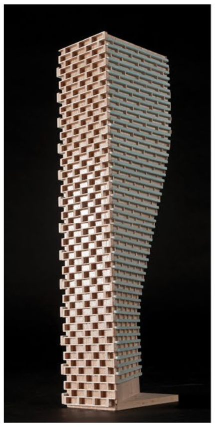
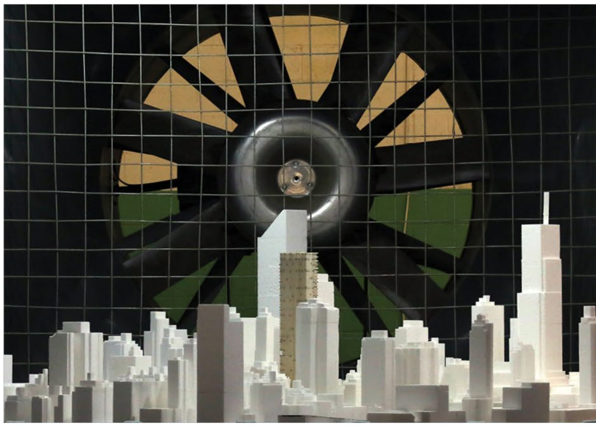
ROADWAY TRAFFIC NOISE ASSESSMENT

1765 Montreal Road
Ottawa, Ontario

Report: 21-403 – Roadway Traffic Noise





November 15, 2022

PREPARED FOR
Landric Homes
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PREPARED BY
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EXECUTIVE SUMMARY

This report describes a roadway traffic noise assessment undertaken in support of a Site Plan Control (SPC) application for a proposed development comprising a nine-storey residential building and two 12-unit stacked townhouses, located at 1765 Montreal Road in Ottawa, Ontario. The major source of roadway traffic noise includes Montreal Road. Figure 1 illustrates the site location with surrounding context.

The assessment is based on (i) theoretical noise prediction methods that conform to the Ministry of the Environment, Conservation and Parks (MECP), Ministry of Transportation of Ontario (MTO), 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) site plan drawings provided by Landric Homes in January 2022.

It should be noted that the acoustic model used in this report was based on drawings received in January 2022. Gradient Wind has since received updated architectural drawings in October 2022 which introduce negligible changes to the proposed townhouses from an acoustics perspective. These changes include the conversion of the stacked townhouses to traditional townhouses. As such, the results and recommendations in this assessment remain unchanged.

The results of the current analysis indicated that noise levels at Plane of Window (POW) receptors will range between 43 and 68 dBA during the daytime period (07:00-23:00) and between 35 and 60 dBA during the nighttime period (23:00-07:00). The highest noise level (68 dBA) occurs at the south façade of Building A, which is nearest and most exposed to Montreal Road.

Building components with a higher Sound Transmission Class (STC) rating will be required on the south façade of Building A as exterior noise levels are expected to exceed 65 dBA. The results of the analysis also indicate that Building A will require central air conditioning, which will allow occupants to keep windows closed and maintain a comfortable living environment. Warning Clauses will also be required on all Lease, Purchase and Sale Agreements, as summarized in Section 6. Furthermore, as noise levels at the townhomes are expected to fall below 55 dBA during the daytime period, ventilation is not required for noise mitigation purposes.

Noise levels at the Building A Level 7 amenity terrace fall below the ENCG noise criterion for OLAs. As such, noise mitigation is not required.

With regard to stationary noise impacts, a stationary noise study is recommended for the site during the detailed design once mechanical plans for the proposed buildings become available. This study would assess impacts of stationary noise from rooftop mechanical units serving the proposed buildings on surrounding noise sensitive areas. This study will include recommendations for any noise control measures that may be necessary to ensure noise levels fall below ENCG limits. As the mechanical equipment will primarily reside in the mechanical level located on the high roof, noise levels on the surrounding noise sensitive properties are expected to be negligible. In the event that noise levels exceed the ENCG criteria, noise impacts can generally be minimized by judicious selection and placement of the equipment.

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1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Landric Homes to undertake a roadway traffic noise assessment for a proposed development comprising a nine-storey residential building and two 12-unit stacked townhouses, located at 1765 Montreal Road in Ottawa, Ontario. This report summarizes the methodology, results, and recommendations related to the assessment of exterior and interior noise levels generated by local roadway traffic.

Our work is based on theoretical noise calculation methods conforming to the City of Ottawa[1], Ministry of Transportation Ontario (MTO)[2], and Ministry of the Environment, Conservation and Parks (MECP)[3] guidelines. Noise calculations were based on site plan drawings provided by Landric Homes in January 2022, with future traffic volumes corresponding to the City of Ottawa's Official Plan (OP) roadway classifications.

2. TERMS OF REFERENCE

The focus of this roadway traffic noise assessment is a proposed development comprising a nine-storey residential building and two 12-unit stacked townhouses, located at 1765 Montreal Road in Ottawa, Ontario. The proposed development is located on a rectangular parcel of land fronted by Montreal Road to the south.

The proposed nine-storey, L-shaped residential building (denoted as Building A for the purpose of this assessment), is situated at the south end of the site. The building includes a parking level below grade. The ground floor includes a lobby area, building support facilities, as well as residential units. The remaining floors above are primarily reserved for residential use. The floor plate rises with a uniform planform until Level 5 where the north façade sets back to accommodate a private balcony. The floor plate rises with a uniform planform from Level 5 to Level 6. At Level 7 north façade sets back to accommodate a communal amenity terrace. The floor plate rises with a uniform planform for the remaining floors above.

[1] City of Ottawa Environmental Noise Control Guidelines, January 2016
[2] Ministry of Transportation Ontario, "*Environmental Guide for Noise*", August 2021
[3] Ontario Ministry of the Environment, Conservation and Parks – Environmental Noise Guidelines, Publication NPC-300, Queens Printer for Ontario, Toronto, 2013

The two stacked townhome buildings are situated at the north end of the development in-line with the north property line. The buildings comprise 4-storeys and include 12-units. For the purpose of this assessment, the townhomes are denoted as Townhouse A and Townhouse B beginning from the west to the east, respectively. The site includes outdoor parking spaces between the residential building and the townhomes.

Primary source of noise impacting the site includes roadway traffic along Montreal Road. Figure 1 illustrates the site location with 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 Roadway Traffic Noise

4.2.1 Criteria for Roadway Traffic Noise

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

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

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. As per NPC-300, parks/parkettes are not defined as Outdoor Living Areas or noise sensitive spaces.

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 is also being accepted in the updated Environmental Guide for Noise of Ontario, 2021 by the Ministry of Transportation (MTO)[8]. This computer program can represent three-dimensional surfaces and 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 nine receptor locations were identified around the site, as illustrated in Figure 2.

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:

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[7] MECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.1.3
[8] Ministry of Transportation, Environmental Guide for Noise, 2021. Retrieved from https://prod-environmental-registry.s3.amazonaws.com/2021-08/Environmental%20Guide%20for%20Noise%20 2021%20%28Aug%202021 %29.pdf

- 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.
- Ground surfaces were taken to be reflective due to the presence of hard (paved) ground.
- The study site was treated as having flat or gently sloping topography along Montreal Road. The site elevation was based on a grading profile provided by Landric Homes in January 2022.
- Massing associated with the study site was included as potential noise screening elements.
- Nine receptors were strategically placed throughout the study area.
- Receptor distances and exposure angles are illustrated in Figure 4.

4.2.3 Roadway Traffic Volumes

The ENCG dictates that noise calculations should consider future sound levels based on a roadway's classification at the mature state of development. Therefore, traffic volumes are based on the roadway classifications outlined in the City of Ottawa's Official Plan (OP) and Transportation Master Plan[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.

TABLE 2: ROADWAY TRAFFIC DATA

Segment	Roadway Traffic Data	Speed Limit (km/h)	Traffic Volumes
Montreal Road	4-Lane Urban Arterial Divided (4-UAD)	60	**35,000**

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

4.3 Indoor Noise Calculations

The difference between outdoor and indoor noise levels is the noise attenuation provided by the building envelope. According to common industry practice, complete walls and individual wall elements are rated according to the Sound Transmission Class (STC). The STC ratings of common residential walls built in conformance with the Ontario Building Code (2012) typically exceed STC 35, depending on exterior cladding, thickness and interior finish details. For example, brick veneer walls can achieve STC 50 or more. Standard commercially sided exterior metal stud walls have around STC 45. Standard good quality double-glazed non-operable windows can have STC ratings ranging from 25 to 40, depending on the window manufacturer, pane thickness and inter-pane spacing. As previously mentioned, the windows are the known weak point in a partition.

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

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

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

[10] Building Practice Note: Controlling Sound Transmission into Buildings by J.D. Quirt, National Research Council of Canada, September 1985
[11] CMHC, Road & Rail Noise: Effects on Housing

5. RESULTS

5.1 Roadway Traffic Noise Levels

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

TABLE 3: EXTERIOR NOISE LEVELS DUE TO ROADWAY TRAFFIC

Receptor Number	Receptor Height Above Grade/Roof (m)	Receptor Location	Predictor-Lima Noise Level (dBA)	
			Day	Night
1	25.7	POW – Building A - West Facade	65	58
2	25.7	POW – Building A - South Facade	68	60
3	25.7	POW - Building A - East Facade	65	58
4	25.7	POW - Building A - North Facade	43	35
5	11.35	POW - Townhouse A - East Facade	53	46
6	11.35	POW - Townhouse A - South Facade	54	47
7	11.35	POW - Townhouse B - South Facade	53	46
8	11.35	POW - Townhouse B - East Facade	53	46
9	1.5	OLA - Building A - Level 7 Terrace	53	N/A*

*Nighttime noise levels are not considered as per ENCG

The results of the current analysis indicated that noise levels at Plane of Window (POW) receptors will range between 43 and 68 dBA during the daytime period (07:00-23:00) and between 35 and 60 dBA during the nighttime period (23:00-07:00). The highest noise level (68 dBA) occurs at the south façade of Building A, which is nearest and most exposed to Montreal Road. Figures 5 and 6 illustrate daytime and nighttime noise contours throughout the site at a height of 10 m above grade.

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. Upgraded building components will be required for the dwellings where noise levels exceed 65 dBA at the Plane of Window (POW), as per ENCG criteria. Building components compliant with the Ontario Building Code (OBC 2020) will be sufficient for all other dwellings.

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
R1	POW – Building A - West Facade	25.7	68	61	65	58
R6	POW - Townhouse A - South Facade	11.35	57	50	54	47

5.2 Noise Control Measures

The noise levels predicted due to roadway traffic exceed the criteria listed in Section 4.2 for building components. As discussed in Section 4.3, the anticipated STC requirements for windows and walls have been estimated based on the overall noise reduction required for each intended use of space (STC = Outdoor Noise Level – Targeted Indoor Noise Levels). The STC requirements for the windows are summarized below for the development (see Figure 3):

- **Bedroom Windows**

(i) Bedroom windows facing south for Building A will require a minimum STC of 31.

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

- **Living Room Windows**

(i) Living room windows facing south for Building A will require a minimum STC of 26.

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

- **Exterior Walls**

(i) Exterior wall components on the south façade of Building A will 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 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 punch window and wall system may be used. A review of window supplier literature indicates that the specified STC

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

ratings can be achieved by a variety of window systems that have 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 Building A will require central air conditioning, which will allow occupants to keep windows closed and maintain a comfortable living environment (see Figure 3). In addition to ventilation requirements, Warning Clauses will also be required in all Lease, Purchase and Sale Agreements, as summarized in Section 6. Furthermore, as noise levels at the townhomes are expected to fall below 55 dBA during the daytime period, ventilation is not required for noise mitigation purposes.

Noise levels at the Building A Level 7 amenity terrace fall below the ENCG noise criterion for OLAs. As such, noise mitigation is not required.

6. CONCLUSIONS AND RECOMMENDATIONS

The results of the current analysis indicated that noise levels at Plane of Window (POW) receptors will range between 43 and 68 dBA during the daytime period (07:00-23:00) and between 35 and 60 dBA during the nighttime period (23:00-07:00). The highest noise level (68 dBA) occurs at the south façade of Building A, which is nearest and most exposed to Montreal Road. Figures 5 and 6 illustrate daytime and nighttime noise contours throughout the site at a height of 4.5 m above grade.

Building components with a higher Sound Transmission Class (STC) rating will be required on the south façade of Building A as exterior noise levels are expected to exceed 65 dBA. The results of the analysis also indicate that Building A will require central air conditioning, which will allow occupants to keep windows closed and maintain a comfortable living environment. Furthermore, as noise levels at the townhomes are expected to fall below 55 dBA during the daytime period, ventilation is not required for noise mitigation purposes.

A Type D Warning Clause will also be required be placed on all Lease, Purchase and Sale Agreements for Building A, 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, Conservation and Parks."*

Noise levels at the Building A Level 7 amenity terrace fall below the ENCG noise criterion for OLAs. As such, noise mitigation is not required.

With regard to stationary noise impacts, a stationary noise study is recommended for the site during the detailed design once mechanical plans for the proposed building become available. This study would assess impacts of stationary noise from rooftop mechanical units serving the proposed building on surrounding noise sensitive areas. This study will include recommendations for any noise control measures that may be necessary to ensure noise levels fall below ENCG limits. As the mechanical equipment will primarily reside in the mechanical level located on the high roof, noise levels on the surrounding noise sensitive properties are expected to be negligible. In the event that noise levels exceed the ENCG criteria, noise impacts can generally be minimized by judicious selection and placement of the equipment.

This concludes our roadway 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,

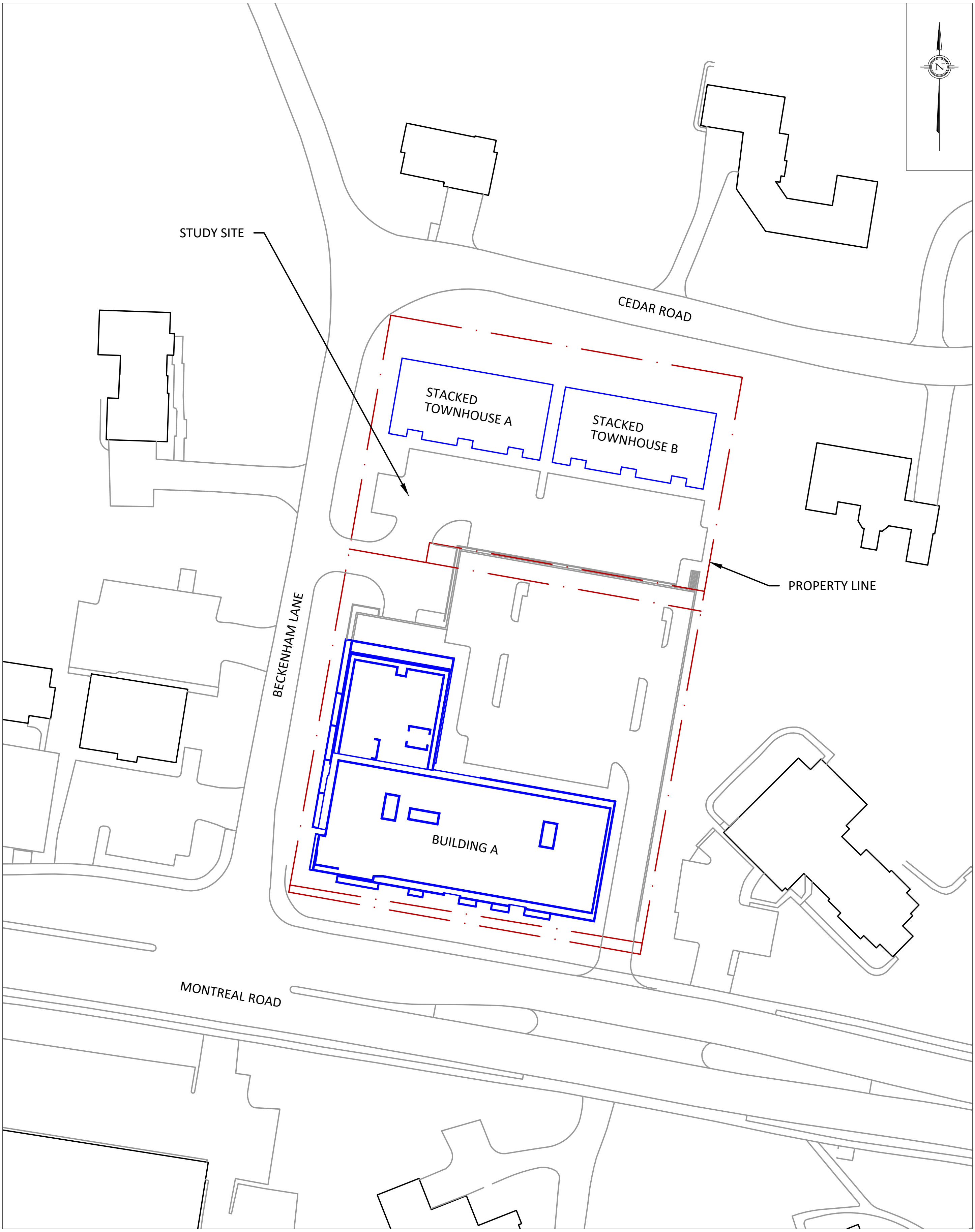
Gradient Wind Engineering Inc.

Giuseppe Garro, MASc.
Environmental Scientist

Joshua Foster, P.Eng.
Lead Engineer

LICENSED PROFESSIONAL ENGINEER
J. R. FOSTER
100155655
PROVINCE OF ONTARIO

Gradient Wind File #21-403 – Roadway Traffic Noise



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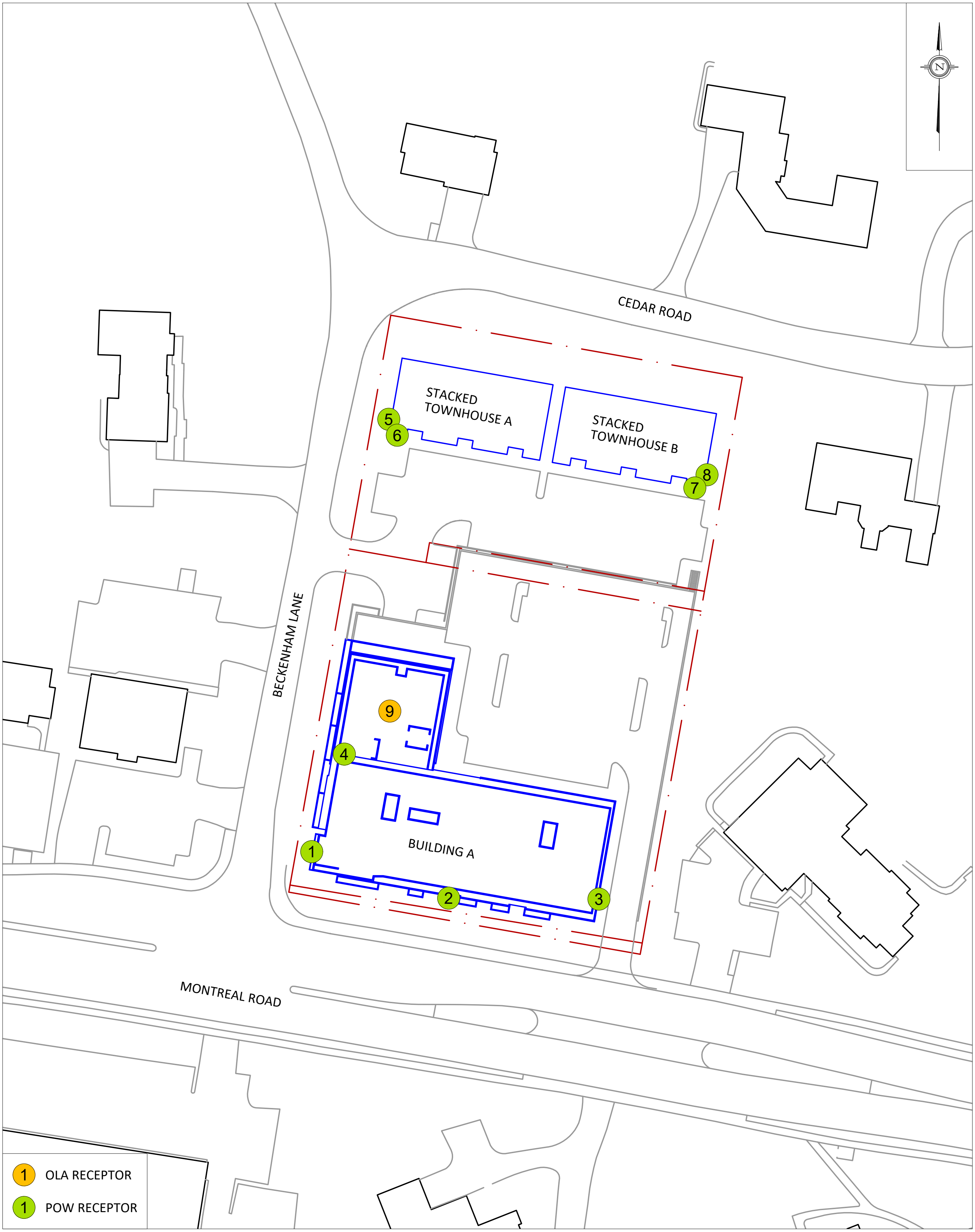
PROJECT	1765 MONTREAL ROAD, OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT		
SCALE	1:1000 (APPROX.)	DRAWING NO.	GW21-403-1
DATE	JANUARY 17, 2022	DRAWN BY	G.G.

DESCRIPTION

FIGURE 1:
SITE PLAN AND SURROUNDING CONTEXT



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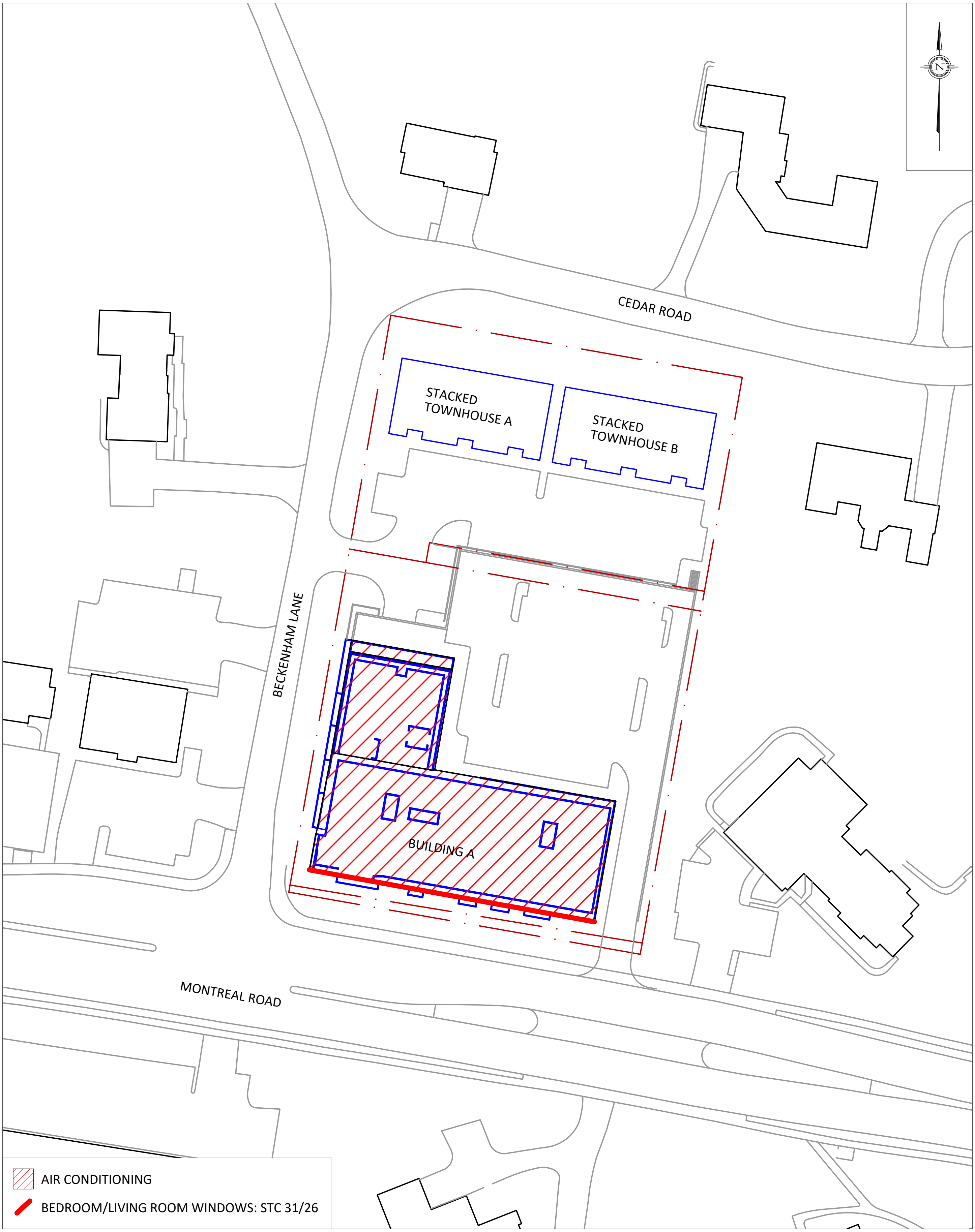
SCALE	1:1000 (APPROX.)	DRAWING NO.	GW21-403-2
DATE	JANUARY 17, 2022	DRAWN BY	G.G.

DESCRIPTION

FIGURE 2:
RECEPTOR LOCATIONS



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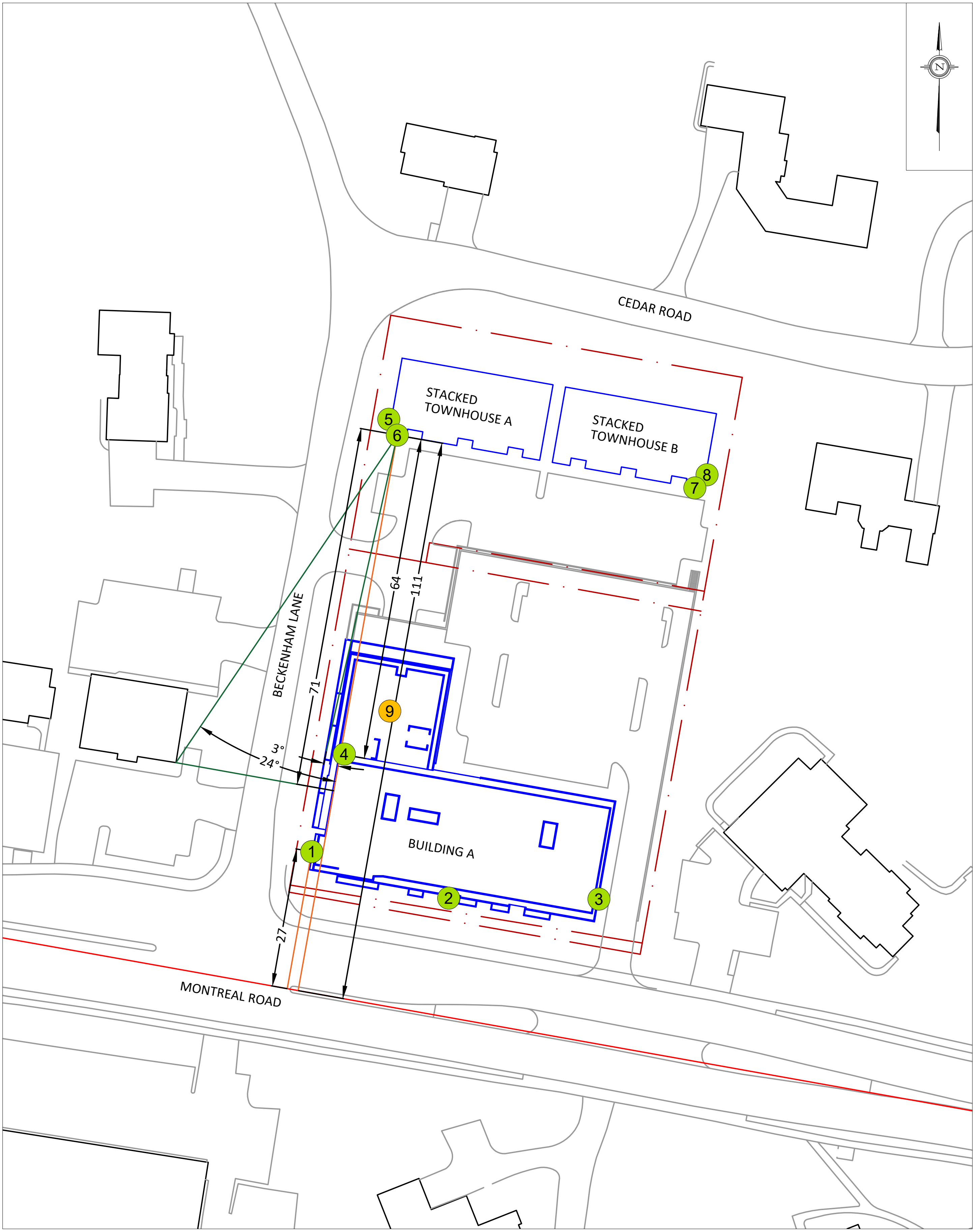
PROJECT	1765 MONTREAL ROAD, OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT		DESCRIPTION
SCALE	1:1000 (APPROX.)	DRAWING NO. GW21-403-3	FIGURE 3: WINDOW STC AND VENTILATION REQUIREMENTS
DATE	JANUARY 17, 2022	DRAWN BY G.G.	



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SCALE	1:1000 (APPROX.)	DRAWING NO.	GW21-403-4
DATE	JANUARY 17, 2022	DRAWN BY	G.G.

DESCRIPTION

FIGURE 4:
STAMSON INPUT PARAMETERS

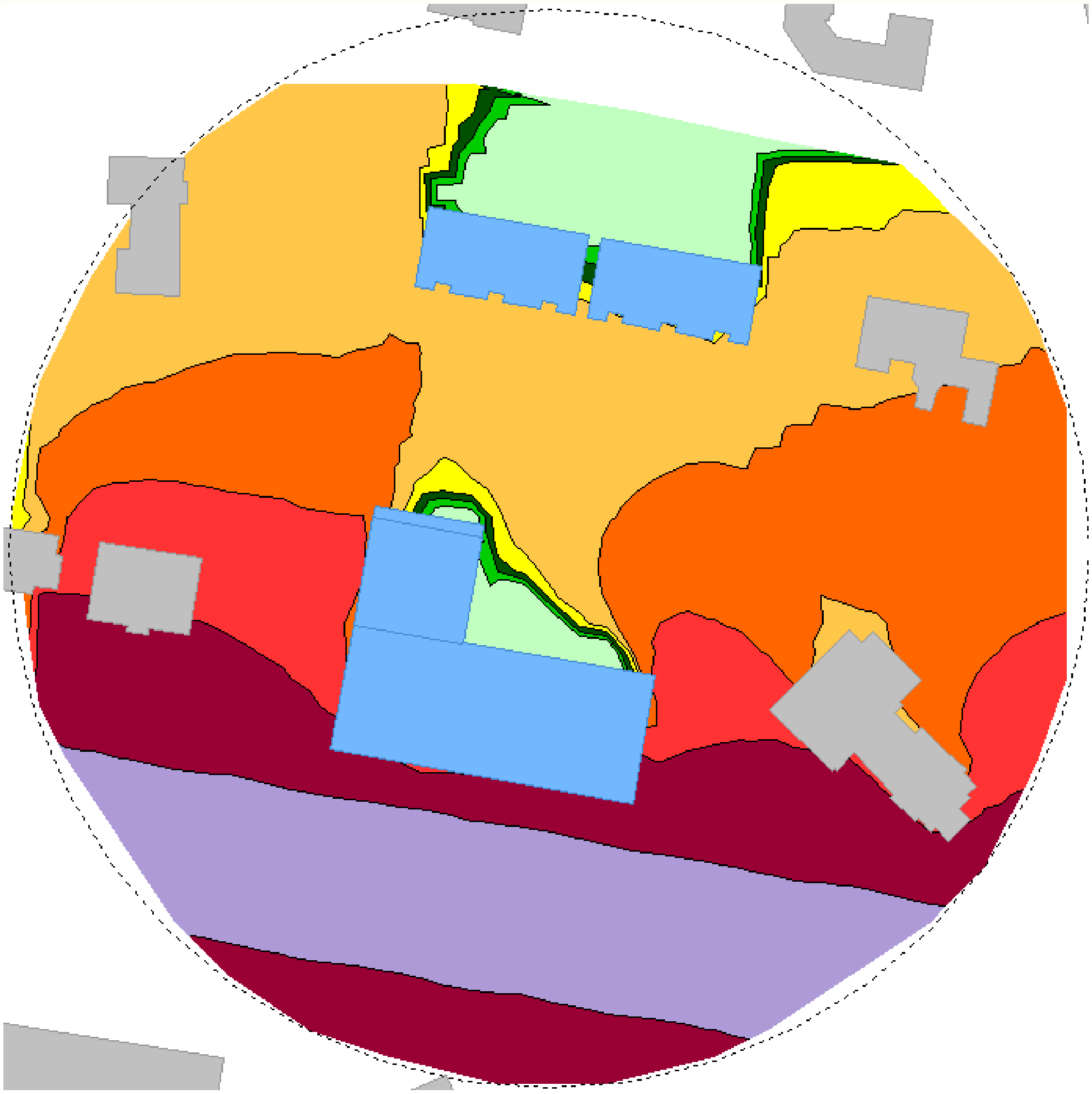
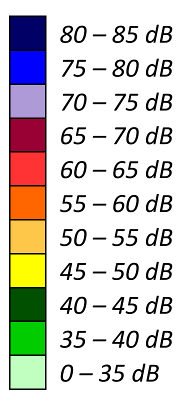


FIGURE 5: DAYTIME TRAFFIC NOISE CONTOURS (10 M ABOVE GRADE)



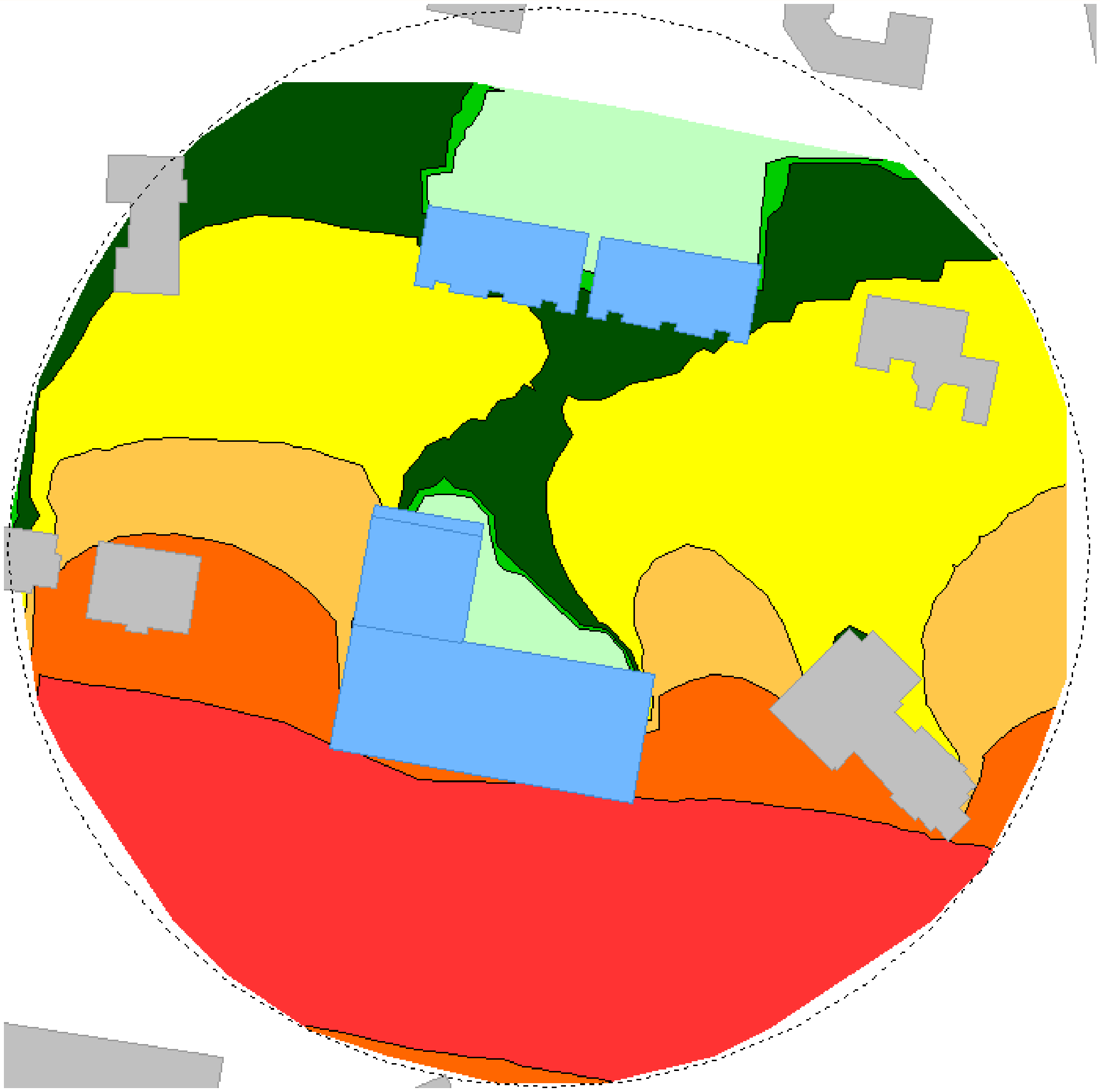
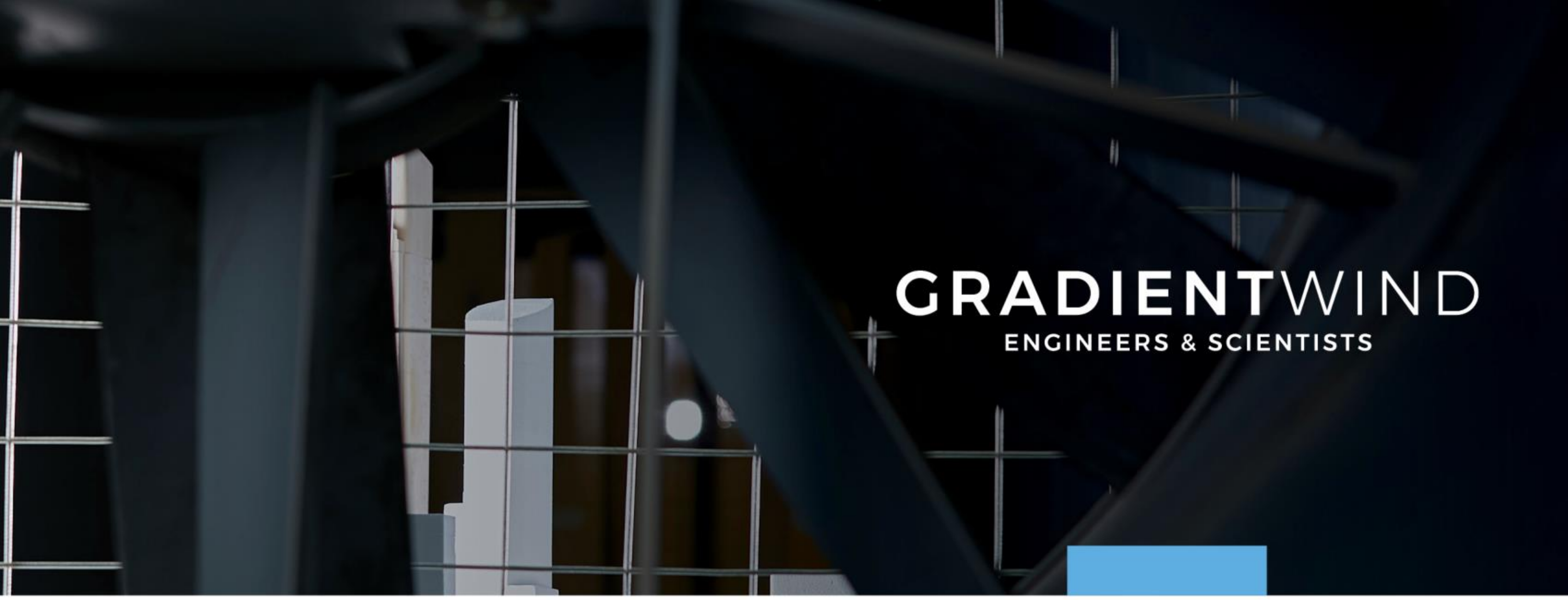
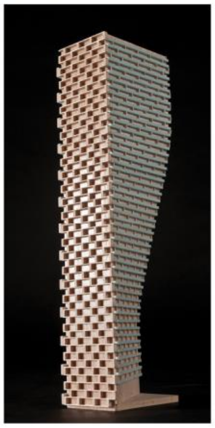
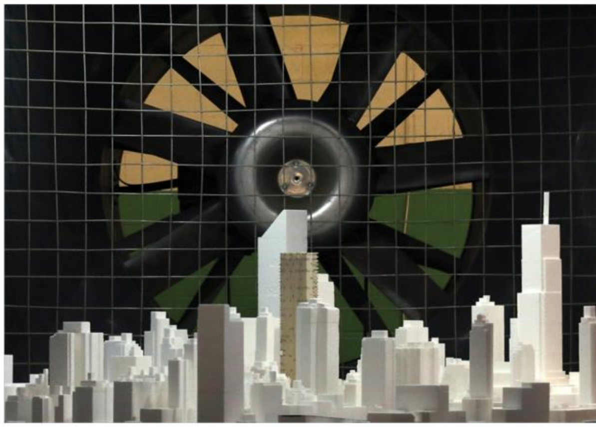


FIGURE 6: NIGHTTIME TRAFFIC NOISE CONTOURS
(10 M ABOVE GRADE)

80 – 85 dB
75 – 80 dB
70 – 75 dB
65 – 70 dB
60 – 65 dB
55 – 60 dB
50 – 55 dB
45 – 50 dB
40 – 45 dB
35 – 40 dB
0 – 35 dB







APPENDIX A

STAMSON 5.04 – INPUT AND OUTPUT DATA

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```
 STAMSON 5.0        NORMAL REPORT        Date: 14-01-2022 16:41:07
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r1.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: MR (day/night)
--------------------------------------
Car traffic volume  : 28336/2464  veh/TimePeriod  *
Medium truck volume :  2254/196   veh/TimePeriod  *
Heavy truck volume  :  1610/140   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  35000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: MR (day/night)
------------------------------------
Angle1   Angle2           :   0.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  27.00 / 27.00  m
Receiver height           :  25.70 / 25.70  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


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

Source height = 1.50 m

ROAD (0.00 + 68.11 + 0.00) = 68.11 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
     0     90   0.00  73.68   0.00  -2.55  -3.01   0.00   0.00   0.00
68.11
--------------------------------------------------------------------------
--
```

```
Segment Leq : 68.11 dBA

Total Leq All Segments: 68.11 dBA

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

Source height = 1.50 m

ROAD (0.00 + 60.52 + 0.00) = 60.52 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
     0     90   0.00  66.08   0.00  -2.55  -3.01   0.00   0.00   0.00
60.52
--------------------------------------------------------------------------
--

Segment Leq : 60.52 dBA

Total Leq All Segments: 60.52 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 68.11
                         (NIGHT): 60.52
```

```
STAMSON 5.0        NORMAL REPORT        Date: 14-01-2022 16:41:15
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r6.te                 Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: MR1 (day/night)
---------------------------------------
Car traffic volume  : 28336/2464  veh/TimePeriod  *
Medium truck volume :  2254/196   veh/TimePeriod  *
Heavy truck volume  :  1610/140   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  35000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: MR1 (day/night)
-------------------------------------
Angle1   Angle2           : -90.00 deg   3.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 111.00 / 111.00 m
Receiver height           :  11.35 / 11.35  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 3.00 deg
Barrier height            :  28.00 m
Barrier receiver distance :  64.00 / 64.00  m
Source elevation          : 106.00 m
Receiver elevation        : 102.00 m
Barrier elevation         : 106.00 m
Reference angle           :   0.00

Road data, segment # 2: MR2 (day/night)
---------------------------------------
Car traffic volume  : 28336/2464  veh/TimePeriod  *
Medium truck volume :  2254/196   veh/TimePeriod  *
Heavy truck volume  :  1610/140   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)
```

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

    24 hr Traffic Volume (AADT or SADT):  35000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: MR2 (day/night)
-------------------------------------
Angle1   Angle2           :   3.00 deg   24.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 111.00 / 111.00 m
Receiver height           :  11.35 / 11.35  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :   3.00 deg   Angle2 : 24.00 deg
Barrier height            :   0.00 m
Barrier receiver distance :  64.00 / 64.00  m
Source elevation          : 106.00 m
Receiver elevation        : 102.00 m
Barrier elevation         : 106.00 m
Reference angle           :   0.00

Road data, segment # 3: MR3 (day/night)
---------------------------------------
Car traffic volume  : 28336/2464  veh/TimePeriod  *
Medium truck volume :  2254/196   veh/TimePeriod  *
Heavy truck volume  :  1610/140   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  35000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 3: MR3 (day/night)
-------------------------------------
Angle1   Angle2           :  24.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 111.00 / 111.00 m
```

```
Receiver height              :  11.35 / 11.35  m
Topography                   :      2       (Flat/gentle slope; with barrier)
Barrier angle1               :  24.00 deg   Angle2 : 90.00 deg
Barrier height               :   7.00 m
Barrier receiver distance :  71.00 / 71.00  m
Source elevation             : 106.00 m
Receiver elevation           : 102.00 m
Barrier elevation            : 106.00 m
Reference angle              :   0.00

Results segment # 1: MR1 (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 !        11.35 !         3.97 !       109.97

ROAD (0.00 + 43.27 + 0.00) = 43.27 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90      3   0.00  73.68   0.00  -8.69  -2.87   0.00   0.00 -18.85
43.27
--------------------------------------------------------------------------
--

Segment Leq : 43.27 dBA

Results segment # 2: MR2 (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 !        11.35 !         3.97 !       109.97

ROAD (0.00 + 55.65 + 0.00) = 55.65 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
```

```
    3     24    0.00   73.68    0.00   -8.69   -9.33    0.00    0.00    0.00
55.65*
    3     24    0.00   73.68    0.00   -8.69   -9.33    0.00    0.00    0.00
55.65
--------------------------------------------------------------------------
--

 * Bright Zone !

Segment Leq : 55.65 dBA

Results segment # 3: MR3 (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 !       11.35 !        3.61 !       109.61

ROAD (0.00 + 52.05 + 0.00) = 52.05 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   24     90    0.00   73.68    0.00   -8.69   -4.36    0.00    0.00   -8.58
52.05
--------------------------------------------------------------------------
--

Segment Leq : 52.05 dBA

Total Leq All Segments: 57.39 dBA

Results segment # 1: MR1 (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 !       11.35 !        3.97 !       109.97

ROAD (0.00 + 35.67 + 0.00) = 35.67 dBA
```

```
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90      3   0.00  66.08   0.00  -8.69  -2.87   0.00   0.00 -18.85
35.67
--------------------------------------------------------------------------
--

Segment Leq : 35.67 dBA

Results segment # 2: MR2 (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 !        11.35 !         3.97 !        109.97

ROAD (0.00 + 48.06 + 0.00) = 48.06 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
     3     24   0.00  66.08   0.00  -8.69  -9.33   0.00   0.00   0.00
48.06*
     3     24   0.00  66.08   0.00  -8.69  -9.33   0.00   0.00   0.00
48.06
--------------------------------------------------------------------------
--

 * Bright Zone !

Segment Leq : 48.06 dBA

Results segment # 3: MR3 (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 !        11.35 !         3.61 !        109.61
```

```
ROAD (0.00 + 44.45 + 0.00) = 44.45 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
    24     90   0.00  66.08   0.00  -8.69  -4.36   0.00   0.00  -8.58
44.45
--------------------------------------------------------------------------
--

Segment Leq : 44.45 dBA

Total Leq All Segments: 49.80 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 57.39
                         (NIGHT): 49.80
```