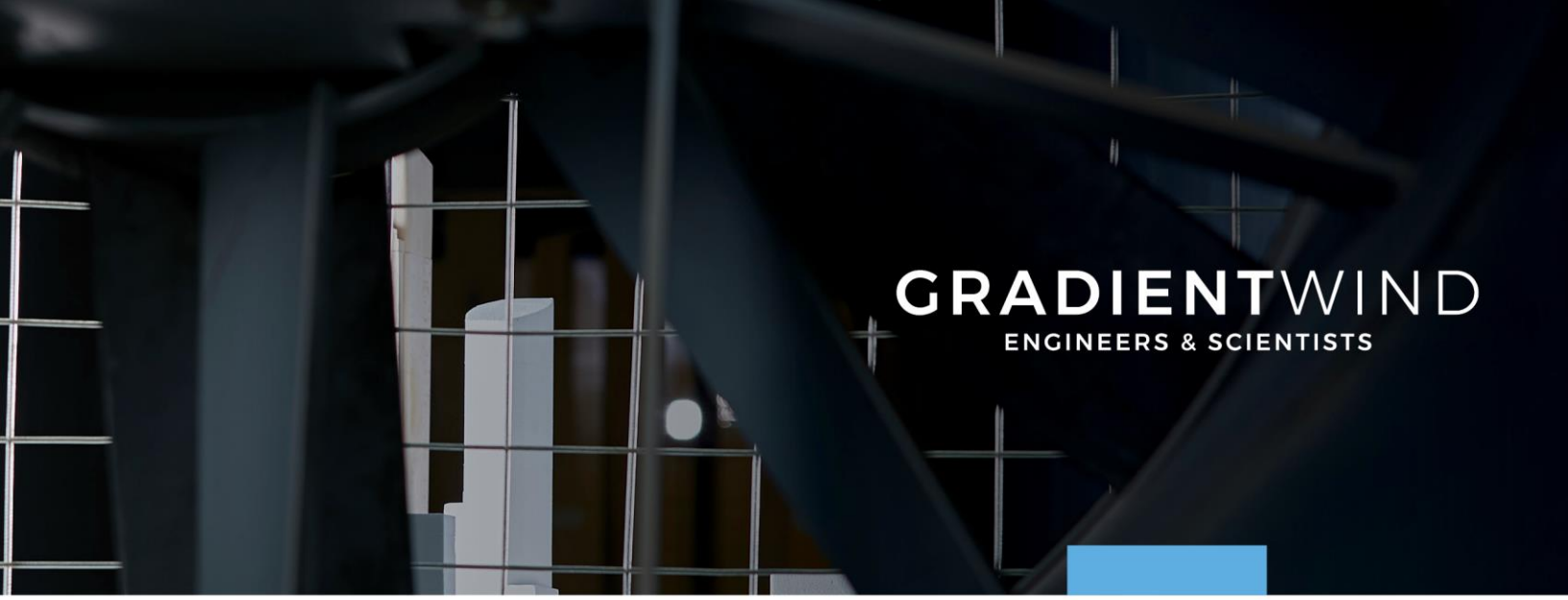
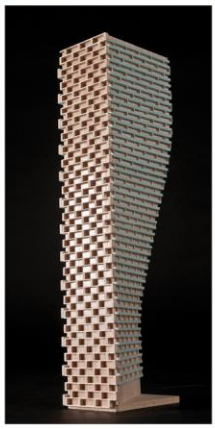


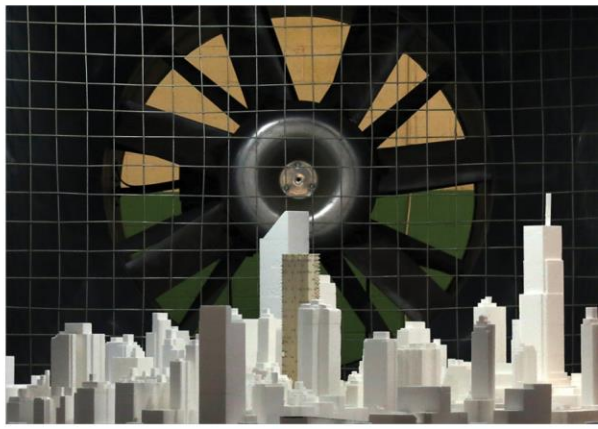
GRADIENTWIND
ENGINEERS & SCIENTISTS

TRANSPORTATION NOISE & VIBRATION ASSESSMENT

2040 Arrowsmith Drive
Ottawa, Ontario

REPORT: GW22-359 – Noise & Vibration





January 20, 2023

PREPARED FOR

Wigwamen Incorporated
23 Lesmill Rd, Unit 106
Toronto, Ontario, M3B 3P6

PREPARED BY

Efser Kara, MSc, LEED GA, Acoustic Scientist
Joshua Foster, P.Eng., Lead Engineer

EXECUTIVE SUMMARY

This document describes an environmental noise & vibration assessment performed for a proposed development located at 2040 Arrowsmith Drive in Ottawa, Ontario. This study was conducted to satisfy the requirements of Zoning By-Law Amendment (ZBA) and Site Plan Control (SPC) applications.

The proposed development comprises a six-storey affordable housing building, containing 50 rental units and a new space for the Gloucester Emergency Food Cupboard (GEFC). The major sources of noise in the area are Highway 174 and the future light rail transit (LRT) line currently under construction.

The assessment is based on: (i) theoretical noise prediction methods that conform to the Ministry of the Environment (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) architectural drawings received from Vandenberg & Wildeboer Architects.

The results of the current analysis indicate that noise levels will range between 50 and 74 dBA during the daytime period (07:00-23:00) and between 43 and 66 dBA during the nighttime period (23:00-07:00). The highest noise levels (73 and 74 dBA) occur along the south and east façade of the study building which is nearest and most exposed to Highway 174, the dominant source of transportation noise.

The 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, a Type D Warning Clauses will also be required to be placed on all Lease, Purchase and Sale Agreements, as summarized in Section 6.

Noise levels at the green roof (Receptor 5) and the amenity patio (Receptor 6) exceed the ENCG criteria for outdoor living areas. Therefore, a noise barrier study was conducted. Our investigations showed that the sound levels cannot be lowered to or below 60 dBA even with a 3-metre-high barrier (see Table 4). Therefore, we recommend not using the green roof or at-grade patio for the quiet enjoyment of the outdoors. Alternatively, moving the patio to the northwest of the building could minimize the impacts on the area because the surrounding buildings will shield the area from the highway. If the area is designated

as an outdoor living area a Type B warning clause will be required in all Lease, Purchase and Sale Agreements, as summarized in Section 6.

Vibration levels due to railway activity in the area are expected to fall below the criterion of 0.14 mm/s and the ground-bourne noise level to be below 35 dBA criterion at the property line. As a result, mitigation for vibrations is not required.

With regard to stationary noise impacts, the site is surrounded by low- to mid-rise residential buildings. There is no significant rooftop equipment close to the study site and the future LRT stations are at a sufficient distance to be considered insignificant in terms of noise levels produced. Therefore, any noise impact on the development site from the station is not anticipated.

For off-site stationary noise impacts from the proposed building onto the surroundings, the stationary noise levels can be reduced by judicious selection and placement of the mechanical equipment or the incorporation of silencers and noise screens as necessary. It is recommended that any large pieces of HVAC equipment be placed in the middle of the roof, avoiding the line of site with the surrounding residential dwellings. Therefore, we anticipate that noise levels compliant with ENCG and NPC-300 limits can be achieved with prudent planning of the mechanical areas and equipment. The final selection of the mechanical equipment should be reviewed by a qualified acoustic engineer prior to the installation of the equipment.

TABLE OF CONTENTS

1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Wigwamen Incorporated to undertake an environmental noise and vibration study of Phase 2 of a proposed mixed-use multi-phase development located at 2040 Arrowsmith Drive in Ottawa, Ontario. This report summarizes the methodology, results and recommendations related to an environmental noise and ground vibration assessment. Gradient Wind's scope of work involved assessing exterior and interior noise levels, as well as ground vibration generated by local roadway and LRT traffic noise sources. The assessment was performed on the basis of theoretical noise calculation methods conforming to the City of Ottawa[1] and Ministry of the Environment NPC-300[2] guidelines. Noise calculations were based on architectural drawings received from Vandenberg & Wildeboer Architects, dated October 31, 2018, with future traffic volumes corresponding to the City of Ottawa's Official Plan (OP) roadway classifications.

2. TERMS OF REFERENCE

The focus of this environmental noise and vibration assessment is an apartment building located at 2040 Arrowsmith Drive in Ottawa, Ontario.

The proposed development comprises a six-storey affordable housing building, containing 50 rental units and a new space for the Gloucester Emergency Food Cupboard (GEFC). The first floor features a green roof along the east elevation. At grade, bicycle parking is located to the west and south of the building and an outdoor amenity patio is featured to the southeast. A community garden drop-off/pick-up, snow storage, and existing surface parking are located south of the proposed building.

The major sources of noise in the area are Highway 174 and the future light rail transit (LRT) line currently under construction. In addition to the traffic noise impact from the sources, the vibrations from the LRT line were also considered in this study.

[1] City of Ottawa Environmental Noise Control Guidelines, January 2016
[2] Ministry of the Environment – Publication NPC-300

3. OBJECTIVES

The main goals of this work 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 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 and LRT Traffic Noise

4.2.1 Criteria for Roadway and LRT 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	Leq (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 normally triggers the need for central air conditioning. Where noise levels exceed 65 dBA daytime and 60 dBA nighttime, building components will require higher levels of sound attenuation[6].

The sound level criterion for outdoor living areas is 55 dBA, which applies during the daytime (07:00 to 23:00). When noise levels exceed 55 dBA, mitigation must be provided to reduce noise levels where technically and administratively feasible to acceptable levels at or below the criterion.

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

4.2.2 Theoretical Roadway and LRT Noise Predictions

Noise predictions were performed with the aid of the MOECP 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.
- Surrounding buildings were included as barriers where applicable.
- Noise receptors were strategically placed at 6 locations around the study site (see Figure 2).
- Receptor distances and exposure angles are illustrated for a sample of receptors in Figure 3-6.

4.2.3 Roadway and LRT 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. Future LRT volumes were obtained through a representative of the Rail Implementation Office.

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

TABLE 2: ROADWAY AND LRT TRAFFIC DATA

Segment	Roadway Traffic Data	Speed Limit (km/h)	Traffic Volumes
Highway 174 WB	6-Freeway	100	**55,000**
Highway 174 EB	6-Freeway	100	**55,000**
Confederation Line LRT Phase 2	LRT	70	**540 Day / 60 Night***

* 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 (2020) 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 and rail 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[8] 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 vary according to the intended use of a space

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

Based on published research[9], 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).

4.4 Ground Vibration & Ground-borne Noise

4.4.1 Background on Vibrations

Transit 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.

Similar to sound waves in air, ground vibrations also 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. The repetitive motion of steel 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 noise signature that is unique to that structure and soil combination.

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 measurement units of ground vibration are millimetres per second (mm/s) or inches per second (in/s). Since vibrations can vary

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

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 to 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.

4.4.2 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*[10], 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.

4.4.3 Theoretical Ground Vibration Prediction Procedure

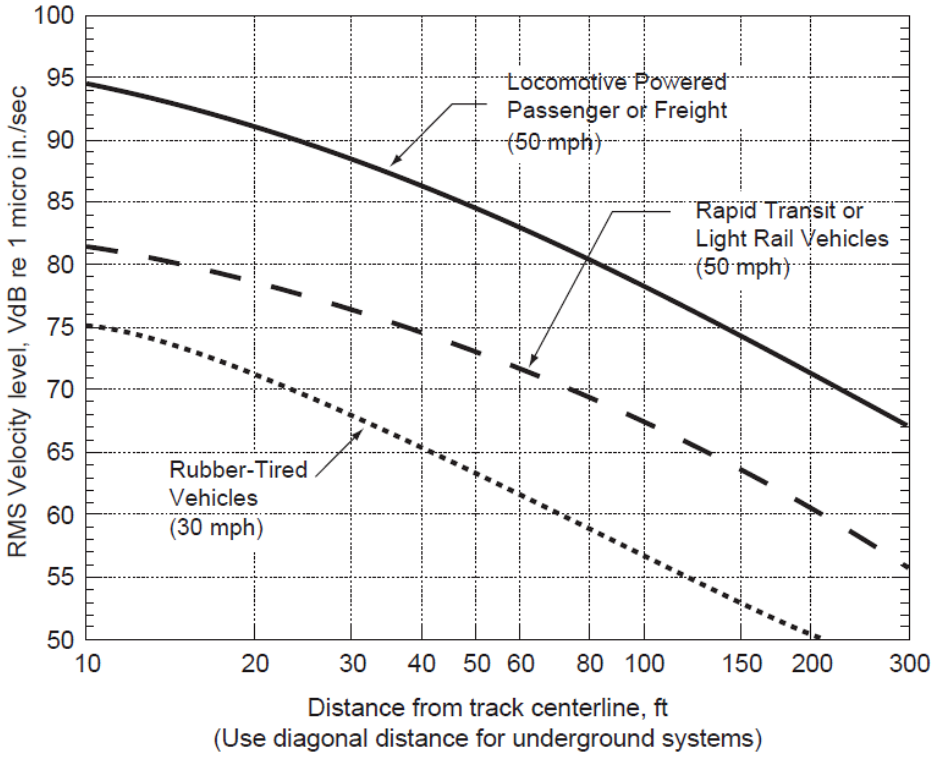
Potential vibration impacts of the trains were predicted using the Federal Transit Authority's (FTA) Transit Noise and Vibration Impact Assessment[11] protocol. The FTA general vibration assessment is based on an upper bound generic set of curves that show vibration level attenuation with distance. These 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.

Confederation Line LRT passes approximately 24 metres to the south of the development. Therefore, the vibration impact of the LRT line on the building was determined using a set of curves for Rapid Transit or

[10] Dialog and J.E. Coulter Associates Limited, prepared for The Federation of Canadian Municipalities and The Railway Associated of Canada, May 2013
[11] C. E. Hanson; D. A. Towers; and L. D. Meister, Transit Noise and Vibration Impact Assessment, Federal Transit Administration, May 2006

Light Rail Vehicles at a speed of 43 mph (equals to 70 km/hr, maximum speed for the train) using FTA's Transit Noise and Vibration Impact Assessment protocol. Adjustment factors were considered based on the following information:

- The maximum operating speed of the train is 70 km/h (43 mph)
- The distance between the development's property line and the closest LRT track is 24 m
- There are no crossover tracks near the development
- The vehicles are assumed to have soft primary suspensions
- Tracks are not welded, though in otherwise good condition
- Soil conditions; propagation through rock
- The building's foundation is large masonry on piles



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 Roadway Traffic Noise Levels

The results of the roadway traffic noise calculations are summarized in Table 3 below. A complete set of input and output data from all STAMSON 5.04 calculations are available in Appendix A. The source-to-receiver distances and angles are illustrated in Figures 3 to 6.

TABLE 3: EXTERIOR NOISE LEVELS DUE TO ROAD AND LRT TRAFFIC

Receptor Number	Receptor Height Above Grade (m)	Receptor Location	STAMSON 5.04 Noise Level (dBA)	
			Day	Night
1	16.5	POW – 6th Floor – North Façade	50	43
2	16.5	POW – 6th Floor – West Façade	59	51
3	16.5	POW – 6th Floor – South Façade	73	65
4	16.5	POW – 6th Floor – East Façade	74	66
5	5.5	OLA – Green Roof (East)	71	N/A*
6	1.5	OLA – Amenity Patio (East)	74	N/A*

*The OLA noise levels are not considered during the nighttime as per ENCG.

The results of the current analysis indicate that noise levels will range between 50 and 74 dBA during the daytime period (07:00-23:00) and between 43 and 66 dBA during the nighttime period (23:00-07:00). The highest noise levels (73 and 74 dBA) occur along the south and east façade of the study building which is nearest and most exposed to Highway 174, the dominant source of transportation noise.

The outdoor living areas (OLA) (green roof and at-grade amenity patio) exceed the ENCG requirements. A barrier study was conducted using STAMSON for these areas.

5.2 Noise Control Measures

The noise levels predicted due to road traffic exceed the criteria listed in the ENCG 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). 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 7):

- **Bedroom Windows / Spandrel panels**

(i) Bedroom windows facing south and east of the building will require a minimum STC of 37

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

- **Living Room Windows / Spandrel panels**

(i) Living room windows facing south and east of the building will require a minimum STC of 32

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

- **Exterior Walls**

(i) Exterior wall components facing east, south or west on Tower B and Podium require a minimum STC of 45 which will be achieved with brick cladding or an acoustical equivalent according to NRC test data[12]

The STC requirements for windows would 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. Several manufacturers and various combinations of window components can provide 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. 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

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

to ventilation requirements, Warning Clauses will also be required to be placed on all Lease, Purchase and Sale Agreements, as summarized in Section 6.

5.2.1 Noise Barrier Calculations

Noise levels calculated using STAMSON at the green roof (Receptor 5) and the amenity patio (Receptor 6) exceed the ENCG criteria for outdoor living areas. Gradient Wind investigated mitigation options using the STAMSON barrier study.

Our investigations showed that the sound levels cannot be lowered to or below 60 dBA, even with a 3-metre-high barrier (see Table 4). Therefore, we recommend not using the green roof or at-grade patio for the quiet enjoyment of the outdoors. Alternatively, moving the patio to the northwest of the building could minimize the impacts on the area because the surrounding buildings will shield the area from the highway.

If the area is designated as an outdoor living area, a Type B warning clause will be required in all Lease, Purchase and Sale Agreements, as summarized in Section 6. Table 5 summarizes the results of the barrier investigation at 1.5, 2, 2.5 and 3 metres above the walking surface of the green roof and amenity patio.

TABLE 4: RESULTS OF NOISE BARRIER INVESTIGATION

Receptor ID	Above Grade Receptor Height (m)	Receptor Location	Barrier Height Above Walking Surface (m)	Daytime L_{eq} Noise Levels (dBA)	
				Without Barrier	With Barrier
R5	5.5	OLA – Green Roof (East)	1.5	71	66
			2.0		65
			2.5		63
			3.0		61
R6	1.5	OLA – Amenity Patio (East)	1.5	74	69
			2.0		68
			2.5		65
			3.0		63

5.3 Ground Vibrations & Ground-borne Noise Levels

Based on an offset distance of 24 meters between the railway centerline and the property line, the estimated vibration levels at the property line are expected to be 0.035 mm/s RMS (63 dBV) as per the FTA protocol. Details of the calculation are provided in Appendix B. Since predicted vibration levels do not exceed the criterion of 0.14 mm/s RMS at the property line, vibration mitigation will not be required.

According to the United States Federal Transit Authority's vibration assessment protocol, ground-borne noise can be estimated by subtracting 35 dB from the velocity vibration level in dBV. Since measured vibration levels were found to be 63 dBV, ground-borne noise levels are expected to be 28 dBA. This is below the ground-borne noise criteria of 35 dBA.

6. CONCLUSIONS AND RECOMMENDATIONS

The results of the current analysis indicate that noise levels will range between 50 and 74 dBA during the daytime period (07:00-23:00) and between 43 and 66 dBA during the nighttime period (23:00-07:00). The highest noise levels (73 and 74 dBA) occur along the south and east façade of the study building which is nearest and most exposed to Highway 174, the dominant source of transportation noise.

The 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, the following 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."*

In addition, the Rail Construction Program Office recommends that the warning clause identified below be included in all agreements of purchase and sale and lease agreements for the proposed development including those prepared prior to the registration of the Site Plan Agreement:

"The Owner hereby acknowledges and agrees:

i) The proximity of the proposed development of the lands described in Schedule "A" hereto (the "Lands") to the City's existing and future transit operations, may result in noise, vibration, electromagnetic interferences, stray current transmissions, smoke and particulate matter (collectively referred to as "Interferences") to the development;

ii) It has been advised by the City to apply reasonable attenuation measures with respect to the level of the Interferences on and within the Lands and the proposed development; and

iii) The Owner acknowledges and agrees all agreements of purchase and sale and lease agreements, and all information on all plans and documents used for marketing purposes, for the whole or any part of the subject lands, shall contain the following clauses which shall also be incorporated in all transfer/deeds and leases from the Owner so that the clauses shall be covenants running with the lands for the benefit of the owner of the adjacent road:

'The Transferee/Lessee for himself, his heirs, executors, administrators, successors and assigns acknowledges being advised that a public transit light-rail rapid transit system (LRT) is proposed to be located in proximity to the subject lands, and the construction, operation and maintenance of the LRT may result in environmental impacts including, but not limited to noise, vibration, electromagnetic interferences, stray current transmissions, smoke and particulate matter (collectively referred to as the Interferences) to the subject lands. The Transferee/Lessee acknowledges and agrees that despite the inclusion of noise control features within the subject lands, Interferences may continue to be of concern, occasionally interfering with some activities of the occupants on the subject lands.

The Transferee covenants with the Transferor and the Lessee covenants with the Lessor that the above clauses verbatim shall be included in all subsequent lease agreements, agreements of purchase and sale and deeds conveying the lands described herein,

which covenants shall run with the lands and are for the benefit of the owner of the adjacent road.'"

Noise levels at the green roof (Receptor 5) and the amenity patio (Receptor 6) exceed the ENCG criteria for outdoor living areas. Therefore, a noise barrier study was conducted. Our investigations showed that the sound levels cannot be lowered to or below 60 dBA even with a 3-metre-high barrier (see Table 4). Therefore, we recommend not using the green roof or at-grade patio for the quiet enjoyment of the outdoors. Alternatively, moving the patio to the northwest of the building could minimize the impacts on the area because the surrounding buildings will shield the area from the highway. If the area is designated as an outdoor living area the following warning clause will be required in 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."

Vibration levels due to railway activity in the area are expected to fall below the criterion of 0.14 mm/s and the ground-bourne noise level to be below 35 dBA criterion at the property line. As a result, mitigation for vibrations is not required.

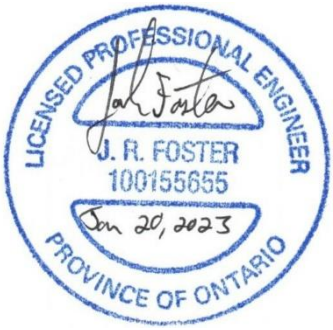
With regard to stationary noise impacts, the site is surrounded by low- to mid-rise residential buildings. There is no significant rooftop equipment close to the study site and the future LRT stations are at a sufficient distance to be considered insignificant in terms of noise levels produced Therefore, any noise impact on the development site from the station is not anticipated.

For off-site impacts from the proposed building onto the surroundings, the stationary noise levels can be reduced by judicious selection and placement of the mechanical equipment or the incorporation of silencers and noise screens as necessary. It is recommended that any large pieces of HVAC equipment be placed in the middle of the roof, avoiding the line of site with the surrounding residential dwellings. Therefore, we anticipate that noise levels compliant with ENCG and NPC-300 limits can be achieved with prudent planning of the mechanical areas and equipment. The final selection of the mechanical equipment should be reviewed by a qualified acoustic engineer prior to the installation of the equipment.

This concludes our traffic noise 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,

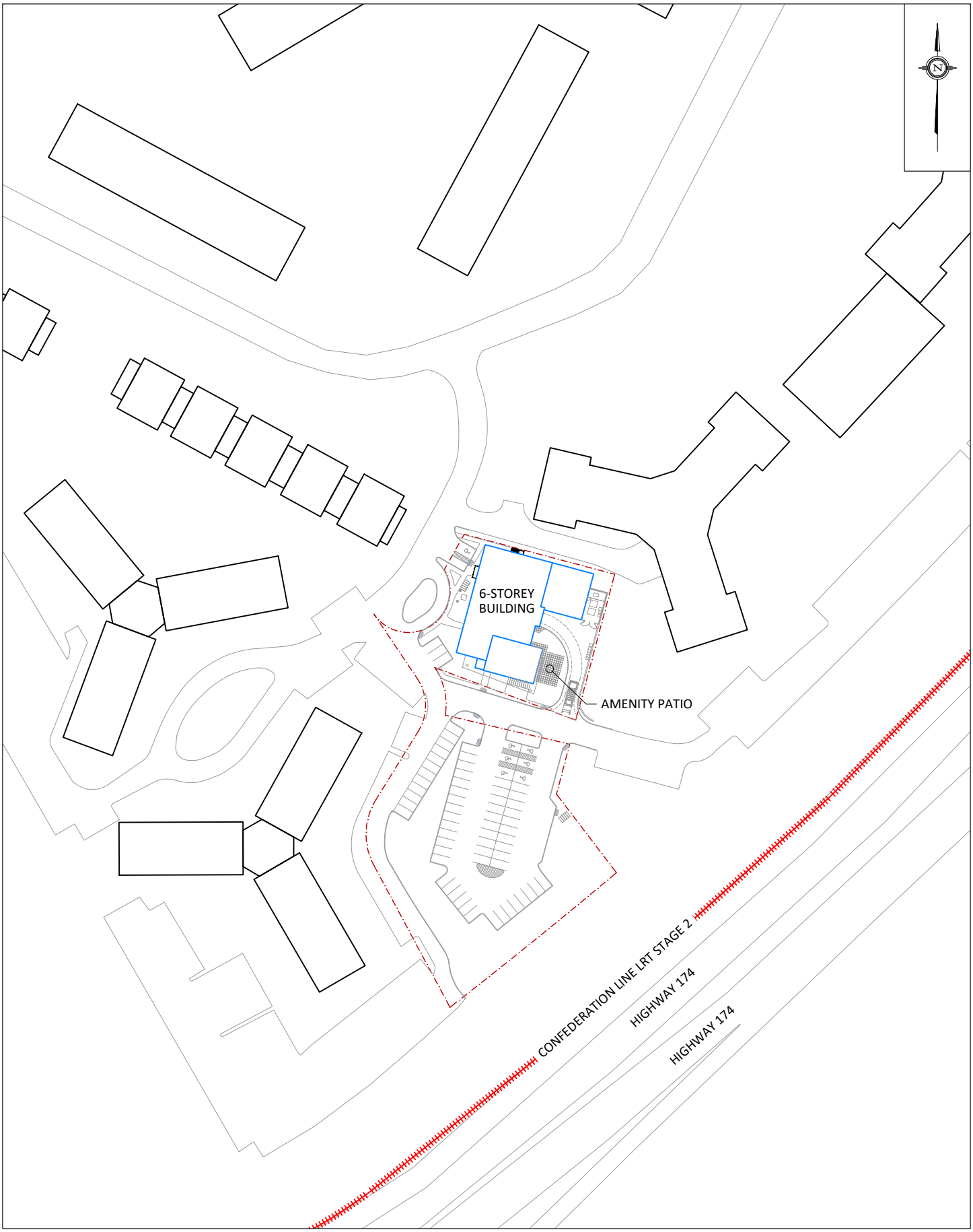
Gradient Wind Engineering Inc.



Efser Kara, MSc, LEED GA
Acoustic Scientist

Joshua Foster, P.Eng.
Lead Engineer

Gradient Wind File #22-359 – Noise & Vibration



GRADIENTWIND
ENGINEERS & SCIENTISTS

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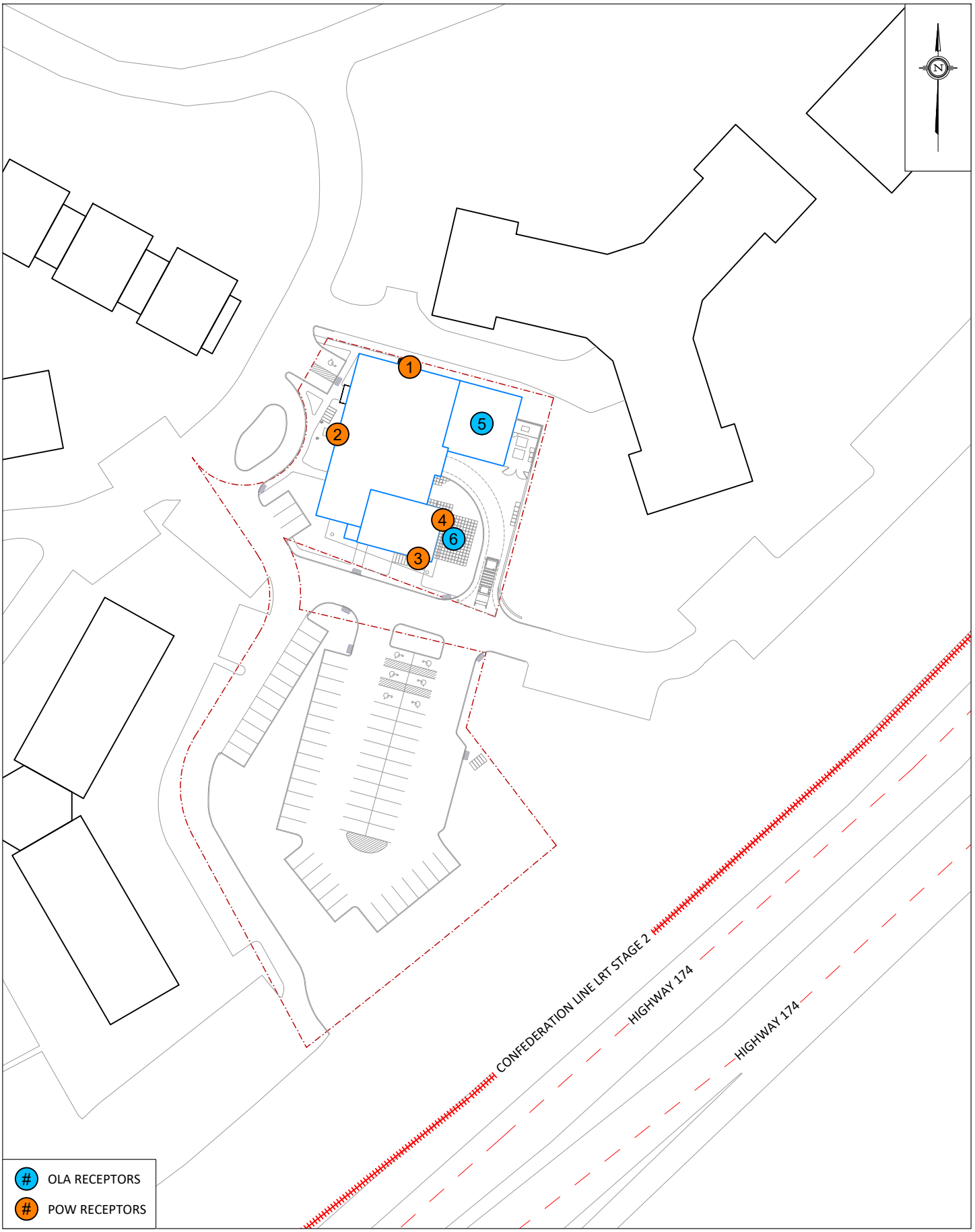
PROJECT	2040 ARROWSMITH DRIVE, OTTAWA TRANSPORTATION NOISE & VIBRATION ASSESSMENT		DESCRIPTION
SCALE	1:1500 (APPROX.)	DRAWING NO.	22-359- 1
DATE	JANUARY 5, 2023	DRAWN BY	E.K.

FIGURE 1:
SITE PLAN AND SURROUNDING CONTEXT



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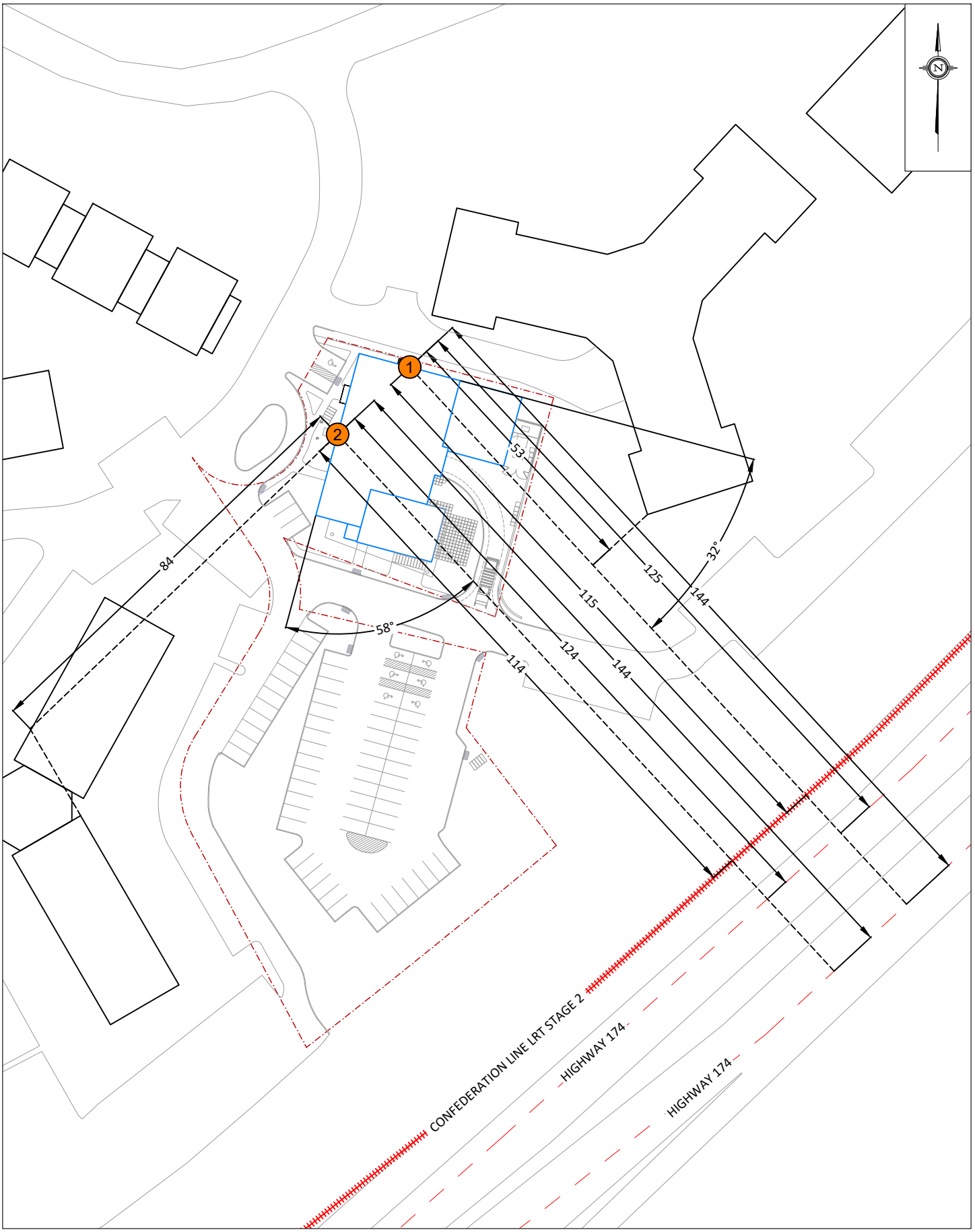
PROJECT	2040 ARROWSMITH DRIVE, OTTAWA TRANSPORTATION NOISE & VIBRATION ASSESSMENT		
SCALE	1:1000 (APPROX.)	DRAWING NO.	22-359- 2
DATE	JANUARY 5, 2023	DRAWN BY	E.K.

DESCRIPTION

FIGURE 2:
RECEPTOR LOCATIONS



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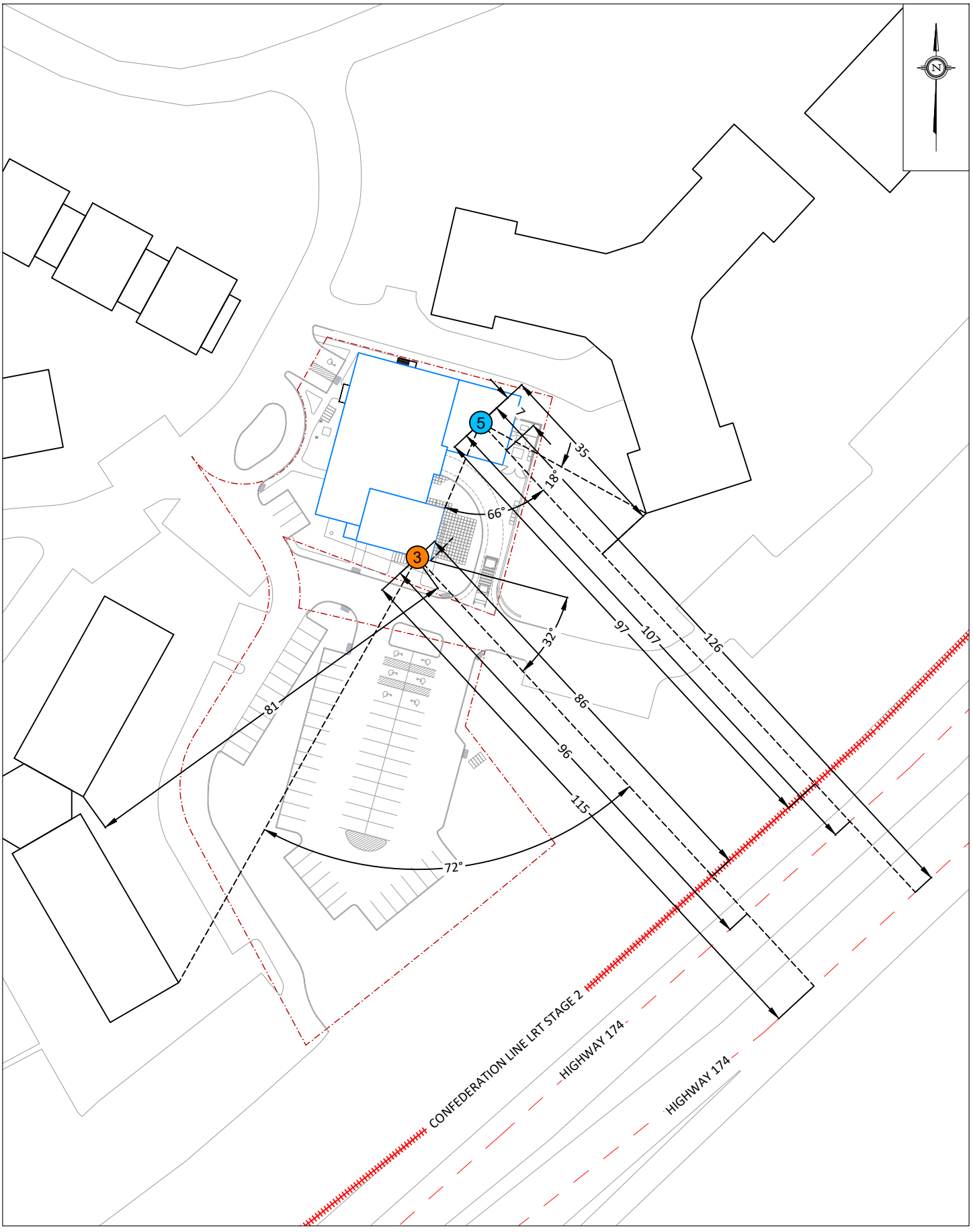
PROJECT	2040 ARROWSMITH DRIVE, OTTAWA TRANSPORTATION NOISE & VIBRATION ASSESSMENT		
SCALE	1:1000 (APPROX.)	DRAWING NO.	22-359- 3
DATE	JANUARY 5, 2023	DRAWN BY	E.K.

DESCRIPTION

FIGURE 3:
STAMSON INPUT DATA FOR
RECEPTORS 1 & 2



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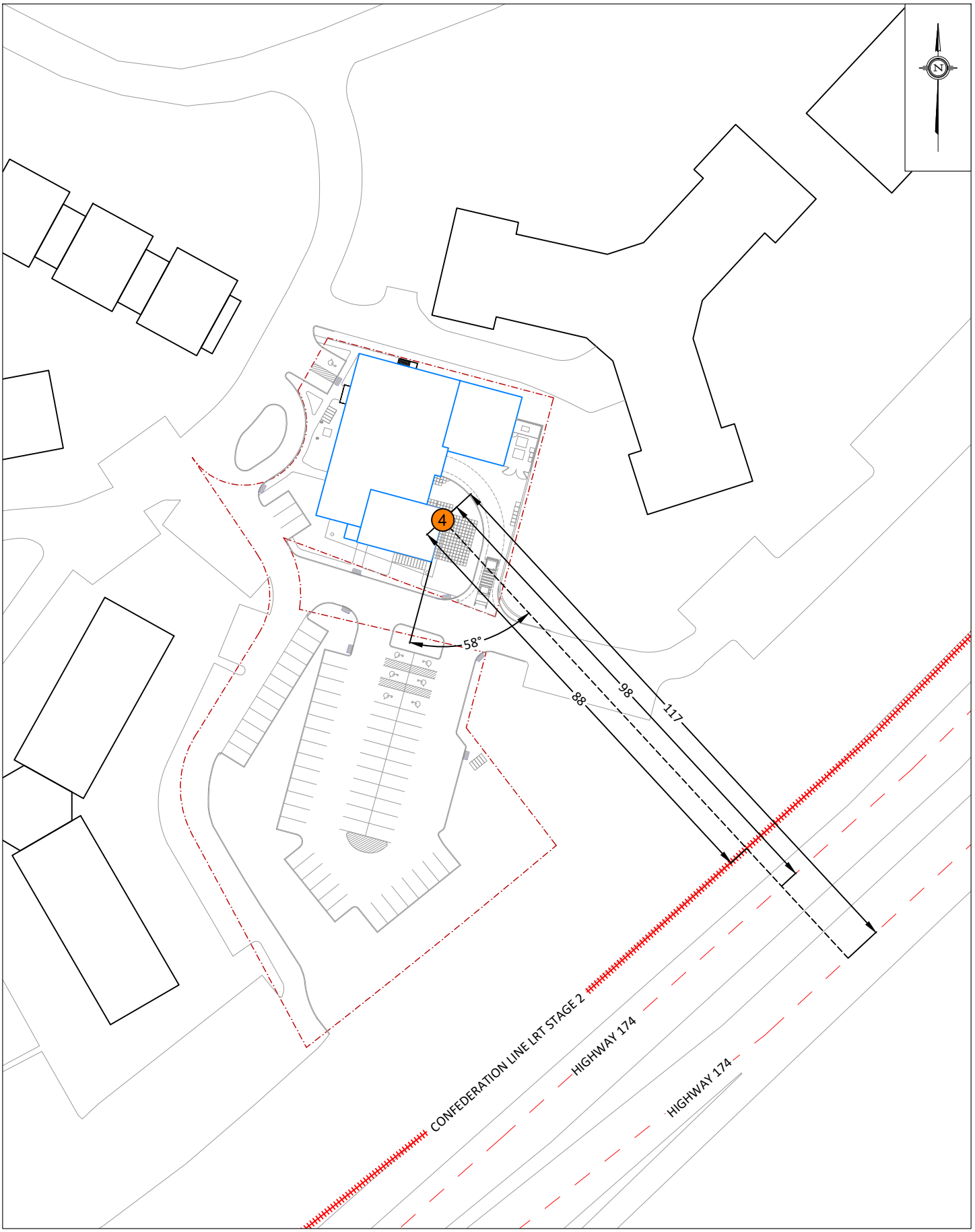
PROJECT	2040 ARROWSMITH DRIVE, OTTAWA TRANSPORTATION NOISE & VIBRATION ASSESSMENT		
SCALE	1:1000 (APPROX.)	DRAWING NO.	22-359- 4
DATE	JANUARY 5, 2023	DRAWN BY	E.K.

DESCRIPTION

FIGURE 4:
STAMSON INPUT DATA FOR
RECEPTORS 3 & 5



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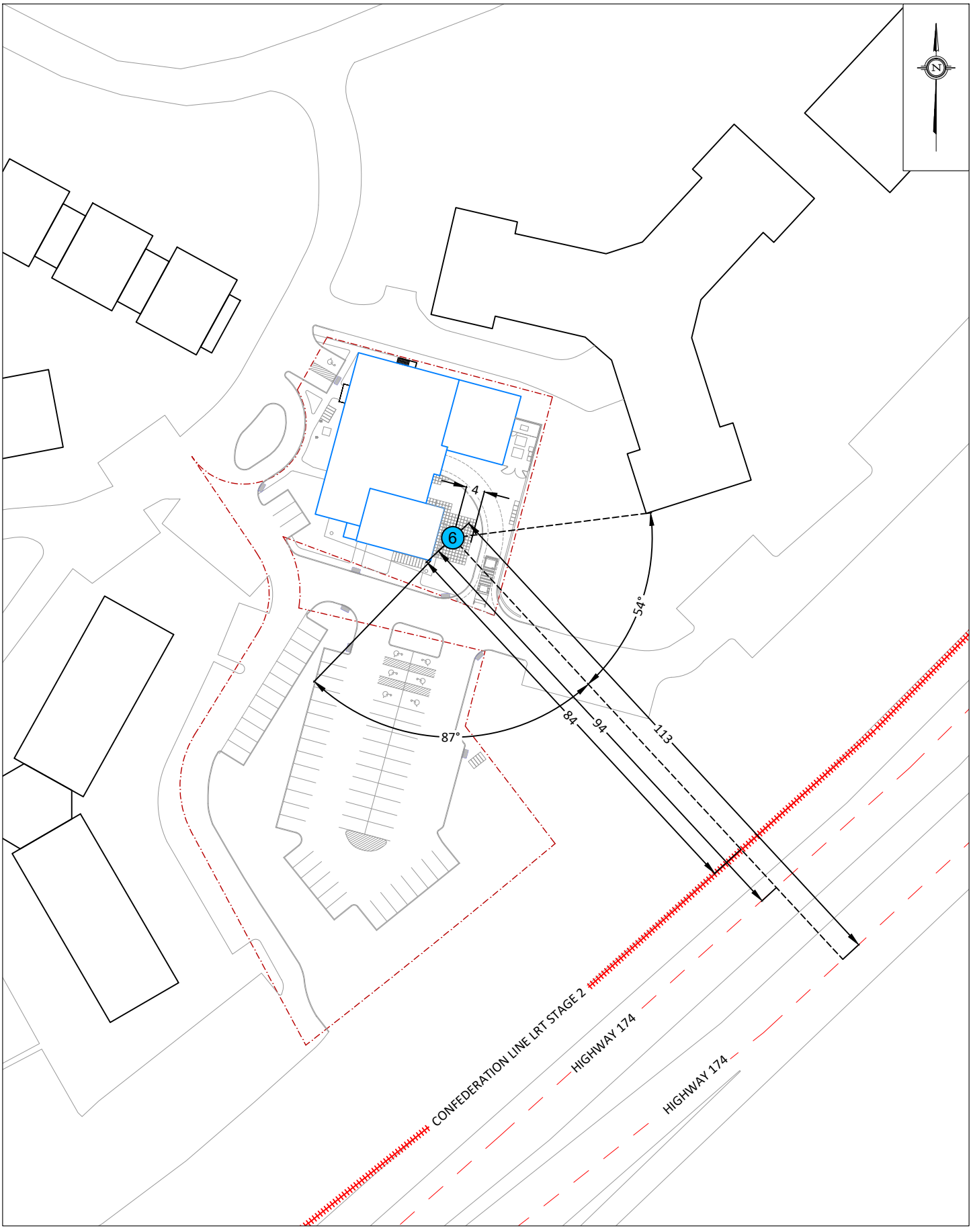
PROJECT	2040 ARROWSMITH DRIVE, OTTAWA TRANSPORTATION NOISE & VIBRATION ASSESSMENT		
SCALE	1:1000 (APPROX.)	DRAWING NO.	22-359- 5
DATE	JANUARY 5, 2023	DRAWN BY	E.K.

DESCRIPTION

FIGURE 5:
STAMSON INPUT DATA FOR
RECEPTORS 4



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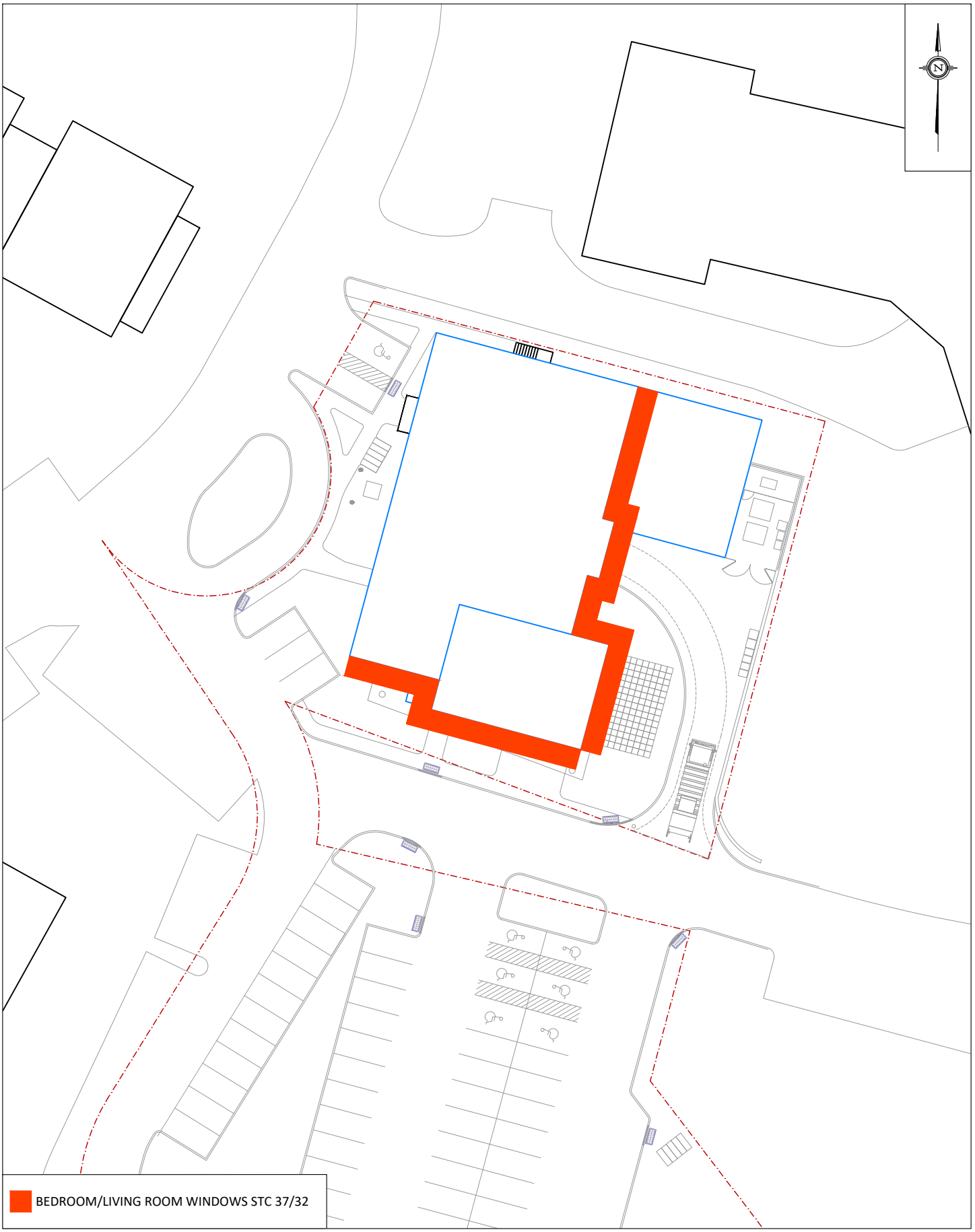
PROJECT	2040 ARROWSMITH DRIVE, OTTAWA TRANSPORTATION NOISE & VIBRATION ASSESSMENT		DESCRIPTION
SCALE	1:1000 (APPROX.)	DRAWING NO.	22-359- 6
DATE	JANUARY 5, 2023	DRAWN BY	E.K.

FIGURE 6:
STAMSON INPUT DATA FOR
RECEPTORS 6



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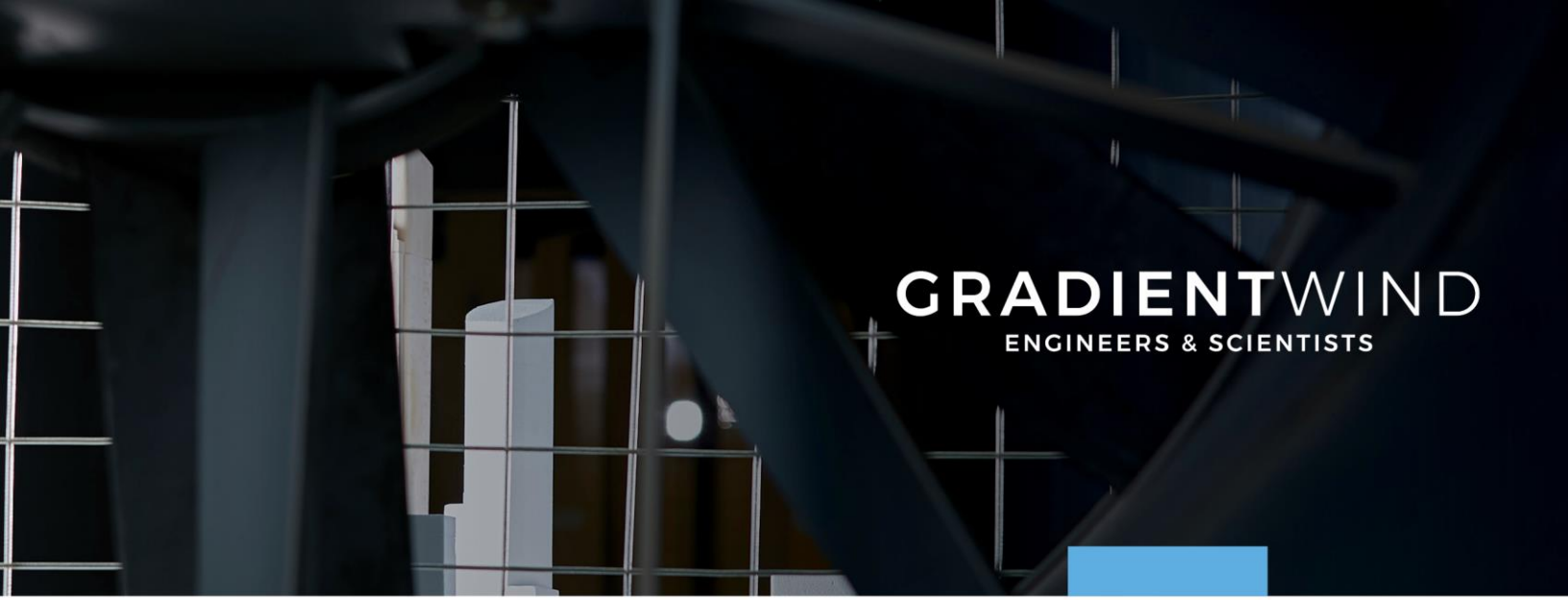
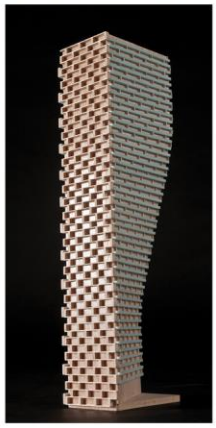
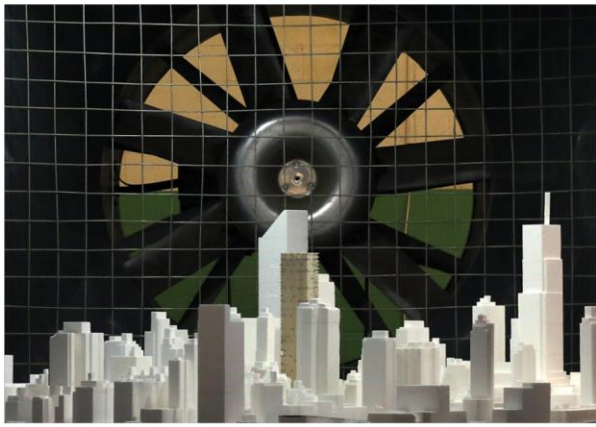
PROJECT	2040 ARROWSMITH DRIVE, OTTAWA TRANSPORTATION NOISE & VIBRATION ASSESSMENT		DESCRIPTION
SCALE	1:1000 (APPROX.)	DRAWING NO.	22-359- 7
DATE	JANUARY 5, 2023	DRAWN BY	E.K.

FIGURE 7:
STC REQUIREMENTS







APPENDIX A

STAMSON 5.04 – INPUT AND OUTPUT DATA

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STAMSON 5.0 NORMAL REPORT Date: 03-01-2023 15:52:50
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r01.te Time Period: Day/Night 16/8 hours
Description:

Road data, segment # 1: Highway174WB (day/night)

Car traffic volume : 44528/3872 veh/TimePeriod *
Medium truck volume : 3542/308 veh/TimePeriod *
Heavy truck volume : 2530/220 veh/TimePeriod *
Posted speed limit : 100 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): 55000
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: Highway174WB (day/night)

Angle1 Angle2 : -90.00 deg -32.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 125.00 / 125.00 m
Receiver height : 16.50 / 16.50 m
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : -90.00 deg Angle2 : -32.00 deg
Barrier height : 38.00 m
Barrier receiver distance : 53.00 / 53.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00

Road data, segment # 2: Highway174EB (day/night)

Car traffic volume : 44528/3872 veh/TimePeriod *
Medium truck volume : 3542/308 veh/TimePeriod *
Heavy truck volume : 2530/220 veh/TimePeriod *
Posted speed limit : 100 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): 55000
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: Highway174EB (day/night)

Angle1 Angle2 : -90.00 deg -32.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 144.00 / 144.00 m
Receiver height : 16.50 / 16.50 m
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : -90.00 deg Angle2 : -32.00 deg
Barrier height : 38.00 m
Barrier receiver distance : 53.00 / 53.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00

Results segment # 1: Highway174WB (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 ! 16.50 ! 10.14 ! 10.14

ROAD (0.00 + 47.50 + 0.00) = 47.50 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 -32 0.00 80.15 0.00 -9.21 -4.92 0.00 0.00 -18.52 47.50

Segment Leq : 47.50 dBA

Results segment # 2: Highway174EB (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 ! 16.50 ! 10.98 ! 10.98

ROAD (0.00 + 47.07 + 0.00) = 47.07 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 -32 0.00 80.15 0.00 -9.82 -4.92 0.00 0.00 -18.33 47.07

Segment Leq : 47.07 dBA

Total Leq All Segments: 50.30 dBA

Results segment # 1: Highway174WB (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 ! 16.50 ! 10.14 ! 10.14

ROAD (0.00 + 39.91 + 0.00) = 39.91 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 -32 0.00 72.55 0.00 -9.21 -4.92 0.00 0.00 -18.52 39.91

Segment Leq : 39.91 dBA

Results segment # 2: Highway174EB (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 ! 16.50 ! 10.98 ! 10.98

ROAD (0.00 + 39.48 + 0.00) = 39.48 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 -32 0.00 72.55 0.00 -9.82 -4.92 0.00 0.00 -18.33 39.48

Segment Leq : 39.48 dBA

Total Leq All Segments: 42.71 dBA

RT/Custom data, segment # 1: LRT Phase 2 (day/night)
---
1 - 4-car SRT:
Traffic volume : 540/60 veh/TimePeriod
Speed : 70 km/h

Data for Segment # 1: LRT Phase 2 (day/night)

Angle1 Angle2 : -90.00 deg -32.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 115.00 / 115.00 m
Receiver height : 16.50 / 16.50 m
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : -90.00 deg Angle2 : -32.00 deg
Barrier height : 38.00 m
Barrier receiver distance : 53.00 / 53.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00

Results segment # 1: LRT Phase 2 (day)

Source height = 0.50 m

Barrier height for grazing incidence

Source ! Receiver ! Barrier ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)

0.50 ! 16.50 ! 9.13 ! 9.13

RT/Custom (0.00 + 31.01 + 0.00) = 31.01 dBA
Angle1 Angle2 Alpha RefLeq D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 -32 0.00 63.44 -8.85 -4.92 0.00 0.00 -18.66 31.01

Segment Leq : 31.01 dBA

Total Leq All Segments: 31.01 dBA

Results segment # 1: LRT Phase 2 (night)

Source height = 0.50 m

Barrier height for grazing incidence

Source ! Receiver ! Barrier ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
---+---+---+---
0.50 ! 16.50 ! 9.13 ! 9.13

RT/Custom (0.00 + 24.48 + 0.00) = 24.48 dBA
Angle1 Angle2 Alpha RefLeq D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 -32 0.00 56.91 -8.85 -4.92 0.00 0.00 -18.66 24.48

Segment Leq : 24.48 dBA

Total Leq All Segments: 24.48 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 50.35
(NIGHT): 42.78

STAMSON 5.0 NORMAL REPORT Date: 03-01-2023 16:06:26
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r02.te Time Period: Day/Night 16/8 hours
Description:

Road data, segment # 1: Highway174WB (day/night)

Car traffic volume : 44528/3872 veh/TimePeriod *
Medium truck volume : 3542/308 veh/TimePeriod *
Heavy truck volume : 2530/220 veh/TimePeriod *
Posted speed limit : 100 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): 55000
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: Highway174WB (day/night)

Angle1 Angle2 : 58.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 124.00 / 124.00 m
Receiver height : 16.50 / 16.50 m
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : 58.00 deg Angle2 : 90.00 deg
Barrier height : 11.00 m
Barrier receiver distance : 84.00 / 84.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00

Road data, segment # 2: Highway174EB (day/night)

Car traffic volume : 44528/3872 veh/TimePeriod *
Medium truck volume : 3542/308 veh/TimePeriod *
Heavy truck volume : 2530/220 veh/TimePeriod *
Posted speed limit : 100 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): 55000
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: Highway174EB (day/night)

Angle1 Angle2 : 58.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 144.00 / 144.00 m
Receiver height : 16.50 / 16.50 m
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : 58.00 deg Angle2 : 90.00 deg
Barrier height : 11.00 m
Barrier receiver distance : 84.00 / 84.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00

Results segment # 1: Highway174WB (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 ! 16.50 ! 6.34 ! 6.34

ROAD (0.00 + 55.14 + 0.00) = 55.14 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
58 90 0.00 80.15 0.00 -9.17 -7.50 0.00 0.00 -8.34 55.14

Segment Leq : 55.14 dBA

Results segment # 2: Highway174EB (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 ! 16.50 ! 7.75 ! 7.75

ROAD (0.00 + 56.16 + 0.00) = 56.16 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
58 90 0.00 80.15 0.00 -9.82 -7.50 0.00 0.00 -6.67 56.16

Segment Leq : 56.16 dBA

Total Leq All Segments: 58.69 dBA

Results segment # 1: Highway174WB (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 ! 16.50 ! 6.34 ! 6.34

ROAD (0.00 + 47.54 + 0.00) = 47.54 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
58 90 0.00 72.55 0.00 -9.17 -7.50 0.00 0.00 -8.34 47.54

Segment Leq : 47.54 dBA

Results segment # 2: Highway174EB (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 ! 16.50 ! 7.75 ! 7.75

ROAD (0.00 + 48.56 + 0.00) = 48.56 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
58 90 0.00 72.55 0.00 -9.82 -7.50 0.00 0.00 -6.67 48.56

Segment Leq : 48.56 dBA

Total Leq All Segments: 51.09 dBA

RT/Custom data, segment # 1: LRT Phase 2 (day/night)
---
1 - 4-car SRT:
Traffic volume : 540/60 veh/TimePeriod
Speed : 70 km/h

Data for Segment # 1: LRT Phase 2 (day/night)

Angle1 Angle2 : 58.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 114.00 / 114.00 m
Receiver height : 16.50 / 16.50 m
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : 58.00 deg Angle2 : 90.00 deg
Barrier height : 11.00 m
Barrier receiver distance : 84.00 / 84.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00

Results segment # 1: LRT Phase 2 (day)

Source height = 0.50 m

Barrier height for grazing incidence

Source ! Receiver ! Barrier ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
---+---+---+---
0.50 ! 16.50 ! 4.71 ! 4.71

RT/Custom (0.00 + 36.91 + 0.00) = 36.91 dBA
Angle1 Angle2 Alpha RefLeq D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
58 90 0.00 63.44 -8.81 -7.50 0.00 0.00 -10.22 36.91

Segment Leq : 36.91 dBA

Total Leq All Segments: 36.91 dBA

Results segment # 1: LRT Phase 2 (night)

Source height = 0.50 m

Barrier height for grazing incidence

Source ! Receiver ! Barrier ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
---+---+---+---
0.50 ! 16.50 ! 4.71 ! 4.71

RT/Custom (0.00 + 30.37 + 0.00) = 30.37 dBA
Angle1 Angle2 Alpha RefLeq D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
58 90 0.00 56.91 -8.81 -7.50 0.00 0.00 -10.22 30.37

Segment Leq : 30.37 dBA

Total Leq All Segments: 30.37 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 58.72
(NIGHT): 51.13

STAMSON 5.0 NORMAL REPORT Date: 03-01-2023 16:12:36
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r03.te Time Period: Day/Night 16/8 hours
Description:

Road data, segment # 1: Highway174WB (day/night)

Car traffic volume : 44528/3872 veh/TimePeriod *
Medium truck volume : 3542/308 veh/TimePeriod *
Heavy truck volume : 2530/220 veh/TimePeriod *
Posted speed limit : 100 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): 55000
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: Highway174WB (day/night)

Angle1 Angle2 : -32.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 96.00 / 96.00 m
Receiver height : 16.50 / 16.50 m
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : 72.00 deg Angle2 : 90.00 deg
Barrier height : 11.00 m
Barrier receiver distance : 81.00 / 81.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00

Road data, segment # 2: Highway174EB (day/night)

Car traffic volume : 44528/3872 veh/TimePeriod *
Medium truck volume : 3542/308 veh/TimePeriod *
Heavy truck volume : 2530/220 veh/TimePeriod *
Posted speed limit : 100 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): 55000
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: Highway174EB (day/night)

Angle1 Angle2 : -32.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 115.00 / 115.00 m
Receiver height : 16.50 / 16.50 m
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : 72.00 deg Angle2 : 90.00 deg
Barrier height : 11.00 m
Barrier receiver distance : 81.00 / 81.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00

Results segment # 1: Highway174WB (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 ! 16.50 ! 3.84 ! 3.84

ROAD (69.70 + 51.38 + 0.00) = 69.77 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-32 72 0.00 80.15 0.00 -8.06 -2.38 0.00 0.00 0.00 69.70
---
72 90 0.00 80.15 0.00 -8.06 -10.00 0.00 0.00 -10.70 51.38

Segment Leq : 69.77 dBA

Results segment # 2: Highway174EB (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 ! 16.50 ! 5.93 ! 5.93

ROAD (68.92 + 53.53 + 0.00) = 69.04 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-32 72 0.00 80.15 0.00 -8.85 -2.38 0.00 0.00 0.00 68.92
---
72 90 0.00 80.15 0.00 -8.85 -10.00 0.00 0.00 -7.77 53.53

Segment Leq : 69.04 dBA

Total Leq All Segments: 72.43 dBA

Results segment # 1: Highway174WB (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 ! 16.50 ! 3.84 ! 3.84

ROAD (62.11 + 43.79 + 0.00) = 62.17 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-32 72 0.00 72.55 0.00 -8.06 -2.38 0.00 0.00 0.00 62.11
---
72 90 0.00 72.55 0.00 -8.06 -10.00 0.00 0.00 -10.70 43.79

Segment Leq : 62.17 dBA

Results segment # 2: Highway174EB (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 ! 16.50 ! 5.93 ! 5.93

ROAD (61.32 + 45.94 + 0.00) = 61.45 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-32 72 0.00 72.55 0.00 -8.85 -2.38 0.00 0.00 0.00 61.32
---
72 90 0.00 72.55 0.00 -8.85 -10.00 0.00 0.00 -7.77 45.94

Segment Leq : 61.45 dBA

Total Leq All Segments: 64.84 dBA

RT/Custom data, segment # 1: LRT Phase 2 (day/night)
---
1 - 4-car SRT:
Traffic volume : 540/60 veh/TimePeriod
Speed : 70 km/h

Data for Segment # 1: LRT Phase 2 (day/night)

Angle1 Angle2 : -32.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 86.00 / 86.00 m
Receiver height : 16.50 / 16.50 m
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : 72.00 deg Angle2 : 90.00 deg
Barrier height : 11.00 m
Barrier receiver distance : 81.00 / 81.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00

Results segment # 1: LRT Phase 2 (day)

Source height = 0.50 m

Barrier height for grazing incidence

Source ! Receiver ! Barrier ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)

0.50 ! 16.50 ! 1.43 ! 1.43

RT/Custom (53.47 + 31.83 + 0.00) = 53.50 dBA
Angle1 Angle2 Alpha RefLeq D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-32 72 0.00 63.44 -7.58 -2.38 0.00 0.00 0.00 53.47
---
72 90 0.00 63.44 -7.58 -10.00 0.00 0.00 -14.02 31.83

Segment Leq : 53.50 dBA
Total Leq All Segments: 53.50 dBA

Results segment # 1: LRT Phase 2 (night)

Source height = 0.50 m

Barrier height for grazing incidence

Source ! Receiver ! Barrier ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
---+---+---+---
0.50 ! 16.50 ! 1.43 ! 1.43

RT/Custom (46.94 + 25.30 + 0.00) = 46.97 dBA
Angle1 Angle2 Alpha RefLeq D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-32 72 0.00 56.91 -7.58 -2.38 0.00 0.00 0.00 46.94
---
72 90 0.00 56.91 -7.58 -10.00 0.00 0.00 -14.02 25.30

Segment Leq : 46.97 dBA

Total Leq All Segments: 46.97 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 72.49
(NIGHT): 64.91

STAMSON 5.0 NORMAL REPORT Date: 03-01-2023 16:22:48
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r04.te Time Period: Day/Night 16/8 hours
Description:

Road data, segment # 1: Highway174WB (day/night)

Car traffic volume : 44528/3872 veh/TimePeriod *
Medium truck volume : 3542/308 veh/TimePeriod *
Heavy truck volume : 2530/220 veh/TimePeriod *
Posted speed limit : 100 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): 55000
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: Highway174WB (day/night)

Angle1 Angle2 : -90.00 deg 58.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 98.00 / 98.00 m
Receiver height : 16.50 / 16.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

Road data, segment # 2: Highway174EB (day/night)

Car traffic volume : 44528/3872 veh/TimePeriod *
Medium truck volume : 3542/308 veh/TimePeriod *
Heavy truck volume : 2530/220 veh/TimePeriod *
Posted speed limit : 100 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): 55000
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: Highway174EB (day/night)

Angle1 Angle2 : -90.00 deg 58.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 117.00 / 117.00 m
Receiver height : 16.50 / 16.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

Results segment # 1: Highway174WB (day)

Source height = 1.50 m

ROAD (0.00 + 71.15 + 0.00) = 71.15 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 58 0.00 80.15 0.00 -8.15 -0.85 0.00 0.00 0.00 71.15

Segment Leq : 71.15 dBA

Results segment # 2: Highway174EB (day)

Source height = 1.50 m

ROAD (0.00 + 70.38 + 0.00) = 70.38 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 58 0.00 80.15 0.00 -8.92 -0.85 0.00 0.00 0.00 70.38

Segment Leq : 70.38 dBA

Total Leq All Segments: 73.79 dBA

Results segment # 1: Highway174WB (night)

Source height = 1.50 m

ROAD (0.00 + 63.55 + 0.00) = 63.55 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 58 0.00 72.55 0.00 -8.15 -0.85 0.00 0.00 0.00 63.55

Segment Leq : 63.55 dBA

Results segment # 2: Highway174EB (night)

Source height = 1.50 m

ROAD (0.00 + 62.78 + 0.00) = 62.78 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	58	0.00	72.55	0.00	-8.92	-0.85	0.00	0.00	0.00	62.78

Segment Leq : 62.78 dBA

Total Leq All Segments: 66.19 dBA

RT/Custom data, segment # 1: LRT Phase 2 (day/night)
---
1 - 4-car SRT:
Traffic volume : 540/60 veh/TimePeriod
Speed : 70 km/h

Data for Segment # 1: LRT Phase 2 (day/night)

Angle1 Angle2 : -90.00 deg 58.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 88.00 / 88.00 m
Receiver height : 16.50 / 16.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

Results segment # 1: LRT Phase 2 (day)

Source height = 0.50 m

RT/Custom (0.00 + 54.90 + 0.00) = 54.90 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	58	0.00	63.44	-7.68	-0.85	0.00	0.00	0.00	54.90

Segment Leq : 54.90 dBA

Total Leq All Segments: 54.90 dBA

Results segment # 1: LRT Phase 2 (night)

Source height = 0.50 m

RT/Custom (0.00 + 48.37 + 0.00) = 48.37 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	58	0.00	56.91	-7.68	-0.85	0.00	0.00	0.00	48.37

Segment Leq : 48.37 dBA

Total Leq All Segments: 48.37 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 73.85
(NIGHT): 66.26

STAMSON 5.0 NORMAL REPORT Date: 03-01-2023 18:32:27
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r05.te Time Period: Day/Night 16/8 hours
Description:

Road data, segment # 1: Highway174WB (day/night)

Car traffic volume : 44528/3872 veh/TimePeriod *
Medium truck volume : 3542/308 veh/TimePeriod *
Heavy truck volume : 2530/220 veh/TimePeriod *
Posted speed limit : 100 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): 55000
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: Highway174WB (day/night)

Angle1 Angle2 : -18.00 deg 66.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 107.00 / 107.00 m
Receiver height : 5.50 / 5.50 m
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : -18.00 deg Angle2 : 66.00 deg
Barrier height : 4.00 m
Barrier receiver distance : 7.00 / 7.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00

Road data, segment # 2: Highway174EB (day/night)

Car traffic volume : 44528/3872 veh/TimePeriod *
Medium truck volume : 3542/308 veh/TimePeriod *
Heavy truck volume : 2530/220 veh/TimePeriod *
Posted speed limit : 100 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): 55000
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: Highway174EB (day/night)

Angle1 Angle2 : -18.00 deg 66.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 126.00 / 126.00 m
Receiver height : 5.50 / 5.50 m
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : -18.00 deg Angle2 : 66.00 deg
Barrier height : 4.00 m
Barrier receiver distance : 7.00 / 7.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00

Road data, segment # 3: HighwayWB_Ba (day/night)

Car traffic volume : 44528/3872 veh/TimePeriod *
Medium truck volume : 3542/308 veh/TimePeriod *
Heavy truck volume : 2530/220 veh/TimePeriod *
Posted speed limit : 100 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): 55000
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 # 3: HighwayWB_Ba (day/night)

Angle1 Angle2 : -90.00 deg -18.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 107.00 / 107.00 m
Receiver height : 5.50 / 5.50 m
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : -90.00 deg Angle2 : -18.00 deg
Barrier height : 38.00 m
Barrier receiver distance : 35.00 / 35.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00

Road data, segment # 4: HighwayEB_Ba (day/night)

Car traffic volume : 44528/3872 veh/TimePeriod *
Medium truck volume : 3542/308 veh/TimePeriod *
Heavy truck volume : 2530/220 veh/TimePeriod *
Posted speed limit : 100 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): 55000
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 # 4: HighwayEB_Ba (day/night)

Angle1 Angle2 : -90.00 deg -18.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 126.00 / 126.00 m
Receiver height : 5.50 / 5.50 m
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : -90.00 deg Angle2 : -18.00 deg
Barrier height : 38.00 m
Barrier receiver distance : 35.00 / 35.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00

Results segment # 1: Highway174WB (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 ! 5.50 ! 5.24 ! 5.24

ROAD (0.00 + 68.30 + 0.00) = 68.30 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-18 66 0.00 80.15 0.00 -8.53 -3.31 0.00 0.00 -0.11 68.20*
-18 66 0.00 80.15 0.00 -8.53 -3.31 0.00 0.00 0.00 68.30
---

* Bright Zone !

Segment Leq : 68.30 dBA

Results segment # 2: Highway174EB (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 ! 5.50 ! 5.28 ! 5.28

ROAD (0.00 + 67.59 + 0.00) = 67.59 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-18 66 0.00 80.15 0.00 -9.24 -3.31 0.00 0.00 -0.08 67.52*
-18 66 0.00 80.15 0.00 -9.24 -3.31 0.00 0.00 0.00 67.59
---

* Bright Zone !

Segment Leq : 67.59 dBA

Results segment # 3: HighwayWB_Ba (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 ! 5.50 ! 4.19 ! 4.19

ROAD (0.00 + 48.37 + 0.00) = 48.37 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 -18 0.00 80.15 0.00 -8.53 -3.98 0.00 0.00 -19.27 48.37

Segment Leq : 48.37 dBA

Results segment # 4: HighwayEB_Ba (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 ! 5.50 ! 4.39 ! 4.39

ROAD (0.00 + 47.72 + 0.00) = 47.72 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 -18 0.00 80.15 0.00 -9.24 -3.98 0.00 0.00 -19.21 47.72

Segment Leq : 47.72 dBA

Total Leq All Segments: 71.01 dBA

Results segment # 1: Highway174WB (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 ! 5.50 ! 5.24 ! 5.24

ROAD (0.00 + 60.71 + 0.00) = 60.71 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-18 66 0.00 72.55 0.00 -8.53 -3.31 0.00 0.00 -0.11 60.60*
-18 66 0.00 72.55 0.00 -8.53 -3.31 0.00 0.00 0.00 60.71
---

* Bright Zone !

Segment Leq : 60.71 dBA

Results segment # 2: Highway174EB (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 ! 5.50 ! 5.28 ! 5.28

ROAD (0.00 + 60.00 + 0.00) = 60.00 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-18 66 0.00 72.55 0.00 -9.24 -3.31 0.00 0.00 -0.08 59.92*
-18 66 0.00 72.55 0.00 -9.24 -3.31 0.00 0.00 0.00 60.00
---

* Bright Zone !

Segment Leq : 60.00 dBA

Results segment # 3: HighwayWB_Ba (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 ! 5.50 ! 4.19 ! 4.19

ROAD (0.00 + 40.77 + 0.00) = 40.77 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 -18 0.00 72.55 0.00 -8.53 -3.98 0.00 0.00 -19.27 40.77

Segment Leq : 40.77 dBA

Results segment # 4: HighwayEB_Ba (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 ! 5.50 ! 4.39 ! 4.39

ROAD (0.00 + 40.12 + 0.00) = 40.12 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 -18 0.00 72.55 0.00 -9.24 -3.98 0.00 0.00 -19.21 40.12

Segment Leq : 40.12 dBA

Total Leq All Segments: 63.42 dBA

RT/Custom data, segment # 1: LRT Phase 2 (day/night)
---
1 - 4-car SRT:
Traffic volume : 540/60 veh/TimePeriod
Speed : 70 km/h

Data for Segment # 1: LRT Phase 2 (day/night)

Angle1 Angle2 : -18.00 deg 66.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 97.00 / 97.00 m
Receiver height : 5.50 / 5.50 m
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : -18.00 deg Angle2 : 66.00 deg
Barrier height : 4.00 m
Barrier receiver distance : 7.00 / 7.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00

RT/Custom data, segment # 2: LRT-Barrier (day/night)
---
1 - 4-car SRT:
Traffic volume : 540/60 veh/TimePeriod
Speed : 70 km/h

Data for Segment # 2: LRT-Barrier (day/night)

Angle1 Angle2 : -90.00 deg -18.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 97.00 / 97.00 m
Receiver height : 5.50 / 5.50 m
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : -90.00 deg Angle2 : -18.00 deg
Barrier height : 38.00 m
Barrier receiver distance : 35.00 / 35.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00

Results segment # 1: LRT Phase 2 (day)

Source height = 0.50 m

Barrier height for grazing incidence

Source ! Receiver ! Barrier ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
---+---+---+---
0.50 ! 5.50 ! 5.14 ! 5.14

RT/Custom (0.00 + 52.02 + 0.00) = 52.02 dBA
Angle1 Angle2 Alpha RefLeq D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-18 66 0.00 63.44 -8.11 -3.31 0.00 0.00 -0.23 51.79*
-18 66 0.00 63.44 -8.11 -3.31 0.00 0.00 0.00 52.02
---

* Bright Zone !

Segment Leq : 52.02 dBA

Results segment # 2: LRT-Barrier (day)

Source height = 0.50 m

Barrier height for grazing incidence

Source ! Receiver ! Barrier ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
---+---+---+---
0.50 ! 5.50 ! 3.70 ! 3.70

RT/Custom (0.00 + 32.04 + 0.00) = 32.04 dBA
Angle1 Angle2 Alpha RefLeq D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 -18 0.00 63.44 -8.11 -3.98 0.00 0.00 -19.32 32.04

Segment Leq : 32.04 dBA

Total Leq All Segments: 52.06 dBA

Results segment # 1: LRT Phase 2 (night)

Source height = 0.50 m

Barrier height for grazing incidence

Source ! Receiver ! Barrier ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
---+---+---+---
0.50 ! 5.50 ! 5.14 ! 5.14

RT/Custom (0.00 + 45.49 + 0.00) = 45.49 dBA
Angle1 Angle2 Alpha RefLeq D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-18 66 0.00 56.91 -8.11 -3.31 0.00 0.00 -0.23 45.26*
-18 66 0.00 56.91 -8.11 -3.31 0.00 0.00 0.00 45.49
---

* Bright Zone !

Segment Leq : 45.49 dBA

Results segment # 2: LRT-Barrier (night)

Source height = 0.50 m

Barrier height for grazing incidence

Source ! Receiver ! Barrier ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
---+---+---+---
0.50 ! 5.50 ! 3.70 ! 3.70

RT/Custom (0.00 + 25.50 + 0.00) = 25.50 dBA
Angle1 Angle2 Alpha RefLeq D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 -18 0.00 56.91 -8.11 -3.98 0.00 0.00 -19.32 25.50

Segment Leq : 25.50 dBA

Total Leq All Segments: 45.53 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 71.07
(NIGHT): 63.49

STAMSON 5.0 NORMAL REPORT Date: 03-01-2023 18:36:26
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r05b.te Time Period: Day/Night 16/8 hours
Description:

Road data, segment # 1: Highway174WB (day/night)

Car traffic volume : 44528/3872 veh/TimePeriod *
Medium truck volume : 3542/308 veh/TimePeriod *
Heavy truck volume : 2530/220 veh/TimePeriod *
Posted speed limit : 100 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): 55000
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: Highway174WB (day/night)

Angle1 Angle2 : -18.00 deg 66.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 107.00 / 107.00 m
Receiver height : 5.50 / 5.50 m
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : -18.00 deg Angle2 : 66.00 deg
Barrier height : 4.00 m
Barrier receiver distance : 7.00 / 7.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00

Road data, segment # 2: Highway174EB (day/night)

Car traffic volume : 44528/3872 veh/TimePeriod *
Medium truck volume : 3542/308 veh/TimePeriod *
Heavy truck volume : 2530/220 veh/TimePeriod *
Posted speed limit : 100 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): 55000
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: Highway174EB (day/night)

Angle1 Angle2 : -18.00 deg 66.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 126.00 / 126.00 m
Receiver height : 5.50 / 5.50 m
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : -18.00 deg Angle2 : 66.00 deg
Barrier height : 4.00 m
Barrier receiver distance : 7.00 / 7.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00

Road data, segment # 3: HighwayWB_Ba (day/night)

Car traffic volume : 44528/3872 veh/TimePeriod *
Medium truck volume : 3542/308 veh/TimePeriod *
Heavy truck volume : 2530/220 veh/TimePeriod *
Posted speed limit : 100 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): 55000
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 # 3: HighwayWB_Ba (day/night)

Angle1 Angle2 : -90.00 deg -18.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 107.00 / 107.00 m
Receiver height : 5.50 / 5.50 m
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : -90.00 deg Angle2 : -18.00 deg
Barrier height : 38.00 m
Barrier receiver distance : 35.00 / 35.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00

Road data, segment # 4: HighwayEB_Ba (day/night)

Car traffic volume : 44528/3872 veh/TimePeriod *
Medium truck volume : 3542/308 veh/TimePeriod *
Heavy truck volume : 2530/220 veh/TimePeriod *
Posted speed limit : 100 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): 55000
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 # 4: HighwayEB_Ba (day/night)

Angle1 Angle2 : -90.00 deg -18.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 126.00 / 126.00 m
Receiver height : 5.50 / 5.50 m
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : -90.00 deg Angle2 : -18.00 deg
Barrier height : 38.00 m
Barrier receiver distance : 35.00 / 35.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00

Results segment # 1: Highway174WB (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 ! 5.50 ! 5.24 ! 5.24

ROAD (0.00 + 68.30 + 0.00) = 68.30 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-18 66 0.00 80.15 0.00 -8.53 -3.31 0.00 0.00 -0.11 68.20*
-18 66 0.00 80.15 0.00 -8.53 -3.31 0.00 0.00 0.00 68.30
---

* Bright Zone !

Segment Leq : 68.30 dBA

Results segment # 2: Highway174EB (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 ! 5.50 ! 5.28 ! 5.28

ROAD (0.00 + 67.59 + 0.00) = 67.59 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-18 66 0.00 80.15 0.00 -9.24 -3.31 0.00 0.00 -0.08 67.52*
-18 66 0.00 80.15 0.00 -9.24 -3.31 0.00 0.00 0.00 67.59
---

* Bright Zone !

Segment Leq : 67.59 dBA

Results segment # 3: HighwayWB_Ba (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 ! 5.50 ! 4.19 ! 4.19

ROAD (0.00 + 48.37 + 0.00) = 48.37 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 -18 0.00 80.15 0.00 -8.53 -3.98 0.00 0.00 -19.27 48.37

Segment Leq : 48.37 dBA

Results segment # 4: HighwayEB_Ba (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 ! 5.50 ! 4.39 ! 4.39

ROAD (0.00 + 47.72 + 0.00) = 47.72 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 -18 0.00 80.15 0.00 -9.24 -3.98 0.00 0.00 -19.21 47.72

Segment Leq : 47.72 dBA

Total Leq All Segments: 71.01 dBA

Barrier table for segment # 1: Highway174WB (day)

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
5.00	5.00	68.30	68.30
5.50	5.50	63.08	63.08
6.00	6.00	61.63	61.63
6.50	6.50	59.57	59.57
7.00	7.00	57.51	57.51

Barrier table for segment # 2: Highway174EB (day)

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
5.00	5.00	67.59	67.59
5.50	5.50	62.43	62.43
6.00	6.00	61.08	61.08
6.50	6.50	59.05	59.05
7.00	7.00	56.99	56.99

Barrier table for segment # 3: HighwayWB_Ba (day)

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
39.00	39.00	48.33	48.33
39.50	39.50	48.32	48.32
40.00	40.00	48.30	48.30
40.50	40.50	48.29	48.29
41.00	41.00	48.27	48.27

Barrier table for segment # 4: HighwayEB_Ba (day)

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
39.00	39.00	47.68	47.68
39.50	39.50	47.66	47.66
40.00	40.00	47.64	47.64
40.50	40.50	47.63	47.63
41.00	41.00	47.61	47.61

Results segment # 1: Highway174WB (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 ! 5.50 ! 5.24 ! 5.24

ROAD (0.00 + 60.71 + 0.00) = 60.71 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-18 66 0.00 72.55 0.00 -8.53 -3.31 0.00 0.00 -0.11 60.60*
-18 66 0.00 72.55 0.00 -8.53 -3.31 0.00 0.00 0.00 60.71
---

* Bright Zone !

Segment Leq : 60.71 dBA

Results segment # 2: Highway174EB (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 ! 5.50 ! 5.28 ! 5.28

ROAD (0.00 + 60.00 + 0.00) = 60.00 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-18 66 0.00 72.55 0.00 -9.24 -3.31 0.00 0.00 -0.08 59.92*
-18 66 0.00 72.55 0.00 -9.24 -3.31 0.00 0.00 0.00 60.00
---

* Bright Zone !

Segment Leq : 60.00 dBA

Results segment # 3: HighwayWB_Ba (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 ! 5.50 ! 4.19 ! 4.19

ROAD (0.00 + 40.77 + 0.00) = 40.77 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 -18 0.00 72.55 0.00 -8.53 -3.98 0.00 0.00 -19.27 40.77

Segment Leq : 40.77 dBA

Results segment # 4: HighwayEB_Ba (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 ! 5.50 ! 4.39 ! 4.39

ROAD (0.00 + 40.12 + 0.00) = 40.12 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 -18 0.00 72.55 0.00 -9.24 -3.98 0.00 0.00 -19.21 40.12

Segment Leq : 40.12 dBA

Total Leq All Segments: 63.42 dBA

RT/Custom data, segment # 1: LRT Phase 2 (day/night)
---
1 - 4-car SRT:
Traffic volume : 540/60 veh/TimePeriod
Speed : 70 km/h

Data for Segment # 1: LRT Phase 2 (day/night)

Angle1 Angle2 : -18.00 deg 66.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 97.00 / 97.00 m
Receiver height : 5.50 / 5.50 m
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : -18.00 deg Angle2 : 66.00 deg
Barrier height : 4.00 m
Barrier receiver distance : 7.00 / 7.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00

RT/Custom data, segment # 2: LRT-Barrier (day/night)
---
1 - 4-car SRT:
Traffic volume : 540/60 veh/TimePeriod
Speed : 70 km/h

Data for Segment # 2: LRT-Barrier (day/night)

Angle1 Angle2 : -90.00 deg -18.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 97.00 / 97.00 m
Receiver height : 5.50 / 5.50 m
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : -90.00 deg Angle2 : -18.00 deg
Barrier height : 38.00 m
Barrier receiver distance : 35.00 / 35.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00

Results segment # 1: LRT Phase 2 (day)

Source height = 0.50 m

Barrier height for grazing incidence

Source ! Receiver ! Barrier ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
---+---+---+---
0.50 ! 5.50 ! 5.14 ! 5.14

RT/Custom (0.00 + 52.02 + 0.00) = 52.02 dBA
Angle1 Angle2 Alpha RefLeq D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-18 66 0.00 63.44 -8.11 -3.31 0.00 0.00 -0.23 51.79*
-18 66 0.00 63.44 -8.11 -3.31 0.00 0.00 0.00 52.02
---

* Bright Zone !

Segment Leq : 52.02 dBA

Results segment # 2: LRT-Barrier (day)

Source height = 0.50 m

Barrier height for grazing incidence

Source ! Receiver ! Barrier ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
---+---+---+---
0.50 ! 5.50 ! 3.70 ! 3.70

RT/Custom (0.00 + 32.04 + 0.00) = 32.04 dBA
Angle1 Angle2 Alpha RefLeq D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 -18 0.00 63.44 -8.11 -3.98 0.00 0.00 -19.32 32.04

Segment Leq : 32.04 dBA

Total Leq All Segments: 52.06 dBA

Barrier table for segment # 1: LRT Phase 2 (day)

Barrier Height	Elev of Barr Top	RT/CUST dBA	Tot Leq dBA
5.00	5.00	52.02	52.02
5.50	5.50	46.60	46.60
6.00	6.00	44.95	44.95
6.50	6.50	42.84	42.84
7.00	7.00	40.81	40.81

Barrier table for segment # 2: LRT-Barrier (day)

Barrier Height	Elev of Barr Top	RT/CUST dBA	Tot Leq dBA
39.00	39.00	32.00	32.00
39.50	39.50	31.99	31.99
40.00	40.00	31.97	31.97
40.50	40.50	31.96	31.96
41.00	41.00	31.95	31.95

Results segment # 1: LRT Phase 2 (night)

Source height = 0.50 m

Barrier height for grazing incidence

Source ! Receiver ! Barrier ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
---+---+---+---
0.50 ! 5.50 ! 5.14 ! 5.14

RT/Custom (0.00 + 45.49 + 0.00) = 45.49 dBA
Angle1 Angle2 Alpha RefLeq D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-18 66 0.00 56.91 -8.11 -3.31 0.00 0.00 -0.23 45.26*
-18 66 0.00 56.91 -8.11 -3.31 0.00 0.00 0.00 45.49
---

* Bright Zone !

Segment Leq : 45.49 dBA

Results segment # 2: LRT-Barrier (night)

Source height = 0.50 m

Barrier height for grazing incidence

Source ! Receiver ! Barrier ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
---+---+---+---
0.50 ! 5.50 ! 3.70 ! 3.70

RT/Custom (0.00 + 25.50 + 0.00) = 25.50 dBA
Angle1 Angle2 Alpha RefLeq D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 -18 0.00 56.91 -8.11 -3.98 0.00 0.00 -19.32 25.50

Segment Leq : 25.50 dBA

Total Leq All Segments: 45.53 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 71.07
(NIGHT): 63.49

STAMSON 5.0 NORMAL REPORT Date: 03-01-2023 17:49:45
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r06.te Time Period: Day/Night 16/8 hours
Description:

Road data, segment # 1: Highway174WB (day/night)

Car traffic volume : 44528/3872 veh/TimePeriod *
Medium truck volume : 3542/308 veh/TimePeriod *
Heavy truck volume : 2530/220 veh/TimePeriod *
Posted speed limit : 100 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): 55000
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: Highway174WB (day/night)

Angle1 Angle2 : -54.00 deg 87.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 94.00 / 94.00 m
Receiver height : 1.50 / 1.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

Road data, segment # 2: Highway174EB (day/night)

Car traffic volume : 44528/3872 veh/TimePeriod *
Medium truck volume : 3542/308 veh/TimePeriod *
Heavy truck volume : 2530/220 veh/TimePeriod *
Posted speed limit : 100 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): 55000
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: Highway174EB (day/night)

Angle1 Angle2 : -54.00 deg 87.00 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 : 1.50 / 1.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

Results segment # 1: Highway174WB (day)

Source height = 1.50 m

ROAD (0.00 + 71.12 + 0.00) = 71.12 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-54 87 0.00 80.15 0.00 -7.97 -1.06 0.00 0.00 0.00 71.12

Segment Leq : 71.12 dBA

Results segment # 2: Highway174EB (day)

Source height = 1.50 m

ROAD (0.00 + 70.32 + 0.00) = 70.32 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-54 87 0.00 80.15 0.00 -8.77 -1.06 0.00 0.00 0.00 70.32

Segment Leq : 70.32 dBA

Total Leq All Segments: 73.75 dBA

Results segment # 1: Highway174WB (night)

Source height = 1.50 m

ROAD (0.00 + 63.52 + 0.00) = 63.52 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-54 87 0.00 72.55 0.00 -7.97 -1.06 0.00 0.00 0.00 63.52

Segment Leq : 63.52 dBA

Results segment # 2: Highway174EB (night)

Source height = 1.50 m

ROAD (0.00 + 62.72 + 0.00) = 62.72 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-54	87	0.00	72.55	0.00	-8.77	-1.06	0.00	0.00	0.00	62.72

Segment Leq : 62.72 dBA

Total Leq All Segments: 66.15 dBA

RT/Custom data, segment # 1: LRT Phase 2 (day/night)
---
1 - 4-car SRT:
Traffic volume : 540/60 veh/TimePeriod
Speed : 70 km/h

Data for Segment # 1: LRT Phase 2 (day/night)

Angle1 Angle2 : -54.00 deg 87.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 84.00 / 84.00 m
Receiver height : 1.50 / 1.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

Results segment # 1: LRT Phase 2 (day)

Source height = 0.50 m

RT/Custom (0.00 + 54.89 + 0.00) = 54.89 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-54	87	0.00	63.44	-7.48	-1.06	0.00	0.00	0.00	54.89

Segment Leq : 54.89 dBA

Total Leq All Segments: 54.89 dBA

Results segment # 1: LRT Phase 2 (night)

Source height = 0.50 m

RT/Custom (0.00 + 48.36 + 0.00) = 48.36 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-54	87	0.00	56.91	-7.48	-1.06	0.00	0.00	0.00	48.36

Segment Leq : 48.36 dBA

Total Leq All Segments: 48.36 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 73.80
(NIGHT): 66.22

STAMSON 5.0 NORMAL REPORT Date: 04-01-2023 10:59:51
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r06b.te Time Period: Day/Night 16/8 hours
Description:

Road data, segment # 1: Highway174WB (day/night)

Car traffic volume : 44528/3872 veh/TimePeriod *
Medium truck volume : 3542/308 veh/TimePeriod *
Heavy truck volume : 2530/220 veh/TimePeriod *
Posted speed limit : 100 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): 55000
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: Highway174WB (day/night)

Angle1 Angle2 : -54.00 deg 87.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 94.00 / 94.00 m
Receiver height : 1.50 / 1.50 m
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : -54.00 deg Angle2 : 87.00 deg
Barrier height : 1.00 m
Barrier receiver distance : 4.00 / 4.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00

Road data, segment # 2: Highway174EB (day/night)

Car traffic volume : 44528/3872 veh/TimePeriod *
Medium truck volume : 3542/308 veh/TimePeriod *
Heavy truck volume : 2530/220 veh/TimePeriod *
Posted speed limit : 100 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): 55000
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: Highway174EB (day/night)

Angle1 Angle2 : -54.00 deg 87.00 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 : 1.50 / 1.50 m
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : -54.00 deg Angle2 : 87.00 deg
Barrier height : 1.00 m
Barrier receiver distance : 4.00 / 4.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00

Results segment # 1: Highway174WB (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 + 71.12 + 0.00) = 71.12 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-54 87 0.00 80.15 0.00 -7.97 -1.06 0.00 0.00 -3.53 67.59*
-54 87 0.00 80.15 0.00 -7.97 -1.06 0.00 0.00 0.00 71.12
---

* Bright Zone !

Segment Leq : 71.12 dBA

Results segment # 2: Highway174EB (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 + 70.32 + 0.00) = 70.32 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-54 87 0.00 80.15 0.00 -8.77 -1.06 0.00 0.00 -3.54 66.77*
-54 87 0.00 80.15 0.00 -8.77 -1.06 0.00 0.00 0.00 70.32
---

* Bright Zone !

Segment Leq : 70.32 dBA

Total Leq All Segments: 73.75 dBA

Barrier table for segment # 1: Highway174WB (day)

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
1.00	1.00	71.12	71.12
1.50	1.50	66.12	66.12
2.00	2.00	64.99	64.99
2.50	2.50	62.72	62.72
3.00	3.00	60.51	60.51
3.50	3.50	58.65	58.65
4.00	4.00	57.11	57.11

Barrier table for segment # 2: Highway174EB (day)

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
1.00	1.00	70.32	70.32
1.50	1.50	65.32	65.32
2.00	2.00	64.20	64.20
2.50	2.50	61.94	61.94
3.00	3.00	59.73	59.73
3.50	3.50	57.88	57.88
4.00	4.00	56.34	56.34

Results segment # 1: Highway174WB (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 + 63.52 + 0.00) = 63.52 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-54 87 0.00 72.55 0.00 -7.97 -1.06 0.00 0.00 -3.53 59.99*
-54 87 0.00 72.55 0.00 -7.97 -1.06 0.00 0.00 0.00 63.52
---

* Bright Zone !

Segment Leq : 63.52 dBA

Results segment # 2: Highway174EB (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 + 62.72 + 0.00) = 62.72 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-54 87 0.00 72.55 0.00 -8.77 -1.06 0.00 0.00 -3.54 59.18*
-54 87 0.00 72.55 0.00 -8.77 -1.06 0.00 0.00 0.00 62.72
---

* Bright Zone !

Segment Leq : 62.72 dBA

Total Leq All Segments: 66.15 dBA

RT/Custom data, segment # 1: LRT Phase 2 (day/night)
---
1 - 4-car SRT:
Traffic volume : 540/60 veh/TimePeriod
Speed : 70 km/h

Data for Segment # 1: LRT Phase 2 (day/night)

Angle1 Angle2 : -54.00 deg 87.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 84.00 / 84.00 m
Receiver height : 1.50 / 1.50 m
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : -54.00 deg Angle2 : 87.00 deg
Barrier height : 1.00 m
Barrier receiver distance : 4.00 / 4.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00

Results segment # 1: LRT Phase 2 (day)

Source height = 0.50 m

Barrier height for grazing incidence

Source ! Receiver ! Barrier ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
---+---+---+---
0.50 ! 1.50 ! 1.45 ! 1.45

RT/Custom (0.00 + 54.89 + 0.00) = 54.89 dBA
Angle1 Angle2 Alpha RefLeq D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-54 87 0.00 63.44 -7.48 -1.06 0.00 0.00 -3.83 51.07*
-54 87 0.00 63.44 -7.48 -1.06 0.00 0.00 0.00 54.89
---

* Bright Zone !

Segment Leq : 54.89 dBA

Total Leq All Segments: 54.89 dBA

Barrier table for segment # 1: LRT Phase 2 (day)

Barrier ! Elev of ! RT/CUST ! Tot Leq !
Height ! Barr Top! dBA ! dBA !
---+---+---+---
1.00 ! 1.00 ! 54.89 ! 54.89 !
1.50 ! 1.50 ! 49.88 ! 49.88 !
2.00 ! 2.00 ! 48.57 ! 48.57 !
2.50 ! 2.50 ! 46.26 ! 46.26 !
3.00 ! 3.00 ! 44.06 ! 44.06 !
3.50 ! 3.50 ! 42.23 ! 42.23 !
4.00 ! 4.00 ! 40.71 ! 40.71 !

Results segment # 1: LRT Phase 2 (night)

Source height = 0.50 m

Barrier height for grazing incidence

Source ! Receiver ! Barrier ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
---+---+---+---
0.50 ! 1.50 ! 1.45 ! 1.45

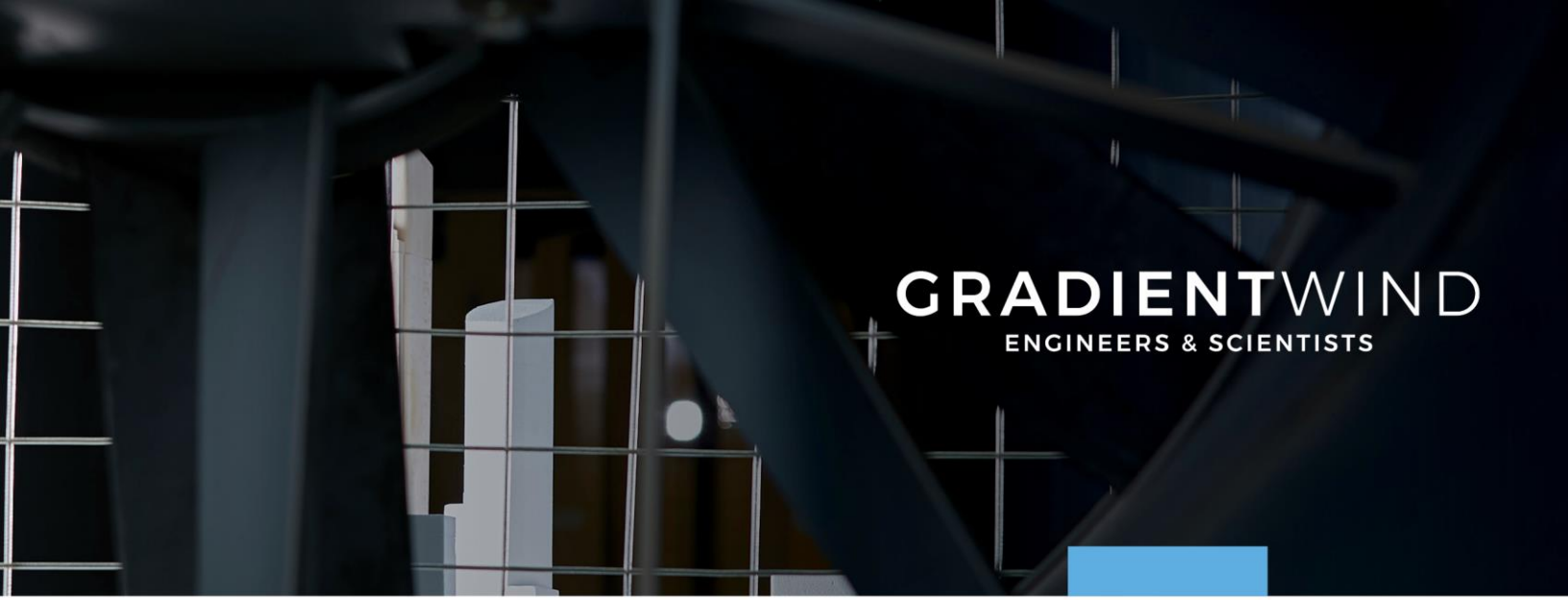
RT/Custom (0.00 + 48.36 + 0.00) = 48.36 dBA
Angle1 Angle2 Alpha RefLeq D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-54 87 0.00 56.91 -7.48 -1.06 0.00 0.00 -3.83 44.54*
-54 87 0.00 56.91 -7.48 -1.06 0.00 0.00 0.00 48.36
---

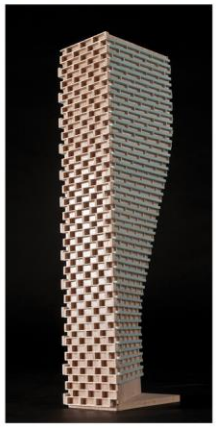
* Bright Zone !

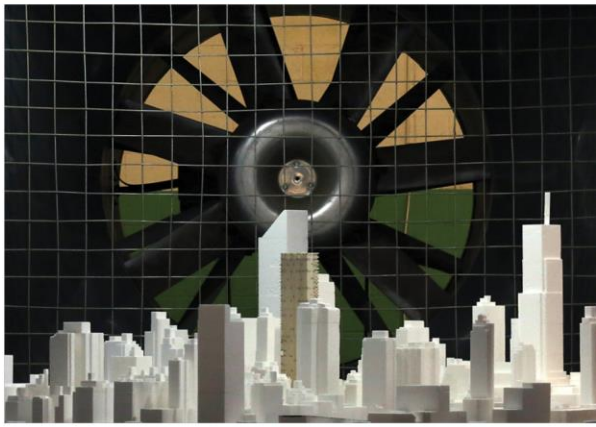
Segment Leq : 48.36 dBA

Total Leq All Segments: 48.36 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 73.80
(NIGHT): 66.22







APPENDIX B

FTA VIBRATION CALCULATIONS

127 WALGREEN ROAD, OTTAWA, ON, CANADA K0A 1L0 | 613 836 0934
GRADIENTWIND.COM

GW22-359

Possible Vibration Impacts on the Study Site
Perdicted using FTA General Assesment

Train Speed 70 km/h 43.5 mph

	Distance from	
	(m)	(ft)
LRT	24.0	78.7

Vibration

From FTA Manual Fig 10-1

Vibration Levels at distance from track	70	dBV re 1 micro in/sec

Adjustment Factors FTA Table 10-1

Speed reference 50 mph	-1	Speed Limit of 70 km/h (43.5 mph)
Vehicle Parameters	0	Assume Soft primary suspension, Weels run true
Track Condition	0	Worn or Corrugated Track
Track Treatments	0	None
Type of Transit Structure	0	Station
Efficient vibration Propagation	0	Propagation through rock
Vibration Levels at Fdn	69	
Coupling to Building Foundation	-10	Large masonry on piles
Floor to Floor Attenuation	-2.0	Ground Floor Ocupied
Amplification of Floor and Walls	6	
Total Vibration Level	62.8	dBV or 0.035 mm/s
Noise Level in dBA	27.8	dBA