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Noise and Vibration Feasibility Study
Proposed Land Severance
165 Railway Avenue
Komoka, Ontario

Prepared for:

13322068 Canada Inc.
55 Clarke Road, Unit 1
London, ON
N5W 5Y2

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Noise and Vibration Feasibility Study,
165 Railway Avenue,
Komoka, Ontario.

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1 Introduction and Summary

HGC Engineering was retained by 13322068 Canada Inc. to conduct a Noise and Vibration Feasibility Study for a proposed land severance located at 165 Railway Avenue, in Komoka, Ontario. The purpose of this study is to determine the impact of environmental noise and vibration from the surrounding area in accordance with the Ministry of Environment, Conservation, and Parks (MECP) guidelines. The parcel located at 165 Railway Avenue is to be severed into two lots, with the existing dwelling remaining on the east lot and a 2-storey single-detached dwelling proposed on the severed parcel lot to the west. This study has been prepared as part of the approvals process, specifically requested by the Town and as part of Canadian National's (CN) easement requirements.

The primary noise sources at the proposed development site were determined to be rail traffic on CN railway lines to the north. Relevant traffic data was obtained from CN personnel and HGC Engineering files. The data was used to predict future traffic sound levels at the locations of the proposed building façades and in the rear yard outdoor living area. The predicted sound levels were evaluated with respect to the guidelines of the Ministry of the Environment, Conservation and Parks (MECP) and CN.

The sound level predictions indicate that with suitable noise control measures integrated into the design of the proposed building, it is feasible to achieve MECP guideline sound levels. A central air conditioning system, upgraded glazing constructions, brick exterior façade construction, and noise barriers will be required for the proposed development. Associated acoustical requirements are specified in this report. Noise warning clauses are also required to inform future occupants of the sound level excesses, and the proximity to the railway line and commercial/institutional/recreational facilities.

Ground-borne vibration measurements were performed for five train pass-bys at the various distances from the railway right-of-way. Measured vibration levels were found to momentarily exceed the criteria during train pass-bys at the closer measurement location. Vibration mitigation measures in the form of heavier foundations are recommended. The proposed dwelling should be provided with a north foundation wall with a minimum concrete thickness of 300 mm. When architectural and structural drawings are available for the proposed building, they should be reviewed

to confirm the recommended construction. A vibration warning clause should be included in the property and tenancy agreements of the dwelling units to inform the future owners and tenants of the possible momentary vibration excesses during rail pass-bys.

2 Site Description and Noise Sources

The key plan for the site is attached as Figure 1. The site is located on the north side of Railway Avenue, east of Queen Street, in Komoka, Ontario. The CN Chatham Subdivision railway line is located directly adjacent to the north property line of the site. The CN Strathroy Subdivision railway line is located 80 m north of the proposed site. A site plan is provided as Figure 2. The proposed land severance will include a proposed dwelling unit on the west parcel and the existing dwelling will remain on the east parcel.

HGC Engineering personnel visited the site during the month of March 2022 to observe the acoustical environment, measure background sound levels, identify significant noise sources within the vicinity, and perform ground-borne vibration measurements of train pass-bys. This area is considered Class 2 in terms of its acoustical environment. Rail traffic on the CN rail lines were confirmed to be the dominant noise sources. East and west of the site are existing residential dwellings. Further east there is a feed manufacturer (Masterfeeds) and an associated animal feed store (Hoskin Feed & Country Store). It is understood that the facility has a valid environmental compliance approval. Therefore, it is expected that the facility is operating in compliance with MECP noise guidelines at the closest homes to the facility and as such, the proposed building is not expected to pose additional noise constraints for the facility. Southwest of the site is Providence Refromed Collegiate private school. Southeast of the site is the Komoka Wellness Centre. Noise from these facilities was not audible at the subject site during the site visit. Nevertheless, a noise warning clause is recommended in Section 7 to inform future occupants of the nearby commercial, institutional, and recreational uses in the area and that sounds from these facilities may be audible at times.

3 Noise and Vibration Criteria

3.1 Sound Level Criteria

Guidelines for acceptable levels of rail traffic noise impacting residential developments are given in the MECP publication NPC-300, "Environmental Noise Guideline Stationary and Transportation Sources – Approval and Planning", release date October 21, 2013 and are listed in Table I below. The values in Table I are energy equivalent (average) sound levels [L_{EQ}] in units of A-weighted decibels [dBA]. The Railway Association of Canada/Federation of Canadian Municipalities "Report Research Phase 3: Proximity Guidelines and Best Practices" dated November 2006 and Guidelines for New Development in Proximity to Railway Operations dated May 2013 were also reviewed.

Table I: MECP Rail Traffic Noise Criteria (dBA)

Space	Daytime L_{EQ} (16 hour)	Nighttime L_{EQ} (8 hour)
Outdoor Living Areas	55 dBA	--
Inside Living/Dining Rooms	40 dBA	35 dBA
Inside Bedrooms	40 dBA	35 dBA

Daytime refers to the period between 07:00 and 23:00, while nighttime refers to the period between 23:00 and 07:00. The term "Outdoor Living Area" (OLA) is a noise sensitive space intended for the quiet enjoyment of the outdoor environment and is readily accessible from the building. OLA's include backyard and side yard areas of single family, semi-detached, and townhouse dwellings, gardens, terraces and patios, balconies and elevated terraces (e.g. Rooftops) that are not enclosed with a minimum depth of 4 meters and common outdoor areas associated with high-rise and other multi-unit buildings and passive recreational areas such as parks if identified by the City.

The guidelines in the MECP publication allow the daytime sound levels in an Outdoor Living Area to be exceeded by up to 5 dBA, without mitigation, if warning clauses are placed in the purchase and rental agreements to the property. Where OLA sound levels exceed 60 dBA, physical mitigation is required to reduce the OLA sound level to below 60 dBA and as close to 55 dBA as technically, economically, and administratively practical.

Indoor guidelines are 5 dBA more stringent for rail noise than for road noise, to account for the low frequency (rumbling) character of locomotive sound, and its greater potential to transmit through exterior wall/window assemblies.

A central air conditioning system as an alternative means of ventilation to open windows is required for dwellings where nighttime sound levels outside bedroom or living/dining room windows exceed 60 dBA or daytime sound levels outside bedroom or living/dining room windows exceed 65 dBA. Forced air ventilation with ducts sized to accommodate the future installation of air conditioning is required when nighttime sound levels at bedroom or living/dining room windows are in the range of 51 to 60 dBA or when daytime sound levels at bedroom or living/dining room windows are in the range of 56 to 65 dBA.

Building components such as walls, windows and doors must be designed to achieve indoor sound level criteria when the plane of window nighttime sound level is greater than 60 dBA or the daytime sound level is greater than 65 dBA due to traffic noise.

Warning clauses are required to notify future residents of possible excesses when nighttime sound levels exceed 50 dBA at the plane of the bedroom/living/dining room window and daytime sound levels exceed 55 dBA in the outdoor living area and at the plane of the bedroom/living/dining room window.

In addition, the exterior walls of the first row of dwellings next to railway tracks are to be built to a minimum of brick veneer or masonry equivalent construction, from the foundation to the rafters when the rail traffic Leq (24-hour), estimated at a location of a nighttime receptor is greater than 60 dBA and the first row of dwellings is within 100 metres of the tracks.

The railway also provides minimum requirements for safety as well as sound for proposed residential developments located adjacent to their rights-of-way. These refer to minimum required setbacks, berms, fencing, and warning clauses. The reader is referred to a copy of CN requirements for a new development adjacent to a principal main line, which is located in Appendix A.

3.2 Ground-Borne Vibration from Rail Traffic

CN provides guidance and vibration criteria for residential developments. CN guidelines require measurements of ground-borne vibration when residential dwelling units are to be located within 75 m of a rail line. The CN Chatham Subdivision railway line right-of-way to the north is approximately 9.5 m from the proposed dwellings.

Vibration is typically measured in terms of oscillatory velocity or acceleration. The limits for acceptable ground-borne vibration are an RMS velocity of 0.14 mm/s (-17 dB re 1 mm/s) between the frequencies of 4 and 200 Hz. CN often considers RMS velocities in the range of 0.14 to 0.20 mm/s to be a marginal exceedance.

CN limits for acceptable ground-borne vibration are also presented as a curve of maximum allowable vibratory acceleration levels, in units of decibels relative to the acceleration due to gravity (dB re 1g), versus one-third octave band frequency. The CN spectral criteria have been overlaid on the graphs of measured vibration for easy reference.

4 Traffic Noise Assessment

4.1 Rail Traffic Data

Rail traffic data for the CN Chatham Subdivision and CN Strathroy Subdivision rail lines located to the north were obtained from CN personnel and HGC Engineering files, and is attached in Appendix B. Both lines are used for freight and passenger operations and are classified as principal main lines. For the CN Chatham Subdivision line, the maximum permissible train speed in the area of the site is 97 km/h (60 mi/h) for passenger trains, and 64 km/h (40 mi/h) for freight trains. For the CN Strathroy Subdivision line, the maximum permissible train speed in the area of the site is 129 km/h (80 mi/h) for passenger trains, and 97 km/h (60 mi/h) for freight trains. The CN rail traffic data was provided for the year 2019. For the purposes of this study, traffic volumes were grown at a conservative rate of 2.5% per year, and average future volumes that will exist in ten years (2032) were then calculated, as required by MECP guidelines. In conformance with CN assessment requirements, the maximum speeds, maximum number of cars, and locomotives per train were used in the traffic noise analysis to yield a worst-case estimate of train noise. The rail volumes and other inputs used in the analysis are summarized in Table II.

Table II: 2032 Projected Road Traffic Data

Rail Line	Type of Train	Number of Trains Day/Night	Number of Locomotives	Number of Cars	Max Speed (KPH)
CN Chatham Subdivision	Freight	1.4 / 1.4	4	140	64
	Passenger	11.0 / 0	2	10	97
CN Strathroy Subdivision	Freight	15.2 / 4.1	4	140	97
	Way Freight	2.8 / 0	4	25	97
	Passenger	11.0 / 0	2	10	129

4.2 Traffic Noise Prediction

To assess the levels of rail traffic noise which will impact the site in the future, predictions were made using STAMSON version 5.04, a computer algorithm developed by the MECP. Sample STAMSON output is included in Appendix C. Absorptive ground surface was used in the STAMSON calculation.

The predictions were performed at the top floor of the proposed residential building during daytime and nighttime hours to investigate ventilation requirements and in the rear yard outdoor living area to determine acoustic barrier requirements. The distance setbacks of the proposed building from the railway indicated on the site plan and aerial photos were used in the analysis. The results of these predictions are summarized in Table III. The acoustic requirements may be subject to modifications if the site plan is changed significantly.

Table III: Traffic Sound Level Predictions [dBA], Without Mitigation

Prediction Location	Location	Daytime – $L_{EQ-16\ hr}$ Road/Rail/Total	Nighttime – $L_{EQ-8\ hr}$ Road/Rail/Total
[A]	North Façade	68	65
[B]	East Façade	65	62
[C]	West Façade	64	61
[D]	Rear Yard OLA	66	--

5 Discussion and Recommendations

The sound level predictions indicate that the future traffic sound levels will exceed the MECP guidelines at the façades of the proposed building and in the rear yard outdoor living area. Recommendations are provided in the following sections.

5.1 Outdoor Living Areas

Typically, a safety berm 2.5 m in height along with a 3 m high acoustic wall on top is required along the railway right-of-way. It is noted that there are no existing safety berms nor noise barriers along the railway in the area, the railway authority should be contacted for clarification regarding the berm requirements along the elevated railway line.

The predicted daytime sound level in the rear yard of the proposed dwelling unit (Prediction Location [D]) is 66 dBA, 11 dBA in excess of the MECP limit of 55 dBA. Physical mitigation in the form of an acoustic barrier is required for this area. An acoustic barrier 4.7 m in height will be required along the north property line of the proposed dwelling, as well as 2.8 m high acoustic barriers along the east and west property lines, to reduce traffic noise in the rear yard to 60 dBA.

The preliminary location of the required acoustic barriers is shown in Figure 3. The wall component of the barrier should be of a solid construction with a surface density of no less than 20 kg/m^2. The walls may be constructed from a variety of materials such as glass, wood, brick, pre-cast concrete or other concrete/wood composite systems provided that it is free of gaps or cracks. The heights and extents of the barriers should be chosen to reduce the sound levels in the OLA's to below 60 dBA and as close to 55 dBA as is technically, administratively and economically practical, subject to the approval of the municipality respecting any applicable fence height by-laws.

It is noted that there are no existing safety berms nor noise barriers for the subject lands and surrounding residential properties. Since it is an infill project, the high noise barrier may not be suitable for the area as the existing neighbouring residences may find the height of the barrier intrusive. The City could consider an alternative location to be designated as the outdoor living area such as the front yard where the sound levels were found to be 58 dBA as the dwelling itself provides shielding.

5.2 Minimum Distance Setbacks

For noise control and safety reasons, CN policies stipulate that the minimum required setback between a new dwelling and a Main Line is to be a minimum of 30 metres. It is observed that existing residences along Railway Avenue adjacent to the subject site are located at a distance of 15 m from the railway right-of-way. The nearest dwelling is proposed at 9.16 m from the railway right-of-way. This variance from the criteria should be submitted to the railway authority for acceptance.

5.3 Indoor Living Areas and Ventilation Requirements

The predicted future sound levels at the façades of the proposed dwelling unit will be greater than 65 dBA during the daytime and/or 60 dBA during the nighttime hours. To address these excesses, the MECP guidelines recommend that the building be equipped with central air conditioning systems, so that the windows can be closed.

Window or through-the-wall air conditioning units are not recommended because of the noise they produce and because the units penetrate through the exterior wall which degrades the overall sound insulating properties of the envelope. The location, installation, and sound ratings of the outdoor air conditioning devices should minimize noise impacts and comply with criteria of MECP publication NPC-300. Associated warning clauses are also recommended.

5.4 Building Façade Constructions

Predicted sound levels at the building facades were used to determine sound insulation requirements of the building envelope. The required acoustic insulation of the wall and window components was determined using methods developed by the National Research Council (NRC).

Detailed glazing requirements for different facades and spaces could be considered in value engineering, if required, when detailed floor plans and building elevations are available.

Exterior Wall Constructions

According to MECP and CN guidelines, the first row of dwellings with exposure to the railway line which have sound levels exceeding 60 dBA during both nighttime and daytime hours, will require

brick veneer or masonry equivalent exterior walls from foundation to rafters as a minimum construction. This applies to all dwelling unit in the proposed development.

Exterior Doors

There may be swing doors and some glazed sliding patio doors for entry onto the balconies from living/dining/bedrooms. The glazing areas on the doors are to be counted as part of the total window glazing area. If exterior swing doors are to be used, they shall be insulated metal doors equipped with head, jamb and threshold weather seals.

Acoustical Requirements for Glazing

At the time of this report, detailed floor plans and elevations are under development. Assuming a typical window to floor area of 40% (30% fixed and 10% operable) for the living/dining rooms and 25% (20% fixed and 5% operable) for the bedrooms in the proposed building, the minimum acoustical requirement for the basic window glazing, including glass in fixed sections, swing or sliding doors, and operable windows, is provided in Table IV.

Table IV: Required Minimum Glazing STC for Specific Building Façades

Façade	Space	Minimum Glazing STC[1, 2]
North Façade	Living/Dining	STC-33
	Bedroom	
East Façades	Living/Dining	STC-30
	Bedroom	
West Façades	Living/Dining	STC-29
	Bedroom	
South Façades	Living/Dining	OBC
	Bedroom	

Note:
[1] Based on 40% window to floor area ratio for living/dining rooms and 25% for the bedrooms.
[2] STC requirement refers to fixed glazing. Small leaks through operable doors and windows are assumed, however, tight weather seals should be provided to reduce such leakage to the extent feasible.
OBC – Ontario Building Code

Note that acoustic performance varies with manufacturer's construction details, and these are only guidelines to provide some indication of the type of glazing likely to be required. Acoustical test data for the selected assemblies should be requested from the suppliers, to ensure that the stated acoustic performance levels will be achieved by their assemblies.

Further Work

When detailed floor plans and building elevations are available for the units in proposed development, the glazing requirements should be refined based on actual window to floor area ratios. Larger windows in small rooms will result in large window to floor area ratios and higher STC ratings.

6 Vibration Assessment

6.1 Site Measurements

CN requires an assessment of ground-borne vibration through measurement if building foundations are to be located within 75 metres of the railway right-of-way and this has been required by CN personnel with respect to the rail line to the north of the proposed development. The vibration measurements were conducted using a Svantek SV977 Sound and Vibration Metre outfitted with a Wilcoxon Research type 793V velocity transducer correctly field calibrated before and after the measurements between March 7, 2022, and March 14, 2022. The weather conditions were fair, and the temperature ranged between -10 to 5°C. Measurements were performed at the anticipated location of the closest future building façade, 9.5 m from the railway right-of-way, and at a setback distance of 15 m from the railway right-of-way, as indicated with [V1] and [V2] in Figure 2. The results of the measurements are presented in Appendix D. Table V shows the maximum RMS vibration velocity measurements during each of the train pass-bys.

Table V: Peak Vibration Measurements of Train Pass-bys

Train Pass-by	Measurement Location	Measured Vibration Level (mm/s)	Criteria (mm/s)
1	V1	0.16	0.14
	V2	0.11	
2	V1	0.15	
	V2	0.09	
3	V1	0.17	
	V2	0.10	
4	V1	0.14	
	V2	0.08	
5	V1	0.15	
	V2	0.09	

The upper curves in Appendix D show RMS vibration velocity as a function of time for each train pass-by. Vibration levels were found to momentarily exceed the CN limit of 0.14 mm/s at the closest measurement location during train pass-bys. Vibration levels were within the CN limit at the measurement location that was 15 m from the rail line right-of-way. For much of each pass-by the vibration level was below the criteria at the closer measurement location. For the closer measurement location, the measured vibration levels are considered marginal exceedances of the criteria as the levels were below 0.20 mm/s. The lower curves in Appendix D show the maximum measured acceleration as a spectrum of level in dB re g versus one-third octave frequency compared to the CN criteria curve. These figures show that the vibration levels did not exceed the spectral criteria for both measurement locations.

Constructing the proposed dwelling unit using an upgraded building foundation system to increase the mass of the structure and improve the discontinuity between undisturbed soil and the wood-framed structure will help reduce vibration levels in the proposed dwelling unit. Mitigation in the form of poured concrete with a thickness of 300 m for the north foundation walls of the proposed building is recommended if the dwelling is to be constructed at a distance of 9 m from the rail line right-of-way. There would be no requirements if the building is located 15 m from the rail line right-of-way. Once available, the architectural and structural drawings should be reviewed to confirm the proposed foundations and building design is in conformance with the construction and building layout assumed herein. A conceptual drawing of the recommended foundation wall construction is shown in Appendix E.

A vibration warning clause should be included in the property and tenancy agreements of the dwelling unit to inform the future owners and tenants of the vibration excesses as indicated in Section 7.

7 Warning Clauses

The MECP guidelines recommend that warning clauses be included in the property and tenancy agreements for all units with anticipated traffic sound level excesses. Examples are provided below.

Suggested wording for future dwellings with sound level excesses.

Type A:

> Purchasers/tenants are advised that sound levels due to increasing rail traffic may occasionally interfere with some activities of the dwelling occupants as the sound levels exceed the sound level limits of the Municipality and the Ministry of the Environment, Conservation and Parks.

Suggested wording for future dwellings with daytime OLA sound levels exceeding the MECP criteria by 6 dB or more, for which physical mitigation has been provided is given below.

Type B:

> Purchasers/tenants are advised that despite the inclusion of noise control features in the development and within the building units, sound levels due to increasing rail traffic may occasionally interfere with some activities of the dwelling occupants as the sound levels exceed the sound level limits of the Municipality and the Ministry of the Environment, Conservation and Parks.

Suitable wording for future dwellings requiring central air conditioning systems is given below.

Type C:

> This dwelling unit has been supplied with a central air conditioning system which will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the sound level limits of the Municipality and the Ministry of the Environment, Conservation and Parks. (Note: the location and installation of the outdoor air conditioning device should be done so as to minimize the noise impacts and comply with criteria of MECP publication NPC-300.)

Suitable wording to inform future residents of the adjacent commercial, institutional, and/or recreational facilities and that sounds from these facilities may at times be audible.

Type D:

> Purchasers/tenants are advised that due to the proximity of the adjacent commercial/institutional/recreational facilities, noise from the facilities may at times be audible.

Suitable wording for future dwellings where vibration excesses is given below.

Type E:

> Purchasers/tenants are advised that due to the proximity of this dwelling to the nearby railway tracks, vibration from rail pass-bys may be perceptible within this unit.

These sample clauses are provided by the MECP as examples and can be modified by the Municipality as required.

CN's standard warning clause which is required for all residual developments located within 300 m of their main line is given below.

Type F:

> Warning: Canadian National Railway Company or its assigns or successors in interest has or have a right-of-way within 300 metres from the land subject hereof. These may be alteration to or expansions of the railway facilities on such rights-of-way in the future including the possibility that the railway or its assigns or successors as aforesaid may expand its operations, which expansion may affect the living environment of the residents in the vicinity, notwithstanding the inclusion of any noise and vibration attenuating measures in the design of the development and individual dwelling. CNR will not be responsible for any complaints or claims arising from use of such facilities and/or operations on, over or under the aforesaid rights-of-way.

8 Summary of Recommendations

The following list and Table VI summarize the recommendations made in this report.

1. Central air conditioning systems are required for the proposed dwelling unit. The location, installation and sound ratings of the air conditioning devices should comply with NPC-300.

2. Upgraded building constructions will be required for the proposed dwelling unit. Brick veneer or a masonry equivalent exterior wall will be required for the proposed dwelling unit. When detailed floor plans and building elevations are available, the exterior wall and glazing construction should be verified and refined based on actual window to floor area ratios.

3. An acoustic barrier is required on the north, east, and west property lines of the proposed dwelling. Details are provided in Section 5.1 and Figure 3. The height and extent of the noise barrier shall be reviewed when siting and grading plans are available. Alternatively, the City may allow front yard OLA's to reduce the height of the noise barrier.

4. The north foundation walls of the proposed building should be constructed with poured concrete with a thickness of 300 mm. An example of the recommended foundation wall construction is shown in Appendix E. When structural drawings are available, they should be reviewed by the acoustical consultant to confirm the proposed foundations are in line with the assumptions and recommendations provided herein.

5. Warning clauses are required in the property and tenancy agreements and offers of purchase and sale in order to inform future owners/tenants of the sound and vibration level excesses and the proximity to the railway line and commercial/institutional/recreational uses.

The following table summarizes the noise control recommendations and noise warning clauses for the dwellings in the proposed buildings.

Table VI: Summary of Noise Control Requirements and Noise Warning Clauses

Description	Acoustic Barrier	Ventilation Requirements*	Type of Warning Clause	Required STC+	Exterior Wall Construction	Foundation Wall Construction
North Façades	--	Central A/C	A, B, C, D, E, F	STC-33	Brick	300 mm Poured Concrete(1)
East Façades				STC-30		--
West Façades				STC-29		
South Façades				OBC		--
Rear Yard OLA	✓	--	--	--	--	--

Notes:
-- no specific requirement
OBC – meeting the minimum requirements of the Ontario Building Code
* The location, installation and sound rating of the air conditioning condensers must be compliant with MECP Guideline NPC-300, as applicable.
+ With assumed window to floor area ratios of 40% for living rooms/dining rooms and 25% for bedrooms. When detailed floor plans and building elevations are available, an acoustical consultant should review the drawings to refine the window glazing constructions based on actual window to floor area ratios, and to verify exterior wall construction.
(1) – For north foundation wall
✓ Noise barriers 4.7 m in height for the north property line and 2.8 m in height for the east and west property lines would be required to meet MECP guidelines in the rear yard OLA.

8.1 Implementation

To ensure that the noise recommendations outlined above are fully implemented, it is recommended that:

1. When siting and grading plans are available, the height and extent of the noise barrier shall be reviewed to confirm that MECP limits are met.

2. When structural drawings are available for the proposed dwellings units, they should be reviewed by the acoustical consultant to confirm the proposed foundations conform to the assumptions and recommendations provided in this study.

3. When detailed floor plans and building elevations are available, the exterior wall and glazing construction should be verified and refined based on actual window to floor area ratios.

4. Prior to the issuance of occupancy permits for this development, the City's building inspector or a Professional Engineer qualified to perform acoustical engineer services in the province of Ontario should certify that the noise control measures have been properly incorporated, installed, and constructed.

Figure 1: Key Plan

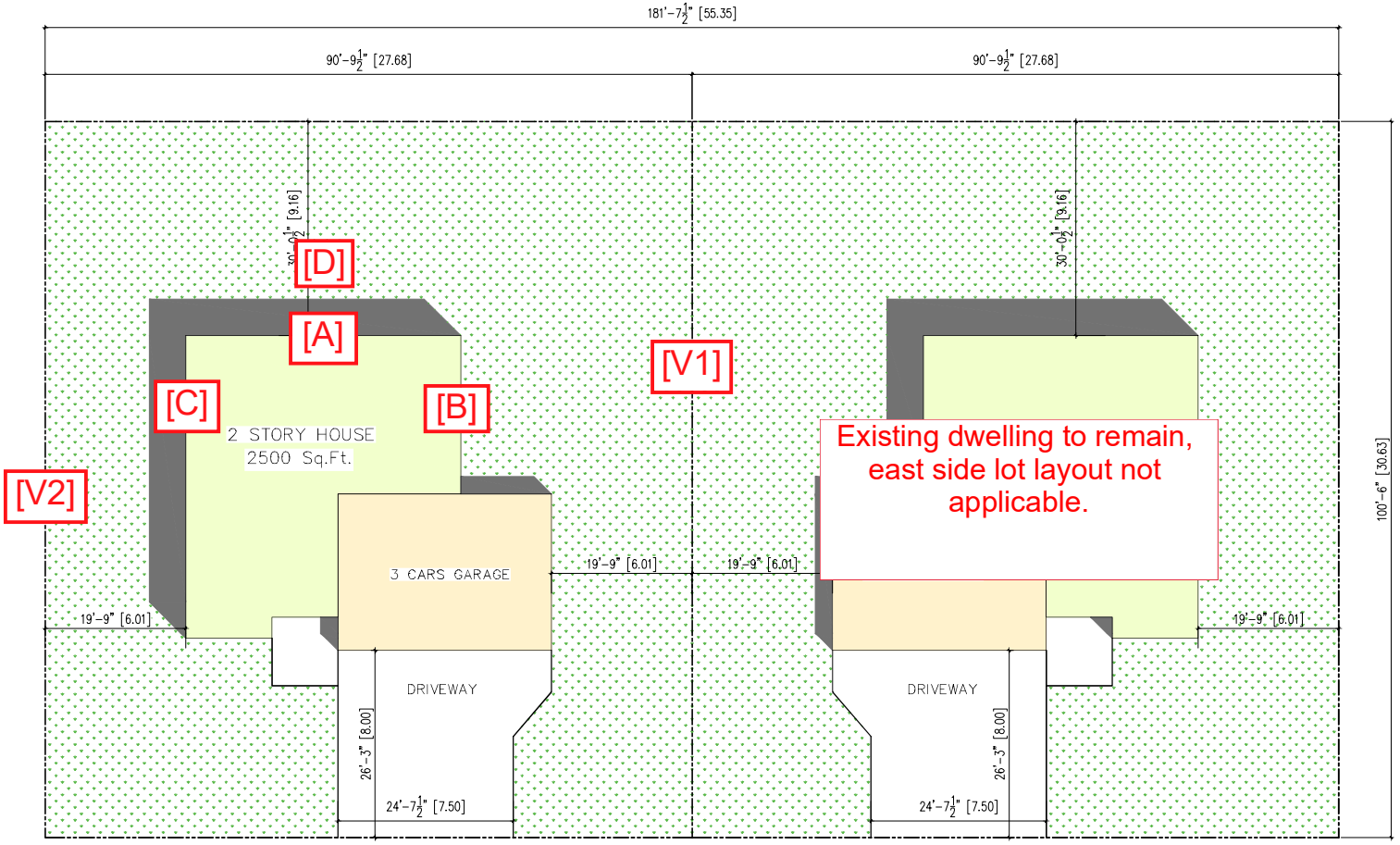

Figure 2 - Proposed Site Plan Showing Prediction Locations and Vibration Measurement Locations

SITE PLAN LAYOUT

165 RAILWAY AVE.

CLIENT

JOB TITLE
TOWN HOUSES

REVISIONS AND ISSUES

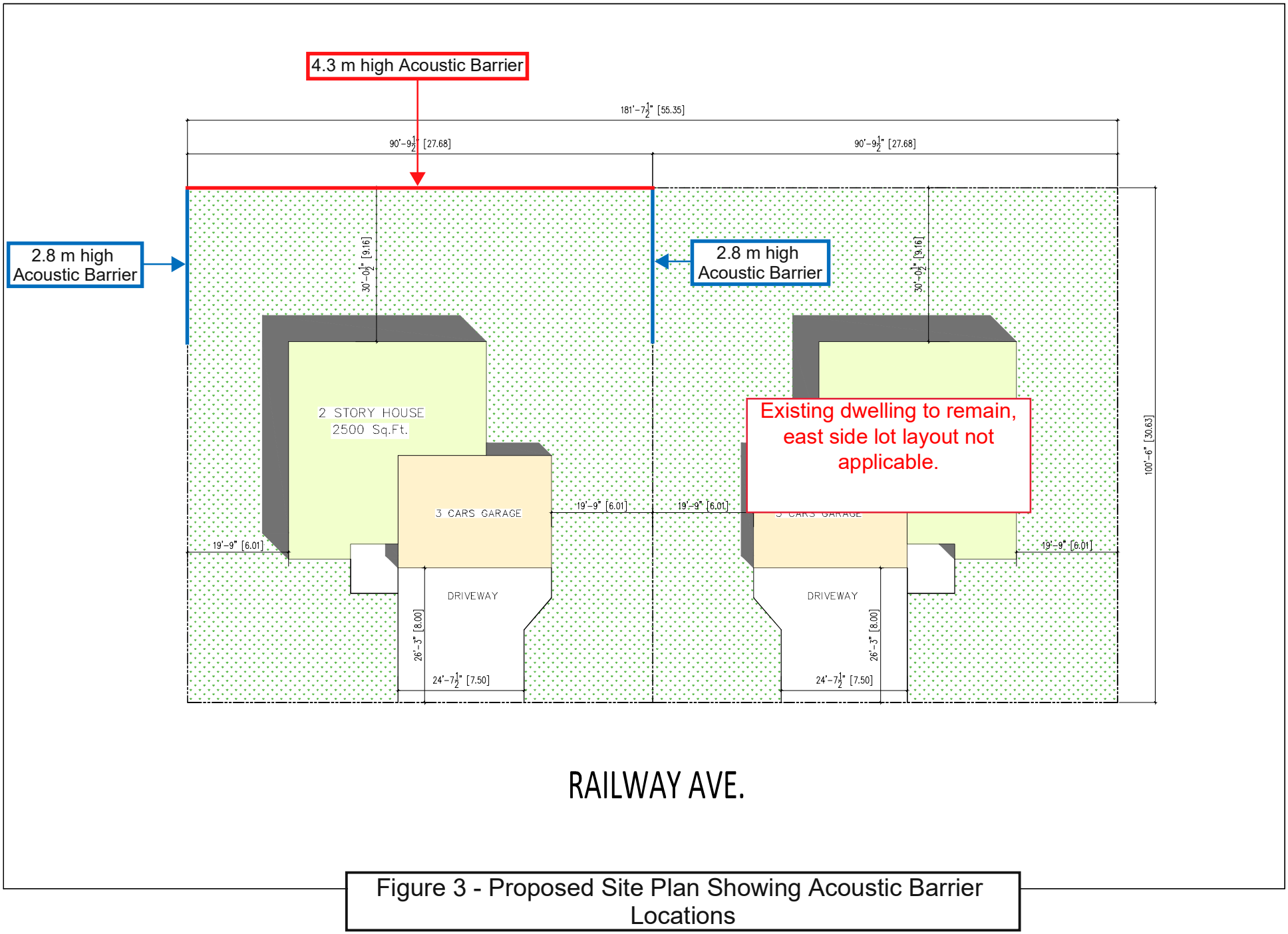

Figure 3 - Proposed Site Plan Showing Acoustic Barrier Locations

Appendix A

Rail Guidelines

Canadian National Railway Properties Inc.
Propriétés ferroviaires du Canadien National Inc.

277 Front Street West
Floor 8
Toronto, Ontario
M5V 2X7

Telephone: (416) 217-6961
Facsimile: (416) 217-6743

277, rue Front ouest
8e étage
Toronto (Ontario)
M5V 2X7

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PRINCIPAL MAIN LINE REQUIREMENTS

A. Safety setback of dwellings from the railway rights-of-way to be a minimum of 30 metres in conjunction with a safety berm. The safety berm shall be adjoining and parallel to the railway rights-of-way with returns at the ends, 2.5 metres above grade at the property line, with side slopes not steeper than 2.5 to 1.

B. The Owner shall engage a consultant to undertake an analysis of noise. At a minimum, a noise attenuation barrier shall be adjoining and parallel to the railway rights-of-way, having returns at the ends, and a minimum total height of 5.5 metres above top-of-rail. Acoustic fence to be constructed without openings and of a durable material weighing not less than 20 kg. per square metre of surface area. Subject to the review of the noise report, the Railway may consider other measures recommended by an approved Noise Consultant.

C. Ground-borne vibration transmission to be evaluated in a report through site testing to determine if dwellings within 75 metres of the railway rights-of-way will be impacted by vibration conditions in excess of 0.14 mm/sec RMS between 4 Hz and 200 Hz. The monitoring system should be capable of measuring frequencies between 4 Hz and 200 Hz, ±3 dB with an RMS averaging time constant of 1 second. If in excess, isolation measures will be required to ensure living areas do not exceed 0.14 mm/sec RMS on and above the first floor of the dwelling.

D. The Owner shall install and maintain a chain link fence of minimum 1.83 metre height along the mutual property line.

E. The following clause should be inserted in all development agreements, offers to purchase, and agreements of Purchase and Sale or Lease of each dwelling unit within 300m of the railway right-of-way: "Warning: Canadian National Railway Company or its assigns or successors in interest has or have a rights-of-way within 300 metres from the land the subject hereof. There may be alterations to or expansions of the railway facilities on such rights-of-way in the future including the possibility that the railway or its assigns or successors as aforesaid may expand its operations, which expansion may affect the living environment of the residents in the vicinity, notwithstanding the inclusion of any noise and vibration attenuating measures in the design of the development and individual dwelling(s). CNR will not be responsible for any complaints or claims arising from use of such facilities and/or operations on, over or under the aforesaid rights-of-way."

F. Any proposed alterations to the existing drainage pattern affecting railway property must receive prior concurrence from the Railway and be substantiated by a drainage report to the satisfaction of the Railway.

G. The Owner shall through restrictive covenants to be registered on title and all agreements of purchase and sale or lease provide notice to the public that the safety berm, fencing and vibration isolation measures implemented are not to be tampered with or altered and further that the Owner shall have sole responsibility for and shall maintain these measures to the satisfaction of CN.

H. The Owner enter into an Agreement stipulating how CN's concerns will be resolved and will pay CN's reasonable costs in preparing and negotiating the agreement.

I. The Owner may be required to grant CN an environmental easement for operational noise and vibration emissions, registered against the subject property in favour of CN.

Appendix B

Rail Traffic Data

System Engineering
Engineering Services

1 Administration Road
Concord, ON, L4K 1B9
T: 905.669.3264
F: 905.760.3406

Train Count Data

TRANSMITTAL

To: *Destinataire :*	HGC Engineering 2000 Argentia Road, Plaza One, Suite 203, Mississauga, Ontario, Canada L5N 1P7	*Project :*	CHM–7.52–Queen Street, Komoka ON STY-10.21- Queen Street, Komoka ON
Att'n:	Mandy Chan	*Routing:*	machan@hgcengineering.com
From: *Expéditeur :*	Umair Naveed	*Date:*	2022/04/25
Cc:	Adjacent Development CN via e-mail		

☐ Urgent ☐ For Your Use ☐ For Review ☐ For Your Information ☐ Confidential

Re: Train Traffic Data – CN Chatham Subdivision and CN Strathroy Subdivision near Queen Street in Komoka, ON,

Please find attached the requested Train Traffic Data. The application fee in the amount of **$500.00** +HST will be invoiced. Per your request, enclosed are two letters. One each for the Chatham subdivision and Strathroy subdivision.

Should you have any questions, please do not hesitate to contact the undersigned at permits.gld@cn.ca.

Sincerely,

Umair Naveed

Umair Naveed
Project Officer Public Works – Eastern Canada
Permits.gld@cn.ca

Date: 2022/04/22 Project Number: CHM–7.52– Queen Street, Komoka ON

Dear Mandy:

Re: Train Traffic Data – CN Chatham Subdivision near Queen Street in Komoka, ON

The following is provided in response to Mandy's 2022/03/02 request for information regarding rail traffic in the vicinity of Queen Street in Komoka at approximately Mile 7.52 on CN's Chatham Subdivision.

Typical daily traffic volumes are recorded below. However, traffic volumes may fluctuate due to overall economic conditions, varying traffic demands, weather conditions, track maintenance programs, statutory holidays and traffic detours that when required may be heavy although temporary. For the purpose of noise and vibration reports, train volumes must be escalated by 2.5% per annum for a 10-year period.

Typical daily traffic volumes at this site location are as follows:

***Maximum train speed is given in Miles per Hour**

	0700-2300			
Type of Train	Volumes	Max.Consist	Max. Speed	Max. Power
Freight	1	140	40	4
Way Freight	0	25	40	4
Passenger	8	10	60	2

	2300-0700			
Type of Train	Volumes	Max.Consist	Max. Speed	Max. Power
Freight	1	140	40	4
Way Freight	0	25	40	4
Passenger	0	10	60	2

The volumes recorded reflect westbound and eastbound freight and passenger operations on CN's Chatham Subdivision.

Except where anti-whistling bylaws are in effect, engine-warning whistles and bells are normally sounded at all at-grade crossings. There is zero at-grade crossing in the immediate vicinity of the study area. Please note that engine warning whistles may be sounded in cases of emergency, as a safety and or warning precaution at station locations and pedestrian crossings and occasionally for operating requirements.

With respect to equipment restrictions, the gross weight of the heaviest permissible car is 286,000 lbs.

The single mainline track is considered to be continuously welded rail throughout the study area.

The Canadian National Railway continues to be strongly opposed to locating developments near railway facilities and rights-of-way due to potential safety and environmental conflicts. Development adjacent to the Railway Right-of-Way is not appropriate without sound impact mitigation measures to reduce the incompatibility. For confirmation of the applicable rail noise, vibration and safety standards, Adjacent Development, Canadian National Railway Properties at Proximity@cn.ca should be contacted directly.

I trust the above information will satisfy your current request.

Sincerely,

Umair Naveed

Umair Naveed
Project Officer Public Works – Eastern Canada
Permits.gld@cn.ca

Date: 2022/04/22 Project Number: STY–10.21–Queen Street, Komoka ON

Dear Mandy:

Re: Train Traffic Data – CN Strathroy Subdivision near Queen Street in Komoka, ON

The following is provided in response to Mandy's 2022/03/02 request for information regarding rail traffic in the vicinity of Queen Street Komoka at approximately Mile 10.21 on CN's Strathroy Subdivision.

Typical daily traffic volumes are recorded below. However, traffic volumes may fluctuate due to overall economic conditions, varying traffic demands, weather conditions, track maintenance programs, statutory holidays and traffic detours that when required may be heavy although temporary. For the purpose of noise and vibration reports, train volumes must be escalated by 2.5% per annum for a 10-year period.

Typical daily traffic volumes at this site location are as follows:

***Maximum train speed is given in Miles per Hour**

	0700-2300			
Type of Train	Volumes	Max.Consist	Max. Speed	Max. Power
Freight	11	140	60	4
Way Freight	2	25	60	4
Passenger	8	10	80	2

	2300-0700			
Type of Train	Volumes	Max.Consist	Max. Speed	Max. Power
Freight	3	140	60	4
Way Freight	0	25	60	4
Passenger	0	10	80	2

The volumes recorded reflect westbound and eastbound freight and passenger operations on CN's Strathroy Subdivision.

Except where anti-whistling bylaws are in effect, engine-warning whistles and bells are normally sounded at all at-grade crossings. There are two (2) at-grade crossings in the immediate vicinity of the study area at Mile 10.67 Komoka Road and Mile 10.95 Oxbow drive. Anti-whistling bylaws are in effect at these crossings. Please note that

engine warning whistles may be sounded in cases of emergency, as a safety and or warning precaution at station locations and pedestrian crossings and occasionally for operating requirements.

With respect to equipment restrictions, the gross weight of the heaviest permissible car is 286,000 lbs.

The double mainline track is considered to be continuously welded rail throughout the study area. The presence of four (4) switches located at Mile 9.71, Mile 9.77, Mile 9.85, and Mile 9.92 may exacerbate the noise and vibration caused by train movements.

The Canadian National Railway continues to be strongly opposed to locating developments near railway facilities and rights-of-way due to potential safety and environmental conflicts. Development adjacent to the Railway Right-of-Way is not appropriate without sound impact mitigation measures to reduce the incompatibility. For confirmation of the applicable rail noise, vibration and safety standards, Adjacent Development, Canadian National Railway Properties at Proximity@cn.ca should be contacted directly.

I trust the above information will satisfy your current request.

Sincerely,

Umair Naveed

Umair Naveed
Project Officer Public Works – Eastern Canada
Permits.gld@cn.ca

Appendix C

Sample Stamson Output

```
STAMSON 5.0        NORMAL REPORT        Date: 30-05-2022 11:40:08
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: n.te                 Time Period: Day/Night 16/8 hours
Description: North facade of proposed dwelling.


Rail data, segment # 1: CN Chatham (day/night)
-----------------------------------------------
Train            ! Trains      ! Speed !# loc !# Cars! Eng  !Cont
Type             !             !(km/h) !/Train!/Train! type !weld
-----------------+-------------+-------+------+------+------+----
  1. Freight     !   1.4/1.4   !  64.0 !  4.0 !140.0 !Diesel! Yes
  2. Passenger   !  11.0/0.0   !  97.0 !  2.0 ! 10.0 !Diesel! Yes

Data for Segment # 1: CN Chatham (day/night)
-----------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  23.70 / 23.70  m
Receiver height           :   4.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
No Whistle
Reference angle           :   0.00

Rail data, segment # 2: CN Strathroy (day/night)
-----------------------------------------------
Train            ! Trains      ! Speed !# loc !# Cars! Eng  !Cont
Type             !             !(km/h) !/Train!/Train! type !weld
-----------------+-------------+-------+------+------+------+----
  1. Freight     !  15.2/4.1   !  97.0 !  4.0 !140.0 !Diesel! Yes
  2. Way Freight !   2.8/0.0   !  97.0 !  4.0 ! 25.0 !Diesel! Yes
  3. Passenger   !  11.0/0.0   ! 129.0 !  2.0 ! 10.0 !Diesel! Yes

Data for Segment # 2: CN Strathroy (day/night)
-----------------------------------------------
Angle1   Angle2           : -60.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  89.60 / 89.60  m
Receiver height           :   4.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
No Whistle
Reference angle           :   0.00

Results segment # 1: CN Chatham (day)
---------------------------------------

LOCOMOTIVE (0.00 + 64.31 + 0.00) = 64.31 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -90     90   0.50  68.45  -2.97  -1.17   0.00   0.00   0.00  64.31
-------------------------------------------------------------------------

WHEEL (0.00 + 55.27 + 0.00) = 55.27 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -90     90   0.60  59.80  -3.18  -1.35   0.00   0.00   0.00  55.27
-------------------------------------------------------------------------

Segment Leq : 64.82 dBA

Results segment # 2: CN Strathroy (day)
---------------------------------------

LOCOMOTIVE (0.00 + 63.61 + 0.00) = 63.61 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
```

```
   -60     90   0.50  76.86 -11.60  -1.65   0.00   0.00   0.00  63.61
-------------------------------------------------------------------------

WHEEL (0.00 + 55.78 + 0.00) = 55.78 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -60     90   0.60  69.99 -12.42  -1.79   0.00   0.00   0.00  55.78
-------------------------------------------------------------------------

Segment Leq : 64.27 dBA

Total Leq All Segments: 67.56 dBA

Results segment # 1: CN Chatham (night)
---------------------------------------

LOCOMOTIVE (0.00 + 61.95 + 0.00) = 61.95 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -90     90   0.50  66.09  -2.97  -1.17   0.00   0.00   0.00  61.95
-------------------------------------------------------------------------

WHEEL (0.00 + 54.74 + 0.00) = 54.74 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -90     90   0.60  59.27  -3.18  -1.35   0.00   0.00   0.00  54.74
-------------------------------------------------------------------------

Segment Leq : 62.71 dBA

Results segment # 2: CN Strathroy (night)
-----------------------------------------

LOCOMOTIVE (0.00 + 59.94 + 0.00) = 59.94 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -60     90   0.50  73.19 -11.60  -1.65   0.00   0.00   0.00  59.94
-------------------------------------------------------------------------

WHEEL (0.00 + 52.57 + 0.00) = 52.57 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -60     90   0.60  66.77 -12.42  -1.79   0.00   0.00   0.00  52.57
-------------------------------------------------------------------------

Segment Leq : 60.67 dBA

Total Leq All Segments: 64.82 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 67.56
                           (NIGHT): 64.82
```

```
STAMSON 5.0        NORMAL REPORT        Date: 30-05-2022 11:41:32
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: ola.te               Time Period: 16 hours
Description: Rear yard OLA of proposed dwelling.


Rail data, segment # 1: CN Chatham
----------------------------------
Train            ! Trains      ! Speed !# loc !# Cars! Eng  !Cont
Type             !             !(km/h) !/Train!/Train! type !weld
-----------------+-------------+-------+------+------+------+----
  1. Freight     !   1.4/1.4   !  64.0 !  4.0 !140.0 !Diesel! Yes
  2. Passenger   !  11.0/0.0   !  97.0 !  2.0 ! 10.0 !Diesel! Yes

Data for Segment # 1: CN Chatham
--------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  20.70 m
Receiver height           :   1.50 m
Topography                :      2       (Flat/gentle slope; with barrier)
No Whistle
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   0.00 m
Barrier receiver distance :  10.00 m
Source elevation          :   4.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Rail data, segment # 2: CN Strathroy
------------------------------------
Train            ! Trains      ! Speed !# loc !# Cars! Eng  !Cont
Type             !             !(km/h) !/Train!/Train! type !weld
-----------------+-------------+-------+------+------+------+----
  1. Freight     !  15.2/4.1   !  97.0 !  4.0 !140.0 !Diesel! Yes
  2. Way Freight !   2.8/0.0   !  97.0 !  4.0 ! 25.0 !Diesel! Yes
  3. Passenger   !  11.0/0.0   ! 129.0 !  2.0 ! 10.0 !Diesel! Yes

Data for Segment # 2: CN Strathroy
----------------------------------
Angle1   Angle2           : -60.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  86.60 m
Receiver height           :   1.50 m
Topography                :      2       (Flat/gentle slope; with barrier)
No Whistle
Barrier angle1            : -60.00 deg   Angle2 : 90.00 deg
Barrier height            :   4.00 m
Barrier receiver distance :  20.70 m
Source elevation          :   3.90 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Results segment # 1: CN Chatham
-------------------------------

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       4.00 !        1.50 !        4.64 !         4.64
       0.50 !        1.50 !        2.95 !         2.95
```

```
LOCOMOTIVE (0.00 + 64.90 + 0.00) = 64.90 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -90     90   0.58  68.45  -2.22  -1.33   0.00   0.00  -0.05  64.85*
   -90     90   0.58  68.45  -2.22  -1.33   0.00   0.00   0.00  64.90
-------------------------------------------------------------------------

 * Bright Zone !

WHEEL (0.00 + 56.02 + 0.00) = 56.02 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -90     90   0.66  59.80  -2.32  -1.46   0.00   0.00  -0.10  55.92*
   -90     90   0.66  59.80  -2.32  -1.46   0.00   0.00   0.00  56.02
-------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 65.43 dBA

Results segment # 2: CN Strathroy
---------------------------------

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       4.00 !        1.50 !        3.03 !         3.03
       0.50 !        1.50 !        2.19 !         2.19

LOCOMOTIVE (0.00 + 59.20 + 0.00) = 59.20 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -60     90   0.34  76.86 -10.24  -1.42   0.00   0.00  -6.00  59.20
-------------------------------------------------------------------------

WHEEL (0.00 + 49.57 + 0.00) = 49.57 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -60     90   0.45  69.99 -11.04  -1.58   0.00   0.00  -7.80  49.57
-------------------------------------------------------------------------

Segment Leq : 59.65 dBA

Total Leq All Segments: 66.45 dBA



TOTAL Leq FROM ALL SOURCES:       66.45
```

Appendix D

Measured Vibration Velocity Levels & Acceleration Spectrums

Figure 4a: Location 1, Pass-by 1
Measured Vibratory Velocity Level

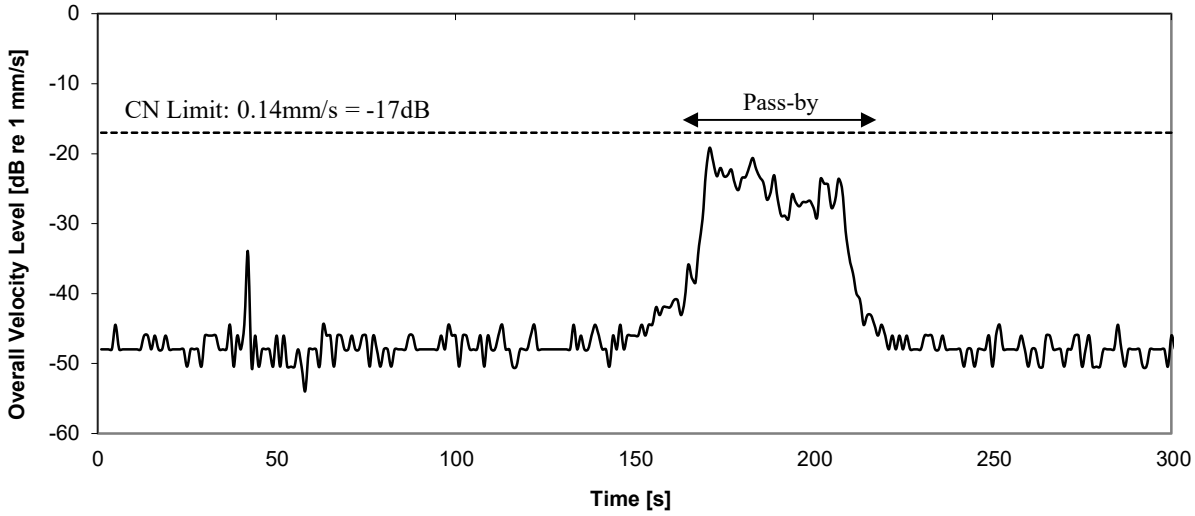


Figure 4b: Location 1, Pass-by 1
Acceleration Spectrum @ Peak Level (1 sec. Duration)

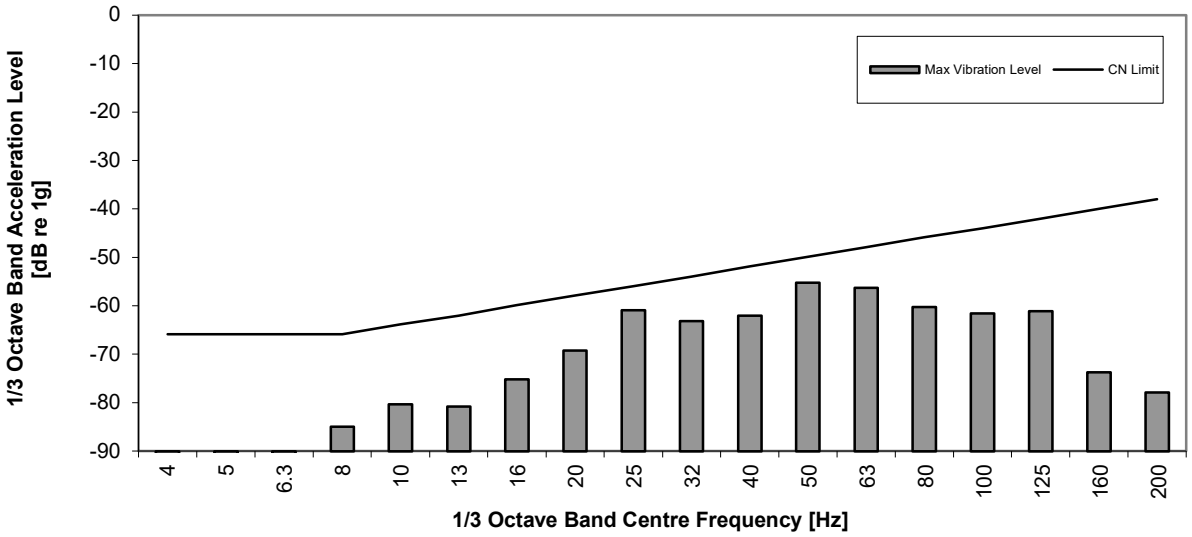


Figure 5a: Location 1, Pass-by 2
Measured Vibratory Velocity Level

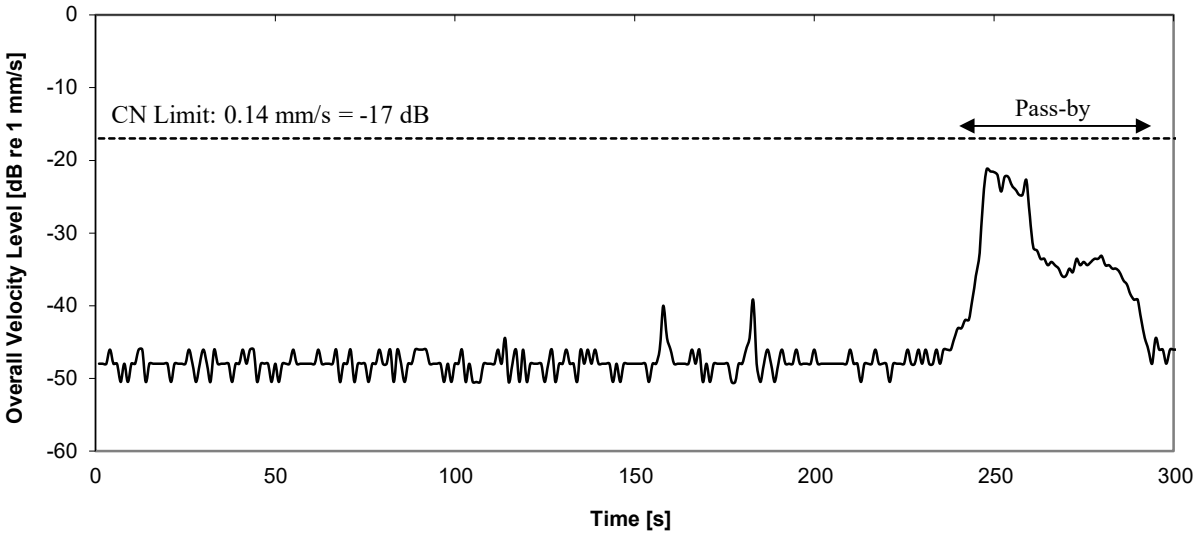


Figure 5b: Location 1, Pass-by 2
Acceleration Spectrum @ Peak Level (1 sec. Duration)

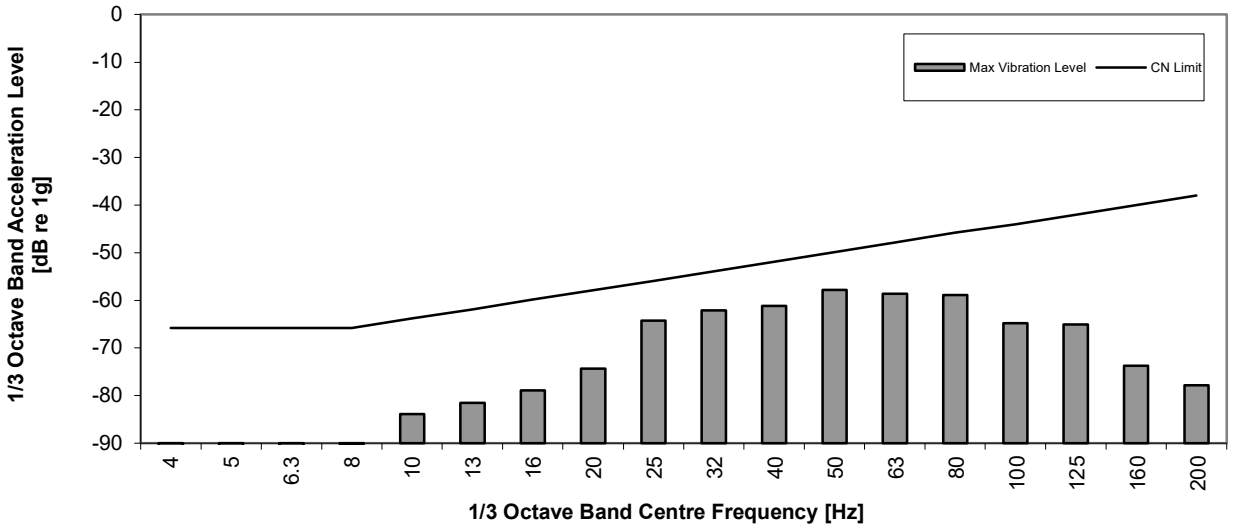


Figure 6a: Location 1, Pass-by 3
Measured Vibratory Velocity Level

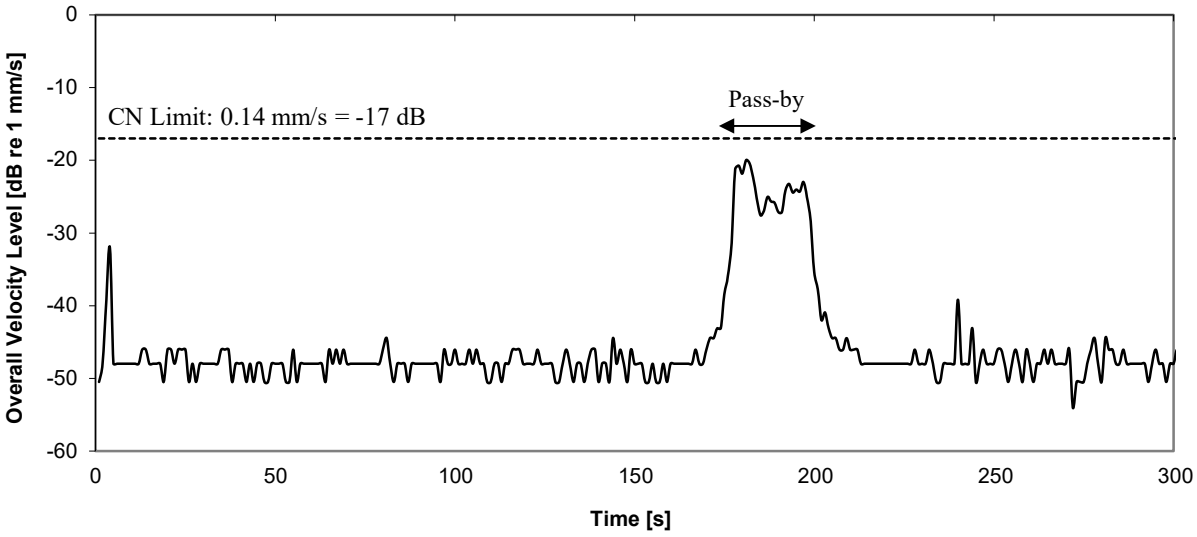


Figure 6b: Location 1, Pass-by 3
Acceleration Spectrum @ Peak Level (1 sec. Duration)

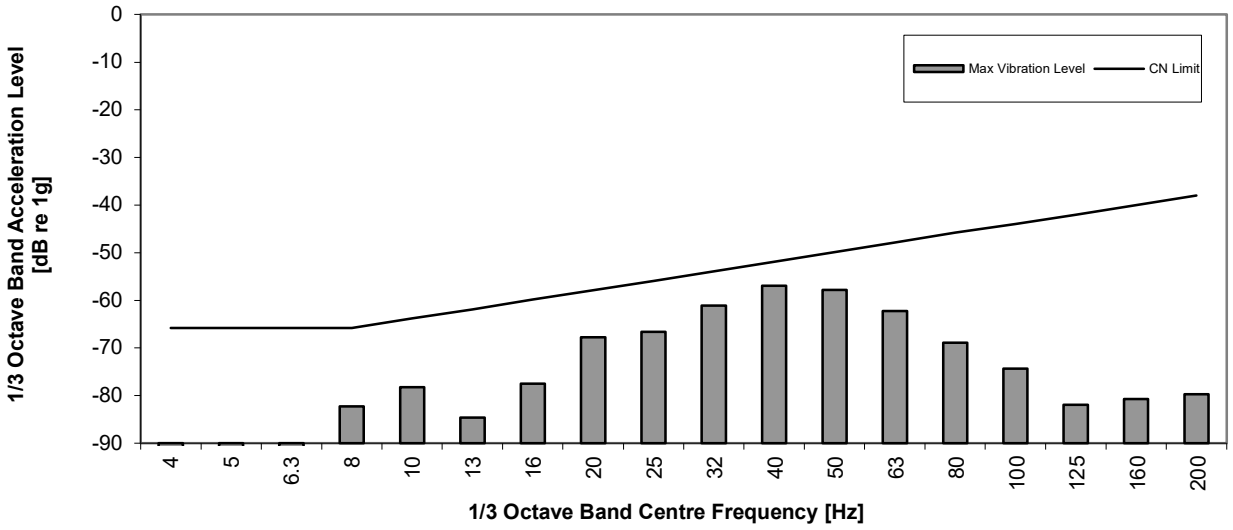


Figure 7a: Location 1, Pass-by 4
Measured Vibratory Velocity Level

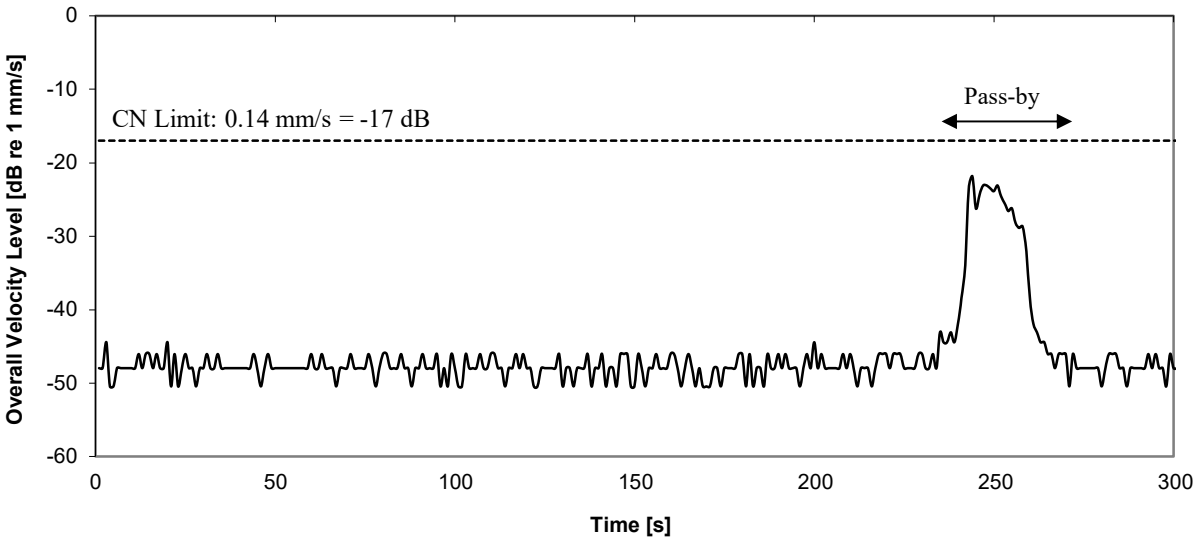


Figure 7b: Location 1, Pass-by 4
Acceleration Spectrum @ Peak Level (1 sec. Duration)

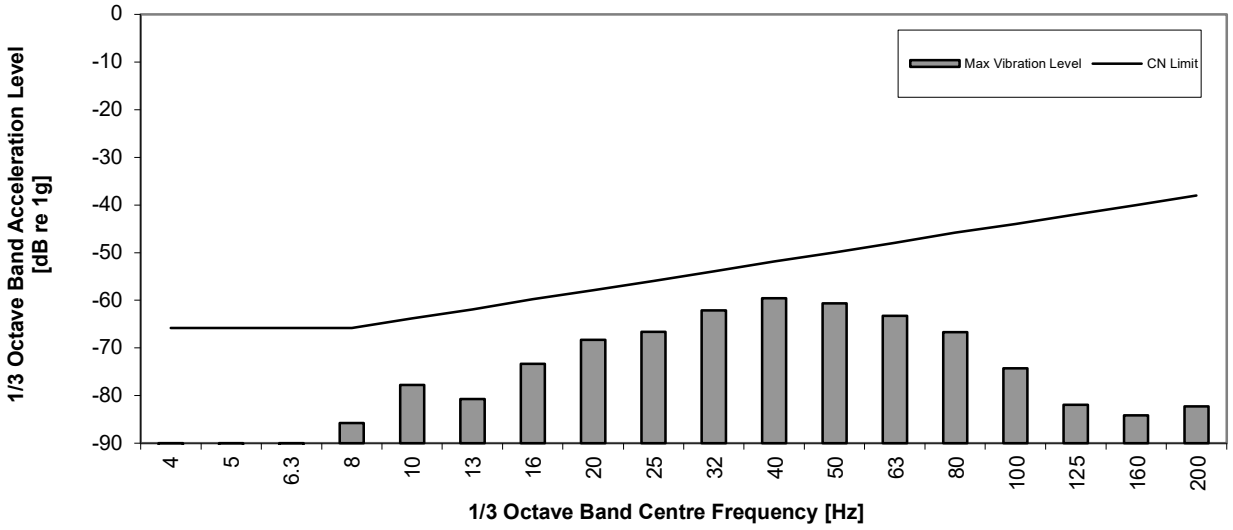


Figure 8a: Location 1, Pass-by 5
Measured Vibratory Velocity Level

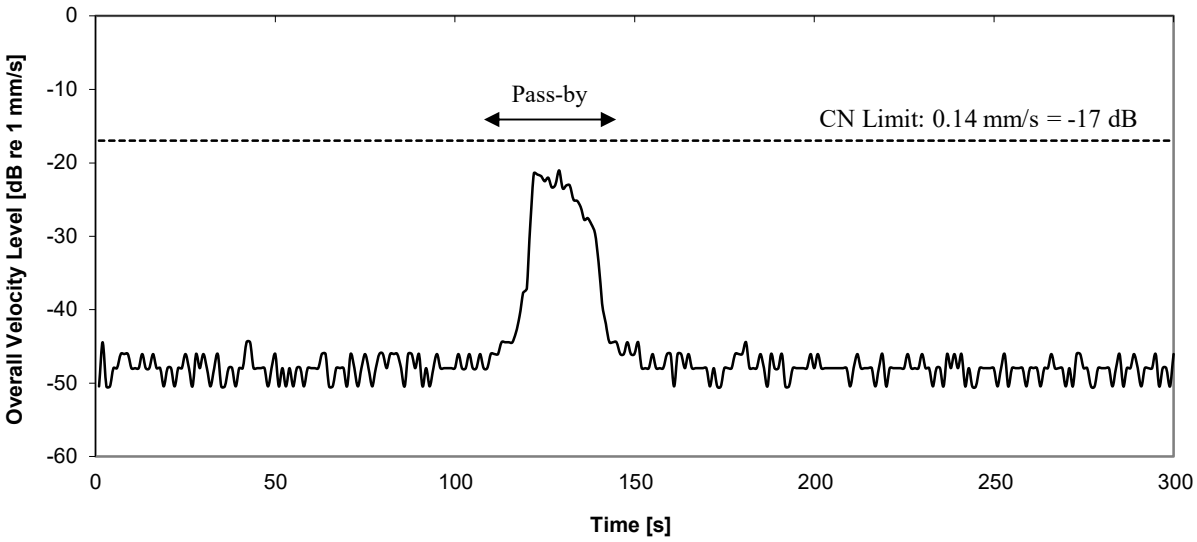


Figure 8b: Location 1, Pass-by 5
Acceleration Spectrum @ Peak Level (1 sec. Duration)

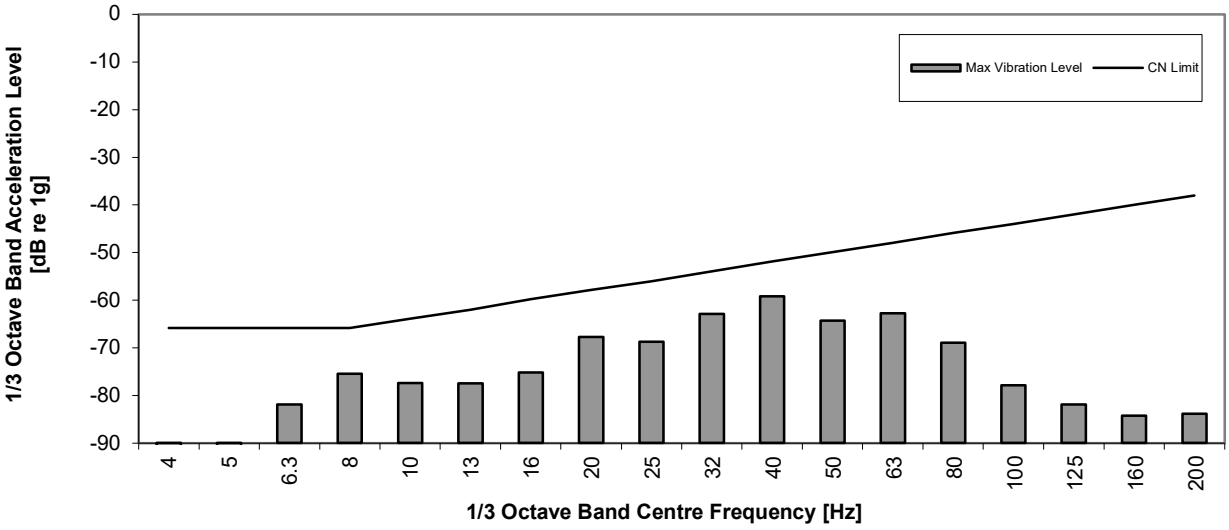


Figure 9a: Location 2, Pass-by 1
Measured Vibratory Velocity Level

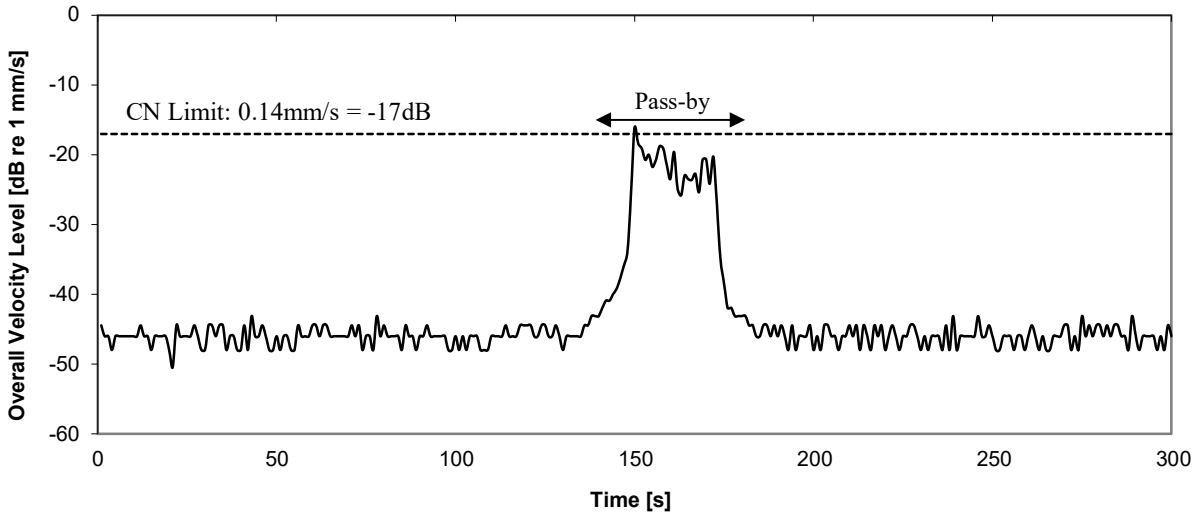


Figure 9b: Location 2, Pass-by 1
Acceleration Spectrum @ Peak Level (1 sec. Duration)

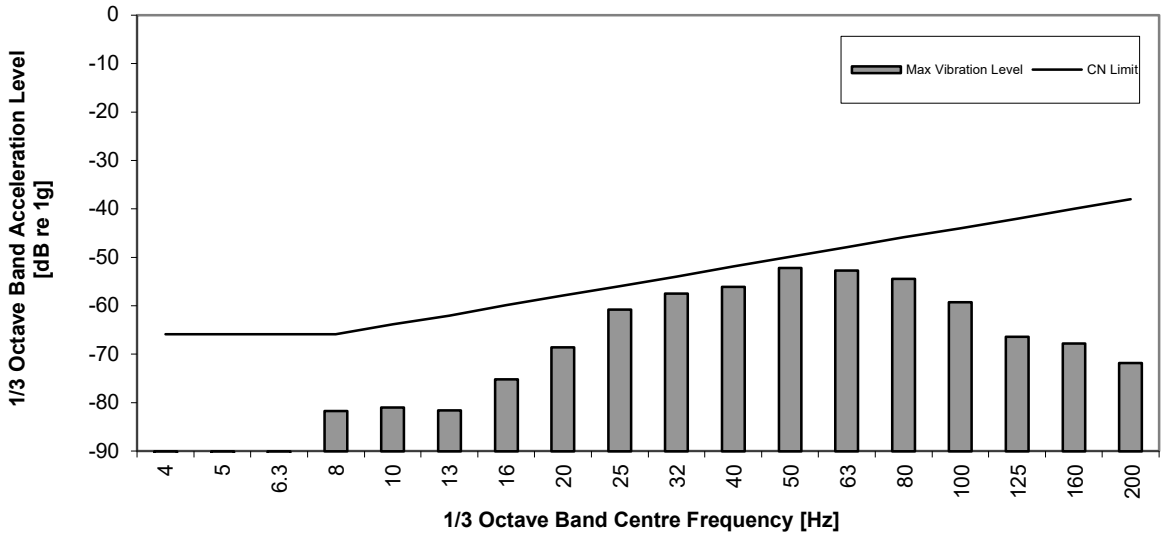


Figure 10a: Location 2, Pass-by 2
Measured Vibratory Velocity Level

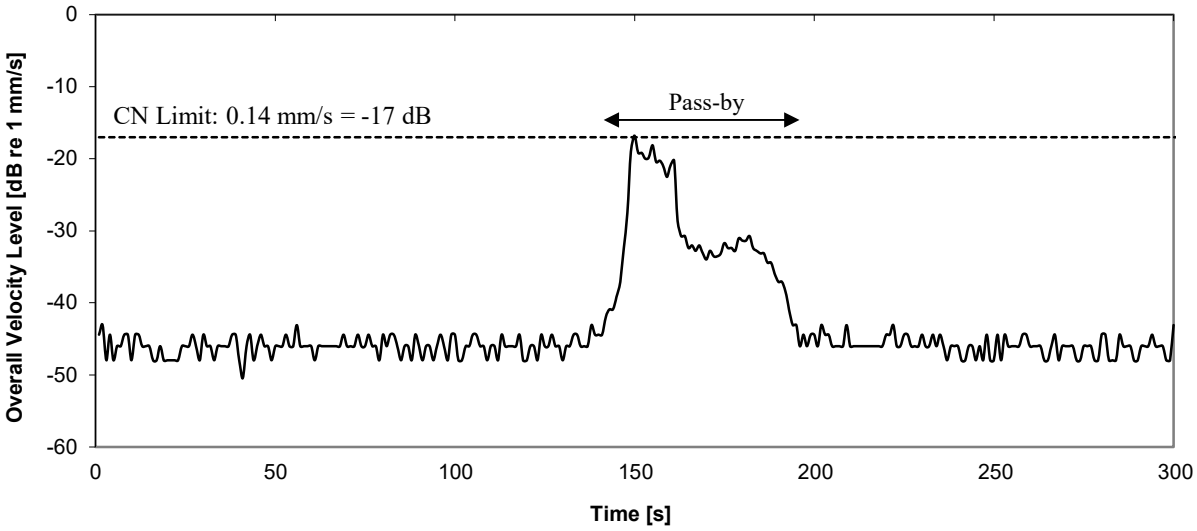


Figure 10b: Location 2, Pass-by 2
Acceleration Spectrum @ Peak Level (1 sec. Duration)

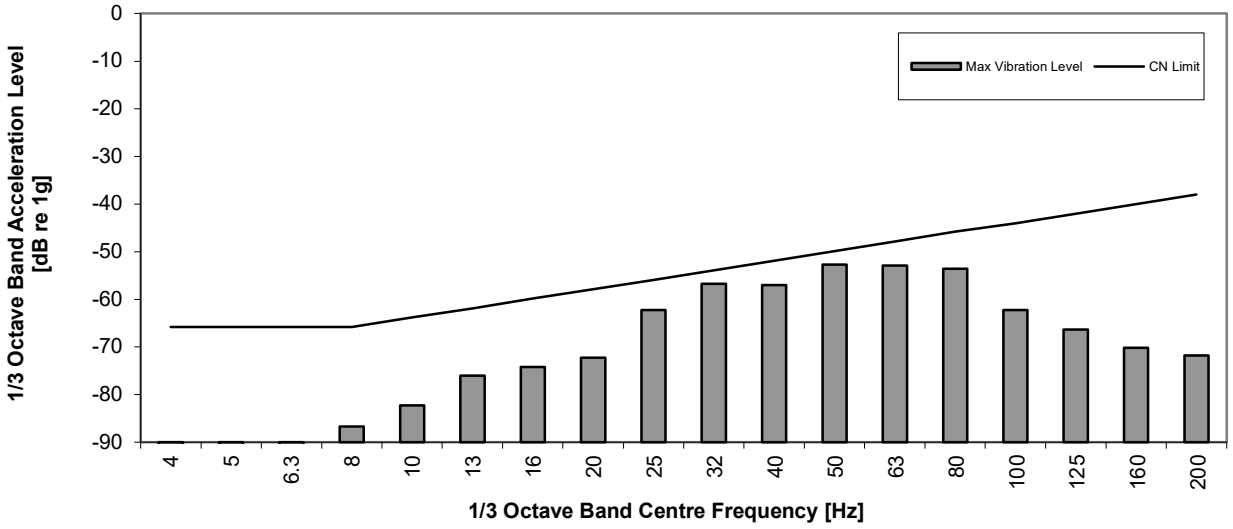


Figure 11a: Location 2, Pass-by 3
Measured Vibratory Velocity Level

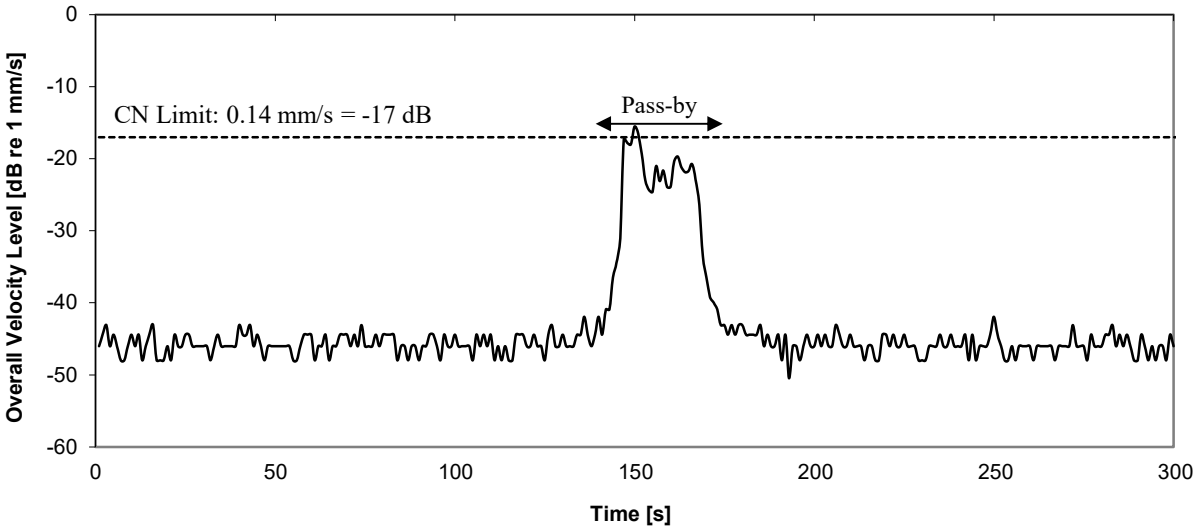


Figure 11b: Location 2, Pass-by 3
Acceleration Spectrum @ Peak Level (1 sec. Duration)

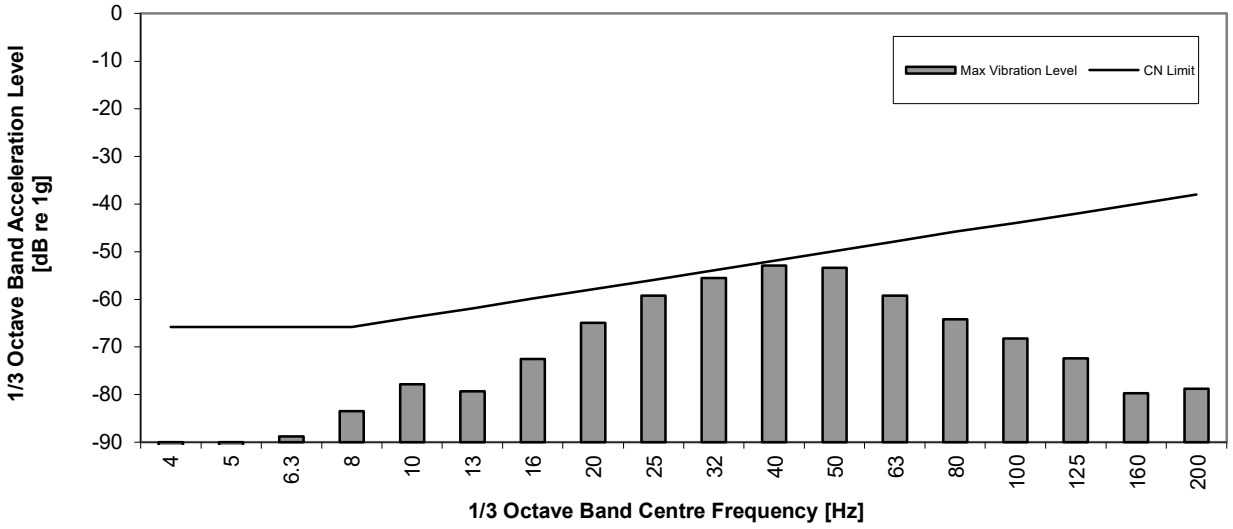


Figure 12a: Location 2, Pass-by 4
Measured Vibratory Velocity Level

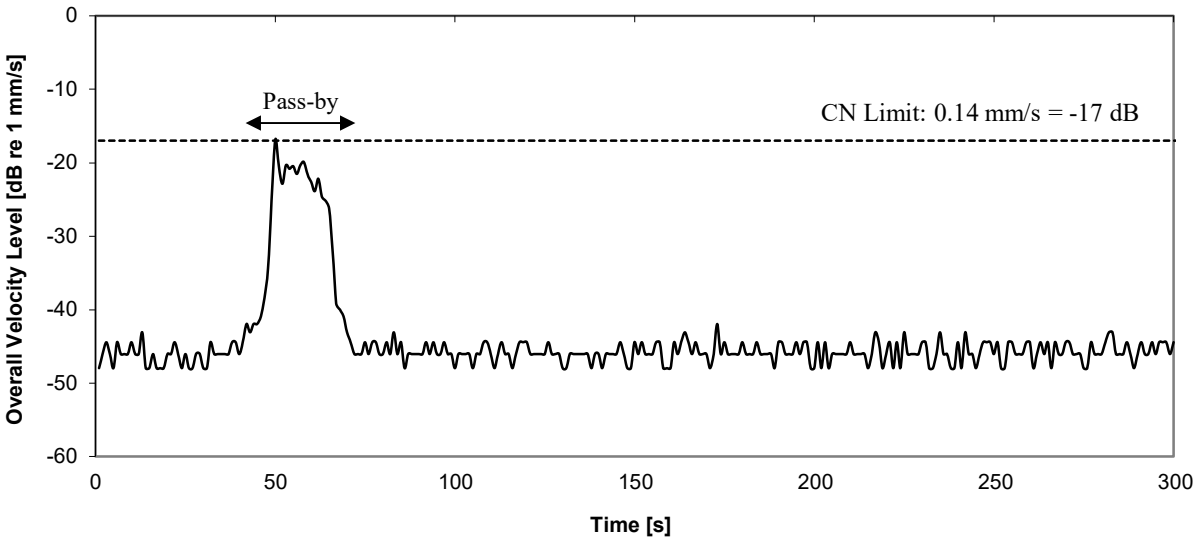


Figure 12b: Location 2, Pass-by 4
Acceleration Spectrum @ Peak Level (1 sec. Duration)

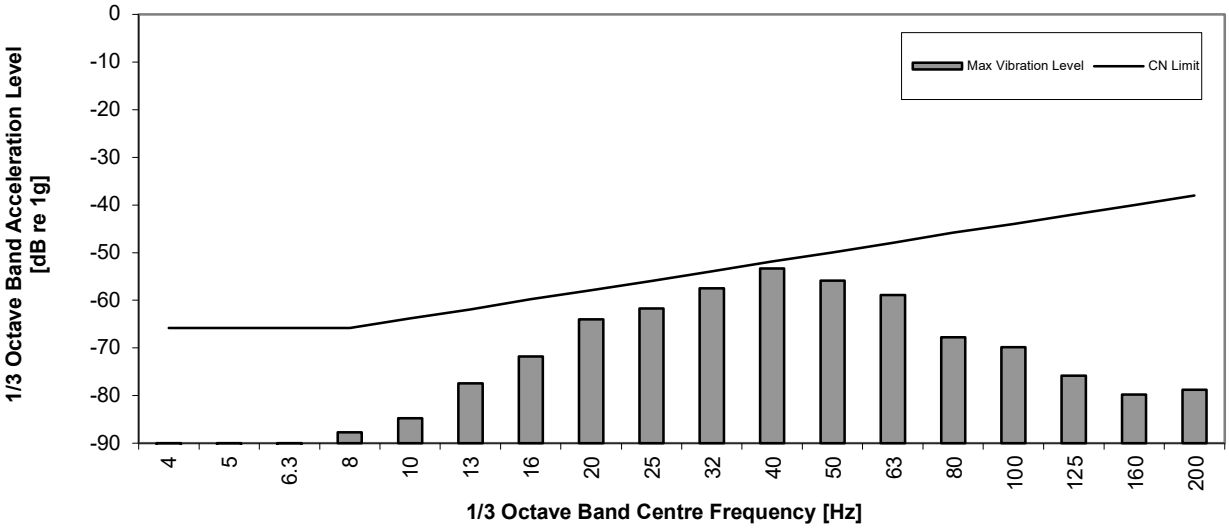


Figure 13a: Location 2, Pass-by 5
Measured Vibratory Velocity Level

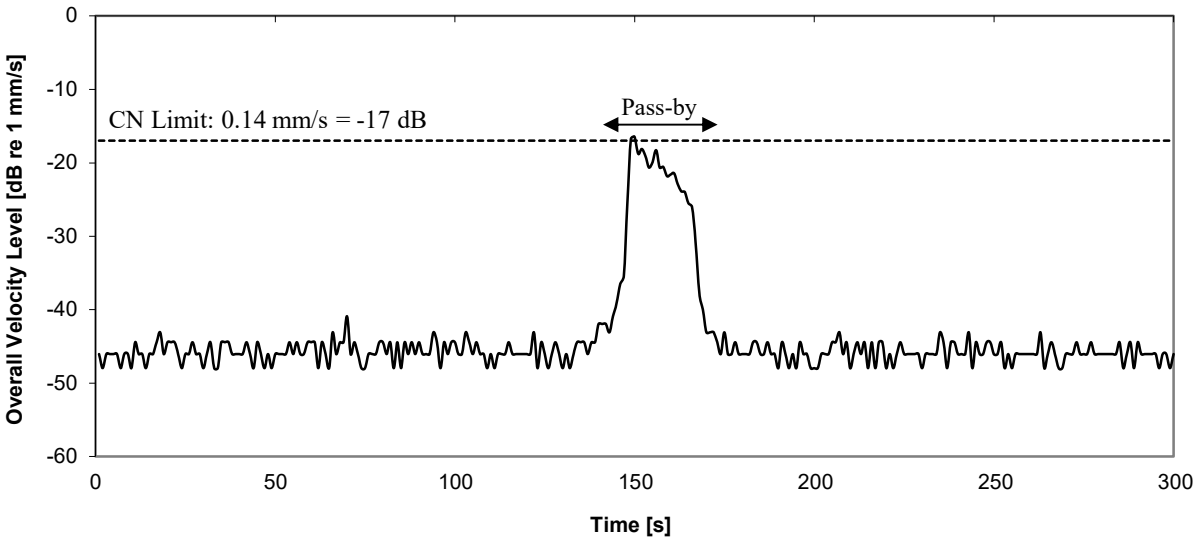
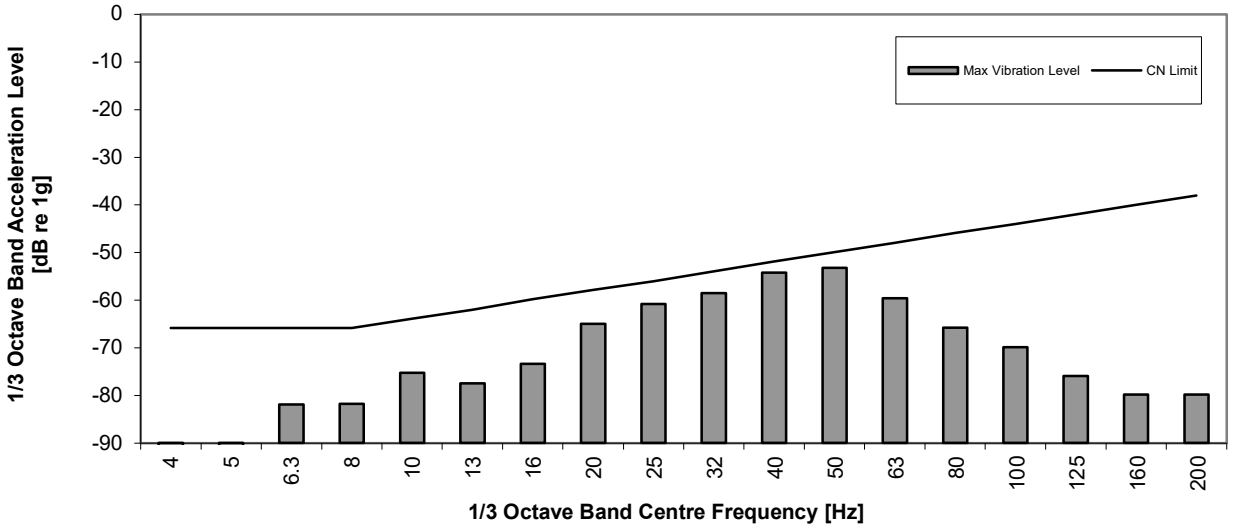
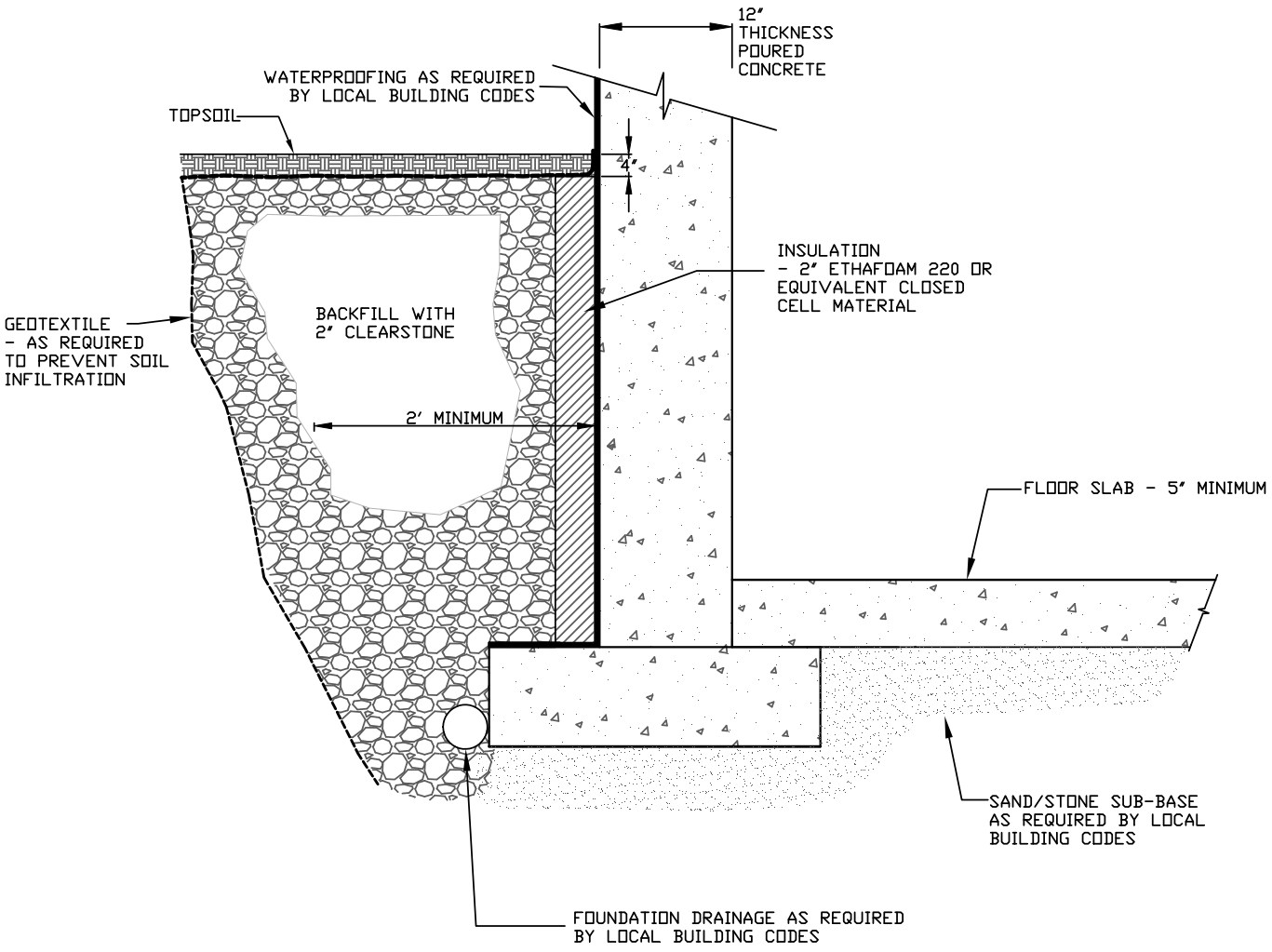


Figure 13b: Location 2, Pass-by 5
Acceleration Spectrum @ Peak Level (1 sec. Duration)



Appendix E

Sample Upgraded Foundation System



NOTES:
1. TAKEN IN PART FROM MATERIALS PREPARED BY WILSON, IHRIG & ASSOC., INC. AND JADE ACOUSTICS, CONSULTANTS TO CN RAIL

CONCEPTUAL FOOTING, BASEMENT FLOOR AND BASEMENT WALL CONSTRUCTION FOR MINIMIZING VIBRATION IN LOW RISE RESIDENTIAL BUILDING CONSTRUCTION

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