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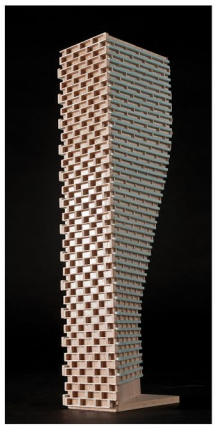
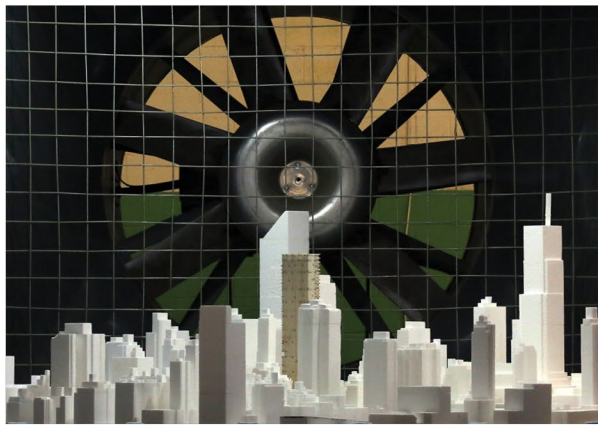
TRANSPORTATION NOISE ASSESSMENT

265 Centrum Boulevard
Ottawa, Ontario

Report: 23-023 –Traffic Noise





March 24, 2023

PREPARED FOR

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EXECUTIVE SUMMARY

This report describes a transportation noise assessment undertaken in support of concurrent Zoning By-Law Amendment (ZBA) and Site Plan Control (SPA) application submissions for the proposed development at 265 Centrum Boulevard in Ottawa, Ontario. The proposed development comprises three rectangular buildings, identified as Tower A, Tower B, and Tower C, rising 35, 30, and 40 storeys, respectively. The major sources of transportation noise include Highway 174, St. Joseph Boulevard, Centrum Boulevard, and Prestone Drive, as well as LRT noise produced by the Confederation Line LRT. Figure 1 illustrates the site location with the surrounding context.

The assessment is based on (i) theoretical noise prediction methods that conform to the Ministry of the Environment, Conservation and Parks (MECP), Ministry of Transportation of Ontario (MTO), and the 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 provided by B+H Architects in March 2023.

The results of the current analysis indicated that noise levels will range between 50 and 70 dBA during the daytime period (07:00-23:00) and between 42 and 62 dBA during the nighttime period (23:00-07:00). The highest noise level (70 dBA) occurs at the north facades of Towers B and C which are nearest and most exposed to Highway 174. Building components with a higher Sound Transmission Class (STC) rating will be required where exterior noise levels exceed 65 dBA, as indicated in Figure 3 and Table 5. Results of the calculations also indicate that Towers A, B, and C will require central air conditioning, which will allow occupants to keep windows closed and maintain a comfortable living environment. A Type D Warning Clause will also be required in all Lease, Purchase and Sale Agreements, as summarized in Section 6. In addition, the Rail Construction Program Office recommends that the LRT Warning Clause identified in Section 6 also be included in all agreements of purchase and sale and lease agreements.

Noise levels at the amenity areas are expected to exceed the 55 dBA OLA noise criterion during the daytime period. Further analysis investigated the noise-mitigating impact of raising the perimeter guards/barriers surrounding the terraces and amenity spaces between 1.1m and 2m above the walking surface. The results of the investigation proved that noise levels can be reduced to 55 or below 60 dBA with an appropriate barrier height. The preferred barrier heights for the amenity spaces are outlined in

Table 5. Reducing noise levels at Tower B and C to 55 dBA would require excessive barrier heights that would not be administratively and financially feasible. Where OLA noise levels are between 55 and 60 dBA, a Type B Warning Clause will be required on all Lease, Purchase and Sale Agreements, as summarized in Section 6.

In addition, the stationary noise impacts of the development onto itself and the surroundings would be considered at a future stage once the mechanical design has progressed and equipment has been selected. Stationary noise sources associated with the development could include rooftop air handling units, cooling towers or dry coolers, and emergency generators. Should noise levels from these units exceed the criteria established in NPC-300, noise from these sources can be controlled to acceptable limits by judicious selection of the equipment, locating the equipment on a high roof away from nearby residential receptors, and where necessary, installing silencers or noise screens.

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1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Bayview Orleans Inc. to undertake transportation noise assessment in support of concurrent Zoning By-Law Amendment (ZBA) and Site Plan Control (SPA) application submissions for the proposed development at 265 Centrum Boulevard in Ottawa, Ontario. This report summarizes the methodology, results, and recommendations related to the assessment of exterior and interior noise levels generated by local transportation traffic.

Our work is based on theoretical noise calculation methods conforming to the City of Ottawa[1] noise guidelines, Ministry of the Environment, Conservation and Parks (MECP)[2] guidelines, as well as the Ministry of Transportation Ontario (MTO)[3] noise guidelines. Noise calculations were based on architectural drawings provided by B+H Architects in March 2023, with future traffic volumes corresponding to the City of Ottawa's Official Plan (OP) roadway classifications.

2. TERMS OF REFERENCE

The focus of this transportation noise assessment is a proposed development located at 265 Centrum Boulevard in Ottawa, Ontario. The proposed development is situated on an irregular parcel of land surrounded bounded by Brisebois Crescent to the north and east, Centrum Boulevard to the south, and a low-rise government building to the west.

The proposed development comprises three rectangular buildings, identified as Tower A, Tower B, and Tower C, rising 35, 30, and 40 storeys, respectively. Tower A will include a 6-storey podium with step-backs along the north, west, and south elevations at Level 7. Tower B will include a 3-storey podium with step-backs along the north, west, and south elevations at Level 4. Tower C will include a 3-storey podium with step-backs along the north, west, and east elevations at Level 4. Additionally, Towers B and C share two levels of underground parking at P3 and P2, and all Towers share one level of underground parking at P1.

[1] City of Ottawa Environmental Noise Control Guidelines, January 2016
[2] Ontario Ministry of the Environment, Conservation and Parks – Environmental Noise Guidelines, Publication NPC-300, Queens Printer for Ontario, Toronto, 2013
[3] Environmental Guide for Noise, February 2022. Ministry of Transportation Ontario

Retail space is located at grade in Tower A. Building support facilities and 2-storey townhouse units comprise the first two levels for each of the buildings. Tower A and B feature indoor amenity space on Level 2 as well as outdoor parkland/amenity space at-grade toward the east elevations of both Towers. Tower A comprises residential and office space at Levels 3-6, amenity space at Level 7, with the remaining floors dedicated to residential use. Tower B comprises residential space at Levels 3-30 with amenity space at Level 21. Tower C comprises residential space at Levels 3, 5-40 with amenity space at Level 4. Each building comprises a mechanical penthouse level on the roof.

The development proposes several amenity spaces at Levels 4 and 8 for Tower A, at-grade for Tower B, and at Level 4 for Tower C. As these spaces are greater than 4 m in depth, they are considered noise sensitive Outdoor Living Areas (OLAs) and were included in the assessment.

The major sources of transportation noise include Highway 174, St. Joseph Boulevard, Centrum Boulevard, and Prestone Drive, as well as LRT noise produced by the Confederation Line LRT. As the future LRT corridor does not fall within 75 m of the proposed development, a ground vibrations assessment is not required. Figure 1 illustrates the site location with the surrounding context.

3. OBJECTIVES

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

4. METHODOLOGY

4.1 Background

Noise can be defined as any obtrusive sound. It is created at a source, transmitted through a medium, such as air, and intercepted by a receiver. Noise may be characterized in terms of the power of the source or the sound pressure at a specific distance. While the power of a source is characteristic of that particular source, the sound pressure depends on the location of the receiver and the path that the noise takes to reach the receiver. Measurement of noise is based on the decibel unit, dBA, which is a logarithmic ratio referenced to a standard noise level (2×10^{-5} Pascals). The 'A' suffix refers to a weighting scale, which better

represents how the noise is perceived by the human ear. With this scale, a doubling of power results in a 3 dBA increase in measured noise levels and is just perceptible to most people. An increase of 10 dBA is often perceived to be twice as loud.

4.2 Transportation Noise

4.2.1 Criteria for Roadway and LRT Noise

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

TABLE 1: INDOOR SOUND LEVEL CRITERIA (ROAD) [4]

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

Predicted noise levels at the plane of window (POW) dictate the action required to achieve the recommended sound levels. An open window is considered to provide a 10 dBA reduction in noise, while

[4] Adapted from ENCG 2016 – Tables 2.2b and 2.2c

a standard closed window is capable of providing a minimum 20 dBA noise reduction[5]. A closed window due to a ventilation requirement will bring noise levels down to achieve an acceptable indoor environment[6]. Therefore, where noise levels exceed 55 dBA daytime and 50 dBA nighttime, the ventilation for the building should consider the need for having windows and doors closed, which triggers the need for forced air heating with provision for central air conditioning. Where noise levels exceed 65 dBA daytime and 60 dBA nighttime, air conditioning will be required and building components will require higher levels of sound attenuation[7].

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

4.2.2 Theoretical Roadway Noise Predictions

The impact of transportation noise sources on the development was determined by two computer modelling programs. To provide a general sense of noise across the site, the employed software program was Predictor-Lima which utilizes the United States Federal Highway Administration's Traffic Noise Model (TNM) to represent the roadway line sources. The TNM model has been accepted as the preferred model as per the revised guideline titled "*Environmental Guide for Noise*" prepared by the Ministry of Transportation Ontario (MTO)[8]. This computer program can represent three-dimensional surfaces and the first reflections of sound waves over a suitable spectrum for human hearing. A set of comparative calculations were performed in the current Ontario traffic noise prediction model, STAMSON, for comparisons to Predictor simulation results.

The STAMSON model is, however, older and requires each receptor to be calculated separately. STAMSON also does not accurately account for building reflections and multiple screening elements, and curved road geometry. A total of 29 receptor locations were identified around the site, as illustrated in Figure 2.

[5] Burberry, P.B. (2014). Mitchell's Environment and Services. Routledge, Page 125
[6] MECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.8
[7] MECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.1.3
[8] Environmental Guide for Noise, February 2022. Ministry of Transportation Ontario

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

- Truck traffic on all roadways was taken to comprise 5% heavy trucks and 7% medium trucks, as per ENCG requirements for noise level predictions.
- The day/night split was taken to be 92% / 8% respectively for all streets.
- The ground surface was modelled as absorptive where grass and foliage (soft ground) are present, and as reflective where pavement and concrete are present (hard ground).
- The study site was treated as having flat or gently sloping topography.
- Massing associated with the study site was included as potential noise screening elements.
- 29 receptors were strategically placed throughout the study area.
- Receptor distances and exposure angles, used in STAMSON calculations, are illustrated in Appendix A.

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[9] 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.

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

TABLE 2: ROADWAY TRAFFIC DATA

Segment	Roadway Traffic Data	Speed Limit (km/h)	Traffic Volumes
Highway 174 Westbound	4-Lane Freeway	100	**36,666**
Highway 174 Eastbound	4-Lane Freeway	100	**36,666**
Confederation Line	LRT	70	**540/60***
St. Joseph Boulevard	4-Lane Urban Arterial-Divided (4-UAD)	60	**35,000**
Centrum Boulevard	2-Lane Urban Collector (2-UCU)	50	**8,000**
Prestone Drive	2-Lane Urban Collector (2-UCU)	40	**8,000**

*Daytime/nighttime volumes based on correspondence with the City of Ottawa on past projects.

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 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 are achieved. The calculation procedure[10] considers:

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

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

Based on published research[11], exterior walls possess specific sound attenuation characteristics that are used as a basis for calculating the required STC ratings of windows in the same partition. Due to the limited information available at the time of the study, detailed floor layouts 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).

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

5. RESULTS AND DISCUSSION

5.1 Transportation Noise Levels

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

TABLE 3: EXTERIOR NOISE LEVELS DUE TO TRANSPORTATION SOURCES

Receptor Number	Receptor Height Above Grade (m)	Receptor Location	Predictor-Lima Noise Level (dBA)	
			Day	Night
R1	18	POW - Tower A - West Facade	66	58
R2	18	POW - Tower A - South Facade	64	57
R3	18	POW - Tower A - East Facade	64	56
R4	18	POW - Tower A - North Facade	63	56
R5	105	POW - Tower A - West Facade	65	57
R6	105	POW - Tower A - South Facade	63	55
R7	105	POW - Tower A - West Facade	63	55
R8	105	POW - Tower A - North Facade	63	55
R9	6	POW - Tower B - North Facade	70	62
R10	6	POW - Tower B - West Facade	66	59
R11	6	POW - Tower B - South Facade	61	54
R12	6	POW - Tower B - East Facade	66	58
R13	88	POW - Tower B - North Facade	69	61
R14	88	POW - Tower B - West Facade	66	58
R15	88	POW - Tower B - South Facade	61	53
R16	88	POW - Tower B - East Facade	65	58
R17	6	POW - Tower C - North Facade	70	62
R18	6	POW - Tower C - West Facade	67	59
R19	6	POW - Tower C - South Facade	50	42
R20	6	POW - Tower C - East Facade	67	60
R21	118	POW - Tower C - North Facade	69	61
R22	118	POW - Tower C - West Facade	66	59
R23	118	POW - Tower C - South Facade	56	48

TABLE 3: EXTERIOR NOISE LEVELS DUE TO TRANSPORTATION SOURCES (CONT.)

Receptor Number	Receptor Height Above Grade (m)	Receptor Location	Predictor-Lima Noise Level (dBA)	
			Day	Night
R24	118	POW - Tower C - East Facade	66	59
R25	1.5	OLA - Tower A - Level 7 Amenity	63	N/a*
R26	1.5	OLA - Tower A - Level 7 Amenity	64	N/a*
R27	1.5	OLA - Tower B - At-Grade Amenity	66	N/a*
R28	1.5	OLA - Tower C - Level 4 Amenity	70	N/a*
R29	1.5	OLA - Tower A - Level 8 Amenity	60	N/a*

*Nighttime noise levels at OLAs are not considered as per ENCG.

The results of the current analysis indicated that noise levels will range between 50 and 70 dBA during the daytime period (07:00-23:00) and between 42 and 62 dBA during the nighttime period (23:00-07:00). The highest noise level (70 dBA) occurs at the north facades of Towers B and C which are nearest and most exposed to Highway 174.

Table 4 shows a comparison in results between Predictor-Lima and STAMSON. Noise levels calculated in STAMSON were found to have a good correlation with Predictor-Lima and variability between the two programs was within an acceptable level of ±0-3 dBA. Sample calculations are presented in Appendix A.

TABLE 4: RESULTS OF STAMSON/PREDICTOR-LIMA CORRELATION

Receptor ID	Receptor Location	Receptor Height (m)	STAMSON 5.04 Noise Level (dBA)		PREDICTOR-LIMA Noise Level (dBA)	
			Day	Night	Day	Night
R11	POW - Tower B - South Facade	6	61	54	61	54
R15	POW - Tower B - South Facade	88	61	53	61	53

5.2 Noise Control Measures

The noise levels predicted due to transportation sources exceed the criteria listed in Section 4.2 for building components. As discussed in Section 4.3, the anticipated STC requirements for windows have

been estimated based on the overall noise reduction required for each intended use of space (STC = outdoor noise level – targeted indoor noise levels). As per the City of Ottawa requirements, detailed STC calculations will be required to be completed prior to building permit application for each unit type. The STC requirements for the windows are summarized in Table 5 below for various units within the development (see Figure 3).

TABLE 5: NOISE CONTROL REQUIREMENTS

Location	Façade	Level	Window STC (Bedroom/Living Room/Office)	Exterior Wall STC	Warning Clauses	A/C
Tower A	West, South, East	1-35	30/25/25	45	Yes	Yes
Tower B	West, East	1-30	30/25/25	45	Yes	Yes
	North	1-30	33/28/25	45	Yes	Yes
Tower C	West, East	1-40	30/25/25	45	Yes	Yes
	North	1-40	33/28/25	45	Yes	Yes

The STC requirements apply to windows, doors, spandrel panels and curtainwall elements. Exterior wall components on these façades are recommended to have a minimum STC of 45, where a window/wall system is used. A review of window supplier literature indicates that the specified STC ratings can be achieved by a variety of window systems having a combination of glass thickness and inter-pane spacing. It is the responsibility of the manufacturer to ensure that the specified window achieves the required STC. This can only be assured by using window configurations that have been certified by laboratory testing. The requirements for STC ratings assume that the remaining components of the building are constructed and installed according to the minimum standards of the Ontario Building Code. The specified STC requirements also apply to swinging and/or sliding patio doors.

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

5.3 Noise Barrier Calculation

Noise levels at the amenity areas are expected to exceed the 55 dBA OLA noise criterion during the daytime period. If these areas are to be used as Outdoor Living Areas, noise control measures are required to reduce the L_{eq} to 60 dBA, and as close to 55 dBA as feasibly possible. Further analysis investigated the noise mitigating impact of raising the perimeter guards/barriers surrounding the terraces and amenity spaces between 1.1m and 2m above the walking surface. Results of the investigation proved that noise levels can be reduced to 55 or below 60 dBA with an appropriate barrier height. The preferred barrier heights for the amenity spaces are outlined in **bold** script in Table 5. Reducing noise levels at Tower B and C to 55 dBA would require excessive barrier heights that would not be administratively and financially feasible. Where OLA noise levels are between 55 and 60 dBA, a Type B Warning Clause will be required on all Lease, Purchase and Sale Agreements, as summarized in Section 6.

TABLE 5: RESULTS OF NOISE BARRIER INVESTIGATION

Reference Receptor	Location	Barrier Height (m)	Daytime L_{eq} Noise Levels (dBA)
R25	OLA - Tower A - Level 7 Amenity	No Barrier	63
		1.1	62
		1.5	**55**
R26	OLA - Tower A - Level 7 Amenity	No Barrier	64
		1.1	59
		1.5	**55**
R27	OLA - Tower B - At-Grade Amenity	No Barrier	66
		1.1	66
		1.5	65
		2	**59**
R28	OLA - Tower C - Level 4 Amenity	No Barrier	70
		1.1	70
		1.5	64
		2	**59**
R29	OLA - Tower A - Level 8 Amenity	No Barrier	60
		1.1	60
		1.3	**55**

6. CONCLUSIONS AND RECOMMENDATIONS

The results of the current analysis indicated that noise levels will range between 50 and 70 dBA during the daytime period (07:00-23:00) and between 42 and 62 dBA during the nighttime period (23:00-07:00). The highest noise level (70 dBA) occurs at the north facades of Towers B and C which are nearest and most exposed to Highway 174. Building components with a higher Sound Transmission Class (STC) rating will be required where exterior noise levels exceed 65 dBA, as indicated in Figure 3 and Table 5.

Results of the calculations also indicate that Towers A, B, and C will require central air conditioning, which will allow occupants to keep windows closed and maintain a comfortable living environment. A Type D Warning Clause will also be required in 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:

> *"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 amenity areas are expected to exceed the 55 dBA OLA noise criterion during the daytime period. Further analysis investigated the noise-mitigating impact of raising the perimeter guards/barriers surrounding the terraces and amenity spaces between 1.1m and 2m above the walking surface. The results of the investigation proved that noise levels can be reduced to 55 or below 60 dBA with an appropriate barrier height. The preferred barrier heights for the amenity spaces are outlined in Table 5. Reducing noise levels at Tower B and C to 55 dBA would require excessive barrier heights that would not be administratively and financially feasible. Where OLA noise levels are between 55 and 60 dBA, a Type B Warning Clause will be required on all Lease, Purchase and Sale Agreements, as summarized below.

Type B:

> *"Purchasers/tenants are advised that despite the inclusion of noise control features in the development and within the building units, sound levels due to increasing road traffic 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."*

In addition, the stationary noise impacts of the development onto itself and the surroundings would be considered at a future stage once the mechanical design has progressed and equipment has been selected. Stationary noise sources associated with the development could include rooftop air handling units, cooling towers or dry coolers, and emergency generators. Should noise levels from these units exceed the criteria established in NPC-300, noise from these sources can be controlled to acceptable limits by judicious selection of the equipment, locating the equipment on a high roof away from nearby residential receptors, and where necessary, installing silencers or noise screens.

This concludes our transportation 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.

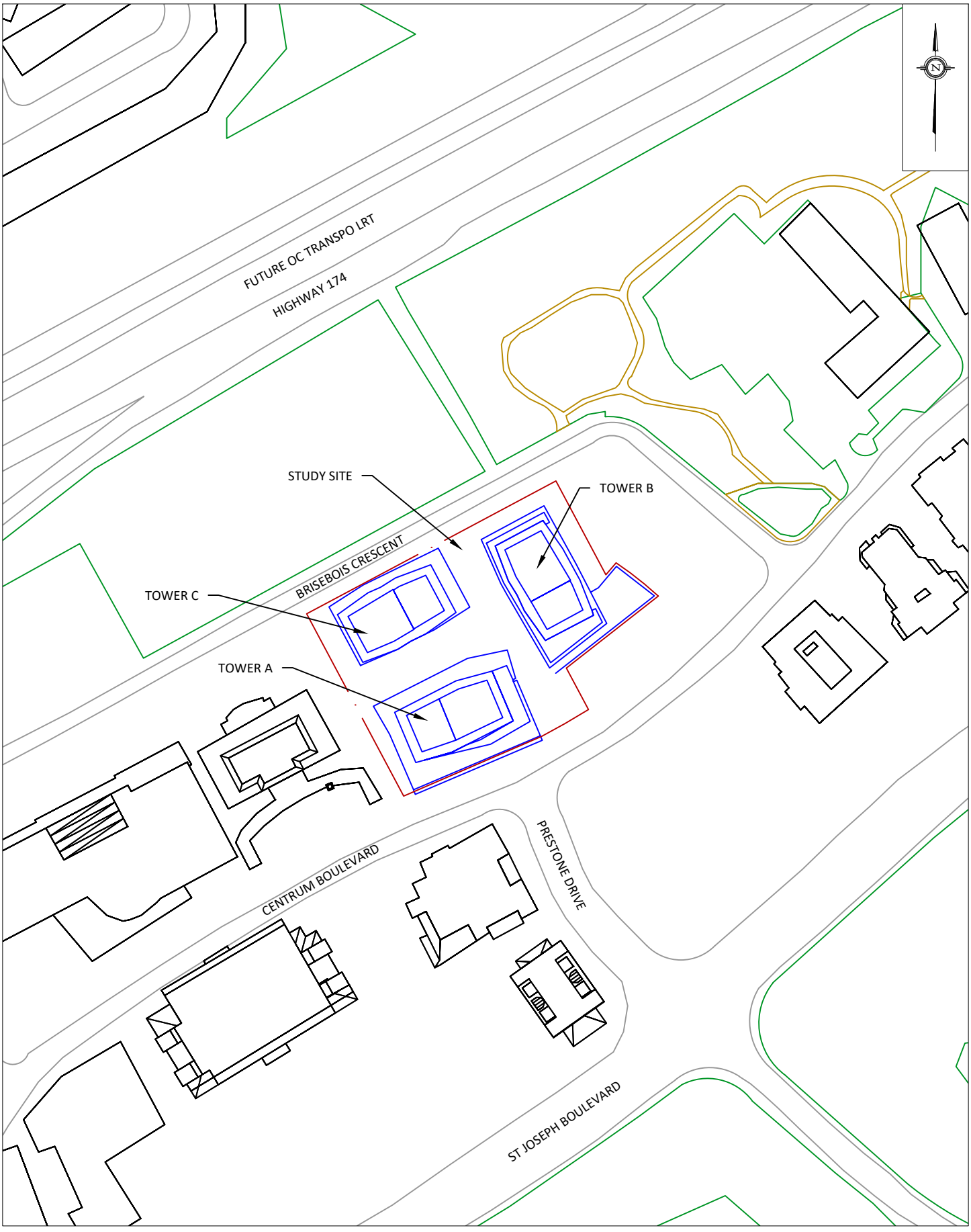
Sincerely,

Gradient Wind Engineering Inc.

Giuseppe Garro, MASc.
Environmental Scientist

Joshua Foster, P.Eng.
Lead Engineer

Gradient Wind File #23-023



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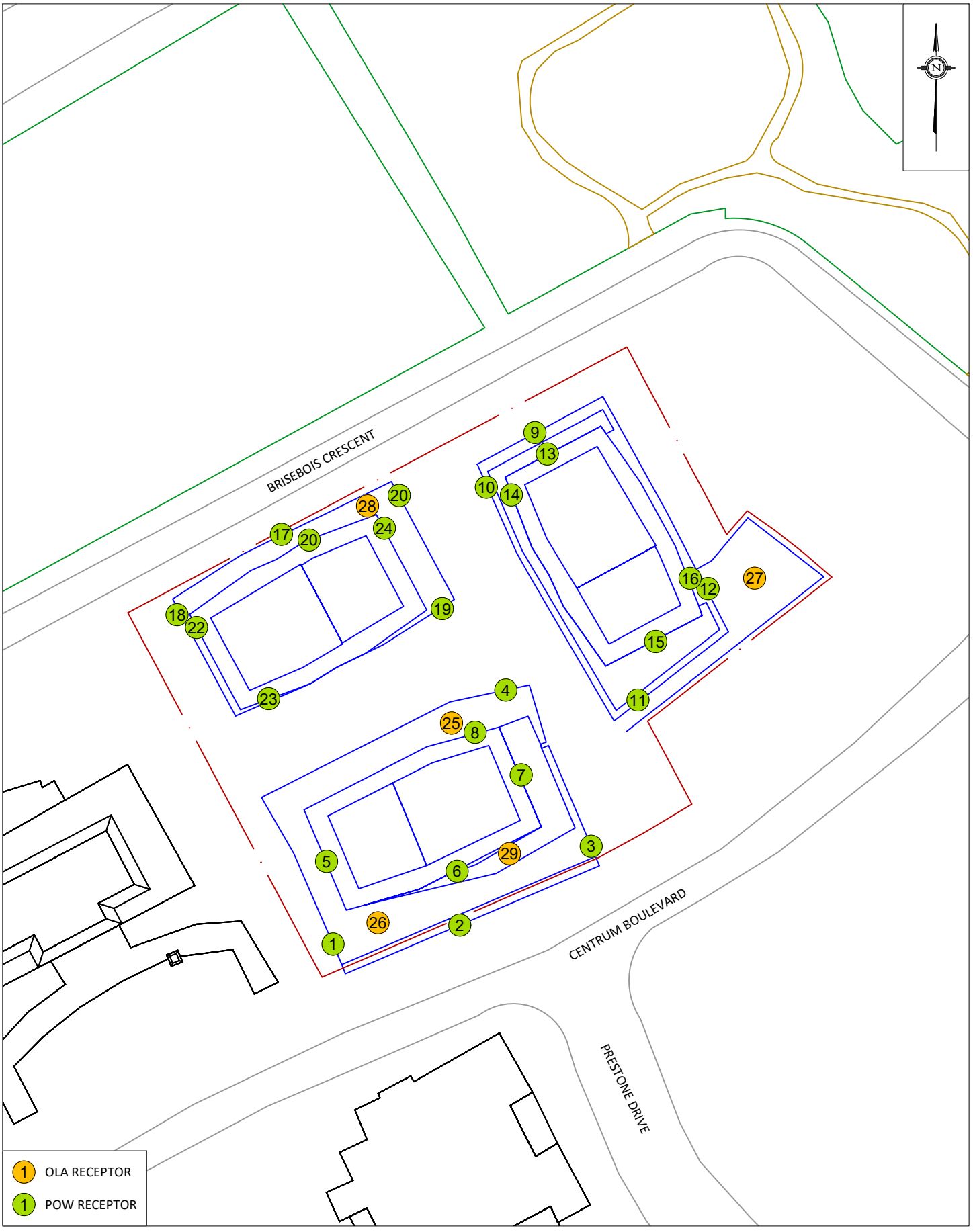
PROJECT	265 CENTRUM BOULEVARD, OTTAWA TRANSPORTATION NOISE ASSESSMENT
SCALE	1:2000 (APPROX.)
DRAWING NO.	GW23-023-1
DATE	MARCH 22, 2023
DRAWN BY	G.G.

DESCRIPTION

FIGURE 1:
SITE PLAN AND SURROUNDING CONTEXT



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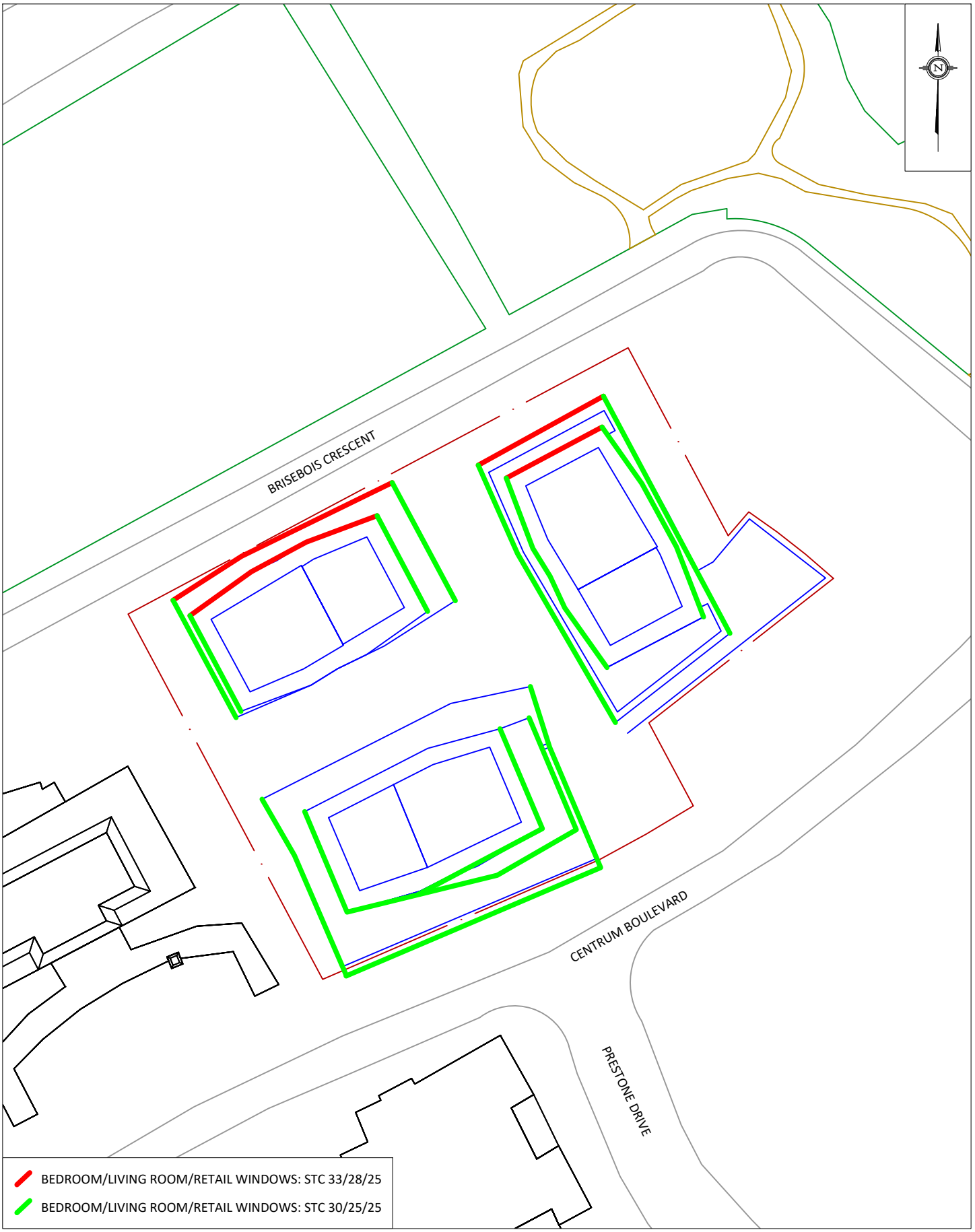
PROJECT	265 CENTRUM BOULEVARD, OTTAWA TRANSPORTATION NOISE ASSESSMENT
SCALE	1:1000 (APPROX.)
DRAWING NO.	GW23-023-2
DATE	MARCH 22, 2023
DRAWN BY	G.G.

DESCRIPTION

FIGURE 2:
RECEPTOR LOCATIONS



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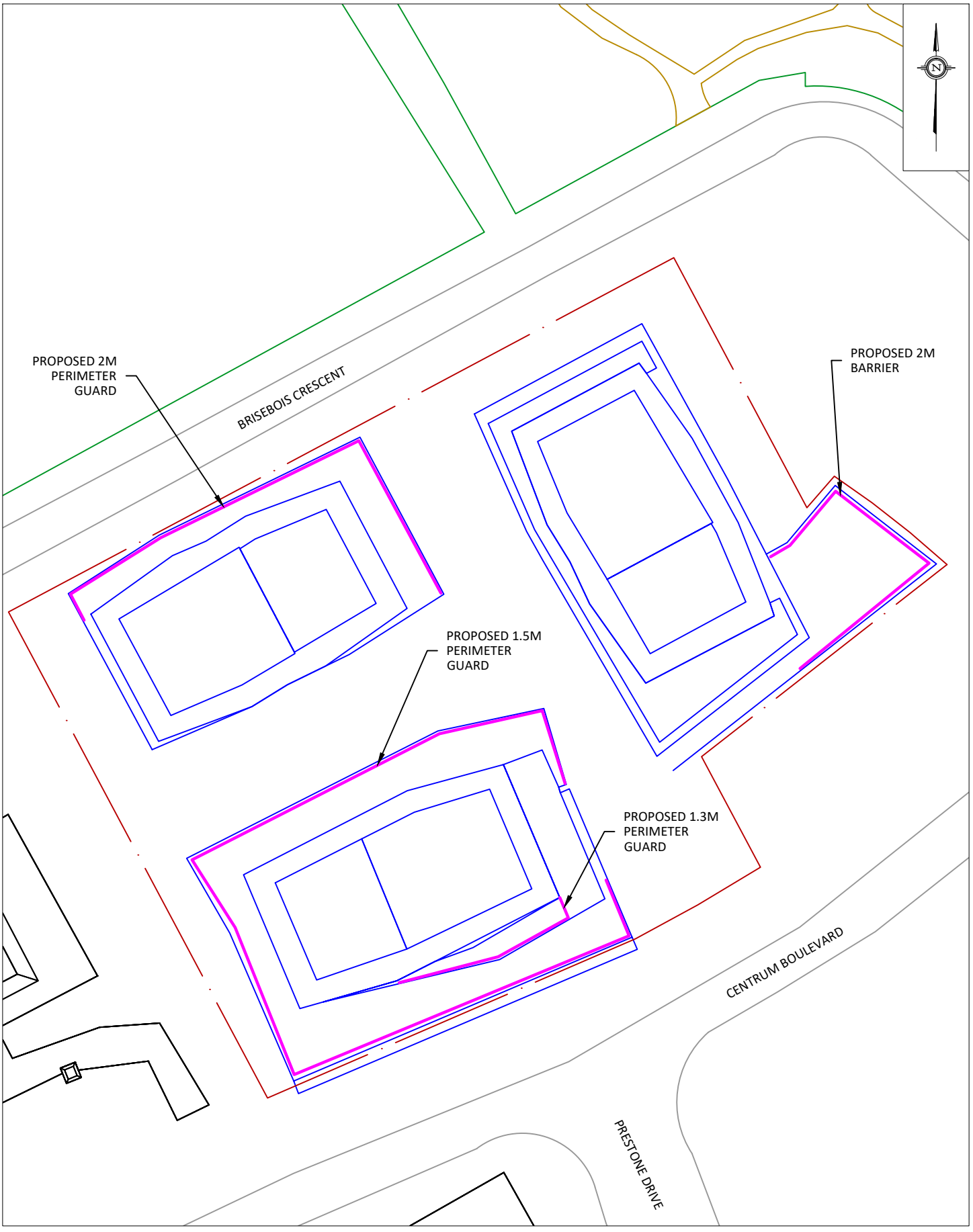
PROJECT	265 CENTRUM BOULEVARD, OTTAWA TRANSPORTATION NOISE ASSESSMENT
SCALE	1:1000 (APPROX.)
DRAWING NO.	GW23-023-3
DATE	MARCH 22, 2023
DRAWN BY	G.G.

DESCRIPTION

FIGURE 3:
WINDOW STC REQUIREMENTS



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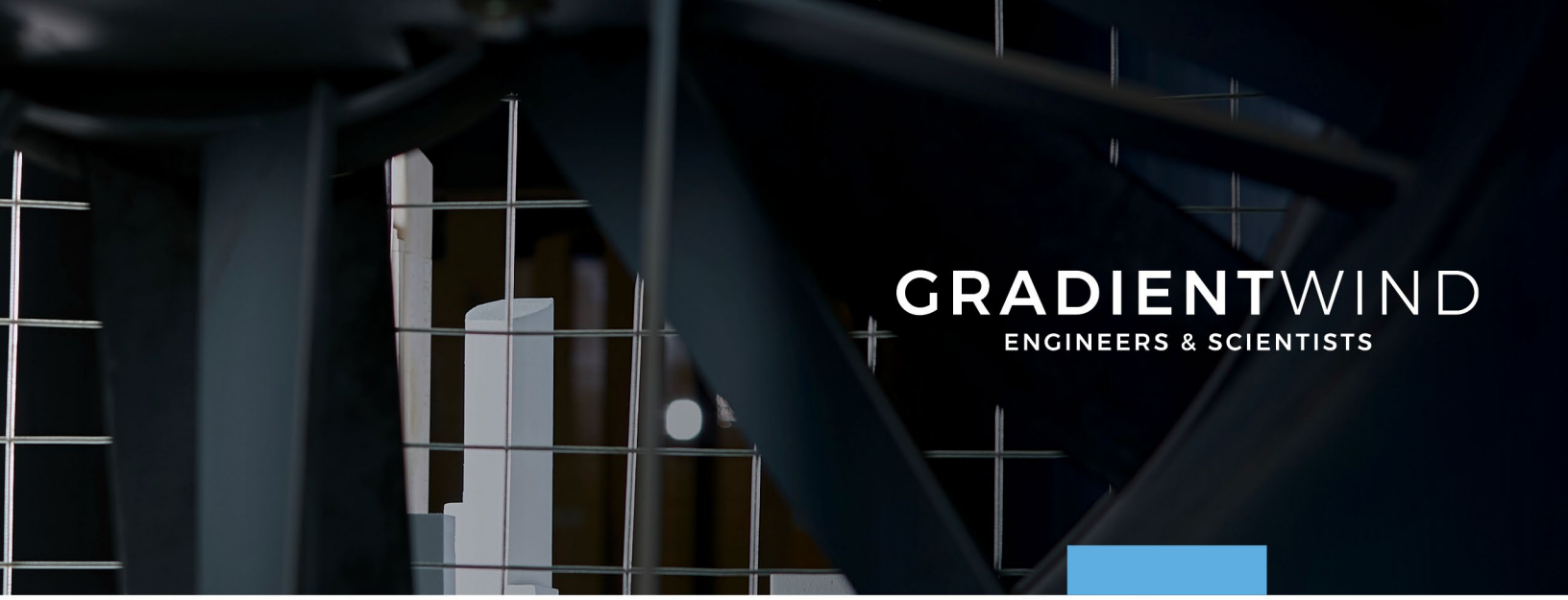
PROJECT	265 CENTRUM BOULEVARD, OTTAWA TRANSPORTATION NOISE ASSESSMENT		DESCRIPTION
SCALE	1:750 (APPROX.)	DRAWING NO.	GW23-023-4
DATE	MARCH 22, 2023	DRAWN BY	G.G.

FIGURE 4:
PROPOSED BARRIER LOCATIONS



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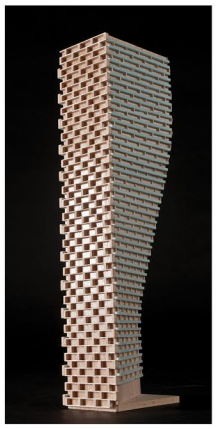

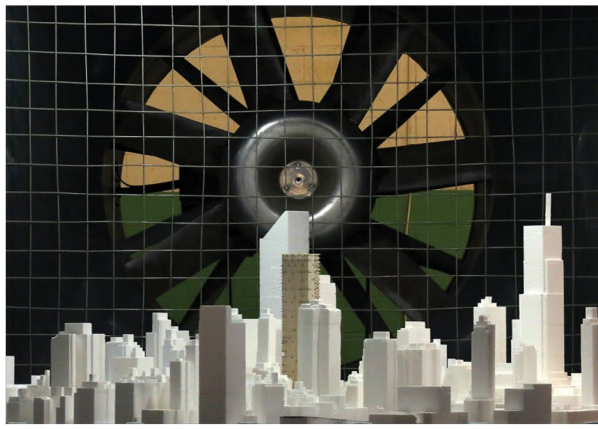

APPENDIX A

STAMSON 5.04 – INPUT AND OUTPUT DATA

127 WALGREEN ROAD, OTTAWA, ON, CANADA K0A 1L0 | 613 836 0934
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```
 STAMSON 5.0         NORMAL REPORT         Date: 23-03-2023 13:33:50
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: R11.te                Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: CB (day/night)
---------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):   8000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: CB (day/night)
-------------------------------------
Angle1   Angle2           : -90.00 deg   50.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  37.00 / 37.00  m
Receiver height           :   6.00 / 6.00   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


Road data, segment # 2: PD (day/night)
---------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    veh/TimePeriod  *
Posted speed limit  :    40 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):   8000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
```

```
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: PD (day/night)
------------------------------------
Angle1   Angle2           : -90.00 deg   -30.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  65.00 / 65.00  m
Receiver height           :   6.00 / 6.00   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


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

Source height = 1.50 m

ROAD (0.00 + 60.74 + 0.00) = 60.74 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90     50   0.00  65.75   0.00  -3.92  -1.09   0.00   0.00   0.00
60.74
-------------------------------------------------------------------------
--

Segment Leq : 60.74 dBA


Results segment # 2: PD (day)
-----------------------------

Source height = 1.50 m

ROAD (0.00 + 52.82 + 0.00) = 52.82 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90    -30   0.00  63.96   0.00  -6.37  -4.77   0.00   0.00   0.00
52.82
-------------------------------------------------------------------------
--

Segment Leq : 52.82 dBA
```

```
Total Leq All Segments: 61.39 dBA


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

Source height = 1.50 m

ROAD (0.00 + 53.14 + 0.00) = 53.14 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90     50   0.00  58.16   0.00  -3.92  -1.09   0.00   0.00   0.00
53.14
-------------------------------------------------------------------------
--

Segment Leq : 53.14 dBA


Results segment # 2: PD (night)
--------------------------------

Source height = 1.50 m

ROAD (0.00 + 45.22 + 0.00) = 45.22 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90    -30   0.00  56.36   0.00  -6.37  -4.77   0.00   0.00   0.00
45.22
-------------------------------------------------------------------------
--

Segment Leq : 45.22 dBA

Total Leq All Segments: 53.79 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 61.39
                           (NIGHT): 53.79
```

```
STAMSON 5.0         NORMAL REPORT         Date: 23-03-2023 13:41:03
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r15.te                Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: CB (day/night)
---------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):   8000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: CB (day/night)
-------------------------------------
Angle1   Angle2           : -90.00 deg   61.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  44.00 / 44.00  m
Receiver height           :  88.00 / 88.00  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


Road data, segment # 2: PD (day/night)
---------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    veh/TimePeriod  *
Posted speed limit  :    40 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):   8000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
```

```
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: PD (day/night)
------------------------------------
Angle1   Angle2           : -90.00 deg   -50.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  41.00 / 41.00  m
Receiver height           :  88.00 / 88.00  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


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

Source height = 1.50 m

ROAD (0.00 + 60.31 + 0.00) = 60.31 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90     61   0.00  65.75   0.00  -4.67  -0.76   0.00   0.00   0.00
60.31
-------------------------------------------------------------------------
--

Segment Leq : 60.31 dBA


Results segment # 2: PD (day)
-----------------------------

Source height = 1.50 m

ROAD (0.00 + 53.06 + 0.00) = 53.06 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90    -50   0.00  63.96   0.00  -4.37  -6.53   0.00   0.00   0.00
53.06
-------------------------------------------------------------------------
--

Segment Leq : 53.06 dBA
```

```
Total Leq All Segments: 61.06 dBA


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

Source height = 1.50 m

ROAD (0.00 + 52.72 + 0.00) = 52.72 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90     61   0.00  58.16   0.00  -4.67  -0.76   0.00   0.00   0.00
52.72
-------------------------------------------------------------------------
--

Segment Leq : 52.72 dBA


Results segment # 2: PD (night)
--------------------------------

Source height = 1.50 m

ROAD (0.00 + 45.46 + 0.00) = 45.46 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90    -50   0.00  56.36   0.00  -4.37  -6.53   0.00   0.00   0.00
45.46
-------------------------------------------------------------------------
--

Segment Leq : 45.46 dBA

Total Leq All Segments: 53.47 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 61.06
                           (NIGHT): 53.47
```