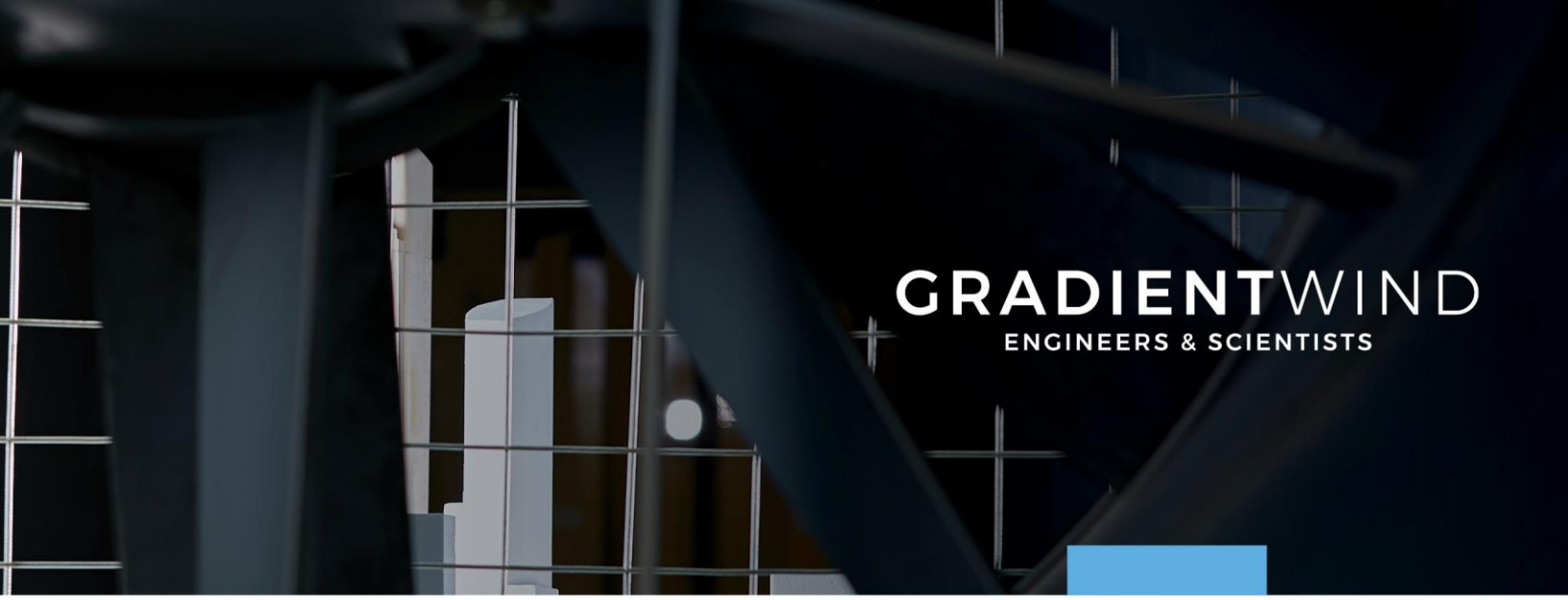
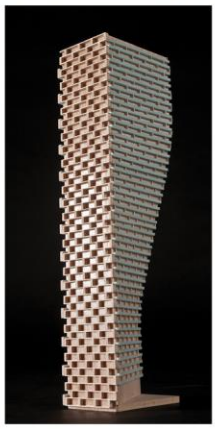


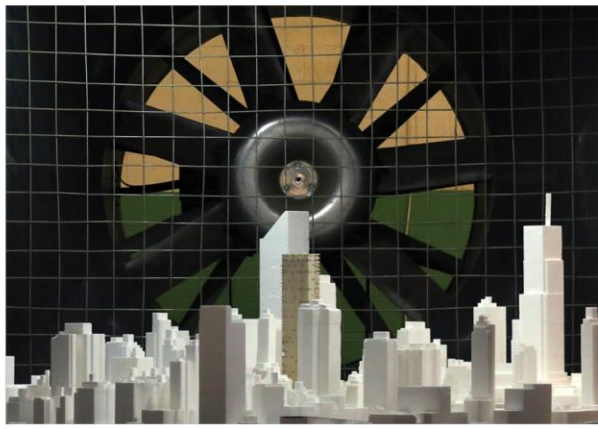
GRADIENTWIND
ENGINEERS & SCIENTISTS

ROADWAY TRAFFIC NOISE ASSESSMENT

2928 Bank Street
Ottawa, Ontario

REPORT: 24-062 – Traffic Noise





May 3rd, 2024

PREPARED FOR

V.I.P. Construction and Engineering
934 Hunt Club, Suite 100
Ottawa, ON K1V 2P4

PREPARED BY

Essraa Alqassab, BASc., Junior Environmental Scientist
Joshua Foster, P.Eng., Principal

EXECUTIVE SUMMARY

This report describes a roadway traffic noise assessment undertaken to satisfy the requirements for a Site Plan Control (SPC) application submission for a proposed residential development located at 2928 Bank Street in Ottawa, Ontario. The proposed development comprises a 4-storey residential building, situated on a rectangular parcel of land at the northwest corner of the Bank Street – Queensdale Avenue intersection. The primary source of roadway traffic is Bank Street. 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 drawings provided by Brian K. Clark Architect in April 2024.

The results of the current analysis indicate that plane-of-window noise levels will range between 67 and 71 dBA during the daytime period (07:00-23:00) and between 59 and 64 dBA during the nighttime period (23:00-07:00). The highest noise level (71 dBA) occurs at the east façade, which is nearest and most exposed to Bank Street. 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.

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 Type D Warning Clause will also be required on all Lease, Purchase and Sale Agreements, as summarized in Section 6.

Unattenuated noise levels at the north and south ground level terraces are expected to reach 67 dBA during the daytime period. Results of the noise barrier investigation proved that the use of a 2.2 m high noise barrier is successful in bringing down noise levels to 60 dBA, or under. In order to achieve 55 dBA, 3.0 and 3.5 m high noise barriers can be used for the south and north terraces, respectively. As this may not be architecturally, economically, or administratively feasible, 2.2 m high noise barrier can be implemented, in combination with a Type B Warning Clause, as summarized in Section 6.

Stationary noise impacts from the environment are expected to be minimal. The site is surrounded by low rise residential and commercial facilities with small mechanical equipment that are not anticipated to negatively impact the study site, from a noise perspective.

Due to the size of the development, stationary noise impact on the surroundings is expected to be minimal. The building will likely have small internal Energy Recovery Ventilators or heat pump systems, with small residential sized air conditioning condensers on the roof. The mechanical system would be required to comply with MECP's Publication NPC-216 Residential Air Conditioning Devices.

TABLE OF CONTENTS

1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by V.I.P Construction & Engineering to undertake a roadway traffic noise assessment to satisfy the requirements for a Site Plan Control (SPC) application submission for a proposed development located at 2928 Bank Street 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] and Ministry of the Environment, Conservation and Parks (MECP)[2] guidelines. Noise calculations were based on drawings provided by Brain K. Clark Architect, provided in April 2024, with future traffic volumes corresponding to the City of Ottawa's Official Plan (OP) roadway classifications.

2. TERMS OF REFERENCE

The focus of this roadway traffic noise assessment is a proposed development located at 2928 Bank Street in Ottawa, Ontario. The proposed development comprises a 4-storey residential building, above an underground parking level, situated on a rectangular parcel of land at the northwest corner of the Queensdale Avenue – Bank Street intersection. The study site is bounded by a low-rise commercial facility to the north, a residential dwelling to the west, Bank Street to the east, and Queensdale Avenue to the south.

The ground level comprises of residential suites, an amenity space and a lobby. Access to the underground parking level is provided from Queensdale Avenue, towards the southwest corner of the site. Above ground parking spaces are provided along the west property line. Levels 2-4 comprise of residential suites along the perimeter of the floorplan.

Balconies/terraces extending less than 4 metres (m) in depth from the façade do not require consideration as Outdoor Living Areas (OLA) as mentioned in the ENCG. Areas considered as OLAs are the north and south

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

ground level terraces. The primary source of roadway traffic noise includes Bank Street. Figure 1 illustrates a complete site plan with surrounding context.

Stationary noise impacts from the environment are expected to be minimal. The site is surrounded by low rise residential and commercial facilities with small mechanical equipment that are not anticipated to negatively impact the study site, from a noise perspective.

Due to the size of the development, stationary noise impact on the surroundings is expected to be minimal. The building will likely have small internal Energy Recovery Ventilators or heat pump systems, with small residential sized air conditioning condensers on the roof. The mechanical system would be required to comply with MECP's Publication NPC-216 Residential Air Conditioning Devices.

3. OBJECTIVES

The principal objectives of this study are to (i) calculate the future noise levels on the study building produced by local roadway traffic, and (ii) ensure that interior and exterior noise levels do not exceed the allowable limits specified by the City of Ottawa's Environmental Noise Control Guidelines as outlined in Section 4.2 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) [3]

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

Predicted noise levels at the plane of window (POW) dictate the action required to achieve the recommended sound levels. An open window is considered to provide a 10 dBA reduction in noise, while a standard closed window is capable of providing a minimum 20 dBA noise reduction[4]. A closed window due to a ventilation requirement will bring noise levels down to achieve an acceptable indoor environment[5]. Therefore, where noise levels exceed 55 dBA daytime and 50 dBA nighttime, the ventilation

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

for the building should consider the need for having windows and doors closed, which triggers the need for forced air heating with provision for central air conditioning. Where noise levels exceed 65 dBA daytime and 60 dBA nighttime, air conditioning will be required and building components will require higher levels of sound attenuation[6].

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

4.2.2 Theoretical Roadway Noise Predictions

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

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

- Truck traffic on all roadways was taken to comprise 5% heavy trucks and 7% medium trucks, as per ENCG requirements for noise level predictions.
- The day/night split for all streets was taken to be 92%/8%, respectively.
- Ground surfaces were taken to be reflective due to the presence of hard (paved) ground.
- Topography was assumed to be a flat/gentle slope surrounding the study building.
- For select sources where appropriate, receptors considered the existing and the proposed buildings as a barrier partially or fully obstructing exposure to the source as illustrated by exposure angles in Figures A1 and A2.
- Noise receptors were strategically placed at 5 locations around the study area (see Figure 2).
- Receptor distances and exposure angles are illustrated in Figures A1 and A2.

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

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[7] which provide additional details on future roadway expansions. Average Annual Daily Traffic (AADT) volumes are then based on data in Table B1 of the ENCG for each roadway classification. Table 2 (below) summarizes the AADT values used for each roadway included in this assessment.

TABLE 2: ROADWAY TRAFFIC DATA

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

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 sources at the plane of the window exceed 65 dBA, calculations must be performed to evaluate the sound transmission quality of the building components to ensure acceptable indoor noise levels. The calculation procedure[8] considers:

[7] City of Ottawa Transportation Master Plan, November 2013
[8] 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[9], exterior walls possess specific sound attenuation characteristics that are used as a basis for calculating the required STC ratings of windows in the same partition. Due to the limited information available at the time of the study, which was prepared for site plan approval, detailed floor layouts and building elevations have not been finalized; therefore, detailed STC calculations could not be performed at this time. As a guideline, the anticipated STC requirements for windows have been estimated based on the overall noise reduction required for each intended use of space (STC = outdoor noise level – targeted indoor noise levels + Safety Factor).

5. RESULTS AND DISCUSSION

5.1 Roadway Traffic Noise Levels

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

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	10.5	POW – 4th Floor – East Façade	71	64
2	10.5	POW – 4th Floor – North Façade	69	61
3	10.5	POW – 4th Floor – South Façade	67	59
4	1.5	OLA – North Terrace	67	N/a*
5	1.5	OLA – South Terrace	65	N/a*

*Noise levels at an OLA during the nighttime period are not considered as per ENCG

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

The results of the current analysis indicate that plane-of-window noise levels will range between 67 and 71 dBA during the daytime period (07:00-23:00) and between 59 and 64 dBA during the nighttime period (23:00-07:00). The highest noise level (71 dBA) occurs at the east façade, which is nearest and most exposed to Bank Street.

5.2 Noise Control Measures

The noise levels predicted due to roadway traffic exceed the criteria listed in Section 4.2 for building components. As discussed in Section 4.3, the anticipated STC requirements for windows have been estimated based on the overall noise reduction required for each intended use of space (STC = outdoor noise level – targeted indoor noise levels + Safety Factor). As per 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 3):

- **Bedroom Windows**

(i) Bedroom windows facing east will require a minimum STC of 34.

(ii) Bedroom windows facing north and south will require a minimum STC of 34.

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

- **Living Room Windows**

(i) Living room windows facing east will require a minimum STC of 34.

(ii) Living room windows facing north and south will require a minimum STC of 34.

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

- **Exterior Walls**

(i) Exterior wall components on the north, south, and east façades will require a minimum STC of 45, which will be achieved with brick cladding or an acoustical equivalent according to NRC test data[10].

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

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

and wall system may be used. Elevation drawings provided in May 2024 show that brick cladding is used for the south and east facades (see Appendix B). 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. We have specified an example window configuration, however several manufacturers and various combinations of window components, such as those proposed, 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.

5.3 Noise Barrier Calculation

Unattenuated noise levels at the north and south ground level terraces are expected to reach 67 dBA during the daytime period. *If these areas are to be used as outdoor living areas*, noise control measures are required to reduce noise levels to 55 dBA, and not above 60 dBA. Further analysis investigated the noise mitigating impact of 2.2 to 3.5 m high noise barriers along the perimeter. Results of the investigation proved that the use of a 2.2 m high noise barrier is successful in bringing down noise levels to 60 dBA, or under. In order to achieve 55 dBA, 3.0 and 3.5 m high noise barriers can be used for the south and north terraces, respectively. As this may not be architecturally or administratively feasible, 2.2 m high noise barrier can be implemented, in combination with a Type B Warning Clause.

Noise barriers shall have a minimum surface density of 20 kg/m^2 and contain no gaps. A Type B Warning Clause will be required on all Lease, Purchase, and Sale Agreements for units sharing these amenity spaces, as summarized in Section 6.

TABLE 4: NOISE BARRIER INVESTIGATION

Receptor Number	Receptor Height Above Grade (m)	Receptor Location	No noise barrier	2.2 m high noise barrier	2.5 m high noise barrier	3.0 m high noise barrier	3.5 m high noise barrier
4	1.5	North Amenity Terrace	67	**60**	59	-	55
5	1.5	South Amenity Terrace	65	**58**	57	55	N/a

6. CONCLUSIONS AND RECOMMENDATIONS

The results of the current analysis indicate that plane-of-window noise levels will range between 67 and 71 dBA during the daytime period (07:00-23:00) and between 59 and 64 dBA during the nighttime period (23:00-07:00). The highest noise level (71 dBA) occurs at the east façade, which is nearest and most exposed to Bank Street. 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.

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 Type D Warning Clause will also be required on all Lease, Purchase and Sale Agreements, as summarized below:

Type D:

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

Unattenuated noise levels at the north and south ground level terraces are expected to reach 67 dBA during the daytime period. Results of the noise barrier investigation proved that the use of a 2.2 m high noise barrier is successful in bringing down noise levels to 60 dBA, or under. In order to achieve 55 dBA, 3.0 and 3.5 m high noise barriers can be used for the south and north terraces, respectively. As this may not be architecturally, economically, or administratively feasible, a 2.2 m high noise barrier can be

implemented, in combination with a Type B Warning Clause on all Lease, Purchase and Sale Agreements,, as seen below:

Type B:

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

The noise barrier must be constructed from materials having a minimum surface density of 20 kg/m2 (STC rating of 30) and contain no gaps. Design of the noise barrier will conform to the requirements outlined in Part 5 of the ENCG. The following information will be required by the City for review prior to installation of the barrier:

1. Shop drawings, signed and sealed by a qualified Professional Engineer licenced by the Professional Engineers of Ontario, showing the details of the acoustic barrier systems components, including material specifications.

2. Structural drawing(s), signed by a qualified Professional Engineer licenced by the Professional Engineers of Ontario, showing foundation details, and specifying design criteria, climatic design loads, as well as applicable geotechnical data used in the design.

3. Layout plan, and wall elevations, showing proposed colours and patterns.

Stationary noise impacts from the environment are expected to be minimal. The site is surrounded by low rise residential and commercial facilities with small mechanical equipment that are not anticipated to negatively impact the study site, from a noise perspective.

Due to the size of the development, stationary noise impact on the surroundings is expected to be minimal. The building will likely have small internal Energy Recovery Ventilators or heat pump systems, with small residential sized air conditioning condensers on the roof. The mechanical system would be required to comply with MECP's Publication NPC-216 Residential Air Conditioning Devices.

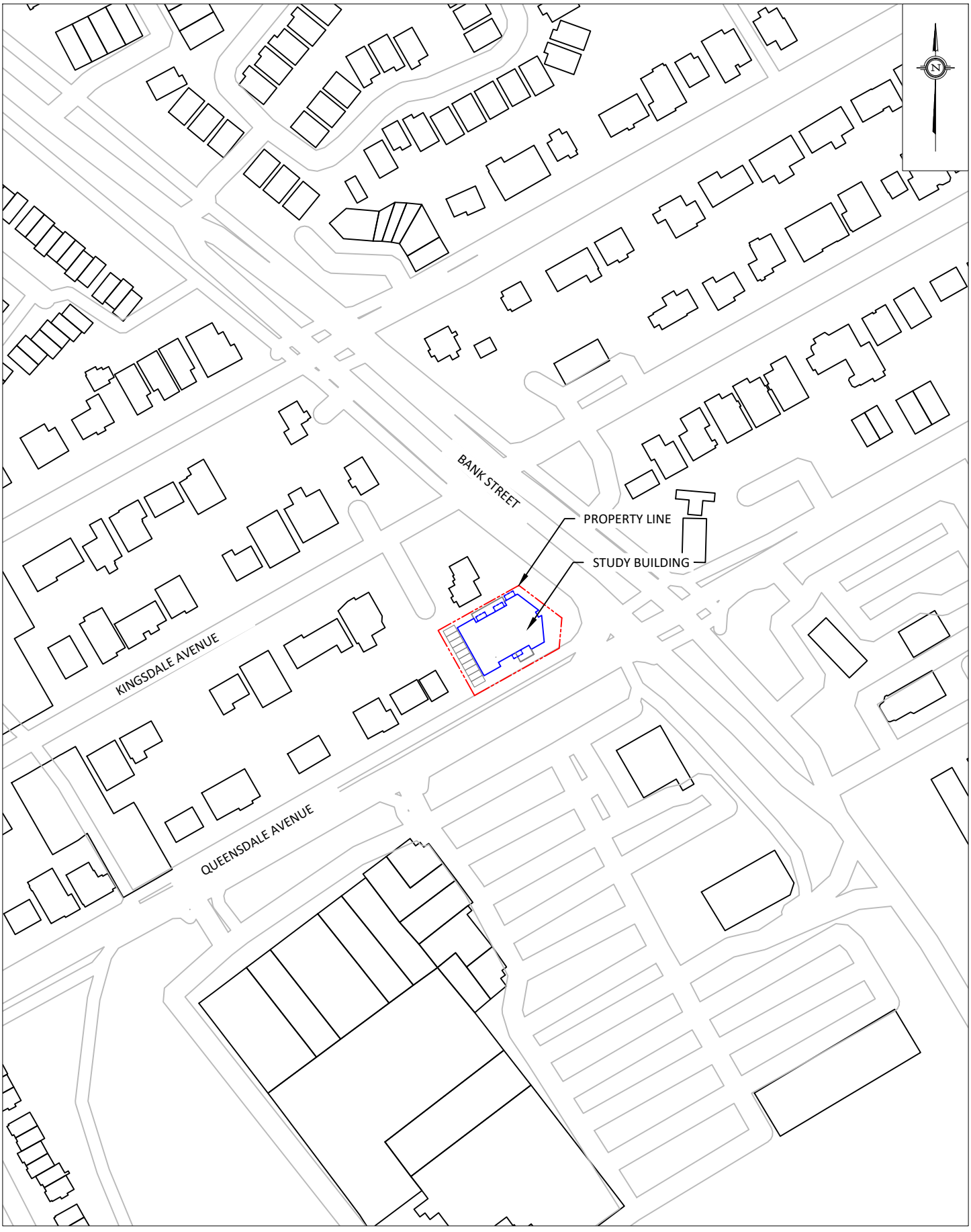
This concludes our traffic noise assessment and report. If you have any questions or wish to discuss our findings, please advise us. In the interim, we thank you for the opportunity to be of service.

Sincerely,

Gradient Wind Engineering Inc.

Essraa Alqassab, BASc.
Junior Environmental Scientist
Gradient Wind File #24-062-Traffic Noise

Joshua Foster, P.Eng.
Lead Engineer



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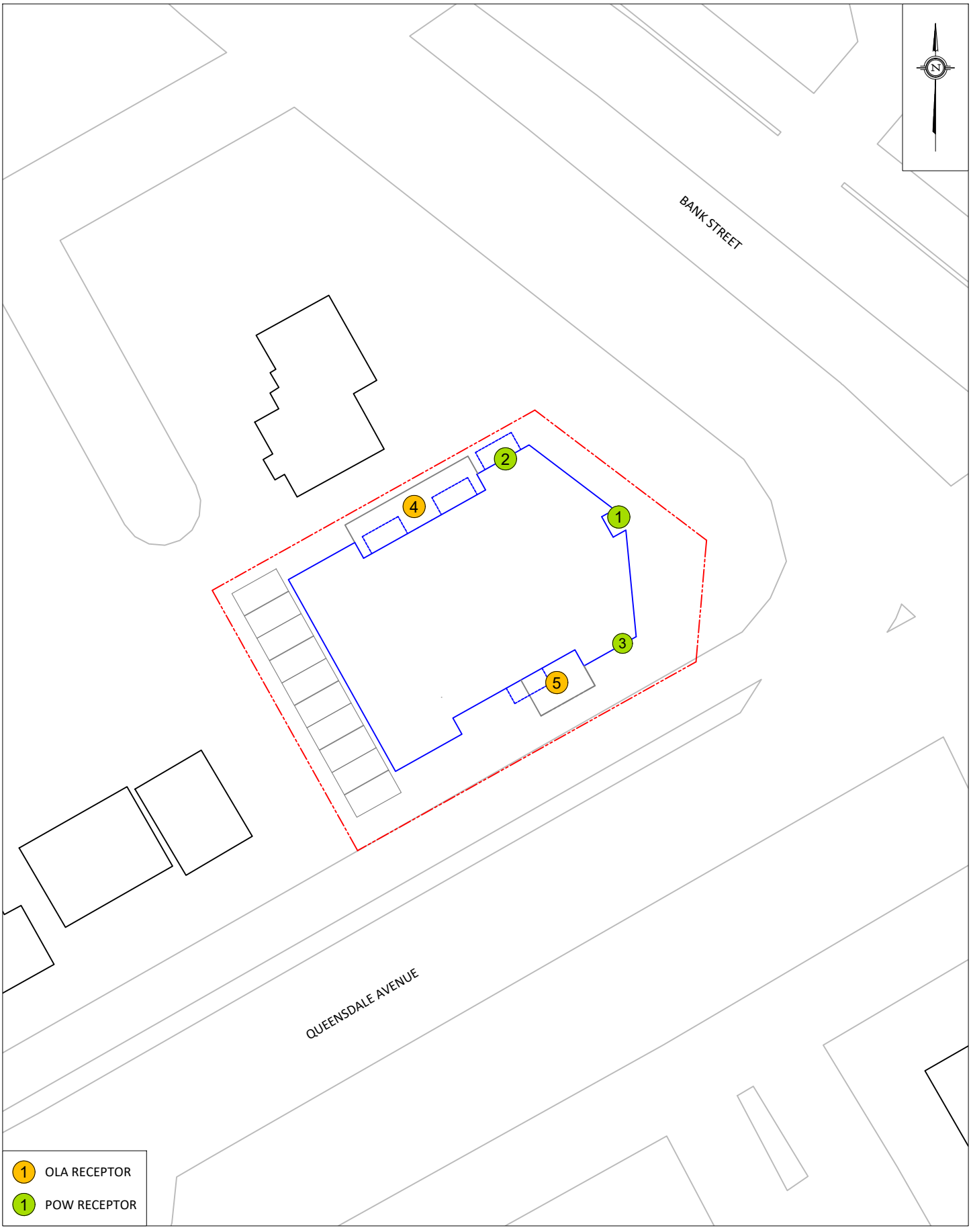
PROJECT	2928 BANK STREET ROADWAY TRAFFIC NOISE ASSESSMENT
SCALE	1:2000 (APPROX.)
DRAWING NO.	GW24-062-1
DATE	APRIL 25, 2024
DRAWN BY	E.A.

DESCRIPTION

FIGURE 1:
SITE PLAN AND SURROUNDING CONTEXT



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PROJECT	2928 BANK STREET ROADWAY TRAFFIC NOISE ASSESSMENT
SCALE	1:200 (APPROX.)
DRAWING NO.	GW24-062-2
DATE	APRIL 25, 2024
DRAWN BY	E.A.

DESCRIPTION

FIGURE 2:
RECEPTOR LOCATIONS

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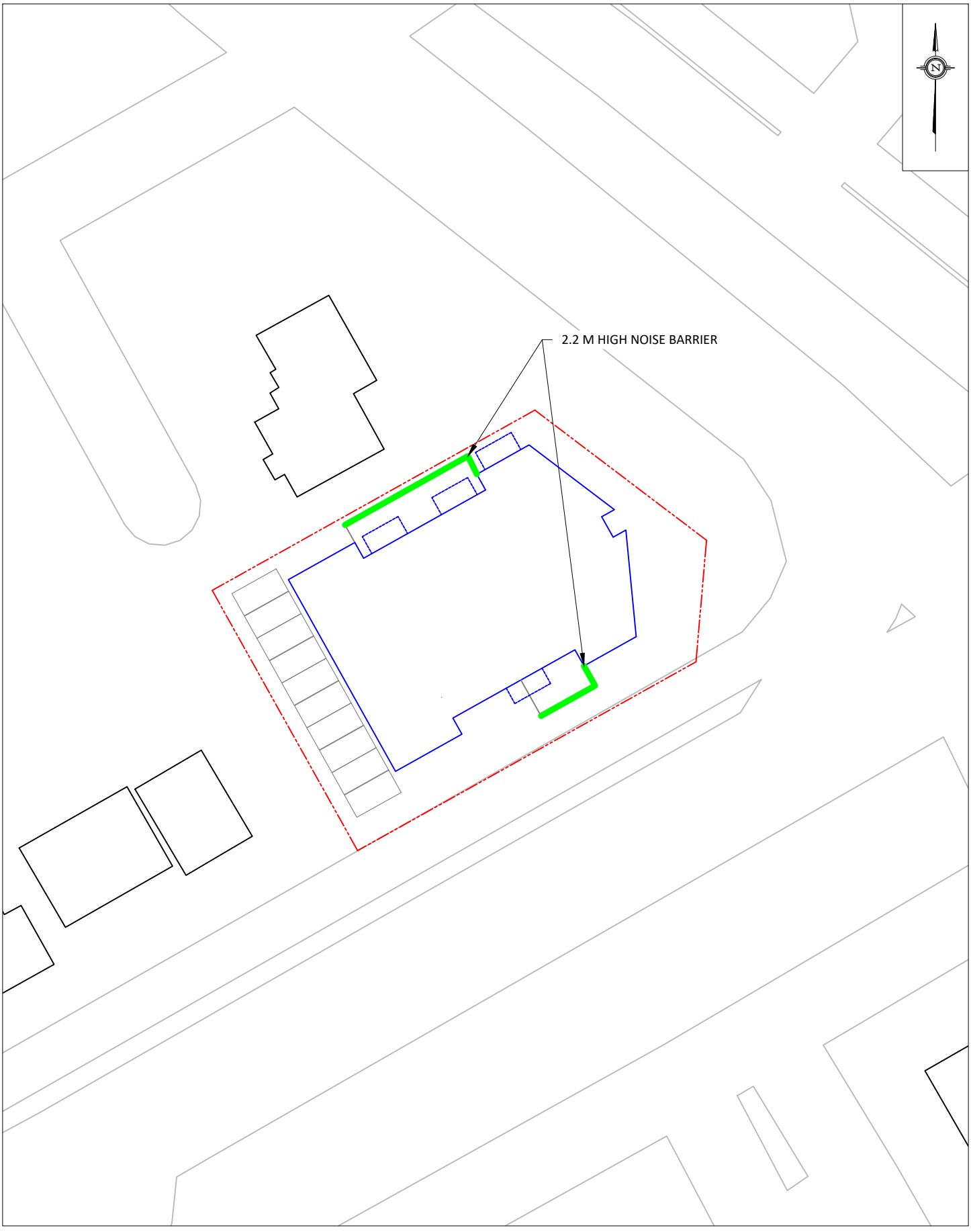
PROJECT	2928 BANK STREET ROADWAY TRAFFIC NOISE ASSESSMENT		
SCALE	1:200 (APPROX.)	DRAWING NO.	GW24-062-3
DATE	APRIL 25, 2024	DRAWN BY	E.A.

DESCRIPTION

FIGURE 3:
WINDOW STC RECOMMENDATIONS



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PROJECT	2928 BANK STREET ROADWAY TRAFFIC NOISE ASSESSMENT		DESCRIPTION
SCALE	1:200 (APPROX.)	DRAWING NO.	GW24-062-4
DATE	APRIL 25, 2024	DRAWN BY	E.A.

FIGURE 4:
NOISE BARRIER RECOMMENDATIONS

APPENDIX A

STAMSON INPUTS AND OUTPUTS

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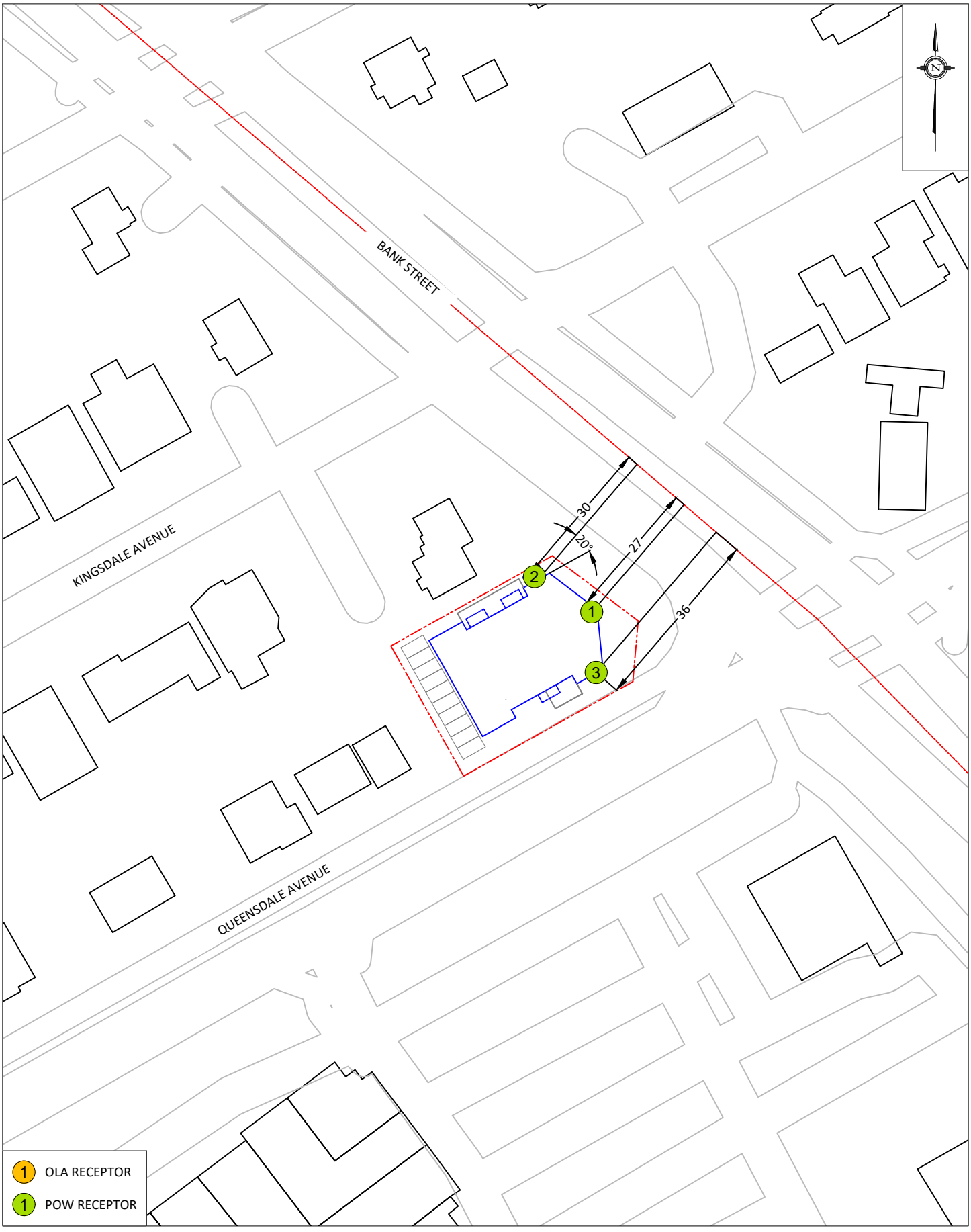

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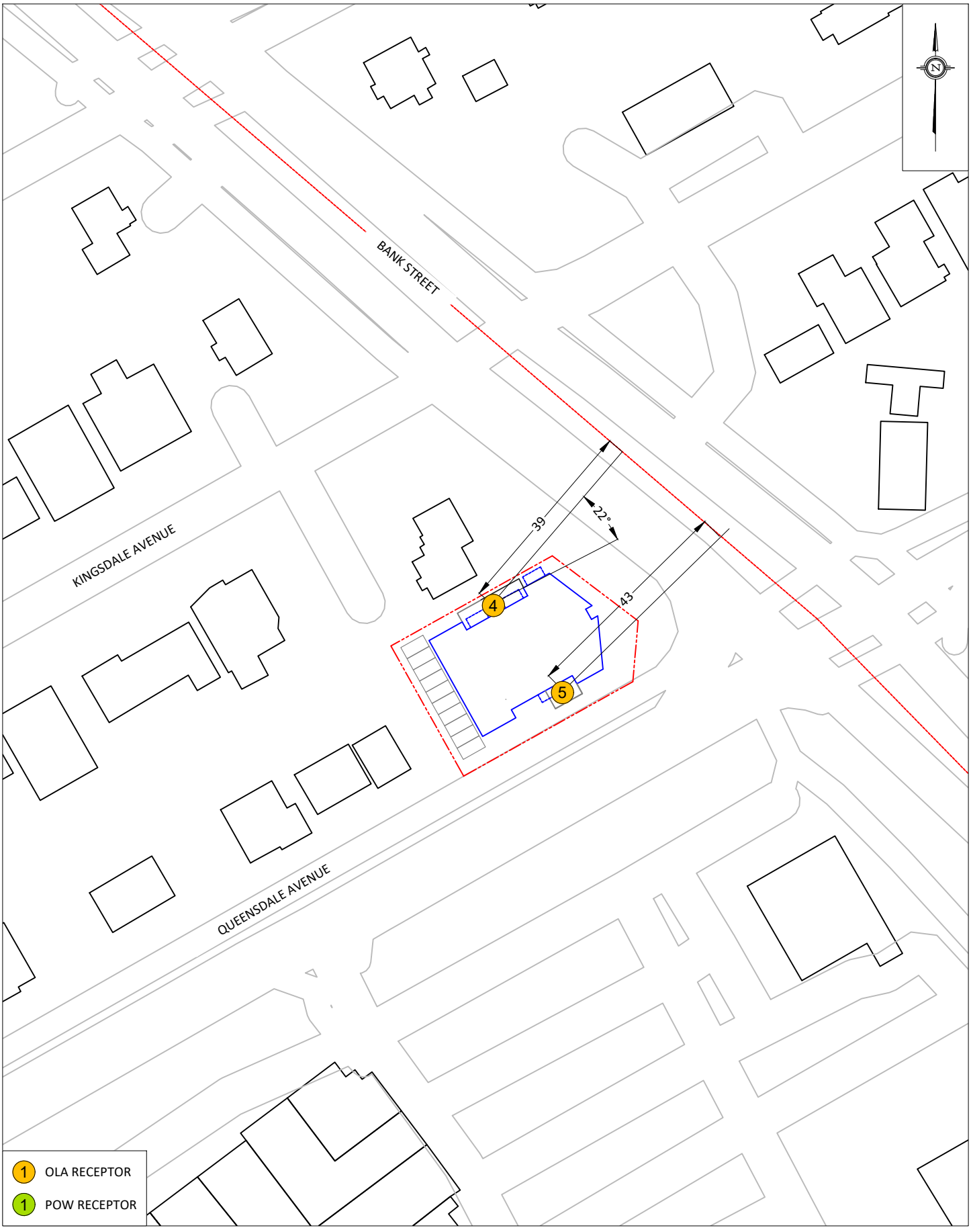
PROJECT	2928 BANK STREET ROADWAY TRAFFIC NOISE ASSESSMENT
SCALE	1:1000 (APPROX.)
DRAWING NO.	GW24-062-A1
DATE	APRIL 25, 2024
DRAWN BY	E.A.
DESCRIPTION	FIGURE A1: STAMSON PARAMETERS (1)



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PROJECT	2928 BANK STREET ROADWAY TRAFFIC NOISE ASSESSMENT
SCALE	1:1000 (APPROX.)
DRAWING NO.	GW24-062-A2
DATE	MAY 1, 2024
DRAWN BY	E.A.

DESCRIPTION

FIGURE A2:
STAMSON PARAMETERS (2)

```
STAMSON 5.0        NORMAL REPORT        Date: 25-04-2024 14:14:38
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Bank St (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: Bank St (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  :  27.00 / 27.00  m
Receiver height           :  10.50 / 10.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


Results segment # 1: Bank St (day)
----------------------------------

Source height = 1.50 m

ROAD (0.00 + 71.12 + 0.00) = 71.12 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90     90    0.00  73.68   0.00  -2.55   0.00   0.00   0.00   0.00
71.12
```

```
-------------------------------------------------------------------------------
--

Segment Leq : 71.12 dBA

Total Leq All Segments: 71.12 dBA


Results segment # 1: Bank St (night)
-----------------------------------

Source height = 1.50 m

ROAD (0.00 + 63.53 + 0.00) = 63.53 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90     90   0.00  66.08   0.00  -2.55   0.00   0.00   0.00   0.00
63.53
-------------------------------------------------------------------------------
--

Segment Leq : 63.53 dBA

Total Leq All Segments: 63.53 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 71.12
                           (NIGHT): 63.53
```

```
STAMSON 5.0        NORMAL REPORT        Date: 25-04-2024 14:17:18
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Bank St (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: Bank St (day/night)
-----------------------------------------
Angle1   Angle2           : -90.00 deg   20.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  30.00 / 30.00  m
Receiver height           :  10.50 / 10.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


Results segment # 1: Bank St (day)
----------------------------------

Source height = 1.50 m

ROAD (0.00 + 68.53 + 0.00) = 68.53 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90     20    0.00  73.68   0.00  -3.01  -2.14   0.00   0.00   0.00
68.53
-------------------------------------------------------------------------------
--
```

```
Segment Leq : 68.53 dBA

Total Leq All Segments: 68.53 dBA


Results segment # 1: Bank St (night)
------------------------------------

Source height = 1.50 m

ROAD (0.00 + 60.93 + 0.00) = 60.93 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90     20   0.00  66.08   0.00  -3.01  -2.14   0.00   0.00   0.00
60.93
-------------------------------------------------------------------------------
--

Segment Leq : 60.93 dBA

Total Leq All Segments: 60.93 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 68.53
                           (NIGHT): 60.93
```

```
STAMSON 5.0        COMPREHENSIVE REPORT        Date: 01-05-2024 12:04:30
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Bank St (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: Bank St (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  :  36.00 / 36.00  m
Receiver height           :  10.50 / 10.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


Segment # 1: Bank St (day)
--------------------------

Source height = 1.50 m

ROAD (0.00 + 66.86 + 0.00) = 66.86 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  -3.80  -3.01   0.00   0.00   0.00
66.86
-------------------------------------------------------------------------------
--
```

```
Segment Leq : 66.86 dBA

Total Leq All Segments: 66.86 dBA


Segment # 1: Bank St (night)
----------------------------

Source height = 1.50 m

ROAD (0.00 + 59.27 + 0.00) = 59.27 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  -3.80  -3.01   0.00   0.00   0.00
59.27
-------------------------------------------------------------------------
--

Segment Leq : 59.27 dBA

Total Leq All Segments: 59.27 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 66.86
                           (NIGHT): 59.27
```

```
STAMSON 5.0        NORMAL REPORT        Date: 01-05-2024 10:10:48
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Bank St (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: Bank St (day/night)
-----------------------------------------
Angle1   Angle2           : -90.00 deg   22.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  39.00 / 39.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


Results segment # 1: Bank St (day)
----------------------------------

Source height = 1.50 m

ROAD (0.00 + 67.47 + 0.00) = 67.47 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90     22    0.00  73.68   0.00  -4.15  -2.06   0.00   0.00   0.00
67.47
```

```
-------------------------------------------------------------------------------
--

Segment Leq : 67.47 dBA

Total Leq All Segments: 67.47 dBA


Results segment # 1: Bank St (night)
-----------------------------------

Source height = 1.50 m

ROAD (0.00 + 59.87 + 0.00) = 59.87 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90     22    0.00  66.08   0.00  -4.15  -2.06   0.00   0.00   0.00
59.87
-------------------------------------------------------------------------------
--

Segment Leq : 59.87 dBA

Total Leq All Segments: 59.87 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 67.47
                           (NIGHT): 59.87
```

```
STAMSON 5.0        NORMAL REPORT        Date: 01-05-2024 10:14:31
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r4b.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Bank St (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: Bank St (day/night)
-----------------------------------------
Angle1   Angle2           : -90.00 deg   22.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  39.00 / 39.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 22.00 deg
Barrier height            :   2.20 m
Barrier receiver distance :   3.00 / 3.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00


Results segment # 1: Bank St (day)
----------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
```

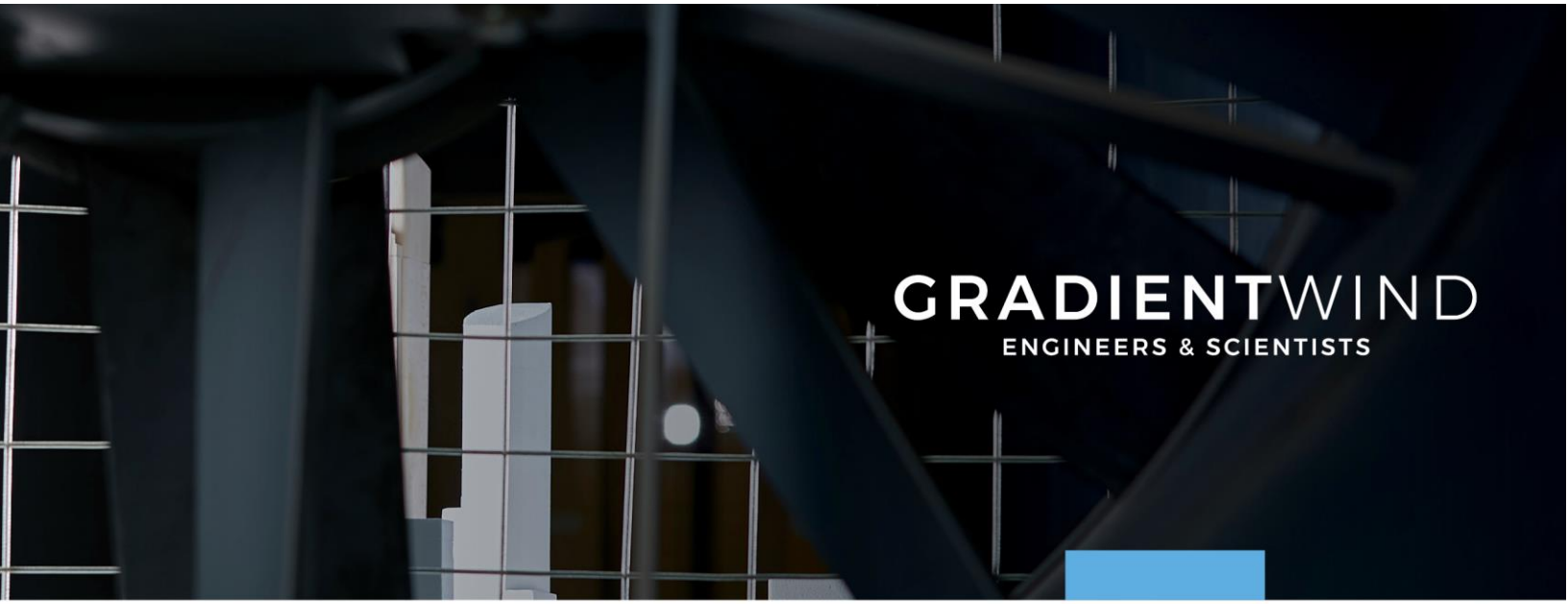
```
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 60.06 + 0.00) = 60.06 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90     22   0.00  73.68   0.00  -4.15  -2.06   0.00   0.00  -7.40
60.06
-------------------------------------------------------------------------------
--

Segment Leq : 60.06 dBA

Total Leq All Segments: 60.06 dBA


Results segment # 1: Bank St (night)
------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 52.47 + 0.00) = 52.47 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90     22   0.00  66.08   0.00  -4.15  -2.06   0.00   0.00  -7.40
52.47
-------------------------------------------------------------------------------
--

Segment Leq : 52.47 dBA

Total Leq All Segments: 52.47 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 60.06
                           (NIGHT): 52.47
```

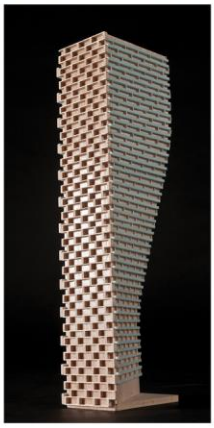
```
STAMSON 5.0        COMPREHENSIVE REPORT        Date: 01-05-2024 12:03:52
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Bank St (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: Bank St (day/night)
-----------------------------------------
Angle1   Angle2           :  15.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  46.00 / 46.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


Segment # 1: Bank St (day)
--------------------------

Source height = 1.50 m

ROAD (0.00 + 65.01 + 0.00) = 65.01 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
    15     90   0.00  73.68   0.00  -4.87  -3.80   0.00   0.00   0.00
65.01
```

```
-------------------------------------------------------------------------------
--

Segment Leq : 65.01 dBA

Total Leq All Segments: 65.01 dBA


Segment # 1: Bank St (night)
----------------------------

Source height = 1.50 m

ROAD (0.00 + 57.41 + 0.00) = 57.41 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
    15     90   0.00  66.08   0.00  -4.87  -3.80   0.00   0.00   0.00
57.41
-------------------------------------------------------------------------------
--

Segment Leq : 57.41 dBA

Total Leq All Segments: 57.41 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 65.01
                           (NIGHT): 57.41
```

```
STAMSON 5.0        COMPREHENSIVE REPORT        Date: 01-05-2024 10:15:49
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r5b.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Bank St (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: Bank St (day/night)
-----------------------------------------
Angle1   Angle2           :  15.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  46.00 / 46.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  15.00 deg   Angle2 : 90.00 deg
Barrier height            :   2.20 m
Barrier receiver distance :   3.00 / 3.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00


Segment # 1: Bank St (day)
--------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
```

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

ROAD (0.00 + 58.04 + 0.00) = 58.04 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
    15     90   0.00  73.68   0.00  -4.87  -3.80   0.00   0.00  -6.97
58.04
-------------------------------------------------------------------------
--

Segment Leq : 58.04 dBA

Total Leq All Segments: 58.04 dBA


Segment # 1: Bank St (night)
----------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 50.44 + 0.00) = 50.44 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
    15     90   0.00  66.08   0.00  -4.87  -3.80   0.00   0.00  -6.97
50.44
-------------------------------------------------------------------------
--

Segment Leq : 50.44 dBA

Total Leq All Segments: 50.44 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 58.04
                           (NIGHT): 50.44
```



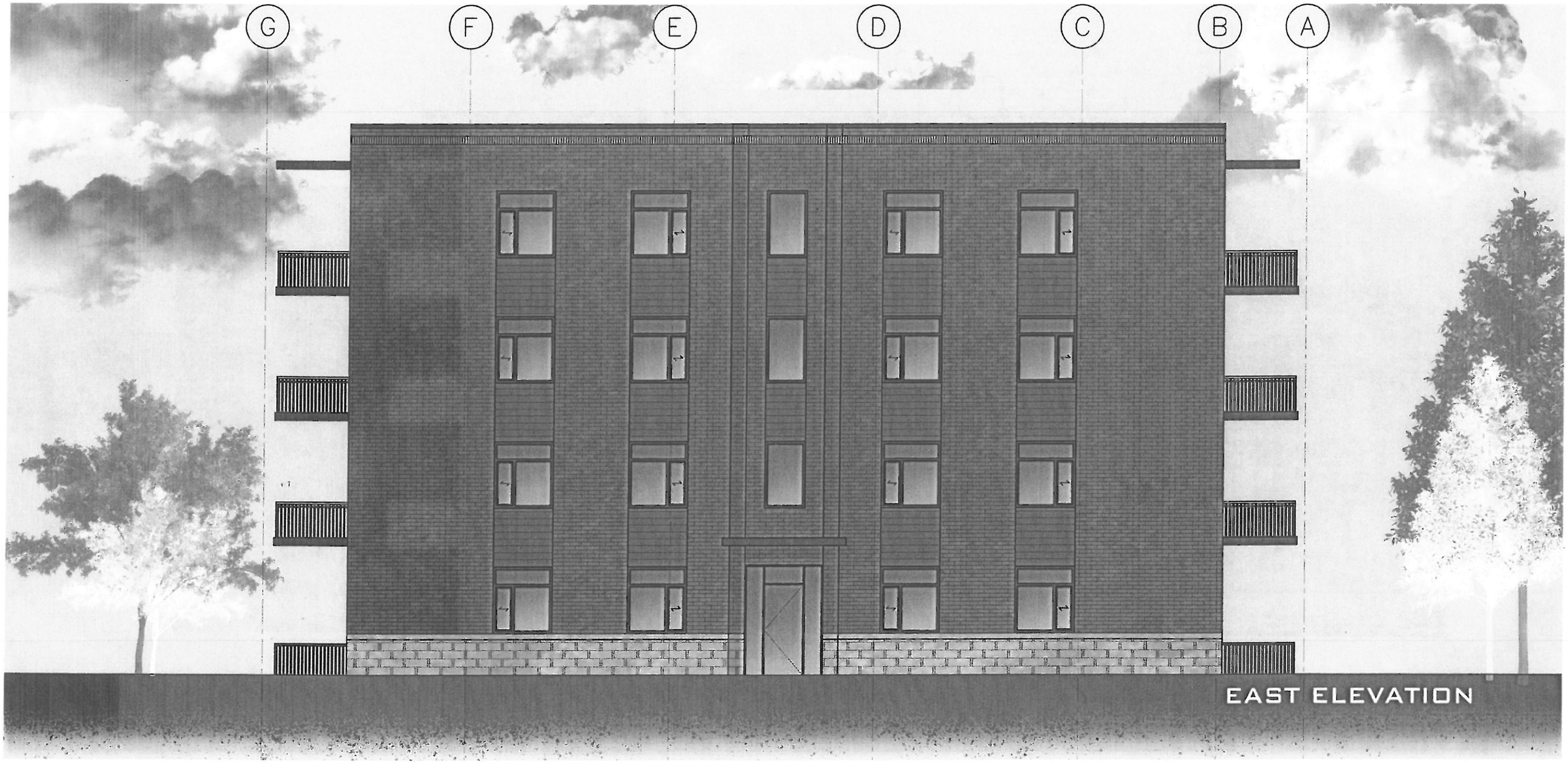


APPENDIX B

ELEVATION DRAWINGS

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

SOUTH ELEVATION



EAST ELEVATION