5 CN Rail Delivery and Pickup

CN Rail currently delivers railcars to the Fibreco rail yard and spots strings of railcars. generally onto tracks 1-4 and 7-10. Empty cars are generally picked up in the same yard on tracks 4-8.

The delivery and pickup noise, which includes locomotive, carriage movement and shunting noise, was modelled using line sources on each track, based on noise measurements taken on site by BKL. For the 2015 scenario, this noise source was distributed evenly across all of the tracks in the rail yard.

A 5 dB regular impulsive sound penalty was added to the carriage shunting noise.

Similar to shipboard generators, low frequency noise from idling locomotives also has the potential to cause annoyance and induce building rattling. However, according to Fibreco's log of CN Rail arrivals, locomotives idle on Fibreco property for only short periods of time during normal switching activity. Through measurements and site observations, BKL did not observe any locomotives idling for an extended amount of time. Therefore, a low frequency noise adjustment was not applied.

In 2020, CN Rail activity at Fibreco is expected to decrease slightly as the number of deliveries and pickups should decrease with higher railcar capacity at the Fibreco rail yard.

7.3.6 Front End Loaders

Currently, Fibreco has three front end loaders on site. Two are used at a time to move full and empty railcars around the yard and to index strings of railcars through the dumper for unloading. Another one is also used for barge unloading. Based on Fibreco's utilization log, the front end loaders have a combined annual usage of 4,353 hours. The log indicates that they are idling 70% of the time and working 30% of the time.

Noise from the front end loaders, including idling, engine revving, backup alarms and horn sounding, was measured on site. Front end loader activity was modelled as area sources covering the rail yard area assuming 50% of the activities occur south of the dumper and the other 50% occur north of the dumper. These sources were calibrated to the site measurements.

In the future, the usage of the front end loaders is expected to increase with more railcars to unload. Operating hours are increased in proportion to the increase of annual railcars unloaded minus the hours used for barge unloading.

A 5 dB tonal penalty was added to the front end loader noise to account for added annoyance from backup alarm noise.

7.3.7 Bull Dozers

There are two bull dozers operating on site to move wood chips around the site. Their area of activity mainly includes the north and south wood chip pile as well as the pellet shed. Based on Fibreco's utilization log, the dozers have a combined annual usage of 2,600 hours with the assumption that they are idling 50% of the time and working 50% of the time.

Noise from the dozers, including idling, engine revving, backup alarms and horn sounding, was measured on site. Dozer activity was modelled as an area source covering their normal area of activity. These sources were calibrated to the site measurements.

In the future, dozers will be decommissioned completely as there will not be any wood chip operation.

7.3.8 Shipboard Generators

One shipboard generator was assumed to be operating whenever ships are being loaded at Fibreco's ship-loading berth. It was assumed that the amount of time a ship is docked would increase in proportion to the increase in throughput. The shipboard generator was modeled as a single point source at an assumed height of 30 metres and was calibrated to previous measurements of shipboard generators conducted by BKL.

Low frequency noise from shipboard generators has the potential to cause additional annoyance and induce building rattling when low frequency octave band levels are above 65 dB (ANSI 2005).

In this case, predictions of shipboard generator low frequency noise levels at the nearest residences were below 65 dB. Therefore, a low frequency noise adjustment was not applied.

7.4 Non-Fibreco Noise Sources

Noise from rail traffic on the CN main line and road traffic on Welch Street, West 1st Street and other local streets in the neighbourhood have been included in the noise model. Sound power levels of these sources were derived using information from the Philip Avenue Overpass project. Detailed noise source tables can be found in Appendix C.

7.4.1 CN Rail

The CN main line that services the area has been included in the noise model using alignment detail and input levels from the Philip Avenue Overpass noise model.

Existing rail noise was modelled by calibrating the sound emission of a single track to measured data collected at nearby baseline measurement locations.

BKL assumed a growth rate of 2% per year when assessing the noise increase related to rail traffic. This results in less than 1 dB increase and therefore was considered to be insignificant.

A rail whistle source at the Pemberton Street crossing has also been included in the model using input levels from the Philip Avenue Overpass noise model. The crossing will be removed in the future with the new Philip Avenue Overpass. Hence, whistling will also be eliminated in the future.

7.4.2 Road Traffic

Road alignments and traffic volumes for local roads such as Welch Street, West 1st Street, Philip Avenue and Pemberton Avenue for 2012 (without overpass) and for 2017 (with overpass)were provided previously by MMM Group for the Philip Avenue Overpass study.. These volumes have also been used in this study.

When assessing noise levels related to road traffic, a 25 per cent increase in traffic generally results in a 1 dB increase in noise level. For this study, road traffic volumes in 2015 are assumed to be the same as 2012 and predicted volumes for 2020 are assumed to be the same as those predicted for 2017 since a 25 per cent change is unlikely to occur in a span of four to six years.

7.4.3 Kinder Morgan Terminals and Vancouver Shipyards

Noise from nearby industrial activity includes Kinder Morgan Terminals and Vancouver Shipyards and was calibrated with community baseline noise measurements. Noise from both sites is assumed to remain unchanged in the future.

7.5 Sound Level Adjustments

The required 5 dB evening and 10 dB nighttime adjustments have been applied in the modelling to all noise that occurs during evening hours (7 pm to 10 pm) and nighttime hours (10 pm to 7 am). The 5 dB adjustment for weekend daytime hours (i.e., Saturdays and Sundays, 7 am to 7 pm) has also been included as Fibreco operates through the weekend. The adjustments are additive, so noise from a rail shunt at night would be adjusted upwards by 22 dB. These adjustments apply to all environmental noise sources, not just those associated with Fibreco.

7.6 Receivers

Calculations were performed for assumed receiver heights of three metres at the facades of the residential buildings included in the study area. Sound contours were calculated at the same height on five-metre-by-five-metre grids throughout the study area.

7.7 Limitations

For sound calculated using the ISO 9613 standard, the indicated accuracy is ± 3 dBA for source-to-receiver distances of up to 1000 metres. Accuracy is unknown at distances beyond 1000 metres. Distances from various points on the Fibreco site to residential receivers north of Fibreco and Bodwell High School are all within 1000 metres.

The estimated sound power levels for Fibreco equipment are based on measurements taken on site except where it was not possible to measure equipment. In such cases, the *SWLs* were predicted using data from Fibreco or previous measurements conducted by BKL.

In general, for individually modelled noise sources that are based on book data (fixed and mobile equipment, roads and railways), the estimated accuracy of the sound power levels is ± 5 dBA. Sound power levels derived from on-site measurements would generally be more accurate, likely ± 3 dBA.

The accuracy of the predicted difference in noise with and without the Project should be better than indicated above because any errors in the model without the Project would also be present in the model with the Project. Hence, any inaccuracies in the predicted difference would result only from newly introduced equipment and operations associated with the Project (i.e., new sources).

8 PREDICTED NOISE LEVELS

8.1 Fibreco-Generated Noise

A summary of the predicted Fibreco-generated noise (i.e., not accounting for other community noise) for each receiver group in each scenario is shown in Table 7.1.

Table 7.1: Summary of Predicted Fibreco-Generated Noise Levels, L_{den} (dBA)

Receiver Group (see Fig. D1, Appendix D)	Fibreco-Generated Noise			
	2015	2020		Increase With Project [3] – [1]
	[1] Pre-Project	[2] Without Project	[3] With Project	
A1	48	48	49	1
A2	47	47	49	2
B1	51	51	51	0
B2	49	49	50	1
C1	58	58	58	0

Fibreco-generated noise levels are predicted to

- remain the same for Group C1, the group with the highest Fibreco noise exposure; and
- increase for Groups A and B2, mainly due to the new conveyor system and baghouse fan as well as the increased throughput. Some of the increased noise was offset by the elimination of dozer activity and impacts from emptied wood chip railcars rolling down a gradual slope and impacting parked cars.

Sound contours are presented in Appendix D and detailed results by receptor are presented in tabular form in Appendix E.

8.2 Total Noise

A summary of the predicted Total noise for each receiver group in each scenario is shown in Table 7.2.

Table 7.2: Summary of Predicted Total Noise Levels, L_{den} (dBA)

Receiver Group (see Fig. D1, Appendix D)	Total Noise			
	2015	2020		Increase With Project [3] – [2]
	[1] Pre-Project	[2] Without Project	[3] With Project	
A1	56	56	56	0
A2	54	54	54	0
B1	57	56	56	-1
B2	54	54	54	0
C	61	61	61	0

The Total Noise is predicted to remain unchanged in the future for all groups except for B1 where a slight decrease is predicted due to train whistle cessation once the future Philip Avenue Overpass is constructed. Total noise with the Project versus without the Project is predicted to remain unchanged for all groups.

In order to illustrate the source contributions at different community locations, Table 7.3 shows the predicted partial noise levels at three of the fronting receivers after Project completion. These receivers were chosen to be representative of the typical community noise environment.

Table 7.3: Partial Noise Levels, With Project 2020, at Three Representative Receivers

Noise Source	Receiver L_{den} [dBA]		
	A1-08	B1-08	C1-01
Total Noise	**56**	**55**	**62**
Fibreco-Generated Noise	***50***	***51***	***58***
Fans	*46*	*47*	*54*
Conveyor	*42*	*43*	*55*
Rail	*40*	*43*	*46*
Mobile Equipment	*40*	*42*	*44*
Shiploader	*37*	*39*	*48*
CN	*38*	*40*	*39*
Other Noise Sources Total	***55***	***53***	***59***
Roads	*53*	*51*	*44*
CN Rail	*50*	*48*	*45*
Other Industries	*46*	*44*	*59*

Table 7.3 shows that Fibreco-generated noise is not the dominant source at the three receivers. At receiver C1-01, Fibreco-generated noise is comparable with noise from Vancouver Shipyards. For Fibreco-generated noise, fans and conveyor system are the dominant noise sources.

9 POTENTIAL MITIGATION

Although the Total Noise is not predicted to increase with the Project in 2020, noise mitigation could be considered to reduce the dominant Fibreco noise sources where practical. As shown in Table 7.3, fans and conveyors noise emissions are the highest among Fibreco sources. Potential mitigation strategies that could be considered include:

- Installing silencers for the outlets of the following fans:
    - Existing Pellet shed dust collector fan
    - Existing Main bag house suction fan
    - Existing Pellet shed exhaust fans
    - Future Dumper bag house fan
- Installing noise barriers between the fans mentioned above and the nearest noise sensitive receptors
- Installing noise barriers along Conveyors 3 and 4 at the ground level on the east and west sides
- Maintaining sections of the existing wooden dust fence and sealing the gaps between the panels

These strategies should be reviewed for practicality and cost-effectiveness in accordance with BATNEEC principles.

10 CONCLUSIONS

VFPA's goal for the Project, and for all tenant-led projects, is to demonstrate that terminal operators can incorporate ongoing efforts to reduce impacts to the community and demonstrate that future community noise levels will not exceed existing levels.

This study assessed potential community noise levels in 2020. It incorporated assumed throughput increases and operational changes at Fibreco and anticipated changes to road and rail traffic.

This report documents existing noise levels in 2015 at potentially affected noise sensitive receiver locations near the Project and predicts noise levels following the completion of the Project in 2020. BKL developed a Cadna/A computer noise model to assess existing and future noise levels at all nearby residences.

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

- Wood chip operations will be completely eliminated.
- Barge import and export will be completely eliminated.
- Unloaded railcars will no longer roll freely down the slope and impact stationary cars.
- CN service efficiency will improve since they will be able to deliver and retrieve more cars at a time, resulting in fewer shunting impacts per car serviced.
- Shipboard generator noise emissions will increase in proportion to the proposed throughput increase.

BKL's noise model included the following factors:

- CN servicing noise (spotting and pulling cars) on Fibreco rail tracks was considered Fibreco-generated noise.
- A 12 dB highly impulsive noise penalty was applied to impact noise from empty railcars free rolling down a gradual slope and impacting parked railcars.
- A 5 dB regular impulsive noise penalty was applied to front end loaders moving rail cars.
- A 5 dB tonal noise penalty was applied to backup beepers from mobile equipment.
- A 12 dB highly impulsive noise penalty was applied to CN servicing noise due to shunting impacts

Based on the assumptions and input data used, BKL predicts a 0 to 2 dBA increase in Fibreco-generated noise throughout the surrounding community once the Project is at full capacity. However, future total noise levels with and without the Project are predicted to remain the same throughout the surrounding community, which shows that Fibreco is not the dominant source in the community. Total noise levels are predicted to remain unchanged in the future relative to existing noise levels, except for a slight decrease in one residential area due to train whistle cessation once the future Philip Avenue Overpass is constructed.

There are a number of noise mitigation strategies, such as fan silencers and noise barriers, that could be investigated to minimize Project noise levels using best available techniques not entailing excessive cost.

11 REFERENCES

American National Standards Institute (ANSI). 2005. Quantities and Procedures for Description and Measurement of Environmental Sound. Part 4: Noise Assessment and Prediction of Long-term Community Response. Reference No. ANSI S12.9-2005 Part 4. New York, Acoustical Society of America.

American National Standards Institute (ANSI). 2007. Quantities and Procedures for Description and Measurement of Environmental Sound - Part 5: Sound Level Descriptors for Determination of Compatible Land Use. Reference No. ANSI/ASA S12.9-2007 Part 5. New York, Acoustical Society of America.

CWA Engineers Inc. 2015. Fibreco Expansion Project: Concept Development Study Report. Vancouver, CWA.

CWA Engineers Inc. 2015. Fibreco Grain Concept Development Project – Terminal Development Operations Design Criteria. Vancouver, CWA.

CWA Engineers Inc. 2015. Preliminary Project Inquiry: Fibreco Terminal Enhancement Project. Vancouver, CWA.

Hatch Mott MacDonald Ltd. 2015. Fibreco Terminal Enhancement Project – Phase 1 Expansion Operational Review Report. Vancouver, HMM.

European Commission Working Group Assessment of Exposure to Noise (EC WG-AEN). 2007. Good Practice Guide for Strategic Noise Mapping and the Production of Associated Data on Noise Exposure. Brussels, European Commission.

International Organisation for Standardization (ISO). 1996. Acoustics - Attenuation of Sound During Propagation Outdoors - Part 2: General Method of Calculation. Reference No. ISO 9613-2:1996. Geneva, International Organisation for Standardization.

International Organisation for Standardization (ISO). 2003. Acoustics - Description, measurement and assessment of environmental noise - Part 1: Basic quantities and assessment procedures. Reference No. ISO 1996-1:2003. Geneva, International Organisation for Standardization.

Ministerie Volkshuisvesting, Ruimetelijke Ordening en Milieubeheer (VROM). 1996. Railway Noise: The Netherlands national computation method "Standaard-Rekenmethode (SRM) II" published in "Reken- en Meetvoorschrift Railverkeerslawaai '96. Nr. 14/1997. VROM.

NMPB-Routes-2008. 2009a. Guide méthodologique, Prévision du bruit routier, Volume 1: Calcul des émissions sonores dues au trafic routier. Référence Sétra: 0924-1. SETRA (Service d'études sur les transports, les routes et leurs aménagements).

NMPB-Routes-2008. 2009b. Methodological guide, Road noise prediction, volume 2: NMPB 2008 - Noise propagation computation including meteorological effects. Référence: LRS 2008-76-069. SETRA (Service d'études sur les transports, les routes et leurs aménagements).

APPENDIX A GLOSSARY

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.

continuous sound level – Generally defined by many BC municipal noise bylaws as the A-weighted sound level, measured using the "slow" time constant (see time constant), for any sound occurring for a duration of more than three minutes in a 15-minute period.

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) to 5 times the sound exposure level obtained during the evening (L_e) (7:00 pm to 11:00 pm) and to 10 times the sound exposure level obtained during the nighttime (L_n) (11:00 pm to 7:00 am) to account for greater human sensitivity to 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.

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.

non-continuous sound level - Generally defined by many BC municipal noise bylaws as the maximum A-weighted sound level using the "slow" time constant.

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 receptors – 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.

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.

shunting – Also called switching. The process of sorting rolling stock into train sets, or the reverse.

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.

Z-weighting – Z-weighting, or zero frequency weighting, has no weighting applied to account for human hearing sensitivity. Also written as dBZ.

APPENDIX B INTRODUCTION TO SOUND AND ENVIRONMENTAL NOISE ASSESSMENT

B.1 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.

B.2 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).

APPENDIX C NOISE SOURCE TABLES

The daily operating times in the following table represent an average day over the course of a year.

Source	Modelled As	SWL Source	Adjustment	Daily Operating Time (minutes) D: Day, E: Evening, N: Night						Sound Power Level (SWL)	Description of change between Existing / Future
				Existing Scenario 2015			Future Scenario 2020				
				D	E	N	D	E	N	dBA	
Rail											
CN Spot/Pull - Locomotive	Line source covering tracks from main line, onto Fibreco yard	BKL Measurements at Fibreco	Tonal +5dB	38	7	13	34	6	12	112	Existing: Estimated based on Fibreco log of CN delivery and pickup Future: Operation time scaled by expected CN trains on site on the future
CN Spot/Pull - Carriages	Line sources representing each track individually	BKL Measurements at Fibreco	Highly Impulsive +12dB	38	7	13	34	6	12	112	Existing: Estimated based on Fibreco log of CN delivery and pickup Future: Operation time scaled by expected CN trains on site on the future
Internal Carriage Movement	Area source covering Fibreco rail yard	BKL Measurements at Fibreco	Regular Impulsive +5dB	429	46	46	541	58	58	112	Existing: Calculated based on Fibreco data Future: Operation time scaled by the throughput increase
Free Rolling Shunting	Line sources representing tracks 4 to 8	Based on BKL previous noise measurements	Highly Impulsive +12dB	720	180	540				138	Existing: Estimated 18 rolling impacts per day calculated based on number of cars unloaded. Future: Free rolling shunting will be eliminated
Railcar Dumper Motor 50HP	Point source	BKL Measurements at Fibreco		112	12	12				107	Existing: Calculated based on Fibreco data Future: Removed with the elimination of chips operation

Source	Modelled As	SWL Source	Adjustment	Daily Operating Time (minutes) D: Day, E: Evening, N: Night						Sound Power Level (SWL)	Description of change between Existing / Future
				Existing Scenario 2015			Future Scenario 2020				
				D	E	N	D	E	N	dBA	
Indexer Motor	Point source	Based on BKL previous noise measurements					541	58	58	86	Existing: N/A Future: Fibreco estimate
Mobile Equipment											
Front End Loaders in Rail Yard (Working)	Area source	BKL Measurements at Fibreco	Tonal +5dB	156	21	33	492	66	104	114	Existing: Calculated from Fibreco log of equipment usage Future: Operating time scaled up by expected number of railcars
Front End Loaders in Rail Yard (Idling)	Area source	BKL Measurements at Fibreco		349	47	74	224	30	47	90	Existing: Calculated from Fibreco log of equipment usage Future: Operating time scaled up by expected number of railcars
Front End Loader Unloading Barge	Point source	BKL Measurements at Fibreco	Tonal +5dB	26	5	5				114	Existing: Calculated from Fibreco log of equipment usage Future: Barge operations to be eliminated
Bulldozers (Working)	Area source	BKL Measurements at Fibreco		176	19	19				111	Existing: Calculated from Fibreco log of equipment usage Future: Barge operations to be eliminated
Bulldozers (Idling)	Area source	BKL Measurements at Fibreco		176	19	19				99	Existing: Calculated from Fibreco log of equipment usage Future: Barge operations to be eliminated

Source	Modelled As	SWL Source	Adjustment	Daily Operating Time (minutes) D: Day, E: Evening, N: Night						Sound Power Level (SWL)	Description of change between Existing / Future
				Existing Scenario 2015			Future Scenario 2020				
				D	E	N	D	E	N	dBA	
Material Transport Systems											
Inbound											
Cv15 Conveyor	Line source	BKL Measurements at Fibreco		429	46	46	541	58	58	107	Existing: Calculated from Fibreco operation log Future: Fibreco estimate based on throughput changes
Cv15 Drive 250 HP	Point source	BKL Measurements at Fibreco								107	
Cv16 Conveyor	Line source	BKL Measurements at Fibreco		105	11	11				107	Existing: Calculated from Fibreco operation log Future: To be removed.
Cv16 Drive 100 HP	Point source	BKL Measurements at Fibreco								102	
Cv17 Conveyor	Line source	BKL Measurements at Fibreco		354	38	38	180	19	19	110	Existing: Calculated from Fibreco operation log Future: Fibreco estimate based on throughput changes
Cv17 Drive 200 HP	Point source	BKL Measurements at Fibreco								105	
Cv18 Conveyor	Line source	BKL Measurements at Fibreco		95	10	10	54	6	6	104	Existing: Calculated from Fibreco operation log Future: Fibreco estimate based on throughput changes
Cv18 Drive 100 HP	Point source	BKL Measurements at Fibreco								102	

Source	Modelled As	SWL Source	Adjustment	Daily Operating Time (minutes) D: Day, E: Evening, N: Night						Sound Power Level (SWL)	Description of change between Existing / Future
				Existing Scenario 2015			Future Scenario 2020				
				D	E	N	D	E	N	dBA	
Cv19 Conveyor	Line source	BKL Measurements at Fibreco		37	4	4				104	Existing: Calculated from Fibreco operation log Future: To be removed.
Cv19 Drive 100 HP	Point source	BKL Measurements at Fibreco								102	
Cv71 Conveyor	Line source	BKL Measurements at Fibreco		222	24	24	126	14	14	104	Existing: Calculated from Fibreco operation log Future: Fibreco estimate based on throughput changes
Cv71 Drive 150 HP	Point source	BKL Measurements at Fibreco								104	
Cv72 Conveyor	Line source	BKL Measurements at Fibreco		222	24	24	126	14	14	108	Existing: Calculated from Fibreco operation log Future: Fibreco estimate based on throughput changes
Cv72 Drive 200 HP	Point source	BKL Measurements at Fibreco								105	
Cv21 Conveyor	Line source	BKL Measurements at Fibreco		26	5	5				110	Existing: Calculated from Fibreco operation log Future: To be removed.
Cv21 Drive 150 HP	Point source	BKL Measurements at Fibreco								105	

Source	Modelled As	SWL Source	Adjustment	Daily Operating Time (minutes) D: Day, E: Evening, N: Night						Sound Power Level (SWL)	Description of change between Existing / Future
				Existing Scenario 2015			Future Scenario 2020				
				D	E	N	D	E	N	dBA	
Cv22 Conveyor	Line source	BKL Measurements at Fibreco		222	24	24				110	Existing: Calculated from Fibreco operation log Future: To be removed.
Cv22 Drive 75 HP	Point source	BKL Measurements at Fibreco								101	
Cv50 Conveyor	Line source	BKL Measurements at Fibreco					135	15	15	109	Existing: N/A Future: Fibreco estimate based on throughput changes
Cv50 Drive 300 HP	Point source	BKL Measurements at Fibreco								107	
Cv51 Conveyor	Line source	BKL Measurements at Fibreco					271	29	29	100	Existing: N/A Future: Fibreco estimate based on throughput changes
Cv51 Drive 300 HP	Point source	BKL Measurements at Fibreco								102	
Cv53 Conveyor	Line source	BKL Measurements at Fibreco					271	29	29	101	Existing: N/A Future: Fibreco estimate based on throughput changes
Cv53 Drive 250 HP	Point source	BKL Measurements at Fibreco								106	

Source	Modelled As	SWL Source	Adjustment	Daily Operating Time (minutes) D: Day, E: Evening, N: Night						Sound Power Level (SWL)	Description of change between Existing / Future
				Existing Scenario 2015			Future Scenario 2020				
				D	E	N	D	E	N	dBA	
Cv54 Conveyor	Line source	BKL Measurements at Fibreco					135	15	15	108	Existing: N/A Future: Fibreco estimate based on throughput changes
Cv54 Drive 300 HP	Point source	BKL Measurements at Fibreco								107	
Cv55 Conveyor	Line source	BKL Measurements at Fibreco					135	15	15	108	Existing: N/A Future: Fibreco estimate based on throughput changes
Cv55 Drive 250 HP	Point source	BKL Measurements at Fibreco								106	
Cv56 Conveyor	Line source	BKL Measurements at Fibreco					135	15	15	108	Existing: N/A Future: Fibreco estimate based on throughput changes
Cv56 Drive 300 HP	Point source	BKL Measurements at Fibreco								107	
Cv57 Conveyor	Line source	BKL Measurements at Fibreco					135	15	15	108	Existing: N/A Future: Fibreco estimate based on throughput changes
Cv57 Drive 250 HP	Point source	BKL Measurements at Fibreco								106	

Source	Modelled As	SWL Source	Adjustment	Daily Operating Time (minutes) D: Day, E: Evening, N: Night						Sound Power Level (SWL)	Description of change between Existing / Future
				Existing Scenario 2015			Future Scenario 2020				
				D	E	N	D	E	N	dBA	
BE02 Bucket Elevator Drive 300 HP	Line source	BKL Measurements at Fibreco					271	29	29	107	Existing: N/A Future: Fibreco estimate based on throughput changes
Outbound											
Cv60 Conveyor	Line source	BKL Measurements at Fibreco					143	30	73	110	Existing: N/A Future: Fibreco estimate based on throughput changes
Cv60 Drive 200 HP	Point source	BKL Measurements at Fibreco								105	
Cv61 Conveyor	Line source	BKL Measurements at Fibreco					143	30	73	110	Existing: N/A Future: Fibreco estimate based on throughput changes
Cv61 Drive 200 HP	Point source	BKL Measurements at Fibreco								105	
Cv65 Conveyor	Line source	BKL Measurements at Fibreco					143	30	73	104	Existing: N/A Future: Fibreco estimate based on throughput changes
Cv65 Drive 150 HP	Point source	BKL Measurements at Fibreco								104	

Source	Modelled As	SWL Source	Adjustment	Daily Operating Time (minutes) D: Day, E: Evening, N: Night						Sound Power Level (SWL)	Description of change between Existing / Future
				Existing Scenario 2015			Future Scenario 2020				
				D	E	N	D	E	N	dBA	
Cv2 Conveyor	Line source	BKL Measurements at Fibreco		257	55	130	287	61	145	109	Existing: Calculated from Fibreco operation log Future: Fibreco estimate based on throughput changes
Cv2 Drive 200 HP	Point source	BKL Measurements at Fibreco								105	
Cv3 Conveyor	Line source	BKL Measurements at Fibreco		257	55	130	287	61	145	114	Existing: Calculated from Fibreco operation log Future: Fibreco estimate based on throughput changes
Cv3 Drive 350 HP	Point source	BKL Measurements at Fibreco								108	
Cv4 Conveyor	Line source	BKL Measurements at Fibreco		187	40	95	96	20	48	110	Existing: Calculated from Fibreco operation log Future: Fibreco estimate based on throughput changes
Cv4 Drive 200 HP	Point source	BKL Measurements at Fibreco								105	
Cv5 Conveyor	Line source	BKL Measurements at Fibreco		116	25	59	67	14	34	100	Existing: Calculated from Fibreco operation log Future: Fibreco estimate based on throughput changes
Cv5 Drive 100 HP	Point source	BKL Measurements at Fibreco								102	

Source	Modelled As	SWL Source	Adjustment	Daily Operating Time (minutes) D: Day, E: Evening, N: Night						Sound Power Level (SWL)	Description of change between Existing / Future
				Existing Scenario 2015			Future Scenario 2020				
				D	E	N	D	E	N	dBA	
Cv6 Conveyor	Line source	BKL Measurements at Fibreco								-	Existing: Underground - not modelled
Cv6 Drive 300 HP	Point source	BKL Measurements at Fibreco								-	Future: Underground - not modelled
Cv32 Conveyor	Line source	BKL Measurements at Fibreco		9	2	5				108	Existing: Calculated from Fibreco operation log
Cv32 Drive 300 HP	Point source	BKL Measurements at Fibreco								107	Future: To be removed.
CvS1 Conveyor	Line source	BKL Measurements at Fibreco		257	55	130	287	61	145	103	Existing: Calculated from Fibreco operation log
CvS1 Drive 60 HP	Point source	BKL Measurements at Fibreco								100	Future: Fibreco estimate based on throughput changes
CvS2 Conveyor	Line source	BKL Measurements at Fibreco		257	55	130	287	61	145	99	Existing: Calculated from Fibreco operation log
CvS2 Drive 60 HP	Point source	BKL Measurements at Fibreco								100	Future: Fibreco estimate based on throughput changes

Source	Modelled As	SWL Source	Adjustment	Daily Operating Time (minutes) D: Day, E: Evening, N: Night						Sound Power Level (SWL)	Description of change between Existing / Future
				Existing Scenario 2015			Future Scenario 2020				
				D	E	N	D	E	N	dBA	
CvS3 Conveyor	Line source	BKL Measurements at Fibreco		257	55	130	287	61	145	94	Existing: Calculated from Fibreco operation log Future: Fibreco estimate based on throughput changes
CvS3 Drive 50 HP	Point source	BKL Measurements at Fibreco								99	
Blower Motors 3 X 700 HP	Point Source	BKL Measurements at Fibreco		91	19	46				105	Existing: Calculated from Fibreco operation log Future: To be removed.
Blower Outlet	Point Source	BKL Measurements at Fibreco		91	19	46				120	Existing: Calculated from Fibreco operation log Future: To be removed.
Fans											
Pellet Shed Dust Collector Fan	Point source	BKL Measurements at Fibreco		216	54	162	216	54	162	104	Existing: Fibreco estimate Future: Operation time estimated to remain unchanged
Main Bag House Suction Fan Outlet	Point source	BKL Measurements at Fibreco		216	54	162	216	54	162	115	Existing: Fibreco estimate Future: Operation time estimated to remain unchanged
Silo Fans	Point source	BKL Measurements at Fibreco		216	54	162	216	54	162	102	Existing: Fibreco estimate Future: Operation time estimated to remain unchanged

Source	Modelled As	SWL Source	Adjustment	Daily Operating Time (minutes) D: Day, E: Evening, N: Night						Sound Power Level (SWL)	Description of change between Existing / Future
				Existing Scenario 2015			Future Scenario 2020				
				D	E	N	D	E	N	dBA	
Pellet Shed Exhaust Fans	Point source	BKL Measurements at Fibreco		720	180	540	720	180	540	104	Existing: 24/7 operation Future: 24/7 operation
Dumper Compressor	Point source	BKL Measurements at Fibreco		112	12	12				107	Existing: Calculated based on Fibreco operation log Future: To be removed with elimination of chips operations
Dumper Bag House Fan	Point source	BKL Measurements at Fibreco					541	58	58	107	Existing: N/A Future: Fibreco estimate based on throughput changes
CN Rail											
Through Track	Rail source	Based on measurements completed by BKL, and projected traffic increase		720	180	540	720	180	540	-	As described in Section 6.5.1
Rail Whistle	Line source	Based on measurements completed by BKL		720	180	540	720	180	540	119	As described in Section 6.5.1

Source	Modelled As	SWL Source	Adjustment	Daily Operating Time (minutes) D: Day, E: Evening, N: Night						Sound Power Level (SWL)	Description of change between Existing / Future
				Existing Scenario 2015			Future Scenario 2020				
				D	E	N	D	E	N	dBA	
Roads											
Roads	Road sources	Based on road traffic volumes used in Philip Avenue Overpass Project		720	180	540	720	180	540	-	As described in Section 6.5.2
Neighbouring Terminals											
Vancouver Shipyards	Point source	Back-calculated from community noise measurements		720	180	540	720	180	540	-	As described in Section 6.5.3
Kinder Morgan Terminals	Point source	Back-calculated from community noise measurements		720	180	540	720	180	540	-	As described in Section 6.5.3

APPENDIX D FIGURES AND NOISE CONTOURS

Figure D1: Study Area and Noise Sensitive Receiver Groups

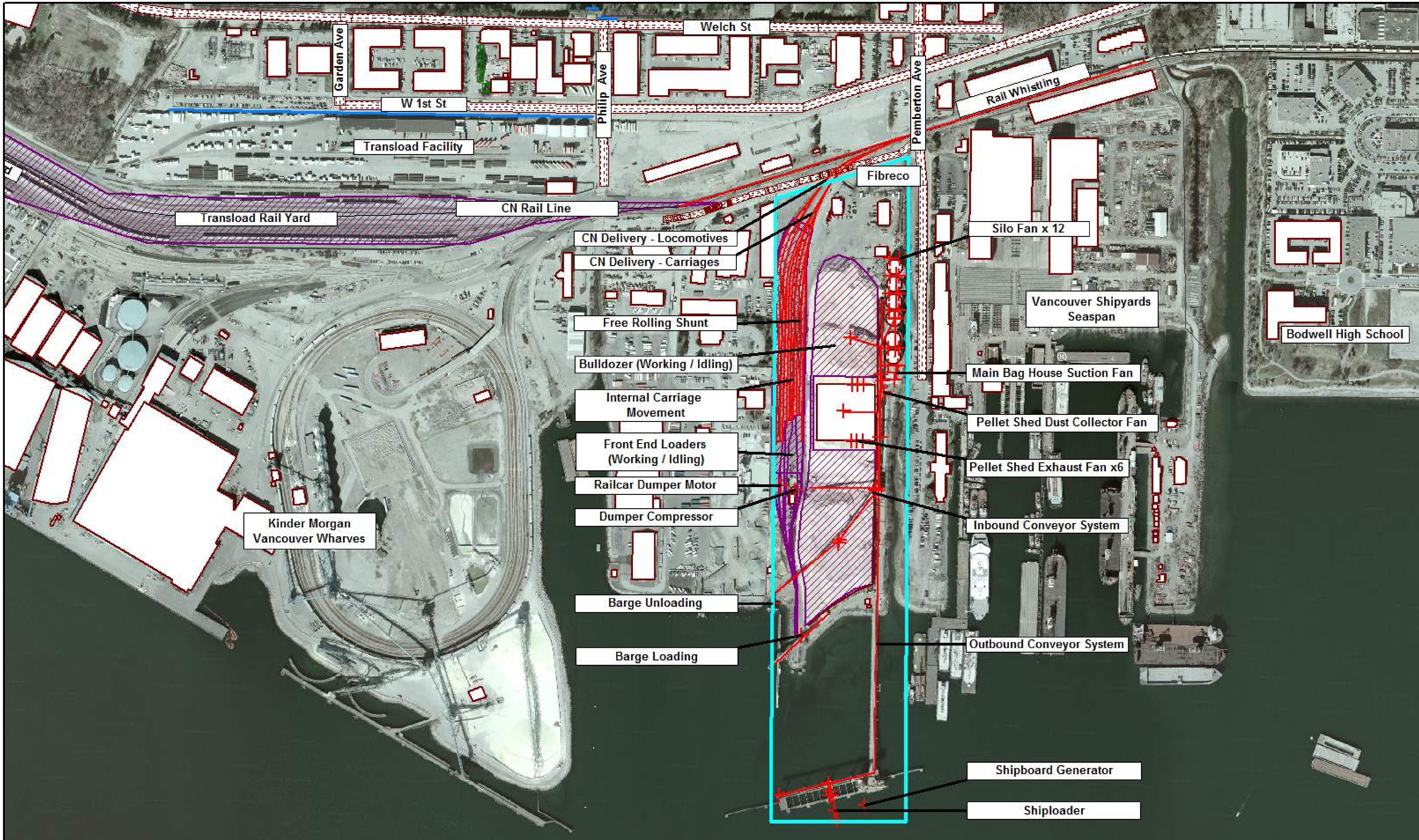

Figure D2: Layout of Pre-Project Noise Sources

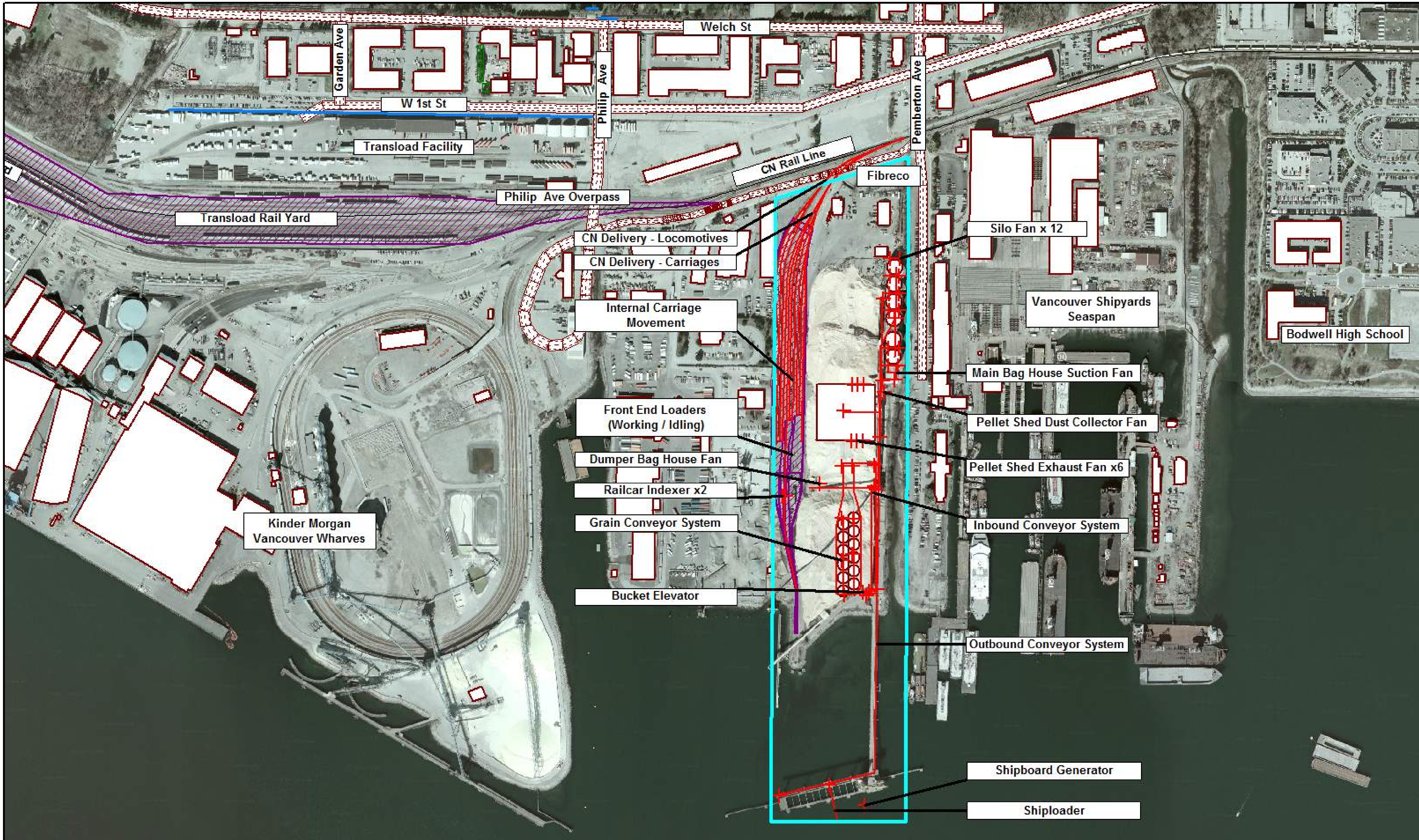

Figure D3: Layout of Post-Project Noise Sources

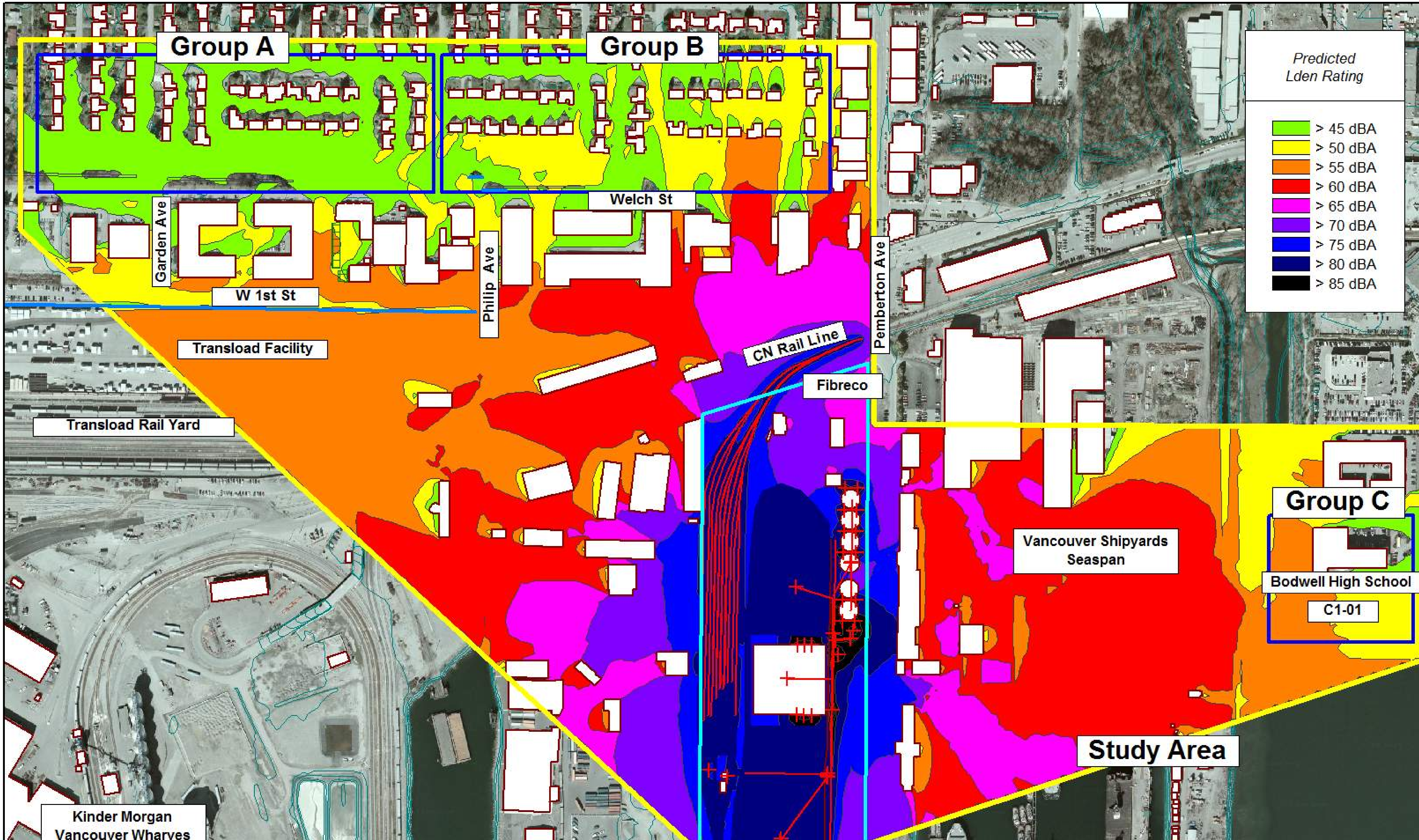

Figure D4: Predicted Existing 2015 Fibreco-Generated Noise Rating

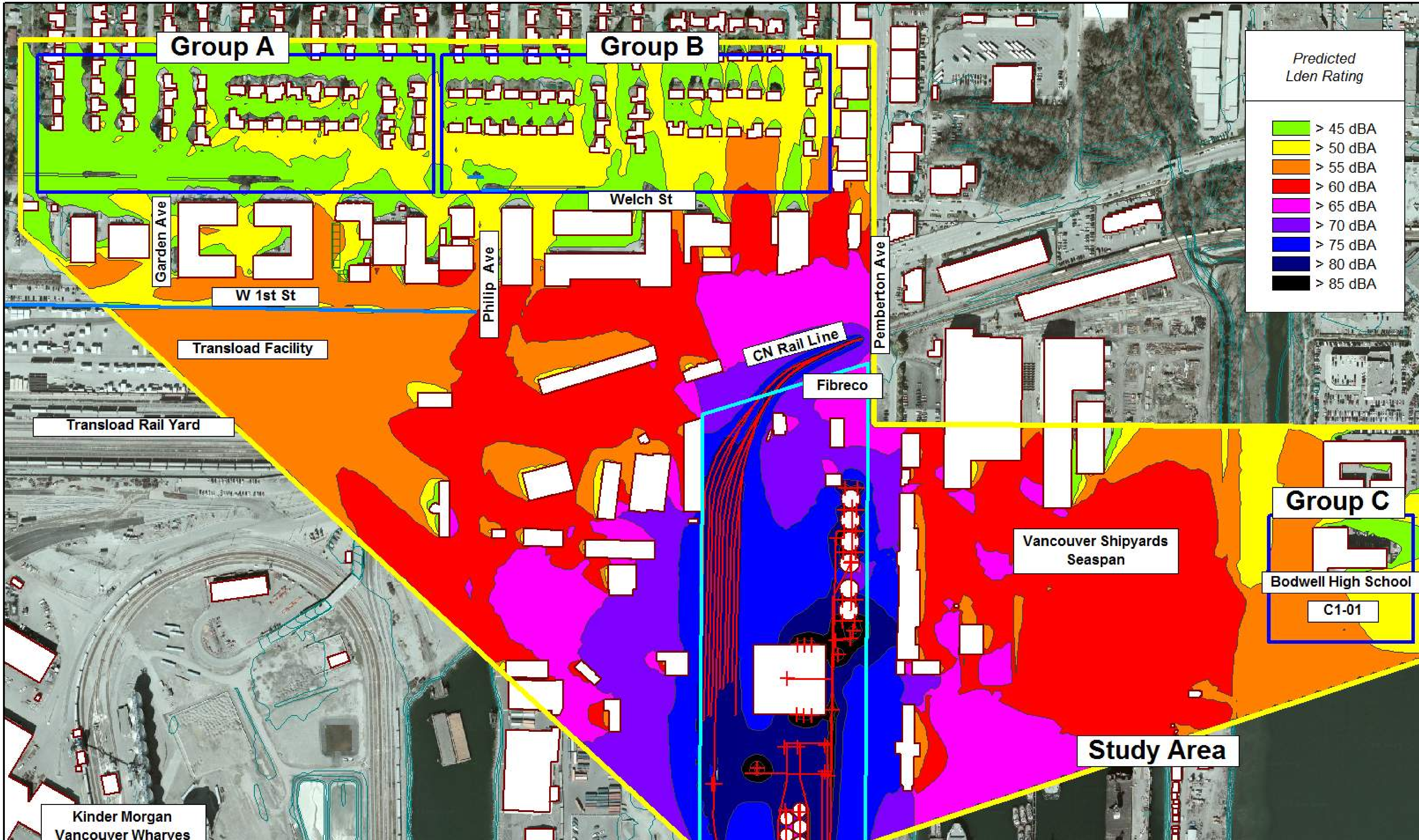

Figure D5: Predicted Future 2020 Fibreco-Generated Noise Rating

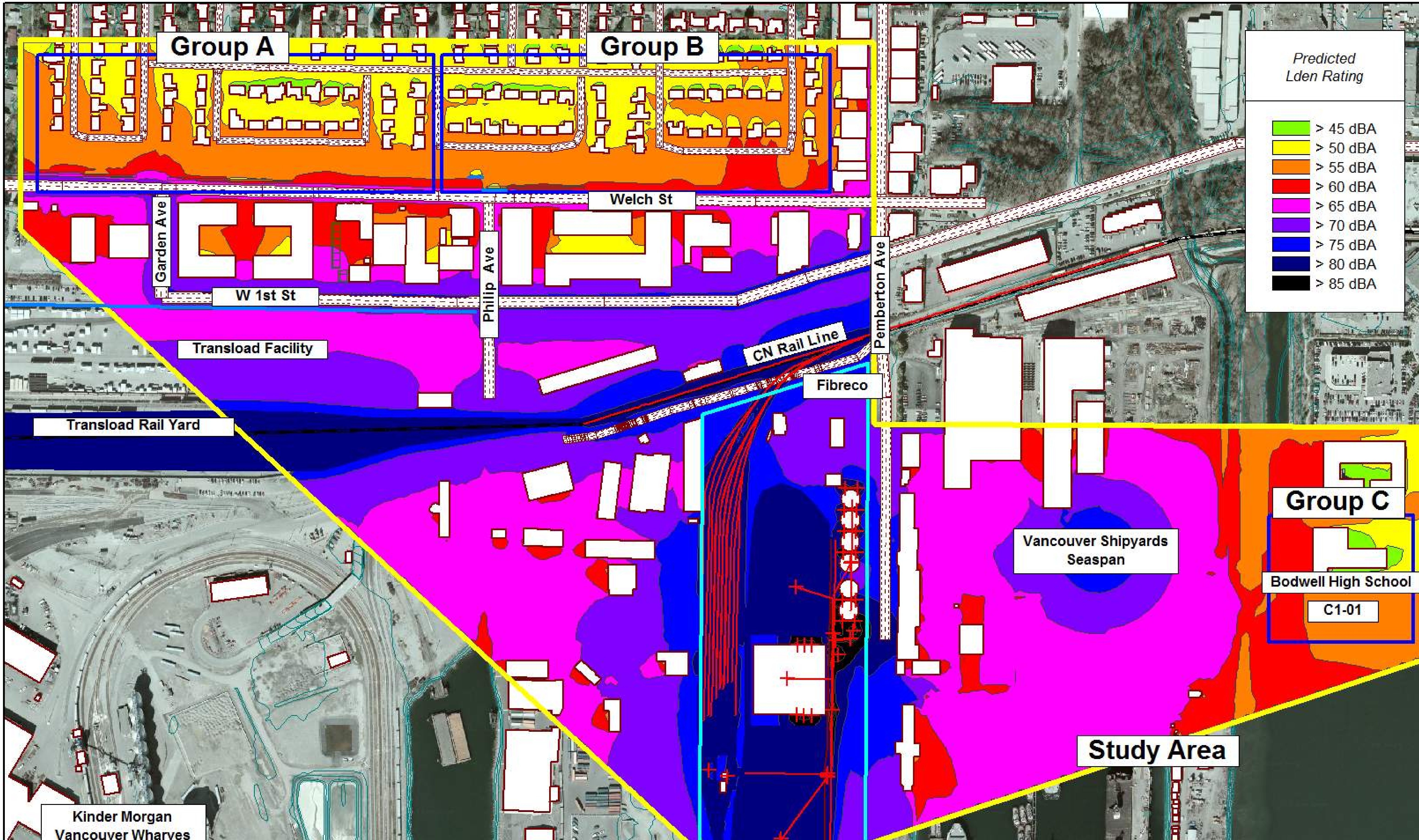

Figure D6: Predicted Existing 2015 Total Noise Rating

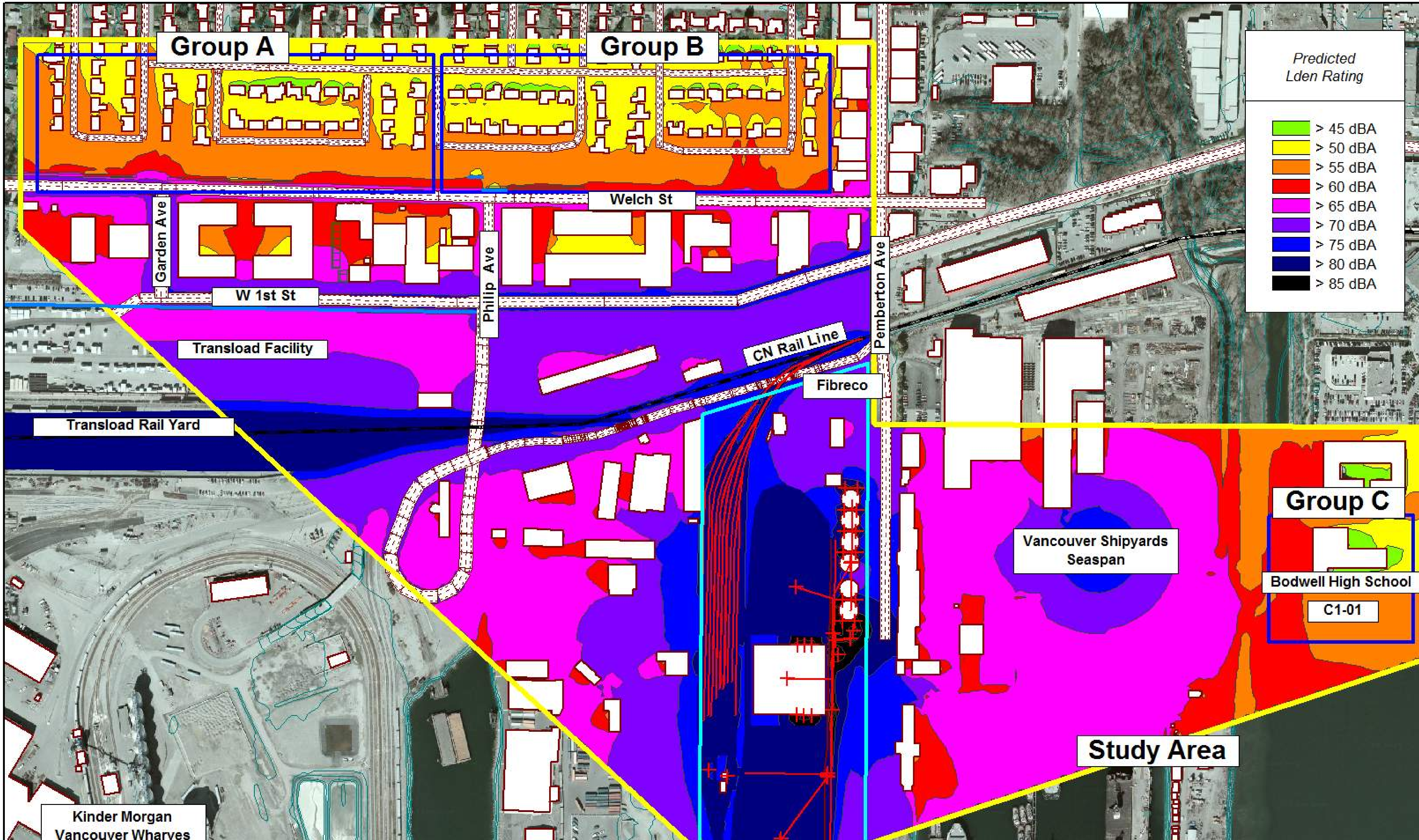

Figure D7: Predicted Future 2020 Without Project Total Noise Rating

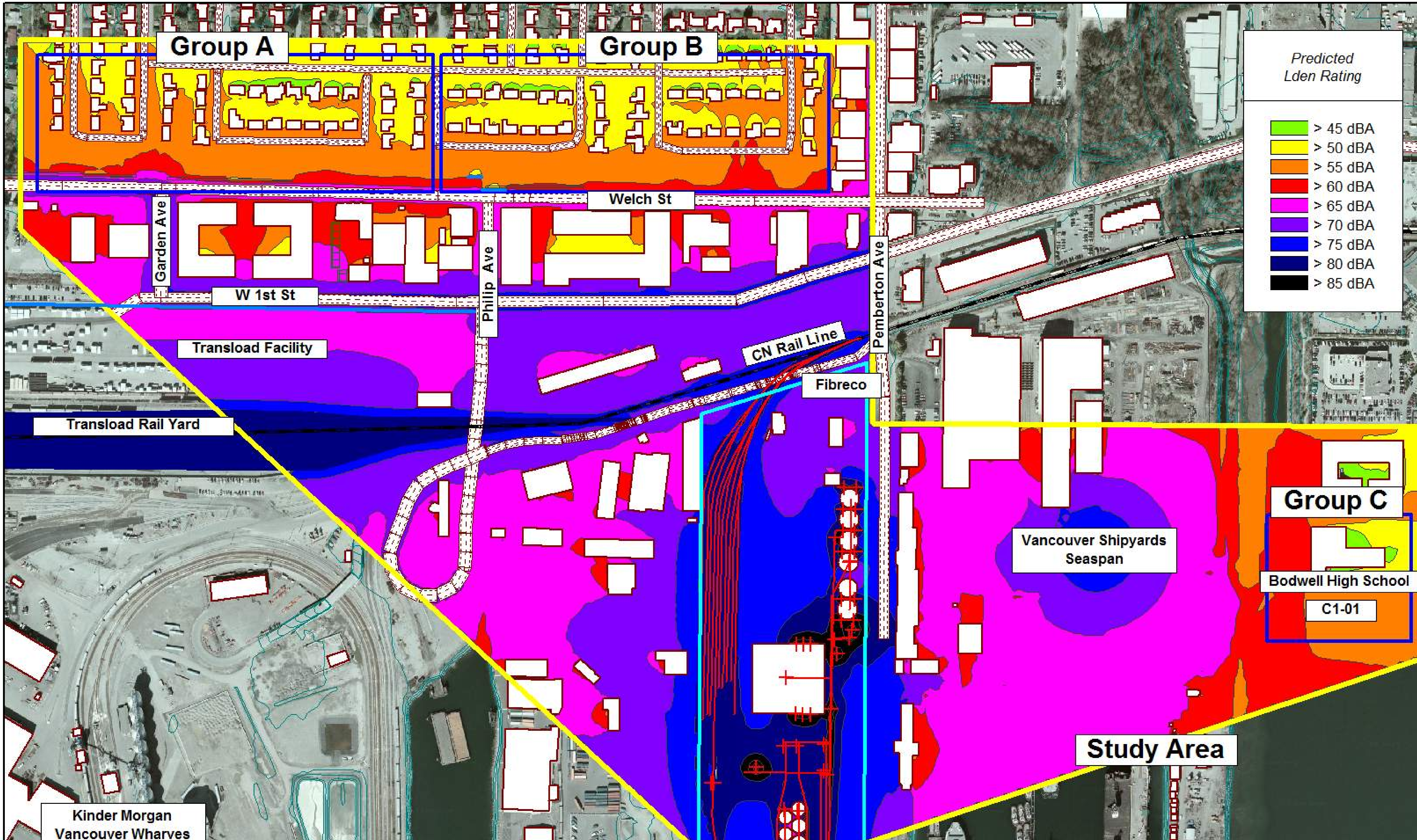

Figure D8: Predicted Future 2020 With Project Total Noise Rating

APPENDIX E RESULTS TABLES

Receiver	Fibreco-generated Noise				Total Noise			
	Exist 2015 [1]	Future 2020 Without Project [2]	Future 2020 With Project [3]	Difference [3] – [1]	Exist 2015 [1]	Future 2020 Without Project [2]	Future 2020 With Project [3]	Difference [3] – [2]
Name	L_{den} dBA	L_{den} dBA	L_{den} dBA		L_{den} dBA	L_{den} dBA	L_{den} dBA	
A1-01	46	46	48	2	57	57	57	0
A1-02	47	47	48	2	57	58	58	0
A1-03	47	47	49	2	58	58	58	0
A1-04	47	47	49	2	58	58	58	0
A1-05	47	47	48	2	56	56	56	0
A1-06	48	48	49	1	56	55	56	0
A1-07	48	48	50	2	56	56	56	0
A1-08	48	48	50	2	56	56	56	0
A1-09	48	48	50	2	56	56	56	0
A1-10	48	48	50	2	56	56	57	0
A1-11	48	48	50	2	57	57	57	0
A1-12	48	48	50	2	56	56	57	0
A1-13	50	50	51	1	56	56	56	0
A1-14	49	49	50	1	55	55	55	0
A2-01	46	46	47	2	54	54	55	0
A2-02	45	45	47	2	56	56	56	0
A2-03	46	46	48	2	55	56	56	0
A2-04	46	46	48	2	54	54	54	0
A2-05	48	48	50	2	53	54	54	1

Receiver	Fibreco-generated Noise				Total Noise			
	Exist 2015 [1]	Future 2020 Without Project [2]	Future 2020 With Project [3]	Difference [3] – [1]	Exist 2015 [1]	Future 2020 Without Project [2]	Future 2020 With Project [3]	Difference [3] – [2]
Name	L_{den} dBA	L_{den} dBA	L_{den} dBA		L_{den} dBA	L_{den} dBA	L_{den} dBA	
A2-06	47	47	48	2	53	53	54	1
A2-07	47	47	49	2	54	54	54	0
A2-08	46	46	48	2	53	53	54	0
A2-09	47	47	49	2	54	54	54	0
A2-10	47	47	49	2	54	54	54	0
A2-11	48	48	49	2	54	54	54	0
A2-12	48	48	50	2	55	55	55	0
A2-13	49	49	50	1	53	53	53	1
A2-14	49	49	50	1	54	53	54	0
B1-01	49	49	50	1	56	55	55	0
B1-02	49	49	50	1	56	55	56	0
B1-03	50	50	50	1	56	56	56	0
B1-04	50	50	51	1	56	55	56	0
B1-05	50	50	51	1	56	56	56	0
B1-06	50	50	51	1	56	56	56	0
B1-07	51	51	52	1	56	56	56	0
B1-08	50	50	51	1	55	55	55	0
B1-09	47	47	48	0	55	55	55	0
B1-10	50	50	50	0	57	56	56	0
B1-11	52	52	52	0	57	57	57	0

Receiver	Fibreco-generated Noise				Total Noise			
	Exist 2015 [1]	Future 2020 Without Project [2]	Future 2020 With Project [3]	Difference [3] – [1]	Exist 2015 [1]	Future 2020 Without Project [2]	Future 2020 With Project [3]	Difference [3] – [2]
Name	L_{den} dBA	L_{den} dBA	L_{den} dBA		L_{den} dBA	L_{den} dBA	L_{den} dBA	
B1-12	53	53	53	0	58	58	58	0
B1-13	55	55	55	0	59	58	58	0
B1-14	55	55	55	0	59	58	58	0
B1-15	54	54	54	-1	58	58	58	0
B1-16	53	53	53	0	58	57	58	0
B2-01	48	48	49	1	54	54	54	0
B2-02	48	48	49	1	54	54	54	0
B2-03	48	48	48	1	54	54	54	0
B2-04	48	48	48	1	53	53	53	0
B2-05	48	48	49	1	53	52	53	0
B2-06	47	47	48	1	53	53	53	0
B2-07	49	49	50	1	54	54	54	0
B2-08	51	51	52	1	54	53	54	0
B2-09	50	50	51	1	55	54	55	0
B2-10	48	48	48	0	55	54	54	0
B2-11	50	50	50	0	55	55	54	0
B2-12	52	52	51	0	56	56	55	0
B2-13	52	52	52	0	56	56	56	0
B2-14	52	52	51	0	56	55	55	0
B2-15	51	51	51	0	56	55	55	0

Receiver	Fibreco-generated Noise				Total Noise			
	Exist 2015 [1]	Future 2020 Without Project [2]	Future 2020 With Project [3]	Difference [3] – [1]	Exist 2015 [1]	Future 2020 Without Project [2]	Future 2020 With Project [3]	Difference [3] – [2]
Name	L_{den} dBA	L_{den} dBA	L_{den} dBA		L_{den} dBA	L_{den} dBA	L_{den} dBA	
B2-16	49	49	49	1	54	53	53	0
C1-01	58	58	58	1	61	61	62	0