

**TRAFFIC NOISE
ASSESSMENT**

255 Richmond Road
Ottawa, Ontario

REPORT: GWE21-327 – Traffic Noise



October 28, 2021

PREPARED FOR

Y Street Capital Inc

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EXECUTIVE SUMMARY

This report describes a traffic noise assessment undertaken in support of site plan application for a proposed mixed-use development located at 255 Richmond Road in Ottawa, Ontario. The development is a nine-storey building with predominantly retail at grade and residential units in the remaining floors above. Outdoor amenity areas are provided at certain locations where the building steps back. The major source of traffic noise is Richmond Road to the south of the site. Figure 1 illustrates a complete site plan with surrounding context.

The assessment is based on (i) theoretical noise prediction methods that conform to the Ministry of the Environment, Conservation and Parks (MECP) and City of Ottawa requirements; (ii) noise level criteria as specified by the City of Ottawa's Environmental Noise Control Guidelines (ENCG); (iii) future vehicular traffic volumes based on the City of Ottawa's Official Plan roadway classifications; and (iv) site plan drawings prepared by Vincent P. Colizza Architects Inc. dated October 2021.

The results of the current analysis indicate that noise levels will range between 45 and 68 dBA during the daytime period (07:00-23:00) and between 57 and 61 dBA during the nighttime period (23:00-07:00). The highest noise level (68 dBA) occurs at the south façade, which is nearest and most exposed to Richmond Road. Building components with a higher Sound Transmission Class (STC) rating will be required where exterior noise levels exceed 65 dBA, as indicated in Figure 5.

Results of the 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. A Warning Clause¹ will also be required in all Lease, Purchase and Sale Agreements.

Noise levels at the OLA located at the northeast corner of the building (receptor 6) are expected to approach 57 dBA during the daytime period. Since noise levels exceed 55 dBA at this location, it is recommended to provide mitigation where it is administratively and technically feasible. However, since noise levels do not exceed 60 dBA, mitigation is not required.

¹ City of Ottawa Environmental Noise Control Guidelines, January 2016



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1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Y Street Capital Inc. to undertake a traffic noise assessment in support of site plan application for a proposed mixed-use development at 255 Richmond 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.

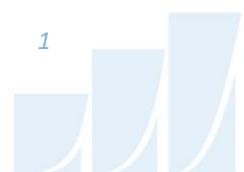
Our work is based on theoretical noise calculation methods conforming to the City of Ottawa² and Ministry of the Environment, Conservation and Parks (MECP)³ guidelines. Noise calculations were based on architectural drawings prepared by Vincent P. Colizza Architects Inc. dated October 2021, with future traffic volumes corresponding to the City of Ottawa's Official Plan (OP) roadway classifications.

2. TERMS OF REFERENCE

The proposed development comprises a nine-storey building with an 'L' shaped plan form located at the northwest corner of Richmond Road and Tweedsmuir Avenue in Ottawa. Three below grade parking levels occupy the full site on a quadrilateral, nearly rectangular, footprint. The floor plans vary on each level with the biggest changes occurring above level four due to setbacks progressively on the north elevation at higher levels. The ground floor contains residential functions, common amenity spaces and double height retail spaces occupying the Richmond Road half of the south elevation. The indoor amenity spaces at the northwest quadrant of the ground floor also connect to an outdoor patio at the north facing corner of the building. Private terraces begin at level four on the north elevation and continue to level seven. At level eight the building footprint reduces to create large private terraces around the full perimeter. Private balconies, either recessed or cantilevered, serve the majority of the remaining suites. Certain outdoor terraces are private and are less than 4 meters in depth, these do not require consideration as outdoor living areas (OLA). The main condominium entrance and ramp to underground parking occur side-by-side on Tweedsmuir Avenue.

² City of Ottawa Environmental Noise Control Guidelines, January 2016

³ Ontario Ministry of the Environment and Climate Change – Environmental Noise Guidelines, Publication NPC-300, Queens Printer for Ontario, Toronto, 2013



The site is surrounded by low-rise residential, and commercial buildings in all directions with one medium-rise residential building to the southeast.

The major source of traffic noise is Richmond Road. Roadways located beyond 100 metres of the study site are not included as sources influencing the study site as per ENCG Section 2.1. Figure 1 illustrates a complete site plan 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 for roadway as listed in Table 1.

TABLE 1: INDOOR SOUND LEVEL CRITERIA (ROAD)⁴

| 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 reduction⁵. A closed window due to a ventilation requirement will bring noise levels down to achieve an acceptable indoor environment⁶. 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 attenuation⁷.

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

⁷ MECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.1.3

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.

4.2.2 Theoretical Roadway Noise Predictions

Noise predictions were performed with the aid of the MECP computerized noise assessment program, STAMSON 5.04, for road analysis. Appendix A includes the STAMSON 5.04 input and output data.

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

- Truck traffic on all roadways was taken to comprise 5% heavy trucks and 7% medium trucks, as per ENCG requirements for noise level predictions.
- The day/night split for all streets was taken to be 92%/8%, respectively.
- Ground surfaces were taken to be reflective due to the presence of hard (paved) ground.
- Topography was assumed to be a flat/gentle slope surrounding the study building.
- For select sources where appropriate, Receptors 1-6 considered the proposed building as a barrier with a height of 29 metres, partially or fully obstructing exposure to the source as illustrated by exposure angles in Figures 3 & 4.
- Noise receptors were strategically placed at 6 locations around the study area (see Figure 2).
- Receptor distances and exposure angles are illustrated in Figures 3 & 4.

4.2.1 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 Plan⁸ which provide additional details on future roadway expansions. Average Annual Daily Traffic (AADT) volumes

⁸ City of Ottawa Transportation Master Plan, November 2013

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 |
|---------------|----------------------------------|--------------------|-----------------|
| Richmond Road | 2-Lane Urban Arterial (2-UAU) | 50 | 15,000 |

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 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 procedure⁹ 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

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

Based on published research¹⁰, 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).

RESULTS AND DISCUSSION

4.4 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.

TABLE 3: EXTERIOR NOISE LEVELS DUE TO ROAD TRAFFIC

| Receptor Number | Receptor Height Above Grade (m) | Receptor Location | STAMSON 5.04 Noise Level (dBA) | |
|-----------------|---------------------------------|--|--------------------------------|-------|
| | | | Day | Night |
| 1 | 26.5 | POW – 9 th Floor – East Façade | 65 | 57 |
| 2 | 26.5 | POW – 9 th Floor – South Façade | 68 | 61 |
| 3 | 26.5 | POW – 9 th Floor – West Façade | 64 | 57 |
| 4 | 23.8 | OLA – Rooftop Outdoor Amenity Area – 8 th Level | 47 | N/A* |
| 5 | 4.7 | OLA – Rooftop Outdoor Amenity Area – 1 st Level | 45 | N/A* |
| 6 | 23.8 | OLA – Rooftop Outdoor Amenity Area – 8 th Level | 57 | N/A* |

*Nighttime noise levels not considered at OLA's as per ENCG

The results of the current analysis indicate that noise levels will range between 45 and 68dBA during the daytime period (07:00-23:00) and between 57 and 61 dBA during the nighttime period (23:00-07:00).

¹⁰ CMHC, Road & Rail Noise: Effects on Housing

The highest noise level (71 dBA) occurs at the south façade, which is nearest and most exposed to Richmond Road.

4.5 Noise Control Measures

The noise levels predicted due to roadway traffic exceed the criteria listed in Section 4.2 for building components. As discussed in Section 4.3, the anticipated STC requirements for windows have been estimated based on the overall noise reduction required for each intended use of space (STC = outdoor noise level – targeted indoor noise levels). As per 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 below for various units within the development (see Figure 7):

- **Bedroom Windows**
 - (i) All bedroom windows on the south façade will require a minimum STC of 31
 - (ii) All other bedroom windows are to satisfy Ontario Building Code (OBC 2012) requirements
- **Living Room Windows**
 - (i) All living room windows on the south façade will require a minimum STC of 26
 - (ii) All other living room windows are to satisfy Ontario Building Code (OBC 2012) requirements
- **Retail Windows**
 - (iii) All retail windows on the south façade will require a minimum STC of 21
 - (iv) All other retail windows are to satisfy Ontario Building Code (OBC 2012) requirements
- **Exterior Walls**
 - (i) Exterior wall components on the south façade will require a minimum STC of 45, which will be achieved with brick cladding or an acoustical equivalent according to NRC test data¹¹

¹¹ J.S. Bradley and J.A. Birta. Laboratory Measurements of the Sound Insulation of Building Façade Elements, National Research Council October 2000.

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 for the wall component, where a punch window and 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 will offer the necessary sound attenuation rating. It is the responsibility of the manufacturer to ensure that the specified window achieves the required STC. This can only be assured by using window configurations that have been certified by laboratory testing. The requirements for STC ratings assume that the remaining components of the building are constructed and installed according to the minimum standards of the Ontario Building Code. The specified STC requirements also apply to swinging and/or sliding patio doors.

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

5. CONCLUSIONS AND RECOMMENDATIONS

The results of the current analysis indicate that noise levels will range between 45 and 68dBA during the daytime period (07:00-23:00) and between 57 and 61 dBA during the nighttime period (23:00-07:00). The highest noise level (68 dBA) occurs at the south façade, which is nearest and most exposed to Richmond Road. Building components with a higher Sound Transmission Class (STC) rating will be required where exterior noise levels exceed 65 dBA, as indicated in Figure 5.

Results of the 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. The following Warning Clause¹² will also be required be placed on all Lease, Purchase and Sale Agreements, as summarized below:

¹² City of Ottawa Environmental Noise Control Guidelines, January 2016

Type D

"This dwelling unit has been supplied with a central air conditioning system which will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the sound level limits of the Municipality and the Ministry of the Environment."

Noise levels at the OLA located at the northeast corner of the building (receptor 6) are expected to approach 57 dBA during the daytime period. Since noise levels exceed 55 dBA at this location, it is recommended to provide mitigation where it is administratively and technically feasible. However, since noise levels do not exceed 60 dBA, mitigation is not required. If mitigation is not provided, the following Warning Clause will be required on all Purchase, Lease, and Sale Agreements:

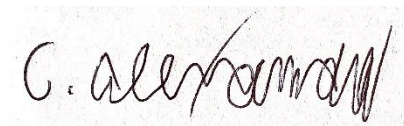
Type A

"Purchasers/tenants are advised that sound levels due to increasing road traffic may occasionally 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."

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.



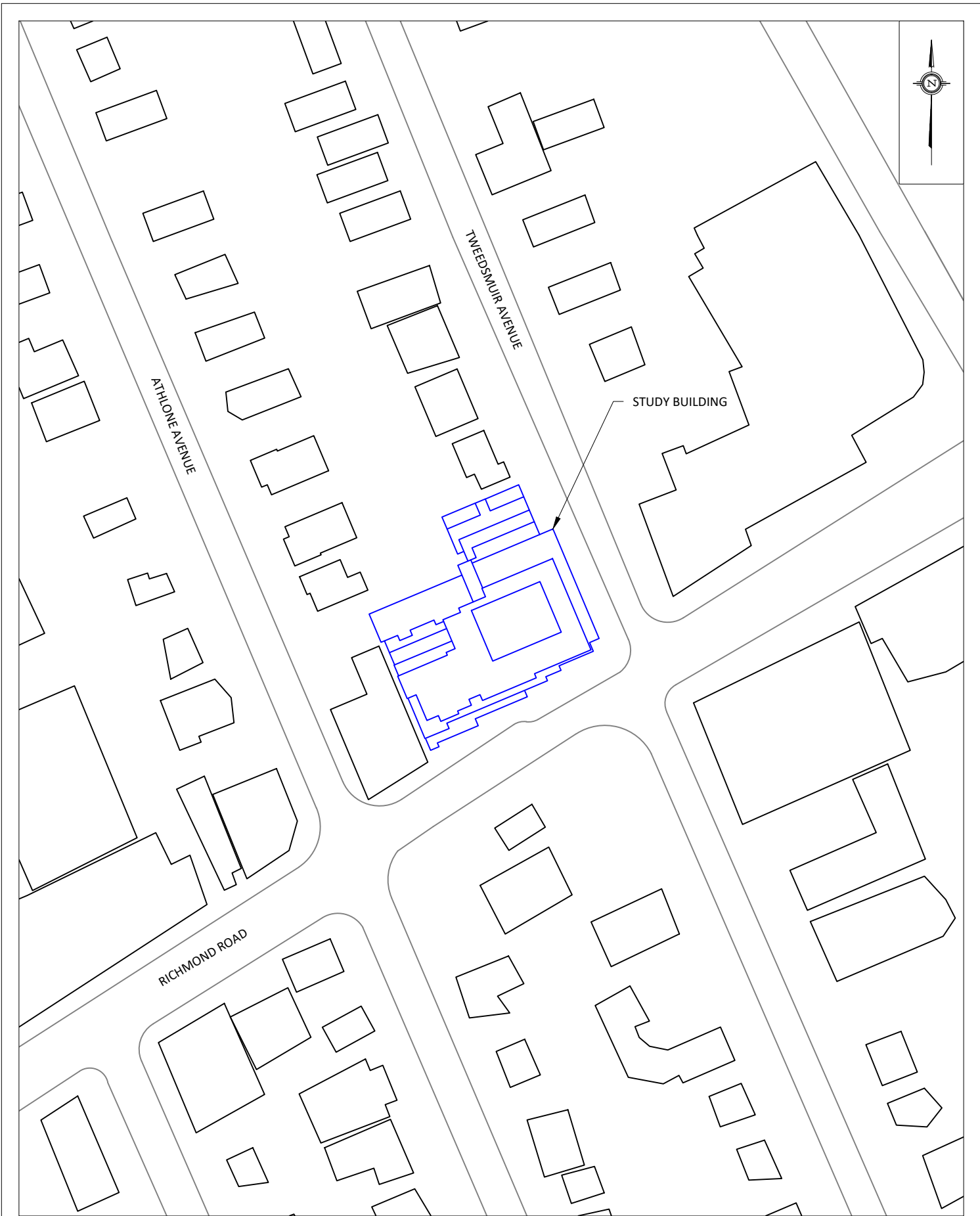
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GWE21-327



Joshua Foster, P.Eng.
Principal





GRADIENTWIND

ENGINEERS & SCIENTISTS

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

PROJECT

255 RICHMOND ROAD, OTTAWA
ROADWAY TRAFFIC NOISE ASSESSMENT

SCALE

1:1000 (APPROX.)

DRAWING NO.

GWE21-327-1

DATE

OCTOBER 25, 2021

DRAWN BY

C.A.

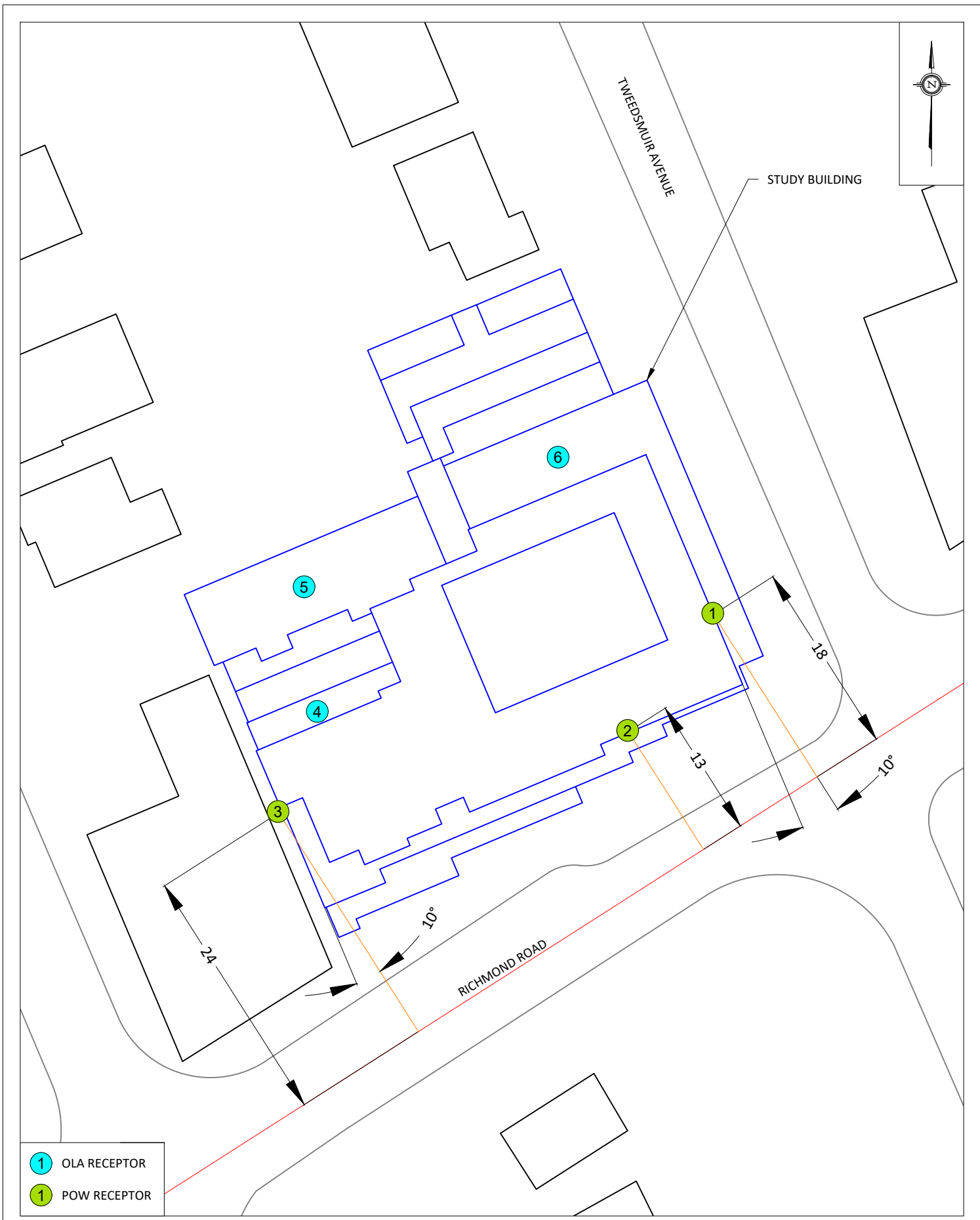
DESCRIPTION

FIGURE 1:
SITE PLAN AND SURROUNDING CONTEXT



- 1 OLA RECEPTOR
- 1 POW RECEPTOR

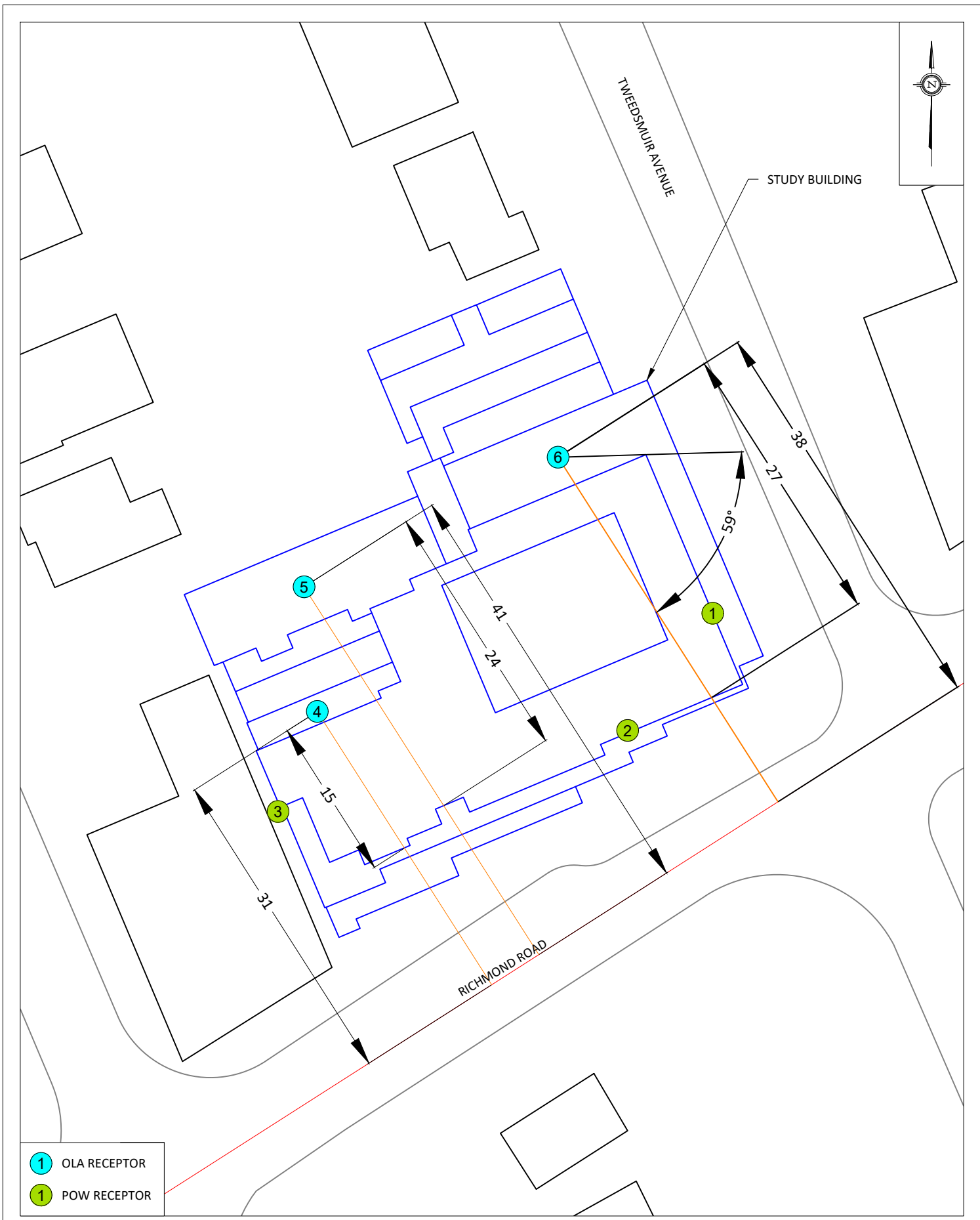
| | | | | | |
|---|---------|---|-------------|-------------|---------------------------------|
| GRADIENTWIND ENGINEERS & SCIENTISTS 127 WALGREEN ROAD, OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM | PROJECT | 255 RICHMOND ROAD, OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT | | DESCRIPTION | FIGURE 2: RECEPTOR LOCATIONS |
| | SCALE | 1:1000 (APPROX.) | DRAWING NO. | GWE21-327-2 | |
| | DATE | OCTOBER 25, 2021 | DRAWN BY | C.A. | |



- ❶ OLA RECEPTOR
- ❶ POW RECEPTOR

| | | | |
|---|---------|---|----------------------------|
| GRADIENTWIND ENGINEERS & SCIENTISTS 127 WALGREEN ROAD, OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM | PROJECT | 255 RICHMOND ROAD, OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT | DESCRIPTION |
| | SCALE | 1:1000 (APPROX.) | DRAWING NO. GWE21-327-3 |
| | DATE | OCTOBER 25, 2021 | DRAWN BY C.A. |

FIGURE 3:
STAMSON INPUT DATA RECEPTORS 1-3



- 1 OLA RECEPTOR
- 1 POW RECEPTOR

| | | | |
|---|---------|---|----------------------------|
| GRADIENTWIND ENGINEERS & SCIENTISTS 127 WALGREEN ROAD, OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM | PROJECT | 255 RICHMOND ROAD, OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT | DESCRIPTION |
| | SCALE | 1:1000 (APPROX.) | DRAWING NO. GWE21-327-4 |
| | DATE | OCTOBER 25, 2021 | DRAWN BY C.A. |

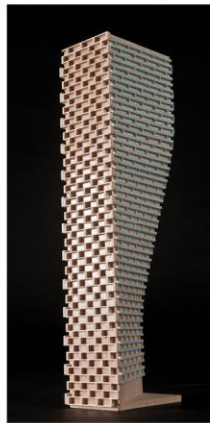
FIGURE 4:
STAMSON INPUT DATA RECEPTORS 4-6



| | | | | | |
|---|---------|---|-------------|-------------|-------------------------|
| GRADIENTWIND ENGINEERS & SCIENTISTS 127 WALGREEN ROAD, OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM | PROJECT | 255 RICHMOND ROAD, OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT | | DESCRIPTION | FIGURE 5: STC RATING |
| | SCALE | 1:1000 (APPROX.) | DRAWING NO. | GWE21-327-5 | |
| | DATE | OCTOBER 25, 2021 | DRAWN BY | C.A. | |

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APPENDIX A

STAMSON 5.04 – INPUT AND OUTPUT DATA

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STAMSON 5.0 NORMAL REPORT Date: 25-10-2021 22:06:46
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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

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

Car traffic volume : 12144/1056 veh/TimePeriod *
Medium truck volume : 966/84 veh/TimePeriod *
Heavy truck volume : 690/60 veh/TimePeriod *
Posted speed limit : 50 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

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

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

Data for Segment # 1: Richomnd (day/night)

Angle1 Angle2 : -90.00 deg 10.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 18.00 / 18.00 m
Receiver height : 26.50 / 26.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

Results segment # 1: Richomnd (day)

Source height = 1.50 m

ROAD (0.00 + 65.14 + 0.00) = 65.14 dBA

| Angle1 | Angle2 | Alpha | RefLeq | P.Adj | D.Adj | F.Adj | W.Adj | H.Adj | B.Adj |
|--------|--------|-------|--------|-------|-------|-------|-------|-------|-------|
| SubLeq | | | | | | | | | |

| | | | | | | | | | |
|-------|----|------|-------|------|-------|-------|------|------|------|
| -- | | | | | | | | | |
| -90 | 10 | 0.00 | 68.48 | 0.00 | -0.79 | -2.55 | 0.00 | 0.00 | 0.00 |
| 65.14 | | | | | | | | | |

Segment Leq : 65.14 dBA

Total Leq All Segments: 65.14 dBA

Results segment # 1: Richomnd (night)

Source height = 1.50 m

ROAD (0.00 + 57.54 + 0.00) = 57.54 dBA

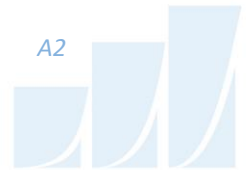
| Angle1 | Angle2 | Alpha | RefLeq | P.Adj | D.Adj | F.Adj | W.Adj | H.Adj | B.Adj |
|--------|--------|-------|--------|-------|-------|-------|-------|-------|-------|
| SubLeq | | | | | | | | | |

| | | | | | | | | | |
|-------|----|------|-------|------|-------|-------|------|------|------|
| -- | | | | | | | | | |
| -90 | 10 | 0.00 | 60.88 | 0.00 | -0.79 | -2.55 | 0.00 | 0.00 | 0.00 |
| 57.54 | | | | | | | | | |

Segment Leq : 57.54 dBA

Total Leq All Segments: 57.54 dBA

TOTAL Leq FROM ALL SOURCES (DAY) : 65.14
(NIGHT) : 57.54



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STAMSON 5.0 NORMAL REPORT Date: 25-10-2021 22:06:57
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r2.te Time Period: Day/Night 16/8 hours
Description:

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

Car traffic volume : 12144/1056 veh/TimePeriod *
Medium truck volume : 966/84 veh/TimePeriod *
Heavy truck volume : 690/60 veh/TimePeriod *
Posted speed limit : 50 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

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

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

Data for Segment # 1: Richomnd (day/night)

Angle1 Angle2 : -90.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 15.00 / 15.00 m
Receiver height : 26.50 / 26.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

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Results segment # 1: Richomnd (day)

Source height = 1.50 m

ROAD (0.00 + 68.48 + 0.00) = 68.48 dBA

| Angle1 | Angle2 | Alpha | RefLeq | P.Adj | D.Adj | F.Adj | W.Adj | H.Adj | B.Adj |
|--------|--------|-------|--------|-------|-------|-------|-------|-------|-------|
|--------|--------|-------|--------|-------|-------|-------|-------|-------|-------|

SubLeq

| | | | | | | | | | |
|-----|----|------|-------|------|------|------|------|------|------|
| -90 | 90 | 0.00 | 68.48 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|-----|----|------|-------|------|------|------|------|------|------|

68.48

Segment Leq : 68.48 dBA

Total Leq All Segments: 68.48 dBA

Results segment # 1: Richomnd (night)

Source height = 1.50 m

ROAD (0.00 + 60.88 + 0.00) = 60.88 dBA

| Angle1 | Angle2 | Alpha | RefLeq | P.Adj | D.Adj | F.Adj | W.Adj | H.Adj | B.Adj |
|--------|--------|-------|--------|-------|-------|-------|-------|-------|-------|
|--------|--------|-------|--------|-------|-------|-------|-------|-------|-------|

SubLeq

| | | | | | | | | | |
|-----|----|------|-------|------|------|------|------|------|------|
| -90 | 90 | 0.00 | 60.88 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|-----|----|------|-------|------|------|------|------|------|------|

60.88

Segment Leq : 60.88 dBA

Total Leq All Segments: 60.88 dBA

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

GRADIENTWIND

ENGINEERS & SCIENTISTS

STAMSON 5.0 NORMAL REPORT Date: 25-10-2021 22:07:10
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r3.te Time Period: Day/Night 16/8 hours
Description:

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

Car traffic volume : 12144/1056 veh/TimePeriod *
Medium truck volume : 966/84 veh/TimePeriod *
Heavy truck volume : 690/60 veh/TimePeriod *
Posted speed limit : 50 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

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

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

Data for Segment # 1: Richomnd (day/night)

Angle1 Angle2 : -90.00 deg -10.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 18.00 / 18.00 m
Receiver height : 26.50 / 26.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00



Results segment # 1: Richomnd (day)

Source height = 1.50 m

ROAD (0.00 + 64.17 + 0.00) = 64.17 dBA

| Angle1 | Angle2 | Alpha | RefLeq | P.Adj | D.Adj | F.Adj | W.Adj | H.Adj | B.Adj |
|--------|--------|-------|--------|-------|-------|-------|-------|-------|-------|
| SubLeq | | | | | | | | | |

| | | | | | | | | | |
|-------|-----|------|-------|------|-------|-------|------|------|------|
| -- | | | | | | | | | |
| -90 | -10 | 0.00 | 68.48 | 0.00 | -0.79 | -3.52 | 0.00 | 0.00 | 0.00 |
| 64.17 | | | | | | | | | |

Segment Leq : 64.17 dBA

Total Leq All Segments: 64.17 dBA

Results segment # 1: Richomnd (night)

Source height = 1.50 m

ROAD (0.00 + 56.57 + 0.00) = 56.57 dBA

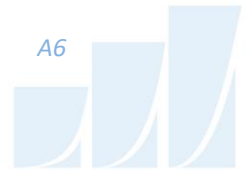
| Angle1 | Angle2 | Alpha | RefLeq | P.Adj | D.Adj | F.Adj | W.Adj | H.Adj | B.Adj |
|--------|--------|-------|--------|-------|-------|-------|-------|-------|-------|
| SubLeq | | | | | | | | | |

| | | | | | | | | | |
|-------|-----|------|-------|------|-------|-------|------|------|------|
| -- | | | | | | | | | |
| -90 | -10 | 0.00 | 60.88 | 0.00 | -0.79 | -3.52 | 0.00 | 0.00 | 0.00 |
| 56.57 | | | | | | | | | |

Segment Leq : 56.57 dBA

Total Leq All Segments: 56.57 dBA

TOTAL Leq FROM ALL SOURCES (DAY) : 64.17
(NIGHT) : 56.57



GRADIENTWIND

ENGINEERS & SCIENTISTS

STAMSON 5.0 NORMAL REPORT Date: 25-10-2021 22:08:23
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r4.te Time Period: Day/Night 16/8 hours
Description:

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

Car traffic volume : 12144/1056 veh/TimePeriod *
Medium truck volume : 966/84 veh/TimePeriod *
Heavy truck volume : 690/60 veh/TimePeriod *
Posted speed limit : 50 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

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

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

Data for Segment # 1: Richomnd (day/night)

Angle1 Angle2 : -90.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 31.00 / 31.00 m
Receiver height : 23.80 / 26.50 m
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : -90.00 deg Angle2 : 90.00 deg
Barrier height : 29.00 m
Barrier receiver distance : 15.00 / 15.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00



GRADIENTWIND

ENGINEERS & SCIENTISTS

Results segment # 1: Richomnd (day)

Source height = 1.50 m

Barrier height for grazing incidence

| Source Height (m) | Receiver Height (m) | Barrier Height (m) | Elevation of Barrier Top (m) |
|-------------------|---------------------|--------------------|------------------------------|
| 1.50 | 23.80 | 13.01 | 13.01 |

ROAD (0.00 + 46.57 + 0.00) = 46.57 dBA

| Angle1 | Angle2 | Alpha | RefLeq | P.Adj | D.Adj | F.Adj | W.Adj | H.Adj | B.Adj |
|--------|--------|-------|--------|-------|-------|-------|-------|-------|--------|
| -90 | 90 | 0.00 | 68.48 | 0.00 | -3.15 | 0.00 | 0.00 | 0.00 | -18.75 |

SubLeq

--

46.57

--

Segment Leq : 46.57 dBA

Total Leq All Segments: 46.57 dBA



GRADIENTWIND

ENGINEERS & SCIENTISTS

Results segment # 1: Richomnd (night)

Source height = 1.50 m

Barrier height for grazing incidence

| Source Height (m) | Receiver Height (m) | Barrier Height (m) | Elevation of Barrier Top (m) |
|-------------------|---------------------|--------------------|------------------------------|
| 1.50 | 26.50 | 14.40 | 14.40 |

ROAD (0.00 + 39.31 + 0.00) = 39.31 dBA

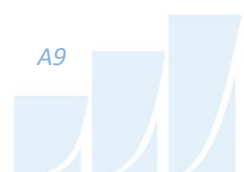
| Angle1 | Angle2 | Alpha | RefLeq | P.Adj | D.Adj | F.Adj | W.Adj | H.Adj | B.Adj |
|--------|--------|-------|--------|-------|-------|-------|-------|-------|--------|
| -90 | 90 | 0.00 | 60.88 | 0.00 | -3.15 | 0.00 | 0.00 | 0.00 | -18.42 |

SubLeq
39.31

Segment Leq : 39.31 dBA

Total Leq All Segments: 39.31 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 46.57
(NIGHT): 39.31



GRADIENTWIND

ENGINEERS & SCIENTISTS

STAMSON 5.0 NORMAL REPORT Date: 25-10-2021 22:08:31
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r5.te Time Period: Day/Night 16/8 hours
Description:

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

Car traffic volume : 12144/1056 veh/TimePeriod *
Medium truck volume : 966/84 veh/TimePeriod *
Heavy truck volume : 690/60 veh/TimePeriod *
Posted speed limit : 50 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

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

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

Data for Segment # 1: Richomnd (day/night)

Angle1 Angle2 : -90.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 41.00 / 31.00 m
Receiver height : 4.70 / 26.50 m
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : -90.00 deg Angle2 : 90.00 deg
Barrier height : 29.00 m
Barrier receiver distance : 24.00 / 15.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00



GRADIENTWIND

ENGINEERS & SCIENTISTS

Results segment # 1: Richomnd (day)

Source height = 1.50 m

Barrier height for grazing incidence

| Source Height (m) | Receiver Height (m) | Barrier Height (m) | Elevation of Barrier Top (m) |
|-------------------|---------------------|--------------------|------------------------------|
| 1.50 | 4.70 | 2.82 | 2.82 |

ROAD (0.00 + 44.62 + 0.00) = 44.62 dBA

| Angle1 | Angle2 | Alpha | RefLeq | P.Adj | D.Adj | F.Adj | W.Adj | H.Adj | B.Adj |
|--------|--------|-------|--------|-------|-------|-------|-------|-------|--------|
| -90 | 90 | 0.00 | 68.48 | 0.00 | -4.37 | 0.00 | 0.00 | 0.00 | -19.49 |

SubLeq

44.62

Segment Leq : 44.62 dBA

Total Leq All Segments: 44.62 dBA



GRADIENTWIND

ENGINEERS & SCIENTISTS

Results segment # 1: Richomnd (night)

Source height = 1.50 m

Barrier height for grazing incidence

| Source Height (m) | Receiver Height (m) | Barrier Height (m) | Elevation of Barrier Top (m) |
|-------------------|---------------------|--------------------|------------------------------|
| 1.50 | 26.50 | 14.40 | 14.40 |

ROAD (0.00 + 39.31 + 0.00) = 39.31 dBA

| Angle1 | Angle2 | Alpha | RefLeq | P.Adj | D.Adj | F.Adj | W.Adj | H.Adj | B.Adj |
|--------|--------|-------|--------|-------|-------|-------|-------|-------|--------|
| -90 | 90 | 0.00 | 60.88 | 0.00 | -3.15 | 0.00 | 0.00 | 0.00 | -18.42 |

SubLeq

39.31

Segment Leq : 39.31 dBA

Total Leq All Segments: 39.31 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 44.62
(NIGHT): 39.31



GRADIENTWIND

ENGINEERS & SCIENTISTS

STAMSON 5.0 NORMAL REPORT Date: 25-10-2021 22:08:41
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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

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

Car traffic volume : 12144/1056 veh/TimePeriod *
Medium truck volume : 966/84 veh/TimePeriod *
Heavy truck volume : 690/60 veh/TimePeriod *
Posted speed limit : 50 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

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

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

Data for Segment # 1: Richomnd (day/night)

Angle1 Angle2 : -90.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 38.00 / 38.00 m
Receiver height : 23.70 / 23.70 m
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : -59.00 deg Angle2 : 90.00 deg
Barrier height : 29.00 m
Barrier receiver distance : 27.00 / 27.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00



GRADIENTWIND

ENGINEERS & SCIENTISTS

Results segment # 1: Richomnd (day)

Source height = 1.50 m

Barrier height for grazing incidence

| Source Height (m) | Receiver Height (m) | Barrier Height (m) | Elevation of Barrier Top (m) |
|-------------------|---------------------|--------------------|------------------------------|
| 1.50 | 23.70 | 7.92 | 7.92 |

ROAD (56.80 + 44.21 + 0.00) = 57.04 dBA

| Angle1 | Angle2 | Alpha | RefLeq | P.Adj | D.Adj | F.Adj | W.Adj | H.Adj | B.Adj |
|--------|--------|-------|--------|-------|-------|-------|-------|-------|-------|
| SubLeq | | | | | | | | | |

| | | | | | | | | | | |
|-------|-----|-----|------|-------|------|-------|-------|------|------|------|
| -- | -90 | -59 | 0.00 | 68.48 | 0.00 | -4.04 | -7.64 | 0.00 | 0.00 | 0.00 |
| 56.80 | | | | | | | | | | |

| | | | | | | | | | | |
|-------|-----|----|------|-------|------|-------|-------|------|------|--------|
| -- | -59 | 90 | 0.00 | 68.48 | 0.00 | -4.04 | -0.82 | 0.00 | 0.00 | -19.41 |
| 44.21 | | | | | | | | | | |

Segment Leq : 57.04 dBA

Total Leq All Segments: 57.04 dBA



GRADIENTWIND

ENGINEERS & SCIENTISTS

Results segment # 1: Richomnd (night)

Source height = 1.50 m

Barrier height for grazing incidence

| Source Height (m) | Receiver Height (m) | Barrier Height (m) | Elevation of Barrier Top (m) |
|-------------------|---------------------|--------------------|------------------------------|
| 1.50 | 23.70 | 7.92 | 7.92 |

ROAD (49.21 + 36.61 + 0.00) = 49.44 dBA

| Angle1 | Angle2 | Alpha | RefLeq | P.Adj | D.Adj | F.Adj | W.Adj | H.Adj | B.Adj |
|--------|--------|-------|--------|-------|-------|-------|-------|-------|-------|
| SubLeq | | | | | | | | | |

| | | | | | | | | | | |
|-------|-----|-----|------|-------|------|-------|-------|------|------|------|
| -- | -90 | -59 | 0.00 | 60.88 | 0.00 | -4.04 | -7.64 | 0.00 | 0.00 | 0.00 |
| 49.21 | | | | | | | | | | |

| | | | | | | | | | | |
|-------|-----|----|------|-------|------|-------|-------|------|------|--------|
| -- | -59 | 90 | 0.00 | 60.88 | 0.00 | -4.04 | -0.82 | 0.00 | 0.00 | -19.41 |
| 36.61 | | | | | | | | | | |

Segment Leq : 49.44 dBA

Total Leq All Segments: 49.44 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 57.04
(NIGHT): 49.44

