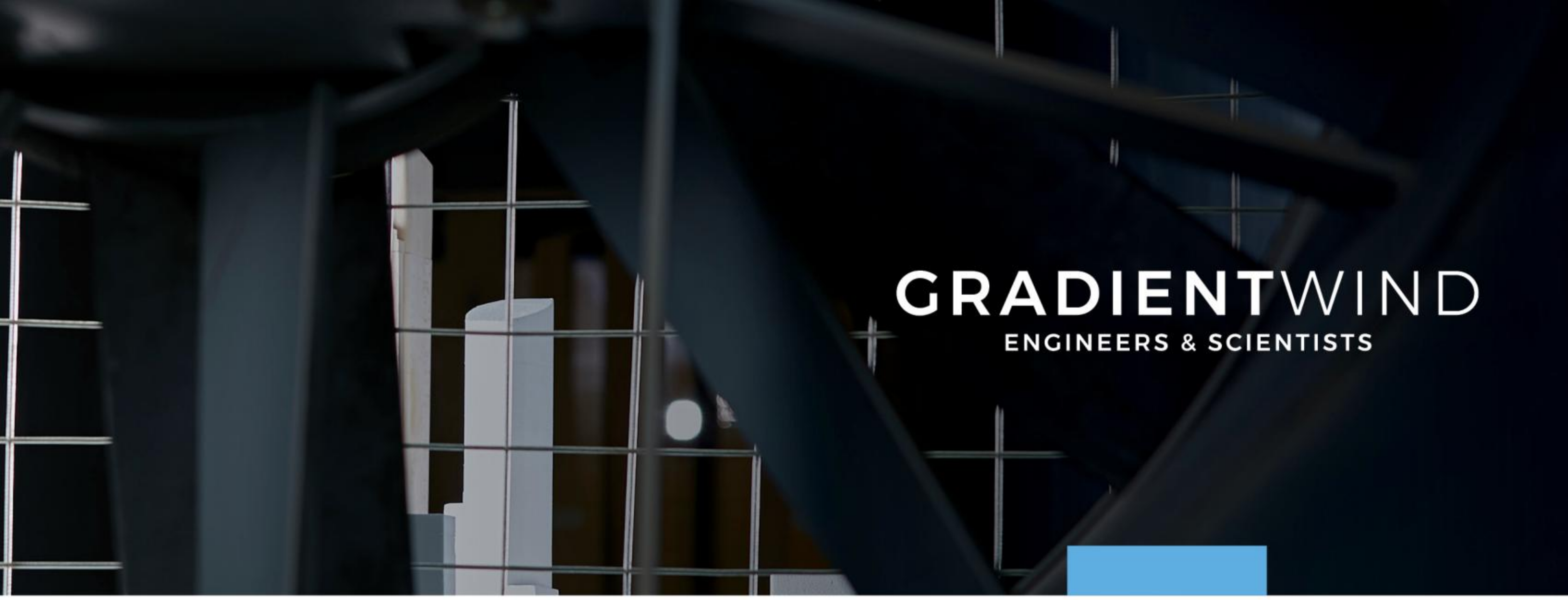
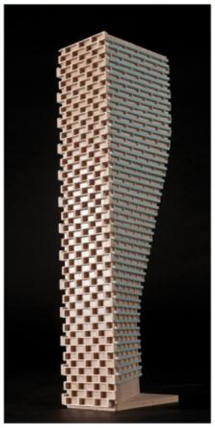
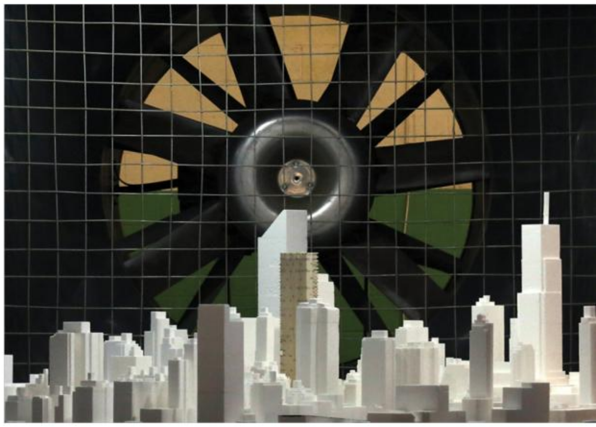


TRANSPORTATION NOISE AND VIBRATION STUDY

85 Albert Street
Ottawa, Ontario

Report: 26-067 – Transportation Noise





August 4, 2026

PREPARED FOR
Thomas Fuller Group of Companies
2700 Queensview Drive
Ottawa, ON
K2B 8H6

PREPARED BY
Nick Cunnington-Bourbonniere, M.A.Sc., Junior Acoustic Scientist
Joshua Foster, P.Eng., Lead Engineer

EXECUTIVE SUMMARY

This report describes a transportation noise and vibration assessment undertaken for the proposed residential redevelopment located at 85 Albert Street in Ottawa, Ontario. The proposed development comprises a conversion of an existing 15-storey office building into a residential building with a rectangular planform. The dominant source of roadway traffic noise impacting the development are Wellington Street, Albert Street, Slater Street, Laurier Avenue, Bank Street, O'Connor Street, Metcalf Street, and Elgin Street. Figure 1 illustrates a site plan with surrounding context.

The assessment is based on (i) theoretical noise prediction methods that conform to the Ministry of the Environment, Conservation and Parks (MECP), and City of Ottawa requirements; (ii) noise level criteria as specified by the City of Ottawa's Environmental Noise Control Guidelines (ENCG); (iii) future vehicular traffic volumes based on the City of Ottawa's Official Plan roadway classifications; and (iv) existing building massing.

The results of the current analysis indicate that noise levels will range between 63 and 66 dBA during the daytime period (07:00-23:00) and between 56 and 58 dBA during the nighttime period (23:00-07:00). The highest noise levels occur at the south façade, which is nearest and most exposed to Albert Street.

The noise levels predicted due to roadway traffic exceed the criteria listed in Section 4.2 for building components. Upgraded building components, including STC rated glazing elements and exterior walls, will be required where noise levels exceed 65 dBA during the daytime, or 60 dBA during the nighttime period, as discussed in Section 4.2.1. Noise control requirements are specified in Section 5.2 and Figure 3. Results of the calculations also indicate that the development will require air conditioning, which will allow occupants to keep windows closed and maintain a comfortable living environment. In addition to ventilation requirements, a Type D Warning Clause will also be required to be placed on all Lease, Purchase and Sale Agreements, as summarized in Section 6 of this report.

Noise levels at the rooftop are expected to fall below 55 dBA during the daytime period. As such, if the area is used as an outdoor amenity area, no noise control measures are required.

Estimated vibration levels at the property line nearest to the rail corridor centerline are expected to be 0.043 mm/s RMS (64.5 dBV), based on the FTA protocol and an offset distance of 53 m to the nearest track centerline. Details of the calculation are provided in Appendix B. Since predicted vibration levels do not exceed the criterion of 0.14 mm/s RMS first floor of the building, vibration mitigation will not be required. As vibration levels are acceptable, correspondingly, regenerated noise levels are also expected to be acceptable.

A review of satellite imagery confirmed there are potential minor sources of stationary noise at the adjacent high-rise buildings. Given the surrounding buildings are taller than the subject site and feature enclosed rooftop units, anticipated stationary noise impacts are expected to comply with the ENCG criteria.

The development's own mechanical equipment has the potential to generate noise off-site at surrounding noise sensitive (residential) developments and on the development itself. Any potential impacts can be minimized by judicious selection of mechanical equipment and its location. It is preferable to locate large pieces of equipment, such as cooling towers and make up air units, on the roof of the towers or in mechanical penthouses. These systems will be designed to comply with the ENCG sound level limits. A stationary noise study will be conducted once detailed rooftop plans and equipment selections are available.

TABLE OF CONTENTS

1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Thomas Fuller Group of Companies to undertake a transportation noise assessment for a proposed development located at 85 Albert Street in Ottawa, Ontario. This report summarizes the methodology, results, and recommendations related to the assessment of exterior and interior noise levels generated by local roadway traffic.

This assessment is based on theoretical noise calculation methods conforming to the Ministry of the Environment, Conservation and Parks (MECP) NPC-300[1] and City of Ottawa Environmental Noise Control Guidelines (ENCG)[2] guidelines. Noise calculations were based on existing building massing, with future traffic volumes corresponding to the City of Ottawa's Official Plan (OP) roadway classifications.

2. TERMS OF REFERENCE

The subject site is located at 85 Albert Street in Ottawa, situated on a parcel of land bounded by Metcalfe Street to the northeast, Albert Street to the northwest, a commercial building to the southwest, and surface parking to the southeast. The proposed development comprises a conversion of a 15-storey office building into a residential building with a rectangular planform. The building currently includes retail uses at grade. Although no outdoor living areas are currently proposed, to the knowledge of Gradient Wind, a rooftop amenity area was considered in the analysis to evaluate the feasibility of a potential future outdoor living area. The subject site is further surrounded by existing mid-rise and high-rise buildings.

The relevant source of roadway traffic noise are Wellington Street, Albert Street, Slater Street, Laurier Avenue, Bank Street, O'Connor Street, Metcalf Street, and Elgin Street. Figure 1 illustrates a site plan with surrounding context. Line 1 of the Light Rail Transit (LRT) runs underground beneath Queen Street and is located approximately 53 m from the northmost façade point of the building to the nearest track centreline.

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[1] Ontario Ministry of the Environment and Climate Change – Environmental Noise Guidelines, Publication NPC-300, Queens Printer for Ontario, Toronto, 2013
[2] City of Ottawa, Environmental Noise Control Guidelines, July 2017

3. OBJECTIVES

The principal objectives of this study are to (i) calculate the future noise levels on the study building produced by local roadway traffic, and (ii) ensure that interior and exterior noise levels do not exceed the allowable limits specified by the City of Ottawa's Environmental Noise Control Guidelines as outlined in Section 4.2 of this report.

4. METHODOLOGY

4.1 Background

Noise can be defined as any obtrusive sound. It is created at a source, transmitted through a medium, such as air, and intercepted by a receiver. Noise may be characterized in terms of the power of the source or the sound pressure at a specific distance. While the power of a source is characteristic of that particular source, the sound pressure depends on the location of the receiver and the path that the noise takes to reach the receiver. Measurement of noise is based on the decibel unit, dBA, which is a logarithmic ratio referenced to a standard noise level (2×10^{-5} Pascals). The 'A' suffix refers to a weighting scale, which better represents how the noise is perceived by the human ear. With this scale, a doubling of power results in a 3 dBA increase in measured noise levels and is just perceptible to most people. An increase of 10 dBA is often perceived to be twice as loud.

4.2 Roadway Traffic Noise

4.2.1 Criteria for Roadway Traffic Noise

For surface roadway traffic noise, the equivalent sound energy level, L_{eq}, provides a measure of the time-varying noise levels, which is well correlated with the annoyance of sound. It is defined as the continuous sound level, which has the same energy as a time-varying noise level over a period of time. For roadways, the L_{eq} is commonly calculated on the basis of a 16-hour (L_{eq16}) daytime (07:00-23:00) / 8-hour (L_{eq8}) nighttime (23:00-07:00) split to assess its impact on residential buildings. The City of Ottawa's Environmental Noise Control Guidelines (ENCG) specify that the recommended indoor noise limit range (that is relevant to this study) is 50, 45, and 40 dBA for retail space, living rooms, and sleeping quarters respectively, as listed in Table 1.

TABLE 1: INDOOR SOUND LEVEL CRITERIA (ROAD) [3]

Type of Space	Time Period	L_{eq} (dBA)
General offices, reception areas, **retail stores**, etc.	07:00 – 23:00	50
Living/dining/den areas of **residences**, hospitals, schools, nursing/retirement homes, day-care centres, theatres, places of worship, libraries, individual or semi-private offices, conference rooms, etc.	07:00 – 23:00	45
Sleeping quarters of hotels/motels	23:00 – 07:00	45
Sleeping quarters of **residences**, hospitals, nursing/retirement homes, etc.	23:00 – 07:00	40

Predicted noise levels at the plane of window (POW) dictate the action required to achieve the recommended sound levels. An open window is considered to provide a 10 dBA reduction in noise, while a standard closed window is capable of providing a minimum 20 dBA noise reduction[4]. A closed window due to a ventilation requirement will bring noise levels down to achieve an acceptable indoor environment[5]. Therefore, where noise levels exceed 55 dBA daytime and 50 dBA nighttime, the ventilation for the building should consider the need for having windows and doors closed, which triggers the need for forced air heating with provision for central air conditioning. Where noise levels exceed 65 dBA daytime and 60 dBA nighttime, air conditioning will be required and building components will require higher levels of sound attenuation[6].

For designated Outdoor Living Areas (OLAs), the sound level limit is 55 dBA during the daytime period. An excess above the limit is acceptable only in cases where the required noise control measures are not feasible for technical, economic or administrative reasons. Furthermore, noise level may not exceed 60 dBA.

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[3] Adapted from ENCG 2017 – Tables 2.2b and 2.2c
[4] Burberry, P.B. (2014). Mitchell's Environment and Services. Routledge, Page 125
[5] MECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.8
[6] MECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.1.3

4.2.2 Roadway Traffic Volumes

The ENCG dictates that noise calculations should consider future sound levels based on a roadway's classification at the mature state of development. Therefore, traffic volumes are based on the roadway classifications outlined in the City of Ottawa's Official Plan (OP) and Transportation Master Plan[7] which provide additional details on future roadway expansions. Average Annual Daily Traffic (AADT) volumes are then based on data in Table B1 of the ENCG for each roadway classification. Table 2 (below) summarizes the AADT values used for each roadway included in this assessment.

TABLE 2: ROADWAY TRAFFIC DATA

Segment	Roadway Traffic Classification	Speed Limit (km/h)	Traffic Volumes
Wellington Street	2-Lane Urban Arterial (2-UAU)	50	**15,000**
Albert Street	2-Lane Urban Arterial (2-UAU)	50	**15,000**
Slater Street	2-Lane Urban Arterial (2-UAU)	50	**15,000**
Laurier Avenue	2-Lane Urban Arterial (2-UAU)	50	**15,000**
Bank Street	2-Lane Urban Arterial (2-UAU)	50	**15,000**
O'Connor Street	2-Lane Urban Arterial (2-UAU)	50	**15,000**
Metcalf Street	2-Lane Urban Arterial (2-UAU)	50	**15,000**
Elgin Street	4-Lane Urban Arterial – Divided (4-UAD)	50	**35,000**

4.2.3 Theoretical Roadway Traffic Noise Predictions

The impact of transportation noise sources on the development was determined by computer modelling. Transportation noise source modelling is based on the software program *CadnaA,* which utilizes the United States Federal Highway Administration's Traffic Noise Model (TNM) to represent the roadway line sources. The TNM analysis model has been recognized by the Ministry of Transportation Ontario (MTO) as the recommended noise model for transportation projects (ref. Environmental Guide for Noise, 2022,

[7] City of Ottawa Transportation Master Plan, November 2013

by the Ministry of Transportation (MTO)[8]). The Ministry of Environment, Conservation and Parks has also adopted the TMN model as per their "Draft Guideline Noise Pollution Control Publications 306 (NPC-306)[9].

A set of comparative calculations were also performed for comparisons using STAMSON. The *CadnaA* computer program can represent three-dimensional surfaces and one order of reflection of sound waves over a suitable spectrum for human hearing. The STAMSON model, however, is an older software and requires each receptor to be calculated separately. STAMSON also does not accurately account for building reflections, multiple screening elements, and curved road geometry. The result of the comparative calculations can be seen in Section 5, Table 4.

Roadway traffic noise calculations were performed by treating each roadway segment as separate line sources of noise, and by using existing building locations as noise barriers. In addition to the traffic volumes summarized in Table 2, theoretical noise predictions were based on the following parameters:

- Truck traffic on all roadways was taken to comprise 5% heavy trucks and 7% medium trucks, as per ENCG requirements for noise level predictions.
- The day/night split for all streets was taken to be 92%/8%, respectively.
- Ground surfaces for receptors were taken to be reflective due to the presence of hard (paved) ground.
- Topography was assumed to be a gentle slope surrounding the study building.
- Noise receptors were strategically placed at 7 locations around the study area (see Figure 2).

4.3 Indoor Noise Calculations

The difference between outdoor and indoor noise levels is the noise attenuation provided by the building envelope. According to common industry practice, complete walls and individual wall elements are rated according to the Sound Transmission Class (STC). The STC ratings of common residential walls built in conformance with the Ontario Building Code (2024) typically exceed STC 35, depending on exterior cladding, thickness and interior finish details. For example, brick veneer walls can achieve STC 50 or more.

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[8] Ministry of Transportation, Environmental Guide for Noise, 2022. Retrieved from Environmental Guide for Noise 2022

[9] Ministry of Environment, Conservation and Parks, Ontario, "Methods to determine Sound Levels Due to Road and Rail Traffic", Draft February 12, 2020

Standard commercially sided exterior metal stud walls have around STC 45. Standard good quality double-glazed non-operable windows can have STC ratings ranging from 25 to 40, depending on the window manufacturer, pane thickness and inter-pane spacing. As previously mentioned, the windows are the known weak point in a partition.

As per Section 4.2, when daytime noise levels from road sources at the plane of the window exceed 65 dBA, or nighttime noise levels exceed 60 dBA, calculations must be performed to evaluate the sound transmission quality of the building components to ensure acceptable indoor noise levels. The calculation procedure[10] considers:

- Window type and total area as a percentage of total room floor area.
- Exterior wall type and total area as a percentage of the total room floor area.
- Acoustic absorption characteristics of the room.
- Outdoor noise source type and approach geometry.
- Indoor sound level criteria, which varies according to the intended use of a space.

Based on published research[11], exterior walls possess specific sound attenuation characteristics that are used as a basis for calculating the required STC ratings of windows in the same partition. Due to the limited information available at the time of the study, detailed floor layouts and building elevations have not been finalized; therefore, detailed STC calculations could not be performed at this time. As a guideline, the anticipated STC requirements for windows have been estimated based on the overall noise reduction required for each intended use of space (STC = outdoor noise level – targeted indoor noise levels + safety factor).

4.4 Ground Vibration and Ground-borne Noise

Rail systems and heavy vehicles on roadways can produce perceptible levels of ground vibrations, especially when they are in close proximity to residential neighbourhoods or vibration-sensitive buildings. Similar to sound waves in air, vibrations in solids are generated at a source, propagated through a medium, and intercepted by a receiver. In the case of ground vibrations, the medium can be uniform, or more

[10] Building Practice Note: Controlling Sound Transmission into Buildings by J.D. Quirt, National Research Council of Canada, September 1985

[11] CMHC, Road & Rail Noise: Effects on Housing

often, a complex layering of soils and rock strata. Also, similar to sound waves in air, ground vibrations produce perceptible motions and regenerated noise known as 'ground-borne noise' when the vibrations encounter a hollow structure such as a building. Ground-borne noise and vibrations are generated when there is excitation of the ground, such as from a train or subway. Repetitive motion of the wheels on the track or rubber tires passing over an uneven surface causes vibration to propagate through the soil. When they encounter a building, vibrations pass along the structure of the building beginning at the foundation and propagating to all floors. Air inside the building excited by the vibrating walls and floors represents regenerated airborne noise. Characteristics of the soil and the building are imparted to the noise, thereby creating a unique noise signature.

Human response to ground vibrations is dependent on the magnitude of the vibrations, which is measured by the root mean square (RMS) of the movement of a particle on a surface. Typical units of ground vibration measures are millimeters per second (mm/s), or inch per second (in/s). Since vibrations can vary over a wide range, it is also convenient to represent them in decibel units, or dBV. In North America, it is common practice to use the reference value of one micro-inch per second (µin/s) to represent vibration levels for this purpose. The threshold level of human perception of vibrations is about 0.10 mm/s RMS or about 72 dBV. Although somewhat variable, the threshold of annoyance for continuous vibrations is 0.5 mm/s RMS (or 85 dBV), five times higher than the perception threshold, whereas the threshold for significant structural damage is 10 mm/s RMS (or 112 dBV), at least one hundred times higher than the perception threshold level.

4.4.1 Ground Vibration Criteria

The Canadian Railway Association and Canadian Association of Municipalities have set standards for new sensitive land developments within 300 metres of a railway right-of-way, as published in their document *Guidelines for New Development in Proximity to Railway Operations*[12], which indicate that vibration conditions should not exceed 0.14 mm/s RMS averaged over a one-second time-period at the first floor and above of the proposed building. As the main vibration source is due to a mainline railway which has infrequent events, the 0.14 mm/s RMS (75 dBV) vibration criteria and 40 dBA ground-borne noise criteria were adopted for this study.

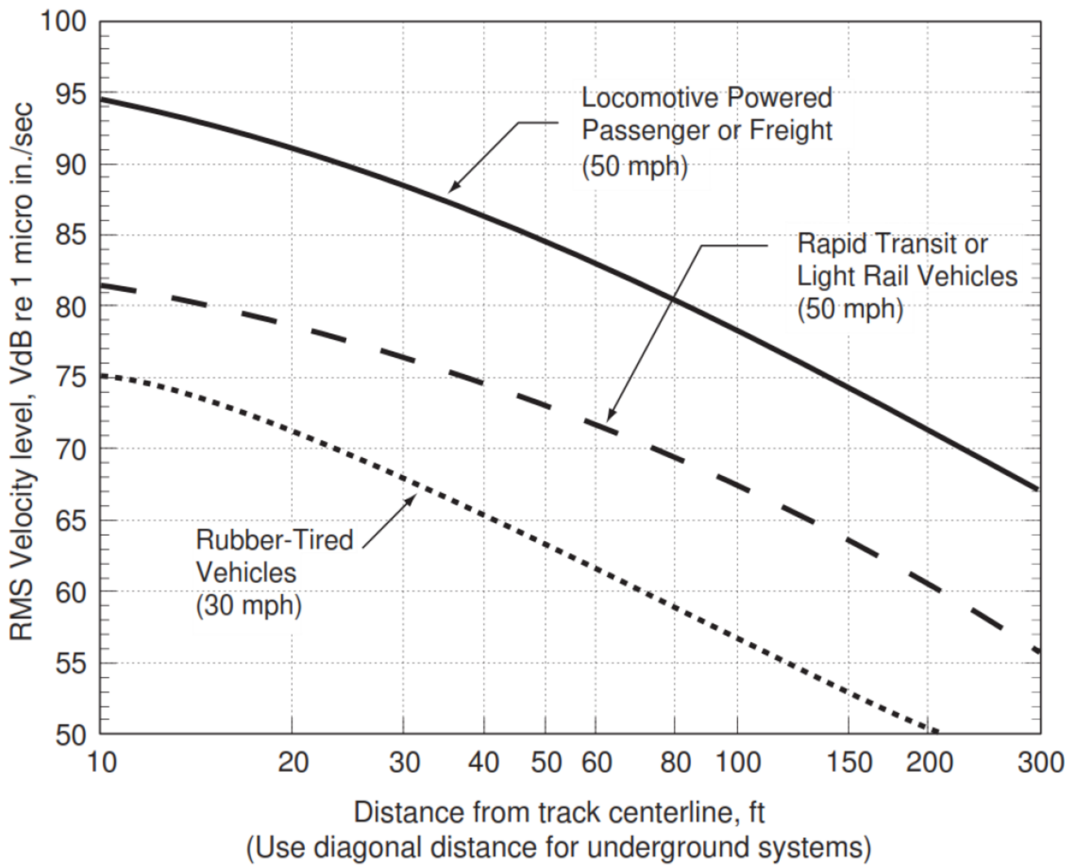
[12] Dialog and J.E. Coulter Associates Limited, May 2013

4.4.2 Theoretical Ground Vibration Prediction Procedure

Potential vibration impacts of the LRT Line 1 were predicted using the Federal Transit Authority's (FTA) *Transit Noise and Vibration Impact Assessment*[13] protocol. The FTA general vibration assessment is based on an upper bound generic set of curves that show vibration level attenuation with distance. These curves, illustrated in the figure on the following page, are based on ground vibration measurements at various transit systems throughout North America. Vibration levels at points of reception are adjusted by various factors to incorporate known characteristics of the system being analyzed, such as the operating speed of the vehicle, conditions of the track, construction of the track and geology, as well as the structural type of the impacted building structures. The vibration impact on the building was determined using a set of curves for locomotive-powered passenger or freight at a speed of 50 mph. Adjustment factors were considered based on the following information:

- The maximum operating speed of the of the LRT line 1 trains is 50 mph (80 km/hr).
- The offset distance between the property line and the closest track centreline is 53 m.
- The vehicles are assumed to have soft primary suspensions.
- Tracks are welded and in good condition.
- Soil conditions efficiently propagate vibrations.
- The type of transit structure is covered.
- The building's foundation coupling is large masonry on spread footings.

[13] Transit Noise and Vibration Impact Assessment, Federal Transit Administration, May 2006



FTA GENERALIZED CURVES OF VIBRATION LEVELS VERSUS DISTANCE (ADOPTED FROM FIGURE 10-1, FTA TRANSIT NOISE AND VIBRATION IMPACT ASSESSMENT)

5. RESULTS

5.1 Roadway Traffic Noise Levels

The results of the roadway traffic noise calculations are summarized in Table 3 below.

TABLE 3: EXTERIOR NOISE LEVELS DUE TO ROADWAY TRAFFIC

Receptor Number / Type	Receptor Height Above Grade (m)	Receptor Location	CadnaA Noise Level (dBA)	
			Day	Night
R1 / POW	10.5	Level 3 – Southeast Facade	66	58
R1 / POW	31.5	Level 10 – Southeast Facade	65	58
R1 / POW	46.5	Level 15 – Southeast Facade	65	58
R2 / POW	10.5	Level 3 – Southwest Facade	65	58
R2 / POW	31.5	Level 10 – Southwest Facade	65	58
R2 / POW	46.5	Level 15 – Southwest Facade	64	56
R3 / POW	10.5	Level 3 – Northeast Facade	65	57
R3 / POW	31.5	Level 10 – Northeast Facade	65	57
R3 / POW	46.5	Level 15 – Northeast Facade	65	57
R4 / OLA	54.5	Rooftop Amenity	51	N/A*

*Noise levels during the nighttime are not considered for OLAs

The results of the current analysis indicate that noise levels will range between 63 and 66 dBA during the daytime period (07:00-23:00) and between 56 and 58 dBA during the nighttime period (23:00-07:00). The highest noise levels occur at the south façade, which is nearest and most exposed to Albert Street. Noise levels at the rooftop amenity location considered are expected to fall below 55 dBA during the daytime period. As such, additional noise control measures are not required.

The noise levels predicted due to roadway traffic exceed the criteria listed in Section 4.2 for building components. Upgraded building components, including STC rated glazing elements and exterior walls, will be required where noise levels exceed 65 dBA during the daytime, or 60 dBA during the nighttime period, as discussed in Section 4.2.1. Results of the calculations also indicate that the development will require air conditioning as well as a Type D Warning Clause, as summarized in Section 6 of this report.

Table 4 below provides a comparison between CadnaA and STAMSON. Noise levels calculated in STAMSON were found to have a good correlation with CadnaA, and variability between the two programs was within an acceptable level of ±0-3 dBA.

TABLE 4: RESULT CORRELATION WITH STAMSON

Receptor Number	Receptor Location	Receptor Height (m)	CADNAA Noise Level (dBA)		STAMSON 5.04 Noise Level (dBA)	
			Day	Night	Day	Night
R1	Level 3 – Southeast Facade	10.5	66	58	68	61
R3	Level 3 – Northeast Facade	10.5	65	57	64	57

5.2 Noise Control Measures

The noise levels predicted due to roadway traffic exceed the criteria listed in Section 4.2 for building components. As discussed in Section 4.3, the anticipated STC requirements for windows have been estimated based on the overall noise reduction required for each intended use of space (STC = outdoor noise level – targeted indoor noise levels + safety factor). Figure 3 outlines the required retail, bedroom and living room window STC's for all facades of the development. The STC requirements are summarized below for various units within the development:

- **Bedroom Windows**

(i) Bedroom windows facing northeast and northwest will require a minimum STC of 30.

(ii) All other bedroom windows are to satisfy Ontario Building Code (OBC 2024) requirements.

- **Living Room Windows**

(i) Living room windows facing northeast and northwest will require a minimum STC of 30.

(ii) All other living room windows are to satisfy Ontario Building Code (OBC 2024) requirements.

- **Retail Windows**

(i) Retail windows facing northeast and northwest will require a minimum STC of 25.

(ii) All other retail windows are to satisfy Ontario Building Code (OBC 2024) requirements.

- **Exterior Walls**

(i) Exterior wall components on the northeast and northwest façades will require a minimum STC of 45, which will be achieved with brick cladding or an acoustical equivalent according to NRC test data[14].

The STC requirements apply to windows, doors, spandrel panels and curtainwall elements. Exterior wall components on these façades are recommended to have a minimum STC of 45, where a stud wall system is used. A review of window supplier literature indicates that the specified STC ratings can be achieved by a variety of window systems having a combination of glass thickness and inter-pane spacing. We have specified an example window configuration, however several manufacturers and various combinations of window components, such as those proposed, will offer the necessary sound attenuation rating. It is the responsibility of the manufacturer to ensure that the specified window achieves the required STC. This can only be assured by using window configurations that have been certified by laboratory testing. The requirements for STC ratings assume that the remaining components of the building are constructed and installed according to the minimum standards of the Ontario Building Code.

Results of the calculations also indicate that the development will require central air conditioning, which will allow occupants to keep windows closed and maintain a comfortable living environment. In addition to ventilation requirements, Warning Clauses will also be required on all Lease, Purchase and Sale Agreements, as summarized in Section 6.

5.3 Ground Vibrations and Ground-Borne Noise Levels

Estimated vibration levels at the property line nearest to the rail corridor centerline are expected to be 0.043 mm/s RMS (64.5 dBV), based on the FTA protocol and an offset distance of 53 m to the nearest track centerline. Details of the calculation are provided in Appendix B. Since predicted vibration levels do not exceed the criterion of 0.14 mm/s RMS first floor of the building, vibration mitigation will not be required. As vibration levels are acceptable, correspondingly, regenerated noise levels are also expected to be acceptable.

[14] J.S. Bradley and J.A. Birta. Laboratory Measurements of the Sound Insulation of Building Façade Elements, National Research Council October 2000.

6. CONCLUSIONS AND RECOMMENDATIONS

The results of the current analysis indicate that noise levels will range between 63 and 66 dBA during the daytime period (07:00-23:00) and between 56 and 58 dBA during the nighttime period (23:00-07:00). The highest noise levels occur at the south façade, which is nearest and most exposed to Albert Street.

The noise levels predicted due to roadway traffic exceed the criteria listed in Section 4.2 for building components. Upgraded building components, including STC rated glazing elements and exterior walls, will be required where noise levels exceed 65 dBA during the daytime, or 60 dBA during the nighttime period, as discussed in Section 4.2.1. Noise control requirements are specified in Section 5.2 and Figure 3. Results of the calculations also indicate that the development will require air conditioning, which will allow occupants to keep windows closed and maintain a comfortable living environment. In addition to ventilation requirements, a Type D Warning Clause will also be required to be placed on all Lease, Purchase and Sale Agreements, as summarized below.

Type D:

> *"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."*

Noise levels at the rooftop amenity space assessed are expected to fall below 55 dBA during the daytime period. As such, additional noise control measures are not required.

A review of satellite imagery confirmed there are potential minor sources of stationary noise at the adjacent high-rise buildings. Given the surrounding buildings are taller than the subject site and feature enclosed rooftop units, anticipated stationary noise impacts are expected to comply with the ENCG criteria.

The development's own mechanical equipment has the potential to generate noise off-site at surrounding noise sensitive (residential) developments and on the development itself. Any potential impacts can be minimized by judicious selection of mechanical equipment and its location. It is preferable to locate large pieces of equipment, such as cooling towers and make up air units, on the roof of the towers or in mechanical penthouses. These systems will be designed to comply with the ENCG sound level limits. A stationary noise study will be conducted once detailed rooftop plans and equipment selections are available.

This concludes our transportation noise and vibration assessment and report. If you have any questions or wish to discuss our findings, please advise us. In the interim, we thank you for the opportunity to be of service.

Sincerely,

Gradient Wind Engineering Inc.

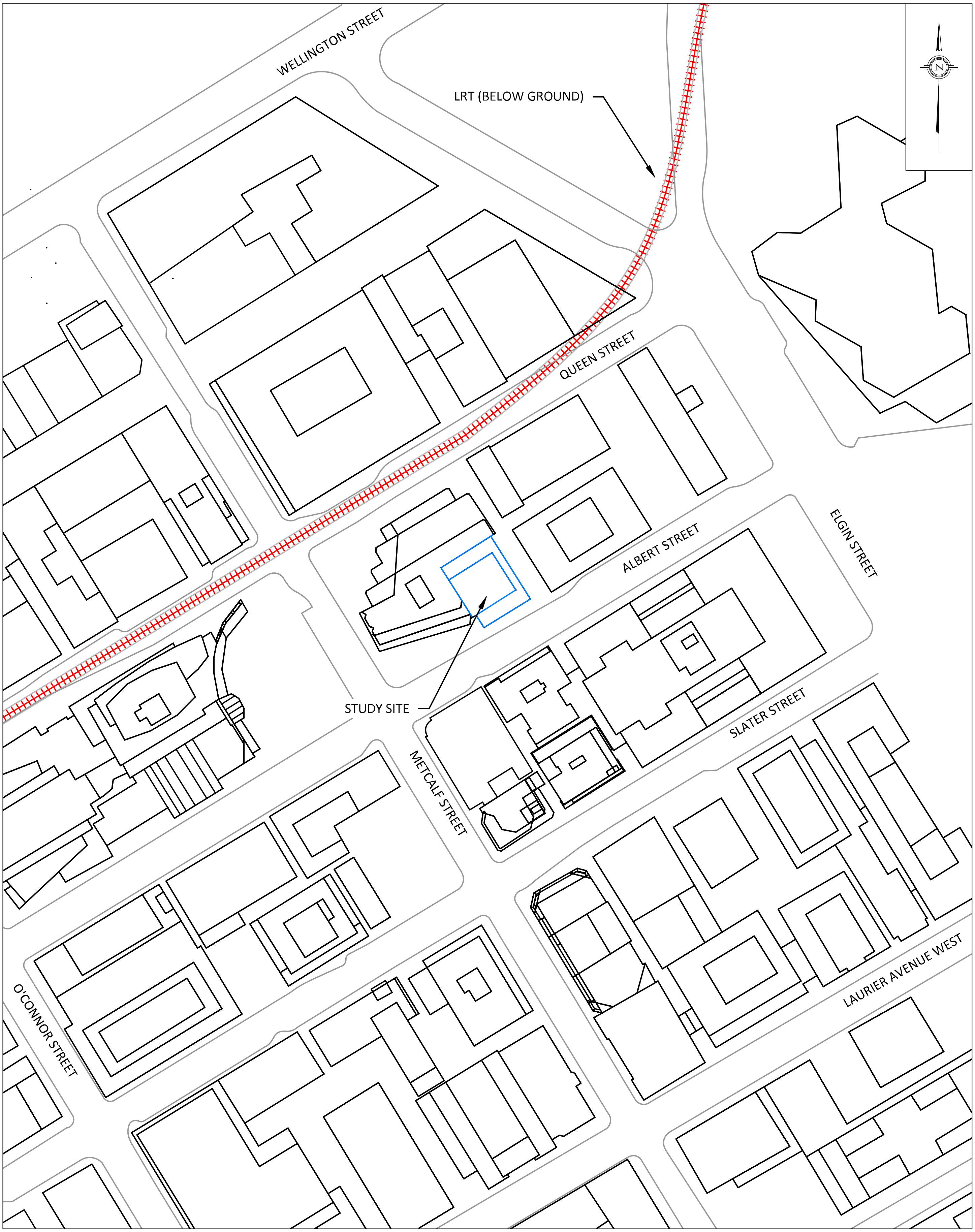
LICENSED PROFESSIONAL ENGINEER
J. R. FOSTER
100155655
2026-08-05
PROVINCE OF ONTARIO

Nick Cunnington-Bourbonniere

Nick Cunnington-Bourbonniere, M.A.Sc.
Junior Acoustic Scientist

Joshua Foster, P.Eng.
Lead Engineer

Gradient Wind File #26-067 – Transportation Noise



GRADIENTWIND
ENGINEERS & SCIENTISTS

127 WALGREEN ROAD , OTTAWA, ON
613 836 0934 • GRADIENTWIND.COM

PROJECT	85 ALBERT STREET, OTTAWA TRANSPORTATION NOISE ASSESSMENT		
SCALE	1:2000 (APPROX.)	DRAWING NO.	GW26-067-1
DATE	JUNE 5, 2026	DRAWN BY	N.C.B.

DESCRIPTION

FIGURE 1:
SITE PLAN AND SURROUNDING CONTEXT

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SCALE	1:500 (APPROX.)
DRAWING NO.	GW26-067-2
DATE	JUNE 5, 2026
DRAWN BY	N.C.B.
DESCRIPTION	FIGURE 2: RECEPTOR LOCATIONS

GRADIENTWIND ENGINEERS & SCIENTISTS 127 WALGREEN ROAD , OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM	PROJECT 85 ALBERT STREET, OTTAWA TRANSPORTATION NOISE ASSESSMENT		DESCRIPTION FIGURE 3: WINDOW STC REQUIREMENTS
	SCALE 1:500 (APPROX.)	DRAWING NO. GW26-067-3	
	DATE JUNE 5, 2026	DRAWN BY N.C.B.	

APPENDIX A

STAMSON 5.04 – SAMPLE INPUT AND OUTPUT DATA

127 WALGREEN ROAD, OTTAWA, ON, CANADA K0A 1L0 | 613 836 0934
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PROJECT	85 ALBERT STREET, OTTAWA TRANSPORTATION NOISE ASSESSMENT		
SCALE	1:500 (APPROX.)	DRAWING NO.	GW26-067-A1
DATE	JUNE 5, 2026	DRAWN BY	N.C.B.

DESCRIPTION

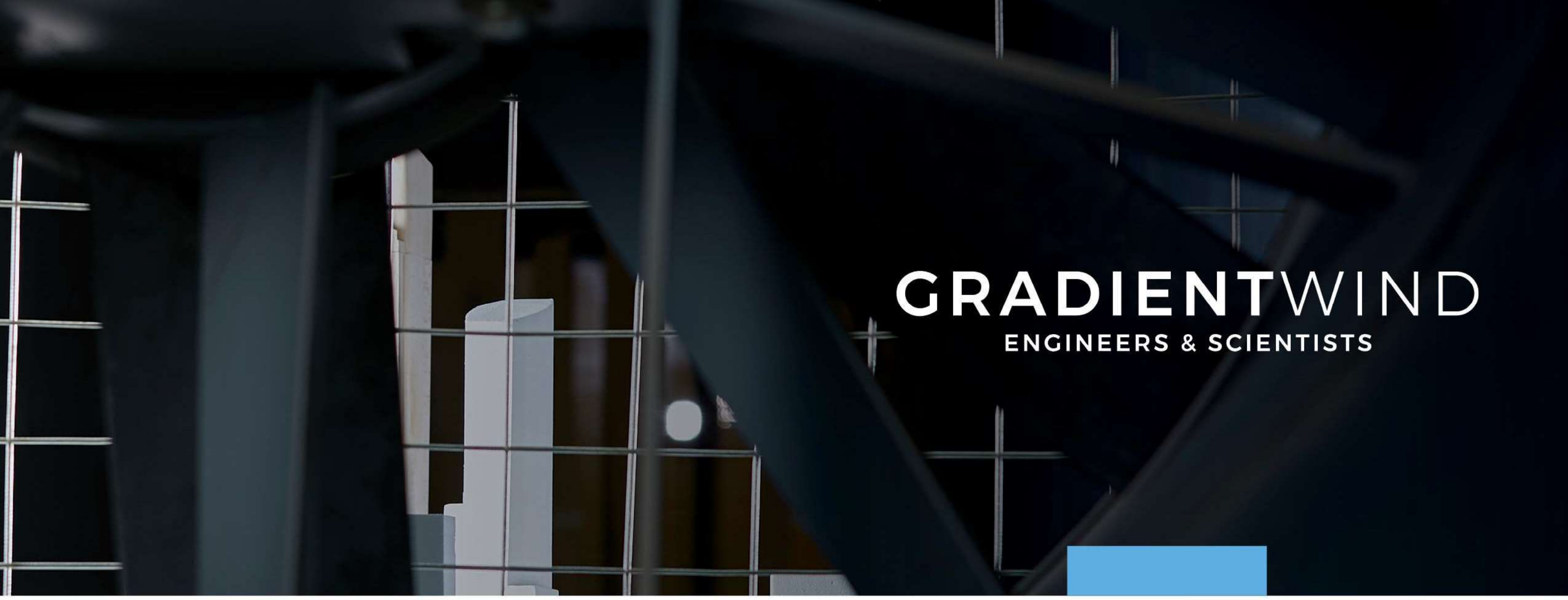
FIGURE A1:
STAMSON INPUT PARAMETERS
RECEPTORS 1 & 3

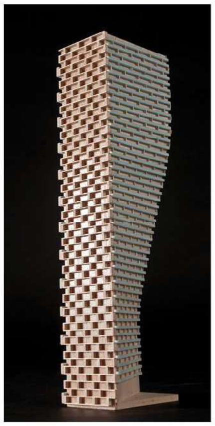
```
STAMSON 5.0        NORMAL REPORT       Date: 08-06-2026 15:24:02
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: 116-2.te             Time Period: Day/Night 16/8 hours
Description: Receptor 1 - 85 Albert


Road data, segment # 1: Albert St (day/night)
---------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Albert St (day/night)
-------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  15.00 / 15.00  m
Receiver height           :  10.50 / 10.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


Results segment # 1: Albert St (day)
------------------------------------

Source height = 1.50 m

ROAD (0.00 + 68.48 + 0.00) = 68.48 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.00  68.48   0.00   0.00   0.00   0.00   0.00   0.00  68.48
----------------------------------------------------------------------------

Segment Leq : 68.48 dBA

Total Leq All Segments: 68.48 dBA


Results segment # 1: Albert St (night)
```

```
--------------------------------------

Source height = 1.50 m

ROAD (0.00 + 60.88 + 0.00) = 60.88 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.00  60.88   0.00   0.00   0.00   0.00   0.00   0.00  60.88
----------------------------------------------------------------------------

Segment Leq : 60.88 dBA

Total Leq All Segments: 60.88 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 68.48
                         (NIGHT): 60.88
```

```
STAMSON 5.0        NORMAL REPORT        Date: 08-06-2026 15:22:45
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: 116-2.te             Time Period: Day/Night 16/8 hours
Description: Receptor 1 - 85 Albert


Road data, segment # 1: Albert St (day/night)
---------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Albert St (day/night)
-------------------------------------------
Angle1   Angle2           :   0.00 deg   67.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  15.00 / 15.00  m
Receiver height           :  10.50 / 10.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


Results segment # 1: Albert St (day)
------------------------------------

Source height = 1.50 m

ROAD (0.00 + 64.19 + 0.00) = 64.19 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
     0     67   0.00  68.48   0.00   0.00  -4.29   0.00   0.00   0.00  64.19
----------------------------------------------------------------------------

Segment Leq : 64.19 dBA

Total Leq All Segments: 64.19 dBA


Results segment # 1: Albert St (night)
```

```
--------------------------------------

Source height = 1.50 m

ROAD (0.00 + 56.59 + 0.00) = 56.59 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
     0     67   0.00  60.88   0.00   0.00  -4.29   0.00   0.00   0.00  56.59
----------------------------------------------------------------------------

Segment Leq : 56.59 dBA

Total Leq All Segments: 56.59 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 64.19
                         (NIGHT): 56.59
```





APPENDIX B

FTA VIBRATION CALCULATIONS

GWE26-067 08-Jun-26

Possible Vibration Impacts on 85 Albert Street
Predicted using FTA General Assesment

80 km/h 49.6 mph

	Distance from C/L	
	(m)	(ft)
LRT	53.0	173.9

Vibration

From FTA Manual Fig 10-1		
Vibration Levels at distance from track	62.5	dBV re 1 micro in/sec
Adjustment Factors FTA Table 10-1		
Speed reference 50 mph	0	Speed assumed to be approx 50 mph
Vehicle Parameters	0	Assume Soft primary suspension, Weels run true
Track Condition	0	
Track Treatments	0	None
Type of Transit Structure	-3	cut and cover tunnel
Efficient vibration Propagation	10	Propagation through rock
Vibration Levels at Fdn	70	
Coupling to Building Foundation	-10	Large Massonry on Spread Footings
Floor to Floor Attenuation	-1.0	5-10 Floors Above Grade
Amplification of Floor and Walls	6	
Total Vibration Level	64.5	dBV or 0.043 mm/s
Noise Level in dBA	29.5	dBA

Table 6-11 Source Adjustment Factors for Generalized Predictions of GB Vibration and Noise

Source Factor	Adjustment to Propagation Curve			Comment
		Reference Speed		
	Vehicle Speed	50 mph	30 mph	
Speed	60 mph	+1.6 dB	+6.0 dB	Vibration level is approximately proportional to 20log(speed/speed$_{ref}$), see **Eq. 6-4.**
	50 mph	0.0 dB	+4.4 dB	
	40 mph	-1.9 dB	+2.5 dB	
	30 mph	-4.4 dB	0.0 dB	
	20 mph	-8.0 dB	-3.5 dB	
Vehicle Parameters (not additive, apply greatest value only)				
Vehicle with stiff primary suspension	+8 dB			Transit vehicles with stiff primary suspensions have been shown to create high vibration levels. Include this adjustment when the primary suspension has a vertical resonance frequency greater than 15 Hz.
Resilient Wheels	0 dB			Resilient wheels do not generally affect ground-borne vibration except at frequencies greater than about 80 Hz.
Worn Wheels or Wheels with Flats	+10 dB			Wheel flats or wheels that are unevenly worn can cause high vibration levels.
Track Conditions (not additive, apply greatest value only)				
Worn or Corrugated Track	+10 dB			Corrugated track is a common problem. Mill scale* on new rail can cause higher vibration levels until the rail has been in use for some time. If there are adjustments for vehicle parameters and the track is worn or corrugated, only include one adjustment.
Special Trackwork within 200 ft	+10 dB (within 100 ft) +5 dB (between 100 and 200 ft)			Wheel impacts at special trackwork will greatly increase vibration levels. The increase will be less at greater distances from the track. Do not include an adjustment for special trackwork more than 200 ft away.
Jointed Track	+5 dB			Jointed track can cause higher vibration levels than welded track.
Uneven Road Surfaces	+5 dB			Rough roads or expansion joints are sources of increased vibration for rubber-tire transit.
Track Treatments (not additive, apply greatest value only)				
Floating Slab Trackbed	-15 dB			The reduction achieved with a floating slab trackbed is strongly dependent on the frequency characteristics of the vibration.
Ballast Mats	-10 dB			Actual reduction is strongly dependent on frequency of vibration.
High-Resilience Fasteners	-5 dB			Slab track with track fasteners that are very compliant in the vertical direction can reduce vibration at frequencies greater than 40 Hz.

*Mill scale on a new rail is a slightly corrugated condition caused by certain steel mill techniques.

Table 6-12 Path Adjustment Factors for Generalized Predictions of GB Vibration and Noise

Path Factor	Adjustment to Propagation Curve			Comment
Resiliently Supported Ties (Low-Vibration Track, LVT)	-10 dB			Resiliently supported tie systems have been found to provide very effective control of low-frequency vibration.
Track Structure (not additive, apply greatest value only)				
Type of Transit Structure	Relative to at-grade tie & ballast:			In general, the heavier the structure, the lower the vibration levels. Putting the track in cut may reduce the vibration levels slightly. Rock-based subways generate higher-frequency vibration.
	Elevated structure		-10 dB	
	Open cut		0 dB	
	Relative to bored subway tunnel in soil:			
	Station		-5 dB	
	Cut and cover		-3 dB	
	Rock-based		-15 dB	
Ground-borne Propagation Effects				
Geologic conditions that promote efficient vibration propagation	Efficient propagation in soil		+10 dB	Refer to the text for guidance on identifying areas where efficient propagation is possible.
	Propagation in rock layer	Dist.	Adjust.	The positive adjustment accounts for the lower attenuation of vibration in rock compared to soil. It is generally more difficult to excite vibrations in rock than in soil at the source.
		50 ft	+2 dB	
		100 ft	+4 dB	
		150 ft	+6 dB	
		200 ft	+9 dB	
Coupling to building foundation	Wood-Frame Houses		-5 dB	In general, the heavier the building construction, the greater the coupling loss.
	1-2 Story Masonry		-7 dB	
	3-4 Story Masonry		-10 dB	
	Large Masonry on Piles		-10 dB	
	Large Masonry on Spread Footings		-13 dB	
	Foundation in Rock		0 dB	

Table 6-13 Receiver Adjustment Factors for Generalized Predictions of GB Vibration and Noise

Receiver Factor	Adjustment to Propagation Curve		Comment
Floor-to-floor attenuation	1 to 5 floors above grade	-2 dB/floor	This factor accounts for dispersion and attenuation of the vibration energy as it propagates through a building starting with the first suspended floor.*
	5 to 10 floors above grade	-1 dB/floor	
Amplification due to resonances of floors, walls, and ceilings	+6 dB		The actual amplification will vary greatly depending on the type of construction. The amplification is lower near the wall/floor and wall/ceiling intersections.

* Floor-to-floor attenuation adjustments for the first floor assume a basement.