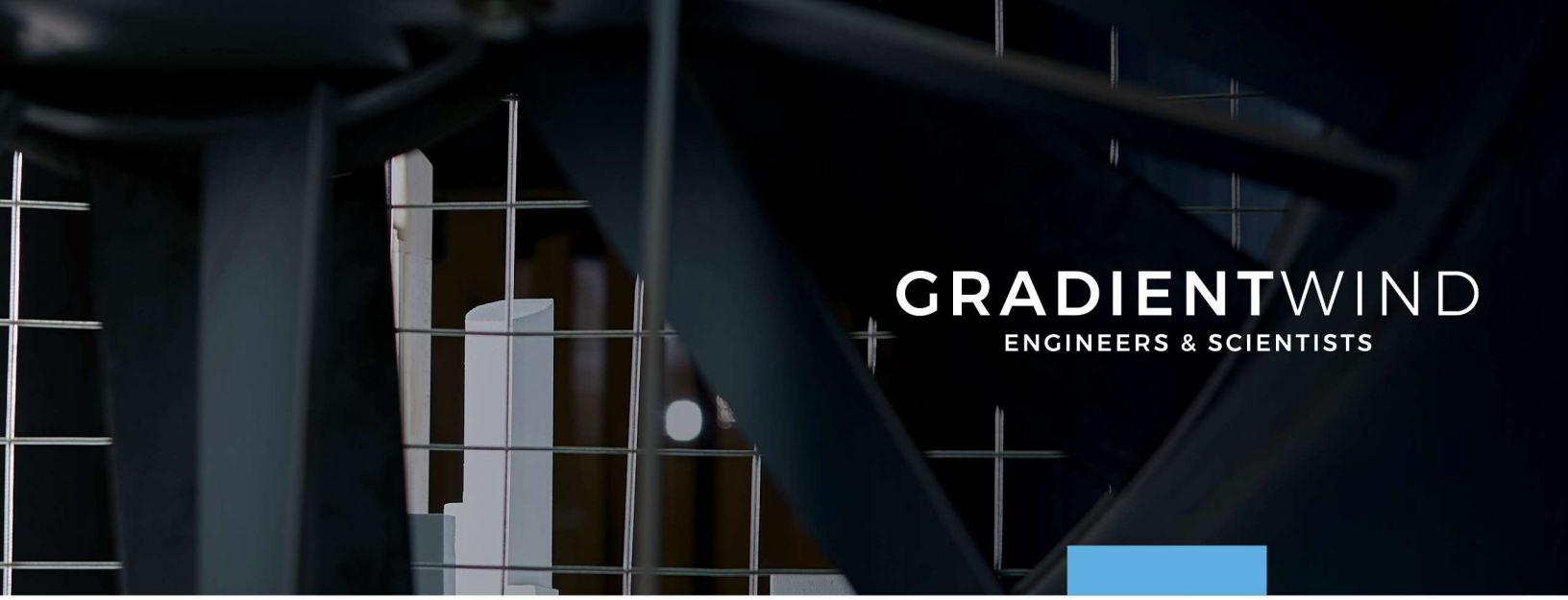
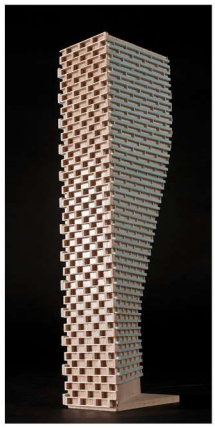


GRADIENTWIND
ENGINEERS & SCIENTISTS

# ROADWAY TRAFFIC NOISE ASSESSMENT

393 McArthur Avenue
Ottawa, Ontario

REPORT: GW21-279 – Traffic Noise



February 17, 2022


PREPARED FOR
Elite Homes Management Inc.
12 Escade Drive
Nepean, ON K2G 6R9

PREPARED BY
Tanyon Matheson-Fitchett, B.Eng., Junior Environmental Scientist
Joshua Foster, P.Eng., Lead Engineer

# EXECUTIVE SUMMARY

This report describes a roadway traffic noise assessment undertaken in support of site plan application for a proposed mid-rise residential development at 393 McArthur Avenue in Ottawa, Ontario. The study site is located in the middle of a parcel of land bounded by McArthur Avenue to the south, and Belisle Street to the east. Outdoor Living Areas are assessed at the north side of level 5. The major source of traffic noise is McArthur Avenue which borders the site to the south. 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) architectural drawings prepared by CSV Architects dated March 2021.

The results of the current analysis indicate that noise levels will range between 55 and 67 dBA during the daytime period (07:00-23:00) and between 53 and 59 dBA during the nighttime period (23:00-07:00). The highest noise level (67 dBA) occurs at the south façade, which is nearest and most exposed to McArthur Avenue. 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 Clause[1] will also be required in all Lease, Purchase and Sale Agreements, as summarized in Section 6.

Noise levels at the 5th floor private terraces on the north side of the building (Receptor 5) are expected to approach 55 dBA during the daytime period. As the noise levels meet ENCG criteria for Outdoor Living Areas, noise control measures are not required.

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

The surrounding area was evaluated for sources of stationary noise impacting the proposed development. Sources identified include a cluster of Rooftop HVAC Units (RTUs) atop the nearby public school. The setback distance from the RTUs to the proposed development is approximately 55 metres. Hand calculations revealed the setback distance is expected to sufficiently attenuate noise levels to meet the exclusionary limits for stationary noise, outlined in the ENCG. Therefore, impacts from stationary noise sources on the proposed development are within acceptable levels.

The building's own proposed HVAC equipment has the potential for noise impacts on surrounding buildings and the study building itself. Typically, noise levels can be controlled by judicious selection and placement of the equipment and the introduction of silencers or noise screens where needed. A stationary noise study will be performed once mechanical plans for the proposed building become available. This study will include recommendations for any noise control measures that may be necessary to ensure noise levels fall below ENCG limits.

# TABLE OF CONTENTS

# 1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Elite Homes Management Inc. to undertake a roadway traffic noise assessment for a proposed mid-rise residential development located at 393 McArthur Avenue 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[2] and Ministry of the Environment, Conservation and Parks (MECP)[3] guidelines. Noise calculations were based on architectural drawings prepared by CSV Architects dated March 2021, with future traffic volumes corresponding to the City of Ottawa's Official Plan (OP) roadway classifications.

# 2. TERMS OF REFERENCE

The focus of this traffic noise assessment is a proposed mid-rise residential development at 393 McArthur Avenue in Ottawa, Ontario. The study site is located in the middle of a parcel of land bounded by McArthur Avenue to the south, and Belisle Street to the east.

The proposed development is a 6-storey building of nearly rectangular planform. A commercial unit, residential units, lobby, and various building support functions occupy the first floor. Levels 2-6 are reserved for residential occupancy. Floorplates set back from the north elevation at level 5 to accommodate private terraces. Balconies which extend less than 4 metres from the façade do not require consideration as Outdoor Living Areas (OLA) in this study.

The site is surrounded by low-rise commercial buildings to the east and west on McArthur Avenue, low-rise residential neighbourhoods to the north and south, a public school approximately 55 metres to the immediate northwest, and a grouping of 3-storey apartment buildings to the southwest. The major source of roadway traffic noise is McArthur Avenue, classified as an arterial road. Figure 1 illustrates a complete site plan with surrounding context.

[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

# 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 ($2\times10^{-5}$ 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 reduction[5]. A closed window due to a ventilation requirement will bring noise levels down to achieve an acceptable indoor environment[6]. Therefore, where noise levels exceed 55 dBA daytime and 50 dBA nighttime, the ventilation for the building should consider the need for having windows and doors closed, which triggers the need for forced air heating with provision for central air conditioning. Where noise levels exceed 65 dBA daytime and 60 dBA nighttime, air conditioning will be required and building components will require higher levels of sound attenuation[7].

The sound level criterion for outdoor living areas 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.

[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

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.
- Receptor height was taken to be 17.5 metres at Level 6 for the centre of the window (height to 6$^{th}$ floor slab + 1.5 metres) for Receptors 1-4, and 14.5 m for terrace Receptor 5.
- For select sources where appropriate, Receptors 1-5 considered the proposed building as a barrier with a height of 19 metres, partially or fully obstructing exposure to the source as illustrated by exposure angles in Figures 3 and 4.
- Noise receptors were strategically placed at 5 locations around the study area (see Figure 2).
- Receptor distances and exposure angles are illustrated in Figures 3 and 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 Plan[8] 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 |
|---|---|---|---|
| McArthur Avenue | 2 Lane Urban Arterial Undivided (2-UAU) | 40 | **15,000** |

[8] 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. The calculation procedure[9] 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[10], exterior walls possess specific sound attenuation characteristics that are used as a basis for calculating the required STC ratings of windows in the same partition. Due to the limited information available at the time of the study, which was prepared for site plan approval, detailed floor layouts and building elevations have not been finalized; therefore, detailed STC calculations could not be performed at this time. As a guideline, the anticipated STC requirements for windows have been estimated based on the overall noise reduction required for each intended use of space (STC = outdoor noise level – targeted indoor noise levels).

## 4.4 Stationary Noise

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

For stationary sources, the $L_{eq}$ is commonly calculated on an hourly interval. Stationary sources are defined as "all sources of sound and vibration, whether fixed or mobile, that exist or operate on a premises, property or facility, the combined sound and vibration levels of which are emitted beyond the property boundary of the premises, property or facility, unless the source(s) is (are) due to construction" [11]. The only significant stationary noise sources identified nearby are the cluster of Rooftop HVAC Units (RTU) atop the Robert E. Wilson Public School approximately 50 metres to the northwest.

Criterion for stationary noise is based on the classification of the surrounding area. In this case, an urban environment is considered to be Class 1. The study site is considered to be a Class 1 area because it is located in proximity to an arterial roadway. These conditions indicate that the sound field is dominated by manmade sources, in particular McArthur Avenue. The recommended maximum noise levels for a Class 1 area in an urban environment at a Point of Reception (POR) are the exclusionary limits outlined in Table 3 below, or background noise levels, whichever may be higher.

**TABLE 3: EXCLUSIONARY LIMITS FOR CLASS 1 AREA**

| Time of Day | Outdoor Points of Reception (dBA) | Plane of Window (dBA) |
|---|---|---|
| 07:00 – 19:00 | 50 | 50 |
| 19:00 – 23:00 | 50 | 50 |
| 23:00 – 07:00 | N/A | 45 |

### 4.4.1 Determination of Noise Source Power Levels

Mechanical information for the adjacent automotive repair garage was assumed based on Gradient Wind's experience with similar buildings and a review of satellite images. A total of 16 RTUs were identified, each assumed to have a sound power level of 79 dBA. Using logarithmic addition, the equivalent sound power level for all 16 RTUs is 91 dBA. The average distance to the cluster of RTUs is 55 metres from the proposed building façade.

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

### 4.4.2 Stationary Source Noise Predictions

A high-level noise assessment was made by performing simple hand calculations to determine potential impacts. The impact of existing stationary noise sources on the proposed development was determined by calculations using the sound power level described above and the distance between the source and the receiver. Equation 1 was used to convert the sound power level to the sound pressure level at each POR[12].

$$L_{eq} = L_W - \left|10\log\left(\frac{Q}{4\pi r^2}\right)\right| \qquad \text{(Eq.1)}$$

*Where:*

*$L_W$ = Sound Power Level (dBA)*

*$L_{eq}$ = Equivalent Sound Pressure Level [1 hour (dBA)]*

*Q = Directivity Factor (2 for hemispherical radiation)*

*r = Distance between Source and Receiver (m)*

*(50% operation during nighttime = -3 dBA).*

Using Equation 1, the expected daytime $L_{eq}$ at the nearest plane of window along the west façade of the proposed building is expected to be 48 dBA. It is expected that the RTUs will be reduced to 50% operation or less during the nighttime period, as the school will be unoccupied. The nighttime $L_{eq}$ is expected to approach 45 dBA. The noise from the RTU cluster falls below the exclusionary limits, therefore no stationary noise impacts are expected.

[12] ASHRAE. 2009. *ASHRAE Handbook – 2009 Fundamentals*, Chapter 8. Atlanta, GA: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

# 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 | 17.5 | POW – 6th Floor – West Façade | 63 | 56 |
| 2 | 17.5 | POW – 6th Floor – South Façade | 67 | 59 |
| 3 | 17.5 | POW – 6th Floor – East Façade | 63 | 55 |
| 4 | 17.5 | POW – 6th Floor – Northeast Façade | 60 | 53 |
| 5 | 14.5 | OLA – 5th Floor – Private Terraces | 55 | N/A* |

*Nighttime noise levels not considered at OLA receptors, as per ENCG

The results of the current analysis indicate that noise levels will range between 55 and 67 dBA during the daytime period (07:00-23:00) and between 53 and 59 dBA during the nighttime period (23:00-07:00). The highest noise level (67 dBA) occurs at the south façade, which is nearest and most exposed to McArthur Avenue.

## 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). 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 5):

- **Bedroom Windows**

(i) Bedroom windows facing south will require a minimum STC of 30.

(ii) All other bedroom windows are to satisfy Ontario Building Code (OBC 2012) requirements

- **Living Room Windows**

(i) Living room windows facing south will require a minimum STC of 25

(ii) All other living room windows are to satisfy Ontario Building Code (OBC 2012) requirements

- **Commercial Windows**

(iii) Commercial windows facing south will require a minimum STC of 20

(iv) All other living room 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 data[13]

The STC requirements apply to windows, doors, spandrel panels and curtainwall elements. Exterior wall components on these façades are recommended to have a minimum STC of 45, where a window/wall system is used. A review of window supplier literature indicates that the specified STC ratings can be achieved by a variety of window systems having a combination of glass thickness and inter-pane spacing. 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.

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

# 6. CONCLUSIONS AND RECOMMENDATIONS

The results of the current analysis indicate that noise levels will range between 55 and 67 dBA during the daytime period (07:00-23:00) and between 53 and 59 dBA during the nighttime period (23:00-07:00). The highest noise level (67 dBA) occurs at the south façade, which is nearest and most exposed to McArthur Avenue. 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 Clause[14] will also be required be placed on all Lease, Purchase and Sale Agreements, as summarized below:

> *"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 5th floor private terraces on the north side of the building (Receptor 5) are expected to approach 55 dBA during the daytime period. As the noise levels meet ENCG criteria for Outdoor Living Areas, noise control measures are not required.

The surrounding area was evaluated for sources of stationary noise impacting the proposed development. Sources identified include a cluster of Rooftop HVAC Units (RTUs) atop the nearby public school. The setback distance from the RTUs to the proposed development is approximately 55 metres. Hand calculations revealed the setback distance is expected to sufficiently attenuate noise from the RTUs. Noise levels are expected to meet the exclusionary limits for stationary noise outlined in the ENCG. Therefore, impacts from stationary noise sources on the proposed development are within acceptable levels.

The building's own proposed HVAC equipment has the potential for noise impacts on surrounding buildings and the study building itself. Typically, noise levels can be controlled by judicious selection and placement of the equipment and the introduction of silencers or noise screens where needed. A stationary

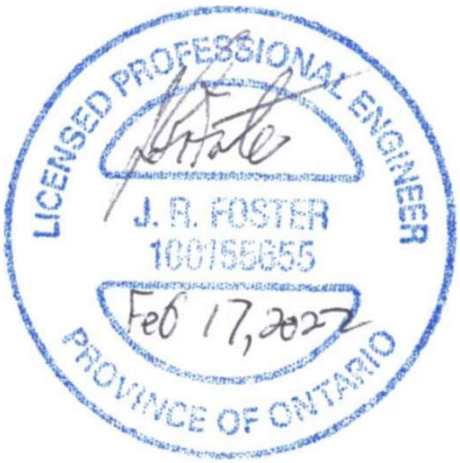
[14] Ontario Ministry of the Environment and Climate Change – Environmental Noise Guidelines, Publication NPC-300, Queens Printer for Ontario, Toronto, 2013

noise study will be performed once mechanical plans for the proposed building become available. This study will include recommendations for any noise control measures that may be necessary to ensure noise levels fall below ENCG limits.

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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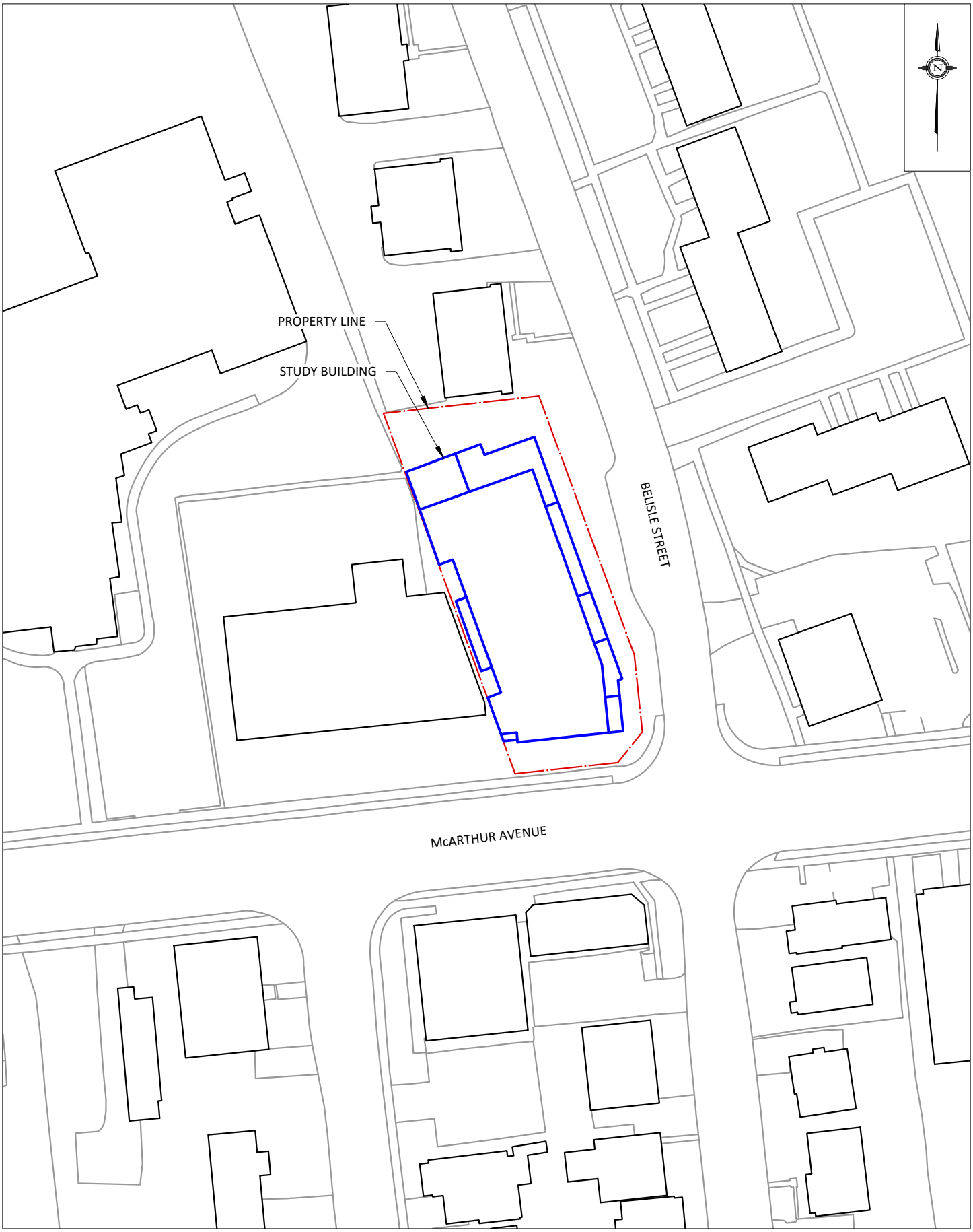
Lead Engineer

*Gradient Wind File No. 21-279 - Traffic Noise*

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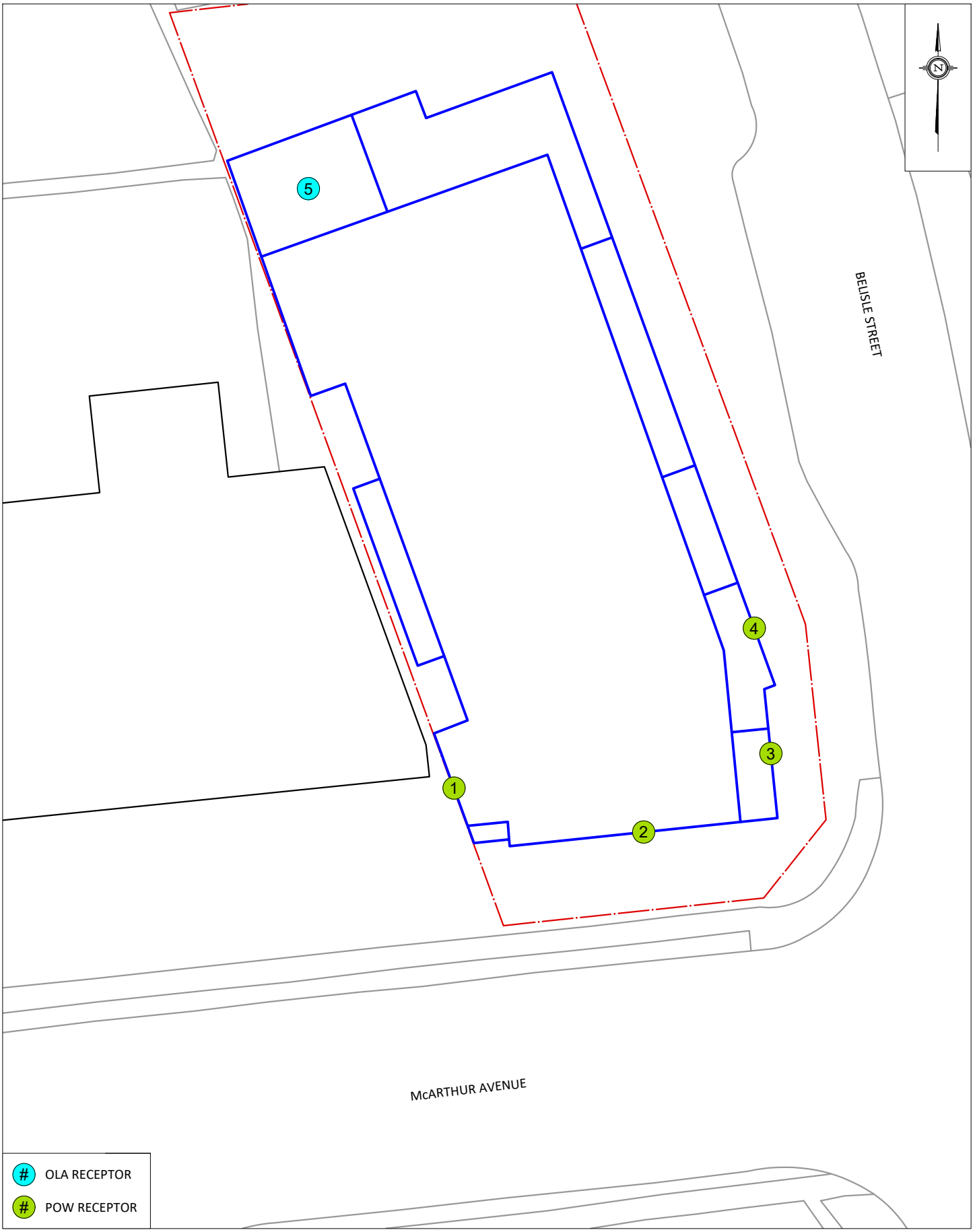
| SCALE | 1:800 (APPROX.) |
| DRAWING NO. | GW21-279-1 |
| DATE | SEPTEMBER 10, 2021 |
| DRAWN BY | T.M.F. |

DESCRIPTION

FIGURE 1:
SITE PLAN AND SURROUNDING CONTEXT

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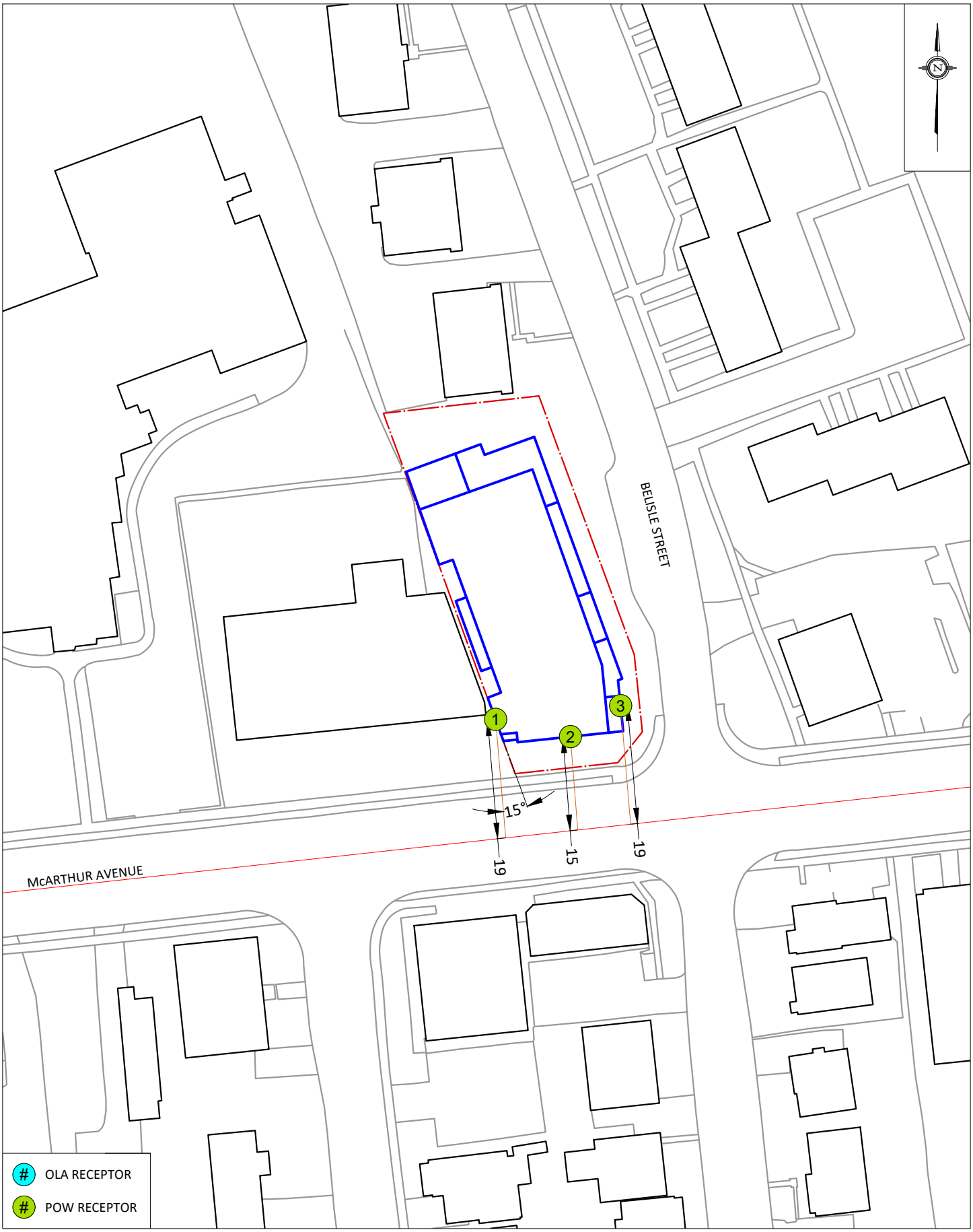
| DATE | SEPTEMBER 10, 2021 | DRAWN BY | T.M.F. |

FIGURE 2:
RECEPTOR LOCATIONS

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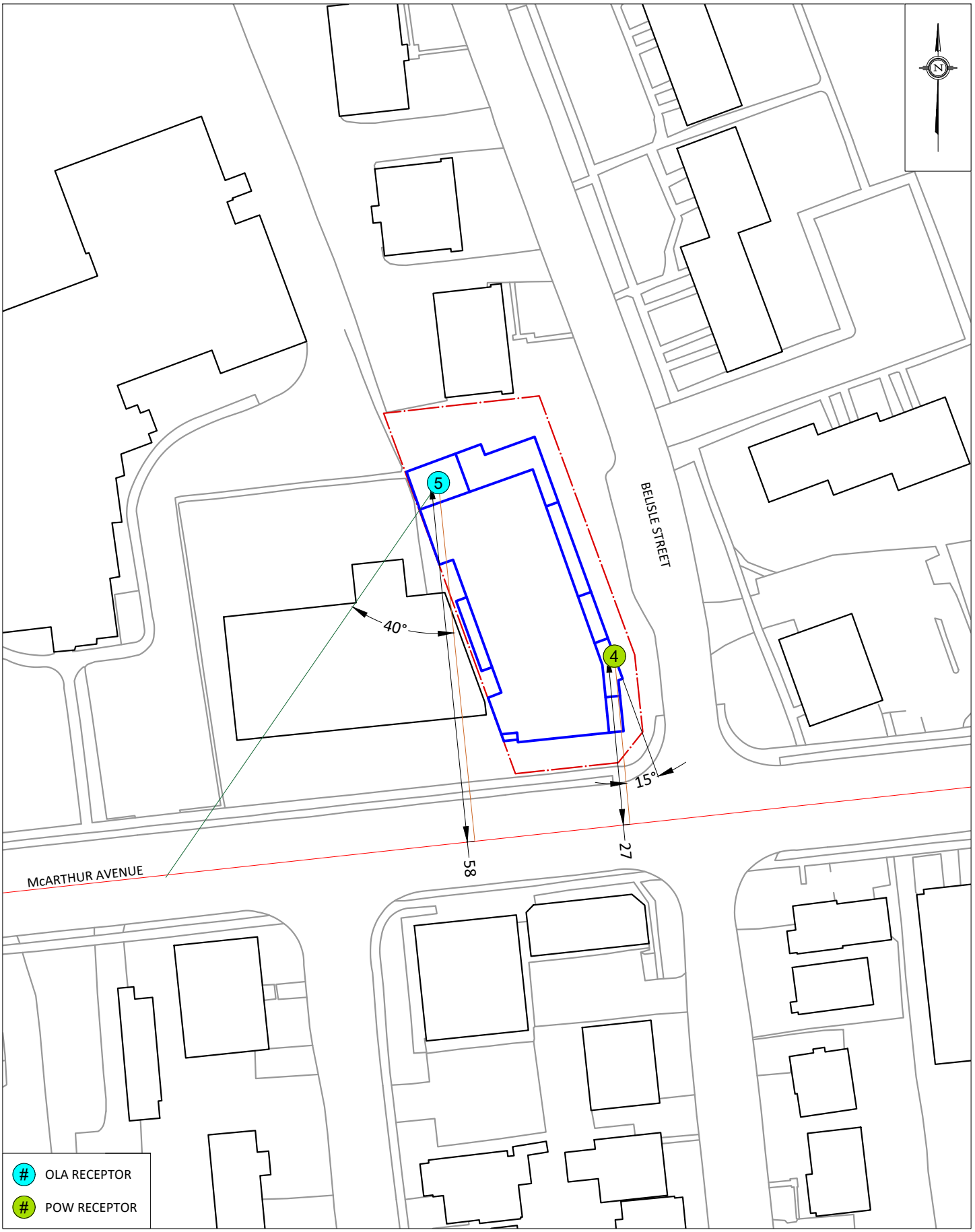
| DATE | SEPTEMBER 13, 2021 |
| DRAWN BY | T.M.F. |

DESCRIPTION

FIGURE 3:
RECEPTORS 1 - 3 STAMSON INPUT PARAMETERS

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| DRAWING NO. | GW21-279-4 |
| DATE | SEPTEMBER 13, 2021 |
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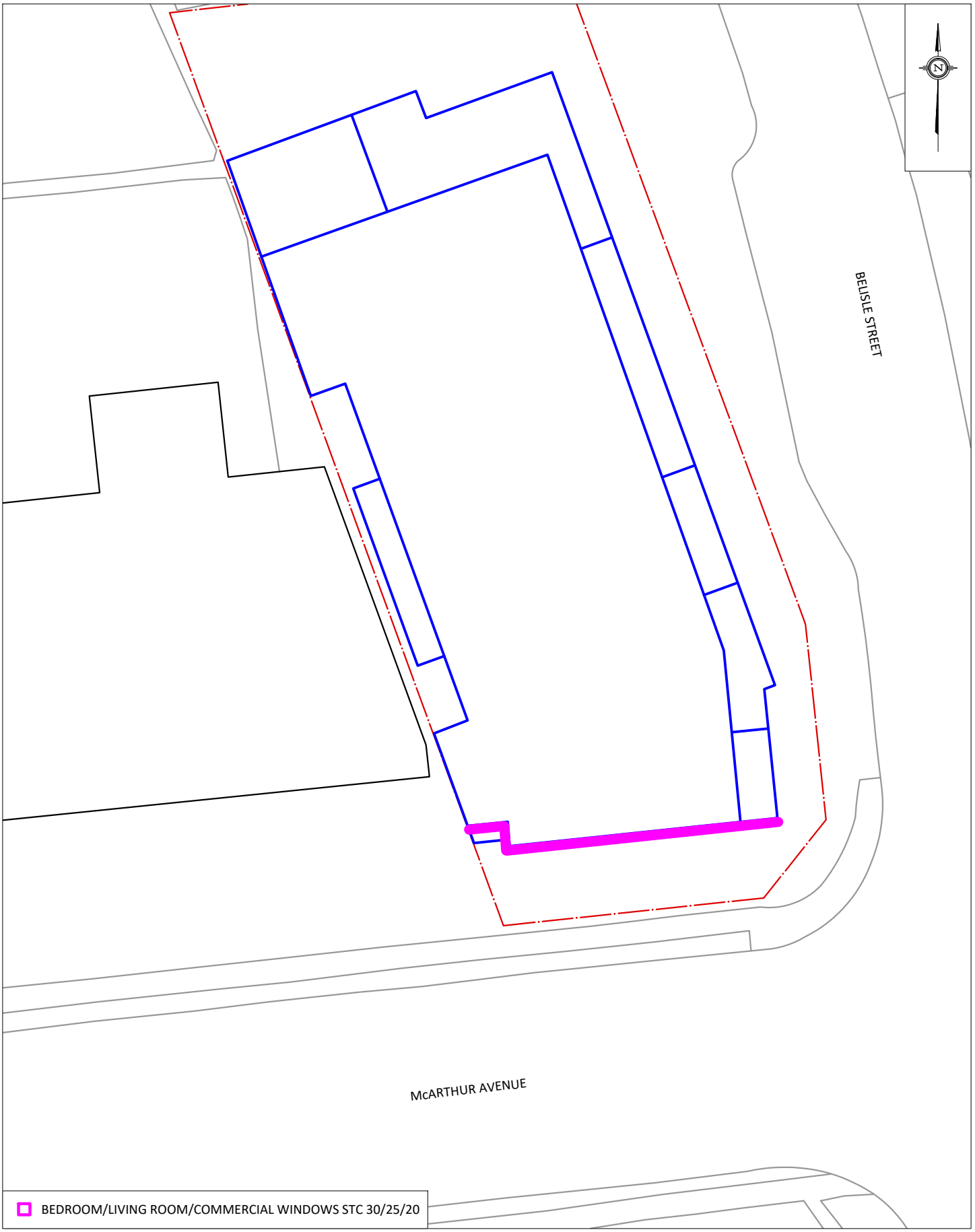
DESCRIPTION

FIGURE 4:
RECEPTORS 4 AND 5 STAMSON INPUT PARAMETERS

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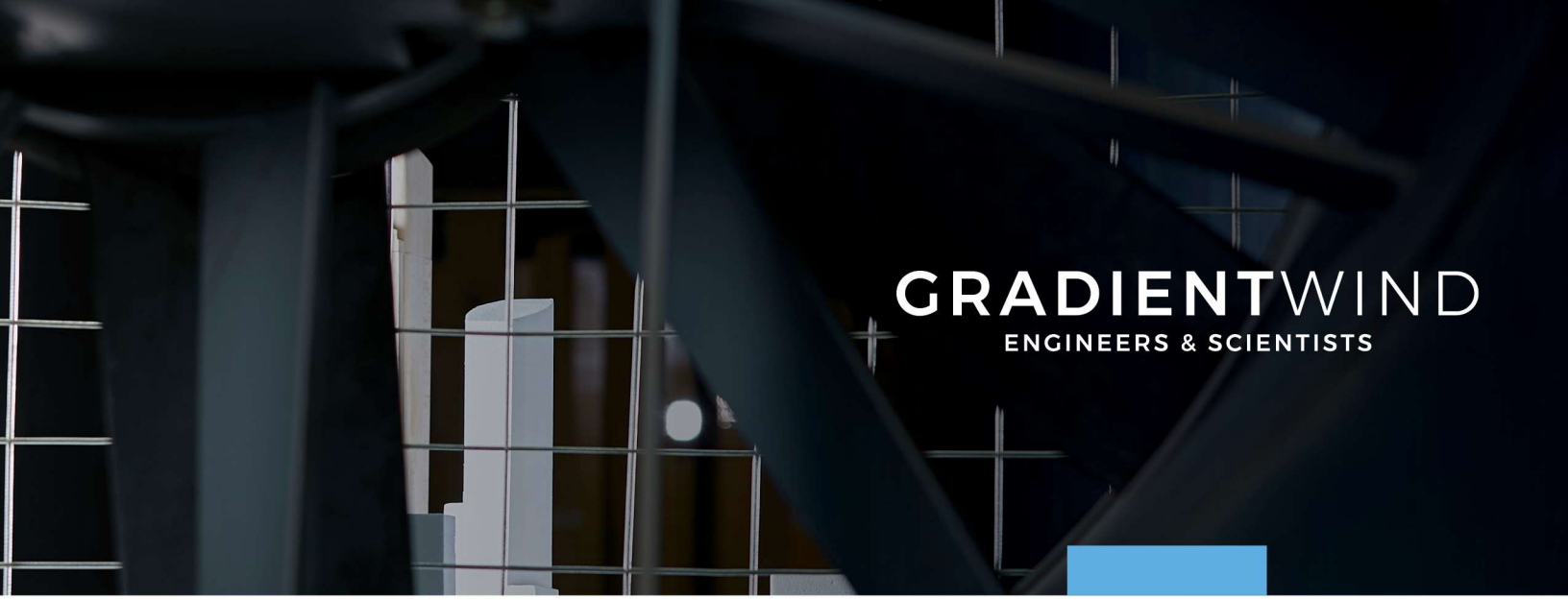
| SCALE | 1:300 (APPROX.) | DRAWING NO. | GW21-279-5 |
| DATE | SEPTEMBER 13, 2021 | DRAWN BY | T.M.F. |

FIGURE 5:
WINDOW STC REQUIREMENTS



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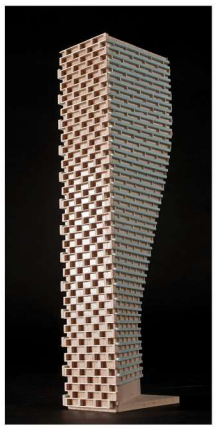

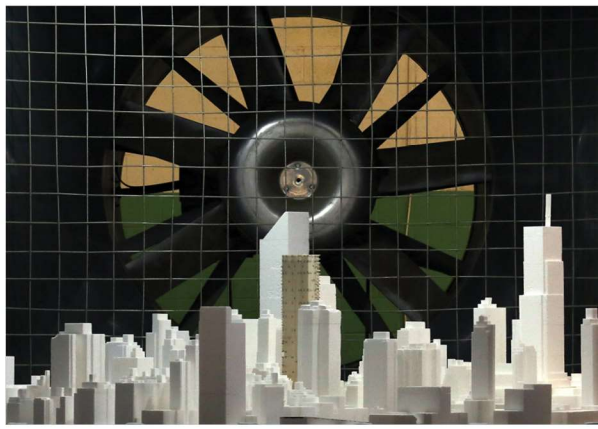

# APPENDIX A

# STAMSON 5.04 – INPUT AND OUTPUT DATA

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GRADIENTWIND.COM

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STAMSON 5.0        NORMAL REPORT        Date: 13-09-2021 14:57:19
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: McARTHUR (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  :    40 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  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: McARTHUR (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  :  19.00 / 19.00  m
Receiver height           :  17.50 / 17.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Results segment # 1: McARTHUR (day)
-----------------------------------

Source height = 1.50 m

ROAD (0.00 + 63.32 + 0.00) = 63.32 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -15     90   0.00  66.69   0.00  -1.03  -2.34   0.00   0.00   0.00  63.32
-------------------------------------------------------------------------------

Segment Leq : 63.32 dBA

Total Leq All Segments: 63.32 dBA

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

Source height = 1.50 m

ROAD (0.00 + 55.72 + 0.00) = 55.72 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -15     90   0.00  59.09   0.00  -1.03  -2.34   0.00   0.00   0.00  55.72
-------------------------------------------------------------------------------

Segment Leq : 55.72 dBA

Total Leq All Segments: 55.72 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 63.32
                           (NIGHT): 55.72
```

```
STAMSON 5.0        NORMAL REPORT        Date: 13-09-2021 14:59:05
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: McARTHUR (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  :    40 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  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: McARTHUR (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           :  17.50 / 17.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Results segment # 1: McARTHUR (day)
-----------------------------------

Source height = 1.50 m

ROAD (0.00 + 66.69 + 0.00) = 66.69 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  66.69   0.00   0.00   0.00   0.00   0.00   0.00  66.69
-------------------------------------------------------------------------------

Segment Leq : 66.69 dBA

Total Leq All Segments: 66.69 dBA

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

Source height = 1.50 m

ROAD (0.00 + 59.09 + 0.00) = 59.09 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  59.09   0.00   0.00   0.00   0.00   0.00   0.00  59.09
-------------------------------------------------------------------------------

Segment Leq : 59.09 dBA

Total Leq All Segments: 59.09 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 66.69
                           (NIGHT): 59.09
```

```
STAMSON 5.0        NORMAL REPORT        Date: 13-09-2021 15:00:17
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: McARTHUR (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  :    40 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  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: McARTHUR (day/night)
----------------------------------------------
Angle1   Angle2           : -90.00 deg   1.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  19.00 / 19.00  m
Receiver height           :  17.50 / 17.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Results segment # 1: McARTHUR (day)
-----------------------------------

Source height = 1.50 m

ROAD (0.00 + 62.70 + 0.00) = 62.70 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90      1   0.00  66.69   0.00  -1.03  -2.96   0.00   0.00   0.00  62.70
-------------------------------------------------------------------------------

Segment Leq : 62.70 dBA

Total Leq All Segments: 62.70 dBA

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

Source height = 1.50 m

ROAD (0.00 + 55.10 + 0.00) = 55.10 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90      1   0.00  59.09   0.00  -1.03  -2.96   0.00   0.00   0.00  55.10
-------------------------------------------------------------------------------

Segment Leq : 55.10 dBA

Total Leq All Segments: 55.10 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 62.70
                           (NIGHT): 55.10
```

```
STAMSON 5.0        NORMAL REPORT        Date: 13-09-2021 15:01:30
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: McARTHUR (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  :    40 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  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: McARTHUR (day/night)
----------------------------------------------
Angle1   Angle2           : -90.00 deg   -15.00 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           :  17.50 / 17.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Results segment # 1: McARTHUR (day)
-----------------------------------

Source height = 1.50 m

ROAD (0.00 + 60.33 + 0.00) = 60.33 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90    -15   0.00  66.69   0.00  -2.55  -3.80   0.00   0.00   0.00  60.33
-------------------------------------------------------------------------------

Segment Leq : 60.33 dBA

Total Leq All Segments: 60.33 dBA

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

Source height = 1.50 m

ROAD (0.00 + 52.73 + 0.00) = 52.73 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90    -15   0.00  59.09   0.00  -2.55  -3.80   0.00   0.00   0.00  52.73
-------------------------------------------------------------------------------

Segment Leq : 52.73 dBA

Total Leq All Segments: 52.73 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 60.33
                           (NIGHT): 52.73
```

```
STAMSON 5.0        NORMAL REPORT        Date: 13-09-2021 15:04:08
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: McARTHUR (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  :    40 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  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: McARTHUR (day/night)
----------------------------------------------
Angle1   Angle2           :  40.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  58.00 / 58.00  m
Receiver height           :  14.50 / 17.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Results segment # 1: McARTHUR (day)
-----------------------------------

Source height = 1.50 m

ROAD (0.00 + 55.25 + 0.00) = 55.25 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
    40     90   0.00  66.69   0.00  -5.87  -5.56   0.00   0.00   0.00  55.25
-------------------------------------------------------------------------------

Segment Leq : 55.25 dBA

Total Leq All Segments: 55.25 dBA

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

Source height = 1.50 m

ROAD (0.00 + 47.65 + 0.00) = 47.65 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
    40     90   0.00  59.09   0.00  -5.87  -5.56   0.00   0.00   0.00  47.65
-------------------------------------------------------------------------------

Segment Leq : 47.65 dBA

Total Leq All Segments: 47.65 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 55.25
                           (NIGHT): 47.65
```