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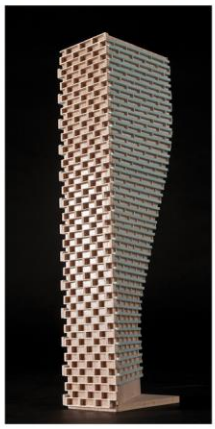
ROADWAY TRAFFIC NOISE ASSESSMENT

1050 & 1060 Bank Street
Ottawa, Ontario

GRADIENT WIND REPORT: 19-188 – Traffic Noise



December 10, 2019

PREPARED FOR
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EXECUTIVE SUMMARY

This report describes a roadway traffic noise assessment undertaken in support of site plan control application for a proposed mixed-use development located at 1050 and 1060 Bank Street in Ottawa, Ontario. The development comprises a 6-storey building with a triangular-shaped floorplan. The ground floor will comprise of commercial/retail units with the remaining floors above dedicated to residential suites. The floorplate steps back on all sides at the 5th level to reveal private terraces on the east side, a common amenity terrace at the south edge, and a public roof area/walkway on the west side. The primary sources of traffic noise are Colonel By Drive, Bank Street, and Sunnyside Avenue. 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 provided by KWC Architects Inc. on October 11th 2019.

The results of the current analysis indicate that noise levels will range between 66 and 70 dBA during the daytime period (07:00-23:00) and between 58 and 63 dBA during the nighttime period (23:00-07:00). The highest noise level (70 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 6.

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[1] will also be required on all Lease, Purchase and Sale Agreements, as summarized in Section 6.

As the building design progresses, the stationary noise impacts of the building on the surroundings would be considered. Stationary noise sources associated with the development are expected to comprise of

[1] City of Ottawa Environmental Noise Control Guidelines, January 2016

make up air units and an emergency generator. These sources are not expected to be a concern at noise sensitive spaces and surrounding properties, provided the following are considered in the design: judicious selection of the equipment, locating the equipment on a high roof away from nearby residential receptors, and where necessary, installing silencers or noise screens.

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1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by 2641723 Ontario Inc. to undertake a roadway traffic noise assessment in support of a site plan control application for a proposed mixed-use development located at 1050 and 1060 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[2] and Ministry of the Environment, Conservation and Parks (MECP)[3] guidelines. Noise calculations were based on architectural drawings provided by KWC Architects Inc., 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 mixed-use development located at 1050 and 1060 Bank Street in Ottawa, Ontario. The development occupies the entire east side of the city block bordered by Aylmer Avenue to the north, Bank Street to the east, Euclid Avenue to the south, and Galt Street to the west. The site is bordered by existing low-rise developments to the west.

The development comprises a 6-storey building with a triangular-shaped floorplan stretched north-south along its long access. The building is contoured to the existing roadways on the north, east, and south faces, and parallel to existing developments to the west. The floorplate steps back on all sides at the 5th level to reveal private terraces on the east side, a common amenity terrace at the south edge, and a public roof area/walkway on the west side. As the terrace is less than 4 meters in depth, it is not considered as an outdoor living area (OLA) and was not included in the analysis.

The floorplate steps back again at the 6th level on the west and south sides. The basement level comprises parking spaces and storage. The basement floor plan includes parking spaces and storage. The ground level comprises a lobby, retail space, and waste and recycling. Levels 2 and above comprise residential

[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

units. The main residential entrance is located at the east side of the building, while secondary residential entrances are located at the north and west sides. Commercial entrances are located on all sides of the building. A ramp at the northwest corner of the site provides access to the basement parking level. Grade-level pedestrian walkways are located on all sides of the proposed development. The primary sources of roadway traffic noise are Colonel By Drive, Bank Street, and Sunnyside Avenue. 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 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 50, 45 and 40 dBA for retail, living rooms and sleeping quarters respectively as listed in Table 1. Based on Gradient Wind's experience, more comfortable indoor noise levels should be targeted toward 47, 42 and 37 dBA to control peak noise, and deficiencies in building envelope construction.

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

[4] Adapted from ENCG 2016 – Tables 2.2b and 2.2c
[5] Burberry, P.B. (2014). Mitchell's Environment and Services. Routledge, Page 125

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.

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. The elevation difference between Colonel By Drive and the study site is 7 meters.
- Receptor height was taken to be 1.5 metres, 12.2 meters and 17.5 meters at Level 1, 4 and 6 for the centre of the window.
- Select receptors considered the proposed and nearby buildings as a barrier partially or fully obstructing exposure to the source as illustrated by exposure angles in Figures 3-5.
- Noise receptors were strategically placed at 6 locations around the study area (see Figure 2).

[6] MOECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.8
[7] 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[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
Colonel By Drive	2-Lane Urban Arterial Undivided (2-UAU)	60	**15,000**
Bank Street	4-Lane Urban Arterial (4-UAU)	40	**30,000**
Sunnyside Avenue	2-Lane Urban Collector (2-UCU)	40	**8,000**

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.

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

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 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).

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.

[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

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	1.5	POW – 1st Floor – North Façade	68	60
2	1.5	POW – 1st Floor – East Façade	70	63
3	12.2	POW – 4th Floor – North Façade	68	60
4	12.2	POW – 4th Floor – East Façade	70	63
5	12.2	POW – 4th Floor – South Façade	66	58
6	17.5	POW – 6th Floor – East Façade	70	62

The results of the current analysis indicate that noise levels will range between 66 and 70 dBA during the daytime period (07:00-23:00) and between 58 and 63 dBA during the nighttime period (23:00-07:00). The highest noise level (70 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). 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 6):

- **Bedroom Windows**

(i) Bedroom windows facing north, east and south will require a minimum STC of 33

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

- **Living Room Windows**

(i) Living room windows facing north, east and south will require a minimum STC of 28

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

- **Retail Windows**

(i) Retail windows facing north, east and south will require a minimum STC of 23

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

- **Exterior Walls**

(i) Exterior wall components on the north, east and south façades will require a minimum STC of 45, which will be achieved with brick cladding or an acoustical equivalent according to NRC test data[11]

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.

[11] 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 66 and 70 dBA during the daytime period (07:00-23:00) and between 58 and 63 dBA during the nighttime period (23:00-07:00). The highest noise level (70 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 6.

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[12] will also be required on all Lease, Purchase and Sale Agreements, as summarized below:

> *"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 roadway traffic may, on occasion, interfere with some activities of the dwelling occupants, as the sound levels exceed the sound level limits of the City and the Ministry of the Environment, Conservation and Parks. To help address the need for sound attenuation, this development includes:*
>
> - *STC rated multi-pane glazing elements and spandrel panels*
> - *North, east and south façade bedroom/living room/retail: STC 33/28/23*
> - *STC rated exterior walls*
> - *North, east, and south façade: STC 45*
>
> *This dwelling unit has also been designed with air conditioning. Air conditioning will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the sound level limits of the City and the Ministry of the Environment Conservation and Parks.*

[12] City of Ottawa Environmental Noise Control Guidelines, January 2016

To ensure that provincial sound level limits are not exceeded, it is important to maintain these sound attenuation features."

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.

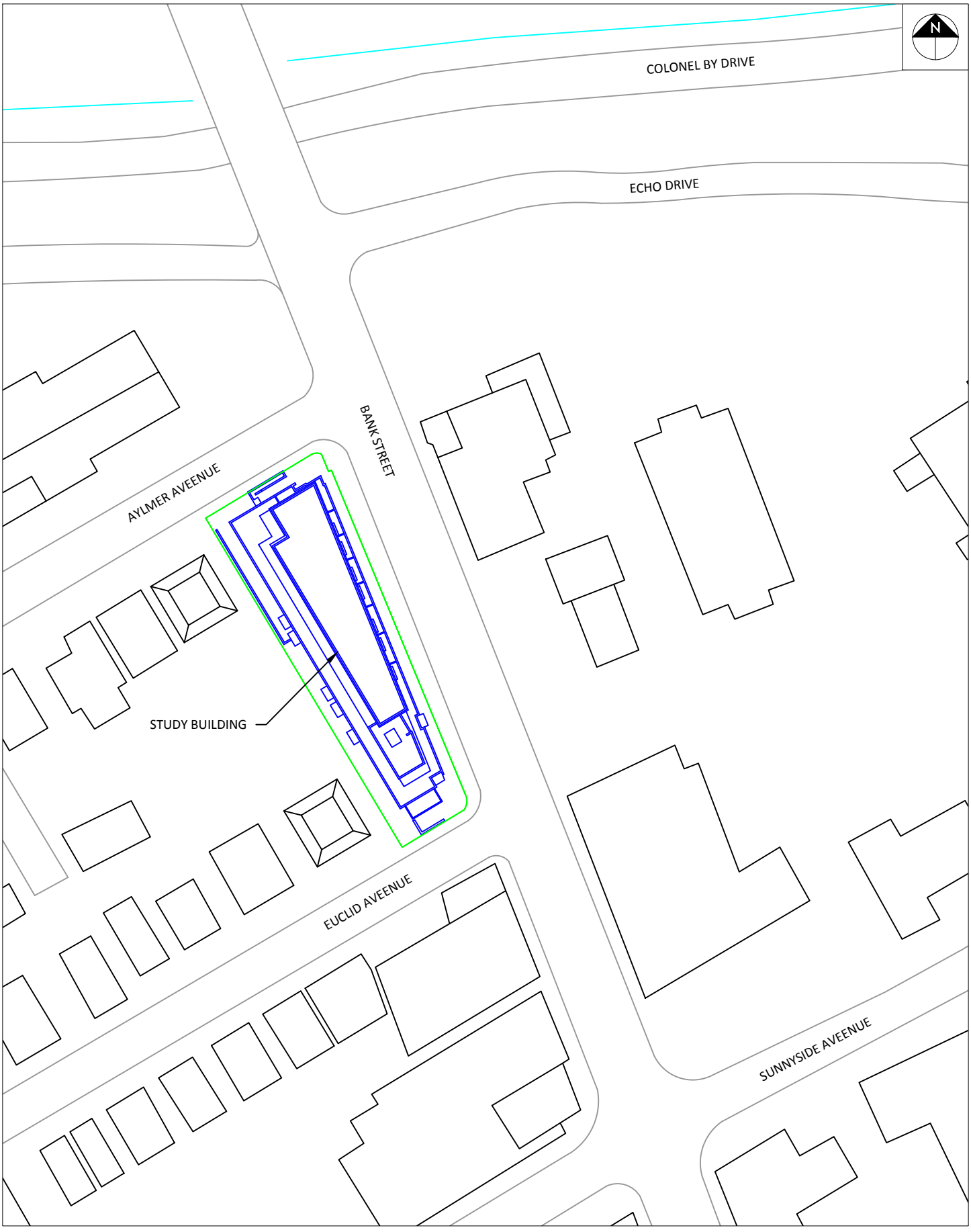
Sincerely,

Gradient Wind Engineering Inc.

Giuseppe Garro, MASc.
Junior Environmental Scientist

Joshua Foster, P.Eng.
Principal

Gradient Wind File #19-188 – Traffic Noise



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SCALE	1:1000 (APPROX.)
DRAWING NO.	GWE19-188-1
DATE	OCTOBER 31, 2019
DRAWN BY	G.G.

DESCRIPTION

FIGURE 1:
SITE PLAN AND SURROUNDING CONTEXT

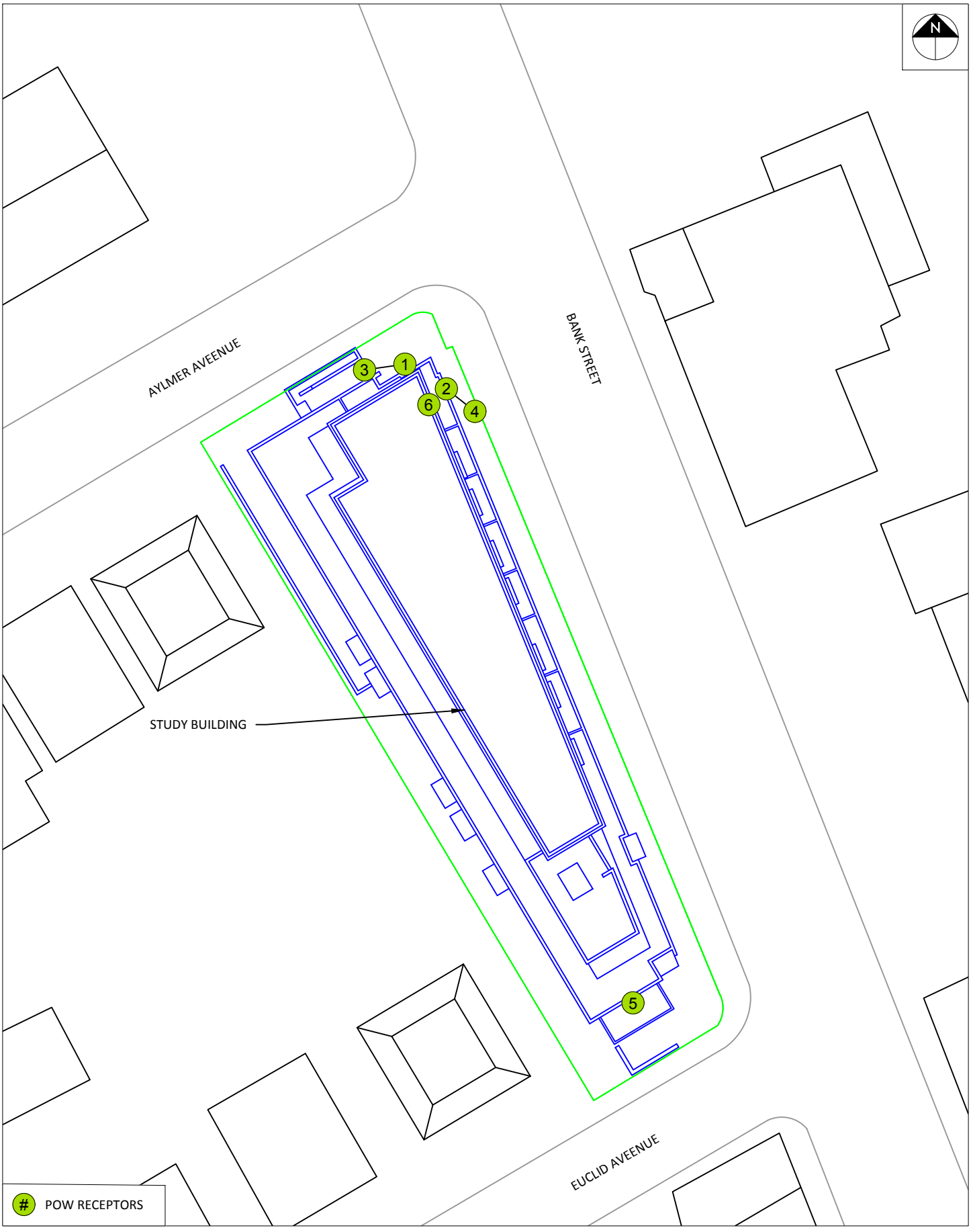

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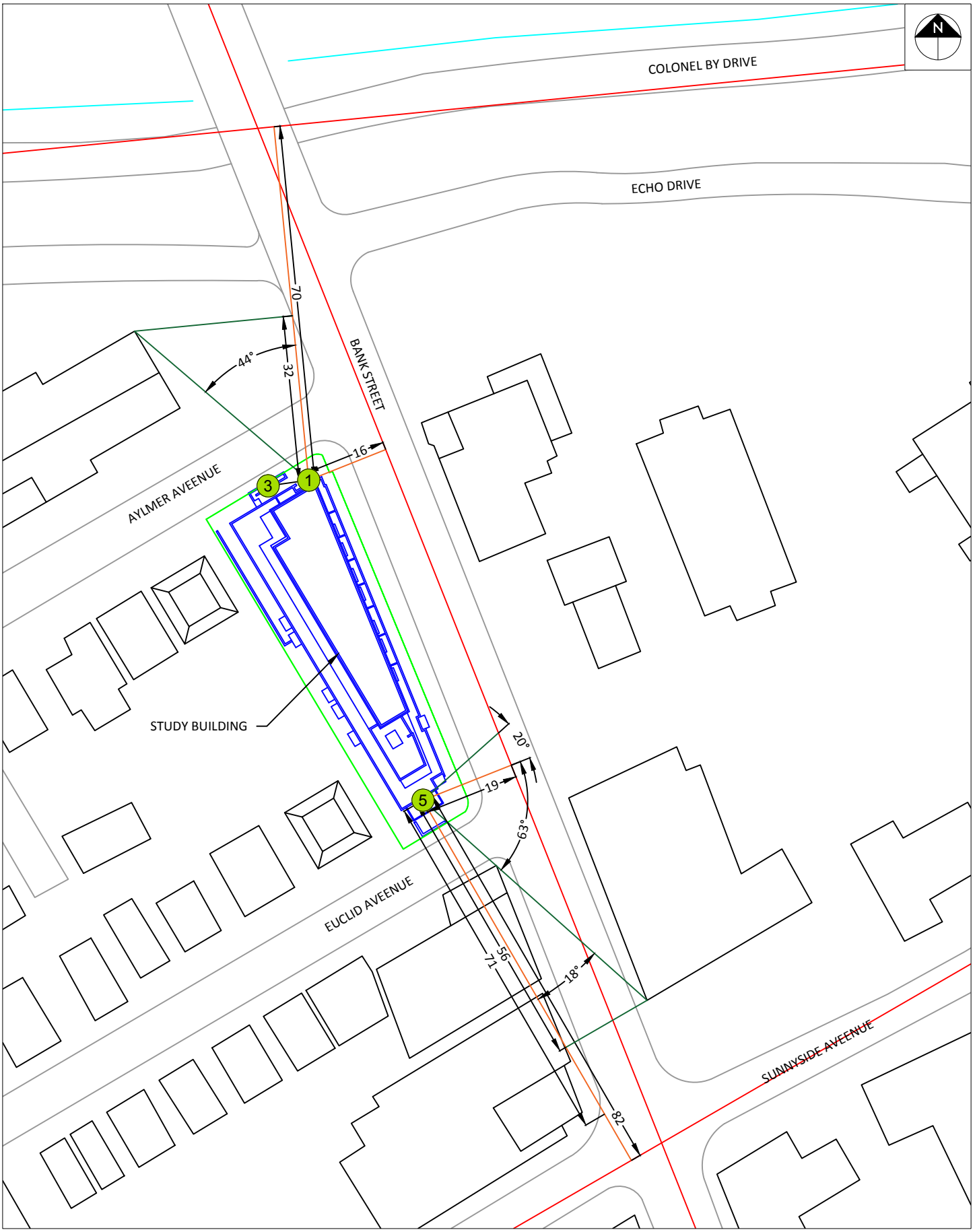
FIGURE 2:
RECEPTOR LOCATIONS



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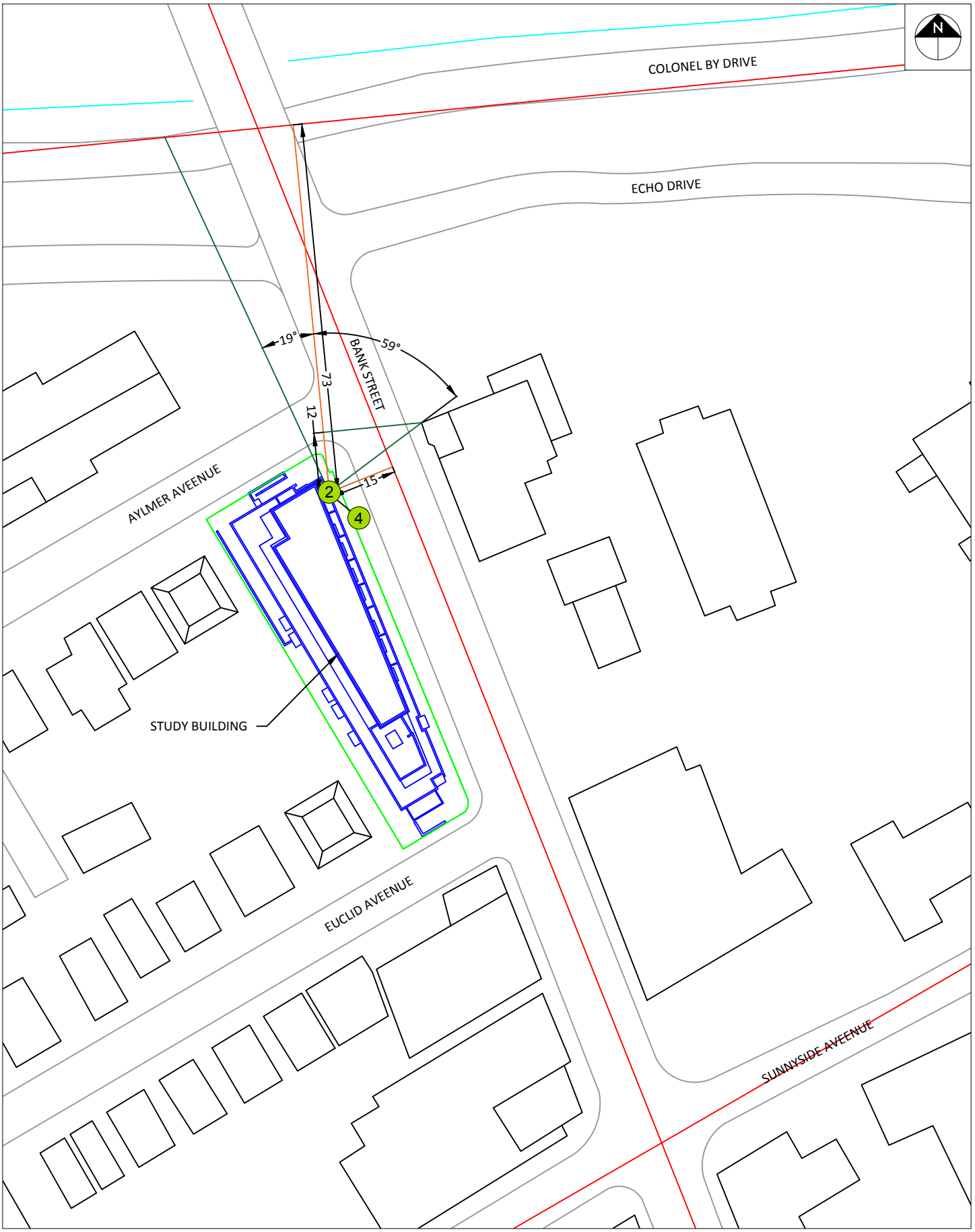
DESCRIPTION

FIGURE 3:
RECEPTOR 1, 3, AND 5 STAMSON INPUT PARAMETERS



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DESCRIPTION

FIGURE 4:
RECEPTOR 2 AND 4 STAMSON INPUT PARAMETERS

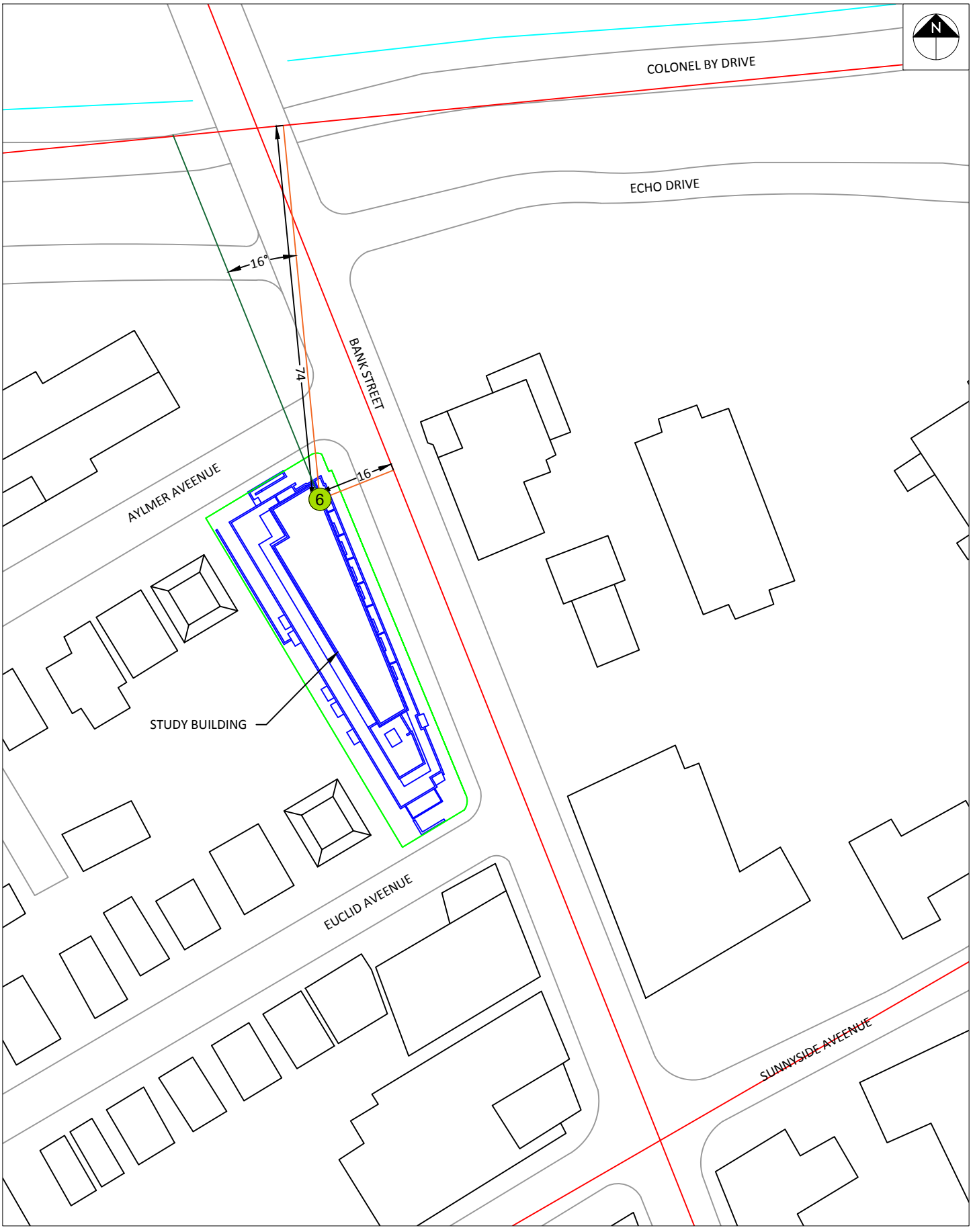

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FIGURE 5:
RECEPTOR 6 STAMSON INPUT PARAMETERS

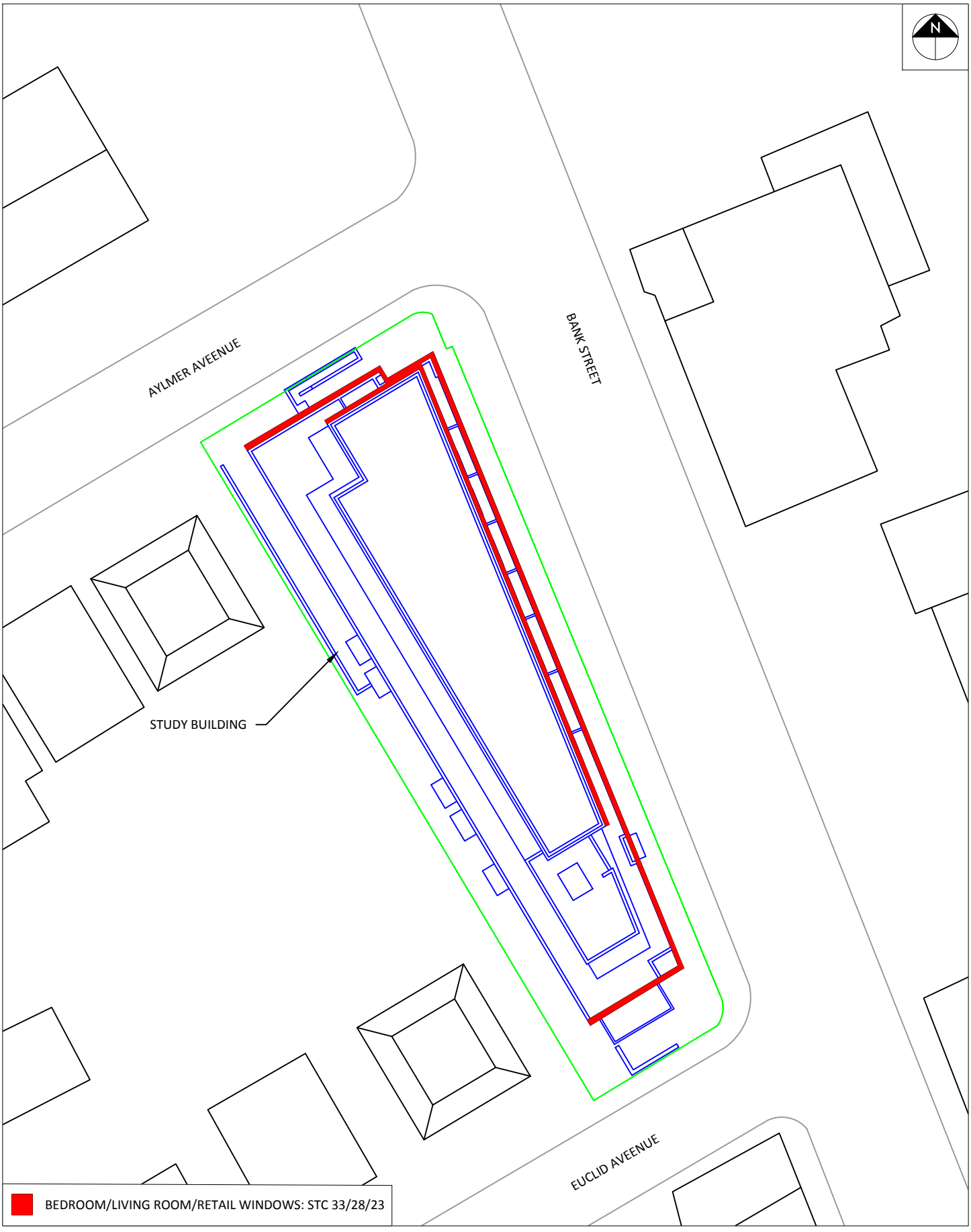

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FIGURE 6:
WINDOW STC REQUIREMENTS

APPENDIX A

STAMSON 5.04 – INPUT AND OUTPUT DATA

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```
STAMSON 5.0         NORMAL REPORT         Date: 31-10-2019 15:57:26
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: CBD (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  :    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):  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: CBD (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  :  70.00 / 70.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      4       (Elevated; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -44.00 deg
Barrier height            :  18.00 m
Elevation                 :   7.00 m
Barrier receiver distance :  32.00 / 32.00  m
Source elevation          :  61.00 m
Receiver elevation        :  68.00 m
Barrier elevation         :  68.00 m
Reference angle           :   0.00


Road data, segment # 2: Bank St (day/night)
-------------------------------------------
Car traffic volume  : 24288/2112  veh/TimePeriod  *
Medium truck volume :  1932/168   veh/TimePeriod  *
Heavy truck volume  :  1380/120   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):  30000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: Bank St (day/night)
-----------------------------------------
Angle1   Angle2           : -90.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  16.00 / 16.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  -1.00 deg   Angle2 : 0.00 deg
Barrier height            :   0.00 m
Barrier receiver distance :   1.00 / 1.00   m
Source elevation          :  68.00 m
Receiver elevation        :  68.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00


Results segment # 1: CBD (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 !       -1.70 !        66.30

ROAD (0.00 + 39.42 + 62.02) = 62.05 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90    -44   0.00  70.00   0.00  -6.69  -5.93   0.00   0.00 -17.97
39.42
-------------------------------------------------------------------------------
--
```

```
   -44     90   0.00  70.00   0.00  -6.69  -1.28   0.00   0.00   0.00
62.02
-------------------------------------------------------------------------
--

Segment Leq : 62.05 dBA


Results segment # 2: 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 !       69.50 !        69.50

ROAD (66.36 + 46.86 + 0.00) = 66.41 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90     -1   0.00  69.70   0.00  -0.28  -3.06   0.00   0.00   0.00
66.36
-------------------------------------------------------------------------
--
    -1      0   0.00  69.70   0.00  -0.28 -22.55   0.00   0.00   0.00
46.86*
    -1      0   0.00  69.70   0.00  -0.28 -22.55   0.00   0.00   0.00
46.86
-------------------------------------------------------------------------
--

 * Bright Zone !

Segment Leq : 66.41 dBA

Total Leq All Segments: 67.77 dBA


Results segment # 1: CBD (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 !       -1.70 !        66.30

ROAD (0.00 + 31.82 + 54.43) = 54.45 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90    -44   0.00  62.40   0.00  -6.69  -5.93   0.00   0.00 -17.97
31.82
-------------------------------------------------------------------------------
--
   -44     90   0.00  62.40   0.00  -6.69  -1.28   0.00   0.00   0.00
54.43
-------------------------------------------------------------------------------
--

Segment Leq : 54.45 dBA


Results segment # 2: 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 !       69.50 !        69.50

ROAD (58.76 + 39.27 + 0.00) = 58.81 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90     -1   0.00  62.10   0.00  -0.28  -3.06   0.00   0.00   0.00
58.76
-------------------------------------------------------------------------------
--
    -1      0   0.00  62.10   0.00  -0.28 -22.55   0.00   0.00   0.00
39.27*
    -1      0   0.00  62.10   0.00  -0.28 -22.55   0.00   0.00   0.00
39.27
-------------------------------------------------------------------------------
--

 * Bright Zone !
```

```
Segment Leq : 58.81 dBA

Total Leq All Segments: 60.17 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 67.77
                           (NIGHT): 60.17
```

```
STAMSON 5.0         NORMAL REPORT         Date: 31-10-2019 15:57:35
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: CBD (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  :    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):  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: CBD (day/night)
-------------------------------------
Angle1   Angle2           : -19.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  73.00 / 73.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      4       (Elevated; with barrier)
Barrier angle1            :  59.00 deg   Angle2 : 90.00 deg
Barrier height            :   6.00 m
Elevation                 :   7.00 m
Barrier receiver distance :  12.00 / 12.00  m
Source elevation          :  61.00 m
Receiver elevation        :  68.00 m
Barrier elevation         :  68.00 m
Reference angle           :   0.00


Road data, segment # 2: Bank St (day/night)
-------------------------------------------
Car traffic volume  : 24288/2112  veh/TimePeriod  *
Medium truck volume :  1932/168   veh/TimePeriod  *
Heavy truck volume  :  1380/120   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):  30000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: 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  :  15.00 / 15.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  -1.00 deg   Angle2 : 0.00 deg
Barrier height            :   0.00 m
Barrier receiver distance :   1.00 / 1.00   m
Source elevation          :  68.00 m
Receiver elevation        :  68.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00


Results segment # 1: CBD (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 !        0.35 !        68.35

ROAD (59.49 + 43.63 + 0.00) = 59.60 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -19     59   0.00  70.00   0.00  -6.87  -3.63   0.00   0.00   0.00
59.49
-------------------------------------------------------------------------------
--
```

```
    59     90   0.00  70.00   0.00  -6.87  -7.64   0.00   0.00 -11.86
43.63
-------------------------------------------------------------------------
--

Segment Leq : 59.60 dBA


Results segment # 2: 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 !       69.50 !        69.50

ROAD (66.64 + 47.14 + 66.69) = 69.70 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90     -1   0.00  69.70   0.00   0.00  -3.06   0.00   0.00   0.00
66.64
-------------------------------------------------------------------------
--
    -1      0   0.00  69.70   0.00   0.00 -22.55   0.00   0.00   0.00
47.14*
    -1      0   0.00  69.70   0.00   0.00 -22.55   0.00   0.00   0.00
47.14
-------------------------------------------------------------------------
--
     0     90   0.00  69.70   0.00   0.00  -3.01   0.00   0.00   0.00
66.69
-------------------------------------------------------------------------
--

 * Bright Zone !

Segment Leq : 69.70 dBA

Total Leq All Segments: 70.10 dBA


Results segment # 1: CBD (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 !        0.35 !        68.35

ROAD (51.90 + 36.03 + 0.00) = 52.01 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -19     59   0.00  62.40   0.00  -6.87  -3.63   0.00   0.00   0.00
51.90
-------------------------------------------------------------------------
--
    59     90   0.00  62.40   0.00  -6.87  -7.64   0.00   0.00 -11.86
36.03
-------------------------------------------------------------------------
--

Segment Leq : 52.01 dBA


Results segment # 2: 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 !       69.50 !        69.50

ROAD (59.04 + 39.55 + 59.09) = 62.10 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90     -1   0.00  62.10   0.00   0.00  -3.06   0.00   0.00   0.00
59.04
-------------------------------------------------------------------------
--
    -1      0   0.00  62.10   0.00   0.00 -22.55   0.00   0.00   0.00
39.55*
    -1      0   0.00  62.10   0.00   0.00 -22.55   0.00   0.00   0.00
39.55
```

```
-------------------------------------------------------------------------------
--
     0      90    0.00   62.10    0.00    0.00   -3.01    0.00    0.00    0.00
59.09
-------------------------------------------------------------------------------
--

 * Bright Zone !

Segment Leq : 62.10 dBA

Total Leq All Segments: 62.51 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 70.10
                           (NIGHT): 62.51
```

```
STAMSON 5.0         NORMAL REPORT         Date: 31-10-2019 15:57:46
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: CBD (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  :    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):  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: CBD (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  :  70.00 / 70.00  m
Receiver height           :  12.20 / 12.20  m
Topography                :      4       (Elevated; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -44.00 deg
Barrier height            :  18.00 m
Elevation                 :   7.00 m
Barrier receiver distance :  32.00 / 32.00  m
Source elevation          :  61.00 m
Receiver elevation        :  68.00 m
Barrier elevation         :  68.00 m
Reference angle           :   0.00


Road data, segment # 2: Bank St (day/night)
-------------------------------------------
Car traffic volume  : 24288/2112  veh/TimePeriod  *
Medium truck volume :  1932/168   veh/TimePeriod  *
Heavy truck volume  :  1380/120   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):  30000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: Bank St (day/night)
-----------------------------------------
Angle1   Angle2           : -90.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  16.00 / 16.00  m
Receiver height           :  12.20 / 12.20  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  -1.00 deg   Angle2 : 0.00 deg
Barrier height            :   0.00 m
Barrier receiver distance :   1.00 / 1.00   m
Source elevation          :  68.00 m
Receiver elevation        :  68.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00


Results segment # 1: CBD (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 !       12.20 !        4.11 !        72.11

ROAD (0.00 + 40.88 + 62.02) = 62.06 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90    -44   0.00  70.00   0.00  -6.69  -5.93   0.00   0.00 -16.50
40.88
-------------------------------------------------------------------------------
--
```

```
   -44     90   0.00  70.00   0.00  -6.69  -1.28   0.00   0.00   0.00
62.02
-------------------------------------------------------------------------
--

Segment Leq : 62.06 dBA


Results segment # 2: 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 !       12.20 !       79.53 !        79.53

ROAD (66.36 + 46.86 + 0.00) = 66.41 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90     -1   0.00  69.70   0.00  -0.28  -3.06   0.00   0.00   0.00
66.36
-------------------------------------------------------------------------
--
    -1      0   0.00  69.70   0.00  -0.28 -22.55   0.00   0.00   0.00
46.86*
    -1      0   0.00  69.70   0.00  -0.28 -22.55   0.00   0.00   0.00
46.86
-------------------------------------------------------------------------
--

 * Bright Zone !

Segment Leq : 66.41 dBA

Total Leq All Segments: 67.77 dBA


Results segment # 1: CBD (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 !       12.20 !        4.11 !        72.11

ROAD (0.00 + 33.28 + 54.43) = 54.46 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90    -44   0.00  62.40   0.00  -6.69  -5.93   0.00   0.00 -16.50
33.28
-------------------------------------------------------------------------------
--
   -44     90   0.00  62.40   0.00  -6.69  -1.28   0.00   0.00   0.00
54.43
-------------------------------------------------------------------------------
--

Segment Leq : 54.46 dBA


Results segment # 2: 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 !       12.20 !       79.53 !        79.53

ROAD (58.76 + 39.27 + 0.00) = 58.81 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90     -1   0.00  62.10   0.00  -0.28  -3.06   0.00   0.00   0.00
58.76
-------------------------------------------------------------------------------
--
    -1      0   0.00  62.10   0.00  -0.28 -22.55   0.00   0.00   0.00
39.27*
    -1      0   0.00  62.10   0.00  -0.28 -22.55   0.00   0.00   0.00
39.27
-------------------------------------------------------------------------------
--

 * Bright Zone !
```

```
Segment Leq : 58.81 dBA

Total Leq All Segments: 60.17 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 67.77
                           (NIGHT): 60.17
```

```
STAMSON 5.0         NORMAL REPORT         Date: 31-10-2019 15:57:54
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: CBD (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  :    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):  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: CBD (day/night)
-------------------------------------
Angle1   Angle2           : -19.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  73.00 / 73.00  m
Receiver height           :  12.20 / 12.20  m
Topography                :      4       (Elevated; with barrier)
Barrier angle1            :  59.00 deg   Angle2 : 90.00 deg
Barrier height            :   6.00 m
Elevation                 :   7.00 m
Barrier receiver distance :  12.00 / 12.00  m
Source elevation          :  61.00 m
Receiver elevation        :  68.00 m
Barrier elevation         :  68.00 m
Reference angle           :   0.00


Road data, segment # 2: Bank St (day/night)
-------------------------------------------
Car traffic volume  : 24288/2112  veh/TimePeriod  *
Medium truck volume :  1932/168   veh/TimePeriod  *
Heavy truck volume  :  1380/120   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):  30000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: 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  :  15.00 / 15.00  m
Receiver height           :  12.20 / 12.20  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  -1.00 deg   Angle2 : 0.00 deg
Barrier height            :   0.00 m
Barrier receiver distance :   1.00 / 1.00   m
Source elevation          :  68.00 m
Receiver elevation        :  68.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00


Results segment # 1: CBD (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 !       12.20 !        9.29 !        77.29

ROAD (59.49 + 55.48 + 0.00) = 60.95 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -19     59   0.00  70.00   0.00  -6.87  -3.63   0.00   0.00   0.00
59.49
-------------------------------------------------------------------------------
--
```

```
    59      90    0.00   70.00    0.00   -6.87   -7.64    0.00    0.00   -0.54
54.95*
    59      90    0.00   70.00    0.00   -6.87   -7.64    0.00    0.00    0.00
55.48
-------------------------------------------------------------------------------
--

 * Bright Zone !

Segment Leq : 60.95 dBA


Results segment # 2: 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 !       12.20 !       79.49 !        79.49

ROAD (66.64 + 47.14 + 66.69) = 69.70 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90     -1    0.00   69.70    0.00    0.00   -3.06    0.00    0.00    0.00
66.64
-------------------------------------------------------------------------------
--
    -1      0    0.00   69.70    0.00    0.00  -22.55    0.00    0.00    0.00
47.14*
    -1      0    0.00   69.70    0.00    0.00  -22.55    0.00    0.00    0.00
47.14
-------------------------------------------------------------------------------
--
     0     90    0.00   69.70    0.00    0.00   -3.01    0.00    0.00    0.00
66.69
-------------------------------------------------------------------------------
--

 * Bright Zone !

Segment Leq : 69.70 dBA

Total Leq All Segments: 70.24 dBA
```

```
Results segment # 1: CBD (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 !       12.20 !        9.29 !        77.29

ROAD (51.90 + 47.89 + 0.00) = 53.35 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -19     59   0.00  62.40   0.00  -6.87  -3.63   0.00   0.00   0.00
51.90
-------------------------------------------------------------------------------
--
    59     90   0.00  62.40   0.00  -6.87  -7.64   0.00   0.00  -0.54
47.35*
    59     90   0.00  62.40   0.00  -6.87  -7.64   0.00   0.00   0.00
47.89
-------------------------------------------------------------------------------
--

 * Bright Zone !

Segment Leq : 53.35 dBA


Results segment # 2: 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 !       12.20 !       79.49 !        79.49

ROAD (59.04 + 39.55 + 59.09) = 62.10 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
```

```
   -90     -1   0.00  62.10   0.00   0.00  -3.06   0.00   0.00   0.00
59.04
-------------------------------------------------------------------------
--
    -1      0   0.00  62.10   0.00   0.00 -22.55   0.00   0.00   0.00
39.55*
    -1      0   0.00  62.10   0.00   0.00 -22.55   0.00   0.00   0.00
39.55
-------------------------------------------------------------------------
--
     0     90   0.00  62.10   0.00   0.00  -3.01   0.00   0.00   0.00
59.09
-------------------------------------------------------------------------
--

 * Bright Zone !

Segment Leq : 62.10 dBA

Total Leq All Segments: 62.64 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 70.24
                           (NIGHT): 62.64
```

```
STAMSON 5.0        NORMAL REPORT        Date: 31-10-2019 15:58:02
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  : 24288/2112  veh/TimePeriod  *
Medium truck volume :  1932/168   veh/TimePeriod  *
Heavy truck volume  :  1380/120   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):  30000
    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           : -20.00 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           :  12.20 / 12.20  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  63.00 deg   Angle2 : 90.00 deg
Barrier height            :  10.00 m
Barrier receiver distance :   9.00 / 9.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00


Road data, segment # 2: Sun Side St1 (day/night)
------------------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    veh/TimePeriod  *
Posted speed limit  :    40 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)
```

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

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

Data for Segment # 2: Sun Side St1 (day/night)
-----------------------------------------------
Angle1   Angle2           : -90.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  82.00 / 82.00  m
Receiver height           :  12.20 / 12.20  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -18.00 deg
Barrier height            :   6.00 m
Barrier receiver distance :  56.00 / 56.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00


Road data, segment # 3: Sun Side St2 (day/night)
-------------------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    veh/TimePeriod  *
Posted speed limit  :    40 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

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

Data for Segment # 3: Sun Side St2 (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   :  82.00 / 82.00  m
Receiver height            :  12.20 / 12.20  m
Topography                 :      2       (Flat/gentle slope; with barrier)
Barrier angle1             :   0.00 deg   Angle2 : 90.00 deg
Barrier height             :  10.00 m
Barrier receiver distance  :  71.00 / 71.00  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 !       12.20 !        7.13 !         7.13

ROAD (65.31 + 51.56 + 0.00) = 65.49 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -20     63   0.00  69.70   0.00  -1.03  -3.36   0.00   0.00   0.00
65.31
-------------------------------------------------------------------------
--
    63     90   0.00  69.70   0.00  -1.03  -8.24   0.00   0.00  -8.87
51.56
-------------------------------------------------------------------------
--

Segment Leq : 65.49 dBA


Results segment # 2: Sun Side St1 (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 !       12.20 !        4.89 !         4.89

ROAD (0.00 + 46.73 + 46.58) = 49.66 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90    -18   0.00  63.96   0.00  -7.38  -3.98   0.00   0.00  -5.87
46.73
-------------------------------------------------------------------------
--
   -18      0   0.00  63.96   0.00  -7.38 -10.00   0.00   0.00   0.00
46.58
-------------------------------------------------------------------------
--

Segment Leq : 49.66 dBA


Results segment # 3: Sun Side St2 (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 !       12.20 !        2.93 !         2.93

ROAD (0.00 + 37.43 + 0.00) = 37.43 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
     0     90   0.00  63.96   0.00  -7.38  -3.01   0.00   0.00 -16.14
37.43
-------------------------------------------------------------------------
--

Segment Leq : 37.43 dBA

Total Leq All Segments: 65.61 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 !       12.20 !        7.13 !         7.13

ROAD (57.71 + 43.96 + 0.00) = 57.89 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -20     63   0.00  62.10   0.00  -1.03  -3.36   0.00   0.00   0.00
57.71
-------------------------------------------------------------------------------
--
    63     90   0.00  62.10   0.00  -1.03  -8.24   0.00   0.00  -8.87
43.96
-------------------------------------------------------------------------------
--

Segment Leq : 57.89 dBA


Results segment # 2: Sun Side St1 (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 !       12.20 !        4.89 !         4.89

ROAD (0.00 + 39.13 + 38.99) = 42.07 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90    -18   0.00  56.36   0.00  -7.38  -3.98   0.00   0.00  -5.87
39.13
-------------------------------------------------------------------------------
--
   -18      0   0.00  56.36   0.00  -7.38 -10.00   0.00   0.00   0.00
38.99
-------------------------------------------------------------------------------
--
```

```
Segment Leq : 42.07 dBA

Results segment # 3: Sun Side St2 (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 !       12.20 !        2.93 !         2.93

ROAD (0.00 + 29.84 + 0.00) = 29.84 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
     0     90   0.00  56.36   0.00  -7.38  -3.01   0.00   0.00 -16.14
29.84
-------------------------------------------------------------------------------
--

Segment Leq : 29.84 dBA

Total Leq All Segments: 58.01 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 65.61
                           (NIGHT): 58.01
```

```
STAMSON 5.0        NORMAL REPORT        Date: 31-10-2019 15:58:11
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: CBD (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  :    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):  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: CBD (day/night)
-------------------------------------
Angle1   Angle2           : -16.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  74.00 / 74.00  m
Receiver height           :  17.50 / 17.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -16.00 deg   Angle2 : 90.00 deg
Barrier height            :  13.60 m
Barrier receiver distance :   2.00 / 2.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00


Road data, segment # 2: Bank St (day/night)
-------------------------------------------
Car traffic volume  : 24288/2112  veh/TimePeriod  *
Medium truck volume :  1932/168   veh/TimePeriod  *
Heavy truck volume  :  1380/120   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):  30000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: 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  :  16.00 / 16.00  m
Receiver height           :  17.50 / 17.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :  13.60 m
Barrier receiver distance :   2.00 / 2.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00


Results segment # 1: CBD (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 !       17.50 !       17.07 !        17.07

ROAD (0.00 + 60.77 + 0.00) = 60.77 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -16     90   0.00  70.00   0.00  -6.93  -2.30   0.00   0.00  -0.04
60.72*
   -16     90   0.00  70.00   0.00  -6.93  -2.30   0.00   0.00   0.00
60.77
-------------------------------------------------------------------------
--
```

```
 * Bright Zone !

Segment Leq : 60.77 dBA


Results segment # 2: 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 !       17.50 !       15.50 !        15.50

ROAD (0.00 + 69.42 + 0.00) = 69.42 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90     90   0.00  69.70   0.00  -0.28   0.00   0.00   0.00  -0.33
69.09*
   -90     90   0.00  69.70   0.00  -0.28   0.00   0.00   0.00   0.00
69.42
-------------------------------------------------------------------------------
--

 * Bright Zone !

Segment Leq : 69.42 dBA

Total Leq All Segments: 69.98 dBA


Results segment # 1: CBD (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 !       17.50 !       17.07 !        17.07

ROAD (0.00 + 53.17 + 0.00) = 53.17 dBA
```

```
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -16     90   0.00  62.40   0.00  -6.93  -2.30   0.00   0.00  -0.04
53.13*
   -16     90   0.00  62.40   0.00  -6.93  -2.30   0.00   0.00   0.00
53.17
-------------------------------------------------------------------------
--

 * Bright Zone !

Segment Leq : 53.17 dBA


Results segment # 2: 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 !       17.50 !       15.50 !        15.50

ROAD (0.00 + 61.82 + 0.00) = 61.82 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90     90   0.00  62.10   0.00  -0.28   0.00   0.00   0.00  -0.33
61.49*
   -90     90   0.00  62.10   0.00  -0.28   0.00   0.00   0.00   0.00
61.82
-------------------------------------------------------------------------
--

 * Bright Zone !

Segment Leq : 61.82 dBA

Total Leq All Segments: 62.38 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 69.98
                           (NIGHT): 62.38
```