Roadway Traffic Noise Assessment

324-326 Donald Street

Ottawa, Ontario

REPORT: GWE17-164 – Traffic Noise

Prepared For:
Alfred Abboud
Upscale Homes Inc.
324 Donald Street
Ottawa, Ontario
K1K 1M5

Prepared By:

Michael Lafortune, Environmental Scientist
Joshua Foster, P.Eng., Principal

December 19, 2017

127 Walgreen Road, Ottawa, Ontario K0A 1L0
T (613) 836-0934 ● www.gradientwind.com

EXECUTIVE SUMMARY

This document describes a roadway traffic noise assessment performed for a proposed residential development located at 324-326 Donald Street, in Ottawa, Ontario. The development comprises a new three-storey building. Amenity space is provided at grade to the rear of the building. Balconies less than 4 m in depth are not considered as outdoor living areas, as per the ENCG. The major source of transportation noise is Donald Street, with minor influence from Lola 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 Theriault Design Architecture.

The results of the current analysis indicate that noise levels will range between 49 and 65 dBA during the daytime period (07:00-23:00) and between 42 and 57 dBA during the nighttime period (23:00-07:00). The highest noise levels (i.e. 65 dBA) occur along the development's north façade, which is nearest and most exposed to Donald Street.

The noise levels predicted due to roadway traffic do not exceed the criteria listed in Section 4.2 for building components. As such, windows are to satisfy Ontario Building Code (OBC 2012) requirements. Results of the calculations also indicate that the development will require forced air heating and provision for central air conditioning. The installation of central air conditioning will allow occupants to keep windows closed and maintain a comfortable living environment. The following Warning Clause[1] will also be required be placed on all Lease, Purchase and Sale Agreements, as summarized below.

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

TABLE OF CONTENTS

1. INTRODUCTION

Gradient Wind Engineering Inc. (GWE) was retained by Upscale Homes Inc., to undertake a roadway traffic noise assessment of a proposed residential development located at 324-326 Donald Street in Ottawa, Ontario. This report summarizes the methodology, results and recommendations related to a roadway traffic noise assessment. GWE's scope of work involved assessing exterior and interior noise levels generated by local roadway traffic. The assessment was performed on the basis of theoretical noise calculation methods conforming to the City of Ottawa[2] and Ministry of the Environment and Climate Change (MOECC)[3] guidelines. Noise calculations were based on architectural drawings received from Theriault Design Architecture, 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 residential development, comprising a new three-storey building. The site is located south of Donald Street, between Edith Avenue and Lola Street. The site is surrounded by residentially zoned land. Amenity space is provided at grade to the rear of the building. Balconies less than 4 m in depth are not considered as outdoor living areas, as per the ENCG. The major source of transportation noise is Donald Street, with minor influence from Lola Street. Figure 1 illustrates a complete site plan with surrounding context.

3. OBJECTIVES

The main goals of this work 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 of this report.

[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

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 study) is 45 and 40 dBA for residence living rooms and sleeping quarters respectively, as listed in Table 1. To account for deficiencies in building construction, theses levels should be targeted toward 42 and 37 dBA.

TABLE 1: INDOOR SOUND LEVEL CRITERIA (ROAD & RAIL)[4]

Type of Space	Time Period	L_{eq} (dBA)	
		Road	Rail
General offices, reception areas, retail stores, etc.	07:00 – 23:00	50	45
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	40
Sleeping quarters of hotels/motels	23:00 – 07:00	45	40
Sleeping quarters of residences, hospitals, nursing/retirement homes, etc.	23:00 – 07:00	40	35

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]. 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[6].

Likewise, Outdoor Living Area's are required to achieve the recommended sound levels with the use of noise control measures, such as noise barriers. Noise levels at the OLA must not exceed 60 dBA in all cases, and should not exceed 55 dBA unless it is unfeasible to do so.

4.2.1 Roadway Traffic Volumes

The ENCG dictates that noise calculations should consider future sound levels based on a roadway's classification at the mature state of development. Therefore, traffic volumes are based on the roadway classifications outlined in the City of Ottawa's Official Plan (OP) and Transportation Master Plan[7] which provide additional details on future roadway expansions. Average Annual Daily Traffic (AADT) volumes

[4] Adapted from ENCG 2016 – Tables 2.2b and 2.2c
[5] Burberry, P.B.. (2014). Mitchell's Environment and Services. Routledge, Page 125
[6] MOECC, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.1.3
[7] City of Ottawa Transportation Master Plan, November 2013

are then based on data in Table B1 of the ENCG for each roadway classification. Table 2 (below) summarizes the AADT values used for each roadway included in this assessment.

TABLE 2: ROADWAY TRAFFIC DATA

Segment	Roadway / Transit Class	Speed Limit (km/h)	Traffic Volume (AADT)
Donald Street	2-UCU	50	**8,000**
Lola Street	2-UCU	50	**8,000**

4.2.2 Theoretical Transportation Noise Predictions

Noise predictions were performed with the aid of the MOECC computerized noise assessment program, STAMSON 5.04, for road and rail analysis. 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 and absorptive intermediate ground surfaces based on specific source-receiver path ground characteristics. Pavement, such as roads and parking lots, is considered as reflective ground, while vegetated space is considered as absorptive ground.
- Topography considered as flat or gently sloping.

Noise receptors were strategically identified at five locations around the study area (see Figure 2).

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 vinyl or wood sided exterior "2X6" walls have around STC 35. Standard good quality double-glazed non-operable windows can have STC ratings ranging from 25 to 40, depending on the window manufacturer, pane thickness and inter-pane spacing. As previously mentioned, the windows are the known weak point in a partition.

As per Section 4.2, when daytime noise levels (from road and rail sources) at the plane of the window exceed 65 dBA, calculations must be performed to evaluate the sound transmission quality of the building components to ensure acceptable indoor noise levels. The calculation procedure[8] 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[9], exterior walls possess specific sound attenuation characteristics that are used as a basis for calculating the required STC ratings of windows in the same partition. Due to the limited information, available at the time of the study, which was prepared for site plan approval, detailed floor layouts and building elevations have not been finalized; therefore, detailed STC calculations could not be performed at this time. As a guideline, the anticipated STC requirements for windows have been estimated based on the overall noise reduction required for each intended use of space (STC = outdoor noise level – targeted indoor noise levels).

5. RESULTS AND RECOMMENDATIONS

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 a sample of input data for Receptor 1 is available in Figure 3.

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

TABLE 3: EXTERIOR NOISE LEVELS DUE TO ROADWAY TRAFFIC SOURCES

Receptor Number	Plane of Window Receptor Location	Noise Level (dBA)	
		Day	Night
1	3rd Floor – North Façade	65	57
2	3rd Floor – East Façade	62	54
3	3rd Floor – South Façade	47	40
4	3rd Floor – West Façade	61	54
5	Ground Level – Rear Yard	49	42

The results of the current analysis indicate that noise levels will range between 49 and 65 dBA during the daytime period (07:00-23:00) and between 42 and 57 dBA during the nighttime period (23:00-07:00). The highest noise levels (i.e. 65 dBA) occur along the development's north façade, which is nearest and most exposed to Donald Street.

5.2 Noise Control Measures

The noise levels predicted due to roadway traffic do not exceed the criteria listed in Section 4.2 for building components. As such, windows are to satisfy Ontario Building Code (OBC 2012) requirements. Results of the calculations also indicate that the development will require forced air heating and provision for central air conditioning. The installation of central air conditioning will allow occupants to keep windows closed and maintain a comfortable living environment. The following Warning Clause[10] will also be required be placed 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 and Climate Change.*
>
> *To help address the need for sound attenuation, this dwelling unit has been designed with forced air heating with provision for central air conditioning. The installation of central air conditioning will allow windows and exterior doors to remain closed, thereby ensuring*

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

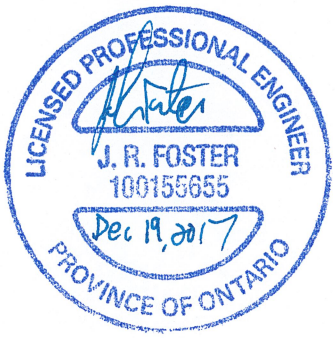
that the indoor sound levels are within the sound level limits of the City and the Ministry of the Environment and Climate Change.

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

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
GWE17-164 – Traffic Noise

Joshua Foster, P.Eng.
Principal

127 Walgreen Road
Ottawa, Ontario
(613) 836 0934

GRADIENT WIND ENGINEERING INC

PROJECT	324-326 DONALD STREET ROADWAY TRAFFIC NOISE ASSESSMENT
SCALE	1:1000 (APPROX.)
DRAWING NO.	GWE17-164-1
DATE	NOVEMBER 2, 2017
DRAWN BY	M.L.

DESCRIPTION

FIGURE 1:
SITE PLAN AND SURROUNDING CONTEXT

127 Walgreen Road
Ottawa, Ontario
(613) 836 0934
GRADIENT WIND ENGINEERING INC

PROJECT	324-326 DONALD STREET ROADWAY TRAFFIC NOISE ASSESSMENT
SCALE	1:250 (APPROX.)
DRAWING NO.	GWE17-164-2
DATE	NOVEMBER 2, 2017
DRAWN BY	M.L.
DESCRIPTION	FIGURE 2: RECEPTOR LOCATIONS

127 Walgreen Road
Ottawa, Ontario
(613) 836 0934

GRADIENT WIND ENGINEERING INC

PROJECT	324-326 DONALD STREET ROADWAY TRAFFIC NOISE ASSESSMENT
SCALE	1:1000 (APPROX.)
DRAWING NO.	GWE17-164-3
DATE	NOVEMBER 2, 2017
DRAWN BY	M.L.

DESCRIPTION

FIGURE 3:
STAMSON SAMPLE INPUT (RECEPTOR 1)

APPENDIX A

STAMSON 5.04 - INPUT AND OUTPUT DATA

```
STAMSON 5.0        NORMAL REPORT        Date: 02-11-2017 10:58:42
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Donald (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: Donald (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  :  18.00 / 18.00  m
Receiver height           :   9.00 / 9.00   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Road data, segment # 2: Lola (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: Lola (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  : 101.00 / 101.00 m
Receiver height           :   9.00 / 9.00   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -22.00 deg
Barrier height            :   6.00 m
Barrier receiver distance :  87.00 / 87.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

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

Source height = 1.50 m

ROAD (0.00 + 64.96 + 0.00) = 64.96 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90     90   0.00  65.75   0.00  -0.79   0.00   0.00   0.00   0.00
64.96
-------------------------------------------------------------------------
--

Segment Leq : 64.96 dBA


Results segment # 2: Lola (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 !        9.00 !        2.54 !         2.54

ROAD (0.00 + 42.65 + 48.34) = 49.38 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90    -22   0.00  65.75   0.00  -8.28  -4.23   0.00   0.00 -10.59
42.65
-------------------------------------------------------------------------
--
   -22      0   0.00  65.75   0.00  -8.28  -9.13   0.00   0.00   0.00
48.34
-------------------------------------------------------------------------
--

Segment Leq : 49.38 dBA

Total Leq All Segments: 65.08 dBA
```

```
Results segment # 1: Donald (night)
----------------------------------

Source height = 1.50 m

ROAD (0.00 + 57.37 + 0.00) = 57.37 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90     90   0.00  58.16   0.00  -0.79   0.00   0.00   0.00   0.00
57.37
-------------------------------------------------------------------------
--

Segment Leq : 57.37 dBA


Results segment # 2: Lola (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 !        9.00 !        2.54 !         2.54

ROAD (0.00 + 35.05 + 40.75) = 41.78 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90    -22   0.00  58.16   0.00  -8.28  -4.23   0.00   0.00 -10.59
35.05
-------------------------------------------------------------------------
--
   -22      0   0.00  58.16   0.00  -8.28  -9.13   0.00   0.00   0.00
40.75
-------------------------------------------------------------------------
--

Segment Leq : 41.78 dBA

Total Leq All Segments: 57.49 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 65.08
                           (NIGHT): 57.49
```

```
STAMSON 5.0        NORMAL REPORT        Date: 02-11-2017 10:58:48
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Donald (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: Donald (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  :  20.00 / 20.00  m
Receiver height           :   9.00 / 9.00   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Road data, segment # 2: LolaL (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: LolaL (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  : 100.00 / 100.00 m
Receiver height           :   9.00 / 9.00   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -23.00 deg
Barrier height            :   6.00 m
Barrier receiver distance :  86.00 / 86.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 3: LolaR (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: LolaR (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  : 100.00 / 100.00 m
Receiver height           :   9.00 / 9.00   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :   0.00 deg   Angle2 : 90.00 deg
Barrier height            :   6.00 m
Barrier receiver distance :  86.00 / 86.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

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

Source height = 1.50 m

ROAD (0.00 + 61.49 + 0.00) = 61.49 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
     0     90   0.00  65.75   0.00  -1.25  -3.01   0.00   0.00   0.00
61.49
-------------------------------------------------------------------------
--

Segment Leq : 61.49 dBA


Results segment # 2: LolaL (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 !        9.00 !        2.55 !         2.55

ROAD (0.00 + 42.67 + 48.58) = 49.57 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90    -23   0.00  65.75   0.00  -8.24  -4.29   0.00   0.00 -10.55
42.67
-------------------------------------------------------------------------
--
   -23      0   0.00  65.75   0.00  -8.24  -8.94   0.00   0.00   0.00
48.58
-------------------------------------------------------------------------
--

Segment Leq : 49.57 dBA
```

```
Results segment # 3: LolaR (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 !        9.00 !        2.55 !         2.55

ROAD (0.00 + 43.25 + 0.00) = 43.25 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
     0     90   0.00  65.75   0.00  -8.24  -3.01   0.00   0.00 -11.25
43.25
-------------------------------------------------------------------------------
--

Segment Leq : 43.25 dBA

Total Leq All Segments: 61.82 dBA


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

Source height = 1.50 m

ROAD (0.00 + 53.90 + 0.00) = 53.90 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
     0     90   0.00  58.16   0.00  -1.25  -3.01   0.00   0.00   0.00
53.90
-------------------------------------------------------------------------------
--

Segment Leq : 53.90 dBA
```

```
Results segment # 2: LolaL (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 !        9.00 !        2.55 !         2.55

ROAD (0.00 + 35.08 + 40.98) = 41.98 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90    -23   0.00  58.16   0.00  -8.24  -4.29   0.00   0.00 -10.55
35.08
-------------------------------------------------------------------------------
--
   -23      0   0.00  58.16   0.00  -8.24  -8.94   0.00   0.00   0.00
40.98
-------------------------------------------------------------------------------
--

Segment Leq : 41.98 dBA
```

```
Results segment # 3: LolaR (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 !        9.00 !        2.55 !         2.55

ROAD (0.00 + 35.66 + 0.00) = 35.66 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
     0     90   0.00  58.16   0.00  -8.24  -3.01   0.00   0.00 -11.25
35.66
-------------------------------------------------------------------------------
--

Segment Leq : 35.66 dBA

Total Leq All Segments: 54.23 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 61.82
                           (NIGHT): 54.23
```

```
STAMSON 5.0        NORMAL REPORT        Date: 02-11-2017 10:58:53
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Lola (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: Lola (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  : 101.00 / 101.00 m
Receiver height           :   9.00 / 9.00   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  12.00 deg   Angle2 : 90.00 deg
Barrier height            :   6.00 m
Barrier receiver distance :  91.00 / 91.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: Lola (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 !        9.00 !        2.24 !         2.24

ROAD (45.71 + 41.62 + 0.00) = 47.14 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
     0     12   0.00  65.75   0.00  -8.28 -11.76   0.00   0.00   0.00
45.71
-------------------------------------------------------------------------------
--
    12     90   0.00  65.75   0.00  -8.28  -3.63   0.00   0.00 -12.21
41.62
-------------------------------------------------------------------------------
--

Segment Leq : 47.14 dBA

Total Leq All Segments: 47.14 dBA
```

```
Results segment # 1: Lola (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 !        9.00 !        2.24 !         2.24

ROAD (38.11 + 34.03 + 0.00) = 39.55 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
     0     12   0.00  58.16   0.00  -8.28 -11.76   0.00   0.00   0.00
38.11
-------------------------------------------------------------------------------
--
    12     90   0.00  58.16   0.00  -8.28  -3.63   0.00   0.00 -12.21
34.03
-------------------------------------------------------------------------------
--

Segment Leq : 39.55 dBA

Total Leq All Segments: 39.55 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 47.14
                           (NIGHT): 39.55
```

```
STAMSON 5.0        NORMAL REPORT        Date: 02-11-2017 10:58:59
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Donald (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: Donald (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  :  20.00 / 20.00  m
Receiver height           :   9.00 / 9.00   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

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

Source height = 1.50 m

ROAD (0.00 + 61.49 + 0.00) = 61.49 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  -1.25  -3.01   0.00   0.00   0.00
61.49
-------------------------------------------------------------------------
--

Segment Leq : 61.49 dBA

Total Leq All Segments: 61.49 dBA


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

Source height = 1.50 m

ROAD (0.00 + 53.90 + 0.00) = 53.90 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  -1.25  -3.01   0.00   0.00   0.00
53.90
-------------------------------------------------------------------------
--

Segment Leq : 53.90 dBA

Total Leq All Segments: 53.90 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 61.49
                           (NIGHT): 53.90
```

```
STAMSON 5.0        NORMAL REPORT        Date: 02-11-2017 10:59:04
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Donald (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: Donald (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  :  42.00 / 42.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   6.00 m
Barrier receiver distance :  24.00 / 24.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 2: LolaL (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: LolaL (day/night)
---------------------------------------
Angle1   Angle2           : -90.00 deg   6.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 103.00 / 103.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -8.00 deg
Barrier height            :   6.00 m
Barrier receiver distance :  93.00 / 93.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 3: LolaR (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: LolaR (day/night)
---------------------------------------
Angle1   Angle2           :   6.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 103.00 / 103.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :   6.00 deg   Angle2 : 90.00 deg
Barrier height            :   6.00 m
Barrier receiver distance :  93.00 / 93.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

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

Source height = 1.50 m

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

ROAD (0.00 + 47.78 + 0.00) = 47.78 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90     90   0.00  65.75   0.00  -4.47   0.00   0.00   0.00 -13.50
47.78
-------------------------------------------------------------------------------
--

Segment Leq : 47.78 dBA


Results segment # 2: LolaL (day)
---------------------------------

Source height = 1.50 m

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

ROAD (0.00 + 37.06 + 40.76) = 42.30 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90     -8   0.30  65.75   0.00 -10.88  -4.27   0.00   0.00 -13.54
37.06
-------------------------------------------------------------------------------
--
    -8      6   0.66  65.75   0.00 -13.89 -11.10   0.00   0.00   0.00
40.76
-------------------------------------------------------------------------------
--

Segment Leq : 42.30 dBA
```

```
Results segment # 3: LolaR (day)
--------------------------------

Source height = 1.50 m

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

ROAD (0.00 + 37.12 + 0.00) = 37.12 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
     6     90   0.30  65.75   0.00 -10.88  -4.14   0.00   0.00 -13.61
37.12
-------------------------------------------------------------------------------
--

Segment Leq : 37.12 dBA

Total Leq All Segments: 49.14 dBA


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

Source height = 1.50 m

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

ROAD (0.00 + 40.19 + 0.00) = 40.19 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90     90   0.00  58.16   0.00  -4.47   0.00   0.00   0.00 -13.50
40.19
-------------------------------------------------------------------------------
--

Segment Leq : 40.19 dBA
```

```
Results segment # 2: LolaL (night)
----------------------------------

Source height = 1.50 m

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

ROAD (0.00 + 29.47 + 33.17) = 34.71 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90     -8    0.30  58.16   0.00 -10.88  -4.27   0.00   0.00 -13.54
29.47
-------------------------------------------------------------------------------
--
    -8      6    0.66  58.16   0.00 -13.89 -11.10   0.00   0.00   0.00
33.17
-------------------------------------------------------------------------------
--

Segment Leq : 34.71 dBA
```

```
Results segment # 3: LolaR (night)
----------------------------------

Source height = 1.50 m

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

ROAD (0.00 + 29.53 + 0.00) = 29.53 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
     6     90   0.30  58.16   0.00 -10.88  -4.14   0.00   0.00 -13.61
29.53
-------------------------------------------------------------------------
--

Segment Leq : 29.53 dBA

Total Leq All Segments: 41.55 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 49.14
                           (NIGHT): 41.55
```