Roadway Traffic Noise Feasibility Assessment

116 York Street

Ottawa, Ontario

REPORT: GWE18-107 – Traffic Noise

Prepared For:

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Prepared By:

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July 16, 2018

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EXECUTIVE SUMMARY

This report describes a traffic noise feasibility assessment performed for a proposed hotel development to be located at 116 York Street in Ottawa, Ontario. The hotel development rises 17-stories (approximately 59 m) above grade, and is located near the southeast corner of the Dalhousie Street and York Street intersection. The major source of transportation noise is from Dalhousie Street. Figure 1 illustrates a complete site plan with surrounding context.

The assessment is based on (i) theoretical noise prediction methods that conform to the Ministry of the Environment and Climate Change (MOECC) 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 received from Saplys Architects Inc. on June 21, 2018.

The results of the current analysis indicate that noise levels will range between 51 and 55 dBA during the daytime period (07:00-23:00) and between 43 and 48 dBA during the nighttime period (23:00-07:00). The highest noise level (i.e. 55 dBA) occurs along the development's north and west facing façades, which are nearest and most exposed to Dalhousie Street.

As roadway traffic noise levels do not exceed the ENCG criteria of 55 dBA, noise control measures will not be required.

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1. INTRODUCTION

Gradient Wind Engineering Inc. (GWE) was retained by Bayview Ottawa Holdings Ltd. to undertake a roadway traffic noise feasibility assessment for a proposed hotel development to be located at 116 York Street in Ottawa, Ontario. This report summarizes the methodology, results, and recommendations related to a roadway traffic noise feasibility assessment. GWE's scope of work involved assessing exterior noise levels generated by local roadway traffic, based on theoretical noise calculation methods conforming to the City of Ottawa[1] and Ministry of the Environment and Climate Change (MOECC)[2] guidelines. Noise calculations were based on architectural drawings received from Saplys Architects Inc. on June 21, 2018, with future roadway traffic volumes based on the City of Ottawa's Official Plan (OP) roadway classifications.

2. TERMS OF REFERENCE

The focus of this roadway traffic noise feasibility assessment is the proposed hotel development to be located at 116 York Street in Ottawa, Ontario. The study site is located approximately 40 m east of Dalhousie Street, on a parcel of land also bounded by York Street to the north, Cumberland Street to the east, and George Street to the south.

The proposed development is a 17-storey building with a two-storey podium, rising approximately 59.4 m above local grade to the top of the roof parapet. The podium planform is rectangular with the short axis oriented along York Street. At grade-level, a coffee shop is located at the northwest side of the building with access from York Street. The east side of the ground floor comprises covered vehicular access to the loading area and underground parking garage, as well as a walkway and pedestrian drop-off. The main hotel entrance is near the centre of the building from the covered walkway. Level 2 comprises a lobby and indoor amenity spaces, with an inset terrace at the northeast corner. The floorplate sets back from the north side at Level 3, which comprises meeting rooms, to create an additional amenity terrace. Floors above Level 3 comprise hotel units. The building planform above Level 3 features slight triangular insets between units, with square insets at the south corners. The floorplate sets back from the northeast corner at Level 4.

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

The major source of transportation noise is from Dalhousie Street. The site is surrounded on all sides by mixed-use land, including residential and commercial use land. Figure 1 illustrates a complete site plan with surrounding context.

3. OBJECTIVES

The principal objective of this work is to calculate the future noise levels on the study building produced by local roadway traffic sources, to ensure that interior noise levels do not exceed the allowable limits specified by NPC-300 and other supporting documentation, as outlined in Section 4 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 vehicle traffic, 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 assessment) is 50 and 45 dBA for hotel lobbies and sleeping quarters respectively, as listed in Table 1.

TABLE 1: INDOOR SOUND LEVEL CRITERIA (ROAD)[3]

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

Predicted noise levels at the plane of window (POW) dictate the action required to achieve the recommended sound levels. An open window is considered to provide a 10 dBA reduction in noise, while a standard closed window is capable of providing a minimum 20 dBA noise reduction[4]. 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 normally triggers the need for central air conditioning (or similar systems). Where noise levels exceed 65 dBA daytime and 60 dBA nighttime, building components will require higher levels of sound attenuation[5].

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.

[3] Adapted from ENCG 2016 – Tables 2.2b and 2.2c
[4] Burberry, P.B. (2014). Mitchell's Environment and Services. Routledge, Page 125
[5] MOECC, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.1.3

4.2.2 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[6] 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 / Transit Class	Speed Limit (km/h)	Traffic Volumes
Dalhousie Street	2-UCU	50	**8,000**

4.2.3 Theoretical Transportation Noise Predictions

Noise predictions were performed with the aid of the MOECC 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, and by using existing building locations as noise barriers. 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 was taken to be 92% / 8% respectively for all streets
- Reflective intermediate ground surfaces are based on specific source-receiver path ground characteristics, which is primarily pavement
- Topography assumed to be a flat/gentle slope
- Surrounding buildings are in some cases used as a barrier row of houses when the line of sight between the source and receiver is broken by the buildings
- Noise receptors were strategically placed at four locations around the assessment area (see Figure 2).

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

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, and STAMSON input parameters are illustrated in Figure 3 and 4.

TABLE 3: EXTERIOR NOISE LEVELS DUE TO ROADWAY TRAFFIC SOURCES

Receptor Number	Plane of Window Receptor Location	Noise Level (dBA)	
		Day	Night
R1	17th Floor – North Façade	55	48
R2	17th Floor – South Façade	51	43
R3	17th Floor – West Façade	55	47
R4	2nd Floor – North Terrace	54	46

The results of the current analysis indicate that noise levels will range between 51 and 55 dBA during the daytime period (07:00-23:00) and between 43 and 48 dBA during the nighttime period (23:00-07:00). The highest noise level (i.e. 55 dBA) occurs along the development's north and west facing façades, which are nearest and most exposed to Dalhousie Street.

6. CONCLUSIONS AND RECOMMENDATIONS

Gradient Wind has performed a traffic noise assessment for a proposed 17-storey hotel to be located at 116 York Street in the Byward Market of Ottawa, Ontario. The primary source of noise impacting the development is Dalhousie Street, which is classified as a collector roadway under the City of Ottawa's Official Plan. The outcome of the study indicates that roadway traffic noise levels do not exceed the ENCG criteria of 55 dBA, and therefore noise control measures will not be required.

Stationary noise from the development's mechanical equipment may adversely impact the surrounding noise-sensitive properties. A review of final equipment selection and locations by a qualified acoustical engineer will be required prior to installation of the equipment, to ensure the proposed development is compatible with the existing and future noise-sensitive land uses.

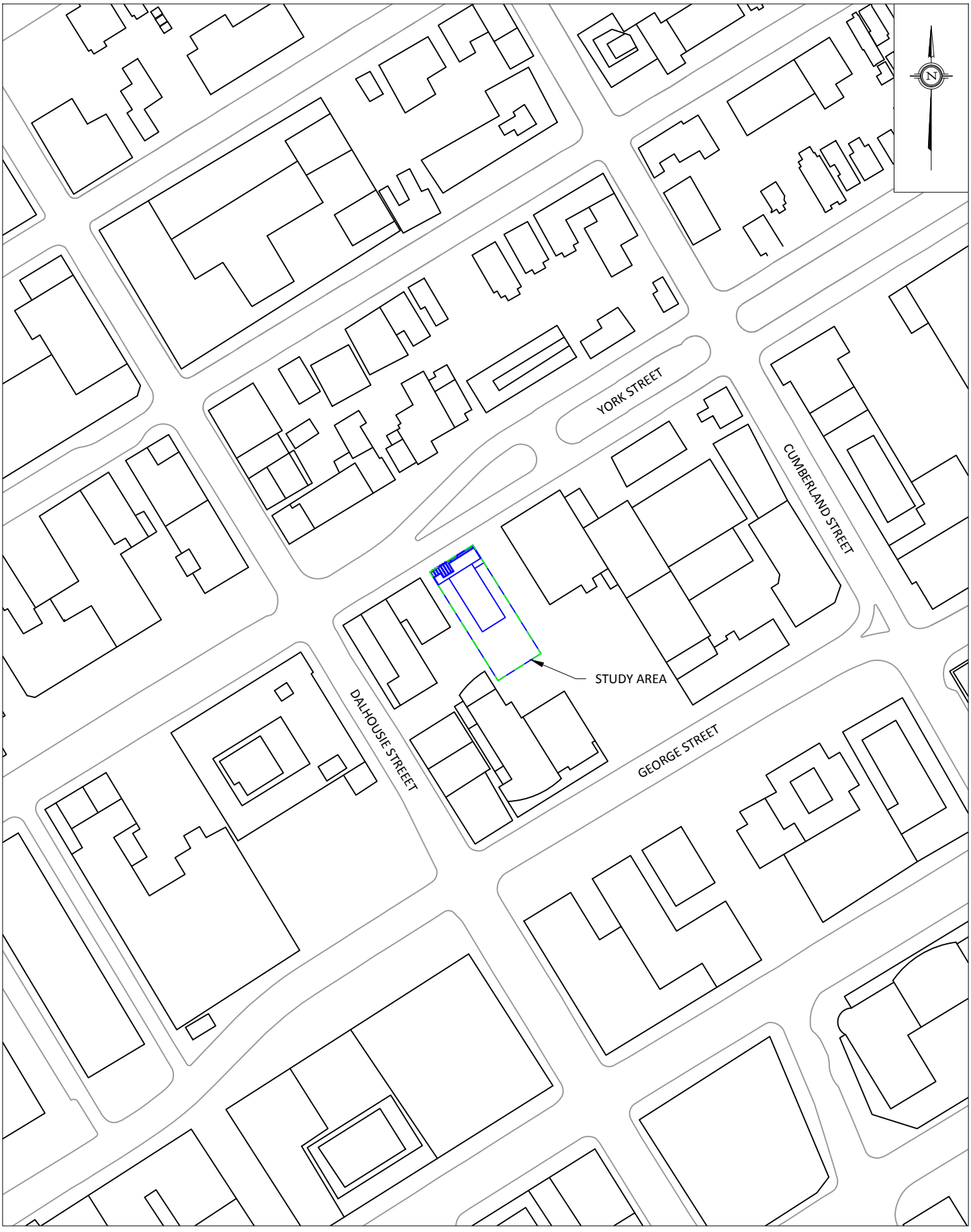
This concludes our assessment and report. If you have any questions or wish to discuss our findings, please advise us. In the interim, we thank you for the opportunity to be of service.

Yours truly,

Gradient Wind Engineering Inc.

Michael Lafortune
Environmental Scientist
GWE18-107 – Traffic Noise

Joshua Foster, P.Eng.
Principal



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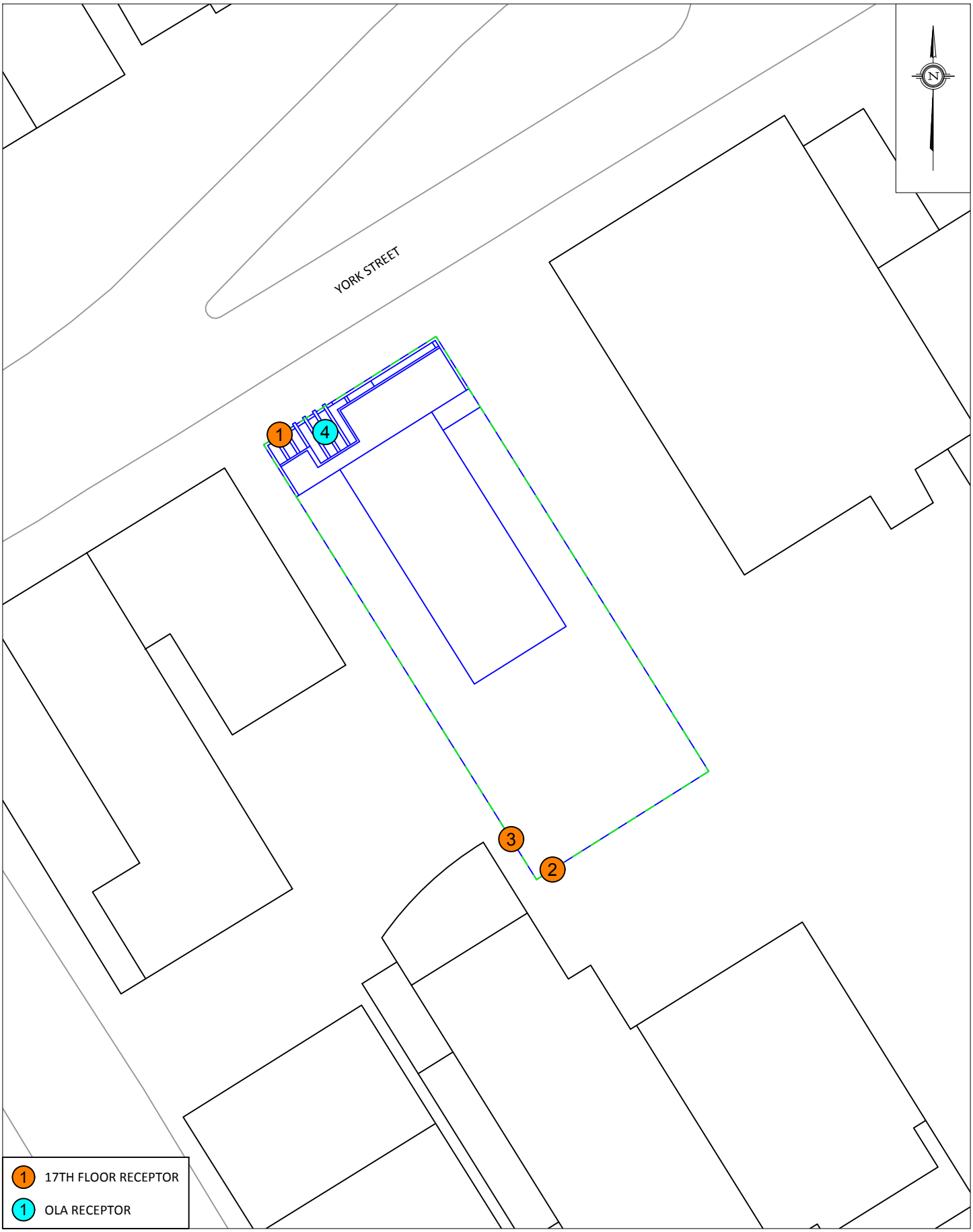
GRADIENT WIND ENGINEERING INC

PROJECT	116 YORK STREET ROADWAY TRAFFIC NOISE FEASIBILITY ASSESSMENT		DESCRIPTION
SCALE	1:2000 (APPROX.)	DRAWING NO.	GWE18-107-1
DATE	JUNE 29, 2018	DRAWN BY	M.L.

FIGURE 1:
SITE PLAN AND SURROUNDING CONTEXT



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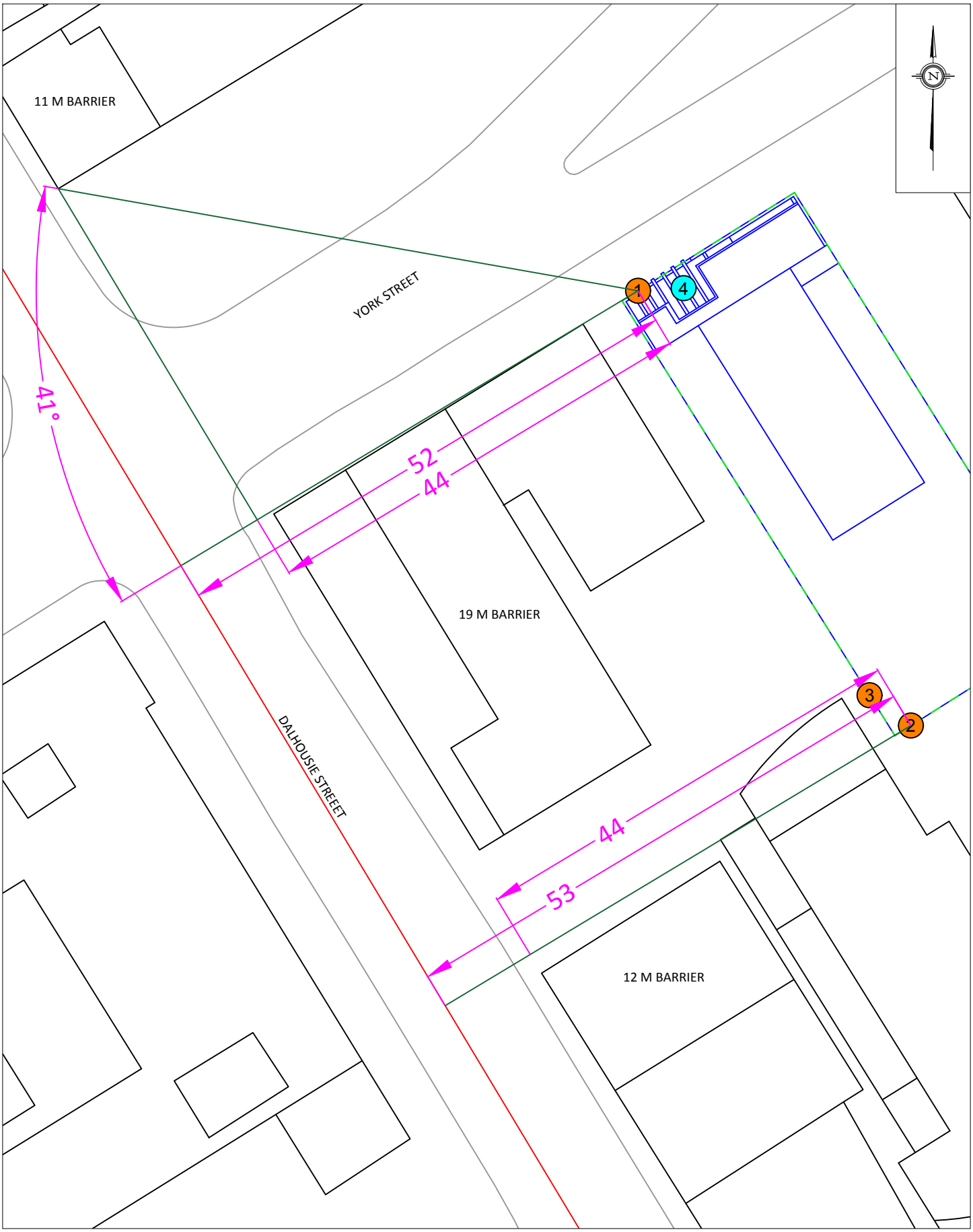
GRADIENT WIND ENGINEERING INC

PROJECT	116 YORK STREET ROADWAY TRAFFIC NOISE FEASIBILITY ASSESSMENT		DESCRIPTION
SCALE	1:500 (APPROX.)	DRAWING NO.	GWE18-107-2
DATE	JUNE 29, 2018	DRAWN BY	M.L.

FIGURE 2:
RECEPTOR LOCATIONS



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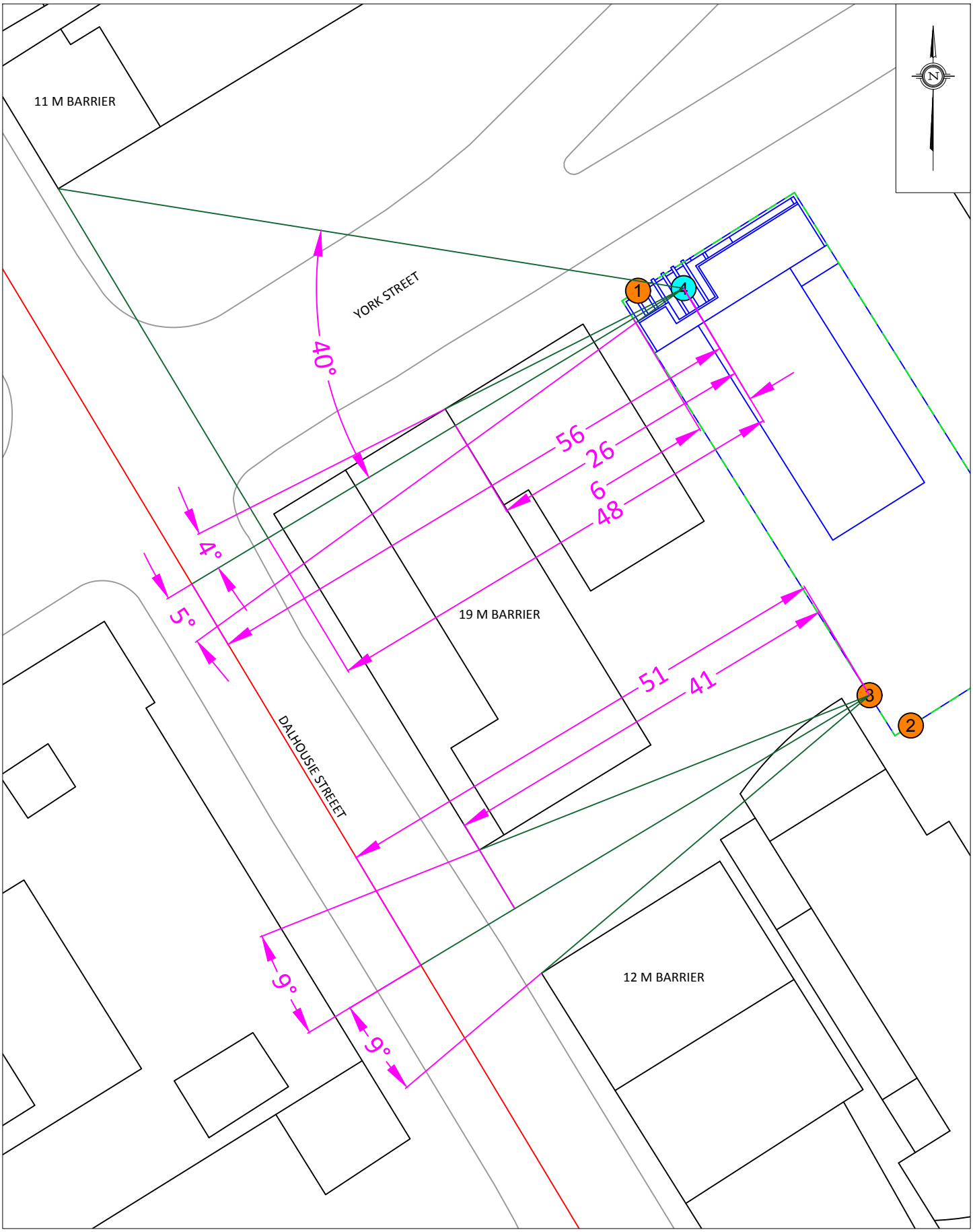
GRADIENT WIND ENGINEERING INC

PROJECT	116 YORK STREET ROADWAY TRAFFIC NOISE FEASIBILITY ASSESSMENT
SCALE	1:500 (APPROX.)
DRAWING NO.	GWE18-107-3
DATE	JUNE 29, 2018
DRAWN BY	M.L.
DESCRIPTION	FIGURE 3: RECEPTOR 1 AND 2 STAMSON INPUT



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GRADIENT WIND ENGINEERING INC

PROJECT	116 YORK STREET ROADWAY TRAFFIC NOISE FEASIBILITY ASSESSMENT
SCALE	1:500 (APPROX.)
DRAWING NO.	GWE18-107-4
DATE	JUNE 29, 2018
DRAWN BY	M.L.
DESCRIPTION	FIGURE 4: RECEPTOR 3 AND 4 STAMSON INPUT

APPENDIX A

STAMSON INPUT AND OUTPUT DATA

```
STAMSON 5.0        NORMAL REPORT        Date: 03-07-2018 10:06:35
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Dal (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  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):   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 # 1: Dal (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  :  52.00 / 52.00  m
Receiver height           :  53.70 / 53.70  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  41.00 deg   Angle2 : 90.00 deg
Barrier height            :  11.00 m
Barrier receiver distance :  44.00 / 44.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: Dal (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 !       53.70 !        9.53 !         9.53

ROAD (53.93 + 48.73 + 0.00) = 55.07 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
     0     41   0.00  65.75   0.00  -5.40  -6.42   0.00   0.00   0.00
53.93
-------------------------------------------------------------------------------
--
    41     90   0.00  65.75   0.00  -5.40  -5.65   0.00   0.00  -5.97
48.73
-------------------------------------------------------------------------------
--

Segment Leq : 55.07 dBA

Total Leq All Segments: 55.07 dBA
```

```
Results segment # 1: Dal (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 !       53.70 !        9.53 !         9.53

ROAD (46.33 + 41.14 + 0.00) = 47.48 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
     0     41   0.00  58.16   0.00  -5.40  -6.42   0.00   0.00   0.00
46.33
-------------------------------------------------------------------------------
--
    41     90   0.00  58.16   0.00  -5.40  -5.65   0.00   0.00  -5.97
41.14
-------------------------------------------------------------------------------
--

Segment Leq : 47.48 dBA

Total Leq All Segments: 47.48 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 55.07
                           (NIGHT): 47.48
```

```
STAMSON 5.0        NORMAL REPORT        Date: 03-07-2018 10:06:40
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Dal (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  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):   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 # 1: Dal (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  :  53.00 / 53.00  m
Receiver height           :  53.70 / 53.70  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 0.00 deg
Barrier height            :  12.00 m
Barrier receiver distance :  44.00 / 44.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: Dal (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 !       53.70 !       10.36 !        10.36

ROAD (0.00 + 50.61 + 0.00) = 50.61 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90      0   0.00  65.75   0.00  -5.48  -3.01   0.00   0.00  -6.65
50.61
-------------------------------------------------------------------------------
--

Segment Leq : 50.61 dBA

Total Leq All Segments: 50.61 dBA
```

```
Results segment # 1: Dal (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 !       53.70 !       10.36 !        10.36

ROAD (0.00 + 43.02 + 0.00) = 43.02 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90      0   0.00  58.16   0.00  -5.48  -3.01   0.00   0.00  -6.65
43.02
-------------------------------------------------------------------------------
--

Segment Leq : 43.02 dBA

Total Leq All Segments: 43.02 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 50.61
                           (NIGHT): 43.02
```

```
STAMSON 5.0        NORMAL REPORT        Date: 03-07-2018 10:06:46
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Dal1 (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  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):   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 # 1: Dal1 (day/night)
--------------------------------------
Angle1   Angle2           : -90.00 deg   9.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  51.00 / 51.00  m
Receiver height           :  53.70 / 53.70  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -9.00 deg
Barrier height            :  12.00 m
Barrier receiver distance :  41.00 / 41.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 2: Dal2 (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  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):   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: Dal2 (day/night)
--------------------------------------
Angle1   Angle2           :   9.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  51.00 / 51.00  m
Receiver height           :  53.70 / 53.70  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :   9.00 deg   Angle2 : 90.00 deg
Barrier height            :  19.00 m
Barrier receiver distance :  41.00 / 41.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: Dal1 (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 !       53.70 !       11.73 !        11.73

ROAD (0.00 + 51.92 + 50.43) = 54.25 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90     -9   0.00  65.75   0.00  -5.31  -3.47   0.00   0.00  -5.05
51.92
-------------------------------------------------------------------------------
--
    -9      9   0.00  65.75   0.00  -5.31 -10.00   0.00   0.00   0.00
50.43
-------------------------------------------------------------------------------
--

Segment Leq : 54.25 dBA
```

```
Results segment # 2: Dal2 (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 !       53.70 !       11.73 !        11.73

ROAD (0.00 + 44.07 + 0.00) = 44.07 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
     9     90   0.00  65.75   0.00  -5.31  -3.47   0.00   0.00 -12.90
44.07
-------------------------------------------------------------------------------
--

Segment Leq : 44.07 dBA

Total Leq All Segments: 54.65 dBA
```

```
Results segment # 1: Dal1 (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 !       53.70 !       11.73 !        11.73

ROAD (0.00 + 44.33 + 42.84) = 46.66 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90     -9   0.00  58.16   0.00  -5.31  -3.47   0.00   0.00  -5.05
44.33
-------------------------------------------------------------------------------
--
    -9      9   0.00  58.16   0.00  -5.31 -10.00   0.00   0.00   0.00
42.84
-------------------------------------------------------------------------------
--

Segment Leq : 46.66 dBA
```

```
Results segment # 2: Dal2 (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 !       53.70 !       11.73 !        11.73

ROAD (0.00 + 36.47 + 0.00) = 36.47 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
     9     90   0.00  58.16   0.00  -5.31  -3.47   0.00   0.00 -12.90
36.47
-------------------------------------------------------------------------------
--

Segment Leq : 36.47 dBA

Total Leq All Segments: 47.06 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 54.65
                           (NIGHT): 47.06
```

```
STAMSON 5.0        NORMAL REPORT        Date: 29-06-2018 14:17:07
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Dal1 (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  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):   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 # 1: Dal1 (day/night)
--------------------------------------
Angle1   Angle2           : -90.00 deg   -5.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  56.00 / 56.00  m
Receiver height           :   5.90 / 5.90   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -5.00 deg
Barrier height            :   8.60 m
Barrier receiver distance :   6.00 / 6.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 2: Dal2 (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  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):   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: Dal2 (day/night)
--------------------------------------
Angle1   Angle2           :  -5.00 deg   4.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  56.00 / 56.00  m
Receiver height           :   5.90 / 5.90   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  -5.00 deg   Angle2 : 4.00 deg
Barrier height            :  19.00 m
Barrier receiver distance :  26.00 / 26.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 3: Dal3 (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  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):   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: Dal3 (day/night)
--------------------------------------
Angle1   Angle2           :   4.00 deg   40.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  56.00 / 56.00  m
Receiver height           :   5.90 / 5.90   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :   4.00 deg   Angle2 : 40.00 deg
Barrier height            :   4.40 m
Barrier receiver distance :   6.00 / 6.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 4: Dal4 (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  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):   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 # 4: Dal4 (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  :  56.00 / 56.00  m
Receiver height           :   5.90 / 5.90   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  40.00 deg   Angle2 : 90.00 deg
Barrier height            :  11.00 m
Barrier receiver distance :  48.00 / 48.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: Dal1 (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 !        5.90 !        5.43 !         5.43

ROAD (0.00 + 43.68 + 0.00) = 43.68 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90     -5   0.00  65.75   0.00  -5.72  -3.26   0.00   0.00 -13.09
43.68
-------------------------------------------------------------------------------
--

Segment Leq : 43.68 dBA
```

```
Results segment # 2: Dal2 (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 !        5.90 !        3.85 !         3.85

ROAD (0.00 + 27.02 + 0.00) = 27.02 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
    -5      4   0.00  65.75   0.00  -5.72 -13.01   0.00   0.00 -20.00
27.02
-------------------------------------------------------------------------------
--

Segment Leq : 27.02 dBA
```

```
Results segment # 3: Dal3 (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 !        5.90 !        5.43 !         5.43

ROAD (0.00 + 53.04 + 0.00) = 53.04 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
     4     40   0.00  65.75   0.00  -5.72  -6.99   0.00   0.00   0.00
53.04*
     4     40   0.00  65.75   0.00  -5.72  -6.99   0.00   0.00   0.00
53.04
-------------------------------------------------------------------------------
--

 * Bright Zone !

Segment Leq : 53.04 dBA
```

```
Results segment # 4: Dal4 (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 !        5.90 !        2.12 !         2.12

ROAD (0.00 + 38.01 + 0.00) = 38.01 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
    40     90   0.00  65.75   0.00  -5.72  -5.56   0.00   0.00 -16.46
38.01
-------------------------------------------------------------------------------
--

Segment Leq : 38.01 dBA

Total Leq All Segments: 53.65 dBA
```

```
Results segment # 1: Dal1 (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 !        5.90 !        5.43 !         5.43

ROAD (0.00 + 36.08 + 0.00) = 36.08 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90     -5   0.00  58.16   0.00  -5.72  -3.26   0.00   0.00 -13.09
36.08
-------------------------------------------------------------------------------
--

Segment Leq : 36.08 dBA
```

```
Results segment # 2: Dal2 (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 !        5.90 !        3.85 !         3.85

ROAD (0.00 + 19.43 + 0.00) = 19.43 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
    -5      4   0.00  58.16   0.00  -5.72 -13.01   0.00   0.00 -20.00
19.43
-------------------------------------------------------------------------------
--

Segment Leq : 19.43 dBA
```

```
Results segment # 3: Dal3 (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 !        5.90 !        5.43 !         5.43

ROAD (0.00 + 45.45 + 0.00) = 45.45 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
     4     40   0.00  58.16   0.00  -5.72  -6.99   0.00   0.00   0.00
45.45*
     4     40   0.00  58.16   0.00  -5.72  -6.99   0.00   0.00   0.00
45.45
-------------------------------------------------------------------------------
--

 * Bright Zone !

Segment Leq : 45.45 dBA
```

```
Results segment # 4: Dal4 (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 !        5.90 !        2.12 !         2.12

ROAD (0.00 + 30.42 + 0.00) = 30.42 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
    40     90   0.00  58.16   0.00  -5.72  -5.56   0.00   0.00 -16.46
30.42
-------------------------------------------------------------------------------
--

Segment Leq : 30.42 dBA

Total Leq All Segments: 46.06 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 53.65
                           (NIGHT): 46.06
```