2024-08-23

Dalhousie Non-Profit Cooperative Inc.
211 Bronson Avenue, suite 224,
Ottawa, ON,
K1R 6H5
c/o **Denis Michaud**, Henry Investments

Dalhousie Non-Profit Cooperative – 10-20 Empress Avenue
Traffic Noise Impact Study R3

Dear Denis,

This report assesses the traffic noise impact on the proposed development at 10-20 Empress Avenue to satisfy the City of Ottawa's decision for a noise attenuation study for the site. The calculations and methodology presented here comply with the City of Ottawa Environmental Noise Control Guidelines (2016) as well as the Ministry of Environment, Conservation and Parks' publication NPC-300.

We have determined that the noise levels generated from Albert Street exceed the acceptable limit of 55 dBA but are below 65 dBA at the plane of the window and exceed 60 dBA at the rooftop patio outdoor living area, as per the City of Ottawa noise guidelines. The noise levels generated from Albert Street are below the acceptable limit of 55 dBA at the first-level patio outdoor living area. Therefore, no Building Component Assessment was required for this assessment. However, it is necessary to include warning clauses in the lease/rental agreement(s) to inform the future tenants of this rental co-op about the high noise levels associated with the proximity to Albert Street. See **Section 4.10** for information about our acoustic mitigation recommendations and **Section 4.11** for the required warning clauses.

Should you have any questions regarding this report, please do not hesitate to contact us.

Sincerely,

Tiffany-Rose Filler, M.Sc.
Acoustic Consultant

Contents

1.0 Introduction & Site Description

Henry Investments has commissioned State of the Art Acoustik Inc. to complete a noise study for a new residential development that will be located at 10-20 Empress Avenue in Ottawa, Ontario. The building consists of a four-storey building with forty-one dwellings. It is located in a mainly residential area and within 100 meters of Albert Street, an arterial road. We have reviewed the projected impact of traffic noise from Albert Street to review conformance with the City of Ottawa Environmental Control Guidelines (ENCG), which are compliant with the Ministry of Environment, Conservation and Parks (MECP) NPC-300.

In **Section 2.0**, the site plan of the building is shown, and the surrounding area is analyzed for possible noise sources which would impact the proposed development. This section also shows angles and distances from the sources to receptor points.

In **Section 3.0**, the noise impact calculation procedure is described, and in **Section 4.0**, the predicted noise impact from Albert Street has been analyzed.

2.0 Site Plan Evaluation

2.1 Project Description

The proposed development consists of a new four-storey cooperative that will be located at 10-20 Empress Avenue in Ottawa, Ontario. The area surrounding the development consists primarily of low-rise residential buildings. The only noise source to be considered for this site is Albert Street, as all other potential road noise sources are located beyond the distances specified in Section 2.2.1 of the City of Ottawa Environmental Noise Control Guidelines. For additional information, please refer to **Section 3.1**.

2.1.1 Outdoor Living Areas (OLAs)

An OLA is characterized as a noise-sensitive land that is intended and designed for the quiet enjoyment of the outdoor environment and is readily accessible from the building. In the context of this project, there are two designated OLAs: one located on the rooftop terrace and community garden, and the other situated at the Level 1 patio.

2.2 Site Plan Review

The following **Figure 2.1** shows the site plan of the proposed building, including its proximity to Albert Street, which is located approximately 32m from the right of way to the closest façade. **Figure 2.2** shows the proposed site with the distance and angles to Albert Street. Albert Street is indicated as an arterial road per the City of Ottawa's Transportation Master Plan Map 7.

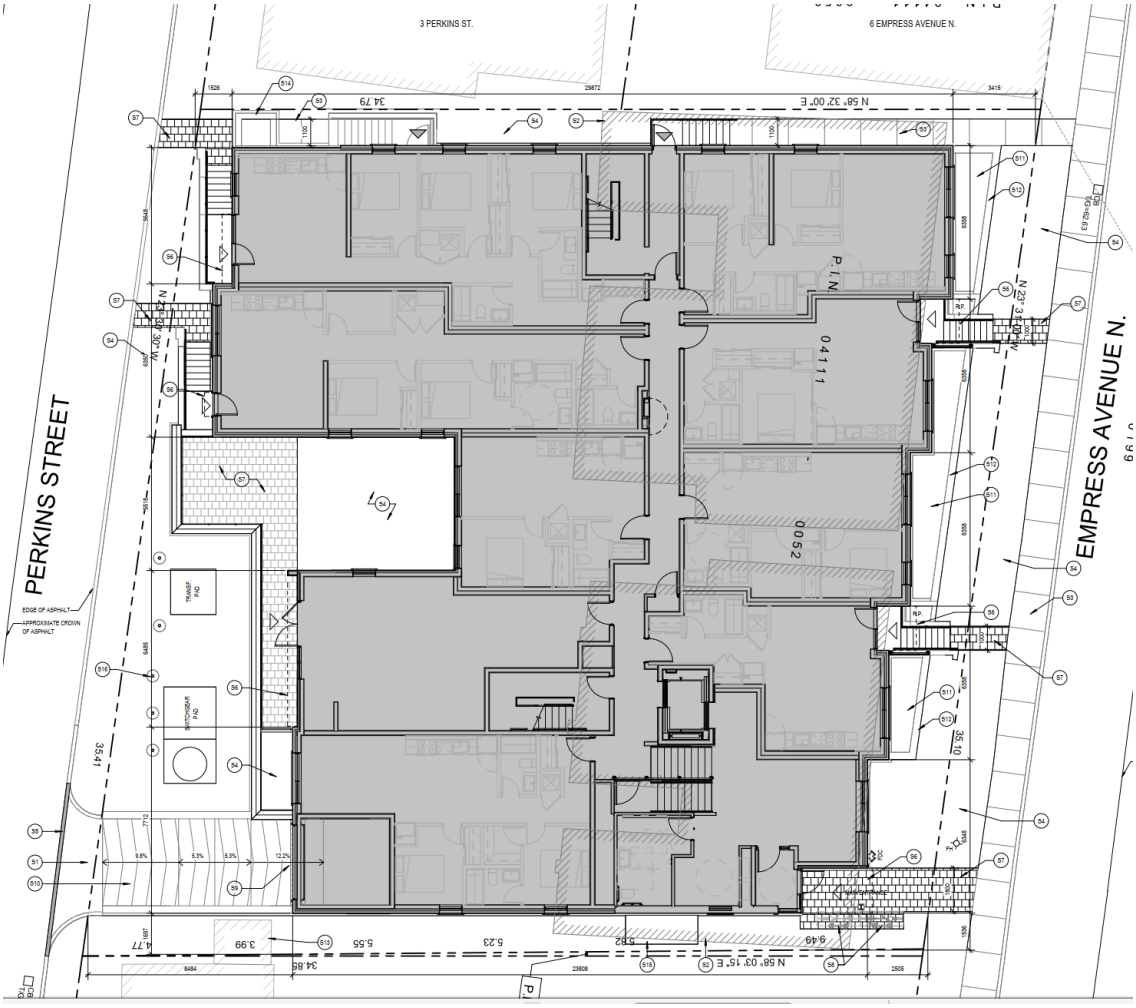


Figure 2.1 – Site plan of 10-20 Empress Avenue.

Figure 2.2 – Surrounding area around 10-20 Empress Avenue (Google Earth Pro)

3.0 Noise Impact Procedure

3.1 City of Ottawa Environmental Noise Guidelines for Traffic Noise (Road & Rail)

This assessment uses the City of Ottawa – Environmental Noise Control Guidelines (ENCG), dated January 2016 and the 2023 update, to assess and mitigate noise from roads, transit ways, railways and aircraft. The maximum road and rail noise levels for outdoor living areas are taken from Table 2.2a of the ENCG and summarized in **Table 3.1** below.

Time	Outdoor Leq Levels (dBA) Class 1, 2 & 3 Areas
	Road/Rail Traffic Noise Level Limit (dBA)
07:00 – 23:00	**55** for Outdoor Living Areas (OLA)

Table 3.1 – Criteria for Outdoor Living Area Road/Rail Noise Levels

The ENCG states that noise control studies are to be prepared when the indoor area is within the following setback distances from the road, highway and railway noise sources:

- 100m from an arterial road or a major collector, light rail corridor or bus rapid transitway
- 250m from an existing or proposed highway
- 300m from a proposed or existing rail corridor or secondary main railway line
- 500m from a 400-series provincial highway or principal main railway line

The traffic noise sources for this site are determined via the City of Ottawa's Transportation Master Plan Map 7, which identifies roads and railways to be considered as traffic noise sources. For 10-20 Empress Avenue, the nearby noise sources are the following:

Roads and Railways	Distance to Façade[1]	Exclusionary Distance Limit
Albert Street	32 metres	100 meters
Booth Street	120 metres	100 meters
Light Rail Transit Line (Pimisi Station)	130 metres	100 meters

[1]Note: The Distance to the Façade Line is calculated from the façade of the proposed development to the right-of-way of the road/railway.

Table 3.3 – List of nearby road noise sources

The noise source must be analyzed when the listed distance to the property line is lower than the respective exclusionary distance limit. Based on the distances in **Table 3.3**, an analysis of the impact of traffic noise is required for Albert Street.

3.2 Noise Attenuation Requirements

This section outlines the required noise control measures and warning clauses and when to apply them, as stipulated by the ENCG and Ministry of Environment, Conservation and Parks (MOECP) for placement within lease/rental agreements.

If sound levels are predicted to be less than the specified criteria, no attenuation measures are required on the part of the proponent. If the predicted noise exceeds the criteria, the City of Ottawa recommends several attenuation measures.

These attenuation measures may include any or all of the following:

- construction of a noise barrier wall and/or berm;
- installation of a forced air ventilation system with provision for central air;
- installation of central air;
- acoustically selected building façade components

Where excessive noise levels may adversely affect the property or its use, the ENCG requires notices in the form of a Warning Clause to be placed on the title in order to alert the buyer or renter of a possible environmental noise condition or a limitation on their property rights. The notices on titles must be included in the Development Agreement(s) and the lease/rental agreement(s).

The City of Ottawa, via MOECP NPC-300, requires a Warning Clause whenever noise could meet or exceed 55 dBA 16-hour L_{eq} at the Outdoor Living Area or Plane of Window of any living area or 50 dBA at the Plane of Window of any sleeping area prior to any noise mitigation. **Table 3.4** provides the types of warning clauses which are taken from Section C8.1 Transportation Sources of the MOECP NPC-300, which also states:

"The use of warning clauses or easements in respect of noise are recommended when circumstances warrant. Noise warning clauses may be used to warn of potential annoyance due to an existing source of noise and/or to warn of excesses above the sound level limits. Direction on the use of warning clauses should be included in agreements that are registered on title to the lands in question. The warning clauses would be included in agreements of Offers of Purchase and Sale, lease/rental agreements and condominium declarations."

In addition, Section C8 also notes: "*A warning clause is not considered a form of noise mitigation. It is not acceptable therefore to use warning clauses in place of physical noise control measures to identify an excess over the MOE or City noise limits*."

TYPE	Warning Clause Text
Type A	Purchasers/tenants are advised that sound levels due to increasing road/rail/Light Rail/transit way traffic may occasionally interfere with some activities of the dwelling occupants as the sound levels exceed the sound level limits of the City and the Ministry of the Environment.
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 road/rail/Light Rail/transitway traffic may on occasions interfere with some activities of the dwelling occupants as the sound levels exceed the sound level limits of the City and the Ministry of the Environment.
Type C	This dwelling unit has been designed with the provision for adding central air conditioning at the occupant's discretion. Installation of central air condition by the occupant in low and medium density developments will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the sound level limits of the City and the Ministry of Environment.

Type D	This dwelling 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 City and the Ministry of Environment.

Table 3.4 - Warning Clause Types (from MOECP NPC-300 Section C8.1)

3.3 Building Component Assessment (AIF Analysis)

According to the ENCG, when noise levels could exceed 65 dBA at the Plane of Windows (POW) of a living area (day) or sleeping quarters (night), the exterior cladding system of the building envelope must be acoustically designed to ensure the indoor noise criteria is achieved. The City of Ottawa recognizes the Acoustic Insulation Factor (AIF[1]) method as an appropriate analysis technique.

To comply with the City of Ottawa policies, the building envelope will require a minimum AIF rating to provide the indoor noise level required for living, dining and bedrooms of residential dwellings as described below.

The City of Ottawa's ENCG outlines the following maximum indoor L_{eq} limits:

- maximum daytime indoor L_{eq} for living spaces should be 45 dBA
- maximum nighttime indoor L_{eq} for bedrooms should be 40 dBA

For the overall exterior wall of any room, the required AIF for road and rail transportation noise is:

Required AIF = Outside L_{eq} - Indoor L_{eq} (Req) + 2dB (1)

When the exterior is comprised of components, then the AIF required of each component is determined by the following equation[1]:

Required AIF = Outside L_{eq} - Indoor L_{eq} (Req) + 10 $\log_{10}$ (Number of Components) + 2dB (2)

The required AIF is based on the Outside L_{eq}, Indoor L_{eq} required and the total number of exterior façade components. The AIF method allows for the number of components to be reduced if any component significantly exceeds the required AIF[1]:

"If the AIF of any component exceeds the required AIF by 10 or more, the calculation should be repeated for the other components with the 'total number of components' reduced by one. This reduction in the number of components lowers the required AIF for the others."

[1] J.D. Quirt, Building Research Note: Acoustic Insulation Factor: A Rating for the Insulation of Buildings against Outdoor Noise, National Research Council [Revised June 1980]

4.0 Surface Transportation Noise Study

The following section describes our analysis of the road noise impact on the new proposed building at 10-20 Empress Avenue.

4.1 Road Traffic Information

This study focuses exclusively on the traffic noise generated by Albert Street, north of the new building's front façade. The proposed building is positioned at a distance greater than 100 meters from any other collector or arterial road, with no nearby rail lines or influence from the airport. Consequently, no other surface noise sources have been considered for this study.

Table 4.1 below summarizes the roadway's parameters obtained from Table B1 on p. 75 of The City of Ottawa Environmental Noise Control Guidelines 2016, "Appendix B: Table of Traffic and Road Parameters To Be Used For Sound Level Predictions" for the respective roadway class.

Roadway	Implied Roadway Class	Annual Average Daily Traffic (AADT) Veh/Day	Posted Speed	Day/Night Split (%)	Medium Trucks (%)	Heavy Trucks (%)
Albert St	4-Lane Urban Arterial Undivided (4-UAU)	30,000	50 km/h	92/8	7	5

Table 4.1 – Summary of Major Roadways

4.2 Procedure Used for Roadway Noise Analysis

To assess the impact of road noise on the proposed development, we employed the Ministry of Environment's STAMSON modelling software version 5.04. This program enables us to input various road variables, including traffic volume, vehicle types, speed, barrier locations, and topography. We can accurately determine the environmental noise impact at specific reception points by utilizing these inputs.

4.3 Points of Reception (POR)

To identify the most severe noise impact on the building's façade, we have selected three PORs based on their proximity to Albert Street. These PORs include the rooftop terrace, the northern façade of the building (3rd floor), and the Level 1 patio. **Figures 4.1 and 4.2** provide an elevation view of all the PORs. **Figure 4.3-4.5** displays the floor plans of each POR. POR1 is positioned at a height of 16.0m above ground level. This is determined by the rooftop terrace's elevation of 14.5m, with the POR situated 1.5m above it. POR2 is located at a height of 9.0m on the 3rd floor, precisely at the plane of the window (POW). POR3 is positioned at a height of 3.50m above ground level. This is determined by the patio's elevation of approximately 2.0m, with the POR situated 1.5m above it. **Table 4.2** below summarizes the POR heights, distances to relevant noise sources, and angles to these sources.

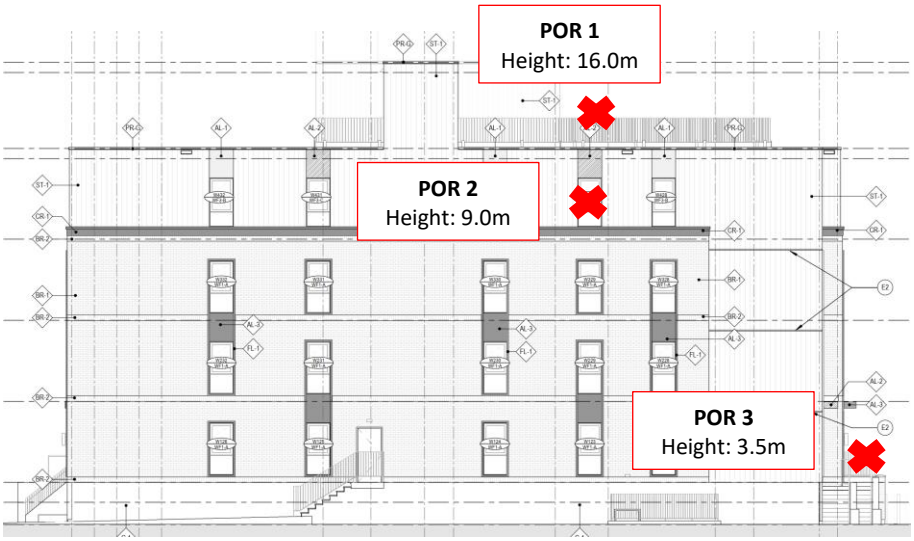


Figure 4.1 – North Elevation of 10-20 Empress Ave showing approximate locations and heights of PORs.

Figure 4.2 – West Elevation of 10-20 Empress Ave showing the approximate height of PORs 1 and 3.

Receiver	Height (m)	Noise Source		
		Albert Street		
		Distance from Source (m)	Angle to source from left	Angle to source from right
POR 1	16.0	54.3	90	90
POR 2	9.0	49.0	90	90
POR 3[1]	3.5	64.0	90	25

Note[1]: POR 3 is partially shielded by the building, limiting the source angle from 25 to 90 degrees.

Table 4.2 – POR height, distance from noise sources, and angles to noise sources.

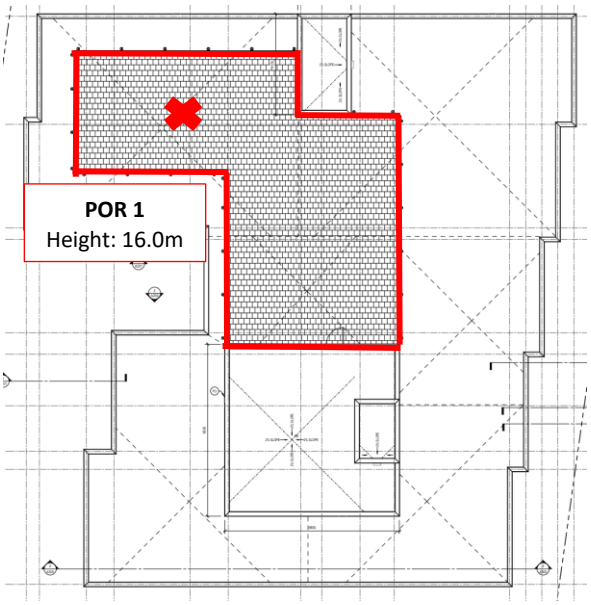


Figure 4.3 – Floor Plan of the rooftop Outdoor Living Area (POR1) of 10-20 Empress Ave. The space associated with the POR is outlined in red. The red 'X' denotes the receiver location used in STAMSON.

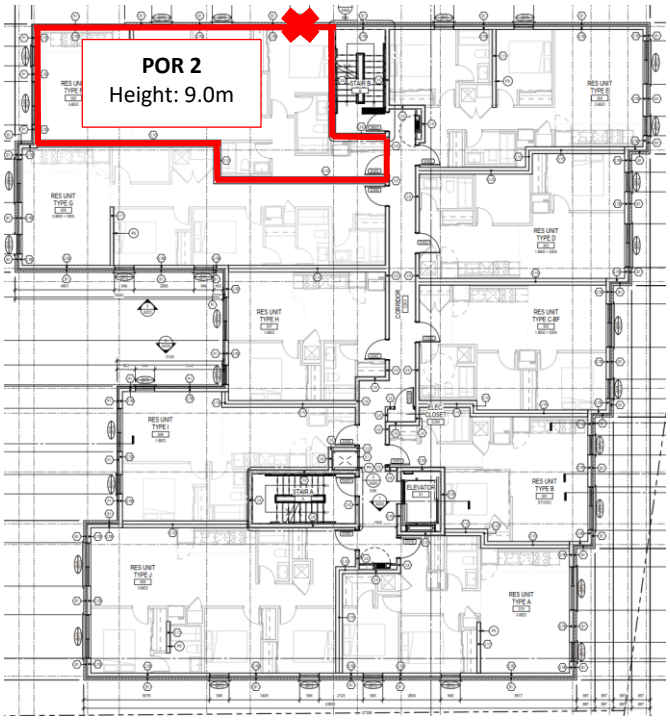


Figure 4.4 – Floor Plan of 3rd floor (POR2) of 10-20 Empress Ave. The room associated with the POR is outlined in red. The red 'X' denotes the receiver location used in STAMSON.

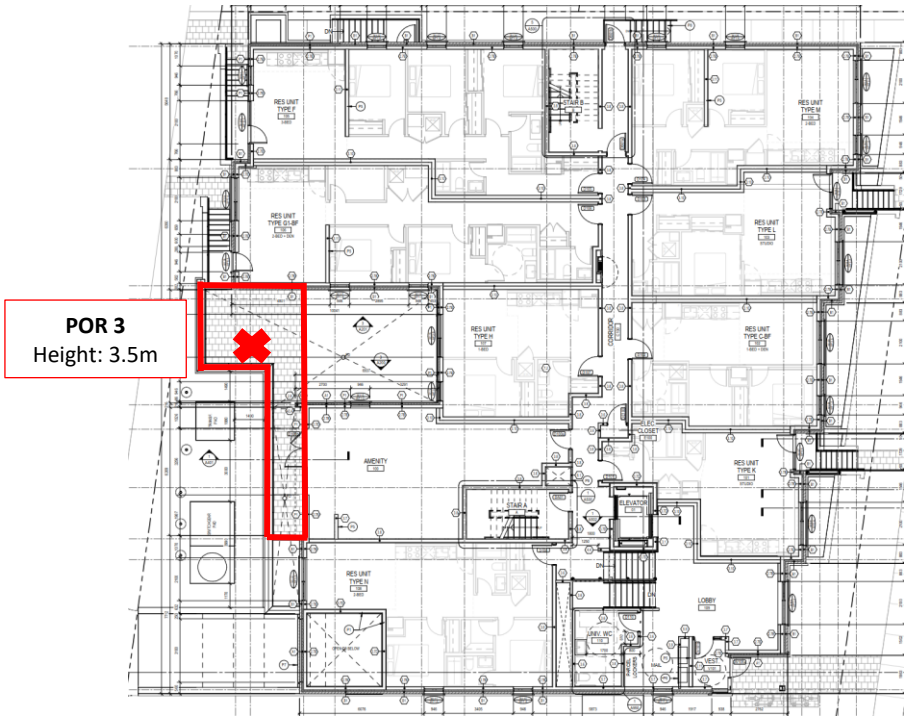


Figure 4.5 – Floor Plan of the Level 1 patio Outdoor Living Area (POR3) of 10-20 Empress Ave. The space associated with the POR is outlined in red. The red 'X' denotes the receiver location used in STAMSON.

4.4 Methodology Used in Traffic Noise Impact Calculation

To assess the impact of road noise on the proposed development, we utilized the Ministry of Environment's STAMSON modelling software version 5.04. This software allows us to input various variables related to road transportation, such as traffic volume, speed, day and night traffic splits, and topography. We can accurately determine the noise impact at specific PORs by utilizing these inputs.

According to the guidelines provided by the City of Ottawa, if noise levels are expected to exceed 65 dBA at the POW of a noise-sensitive building, the building's exterior cladding system must be acoustically designed to ensure compliance with the indoor noise criteria.

4.5 STAMSON Analysis Parameters

The parameters used in STAMSON to assess the noise impact at PORs 1-3 are indicated in **Tables 4.3-4.5**, respectively.

Parameter	Values Used
Road	Albert Street
Time Period	16h/8h
Road Angle	-90° to 90°
Topography	Elevated
Rows of Houses	2
Density of the First Row	50%
Intermediate Surface	Reflective
Receiver Height (m)	16
Source Receiver Distance (m)	54.3
Source Elevation (m)	1.5

Table 4.3 – Parameters used in the STAMSON model for POR 1 (Roof OLA)

Parameter	Values Used
Road	Albert Street
Time Period	16h/8h
Road Angle	-90° to 90°
Topography	Elevated
Rows of Houses	2
Density of the First Row	50%
Intermediate Surface	Reflective
Receiver Height (m)	9.0
Source Receiver Distance (m)	49.0
Source Elevation (m)	1.5

Table 4.4 – Parameters used in the STAMSON model for POR 2 (3rd floor north-west unit)

Parameter	Values Used
Road	Albert Street
Time Period	16h/8h
Road Angle	-90° to -25°
Topography	Elevated
Rows of Houses	2
Density of the First Row	75%
Intermediate Surface	Reflective
Receiver Height (m)	3.5
Source Receiver Distance (m)	64.0
Source Elevation (m)	1.5

Table 4.5 – Parameters used in the STAMSON model for POR 3 (Level 1 Floor Patio OLA)

4.6 Predicted Surface Transportation Noise Levels

Table 4.6 below shows the predicted sound pressure levels at the points of reception from the results of the STAMSON noise software calculation (**Appendix A1**).

Noise Source	POR 1 (dBA)	POR 2 (dBA)		POR 3 (dBA)
	Day	Day	Night	Day
Albert Street	61.7	62.1	54.5	54.1

Table 4.6 – Predicted traffic noise at the PORs

4.7 Roadway Noise Summary and Analysis

We have calculated the predicted noise level caused by traffic using STAMSON and have shown a 16h Leq for daytime hours of **61.7 dBA** at POR1, **62.1 dBA** at POR2, and **54.1 dBA** at POR3. The 8h Leq for nighttime hours is **54.5 dBA** at POR2. Nighttime levels for POR1 and POR3 were not calculated as the exclusionary noise limits for Outdoor Living Areas (OLAs) are only during the daytime. As the levels during the day and at night are below the 65 dBA threshold, an evaluation of exterior building components (AIF analysis) is not required. However, as the predicted noise levels are above 55 dBA for the daytime period at all PORs, warning clauses are required, per the Ministry of Environment requirements.

For POR2, since the daytime sound level at the plane of the bedroom window is greater than 55 dBA and less than 65 dBA, and the nighttime sound level is greater than 50 dBA and less than 60 dBA, the unit must be designed with a provision for the installation of central air conditioning in the future. Warning clause **Type C** is required.

For POR 1, the daytime sound level for the rooftop OLA is greater than 60 dBA. Refer to **Section 4.8** for noise control calculations.

For POR 3, the daytime sound level for the first-floor patio is lower than 55 dBA. No further analysis is required..

4.8 Noise Control Calculations for POR 1 (Rooftop OLA)

Table 4.7 below shows the predicted sound pressure levels at the rooftop OLA from the results of the STAMSON noise software calculation (**Appendix A2**) if the barrier is implemented to achieve 55 dBA or less for the daytime periods for POR 1.

Noise Source	POR 1 (dBA)
	Day
Albert Street	54.9

Table 4.7 – Predicted traffic noise at POR 1 with Ideal Barriers

Table 4.8 below shows the minimum height of the barrier that would need to surround the rooftop OLA to achieve the sound pressure level detailed in **Table 4.7.** The barrier location is illustrated in **Figure 4.6.**

	POR 1
Minimum Barrier Height (m)	2.4

Table 4.8 – Ideal barrier height for POR 1

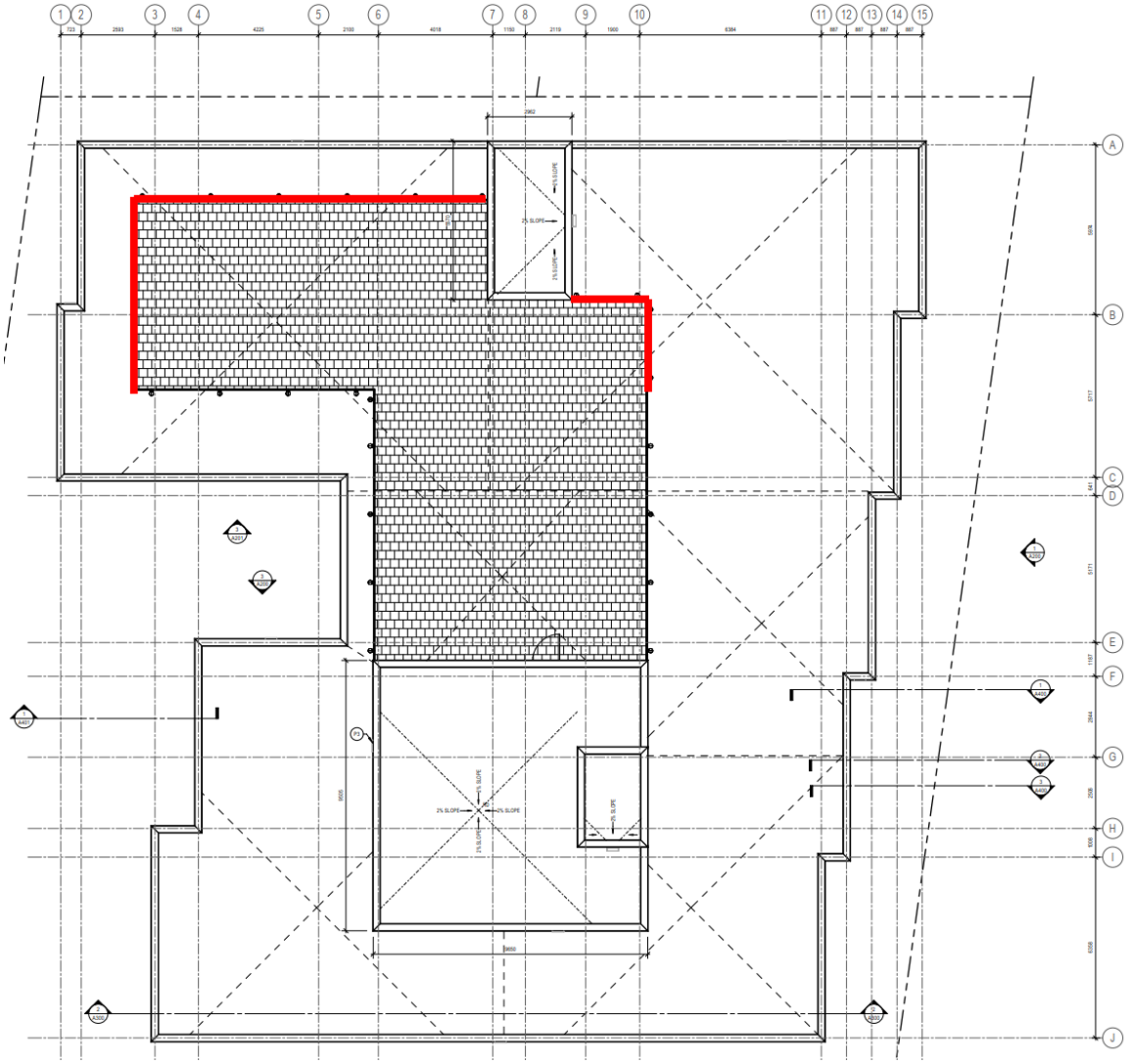


Figure 4.6 – Location of barrier (in red) for POR 1

The required barrier height for POR 1 is 2.4m for each position to meet the ENCG maximum requirement of 55 dBA. Due to the reasoning presented in **Section 4.8.1**, the barrier height at POR 1 was deemed unfeasible and a barrier height deviation is requested. A **Type B** warning clause must be added to rental agreements for prospective tenants if the project proceeds with the alternate barrier height at the rooftop OLA.

This request for deviation follows the procedure identified in **Part 5:TECHNICAL REQUIREMENTS FOR ACOUSTIC BARRIER SYSTEMS - Section 3.1 Submission Document Requirements** of the ENCG.

4.8.1 Requested Deviation to the City of Ottawa's Acoustic Requirements for Rooftop OLA

The following reasoning supports a lower barrier height for the rooftop OLA:

- Integration with Surrounding Architecture: A lower barrier height integrates better with the terrace design, ensuring that the terrace does not feel overly enclosed or obstructed. Additionally, reducing the height mitigates the visual impact on neighbouring buildings, especially since this will be the tallest building in an area characterized by lower building heights.
- Cost and Structural Considerations: This is an affordable housing project, and the construction and maintenance of a 2.4m high barrier would be cost-prohibitive. Installing such a barrier on the roof would require significant structural reinforcing, which is not feasible within the budget constraints of an affordable housing project. A lower barrier height is more practical and cost-effective while still meeting the primary functional requirements of the barrier, such as acoustics and wind protection.
- Uninterrupted Views and Aesthetics: A lower barrier height of 1.3m for the rooftop OLA would ensure uninterrupted views of the river from the rooftop outdoor living area. This is a significant consideration as the terrace is one of only two amenity spaces available to residents. Ensuring residents can enjoy beautiful views of the river and LeBreton Flats enhances the overall living experience and promotes the use of communal spaces. Additionally, the reduced height will help make the amenity space a more inviting and pleasant place for residents, which aligns with the goal of creating high-quality living environments that prioritize resident satisfaction.

Table 4.9 below shows the predicted sound pressure levels at the rooftop OLA from the results of the STAMSON noise software calculation (**Appendix A1**) if the barrier for POR 1 is 1.3m tall.

Noise Source	POR 1 (dBA)
	Day
Albert Street	59.4

Table 4.9 – Predicted traffic noise at POR 1 with alternate barrier height (1.3m-tall)

4.9 Barrier Properties

The surface mass density of the proposed barrier for POR 1 meets the requirement of being at least 20 kg/m^2 as per **Section 3.5.1** in the City of Ottawa's Drafts for Technical Requirements for Noise Control Barrier Systems (see **Appendix A4**). The barrier must also comply with all barrier requirements listed in this document. The detailed drawing for the glass railing product planned for POR 1 is provided in **Figure 4.8**

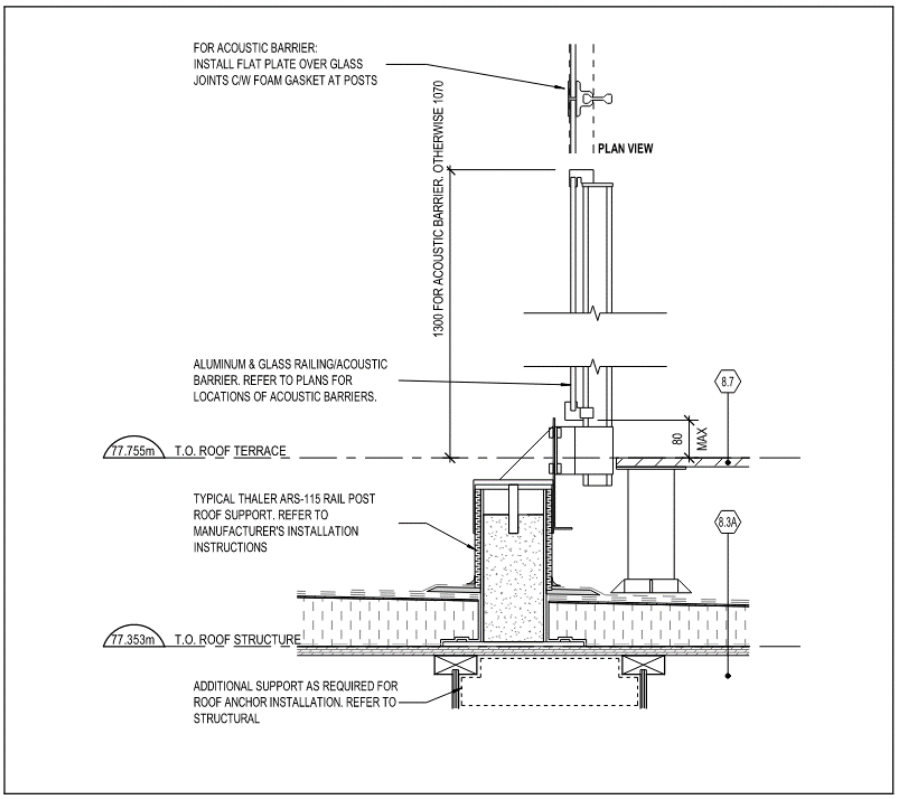


Figure 4.8 – 1.3m-tall Glass Railing Proposed for Installation for Rooftop POR 1

4.10 Warning Clauses

The following warning clauses are required for this property:

Due to the predicted noise at the rooftop outdoor living area (POR 1) being above 60 dBA and the required noise control measures not being feasible due to reasoning detailed in **Section 4.8.1**, a **Type B** warning clause is required:

"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 road/rail/Light Rail/transitway traffic may on occasions interfere with some activities of the dwelling occupants as the sound levels exceed the sound level limits of the City and the Ministry of the Environment."

Due to the predicted noise at the Plane of Window Receptors (POR 2) being between 55 and 60 dBA, a **Type C** warning clause is required:

"This dwelling unit has been designed with the provision for adding central air conditioning at the occupant's discretion. Installation of central air condition by the occupant in low and medium density developments will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the sound level limits of the City and the Ministry of Environment. "

5.0 Conclusion

We have completed the traffic noise impact study for 10-20 Empress Avenue. The only road/rail noise source to consider is Albert Street, which will be located approximately 32 meters north of the property. The daytime predicted noise levels at the plane of window exceed 55 and are below 60 dBA. The daytime predicted noise level at the rooftop outdoor living area exceeds 60 dBA. The daytime predicted noise level at the first level patio outdoor living area is below 55 dBA. The units must be designed with a provision for the installation of central air conditioning in the future, and a Type B and C warning is required.

The required warning clauses are as follows:

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 road/rail/Light Rail/transitway traffic may on occasions interfere with some activities of the dwelling occupants as the sound levels exceed the sound level limits of the City and the Ministry of the Environment."*

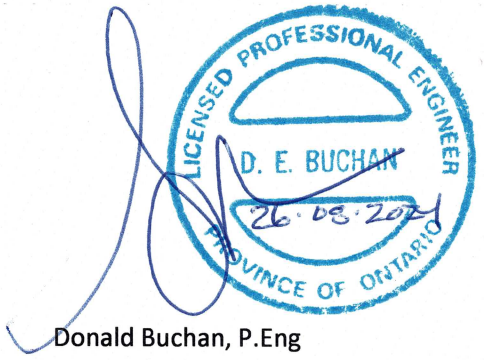
Type C: *"This dwelling unit has been designed with the provision for adding central air conditioning at the occupant's discretion. Installation of central air condition by the occupant in low and medium density developments will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the sound level limits of the City and the Ministry of Environment. "*

If you have any questions or concerns regarding this report, please let us know.

Sincerely,

Tiffany-Rose Filler, M.Sc.,
Acoustic Consultant

Approved By:



Donald Buchan, P.Eng
Principal
Buchan Lawton Parent Ltd.

APPENDIX

Appendix A1 – STAMSON Calculations for all PORs without barriers

A1.1 – STAMSON Calculation for POR1 (Rooftop OLA) without barrier

A1.2 – STAMSON Calculation for POR2 (3rd Floor Bedroom)

A1.3 – STAMSON Calculation for POR3 (Level 1 Patio OLA) without barrier

Appendix A2 – STAMSON Calculations for all OLA PORs with barriers that would meet 55 dBA during the daytime hours

A2.1 – STAMSON Calculation for POR1 (Rooftop OLA) with barrier to meet 55 dBA during the day

Appendix A3 – STAMSON Calculations for POR1 (Rooftop OLA) with a barrier at the height requested by Henry Investment

A3.1 – STAMSON Calculation for POR1 (Rooftop OLA) with Henry Investment's barrier

Appendix A4 – DRAFT Part 5: Technical Requirements for Noise Control Barrier Systems (City of Ottawa)

APPENDIX A1.1: STAMSON Calculations for POR1 (Rooftop OLA) without barrier

STAMSON 5.0 NORMAL REPORT Date: 15-08-2024 22:45:13
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: 10empnb1.te Time Period: Day/Night 16/8 hours
Description:

Road data, segment # 1: Albert Street (day/night)

Car traffic volume : 24288/8096 veh/TimePeriod
Medium truck volume : 1932/644 veh/TimePeriod
Heavy truck volume : 1380/460 veh/TimePeriod
Posted speed limit : 50 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

Data for Segment # 1: Albert Street (day/night)

Angle1 Angle2 : -90.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 2 / 2
House density : 50 %
Surface : 2 (Reflective ground surface)
Receiver source distance : 54.30 / 54.30 m
Receiver height : 1.50 / 1.50 m
Topography : 4 (Elevated; with barrier)
Barrier angle1 : -90.00 deg Angle2 : 90.00 deg
Barrier height : 0.00 m
Elevation : 14.50 m
Barrier receiver distance : 3.30 / 3.30 m
Source elevation : 1.50 m
Receiver elevation : 14.50 m
Barrier elevation : 14.50 m
Reference angle : 0.00

Results segment # 1: Albert Street (day)

Source height = 1.50 m

Barrier height for grazing incidence

Source ! Receiver ! Barrier ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
---+---+---+---
1.50 ! 1.50 ! 0.71 ! 15.21

ROAD (0.00 + 61.68 + 0.00) = 61.68 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	71.49	0.00	-5.59	0.00	0.00	-4.22	0.00	61.68
-90	90	0.00	71.49	0.00	-5.59	0.00	0.00	0.00	-1.55	64.35*
-90	90	0.00	71.49	0.00	-5.59	0.00	0.00	0.00	0.00	65.90

* Bright Zone !

Segment Leq : 61.68 dBA

Total Leq All Segments: 61.68 dBA

Results segment # 1: Albert Street (night)

Source height = 1.50 m

Barrier height for grazing incidence

Source ! Receiver ! Barrier ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
---+---+---+---
1.50 ! 1.50 ! 0.71 ! 15.21

ROAD (0.00 + 59.92 + 0.00) = 59.92 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	69.73	0.00	-5.59	0.00	0.00	-4.22	0.00	59.92
-90	90	0.00	69.73	0.00	-5.59	0.00	0.00	0.00	-1.55	62.59*
-90	90	0.00	69.73	0.00	-5.59	0.00	0.00	0.00	0.00	64.14

* Bright Zone !

Segment Leq : 59.92 dBA

Total Leq All Segments: 59.92 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 61.68
(NIGHT): 59.92

Results segment # 1: Albert Street (night)

Source height = 1.50 m

Barrier height for grazing incidence

Source ! Receiver ! Barrier ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
---+---+---+---
1.50 ! 1.50 ! -1.39 ! 13.11

ROAD (0.00 + 57.31 + 0.00) = 57.31 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	69.73	0.00	-4.77	0.00	0.00	-4.25	0.00	60.71
-90	90	0.00	69.73	0.00	-4.77	0.00	0.00	0.00	-7.65	57.31

Segment Leq : 57.31 dBA

Total Leq All Segments: 57.31 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 61.68
(NIGHT): 57.31

APPENDIX A1.2: STAMSON Calculations for POR2

STAMSON 5.0 SUMMARY REPORT Date: 11-07-2024 23:13:59
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: 10emp2.te Time Period: Day/Night 16/8 hours
Description:

Road data, segment # 1: Albert Street (day/night)

Car traffic volume : 24288/2112 veh/TimePeriod
Medium truck volume : 1932/168 veh/TimePeriod
Heavy truck volume : 1380/120 veh/TimePeriod
Posted speed limit : 50 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

Data for Segment # 1: Albert Street (day/night)

Angle1 Angle2 : -90.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 2 / 2
House density : 50 %
Surface : 2 (Reflective ground surface)
Receiver source distance : 49.00 / 49.00 m
Receiver height : 1.50 / 9.00 m
Topography : 3 (Elevated; no barrier)
Elevation : 7.50 m
Reference angle : 0.00

Result summary (day)

source height (m)	Road Leq (dBA)	Total Leq (dBA)
1.Albert Street	1.50	62.11	62.11
Total		62.11 dBA

Result summary (night)

source height (m)	Road Leq (dBA)	Total Leq (dBA)
1.Albert Street	1.50	54.52	54.52
Total		54.52 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 62.11
(NIGHT): 54.52

APPENDIX A1.3: STAMSON Calculations for POR3 (Level 1 Patio OLA) without barrier

STAMSON 5.0 NORMAL REPORT Date: 22-08-2024 22:23:34
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: 10empnb3.te Time Period: Day/Night 16/8 hours
Description:

Road data, segment # 1: Albert Street (day/night)

Car traffic volume : 24288/8096 veh/TimePeriod
Medium truck volume : 1932/644 veh/TimePeriod
Heavy truck volume : 1380/460 veh/TimePeriod
Posted speed limit : 50 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

Data for Segment # 1: Albert Street (day/night)

Angle1 Angle2 : -90.00 deg -25.00 deg
Wood depth : 0 (No woods.)
No of house rows : 2 / 2
House density : 75 %
Surface : 2 (Reflective ground surface)
Receiver source distance : 64.00 / 64.00 m
Receiver height : 1.50 / 1.50 m
Topography : 4 (Elevated; with barrier)
Barrier angle1 : -90.00 deg Angle2 : -25.00 deg
Barrier height : 0.00 m
Elevation : 2.00 m
Barrier receiver distance : 3.50 / 3.50 m
Source elevation : 1.50 m
Receiver elevation : 2.00 m
Barrier elevation : 2.00 m
Reference angle : 0.00

Results segment # 1: Albert Street (day)

Source height = 1.50 m

Barrier height for grazing incidence

Source ! Receiver ! Barrier ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
---+---+---+---
1.50 ! 1.50 ! 1.47 ! 3.47

ROAD (0.00 + 54.08 + 0.00) = 54.08 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	-25	0.00	71.49	0.00	-6.30	-4.42	0.00	-6.69	0.00	54.08
-90	-25	0.00	71.49	0.00	-6.30	-4.42	0.00	0.00	-0.38	60.39*
-90	-25	0.00	71.49	0.00	-6.30	-4.42	0.00	0.00	0.00	60.77

* Bright Zone !

Segment Leq : 54.08 dBA

Total Leq All Segments: 54.08 dBA

Results segment # 1: Albert Street (night)

Source height = 1.50 m

Barrier height for grazing incidence

Source ! Receiver ! Barrier ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
---+---+---+---
1.50 ! 1.50 ! 1.47 ! 3.47

ROAD (0.00 + 52.32 + 0.00) = 52.32 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 -25 0.00 69.73 0.00 -6.30 -4.42 0.00 -6.69 0.00 52.32
-90 -25 0.00 69.73 0.00 -6.30 -4.42 0.00 0.00 -0.38 58.63*
-90 -25 0.00 69.73 0.00 -6.30 -4.42 0.00 0.00 0.00 59.00
---

* Bright Zone !

Segment Leq : 52.32 dBA

Total Leq All Segments: 52.32 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 54.08
(NIGHT): 52.32

APPENDIX A2.1: STAMSON Calculations for POR1 (Rooftop OLA) with barrier to meet 55 dBA during the day

STAMSON 5.0 NORMAL REPORT Date: 15-08-2024 23:09:38
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: 10emppb1.te Time Period: Day/Night 16/8 hours
Description:

Road data, segment # 1: Albert Street (day/night)

Car traffic volume : 24288/8096 veh/TimePeriod
Medium truck volume : 1932/644 veh/TimePeriod
Heavy truck volume : 1380/460 veh/TimePeriod
Posted speed limit : 50 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

Data for Segment # 1: Albert Street (day/night)

Angle1 Angle2 : -90.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 2 / 2
House density : 50 %
Surface : 2 (Reflective ground surface)
Receiver source distance : 54.30 / 54.30 m
Receiver height : 1.50 / 1.50 m
Topography : 4 (Elevated; with barrier)
Barrier angle1 : -90.00 deg Angle2 : 90.00 deg
Barrier height : 2.40 m
Elevation : 14.50 m
Barrier receiver distance : 3.30 / 3.30 m
Source elevation : 1.50 m
Receiver elevation : 14.50 m
Barrier elevation : 14.50 m
Reference angle : 0.00

Results segment # 1: Albert Street (day)

Source height = 1.50 m

Barrier height for grazing incidence

Source ! Receiver ! Barrier ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
---+---+---+---
1.50 ! 1.50 ! 0.71 ! 15.21

ROAD (0.00 + 54.86 + 0.00) = 54.86 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 90 0.00 71.49 0.00 -5.59 0.00 0.00 -4.22 0.00 61.68
-90 90 0.00 71.49 0.00 -5.59 0.00 0.00 0.00 -11.05 54.86

Segment Leq : 54.86 dBA

Total Leq All Segments: 54.86 dBA

Results segment # 1: Albert Street (night)

Source height = 1.50 m

Barrier height for grazing incidence

Source ! Receiver ! Barrier ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
---+---+---+---
1.50 ! 1.50 ! 0.71 ! 15.21

ROAD (0.00 + 53.09 + 0.00) = 53.09 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 90 0.00 69.73 0.00 -5.59 0.00 0.00 -4.22 0.00 59.92
-90 90 0.00 69.73 0.00 -5.59 0.00 0.00 0.00 -11.05 53.09

Segment Leq : 53.09 dBA

Total Leq All Segments: 53.09 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 54.86
(NIGHT): 53.09

APPENDIX A3.1: STAMSON Calculations for POR3 (Rooftop OLA) with Henry Investment's barrier

STAMSON 5.0 NORMAL REPORT Date: 15-08-2024 23:11:29
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: 10emprb1.te Time Period: Day/Night 16/8 hours
Description:

Road data, segment # 1: Albert Street (day/night)

Car traffic volume : 24288/8096 veh/TimePeriod
Medium truck volume : 1932/644 veh/TimePeriod
Heavy truck volume : 1380/460 veh/TimePeriod
Posted speed limit : 50 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

Data for Segment # 1: Albert Street (day/night)

Angle1 Angle2 : -90.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 2 / 2
House density : 50 %
Surface : 2 (Reflective ground surface)
Receiver source distance : 54.30 / 54.30 m
Receiver height : 1.50 / 1.50 m
Topography : 4 (Elevated; with barrier)
Barrier angle1 : -90.00 deg Angle2 : 90.00 deg
Barrier height : 1.30 m
Elevation : 14.50 m
Barrier receiver distance : 3.30 / 3.30 m
Source elevation : 1.50 m
Receiver elevation : 14.50 m
Barrier elevation : 14.50 m
Reference angle : 0.00

Results segment # 1: Albert Street (day)

Source height = 1.50 m

Barrier height for grazing incidence

Source ! Receiver ! Barrier ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
---+---+---+---
1.50 ! 1.50 ! 0.71 ! 15.21

ROAD (0.00 + 59.42 + 0.00) = 59.42 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 90 0.00 71.49 0.00 -5.59 0.00 0.00 -4.22 0.00 61.68
-90 90 0.00 71.49 0.00 -5.59 0.00 0.00 0.00 -6.48 59.42

Segment Leq : 59.42 dBA

Total Leq All Segments: 59.42 dBA

Results segment # 1: Albert Street (night)

Source height = 1.50 m

Barrier height for grazing incidence

Source ! Receiver ! Barrier ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
---+---+---+---
1.50 ! 1.50 ! 0.71 ! 15.21

ROAD (0.00 + 57.66 + 0.00) = 57.66 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	69.73	0.00	-5.59	0.00	0.00	-4.22	0.00	59.92
-90	90	0.00	69.73	0.00	-5.59	0.00	0.00	0.00	-6.48	57.66

Segment Leq : 57.66 dBA

Total Leq All Segments: 57.66 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 59.42
(NIGHT): 57.66

Appendix A4 – DRAFT Part 5: Technical Requirements for Noise Control Barrier Systems (City of Ottawa)

PLANNING AND GROWTH MANAGEMENT
URBANISME ET GESTION DE LA CROISSANCE

DRAFT

Part 5:
TECHNICAL REQUIREMENTS FOR NOISE CONTROL BARRIER SYSTEMS

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This technical requirement document is a partial review of text of the May 10, 2006 City of Ottawa Environmental Noise Control Guidelines. This review was undertaken to address adjustments made by regulatory bodies (such as the Province of Ontario). This document has not been fully reviewed and edited to ensure full compliance with the City's Standard Tender Documents and renewal policies. This review will take place at a later time.

Contents

1.0 Introduction

This technical requirements document outlines specifications for the design and installation of noise barriers approved or constructed by the City. By necessity noise barriers are high mass, tall, physical barriers that may cross neighbourhoods and obscure the streetscape. While effective for noise attenuation, these barriers have the potential to fragment neighbourhoods, disrupt wildlife movements, create potentially unsafe public spaces and discourage pedestrian use of the street and sidewalk. Noise barriers are expensive and the long term maintenance of these structures may represent a long term financial burden for the City and private land owners. For these reasons noise barriers may only used as a last resort to attenuate noise in outdoor living spaces. Wherever possible, noise barriers must be used in concert with other noise and visual attenuation measures so as to reduce the negative impact of noise barriers to neighbourhoods and the environment.

Within the city noise barriers may be installed in connection with:

- New development approved under the Planning Act;
- Transportation corridors and transit corridor capital works projects that may be subject to the Environmental Assessment process;
- The City's Community Improvement process.

The following summarizes the principles of the noise barrier requirements:

- To introduce noise barriers to the neighbourhood as an mitigation measure only if other mitigation measures are not feasible;
- To use noise barriers in combination with other appropriate mitigation measures;
- To combine noise barrier design with appropriate landscaping to obscure the noise source from the receiver;
- Where appropriate to provide for an active and attractive pedestrian streetscape which is safe and accessible;
- To provide uniform design and construction parameters for the approval and installation of durable and high quality noise barrier systems.
- To ensure that barriers have a life expectancy of at least 20 years;
- To understand the lifecycle cost of barriers prior to their installation;
- To maintain connectivity of pedestrian and cycling walkways through neighbourhoods;
- Encourage the use of friendly, but durable, products that homeowners can relate to or maintain, where necessary;
- Provide realistic warranties that focus on the barrier system, and not only on the panels or materials;

- Provide effective implementation procedures for barrier design and installation.

The specific requirements described in this document are not to be considered all inclusive. Any new design, material or installation technique not specifically addressed in this document should be evaluated with the general fundamentals of acoustics, durability, safety, and functionality in mind.

2. 0 Applicable Standard for Noise Barriers

Certification organizations, such as the Canadian Standards Association (CSA), provide certification services for manufacturers who, under license, may use the appropriate registered CSA marks on products to indicate conformity with CSA Standards.

The City does not maintain a list of approved suppliers. Rather, the City requires noise barriers to bear the CSA mark as a minimum standard for effective acoustical mitigation.

3.0 Planning, Materials, Design and Construction of Noise Barrier Systems

Should the use of noise barriers be found necessary, the following describes the design and components required by the City for Noise Barriers system.

3.1 Submission Document Requirements

The following documents shall be submitted to the City for approval for each noise barrier wall project:

1. Shop drawings, signed and sealed by a qualified Professional Engineer licensed by the Professional Engineers of Ontario, showing the details of noise barrier system components, including material specifications (see 3.1.1 below).
2. Structural drawing(s), signed and sealed by a qualified Professional Engineer licensed by the Professional Engineers of Ontario, showing foundation details and specifying design criteria, climatic design loads, as well as applicable geotechnical data used in the design.
3. Layout plan, and wall elevations, showing proposed colours and patterns.
4. A covering letter stating deviations or exceptions to the City requirements and the reasons/justification for the deviations.

3.1.1 General Submission Information Requirements

In order for the noise barrier system design, and materials, to be qualified and be considered for installation at a specific site, the submission should provide the following information:

1. CSA certification documentation;
2. The manufacturer's name and address and trade name of the product (if applicable);

3. A general statement as to the composition of the materials;
4. An estimate of life cycle cost over the period of installation, maintenance and repair through replacement in 20 or more years;
5. Certification by a Geotechnical Engineer (calculations may be requested);
6. Certification by a Structural Engineer (calculations may be requested);
7. Detailed drawings of the entire noise barrier system and all its components including detailed material specifications;
8. Specifications regarding installation requirements as well as sequence of construction;
9. Noise Reduction Coefficient (NRC) report if the noise barrier is to be considered as sound absorptive; if required by the noise study;
10. Sound Transmission Class (STC) and/or the material surface density.

Any new design, material or installation technique for a noise barrier system will be evaluated for acceptability of use in the City with a view to safety, durability, functionality, esthetics and cost effectiveness.

The design drawings and calculations shall be signed, sealed and dated by a Professional Engineer licensed in the area of expertise for which the approval is being sought.

3.1.2 Plan Requirements

Typical and all worst case cross sections (and additional cross sections as may be necessary) at a reasonable vertical and horizontal scale should be provided to clearly illustrate the proposed berm and/or wall configuration in relation to the future grade at the Outdoor Living Area based on the proposed Lot Grading Plan (for a Noise Feasibility Study, use the existing grades. For a Detailed Study, existing and proposed future grades at the site must be indicated). Cross sections and/or the data in the report must include the location of the noise source, the location and elevation of the receiver, top elevation of the noise barrier, ground elevations of the berm, berm slopes, sidewalks, boulevards, ditches, roadway or railway elevations and property limits of the lands in question. Cross sections must provide all information (distances and heights) required to calculate the sound level reductions due to barriers.

The location of the cross sections must be indicated on a copy of the submitted plan. Preliminary grading plans should identify and make reference to all information shown on the cross sections (Corridor ground elevations, ground elevation at noise receivers, ground and top elevations of the berm, elevations of the rear yards, sidewalks, ditches, boulevards and ground elevation at the building face).

Height of receiver to be used is 1.5m above the ground at a point located 3.0m from the rear and/or closest wall within the identified Outdoor Living Area of the dwelling unit. If the house or development design shows other alternative locations for the Outdoor Living Area, such as a

common Outdoor Living Area, then the receiver location(s) should be shown on the applicable project drawings.

Other suitable and acoustically effective Outdoor Living Area locations may be selected in consultation with the City based on site specific cases.

3.2 Design

3.2.1 System Design

The details presented below refer to noise barriers as a system of various components including the base berm, the wall, and all other associated components.

- The design of noise barriers should have regard for applicable urban design guidelines, landscaping requirements and aesthetic principles.
- Each design must include drainage, grading and landscaping design.
- The design of the barrier should be complimentary with nearby existing barriers.
- All individual components shall be designed to be capable of being assembled on site and to conform to the drawings and specifications. The panels to also be designed to facilitate ease of on-site replacement.
- The design of the system shall be site-specific and in accordance with the Canadian Highway Bridge Design Code (CHBDC), prepared by qualified Professional Engineers and Acoustic Consultants. Input will be required from Geotechnical and/or Structural Engineers.
- The noise barrier shall be designed to withstand all possible forces and loads encountered during the design life of the barrier and remains serviceable. The design shall be site specific with reference to the wind pressure, earthquake load, freezing depth and soil conditions.
- The foundation of the barrier wall shall be designed to be founded on undisturbed soil, and at required depth of embedment as per the design requirements, but not less than the depth of freezing of the area.
- The noise barrier is to be designed and installed so as to accommodate movement of the noise barrier panel during the weather cycle without placing undue stress on any structure and the noise barrier installation, or reducing acoustical attenuation. The joints in the noise barrier are to match the size and location of the structure joints.
- Noise barrier elements should be designed and oriented to minimize entrapment and ponding of water, and accumulation and infiltration of dirt and debris inside and on any surface of any component. Corrugated, or ribbed panels, should be mounted such that the features are oriented vertically.

- Noise barrier panels with fire hose access openings, if required, shall be designed with additional reinforcement and protective coating around the opening, as necessary, to maintain structural integrity.
- The noise barrier is continuous or is turned through appropriate angles away from the source at both ends to protect the receivers from the flanking sides.
- The City may approve the use of an acoustic gate where the installation of the gate is advantageous in order to allow for access to a rear yard amenity area and a shortened length of noise wall
- sufficient measures are to be taken to prevent drumming of the panels caused by wind or ground vibration.
- Where the use of a sound barrier is approved by the City, landscaping for aesthetic purposes will be required to the satisfaction of the City. This landscaping should include trees, shrubs and vines
- City policies pertaining to access to roads and transit systems must be fully considered as part of the barrier design.

3.2.2 Barrier Design

Location

A noise barrier wall should be located entirely on the development under consideration; on the side of the property line which is on private property. Its location should be a minimum of 0.3m from the City right-of-way. The location of the noise barrier wall should take into account requirements for future roadway widening.

The barrier berm should be located entirely on the development under consideration on the side of the property line which is on private property. Only in exceptional cases, the City may accept a portion of the berm and the portion of the berm on the City or railway company right-of-way be subject to acceptance and approval by the authorities having jurisdiction prior to making any commitment to this effect. The design of the berm could be affected by future roadway widening. The proponent and/or their Consultants should prepare the necessary details related to the berm design and address all matters of concern such as compaction, grade elevations, drainage, safety, cover and landscaping, side slopes, maintenance,…etc.

In all cases, the noise barrier wall should be located in an approved location relative to the berm. Only in exceptional cases, the portion of the berm facing the road transportation facility on private property may have to be dedicated to the City at no cost where requested by the City.

Where a barrier is required, the receptors should be located within its acoustical “shadow zone”.

For roadways and bus Transitways, the noise barrier shall be located to conform to the ultimate roadway width and cross section to prevent future barrier relocation.

Information on noise barriers, berms and berm/wall combinations must include location and height of the barrier relative to final grade.

Height

The maximum height of berm/barrier allowed is to be determined in each case by the City.

The minimum acceptable barrier wall height is 2.2m for a flat grade case. In all cases, the noise barrier wall for new development should not exceed 2.5m in height unless approved by the City.

Should the result of the analysis indicate the need for a barrier up to 2.2m high to protect the Outdoor Living Area, there is no need to consider the use of an additional setback to accommodate the planned noise barrier. For situations where the barrier wall height exceeds 2.2m,

In general, the maximum combined barrier height (i.e. berm and wall) above the road or bus Transitway centre line or the ground-oriented Outdoor Living Area should be 4.5m. Otherwise, the proponent should investigate other lot grading possibilities. For railway corridors, the minimum acceptable heights of the berm-wall combination should be consistent with the railway requirements for noise and safety.

The noise barrier system design should provide details of methods and materials to be used to accommodate varying wall heights above the top of footing.

Berm Design

For single family, detached or semi-detached and townhouse residential development, a minimum of 6.0m depth of a relatively flat rear yard is required as measured from the rear face of the building and containing no slope in excess of 4%.

For roadway and bus Transitways, a maximum slope of 3:1 will be required for any earth-work (i.e. berm) adjacent to the boulevard. Slopes steeper than 3:1 will be tolerated on the lot side of the earthwork by the use of retaining walls, where accepted by the City for drainage and landscaping (the 3:1 ratio on the lot side may only be modified at the discretion of the City). For railways, the slope on the railway side should be 2.5:1.

In cases where the attenuation facility is interrupted, barrier returns or parallel screens may be required and the detailed design and calculations of the treatment in such cases will have to be

incorporated into the acoustical report. The report and the grading plan must include a detailed plan and appropriate cross sections of such cases.

Berm setbacks

The following table provides guidance on the additional setbacks required to accommodate a base berm and a wall on top of the berm. The berm must be placed entirely within the property line of the proposed development. The City will not accept any berming on its r.o.w. Maintenance of the barrier, including the side facing the road, is the responsibility of the property owner. Additional setbacks required for berms

BERM HEIGHT	ADDITIONAL SETBACK
0.5m	3.5m
1.0m	6.5m
1.5m	9.5m
2.0m	12.5m
2.5m	15.5m

3.4 Materials

3.4.1 Material - General

Type and surface density of the barrier should be specified and the manufacturer and/or supplier described, if known. The City recommends that the barrier design parameters be similar to those developed by the City with respect to structural specifications, wind loading, footing design, reinforcement, rust protection, warranty requirements,…etc.

Noise barriers should have the following general characteristics:

- Have no holes or gaps.
- the manufacturer should demonstrate to the City that the material has a minimum predicted maintenance free lifespan of 20 years.
- Provide the desired minimum sound level reduction and protect all receiver locations (3m from building face closest to transportation facility) subject to the guidelines.

- All materials should have a flame spread classification less than, or equal to, 140 and smoke developed classification less than, or equal to, 180 when tested in accordance with the ULC standards.
- Be generally resistant to graffiti or include a graffiti resistance coating conforming to relevant ASTM standards

3.4.2 Material – Metal

- Metal and non-metallic components of noise barrier systems, including their performance, such as corrosion and weathering, to be in accordance with the applicable CSA, ASTM, CAN/L1LC, ULC, CSA/CAN and ANSI standards.
- Coatings refer to all paints, stains and laminates. All coated components to be rated for accelerated weathering. All coated steel components to be resistant to corrosion.
- Components which are hot dip galvanized, or coated with a polyvinyl chloride (PVC) plastisol using an epoxy primer using no adhesives for bonding, need not have accelerated weathering test data
- All steel reinforcing to conform to the requirements of the CSA Standards. The bars to be free from rust, scale, or other substances, that will prevent bonding.
- All reinforcing bars should be epoxy coated, conforming to ASTM Standards. The concrete cover over the steel reinforcing should meet the requirements of the CSA Standards and in no case should it be less than 50mm.
- All bare metal components to be either fabricated of nonferrous materials, or hot dip galvanized after fabrication, according to the requirements of CSA Standards. All welding to conform to CSA Standards.
- Steel panels, exposed to traffic and snow removal operations, to be minimum nominal 0.91 mm galvanized steel (20 gauge). All other panels to be of minimum nominal 0.76 mm galvanized steel (22 gauge). All steel sheeting components to be coated with a material meeting the requirements of this standard.
- Acceptable products include galvanized panels and then coated with an organic polyvinyl chloride (PVC) plastisol using an epoxy primer using no adhesives for bonding. The coating system thickness must be 200 um on the surfaces exposed to traffic and snow removal operations, and 100 um thick on all other panel surfaces.
- Pop-rivets shall be either aluminum, with an aluminum mandrel, or aluminum, with a stainless steel mandrel.
- Other composites or metal panels, such as aluminum, may be used as panels for sound barriers, provided that such products are corrosion resistant and meet the acoustic and other performance criteria in this document.

3.4.3 Material – Concrete, Brick, Granular

- Concrete (precast or cast-in-place) to conform to requirements of CSA standards

- All bricks used to be in accordance with the CSA standards.
- All granular materials shall be free from deleterious materials, debris and organic materials. When used, it shall be compacted to 98% of Standard Proctor Dry Density .

3.4.4 Material -Wood

For wooden noise barriers, the following are the minimum acceptable features to qualify as an acceptable noise barrier system:

- All wood products to be made out of graded lumber (conforming to National Lumber Grading Association or Standard Grading Rules of Canadian Lumber 2000) and to be either naturally resistant to decay for a minimum of 20 years, or to be pressure treated. The panel must be composed of tightly fitted wood boards so as to avoid warping, splitting and loosening of particles, knots and imperfections. All boards must be tightly butted and secured.
- All wood shall be selected for good appearance and free of defects and large/heavy knots. In addition, all torn grain and surface stains shall be eliminated by appropriate surface refinishing.
- All skirts, coming in contact with the ground/soil, shall be pressure treated with finished cut edges treated or protected from moisture penetration, and to be buried 100 to 150mm below the finished ground level.
- All exposed panels to be dressed with beveled edges on both sides.
- All wooden posts (metal posts are also acceptable) to have minimum dimensions of 140 x 140mm, or larger, as required by the governing code, dressed to pattern.
- Double posts are required on all directional changes greater than 20°.
- Install coping on top of panels using one piece wood (or other acceptable metal products)
- The use of decorative elements such as pilasters, curved (scalloped) top rail, post caps, wood designs, etc. is preferable. In all cases, the decorative elements should not affect the minimum barrier height requirements, the density, or any other acoustic/structural requirements.
- Wood, and/or metal frames, to be used to support the wood panels in place, and to be designed to allow expansion/contraction of the wood panels/elements, and for making the necessary field adjustments, where required.
- All metal components, if any, used in a wooden sound barrier to conform to the metal or steel component specifications in this document.
- The use of board-on-board panels to meet the stated density/acoustic criteria is acceptable provided that the boards are thoroughly secured. In addition, board-on-board panels shall have tightly butted joints that are staggered, with provision to allow for expansion/contraction, and for making the necessary field adjustments (e.g. for tightening up of developed gaps), where required.
- The use of Tongue and Groove, and V-joints for joining panels is acceptable provided that the tongue or V -joint extent is not less than 19mm (3/4") long.

- Nails, and other fastening devices, must be either hot dip galvanized steel, or made of nonferrous or stainless steel.
- When there is ground contact with wood, the wood must be pressure treated and cut ends to be treated also, or protected from moisture penetration.

3.5 Acoustic Characteristics

3.5.1 Sound Transmission Class

Noise barriers should have one or more of the following acoustic characteristics:

- The Sound Transmission Class (STC) of the panel material to be 20, or greater, when tested in accordance with ASTM-E90 (a test report to be submitted for approval).
- The Sound Transmission Class (STC) of the panel material has historically been demonstrated to be 30 or greater.
- Surface mass density not less than 20 kg/sq. m (4 lbs/sq.ft.) in order to ensure that the sound component transmitted through the barrier material is at least 10 dB below the sound component diffracted across the top of the barrier.

3.5.2 Sound Absorption

If the noise barrier system is specified by the Acoustical Consultant to be sound absorptive, the average Noise Reduction Coefficient (NRC) shall be not less than 0.70 (70%). Sound absorptive materials used to fill cavities in double walled noise barrier systems, to increase sound absorption, shall be semi-rigid type.

If the noise barrier system is specified by the Acoustical Consultant to be sound absorptive, the barrier panels should be tested to determine the Noise Reduction Coefficient (NRC) in accordance with ASTM-C423. A panel or an assembly of panels should be tested, as required, in accordance with the ASTM Procedures for free-standing screens.

The use of alternate methods of providing the necessary sound absorptive qualities by a barrier system should be subject to special approval by the City based on qualified technical data to be submitted by the proponent. This may include the use of double walled noise barrier panels (sandwich construction with perforated facing) or the use of substantial landscaping designs along the barrier faces by a Landscape Architect.

4.0 Installation and Construction

All work and noise barrier materials for specific installations are subject to field certification by the design professionals to ensure adherence to the requirements in this specification.

All materials delivered to the construction site should be visually inspected by the owner, and/or their representative, for proper dimensions, cracks, voids, surface defects, inconsistency in colour and texture, and any other damage or imperfections.

4.1 Height and Alignment

The noise barrier to be constructed to the height and alignment as specified by the Acoustical Consultant. The minimum specified height of the noise barrier to be maintained at all times.

4.2 Footings, Posts And Panels

The foundation, footing and post design, shall meet the objective of constructing a durable sound barrier that meets or exceeds the objectives of this document of a 20-year life expectancy and the set minimum guarantee of 5 years for material and installation of the noise barrier system.

4.2.1 Footings

The footing shall be founded on undisturbed soil at the design embedment length as required but shall be minimum below freezing depth of the area. The founding surface shall be confirmed by a Geotechnical Engineer. All the soft spots to be removed and bottom of the footing protected from freezing. In case of solid rock encountered at a depth less than the freezing depth, foundation shall be carried minimum 300mm in the rock. The concrete of footing shall be as follows:

1. Minimum 28 days compressive strength to be 20 Mpa
2. Ready mix concrete or site mix concrete to confirm CSA-A23.2
3. All site placed concrete to be protected from freezing and to be protected in excessive summer temperature from drying.
4. The concrete in the footing shall be cured for a minimum period of 5 days before the installation of panels.

Footing In Earth

If drilled footing is used, it shall be cast entirely against undisturbed soil. Footing other than drilled caisson to be formed and the excavation shall be backfilled with granular material. The backfilled material to be compacted to 98% Standard Proctor Dry Density of the granular material.

Footing In Rock

When rock is encountered with in the excavation depth of the footing, the footing depth to be embedded minimum 300 mm into the solid rock.

All excavation into rock shall be back filled entirely with concrete. The excavation above the top of rock may be formed to the required dimensions and the remainder of the excavation backfilled with granular materials.

4.2.3 Post

The barrier shall be constructed to the line and grades specified with the tolerance of ± 10mm. The post shall be plumb within a tolerance of ± 10mm in 5m. In all cases for wood posts, the minimum dimension shall be 150mm square.

4.2.3 Panels

The profile of the barrier shall be installed to match the ground profile up to the maximum grade specified on the drawings. To accommodate ground profiles greater than the maximum grade, the barrier shall be stepped in accordance with manufacturer's recommendations.

4.3 Site Grading And Preparation

Earth grading and berm construction associated with the barrier installation shall be completed to within 25mm of the proposed elevation of the bottom of the barrier. Grading shall be completed and approved prior to construction of the barrier footings.

To prevent openings from occurring under the barrier an additional timber, not less than 5mm x 20mm in section, shall be securely fastened horizontally to the bottom of the barrier, and shall extend the full width of each barrier panel between adjacent vertical posts. This additional timber shall be buried to a depth equal to one-half its width during the final grading operation. Earth and pavement grading shall be sloped at a minimum of 2% and a maximum of 50% away from the barrier.

Frozen earth shall not be used for embarkment. Where imported fill is required for backfill or for minor grading, the fill material should be comprised of granular material, select sub-grade material, or other approved fill and to be compacted to at least 98% Standard Proctor Maximum Dry Density (SPMDD). All graded earth to be compacted to at least 98% Standard Proctor Dry Density.

The earth area surrounding the barrier wall shall be sloped away in order to prevent water ponding and water filtration to the barrier footings.

Changes in alignment to occur at the posts, by suitable means, to avoid acoustical degradation.

4.3.1 Masonry Walls

Masonry walls to be installed in accordance with the requirements of AASHTO Guide Specifications for Structural Design of Sound Barriers.

Bricks to be installed on a suitable foundation not less than 500 mm above the final groundline.

The top row of all masonry walls and posts to be protected with coping and/or flashing.

Mortar used to set the bricks, shall be in accordance with the CSA Standards.

4.3.2 Fire Hydrant Access

When the installation of a noise barrier interferes with the access to existing, or proposed fire hydrants, the noise barrier installation should include fire hose access openings and associated identification signs. Location and demand for these openings to be established in cooperation with the local fire department.

Overhead High Voltage Lines

Where the potential of arcing exists, due to the close proximity of existing overhead high voltage lines, each metal panel and girt must be grounded in accordance with CSA Standards and the local Hydro/Utility company.

4.4 Installation

4.4.1 Proponent Responsibilities

- Site preparation and grading
- Foundations
- Delivery, handling, storage and protection
- Erection / installation of noise barrier
- Clean up
- Testing, inspection and quality assurance

An Initial Certification by the proponent's Project Engineer is to be prepared and submitted to the City following completion of the project.

4.4.2 Guarantee and Maintenance Period

The material and installation of the noise barrier system, including landscaping materials, is to be guaranteed for a minimum period of five (5) years from the date of the initial Certification and Performance Acceptance. A Letter of Credit in the amount of 15% of the sound barrier total cost shall be deposited with the City to cover the warranty.

After 3 years from Certification, an inspection is to be carried out by the proponent's Engineer with a report to be submitted to the City. Any components which exhibit defects that are likely to affect the longevity of the barrier shall be replaced and/or repaired by the proponent.

To obtain release of the noted Letter of Credit, a final unconditional warranty inspection shall be prepared by the proponent's Engineer after five (5) years from the date of original Initial Certification and Performance Acceptance of the barrier to certify that there are no deficiencies

of any component of the barrier system; this includes but is not necessarily limited to grading, berm, posts, panels, landscape materials and soil condition.