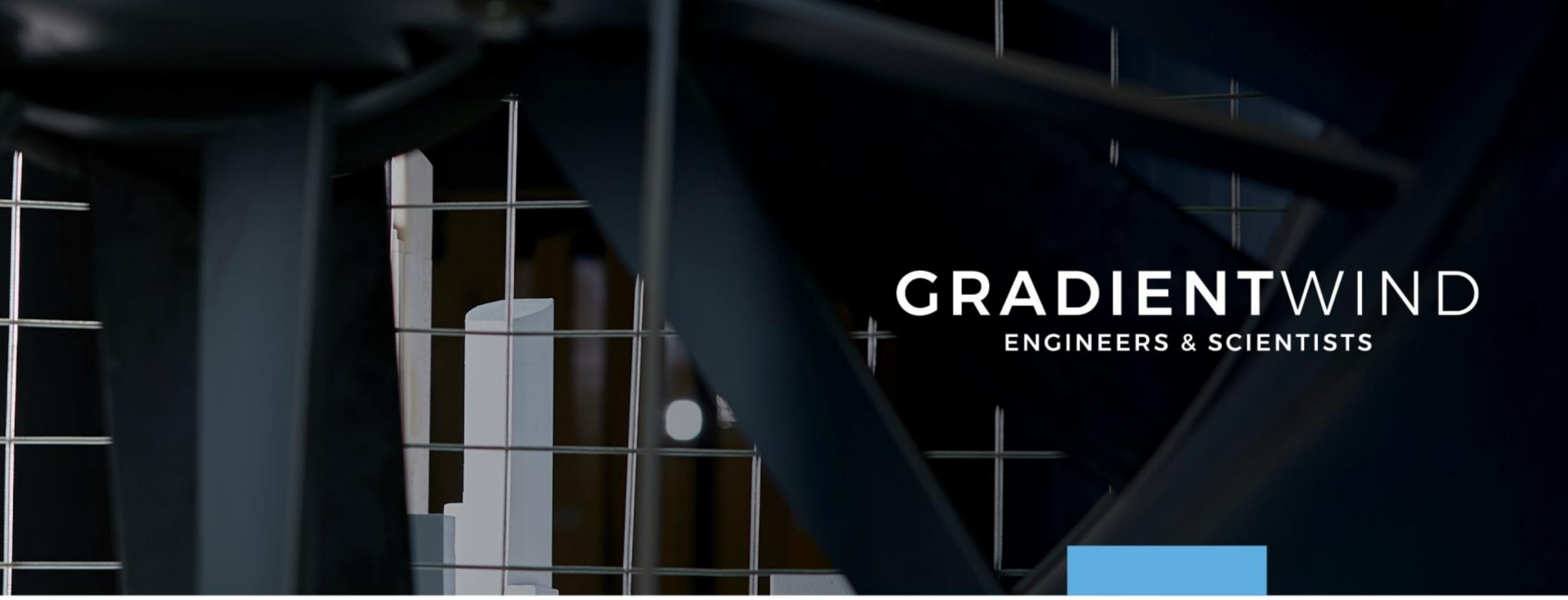
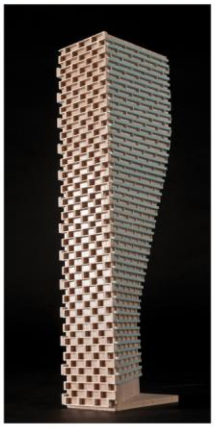
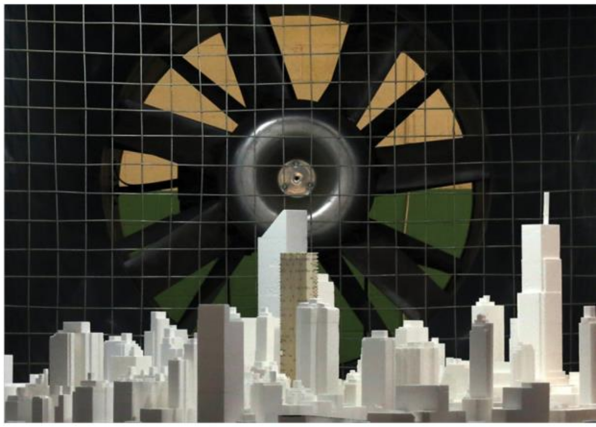


TRANSPORTATION NOISE AND VIBRATION ASSESSMENT

193 Norice Street
Ottawa, Ontario

REPORT: 24-026 – Transportation Noise and Vibration





August 12, 2024

PREPARED FOR
Karnak Developments Inc.
Unit 5 – 2100 Thurston Drive,
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PREPARED BY
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EXECUTIVE SUMMARY

This report describes a transportation noise and vibration assessment in support of a Site Plan Control (SPA) application for the proposed development located at 193 Norice Street in Ottawa, Ontario. The proposed development comprises a four-storey residential building with a rectangular planform. The primary sources of traffic noise on the development are Woodroffe Avenue and Norice Street. Additionally, an existing CN rail line is approximately 330 metres (m) to the south, which constitutes as a source of transportation noise. Although, the CN Rail Line is located more than 300 metres from the subject site, the transportation noise impact of the railway was included in the calculations in this study. The primary source of ground-borne vibration is the CN rail line to the south. As requested by Karnak Developments Inc. a ground vibration study was conducted following the procedures outlined in the Federal Transit Authorities (FTA) protocol. Note that the site is more than 300 metres (m) from the CN rail line to the south, which does not typically require a ground vibrations study. Figure 1 illustrates a complete site plan with the 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; (iv) architectural drawings provided by Rossmann Architecture, dated February 2024; and (v), ground-borne vibration criteria as specified by the Federal Transit Authority (FTA) Protocol.

The results of the current analysis indicate that noise levels will range between 58 and 66 dBA during the daytime period (07:00-23:00) and between 50 and 58 dBA during the nighttime period (23:00-07:00). The highest noise level (66 dBA) occurs at the south and west façades, which is most exposed to the noise sources. Building components with a higher Sound Transmission Class (STC) rating will be required where exterior noise levels exceed 65 dBA, as indicated in Figure 5.

Results of the calculation also indicate the development will require central air conditioning, or similar mechanical ventilation, which will allow occupants to keep windows closed to maintain a comfortable indoor living environment. A Warning Clause will also be required on all Lease, Purchase and Sale Agreements, as summarized in Section 6.

Noise levels at both of the at grade outdoor amenities are expected to exceed 55 dBA during the daytime period without a noise barrier. If these areas are to be used as outdoor living areas, noise control measures are required to reduce noise levels as close as possible to 55 dBA where technically and administratively feasible. Further analysis investigated the noise-mitigating impact of noise barriers ranging from 1.1 m to 2.5 m high above the walking surface (see Table 4). Results of the investigation proved that noise levels for both outdoor amenities can be reduced to below 60 dBA with a 2.5 m high barrier surrounding the north and west perimeters. The barrier must be constructed from materials having a minimum surface density of 20 kg/m2 and contain no gaps Figure 4 illustrates the barrier requirements. As noise levels at the outdoor amenities are slightly above 55 dBA with a 2.5 m high noise barrier, a Type B Warning Clause will also be required to be placed on all Lease, Purchase and Sale Agreements, as summarized in Section 6.

Based on the FTA Generalized Curves of Vibration Levels versus Distance as shown in Section 4, estimated vibration levels at the foundation nearest to the rail corridor are expected to be negligible. By using an offset distance of 309 m (1014 ft) to the nearest track centerline, the RMS velocity level approaches zero. Therefore, vibration levels do not exceed the criterion of 0.14 mm/s RMS at the foundation, concerns due to vibration impacts on the site are not expected. As vibration levels are acceptable, correspondingly, regenerated noise levels are also expected to be acceptable.

TABLE OF CONTENTS

1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Karnak Developments Inc. to undertake a transportation noise and vibration assessment in support of a Site Plan Control (SPA) application for the proposed development located at 193 Norice Street in Ottawa in Ottawa, Ontario. This report summarizes the methodology, results, and recommendations related to the assessment of exterior and interior noise levels generated by local transportation noise and vibration sources.

Our work is based on theoretical noise calculation methods conforming to the City of Ottawa[1] and Ministry of the Environment, Conservation and Parks (MECP)[2] guidelines. Noise calculations were based on architectural drawings provided by Rossmann Architecture, dated February 2024, with future traffic volumes corresponding to the City of Ottawa's Official Plan (OP) roadway classifications.

2. TERMS OF REFERENCE

The focus of this transportation noise and vibration assessment is the proposed residential development located at 193 Norice Street in Ottawa, Ontario. The subject site is situated on a rectangular parcel of land bounded by Westwood Drive to the north, Sullivan Avenue to the east, Norice Street to the south, and Woodroffe Avenue to the west. The proposed development comprises a four-storey building with a rectangular planform. At grade, the building comprises residential units, an amenity space, and a ramp leading to one level of below-grade parking. Vehicular access to underground parking is provided from Norice Street. The remaining levels comprise additional residential units. At grade Outdoor amenities are provided at the rear of the building. This proposal is based on architectural drawings prepared by Rossmann Architecture, dated February 2024.

The site is surrounded by a mix of low and mid-rise buildings from the northwest clockwise to the southeast. The primary sources of traffic noise on the development are Woodroffe Avenue (Arterial) and Norice Street (Collector). Additionally, the existing CN rail line is approximately 330 metres (m) to the south, which constitutes as a source of transportation noise. Although, the CN Rail Line is located more than 300

[1] City of Ottawa Environmental Noise Control Guidelines, January 2016
[2] Ontario Ministry of the Environment and Climate Change – Environmental Noise Guidelines, Publication NPC-300, Queens Printer for Ontario, Toronto, 2013

metres from the subject site, the transportation noise impact of the railway was included in the calculations in this study. The primary source of ground-borne vibration is the CN rail line to the south. As requested by Karnak Developments Inc. a ground vibration study was conducted following the procedures outlined in the Federal Transit Authorities (FTA) protocol. Note that the site is more than 300 metres (m) from the CN rail line to the south, which does not typically require a ground vibrations study. Figure 1 illustrates a complete site plan with the surrounding context.

3. OBJECTIVES

The principal objectives of this study are to (i) calculate the future noise levels on the study buildings produced by local road and railway traffic, (ii) predict vibration levels on the study building produced from the rail line, and (iii) ensure that interior and exterior noise and vibration 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) specifies that the recommended indoor noise limit range (that is relevant to this study) is 45 and 40 dBA for living rooms and sleeping quarters respectively for roadway 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, daycare 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

[3] Adapted from ENCG 2016 – Tables 2.2b and 2.2c
[4] Burberry, P.B. (2014). Mitchell's Environment and Services. Routledge, Page 125
[5] MOECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.8

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].

The sound level criterion for outdoor living areas (OLA) is 55 dBA, which applies during the daytime (07:00 to 23:00). When noise levels exceed 55 dBA, mitigation should be provided to reduce noise levels where technically and administratively feasible to acceptable levels at or below the criterion. Furthermore, noise levels at the OLA must not exceed 60 dBA if mitigation can be technically and administratively achieved.

4.2.2 Theoretical Roadway Noise Predictions

Noise predictions were performed with the aid of the MECP computerized noise assessment program, STAMSON 5.04, for road analysis. Appendix A includes the STAMSON 5.04 input and output data. Roadway traffic noise calculations were performed by treating each roadway segment as separate line sources of noise. 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 were taken to be reflective due to the presence of hard (paved) ground.
- Topography was assumed to be a flat/gentle slope surrounding the study building.
- For select sources where appropriate, receptors considered the proposed and/or existing buildings as a barrier partially or fully obstructing exposure to the source as illustrated by exposure angles in Figure 3.
- Noise receptors were strategically placed at 6 locations around the study area (see Figure 2).
- Receptors were placed at heights of 10.35 metres and 1.5 metres to describe the level 4 plane of window and the at grade outdoor amenities, respectively.
- Receptor distances and exposure angles are illustrated in Figure 3.

[6] MOECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.1.3

4.2.3 Theoretical Railway Traffic Noise Predictions

When an area is influenced by road and rail traffic, the criteria require the outdoor noise impact from each source to be examined separately for comparison to their respective criterion. Calculations were performed with the assistance of STAMSON 5.04. The impact from railway noise is then combined with roadway predictions using a logarithmic addition at each point of reception and compared to the relevant criteria.

Similar to the roadway traffic noise calculations, the railway line was treated as a single-line source of noise. Theoretical noise predictions were based on the following parameters:

- CN Rail Freight trains were modelled with an average of 6 cars and 1 locomotives per train
- The speed of the trains were used as55 km/h in the calculations.
- Whistle events were not considered because there are no level crossings in the area.
- Rail lines are assumed to not be welded along the corridor next to the study site.

4.2.4 Transportation 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]. Daily rail traffic data is based on Gradient Wind's experience, as well as noise reports prepared by others for projects in the area surrounding the rail line of interest[8]. This assessment considers one inbound and one outbound train with the worst-case scenario being the round trip is completed in a single day. The rail traffic is assumed to remain constant over the next 15 years. Table 2 (below) summarizes the AADT values used for each roadway and railway line included in this assessment.

---

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

[8] Noise Impact Assessment – 437 Donald B. Munro Drive, NOVATECH, May 31, 2019

TABLE 2: TRANSPORTATION TRAFFIC DATA

Segment	Roadway / Railway Traffic Data	Speed Limit (km/h)	Traffic Volumes
Woodroffe Avenue	4-Lane Urban Arterial Divided (4-UAD)	60	**35,000**
Norice Street	2-Lane Urban Collector (2-UCU)	40	**8,000**
CN Rail - Freight(Beachburg)	Main Track	55	**2/0***

*Daytime/Nighttime volumes

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 (2012) typically exceed STC 35, depending on exterior cladding, thickness and interior finish details. For example, brick veneer walls can achieve STC 50 or more. 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, calculations must be performed to evaluate the sound transmission quality of the building components to ensure acceptable indoor noise levels. The calculation procedure[9] considers:

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

- 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 vary according to the intended use of a space

Based on published research[10], 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, which was prepared for site plan approval, 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 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.

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

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

In the United States, the Federal Transportation Authority (FTA) has set vibration criteria for sensitive land uses next to transit corridors. Similar standards have been developed by the MECP. These standards indicate that the appropriate criteria for residences is 0.10 mm/s RMS for vibrations. For main line railways, a document titled *Guidelines for New Development in Proximity to Railway Operations*[11], indicates 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. The Federal Transportation Authority (FTA) criterion was adopted as the appropriate standard for this study.

4.4.2 Theoretical Ground Vibration Prediction Procedure

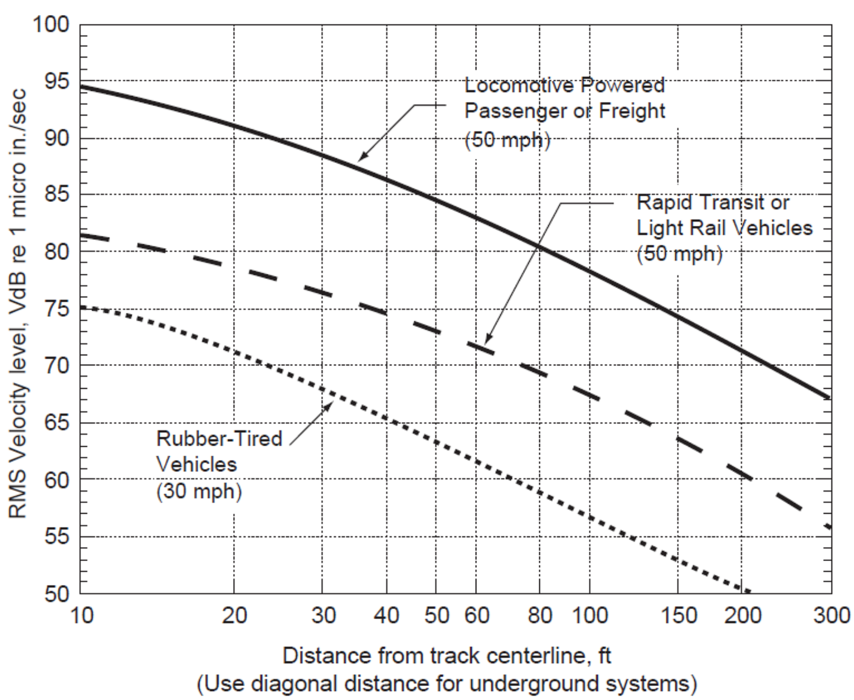
Potential vibration impacts of the trains were predicted using the Federal Transit Authority's (FTA) *Transit Noise and Vibration Impact Assessment*[12] protocol. The FTA general vibration assessment is based on an upper bound generic set of curves that show vibration level attenuation with distance. 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

[11] Dialog and J.E. Coulter Associates Limited, prepared for The Federation of Canadian Municipalities and The Railway Association of Canada, May 2013

[12] C. E. Hanson; D. A. Towers; and L. D. Meister, Transit Noise and Vibration Impact Assessment, Federal Transit Administration, May 2006

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 is determined using a set of curves for different railway types at a speed of 50 mph. The railway curve relevant to this study is the *Locomotive Powered Passenger or Freight* train curve. The adjustment factors to be considered in the calculations are as follows:

- The maximum operating speed of the train is 34 mph (55 km/h) at peak.
- The offset distance between the development and the closest track is 309 m.
- The vehicles are assumed to have soft primary suspensions.
- Tracks jointed with no welds and in good condition.
- Soil conditions do not efficiently propagate vibrations.
- The type of transit structure is Open-cut.
- The building's foundation coupling is Foundation in Rock.



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

5. RESULTS AND DISCUSSION

5.1 Transportation Noise Levels

The results of the transportation noise calculations are summarized in Table 3 below. A complete set of input and output data from all STAMSON 5.04 calculations is available in Appendix A.

TABLE 3: EXTERIOR NOISE LEVELS DUE TO TRANSPORTATION SOURCES

Receptor Number	Receptor Height Above Grade (m)	Receptor Location	Railway Noise Level (dBA)		Roadway Noise Level (dBA)		Total Noise Level (dBA)	
			Day	Night	Day	Night	Day	Night
1	10.35	POW – 4th Floor – South Façade	38	0	66	58	66	58
2	10.35	POW – 4th Floor – East Façade	35	0	58	50	58	50
3	10.35	POW – 4th Floor – North Façade	0	0	62	54	62	54
4	10.35	POW – 4th Floor – West Façade	38	0	66	58	66	58
5	1.5	OLA – 1st Floor – Northeast	0	N/A*	61	N/A*	61	N/A*
6	1.5	OLA – 1st Floor – Northwest	0	N/A*	62	N/A*	62	N/A*

*Noise levels during the nighttime are not considered for OLA's as per ENCG criterion.

The results of the current analysis indicate that noise levels will range between 58 and 66 dBA during the daytime period (07:00-23:00) and between 50 and 58 dBA during the nighttime period (23:00-07:00). The highest noise level (66 dBA) occurs at the south and west façades, which is most exposed to the transportation noise sources.

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). As per the city of Ottawa requirements, detailed STC calculations will be required to be completed prior to the building permit application for each unit type. The STC requirements for the windows are summarized below for various units within the development (see Figure 3):

- **Bedroom Windows**

(i) Bedroom windows facing south and west will require a minimum STC of 29.

(ii) All other bedroom windows are to satisfy Ontario Building Code (OBC 2020) requirements.

- **Living Room Windows**

(i) Living room windows facing south and west will require a minimum STC of 24.

(ii) All other living room windows are to satisfy Ontario Building Code (OBC 2020) requirements.

- **Exterior Walls**

(i) Exterior wall components will require a minimum STC of 45, which will be achieved with brick cladding or an acoustical equivalent according to NRC test data[13].

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 window/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. 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. The specified STC requirements also apply to swinging and/or sliding patio doors.

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 in all Lease, Purchase and Sale Agreements, as summarized in Section 6.

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

5.3 Noise Barrier Calculation

Noise levels at the both of the at grade outdoor amenities are expected to exceed 55 dBA during the daytime period without a noise barrier. If these areas are to be used as outdoor living areas, noise control measures are required to reduce noise levels as close as possible to 55 dBA where technically and administratively feasible. Further analysis investigated the noise-mitigating impact of noise barriers ranging from 1.1 m to 2.5 m high above the walking surface (see Table 4). Results of the investigation proved that noise levels for both outdoor amenities can be reduced to below 60 dBA with a 2.5 m high barrier surrounding the north and west perimeters. The barrier must be constructed from materials having a minimum surface density of 20 kg/m2 and contain no gaps Figure 4 illustrates the barrier requirements. As noise levels at the outdoor amenities are slightly above 55 dBA with a 2.5 m high noise barrier, a Type B Warning Clause will also be required to be placed on all Lease, Purchase and Sale Agreements, as summarized in Section 6.

TABLE 4: RESULTS OF NOISE BARRIER INVESTIGATION

Receptor Number	Receptor Height Above Grade (m)	Receptor Location	Daytime L_{eq} Noise Levels (dBA)				
			No Barrier	With 1.1 m Barrier	With 1.5 m Barrier	With 2 m Barrier	With 2.5 m Barrier
5	1.5	OLA – 1st Floor Northeast	61	61	58	57	**56**
6	1.5	OLA – 1st Floor Northwest	62	62	59	58	**56**

5.4 Ground Vibrations and Ground-Borne Noise Levels

Based on the FTA Generalized Curves of Vibration Levels versus Distance as shown in Section 4, estimated vibration levels at the foundation nearest to the rail corridor are expected to be imperceptible. By using an offset distance of 309 m (1014 ft) to the nearest track centerline, the RMS velocity level approaches zero. Therefore, vibration levels do not exceed the criterion of 0.14 mm/s RMS at the foundation, concerns due to vibration impacts on the site are not expected. As vibration levels are acceptable, correspondingly, regenerated noise levels are also expected to be acceptable.

6. CONCLUSIONS AND RECOMMENDATIONS

The results of the current analysis indicate that noise levels will range between 58 and 66 dBA during the daytime period (07:00-23:00) and between 50 and 58 dBA during the nighttime period (23:00-07:00). The highest noise level (66 dBA) occurs at the south and west façades, which is most exposed to the noise sources. Building components with a higher Sound Transmission Class (STC) rating will be required where exterior noise levels exceed 65 dBA, as indicated in Figure 5.

Results of the calculation also indicate the development will require central air conditioning, or similar mechanical ventilation, which will allow occupants to keep windows closed to maintain a comfortable indoor living environment. The following 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 both of the at grade outdoor amenities are expected to exceed 55 dBA during the daytime period without a noise barrier. If these areas are to be used as outdoor living areas, noise control measures are required to reduce noise levels as close as possible to 55 dBA where technically and administratively feasible. Further analysis investigated the noise-mitigating impact of noise barriers ranging from 1.1 m to 2.5 m high above the walking surface (see Table 4). Results of the investigation proved that noise levels for both outdoor amenities can be reduced to below 60 dBA with a 2.5 m high barrier surrounding the north and west perimeters. The barrier must be constructed from materials having a minimum surface density of 20 kg/m2 and contain no gaps Figure 4 illustrates the barrier requirements. As noise levels at the outdoor amenities are slightly above 55 dBA with a 2.5 m high noise barrier, the following Type B Warning Clause will also be required to be placed on all Lease, Purchase and Sale Agreements, as summarized below:

Type B:

> *"Purchasers/tenants are advised that despite the inclusion of noise control features in the development and within the building units, sound levels due to increasing road traffic (rail traffic) (air traffic) may on occasions interfere with some activities of the dwelling occupants as the sound levels exceed the sound level limits of the Municipality and the Ministry of the Environment."*

Based on the FTA Generalized Curves of Vibration Levels versus Distance as shown in Section 4, estimated vibration levels at the foundation nearest to the rail corridor are expected to be negligible. By using an offset distance of 309 m (1014 ft) to the nearest track centerline, the RMS velocity level approaches zero. Therefore, vibration levels do not exceed the criterion of 0.14 mm/s RMS at the foundation, concerns due to vibration impacts on the site are not expected. As vibration levels are acceptable, correspondingly, regenerated noise levels are also expected to be acceptable.

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,

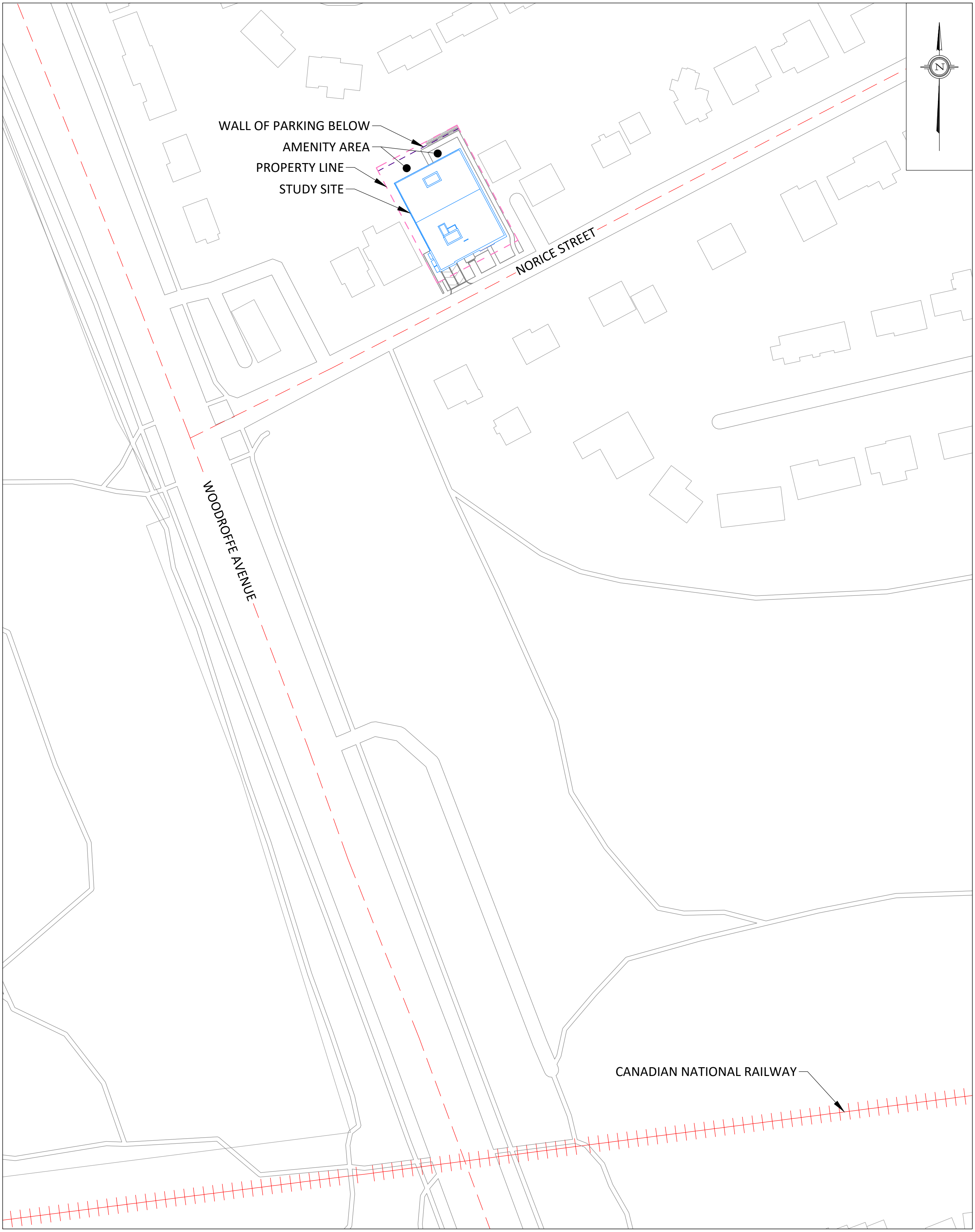
Gradient Wind Engineering Inc.

LICENSED PROFESSIONAL ENGINEER
J. R. FOSTER
100155655
Aug 12, 2024
PROVINCE OF ONTARIO

Benjamin Page, AdvDip.
Junior Environmental Scientist

Joshua Foster, P.Eng.
Principal

Gradient Wind File #24-026-Transportation Noise and Vibration



GRADIENTWIND ENGINEERS & SCIENTISTS 127 WALGREEN ROAD, OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM	PROJECT 193 NORICE STREET, OTTAWA TRANSPORTATION NOISE STUDY		DESCRIPTION FIGURE 1: PROPOSED SITE PLAN AND SURROUNDING CONTEXT
	SCALE 1:1750	DRAWING NO. 24-026-FIG1	
	DATE AUGUST 12, 2024	DRAWN BY B.P.	

GRADIENTWIND ENGINEERS & SCIENTISTS 127 WALGREEN ROAD, OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM	PROJECT: 193 NORICE STREET, OTTAWA TRANSPORTATION NOISE STUDY		DESCRIPTION: FIGURE 2: RECEPTOR LOCATIONS
	SCALE: 1:350	DRAWING NO.: 24-026-FIG2	
	DATE: AUGUST 12, 2024	DRAWN BY: B.P.	

1	OLA RECEPTOR
1	POW RECEPTOR

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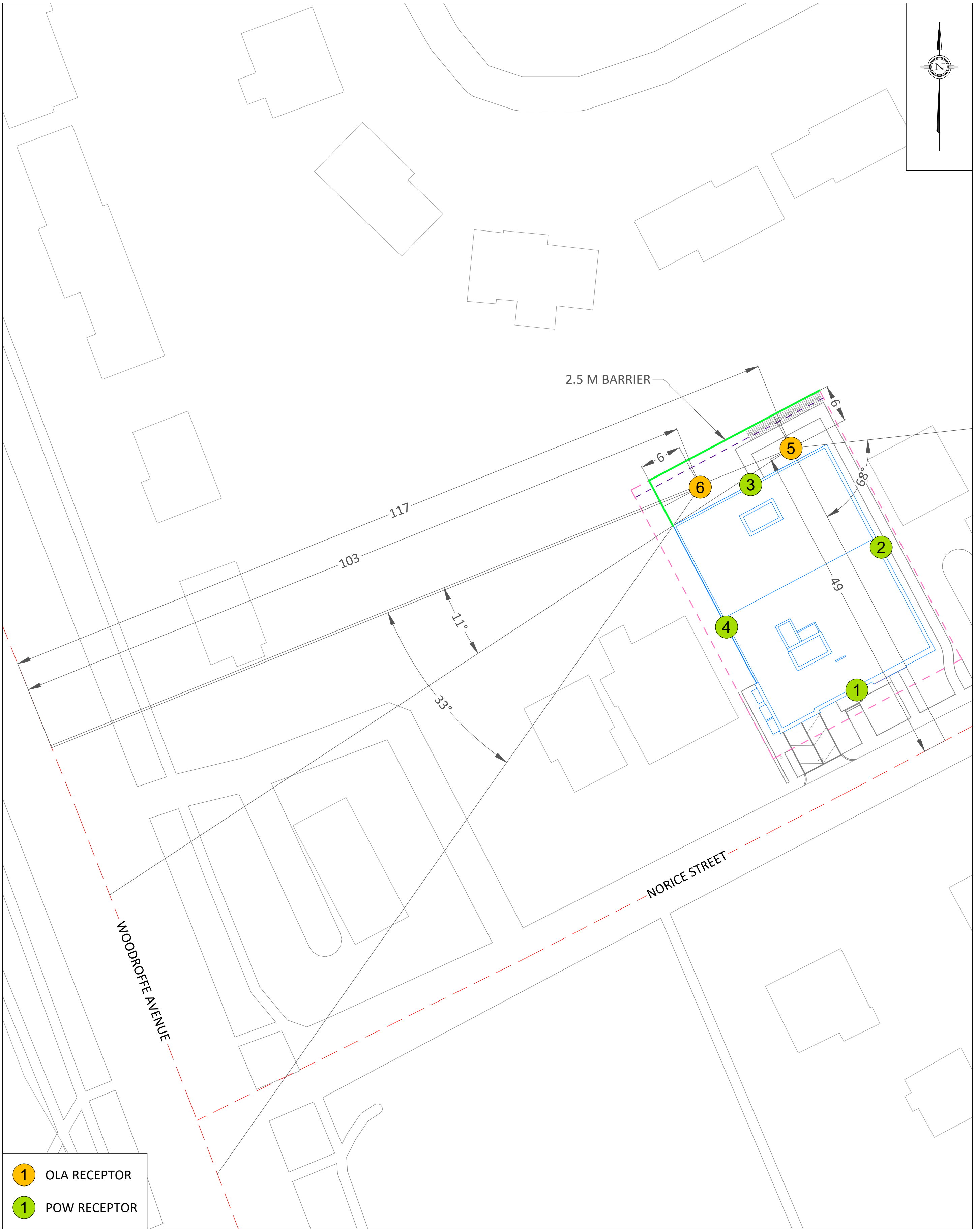
PROJECT: 193 NORICE STREET, OTTAWA TRANSPORTATION NOISE STUDY		DESCRIPTION: FIGURE 3: STAMSON INPUT DATA
SCALE: 1:1750	DRAWING NO.: 24-026-FIG3	
DATE: AUGUST 12, 2024	DRAWN BY: B.P.	



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PROJECT		DESCRIPTION
193 NORICE STREET, OTTAWA TRANSPORTATION NOISE STUDY		FIGURE 4: BARRIER REQUIREMENTS
SCALE 1:750	DRAWING NO. 24-026-FIG4	
DATE AUGUST 12, 2024	DRAWN BY B.P.	

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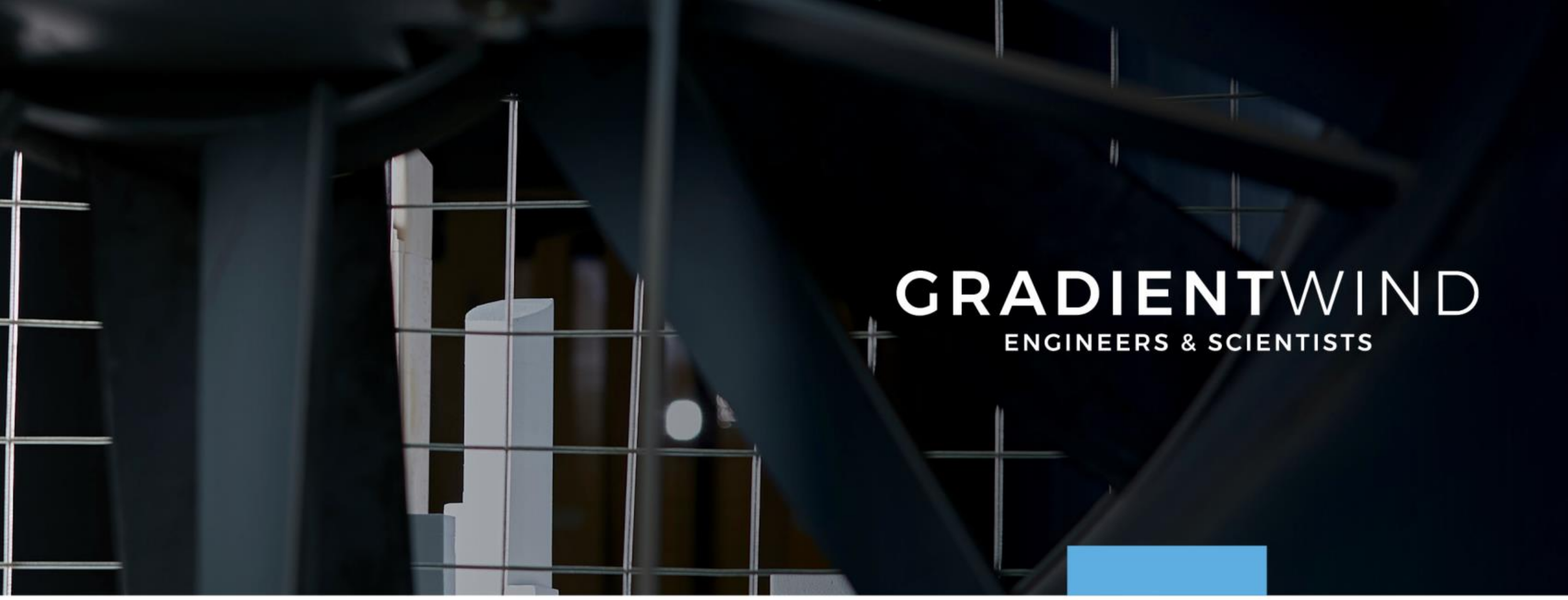
PROJECT	193 NORICE STREET, OTTAWA TRANSPORTATION NOISE STUDY		
SCALE	1:350	DRAWING NO.	24-026-FIG5
DATE	AUGUST 12, 2024	DRAWN BY	B.P.

DESCRIPTION

FIGURE 5:
STC REQUIREMENTS



APPENDIX A

STAMSON 5.04 – INPUT AND OUTPUT DATA

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```
STAMSON 5.0          NORMAL REPORT          Date: 04-04-2024 11:17:32
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: R1.te                 Time Period: Day/Night 16/8 hours
Description:


Rail data, segment # 1: CN RAIL (day/night)
-------------------------------------------
Train             ! Trains       ! Speed !# loc !# Cars! Eng  !Cont
Type              !              !(km/h) !/Train!/Train! type !weld
------------------+--------------+-------+------+------+------+----
  1. DIESEL       !   2.0/0.0    !  55.0 !  1.0 !  6.0 !Diesel!  No

Data for Segment # 1: CN RAIL (day/night)
-----------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      2 / 2
House density             :     35 %
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 309.00 / 309.00 m
Receiver height           :  10.35 / 10.35  m
Topography                :      1       (Flat/gentle slope; no barrier)
No Whistle
Reference angle           :   0.00

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

LOCOMOTIVE (0.00 + 37.16 + 0.00) = 37.16 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.00  53.37 -13.14   0.00   0.00  -3.07   0.00  37.16
----------------------------------------------------------------------

WHEEL (0.00 + 30.44 + 0.00) = 30.44 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.00  46.65 -13.14   0.00   0.00  -3.07   0.00  30.44
----------------------------------------------------------------------

Segment Leq : 38.00 dBA

Total Leq All Segments: 38.00 dBA
```

```
Results segment # 1: CN RAIL (night)
------------------------------------

LOCOMOTIVE (0.00 + -16.21 + 0.00) = 0.00 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.00   0.00 -13.14   0.00   0.00  -3.07   0.00 -16.21
----------------------------------------------------------------------

WHEEL (0.00 + -16.21 + 0.00) = 0.00 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.00   0.00 -13.14   0.00   0.00  -3.07   0.00 -16.21
----------------------------------------------------------------------

Segment Leq : 0.00 dBA

Total Leq All Segments: 0.00 dBA

Road data, segment # 1: WOODROFFE (day/night)
---------------------------------------------
Car traffic volume  : 28336/2464  veh/TimePeriod  *
Medium truck volume :  2254/196   veh/TimePeriod  *
Heavy truck volume  :  1610/140   veh/TimePeriod  *
Posted speed limit  :    60 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):  35000
    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: WOODROFFE (day/night)
-------------------------------------------
Angle1   Angle2           :   0.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 113.00 / 113.00 m
Receiver height           :  10.35 / 10.35  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Road data, segment # 2: NORICE ST (day/night)
---------------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    veh/TimePeriod  *
Posted speed limit  :    40 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):   8000
    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 # 2: NORICE ST (day/night)
-------------------------------------------
Angle1   Angle2            : -85.00 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            :  10.35 / 10.35  m
Topography                 :      1       (Flat/gentle slope; no barrier)
Reference angle            :   0.00

Results segment # 1: WOODROFFE (day)
------------------------------------

Source height = 1.50 m

ROAD (0.00 + 61.90 + 0.00) = 61.90 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
     0     90   0.00  73.68   0.00  -8.77  -3.01   0.00   0.00   0.00  61.90
----------------------------------------------------------------------------

Segment Leq : 61.90 dBA
```

```
Results segment # 2: NORICE ST (day)
------------------------------------

Source height = 1.50 m

ROAD (0.00 + 63.83 + 0.00) = 63.83 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -85     90   0.00  63.96   0.00   0.00  -0.12   0.00   0.00   0.00  63.83
----------------------------------------------------------------------------

Segment Leq : 63.83 dBA

Total Leq All Segments: 65.98 dBA

Results segment # 1: WOODROFFE (night)
--------------------------------------

Source height = 1.50 m

ROAD (0.00 + 54.30 + 0.00) = 54.30 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
     0     90   0.00  66.08   0.00  -8.77  -3.01   0.00   0.00   0.00  54.30
----------------------------------------------------------------------------

Segment Leq : 54.30 dBA

Results segment # 2: NORICE ST (night)
--------------------------------------

Source height = 1.50 m

ROAD (0.00 + 56.24 + 0.00) = 56.24 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -85     90   0.00  56.36   0.00   0.00  -0.12   0.00   0.00   0.00  56.24
----------------------------------------------------------------------------

Segment Leq : 56.24 dBA

Total Leq All Segments: 58.39 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 65.99
                         (NIGHT): 58.39
```

```
STAMSON 5.0          NORMAL REPORT         Date: 04-04-2024 11:11:30
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: R2.te                 Time Period: Day/Night 16/8 hours
Description:

Rail data, segment # 1: CN RAIL (day/night)
-------------------------------------------
Train             ! Trains       ! Speed !# loc !# Cars! Eng  !Cont
Type              !              !(km/h) !/Train!/Train! type !weld
-----------------+-------------+--------+------+------+------+----
  1. DIESEL      !   2.0/0.0    !  55.0 !  1.0 !  6.0 !Diesel!  No

Data for Segment # 1: CN RAIL (day/night)
-----------------------------------------
Angle1   Angle2           : -90.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      2 / 2
House density             :     35 %
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 329.00 / 329.00 m
Receiver height           :  10.35 / 10.35  m
Topography                :      1       (Flat/gentle slope; no barrier)
No Whistle
Reference angle           :   0.00

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

LOCOMOTIVE (0.00 + 33.88 + 0.00) = 33.88 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90      0   0.00  53.37 -13.41  -3.01   0.00  -3.06   0.00  33.88
----------------------------------------------------------------------

WHEEL (0.00 + 27.16 + 0.00) = 27.16 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90      0   0.00  46.65 -13.41  -3.01   0.00  -3.06   0.00  27.16
----------------------------------------------------------------------

Segment Leq : 34.72 dBA

Total Leq All Segments: 34.72 dBA
```

```
Results segment # 1: CN RAIL (night)
------------------------------------

LOCOMOTIVE (0.00 + -19.48 + 0.00) = 0.00 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90      0   0.00   0.00 -13.41  -3.01   0.00  -3.06   0.00 -19.48
----------------------------------------------------------------------

WHEEL (0.00 + -19.48 + 0.00) = 0.00 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90      0   0.00   0.00 -13.41  -3.01   0.00  -3.06   0.00 -19.48
----------------------------------------------------------------------

Segment Leq : 0.00 dBA

Total Leq All Segments: 0.00 dBA

Road data, segment # 1: NORICE (day/night)
------------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    veh/TimePeriod  *
Posted speed limit  :    40 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):   8000
    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: NORICE (day/night)
----------------------------------------
Angle1   Angle2           : -90.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  30.00 / 30.00  m
Receiver height           :  10.35 / 10.35  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Results segment # 1: NORICE (day)
---------------------------------

Source height = 1.50 m

ROAD (0.00 + 57.93 + 0.00) = 57.93 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90      0   0.00  63.96   0.00  -3.01  -3.01   0.00   0.00   0.00  57.93
----------------------------------------------------------------------------

Segment Leq : 57.93 dBA

Total Leq All Segments: 57.93 dBA

Results segment # 1: NORICE (night)
-----------------------------------

Source height = 1.50 m

ROAD (0.00 + 50.34 + 0.00) = 50.34 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90      0   0.00  56.36   0.00  -3.01  -3.01   0.00   0.00   0.00  50.34
----------------------------------------------------------------------------

Segment Leq : 50.34 dBA

Total Leq All Segments: 50.34 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 57.95
                         (NIGHT): 50.34
```

```
STAMSON 5.0        NORMAL REPORT        Date: 04-04-2024 11:14:22
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: R3.te                Time Period: Day/Night 16/8 hours
Description:

Road data, segment # 1: WOODROFFE (day/night)
---------------------------------------------
Car traffic volume  : 28336/2464  veh/TimePeriod  *
Medium truck volume :  2254/196   veh/TimePeriod  *
Heavy truck volume  :  1610/140   veh/TimePeriod  *
Posted speed limit  :    60 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):  35000
    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: WOODROFFE (day/night)
-------------------------------------------
Angle1   Angle2          : -90.00 deg   0.00 deg
Wood depth               :      0       (No woods.)
No of house rows         :      0 / 0
Surface                  :      2       (Reflective ground surface)
Receiver source distance : 110.00 / 110.00 m
Receiver height          :  10.35 / 10.35  m
Topography               :      1       (Flat/gentle slope; no barrier)
Reference angle          :   0.00

Results segment # 1: WOODROFFE (day)
------------------------------------

Source height = 1.50 m

ROAD (0.00 + 62.01 + 0.00) = 62.01 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90      0   0.00  73.68   0.00  -8.65  -3.01   0.00   0.00   0.00  62.01
----------------------------------------------------------------------------

Segment Leq : 62.01 dBA

Total Leq All Segments: 62.01 dBA
```

```
Results segment # 1: WOODROFFE (night)
--------------------------------------

Source height = 1.50 m

ROAD (0.00 + 54.42 + 0.00) = 54.42 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90      0   0.00  66.08   0.00  -8.65  -3.01   0.00   0.00   0.00  54.42
----------------------------------------------------------------------------

Segment Leq : 54.42 dBA

Total Leq All Segments: 54.42 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 62.01
                         (NIGHT): 54.42
```

```
STAMSON 5.0        NORMAL REPORT        Date: 04-04-2024 11:16:22
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: R4.te                Time Period: Day/Night 16/8 hours
Description:

Rail data, segment # 1: CN RAIL (day/night)
-------------------------------------------
Train           ! Trains       ! Speed !# loc !# Cars! Eng  !Cont
Type            !              !(km/h) !/Train!/Train! type !weld
----------------+-------------+--------+------+------+------+----
  1. DIESEL     !   2.0/0.0    !  55.0 !  1.0 !  6.0 !Diesel!  No

Data for Segment # 1: CN RAIL (day/night)
-----------------------------------------
Angle1   Angle2           : -90.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 320.00 / 320.00 m
Receiver height           :  10.35 / 10.35  m
Topography                :      1       (Flat/gentle slope; no barrier)
No Whistle
Reference angle           :   0.00

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

LOCOMOTIVE (0.00 + 37.07 + 0.00) = 37.07 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90      0   0.00  53.37 -13.29  -3.01   0.00   0.00   0.00  37.07
----------------------------------------------------------------------

WHEEL (0.00 + 30.34 + 0.00) = 30.34 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90      0   0.00  46.65 -13.29  -3.01   0.00   0.00   0.00  30.34
----------------------------------------------------------------------

Segment Leq : 37.91 dBA

Total Leq All Segments: 37.91 dBA
```

```
Results segment # 1: CN RAIL (night)
------------------------------------

LOCOMOTIVE (0.00 + -16.30 + 0.00) = 0.00 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90      0   0.00   0.00 -13.29  -3.01   0.00   0.00   0.00 -16.30
----------------------------------------------------------------------

WHEEL (0.00 + -16.30 + 0.00) = 0.00 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90      0   0.00   0.00 -13.29  -3.01   0.00   0.00   0.00 -16.30
----------------------------------------------------------------------

Segment Leq : 0.00 dBA

Total Leq All Segments: 0.00 dBA

Road data, segment # 1: WOODROFFE (day/night)
---------------------------------------------
Car traffic volume  : 28336/2464  veh/TimePeriod  *
Medium truck volume :  2254/196   veh/TimePeriod  *
Heavy truck volume  :  1610/140   veh/TimePeriod  *
Posted speed limit  :    60 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):  35000
    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: WOODROFFE (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  :  99.00 / 99.00  m
Receiver height           :  10.35 / 10.35  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Road data, segment # 2: NORICE ST (day/night)
---------------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    veh/TimePeriod  *
Posted speed limit  :    40 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):   8000
    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 # 2: NORICE ST (day/night)
-------------------------------------------
Angle1   Angle2           : -74.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  30.00 / 30.00  m
Receiver height           :  10.35 / 10.35  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Results segment # 1: WOODROFFE (day)
------------------------------------

Source height = 1.50 m

ROAD (0.00 + 65.48 + 0.00) = 65.48 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.00  73.68   0.00  -8.20   0.00   0.00   0.00   0.00  65.48
----------------------------------------------------------------------------

Segment Leq : 65.48 dBA
```

```
Results segment # 2: NORICE ST (day)
------------------------------------

Source height = 1.50 m

ROAD (0.00 + 57.08 + 0.00) = 57.08 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -74      0   0.00  63.96   0.00  -3.01  -3.86   0.00   0.00   0.00  57.08
----------------------------------------------------------------------------

Segment Leq : 57.08 dBA

Total Leq All Segments: 66.07 dBA

Results segment # 1: WOODROFFE (night)
--------------------------------------

Source height = 1.50 m

ROAD (0.00 + 57.88 + 0.00) = 57.88 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.00  66.08   0.00  -8.20   0.00   0.00   0.00   0.00  57.88
----------------------------------------------------------------------------

Segment Leq : 57.88 dBA

Results segment # 2: NORICE ST (night)
--------------------------------------

Source height = 1.50 m

ROAD (0.00 + 49.49 + 0.00) = 49.49 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -74      0   0.00  56.36   0.00  -3.01  -3.86   0.00   0.00   0.00  49.49
----------------------------------------------------------------------------

Segment Leq : 49.49 dBA

Total Leq All Segments: 58.47 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 66.07
                         (NIGHT): 58.47
```

```
STAMSON 5.0        NORMAL REPORT        Date: 04-04-2024 11:43:33
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: R5.te                Time Period: Day/Night 16/8 hours
Description:

Road data, segment # 1: WOODROFFE (day/night)
---------------------------------------------
Car traffic volume  : 28336/2464  veh/TimePeriod  *
Medium truck volume :  2254/196   veh/TimePeriod  *
Heavy truck volume  :  1610/140   veh/TimePeriod  *
Posted speed limit  :    60 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):  35000
    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: WOODROFFE (day/night)
-------------------------------------------
Angle1   Angle2           : -90.00 deg   11.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      1 / 1
House density             :     35 %
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 117.00 / 117.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Road data, segment # 2: NORICE ST (day/night)
---------------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    veh/TimePeriod  *
Posted speed limit  :    40 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):   8000
    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 # 2: NORICE ST (day/night)
-------------------------------------------
Angle1    Angle2           :  68.00 deg   90.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      1 / 1
House density              :     35 %
Surface                    :      2       (Reflective ground surface)
Receiver source distance   :  49.00 / 49.00  m
Receiver height            :   1.50 / 1.50   m
Topography                 :      1       (Flat/gentle slope; no barrier)
Reference angle            :   0.00

Results segment # 1: WOODROFFE (day)
------------------------------------

Source height = 1.50 m

ROAD (0.00 + 60.55 + 0.00) = 60.55 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     11   0.00  73.68   0.00  -8.92  -2.51   0.00  -1.70   0.00  60.55
----------------------------------------------------------------------------

Segment Leq : 60.55 dBA

Results segment # 2: NORICE ST (day)
------------------------------------

Source height = 1.50 m

ROAD (0.00 + 47.95 + 0.00) = 47.95 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
    68     90   0.00  63.96   0.00  -5.14  -9.13   0.00  -1.74   0.00  47.95
----------------------------------------------------------------------------

Segment Leq : 47.95 dBA

Total Leq All Segments: 60.78 dBA

Results segment # 1: WOODROFFE (night)
--------------------------------------

Source height = 1.50 m

ROAD (0.00 + 52.95 + 0.00) = 52.95 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     11   0.00  66.08   0.00  -8.92  -2.51   0.00  -1.70   0.00  52.95
----------------------------------------------------------------------------

Segment Leq : 52.95 dBA
```

```
Results segment # 2: NORICE ST (night)
--------------------------------------

Source height = 1.50 m

ROAD (0.00 + 40.36 + 0.00) = 40.36 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
    68     90   0.00  56.36   0.00  -5.14  -9.13   0.00  -1.74   0.00  40.36
----------------------------------------------------------------------------

Segment Leq : 40.36 dBA

Total Leq All Segments: 53.18 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 60.78
                         (NIGHT): 53.18
```

```
STAMSON 5.0        NORMAL REPORT        Date: 04-04-2024 13:19:09
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: R5B4.te              Time Period: Day/Night 16/8 hours
Description:

Road data, segment # 1: WOODROFFE (day/night)
---------------------------------------------
Car traffic volume  : 28336/2464  veh/TimePeriod  *
Medium truck volume :  2254/196   veh/TimePeriod  *
Heavy truck volume  :  1610/140   veh/TimePeriod  *
Posted speed limit  :    60 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):  35000
    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: WOODROFFE (day/night)
-------------------------------------------
Angle1   Angle2           : -90.00 deg   11.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      1 / 1
House density             :     35 %
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 117.00 / 117.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 11.00 deg
Barrier height            :   2.50 m
Barrier receiver distance :   6.00 / 6.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Road data, segment # 2: NORICE ST (day/night)
---------------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    veh/TimePeriod  *
Posted speed limit  :    40 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):   8000
    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 # 2: NORICE ST (day/night)
-------------------------------------------
Angle1   Angle2           :  68.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      1 / 1
House density             :     35 %
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  49.00 / 49.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Results segment # 1: WOODROFFE (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 !        1.50 !         1.50

ROAD (0.00 + 54.94 + 0.00) = 54.94 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     11   0.00  73.68   0.00  -8.92  -2.51   0.00  -1.70   0.00  60.55
   -90     11   0.00  73.68   0.00  -8.92  -2.51   0.00   0.00  -7.31  54.94
----------------------------------------------------------------------------

Segment Leq : 54.94 dBA

Results segment # 2: NORICE ST (day)
------------------------------------

Source height = 1.50 m

ROAD (0.00 + 47.95 + 0.00) = 47.95 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
    68     90   0.00  63.96   0.00  -5.14  -9.13   0.00  -1.74   0.00  47.95
----------------------------------------------------------------------------

Segment Leq : 47.95 dBA

Total Leq All Segments: 55.73 dBA
```

```
Results segment # 1: WOODROFFE (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 !        1.50 !         1.50

ROAD (0.00 + 47.34 + 0.00) = 47.34 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     11   0.00  66.08   0.00  -8.92  -2.51   0.00  -1.70   0.00  52.95
   -90     11   0.00  66.08   0.00  -8.92  -2.51   0.00   0.00  -7.31  47.34
----------------------------------------------------------------------------

Segment Leq : 47.34 dBA

Results segment # 2: NORICE ST (night)
--------------------------------------

Source height = 1.50 m

ROAD (0.00 + 40.36 + 0.00) = 40.36 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
    68     90   0.00  56.36   0.00  -5.14  -9.13   0.00  -1.74   0.00  40.36
----------------------------------------------------------------------------

Segment Leq : 40.36 dBA

Total Leq All Segments: 48.13 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 55.73
                         (NIGHT): 48.13
```

```
STAMSON 5.0        NORMAL REPORT        Date: 04-04-2024 11:40:15
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: R6.te                 Time Period: Day/Night 16/8 hours
Description:

Road data, segment # 1: WOODROFFE (day/night)
---------------------------------------------
Car traffic volume  : 28336/2464  veh/TimePeriod  *
Medium truck volume :  2254/196   veh/TimePeriod  *
Heavy truck volume  :  1610/140   veh/TimePeriod  *
Posted speed limit  :    60 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):  35000
    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: WOODROFFE (day/night)
-------------------------------------------
Angle1   Angle2           : -90.00 deg   33.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      1 / 1
House density             :     35 %
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 103.00 / 103.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Results segment # 1: WOODROFFE (day)
------------------------------------

Source height = 1.50 m

ROAD (0.00 + 61.95 + 0.00) = 61.95 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     33   0.00  73.68   0.00  -8.37  -1.65   0.00  -1.70   0.00  61.95
----------------------------------------------------------------------------

Segment Leq : 61.95 dBA

Total Leq All Segments: 61.95 dBA
```

```
Results segment # 1: WOODROFFE (night)
--------------------------------------

Source height = 1.50 m

ROAD (0.00 + 54.36 + 0.00) = 54.36 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     33   0.00  66.08   0.00  -8.37  -1.65   0.00  -1.70   0.00  54.36
----------------------------------------------------------------------------

Segment Leq : 54.36 dBA

Total Leq All Segments: 54.36 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 61.95
                         (NIGHT): 54.36
```

```
STAMSON 5.0        NORMAL REPORT        Date: 04-04-2024 13:36:41
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: R6B4.te              Time Period: Day/Night 16/8 hours
Description:

Road data, segment # 1: WOODROFFE (day/night)
---------------------------------------------
Car traffic volume  : 28336/2464  veh/TimePeriod  *
Medium truck volume :  2254/196   veh/TimePeriod  *
Heavy truck volume  :  1610/140   veh/TimePeriod  *
Posted speed limit  :    60 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):  35000
    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: WOODROFFE (day/night)
-------------------------------------------
Angle1   Angle2           : -90.00 deg   33.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      1 / 1
House density             :     35 %
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 103.00 / 103.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 33.00 deg
Barrier height            :   2.50 m
Barrier receiver distance :   6.00 / 6.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: WOODROFFE (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 !        1.50 !         1.50

ROAD (0.00 + 56.18 + 0.00) = 56.18 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     33   0.00  73.68   0.00  -8.37  -1.65   0.00  -1.70   0.00  61.95
   -90     33   0.00  73.68   0.00  -8.37  -1.65   0.00   0.00  -7.47  56.18
----------------------------------------------------------------------------

Segment Leq : 56.18 dBA

Total Leq All Segments: 56.18 dBA

Results segment # 1: WOODROFFE (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 !        1.50 !         1.50

ROAD (0.00 + 48.59 + 0.00) = 48.59 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     33   0.00  66.08   0.00  -8.37  -1.65   0.00  -1.70   0.00  54.36
   -90     33   0.00  66.08   0.00  -8.37  -1.65   0.00   0.00  -7.47  48.59
----------------------------------------------------------------------------

Segment Leq : 48.59 dBA

Total Leq All Segments: 48.59 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 56.18
                         (NIGHT): 48.59
```