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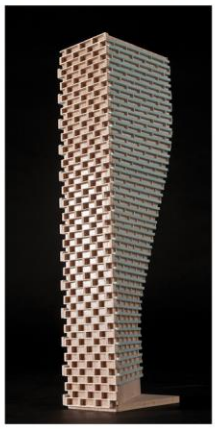
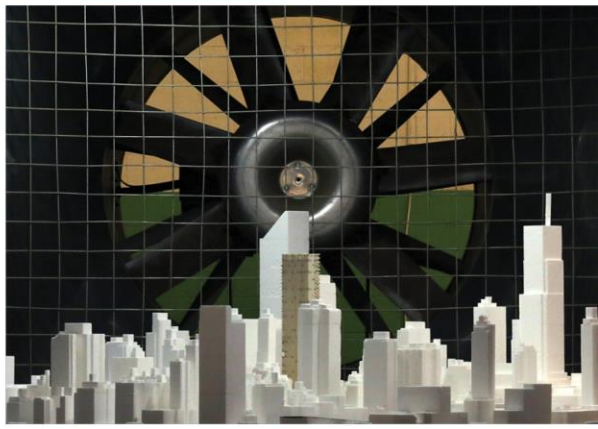
Transportation Noise & Vibration Feasibility Assessment

Phase 1, Gloucester Centre
1980 Ogilvie Road
Ottawa, Ontario

REPORT: GWE19-109 – Noise & Vibration





September 19, 2019

PREPARED FOR

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EXECUTIVE SUMMARY

This document describes a transportation noise & vibration feasibility assessment performed for Phase 1 of the redevelopment of the Gloucester Centre located at 1980 Ogilvie Road in Ottawa, Ontario, comprising a 30-storey mixed-use building rising above a six (6) storey podium, located at the southern edge of the site. The major sources of transportation noise are Highway 174, Blair Road and the Confederation LRT line currently under construction. Outdoor amenity space will be provided atop the 6-storey podium. 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 (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 received from RLA Architecture.

The results of the current analysis indicate that noise levels will range between 55 and 73 dBA during the daytime period (07:00-23:00) and between 47 and 65 dBA during the nighttime period (23:00-07:00). The highest noise levels (i.e. 73 dBA) occur along the south façade, which is nearest and most exposed to Highway 174. The noise levels predicted due to roadway traffic exceed the criteria listed in the ENCG for building components and upgraded building components will be required. The building layouts should consider placing non-sensitive uses, such as bathrooms and utility rooms, along the east façades. Due to the limited information available at the time of the study, which was prepared for rezoning application, detailed STC calculations could not be performed at this time. A detailed roadway traffic noise study will be required at the time of site plan approval to determine specific noise control measures for the development. A detailed review of the window and wall assemblies should be performed by a qualified engineer with expertise in acoustics during the detailed design stage of the building.

The OLA noise levels predicted due to roadway traffic exceed the criteria listed in the ENCG for outdoor living areas, as discussed in Section 4.2. The most feasible measures are insertion of an acoustic barrier surrounding the terrace. If the need arises for OLA noise mitigation, this can be addressed during site plan control. Results of the calculations also indicate that the development will require central air conditioning, or a similar ventilation system, which will allow occupants to keep windows closed and maintain a

comfortable living environment. Warning Clauses will also be required in all Lease, Purchase and Sale Agreements.

There are no significant stationary sources in operation in the area. The existing commercial building and new LRT station are at a sufficient distance to be considered insignificant in terms of noise levels produced by traffic. Noise impacts from the building itself on sensitive areas around the building are expected to be minimal and a detailed acoustic report will address any potential concerns. This report will be competed once the mechanical information for the building is known. Typically, noise levels can be controlled by judicious selection and placement of the equipment and the introduction of silencers or noise screens where needed.

Vibration levels due to railway activity in the area are expected be fall below the criterion of 0.10 mm/s at the nearest residences to the track. As a result, mitigation for vibrations is not required.

TABLE OF CONTENTS

1. INTRODUCTION

Gradient Wind Engineering Inc. (GWE) was retained by First Capital on behalf of Fotenn to undertake a transportation noise and vibration study for Phase 1 of the redevelopment of the Gloucester Centre located at 1980 Ogilvie Road in Ottawa, Ontario. This report summarizes the methodology, results and recommendations related to a transportation noise and ground vibration feasibility assessment for Zoning-By-law Amendment (ZBA). GWE's scope of work involved assessing exterior noise levels, as well as ground vibration generated by local roadway traffic sources. The assessment was performed on the basis of theoretical noise calculation methods conforming to the City of Ottawa[1] and Ministry of the Environment NPC-300[2] guidelines. Noise calculations were based on architectural drawings received from RLA 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 transportation noise and vibration feasibility assessment is Phase 1 of the redevelopment of the Gloucester Centre, comprising a 30-storey mixed-use building rising above a six (6) storey podium, located at the southern edge of the site. The major sources of transportation noise are Highway 174, Blair Road and the Confederation LRT line currently under construction. The building is bound by existing developments to the north and west, a parking lot to the east and an open green space from the east clockwise to the south. Beyond the park, the transitway is found to the south. Outdoor amenity space will be provided atop the 6-storey podium. 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 and railway 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.

[1] City of Ottawa Environmental Noise Control Guidelines, January 2016
[2] Ministry of the Environment – Publication NPC-300

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 and LRT Traffic Noise

4.2.1 Criteria for Roadway and LRT 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 for roadway as listed in Table 1.

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

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[4]. A closed window due to a ventilation requirement will bring noise levels down to achieve an acceptable indoor environment[5]. Therefore, where noise levels exceed 55 dBA daytime and 50 dBA nighttime, the ventilation for the building should consider the need for having windows and doors closed, which normally triggers the need for central air conditioning. Where noise levels exceed 65 dBA daytime and 60 dBA nighttime, building components will require higher levels of sound attenuation[6].

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] MOECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.8
[6] MOECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.1.3

4.2.2 Theoretical Roadway and LRT 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.
- Surrounding buildings included as barriers for some receptors.
- Noise receptors were strategically placed at 9 locations around the study area (see Figure 2).
- The Confederation Line LRT has been modeled using 4-car SRT in STAMSON.
- Receptor distances and exposure angles are illustrated for a sample of receptors in Figure 3-6.

4.2.1 Roadway and LRT Traffic Volumes

The ENCG dictates that noise calculations should consider future sound levels based on a roadway's classification at the mature state of development. Therefore, traffic volumes are based on the roadway classifications outlined in the City of Ottawa's Official Plan (OP) and Transportation Master Plan[7] which provide additional details on future roadway expansions. Average Annual Daily Traffic (AADT) volumes are then based on data in Table B1 of the ENCG for each roadway classification. Table 2 (below) summarizes the AADT values used for each roadway included in this assessment. Future LRT volumes were obtained through a representative of the Rail Implementation Office.

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

TABLE 2: ROADWAY AND LRT TRAFFIC DATA

Segment	Roadway Traffic Data	Speed Limit (km/h)	Traffic Volumes
Highway 174 WB	6-Freeway	100	**110,000**
Blair Road	4-UAU	70	**30,000**
Confederation Line	LRT	70	**540 Day/60 Night**

4.3 Ground Vibration & Ground-borne Noise

Transit systems and heavy vehicles on roadways can produce perceptible levels of ground vibrations, especially when they are in close proximity to residential neighbourhoods or vibration sensitive buildings. Similar to sound waves in air, vibrations in solids are generated at a source, propagated through the medium, and intercepted by a receiver. In the case of ground vibrations, the medium can be uniform, or more often, a complex layering of soils and rock strata. Also, similar to sound waves in air, ground vibrations produce perceptible motions and regenerated noise known as 'ground-borne noise' when the vibrations encounter a hollow structure such as a building. Ground-borne noise and vibrations are generated when there is excitation of the ground, from a train for instance. Repetitive motion of the wheels on the track or rubber tires passing over an uneven surface causes vibration to propagate through the soil. When they encounter a building, vibrations pass along the structure of the building beginning at the foundation and propagating to all floors. Air inside the building excited by the vibrating walls and floors represents regenerated airborne noise. Characteristics of the soil and the building are imparted to the noise, thereby creating a unique noise signature.

Human response to ground vibrations is dependent on the magnitude of the vibrations, which is measured by the root mean square (RMS) of the movement of a particle on a surface. Typical units of ground vibration measures are millimeters per second (mm/s), or inch per second (in/s). Since vibrations can vary over a wide range, it is also convenient to represent them in decibel units, or dBV. In North America, it is common practice to use the reference value of one micro-inch per second (µin/s) to represent vibration levels for this purpose. The threshold level of human perception to vibrations is about 0.10 mm/s RMS or about 72 dBV. Although somewhat variable, the threshold of annoyance for continuous vibrations is (1.0 mm/s RMS or 92 dBV), ten times higher than the perception threshold, whereas the threshold for

significant structural damage is (10 mm/s RMS or 112 dBV) at least one hundred times higher than the annoyance threshold level.

4.3.1 Vibration Criteria

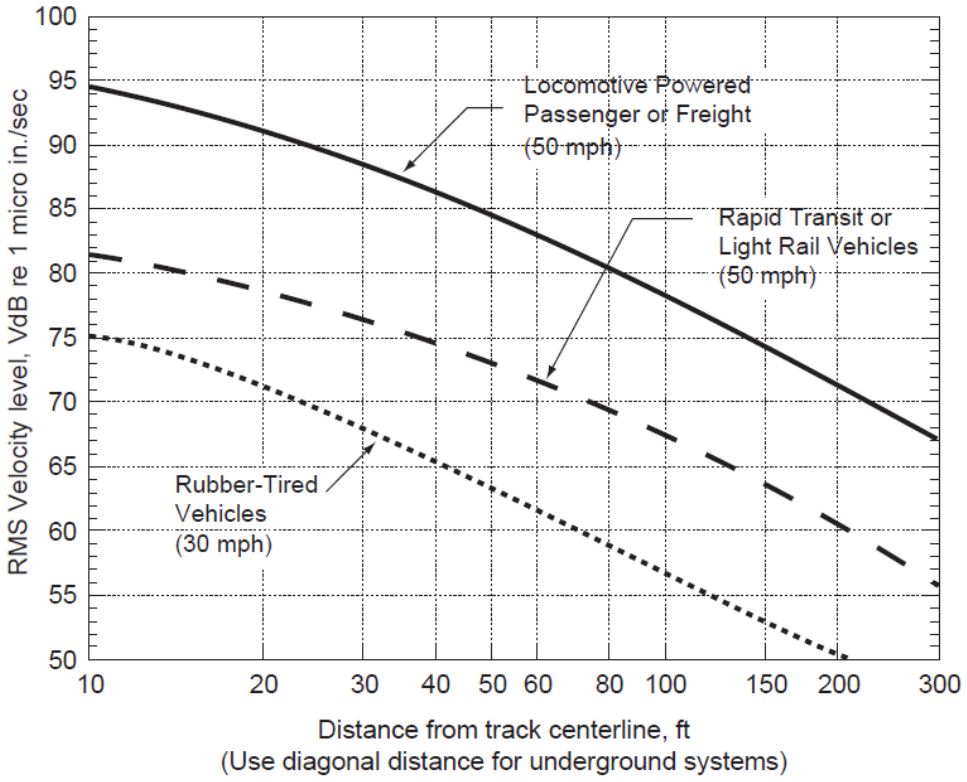
In the United States, the Federal Transportation Authority (FTA) has set vibration criteria for sensitive land use next to Transit corridors. Similar standards have been developed by a partnership between the MECP and the Toronto Transit Commission[8]. These standards indicate that the appropriate criteria for residential buildings are 0.1 mm/s RMS for vibrations. For main line railways, a document titled Guidelines for New Development in Proximity to Railway Operations[9], indicates that vibration conditions should not exceed 0.14 mm/s RMS averaged over a one second time period at the first floor and above of the proposed building. As the main vibration source is due to a LRT system, the 0.1 mm/s RMS (72 dBV) vibration criteria and 35 dBA ground borne noise criteria were adopted for this study.

4.3.2 Theoretical Ground Vibration Prediction Procedure

At the time of this study the confederation line has not begun regular service, therefore theoretical calculations were used to assess vibrations. Potential vibration impacts of the existing LRT rail line were predicted using the FTA's Transit Noise and Vibration Impact Assessment[10] protocol. The FTA general vibration assessment is based on an upper bound generic set of curves that show vibration level attenuation with distance. These curves, illustrated in the figure below, are based on ground vibration measurements at various transit systems throughout North America. Vibration levels at points of reception are adjusted by various factors to incorporate known characteristics of the system being analyzed; such as operating speed of vehicles, conditions of the track, construction of the track and geology; as well as the structural type of the impacted building structures. Based on the setback distance of the closest building, initial vibration levels were deduced from a curve for light rail trains at 50 miles per hour (mph) and applying an adjustment factor of -1 dBV to account for an operational speed of 70 km/h (44 mph). Other factors

[8] MOEE/TTC Protocol for Noise and Vibration Assessment for the Proposed Yonge-Spadina Subway Loop, June 16, 1993
[9] Dialog and J.E. Coulter Associates Limited, prepared for The Federation of Canadian Municipalities and The Railway Associated of Canada, May 2013
[10] C. E. Hanson; D. A. Towers; and L. D. Meister, Transit Noise and Vibration Impact Assessment, Federal Transit Administration, May 2006.

considered; the track was assumed to be have welded joints. Details of the vibration calculations are presented in Appendix B.



FTA GENERALIZED CURVES OF VIBRATION LEVELS VERSUS DISTANCE (ADOPTED FROM FIGURE 10-1, FTA TRANSIT NOISE AND VIBRATION IMPACT ASSESSMENT)

5. RESULTS AND DISCUSSION

5.1 Roadway and LRT Traffic Noise Levels

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

TABLE 3: EXTERIOR NOISE LEVELS DUE TO ROAD AND LRT TRAFFIC

Receptor Number	Receptor Height Above Grade (m)	Receptor Location	STAMSON 5.04 Noise Level (dBA)	
			Day	Night
1	20.5	6th Floor - North Façade	69	61
2	20.5	6th Floor - East Façade	72	64
3	20.5	6th Floor - South Façade	72	65
4	20.5	6th Floor - West Façade	55	47
5	86.5	28th Floor - North Façade	69	61
6	86.5	28th Floor - East Façade	73	65
7	86.5	28th Floor - South Façade	72	64
8	86.5	28th Floor - West Façade	55	47
9	23.5	7th Floor Terrace	68	61

The results of the current analysis indicate that noise levels will range between 55 and 73 dBA during the daytime period (07:00-23:00) and between 47 and 65 dBA during the nighttime period (23:00-07:00). The highest noise levels (i.e. 73 dBA) occur along the south façade, which is nearest and most exposed to Highway 174.

5.2 Noise Control Measures

The OLA noise levels predicted due to roadway traffic exceed the criteria listed in the ENCG for outdoor living areas, as discussed in Section 4.2. Therefore, noise control measures as described below, subscribing to Table 2.3a in the ENCG and listed in order of preference, will be required to reduce the L_{eq} to 55 dBA:

- Distance setback with soft ground
- Insertion of noise insensitive land uses between the source and sensitive points of reception
- Orientation of buildings to provide sheltered zones in rear yards
- Shared outdoor amenity areas
- Earth berms (sound barriers)
- Acoustic barriers

The most feasible measures are insertion of an acoustic barrier surrounding the terrace. The noise levels predicted due to roadway traffic exceed the criteria listed in the ENCG for building components and upgraded building components will be required. Furthermore, results of the calculations also indicate that the development will require central air conditioning, or a similar ventilation system, which will allow occupants to keep windows closed and maintain a comfortable living environment. Warning Clauses will also be required in all Lease, Purchase and Sale Agreements.

5.3 Ground Vibrations & Ground-borne Noise Levels

Based on an offset distance of 52 meters between the railway centerline and the nearest foundation, the estimated vibration levels at the nearest residence façade are expected to be 0.01 mm/s RMS (51 dBV) based on the FTA protocol. Details of the calculation are provided in Appendix B. Since predicted vibration levels are below the criterion of 0.10 mm/s RMS, vibration mitigation will not be required.

According to the United States Federal Transit Authority's vibration assessment protocol, ground borne noise can be estimated by subtracting 35 dB from the velocity vibration level in dBV. Since measured vibration levels were found to be 51 dBV, ground borne noise levels are expected to be below the ground borne noise criteria of 35 dBA.

6. CONCLUSIONS AND RECOMMENDATIONS

The results of the current analysis indicate that noise levels will range between 55 and 73 dBA during the daytime period (07:00-23:00) and between 47 and 65 dBA during the nighttime period (23:00-07:00). The highest noise levels (i.e. 73 dBA) occur along the south façade, which is nearest and most exposed to Highway 174. The noise levels predicted due to roadway traffic exceed the criteria listed in the ENCG for building components and upgraded building components will be required. The building layouts should consider placing non-sensitive uses, such as bathrooms and utility rooms, along the east façades. Due to the limited information available at the time of the study, which was prepared for rezoning application, detailed STC calculations could not be performed at this time. A detailed roadway traffic noise study will be required at the time of site plan approval to determine specific noise control measures for the development. A detailed review of the window and wall assemblies should be performed by a qualified engineer with expertise in acoustics during the detailed design stage of the building.

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There are no significant stationary sources in operation in the area. The existing commercial building and new LRT station are at a sufficient distance to be considered insignificant in terms of noise levels produced by traffic. Noise impacts from the building itself on sensitive areas around the building are expected to be minimal and a detailed acoustic report will address any potential concerns. This report will be competed once the mechanical information for the building is known. Typically, noise levels can be controlled by judicious selection and placement of the equipment and the introduction of silencers or noise screens where needed.

Vibration levels due to railway activity in the area are expected be fall below the criterion of 0.10 mm/s at the nearest residences to the track. As a result, mitigation for vibrations is not required.

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.

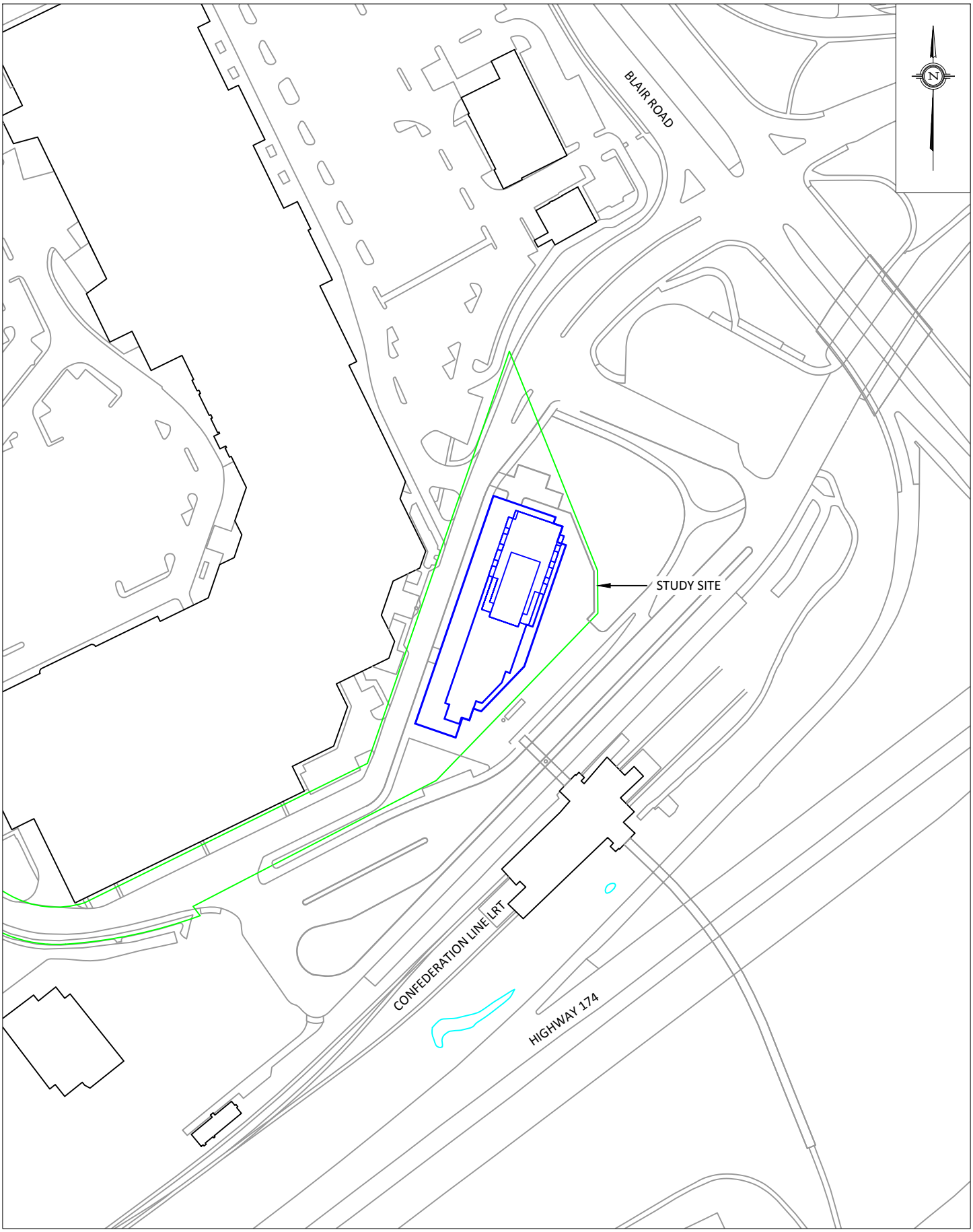
Sincerely,

Gradient Wind Engineering Inc.

Michael Lafortune, C.E.T.
Environmental Scientist

Joshua Foster, P.Eng.
Principal

Gradient Wind File #19-109 – Noise & Vibration



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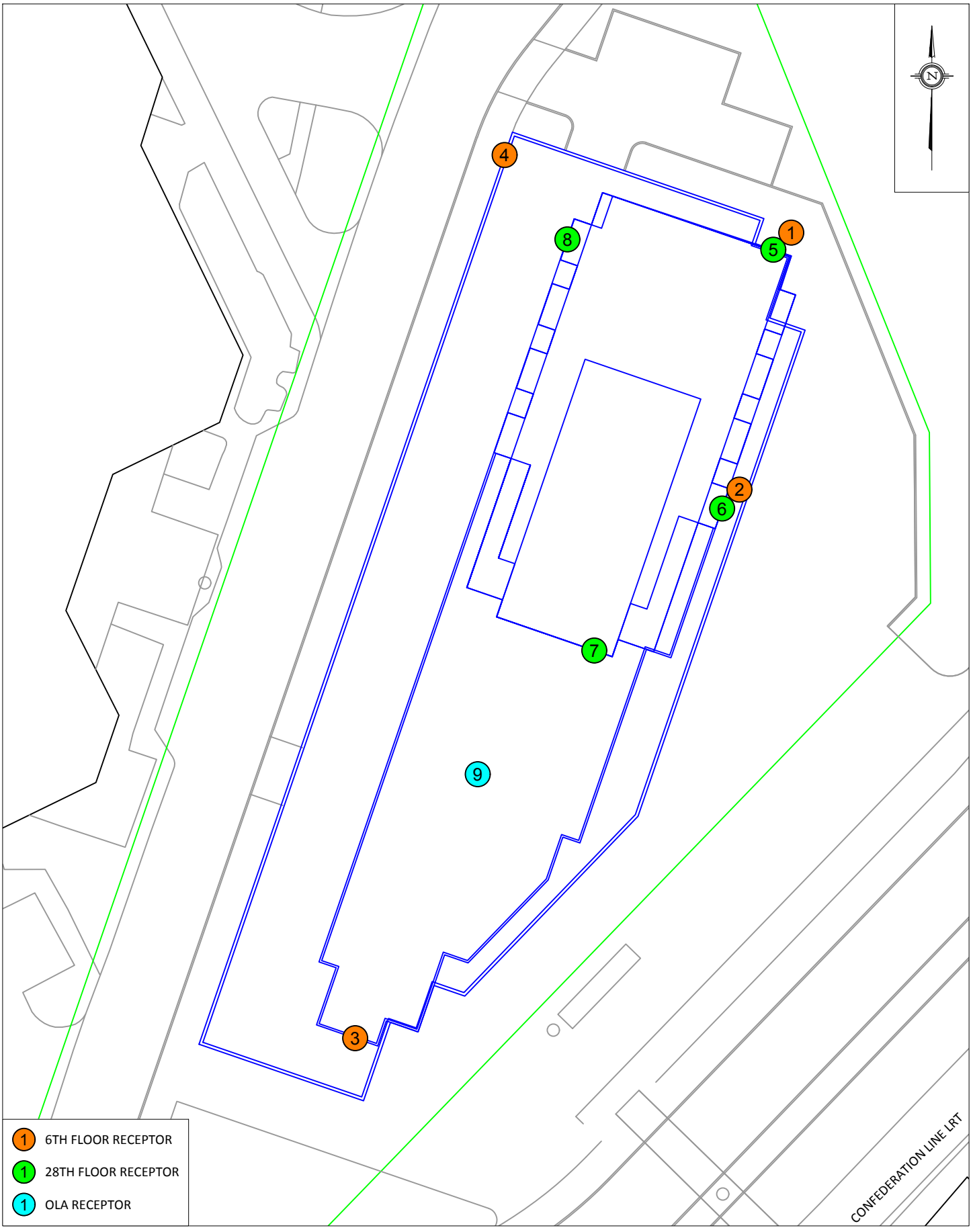
PROJECT	TRANSPORTATION NOISE & VIBRATION ASSESSMENT PHASE 1, GLOUCESTER CENTRE - 1980 OGILVIE ROAD, OTTAWA		DESCRIPTION
SCALE	1:2000 (APPROX.)	DRAWING NO.	GWE19-109-1
DATE	SEPTEMBER 12, 2019	DRAWN BY	M.L.

FIGURE 1:
SITE PLAN AND SURROUNDING CONTEXT



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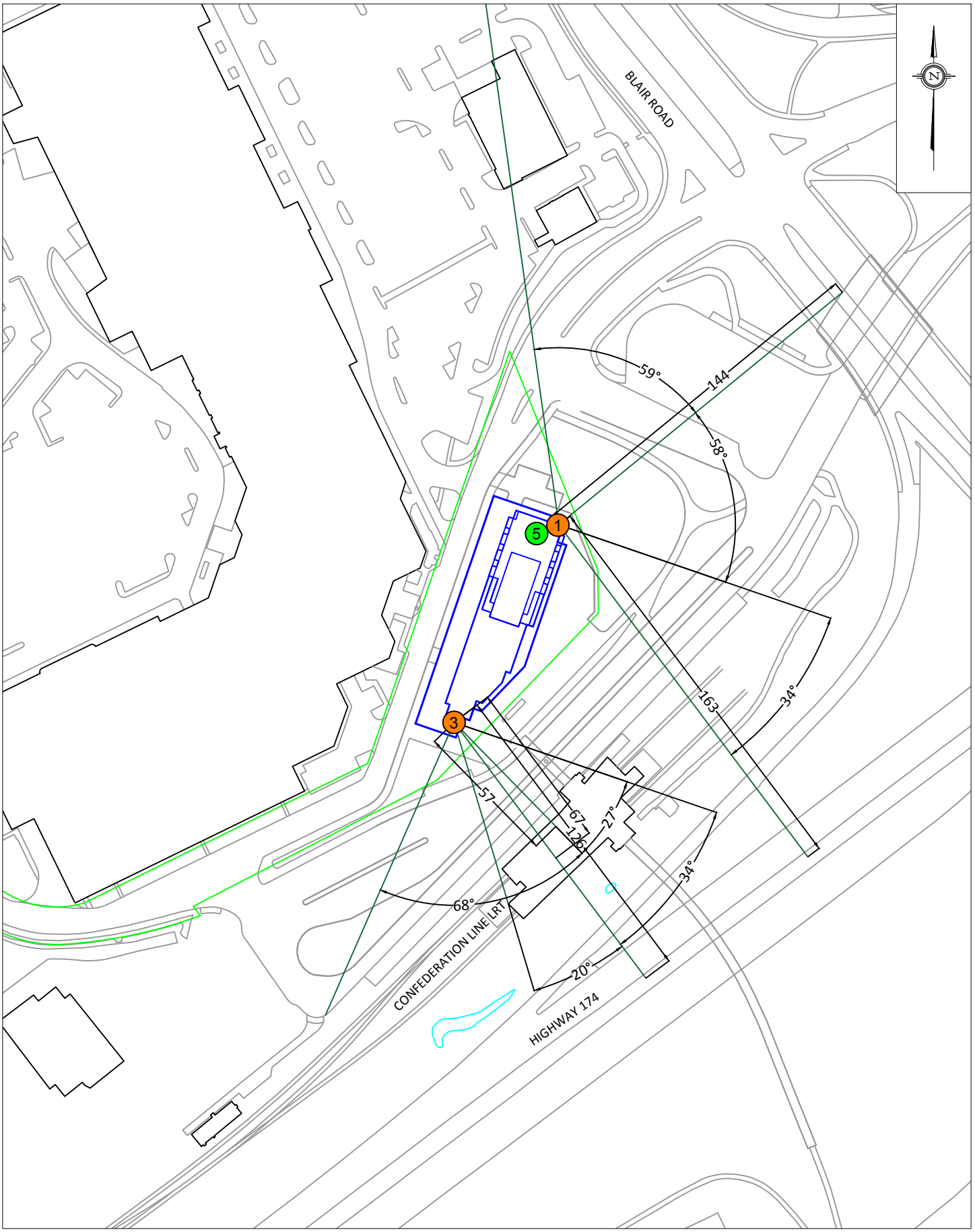
SCALE	1:500 (APPROX.)
DRAWING NO.	GWE19-109-2
DATE	SEPTEMBER 12, 2019
DRAWN BY	M.L.
DESCRIPTION	FIGURE 2: RECEPTOR LOCATIONS



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DATE	SEPTEMBER 12, 2019
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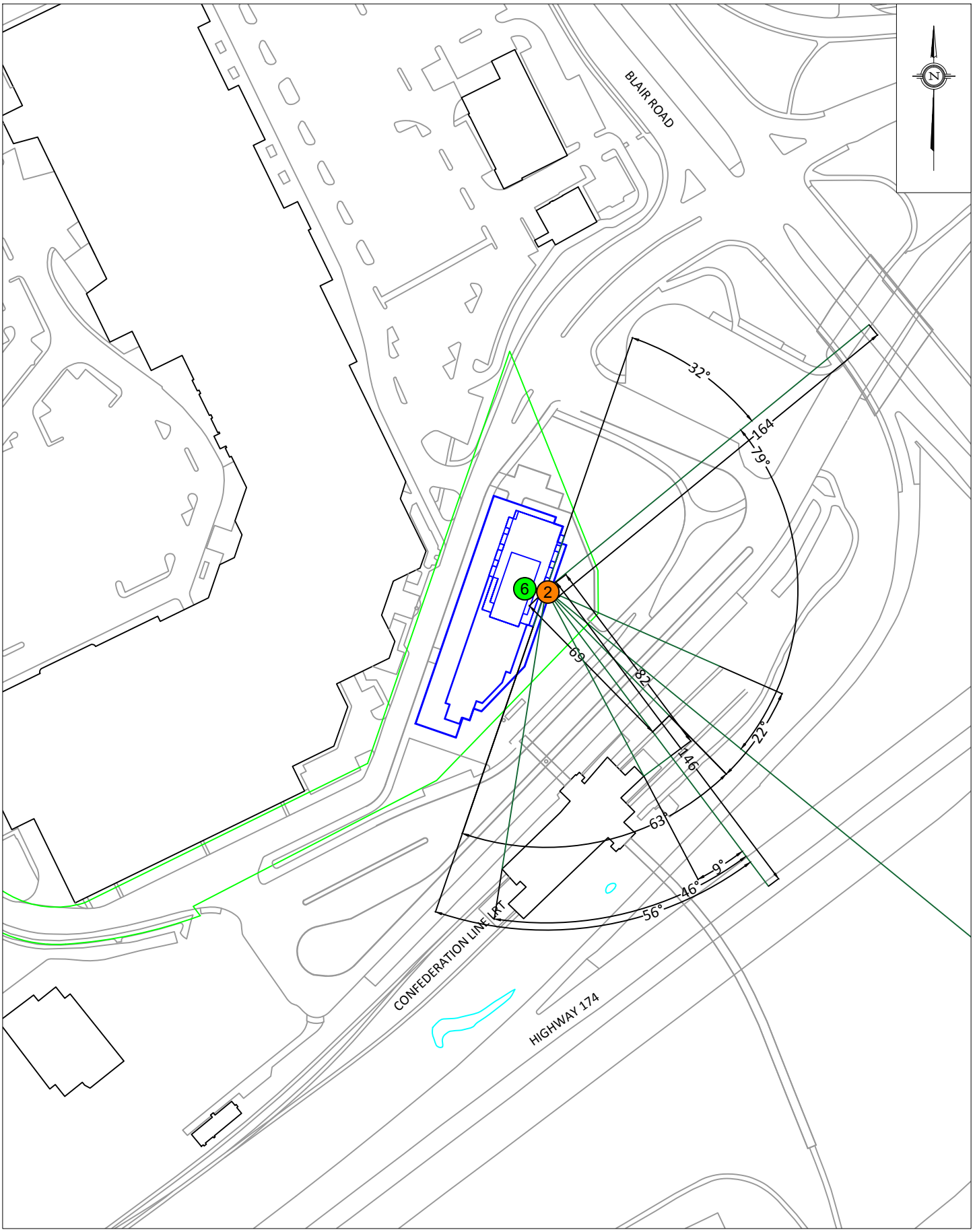
DESCRIPTION

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



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SCALE	1:2000 (APPROX.)
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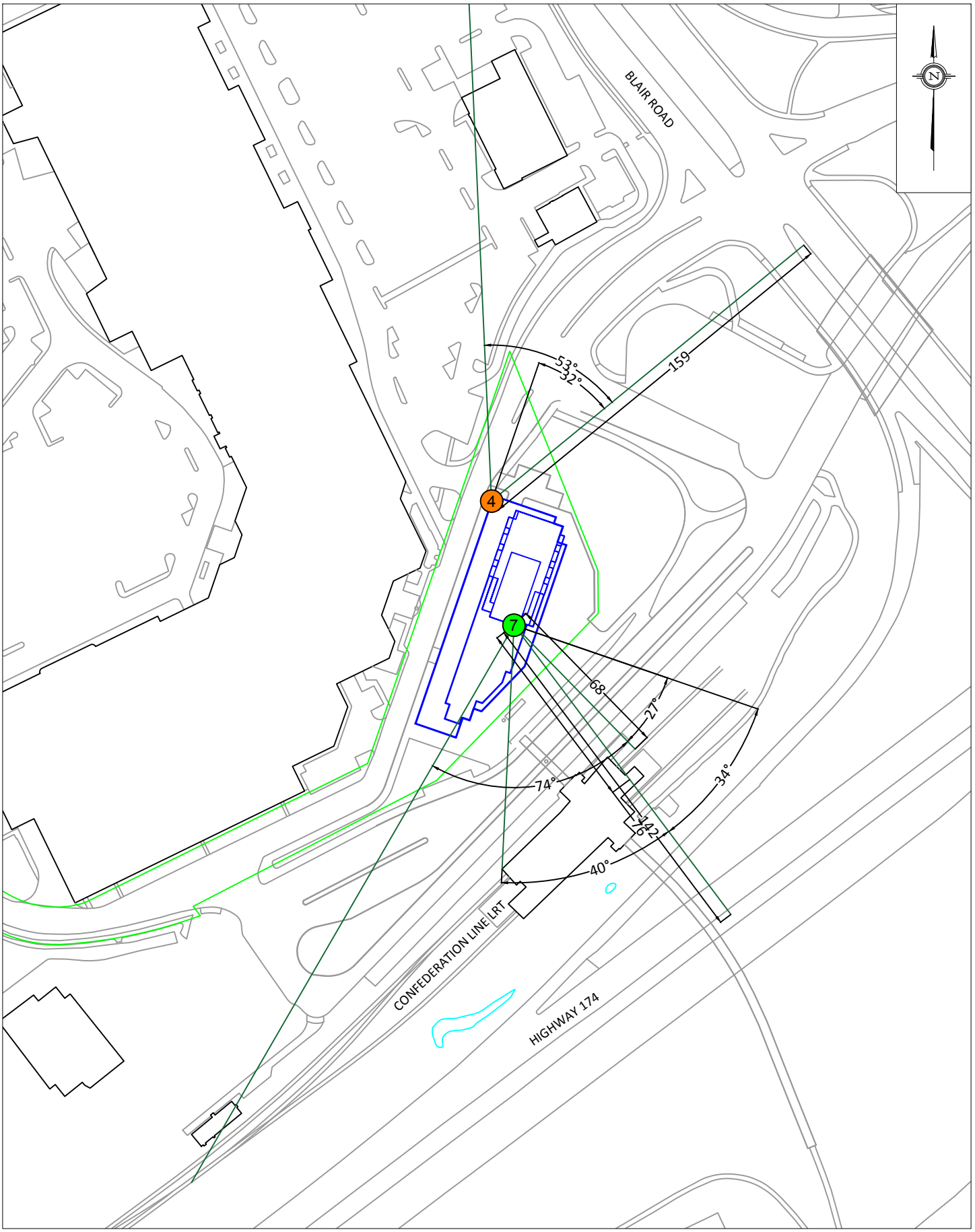
DATE	SEPTEMBER 12, 2019
DRAWN BY	M.L.

DESCRIPTION

FIGURE 4:
STAMSON INPUT PARAMETERS - RECEPTOR 2,6



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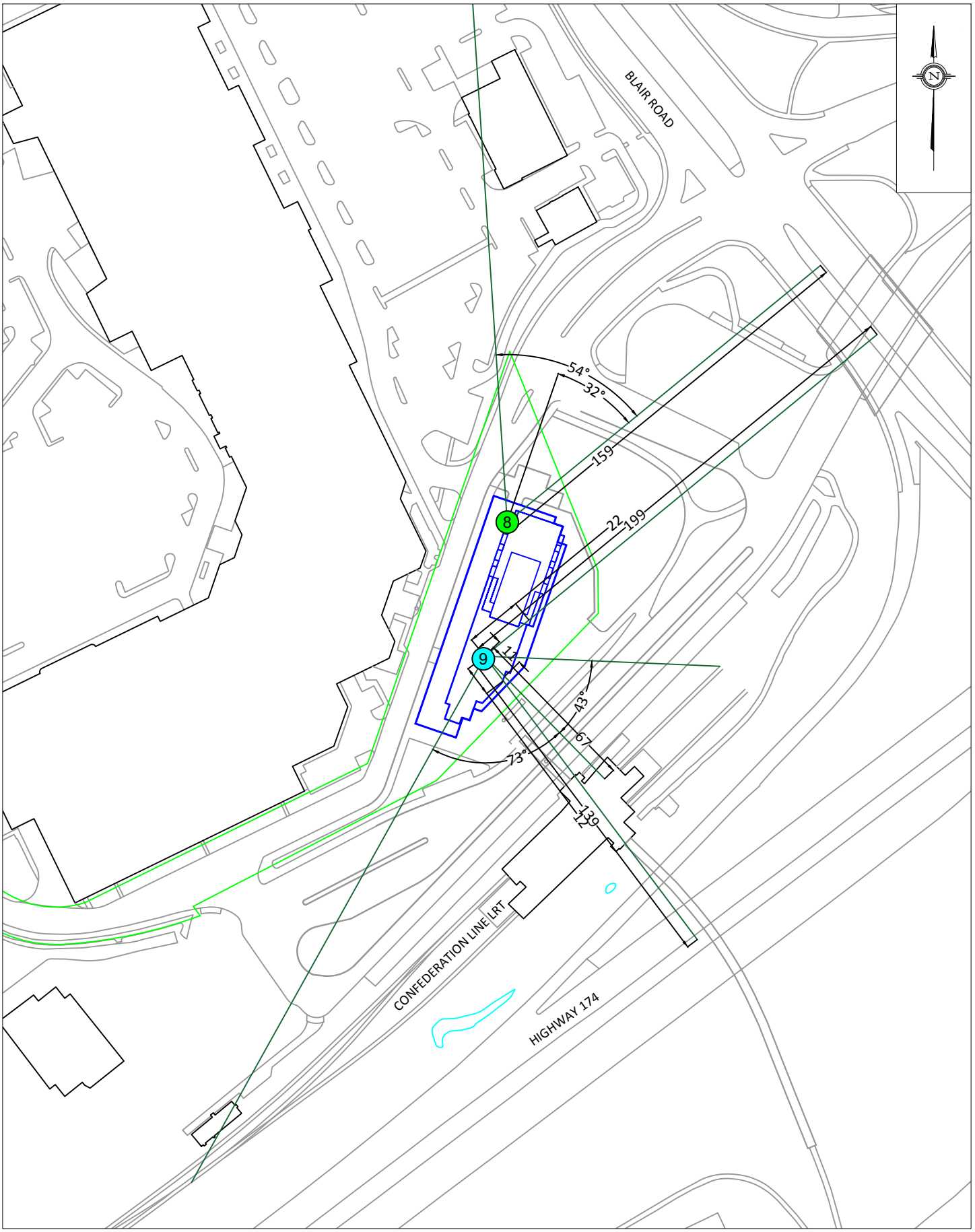
DRAWING NO.	GWE19-109-5
DATE	SEPTEMBER 12, 2019
DRAWN BY	M.L.

DESCRIPTION

FIGURE 5:
STAMSON INPUT PARAMETERS - RECEPTOR 4,7



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DRAWING NO.	GWE19-109-6
DATE	SEPTEMBER 12, 2019
DRAWN BY	M.L.

DESCRIPTION

FIGURE 6:
STAMSON INPUT PARAMETERS - RECEPTOR 8,9

APPENDIX A

STAMSON 5.04 – INPUT AND OUTPUT DATA

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```
STAMSON 5.0        NORMAL REPORT        Date: 04-09-2019 14:50:19
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: 174 (day/night)
----------------------------------------
Car traffic volume  : 89056/7744  veh/TimePeriod  *
Medium truck volume :  7084/616   veh/TimePeriod  *
Heavy truck volume  :  5060/440   veh/TimePeriod  *
Posted speed limit  :   100 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): 110000
    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: 174 (day/night)
-------------------------------------
Angle1   Angle2           : -90.00 deg   -34.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 163.00 / 163.00 m
Receiver height           :  20.50 / 20.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Road data, segment # 2: Blair (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  :    70 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: Blair (day/night)
---------------------------------------
Angle1   Angle2           : -59.00 deg   58.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 144.00 / 144.00 m
Receiver height           :  20.50 / 20.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Results segment # 1: 174 (day)
------------------------------

Source height = 1.50 m

ROAD (0.00 + 67.73 + 0.00) = 67.73 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
--------------------------------------------------------------------------------
   -90    -34   0.00  83.16   0.00 -10.36  -5.07   0.00   0.00   0.00  67.73
--------------------------------------------------------------------------------

Segment Leq : 67.73 dBA


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

Source height = 1.50 m

ROAD (0.00 + 62.63 + 0.00) = 62.63 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
--------------------------------------------------------------------------------
   -59     58   0.00  74.33   0.00  -9.82  -1.87   0.00   0.00   0.00  62.63
--------------------------------------------------------------------------------

Segment Leq : 62.63 dBA

Total Leq All Segments: 68.90 dBA


Results segment # 1: 174 (night)
--------------------------------

Source height = 1.50 m

ROAD (0.00 + 60.13 + 0.00) = 60.13 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
--------------------------------------------------------------------------------
   -90    -34   0.00  75.56   0.00 -10.36  -5.07   0.00   0.00   0.00  60.13
--------------------------------------------------------------------------------

Segment Leq : 60.13 dBA


Results segment # 2: Blair (night)
----------------------------------

Source height = 1.50 m

ROAD (0.00 + 55.04 + 0.00) = 55.04 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
--------------------------------------------------------------------------------
   -59     58   0.00  66.73   0.00  -9.82  -1.87   0.00   0.00   0.00  55.04
--------------------------------------------------------------------------------

Segment Leq : 55.04 dBA

Total Leq All Segments: 61.30 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 68.90
                           (NIGHT): 61.30
```

```
STAMSON 5.0        NORMAL REPORT        Date: 04-09-2019 14:50:24
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: 174 (day/night)
----------------------------------------
Car traffic volume  : 89056/7744  veh/TimePeriod  *
Medium truck volume :  7084/616   veh/TimePeriod  *
Heavy truck volume  :  5060/440   veh/TimePeriod  *
Posted speed limit  :   100 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): 110000
    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: 174 (day/night)
-------------------------------------
Angle1   Angle2           : -90.00 deg   56.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 146.00 / 146.00 m
Receiver height           :  20.50 / 20.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :   9.00 deg   Angle2 : 46.00 deg
Barrier height            :  10.00 m
Barrier receiver distance :  82.00 / 82.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 2: Blair (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  :    70 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: Blair (day/night)
---------------------------------------
Angle1   Angle2           : -32.00 deg   79.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 164.00 / 164.00 m
Receiver height           :  20.50 / 20.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Results segment # 1: 174 (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 !       20.50 !        9.83 !         9.83

ROAD (70.68 + 61.39 + 60.72) = 71.54 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90      9   0.00  83.16   0.00  -9.88  -2.60   0.00   0.00   0.00  70.68
-------------------------------------------------------------------------------
     9     46   0.00  83.16   0.00  -9.88  -6.87   0.00   0.00  -5.02  61.39
-------------------------------------------------------------------------------
    46     56   0.00  83.16   0.00  -9.88 -12.55   0.00   0.00   0.00  60.72
-------------------------------------------------------------------------------

Segment Leq : 71.54 dBA


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

Source height = 1.50 m

ROAD (0.00 + 61.84 + 0.00) = 61.84 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -32     79   0.00  74.33   0.00 -10.39  -2.10   0.00   0.00   0.00  61.84
-------------------------------------------------------------------------------

Segment Leq : 61.84 dBA

Total Leq All Segments: 71.98 dBA


Results segment # 1: 174 (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 !       20.50 !        9.83 !         9.83

ROAD (63.08 + 53.79 + 53.13) = 63.94 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90      9   0.00  75.56   0.00  -9.88  -2.60   0.00   0.00   0.00  63.08
-------------------------------------------------------------------------------
     9     46   0.00  75.56   0.00  -9.88  -6.87   0.00   0.00  -5.02  53.79
-------------------------------------------------------------------------------
    46     56   0.00  75.56   0.00  -9.88 -12.55   0.00   0.00   0.00  53.13
-------------------------------------------------------------------------------

Segment Leq : 63.94 dBA
```

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

Source height = 1.50 m

ROAD (0.00 + 54.24 + 0.00) = 54.24 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -32     79   0.00  66.73   0.00 -10.39  -2.10   0.00   0.00   0.00  54.24
-------------------------------------------------------------------------------

Segment Leq : 54.24 dBA

Total Leq All Segments: 64.38 dBA


RT/Custom data, segment # 1: LRT (day/night)
--------------------------------------------
1 - 4-car SRT:
Traffic volume    :   540/60    veh/TimePeriod
Speed             :    70 km/h

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2           : -22.00 deg   63.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  69.00 / 69.00  m
Receiver height           :  20.50 / 20.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


Results segment # 1: LRT (day)
------------------------------

Source height = 0.50 m

RT/Custom (0.00 + 53.55 + 0.00) = 53.55 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -22     63   0.00  63.44  -6.63  -3.26   0.00   0.00   0.00  53.55
-------------------------------------------------------------------------

Segment Leq : 53.55 dBA

Total Leq All Segments: 53.55 dBA


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

Source height = 0.50 m

RT/Custom (0.00 + 47.02 + 0.00) = 47.02 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -22     63   0.00  56.91  -6.63  -3.26   0.00   0.00   0.00  47.02
-------------------------------------------------------------------------

Segment Leq : 47.02 dBA

Total Leq All Segments: 47.02 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 72.04
                           (NIGHT): 64.46
```


```
STAMSON 5.0        NORMAL REPORT        Date: 04-09-2019 14:51:21
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: 174 (day/night)
----------------------------------------
Car traffic volume  : 89056/7744  veh/TimePeriod  *
Medium truck volume :  7084/616   veh/TimePeriod  *
Heavy truck volume  :  5060/440   veh/TimePeriod  *
Posted speed limit  :   100 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): 110000
    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: 174 (day/night)
-------------------------------------
Angle1   Angle2           : -34.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 126.00 / 126.00 m
Receiver height           :  20.50 / 20.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -34.00 deg   Angle2 : 20.00 deg
Barrier height            :  10.00 m
Barrier receiver distance :  67.00 / 67.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: 174 (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 !       20.50 !       10.39 !        10.39

ROAD (0.00 + 68.69 + 69.81) = 72.30 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -34     20   0.00  83.16   0.00  -9.24  -5.23   0.00   0.00  -4.88  63.81*
   -34     20   0.00  83.16   0.00  -9.24  -5.23   0.00   0.00   0.00  68.69
-------------------------------------------------------------------------------
    20     90   0.00  83.16   0.00  -9.24  -4.10   0.00   0.00   0.00  69.81
-------------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 72.30 dBA

Total Leq All Segments: 72.30 dBA


Results segment # 1: 174 (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 !       20.50 !       10.39 !        10.39

ROAD (0.00 + 61.09 + 62.22) = 64.70 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -34     20   0.00  75.56   0.00  -9.24  -5.23   0.00   0.00  -4.88  56.21*
   -34     20   0.00  75.56   0.00  -9.24  -5.23   0.00   0.00   0.00  61.09
-------------------------------------------------------------------------------
    20     90   0.00  75.56   0.00  -9.24  -4.10   0.00   0.00   0.00  62.22
-------------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 64.70 dBA

Total Leq All Segments: 64.70 dBA
```


```
RT/Custom data, segment # 1: LRT (day/night)
-----------------------------------------
1 - 4-car SRT:
Traffic volume    :   540/60    veh/TimePeriod
Speed             :    70 km/h

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2           : -27.00 deg   68.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  57.00 / 57.00  m
Receiver height           :  20.50 / 20.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


Results segment # 1: LRT (day)
------------------------------

Source height = 0.50 m

RT/Custom (0.00 + 54.86 + 0.00) = 54.86 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -27     68   0.00  63.44  -5.80  -2.78   0.00   0.00   0.00  54.86
-------------------------------------------------------------------------

Segment Leq : 54.86 dBA

Total Leq All Segments: 54.86 dBA


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

Source height = 0.50 m

RT/Custom (0.00 + 48.33 + 0.00) = 48.33 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -27     68   0.00  56.91  -5.80  -2.78   0.00   0.00   0.00  48.33
-------------------------------------------------------------------------

Segment Leq : 48.33 dBA

Total Leq All Segments: 48.33 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 72.38
                           (NIGHT): 64.80
```

```
STAMSON 5.0        NORMAL REPORT        Date: 04-09-2019 14:51:27
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Blair (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  :    70 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: Blair (day/night)
---------------------------------------
Angle1   Angle2           : -53.00 deg   -32.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 159.00 / 159.00 m
Receiver height           :  20.50 / 20.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

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

Source height = 1.50 m

ROAD (0.00 + 54.74 + 0.00) = 54.74 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -53    -32   0.00  74.33   0.00 -10.25  -9.33   0.00   0.00   0.00  54.74
-------------------------------------------------------------------------------

Segment Leq : 54.74 dBA

Total Leq All Segments: 54.74 dBA


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

Source height = 1.50 m

ROAD (0.00 + 47.15 + 0.00) = 47.15 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -53    -32   0.00  66.73   0.00 -10.25  -9.33   0.00   0.00   0.00  47.15
-------------------------------------------------------------------------------

Segment Leq : 47.15 dBA

Total Leq All Segments: 47.15 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 54.74
                           (NIGHT): 47.15
```

```
STAMSON 5.0        NORMAL REPORT        Date: 04-09-2019 14:51:32
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: 174 (day/night)
----------------------------------------
Car traffic volume  : 89056/7744  veh/TimePeriod  *
Medium truck volume :  7084/616   veh/TimePeriod  *
Heavy truck volume  :  5060/440   veh/TimePeriod  *
Posted speed limit  :   100 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): 110000
    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: 174 (day/night)
-------------------------------------
Angle1   Angle2           : -90.00 deg   -34.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 163.00 / 163.00 m
Receiver height           :  86.50 / 86.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Road data, segment # 2: Blair (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  :    70 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: Blair (day/night)
---------------------------------------
Angle1   Angle2           : -59.00 deg   58.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 144.00 / 144.00 m
Receiver height           :  86.50 / 86.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Results segment # 1: 174 (day)
------------------------------

Source height = 1.50 m

ROAD (0.00 + 67.73 + 0.00) = 67.73 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
--------------------------------------------------------------------------------
   -90    -34   0.00  83.16   0.00 -10.36  -5.07   0.00   0.00   0.00  67.73
--------------------------------------------------------------------------------

Segment Leq : 67.73 dBA


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

Source height = 1.50 m

ROAD (0.00 + 62.63 + 0.00) = 62.63 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
--------------------------------------------------------------------------------
   -59     58   0.00  74.33   0.00  -9.82  -1.87   0.00   0.00   0.00  62.63
--------------------------------------------------------------------------------

Segment Leq : 62.63 dBA

Total Leq All Segments: 68.90 dBA


Results segment # 1: 174 (night)
---------------------------------

Source height = 1.50 m

ROAD (0.00 + 60.13 + 0.00) = 60.13 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
--------------------------------------------------------------------------------
   -90    -34   0.00  75.56   0.00 -10.36  -5.07   0.00   0.00   0.00  60.13
--------------------------------------------------------------------------------

Segment Leq : 60.13 dBA


Results segment # 2: Blair (night)
---------------------------------

Source height = 1.50 m

ROAD (0.00 + 55.04 + 0.00) = 55.04 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
--------------------------------------------------------------------------------
   -59     58   0.00  66.73   0.00  -9.82  -1.87   0.00   0.00   0.00  55.04
--------------------------------------------------------------------------------

Segment Leq : 55.04 dBA

Total Leq All Segments: 61.30 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 68.90
                           (NIGHT): 61.30
```


```
STAMSON 5.0        NORMAL REPORT        Date: 04-09-2019 14:51:37
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: 174 (day/night)
----------------------------------------
Car traffic volume  : 89056/7744  veh/TimePeriod  *
Medium truck volume :  7084/616   veh/TimePeriod  *
Heavy truck volume  :  5060/440   veh/TimePeriod  *
Posted speed limit  :   100 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): 110000
    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: 174 (day/night)
-------------------------------------
Angle1   Angle2           : -90.00 deg   56.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 146.00 / 146.00 m
Receiver height           :  86.50 / 86.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :   9.00 deg   Angle2 : 46.00 deg
Barrier height            :  10.00 m
Barrier receiver distance :  82.00 / 82.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 2: Blair (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  :    70 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: Blair (day/night)
---------------------------------------
Angle1   Angle2           : -32.00 deg   79.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 164.00 / 164.00 m
Receiver height           :  86.50 / 86.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Results segment # 1: 174 (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 !       86.50 !       38.76 !        38.76

ROAD (70.68 + 66.40 + 60.72) = 72.37 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90      9   0.00  83.16   0.00  -9.88  -2.60   0.00   0.00   0.00  70.68
-------------------------------------------------------------------------------
     9     46   0.00  83.16   0.00  -9.88  -6.87   0.00   0.00   0.00  66.40*
     9     46   0.00  83.16   0.00  -9.88  -6.87   0.00   0.00   0.00  66.40
-------------------------------------------------------------------------------
    46     56   0.00  83.16   0.00  -9.88 -12.55   0.00   0.00   0.00  60.72
-------------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 72.37 dBA


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

Source height = 1.50 m

ROAD (0.00 + 61.84 + 0.00) = 61.84 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -32     79   0.00  74.33   0.00 -10.39  -2.10   0.00   0.00   0.00  61.84
-------------------------------------------------------------------------------

Segment Leq : 61.84 dBA

Total Leq All Segments: 72.74 dBA
```

```
Results segment # 1: 174 (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 !       86.50 !       38.76 !        38.76

ROAD (63.08 + 58.81 + 53.13) = 64.77 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90      9   0.00  75.56   0.00  -9.88  -2.60   0.00   0.00   0.00  63.08
-------------------------------------------------------------------------------
     9     46   0.00  75.56   0.00  -9.88  -6.87   0.00   0.00   0.00  58.81*
     9     46   0.00  75.56   0.00  -9.88  -6.87   0.00   0.00   0.00  58.81
-------------------------------------------------------------------------------
    46     56   0.00  75.56   0.00  -9.88 -12.55   0.00   0.00   0.00  53.13
-------------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 64.77 dBA


Results segment # 2: Blair (night)
----------------------------------

Source height = 1.50 m

ROAD (0.00 + 54.24 + 0.00) = 54.24 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -32     79   0.00  66.73   0.00 -10.39  -2.10   0.00   0.00   0.00  54.24
-------------------------------------------------------------------------------

Segment Leq : 54.24 dBA

Total Leq All Segments: 65.14 dBA
```

```
RT/Custom data, segment # 1: LRT (day/night)
-----------------------------------------
1 - 4-car SRT:
Traffic volume    :   540/60    veh/TimePeriod
Speed             :    70 km/h

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2           : -22.00 deg   63.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  69.00 / 69.00  m
Receiver height           :  86.50 / 86.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


Results segment # 1: LRT (day)
------------------------------

Source height = 0.50 m

RT/Custom (0.00 + 53.55 + 0.00) = 53.55 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -22     63   0.00  63.44  -6.63  -3.26   0.00   0.00   0.00  53.55
-------------------------------------------------------------------------

Segment Leq : 53.55 dBA

Total Leq All Segments: 53.55 dBA


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

Source height = 0.50 m

RT/Custom (0.00 + 47.02 + 0.00) = 47.02 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -22     63   0.00  56.91  -6.63  -3.26   0.00   0.00   0.00  47.02
-------------------------------------------------------------------------

Segment Leq : 47.02 dBA

Total Leq All Segments: 47.02 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 72.79
                           (NIGHT): 65.20
```

```
STAMSON 5.0        NORMAL REPORT        Date: 04-09-2019 14:51:56
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r7.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: 174 (day/night)
----------------------------------------
Car traffic volume  : 89056/7744  veh/TimePeriod  *
Medium truck volume :  7084/616   veh/TimePeriod  *
Heavy truck volume  :  5060/440   veh/TimePeriod  *
Posted speed limit  :   100 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): 110000
    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: 174 (day/night)
-------------------------------------
Angle1   Angle2           : -34.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 142.00 / 142.00 m
Receiver height           :  86.50 / 86.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -34.00 deg   Angle2 : 40.00 deg
Barrier height            :  10.00 m
Barrier receiver distance :  76.00 / 76.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: 174 (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 !       86.50 !       41.00 !        41.00

ROAD (0.00 + 69.54 + 67.83) = 71.78 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -34     40   0.00  83.16   0.00  -9.76  -3.86   0.00   0.00   0.00  69.54*
   -34     40   0.00  83.16   0.00  -9.76  -3.86   0.00   0.00   0.00  69.54
-------------------------------------------------------------------------------
    40     90   0.00  83.16   0.00  -9.76  -5.56   0.00   0.00   0.00  67.83
-------------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 71.78 dBA

Total Leq All Segments: 71.78 dBA


Results segment # 1: 174 (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 !       86.50 !       41.00 !        41.00

ROAD (0.00 + 61.94 + 60.24) = 64.18 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -34     40   0.00  75.56   0.00  -9.76  -3.86   0.00   0.00   0.00  61.94*
   -34     40   0.00  75.56   0.00  -9.76  -3.86   0.00   0.00   0.00  61.94
-------------------------------------------------------------------------------
    40     90   0.00  75.56   0.00  -9.76  -5.56   0.00   0.00   0.00  60.24
-------------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 64.18 dBA

Total Leq All Segments: 64.18 dBA
```

```
RT/Custom data, segment # 1: LRT (day/night)
-----------------------------------------
1 - 4-car SRT:
Traffic volume    :   540/60    veh/TimePeriod
Speed             :    70 km/h

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2           : -27.00 deg   74.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  68.00 / 68.00  m
Receiver height           :  86.50 / 86.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


Results segment # 1: LRT (day)
------------------------------

Source height = 0.50 m

RT/Custom (0.00 + 54.36 + 0.00) = 54.36 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -27     74   0.00  63.44  -6.56  -2.51   0.00   0.00   0.00  54.36
-------------------------------------------------------------------------

Segment Leq : 54.36 dBA

Total Leq All Segments: 54.36 dBA


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

Source height = 0.50 m

RT/Custom (0.00 + 47.83 + 0.00) = 47.83 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -27     74   0.00  56.91  -6.56  -2.51   0.00   0.00   0.00  47.83
-------------------------------------------------------------------------

Segment Leq : 47.83 dBA

Total Leq All Segments: 47.83 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 71.86
                           (NIGHT): 64.28
```

```
STAMSON 5.0        NORMAL REPORT        Date: 04-09-2019 14:52:04
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r8.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Blair (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  :    70 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: Blair (day/night)
---------------------------------------
Angle1   Angle2           : -54.00 deg   -32.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 159.00 / 159.00 m
Receiver height           :  86.50 / 86.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

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

Source height = 1.50 m

ROAD (0.00 + 54.94 + 0.00) = 54.94 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -54    -32   0.00  74.33   0.00 -10.25  -9.13   0.00   0.00   0.00  54.94
-------------------------------------------------------------------------------

Segment Leq : 54.94 dBA

Total Leq All Segments: 54.94 dBA


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

Source height = 1.50 m

ROAD (0.00 + 47.35 + 0.00) = 47.35 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -54    -32   0.00  66.73   0.00 -10.25  -9.13   0.00   0.00   0.00  47.35
-------------------------------------------------------------------------------

Segment Leq : 47.35 dBA

Total Leq All Segments: 47.35 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 54.94
                           (NIGHT): 47.35
```

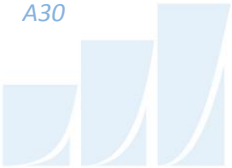
```
STAMSON 5.0        NORMAL REPORT        Date: 04-09-2019 14:52:10
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r9.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: 174 (day/night)
----------------------------------------
Car traffic volume  : 89056/7744  veh/TimePeriod  *
Medium truck volume :  7084/616   veh/TimePeriod  *
Heavy truck volume  :  5060/440   veh/TimePeriod  *
Posted speed limit  :   100 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): 110000
    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: 174 (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  : 139.00 / 139.00 m
Receiver height           :  23.50 / 23.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :  22.00 m
Barrier receiver distance :  12.00 / 12.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 2: Blair (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  :    70 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: Blair (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  : 199.00 / 199.00 m
Receiver height           :  23.50 / 23.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :   0.00 deg   Angle2 : 90.00 deg
Barrier height            :  22.00 m
Barrier receiver distance :  22.00 / 22.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: 174 (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 !       23.50 !       21.60 !        21.60

ROAD (0.00 + 68.26 + 0.00) = 68.26 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  83.16   0.00  -9.67   0.00   0.00   0.00  -5.23  68.26
-------------------------------------------------------------------------------

Segment Leq : 68.26 dBA


Results segment # 2: Blair (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 !       23.50 !       21.07 !        21.07

ROAD (0.00 + 54.41 + 0.00) = 54.41 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
     0     90   0.00  74.33   0.00 -11.23  -3.01   0.00   0.00  -5.68  54.41
-------------------------------------------------------------------------------

Segment Leq : 54.41 dBA

Total Leq All Segments: 68.44 dBA


Results segment # 1: 174 (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 !       23.50 !       21.60 !        21.60

ROAD (0.00 + 60.66 + 0.00) = 60.66 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  75.56   0.00  -9.67   0.00   0.00   0.00  -5.23  60.66
-------------------------------------------------------------------------------

Segment Leq : 60.66 dBA
```


```
Results segment # 2: Blair (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 !       23.50 !       21.07 !        21.07

ROAD (0.00 + 46.81 + 0.00) = 46.81 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
     0     90   0.00  66.73   0.00 -11.23  -3.01   0.00   0.00  -5.68  46.81
-------------------------------------------------------------------------------

Segment Leq : 46.81 dBA

Total Leq All Segments: 60.84 dBA


RT/Custom data, segment # 1: LRT (day/night)
--------------------------------------------
1 - 4-car SRT:
Traffic volume    :   540/60    veh/TimePeriod
Speed             :    70 km/h

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2           : -43.00 deg   73.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  67.00 / 67.00  m
Receiver height           :  23.50 / 23.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -43.00 deg   Angle2 : 73.00 deg
Barrier height            :  22.00 m
Barrier receiver distance :  11.00 / 11.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

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

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       0.50 !       23.50 !       19.72 !        19.72

RT/Custom (0.00 + 44.19 + 0.00) = 44.19 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -43     73   0.00  63.44  -6.50  -1.91   0.00   0.00 -10.84  44.19
-------------------------------------------------------------------------

Segment Leq : 44.19 dBA

Total Leq All Segments: 44.19 dBA


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

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       0.50 !       23.50 !       19.72 !        19.72

RT/Custom (0.00 + 37.66 + 0.00) = 37.66 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -43     73   0.00  56.91  -6.50  -1.91   0.00   0.00 -10.84  37.66
-------------------------------------------------------------------------

Segment Leq : 37.66 dBA

Total Leq All Segments: 37.66 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 68.45
                           (NIGHT): 60.86
```

```
STAMSON 5.0        NORMAL REPORT        Date: 04-09-2019 14:52:16
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r9b.te              Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: 174 (day/night)
----------------------------------------
Car traffic volume  : 89056/7744  veh/TimePeriod  *
Medium truck volume :  7084/616   veh/TimePeriod  *
Heavy truck volume  :  5060/440   veh/TimePeriod  *
Posted speed limit  :   100 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): 110000
    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: 174 (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  : 139.00 / 139.00 m
Receiver height           :  23.50 / 23.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :  23.50 m
Barrier receiver distance :  12.00 / 12.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 2: Blair (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  :    70 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: Blair (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  : 199.00 / 199.00 m
Receiver height           :  23.50 / 23.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :   0.00 deg   Angle2 : 90.00 deg
Barrier height            :  23.50 m
Barrier receiver distance :  22.00 / 22.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: 174 (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 !       23.50 !       21.60 !        21.60

ROAD (0.00 + 65.10 + 0.00) = 65.10 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  83.16   0.00  -9.67   0.00   0.00   0.00  -8.39  65.10
-------------------------------------------------------------------------------

Segment Leq : 65.10 dBA


Results segment # 2: Blair (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 !       23.50 !       21.07 !        21.07

ROAD (0.00 + 51.86 + 0.00) = 51.86 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
     0     90   0.00  74.33   0.00 -11.23  -3.01   0.00   0.00  -8.22  51.86
-------------------------------------------------------------------------------

Segment Leq : 51.86 dBA

Total Leq All Segments: 65.30 dBA


Results segment # 1: 174 (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 !       23.50 !       21.60 !        21.60

ROAD (0.00 + 57.51 + 0.00) = 57.51 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  75.56   0.00  -9.67   0.00   0.00   0.00  -8.39  57.51
-------------------------------------------------------------------------------

Segment Leq : 57.51 dBA
```

```
Results segment # 2: Blair (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 !       23.50 !       21.07 !        21.07

ROAD (0.00 + 44.27 + 0.00) = 44.27 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
     0     90   0.00  66.73   0.00 -11.23  -3.01   0.00   0.00  -8.22  44.27
-------------------------------------------------------------------------------

Segment Leq : 44.27 dBA

Total Leq All Segments: 57.71 dBA


RT/Custom data, segment # 1: LRT (day/night)
--------------------------------------------
1 - 4-car SRT:
Traffic volume    :   540/60    veh/TimePeriod
Speed             :    70 km/h

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2           : -43.00 deg   73.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  67.00 / 67.00  m
Receiver height           :  23.50 / 23.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -43.00 deg   Angle2 : 73.00 deg
Barrier height            :  23.50 m
Barrier receiver distance :  11.00 / 11.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00


Results segment # 1: LRT (day)
------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       0.50 !       23.50 !       19.72 !        19.72

RT/Custom (0.00 + 40.18 + 0.00) = 40.18 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------
   -43     73   0.00  63.44  -6.50  -1.91   0.00   0.00 -14.85  40.18
-------------------------------------------------------------------

Segment Leq : 40.18 dBA

Total Leq All Segments: 40.18 dBA
```

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

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       0.50 !       23.50 !       19.72 !        19.72

RT/Custom (0.00 + 33.64 + 0.00) = 33.64 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -43     73   0.00  56.91  -6.50  -1.91   0.00   0.00 -14.85  33.64
-------------------------------------------------------------------------

Segment Leq : 33.64 dBA

Total Leq All Segments: 33.64 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 65.31
                           (NIGHT): 57.73
```

```
STAMSON 5.0         NORMAL REPORT         Date: 04-09-2019 14:52:21
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r9b2.te              Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: 174 (day/night)
----------------------------------------
Car traffic volume  : 89056/7744  veh/TimePeriod  *
Medium truck volume :  7084/616   veh/TimePeriod  *
Heavy truck volume  :  5060/440   veh/TimePeriod  *
Posted speed limit  :   100 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): 110000
    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: 174 (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  : 139.00 / 139.00 m
Receiver height           :  23.50 / 23.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :  27.00 m
Barrier receiver distance :  12.00 / 12.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 2: Blair (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  :    70 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: Blair (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  : 199.00 / 199.00 m
Receiver height           :  23.50 / 23.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :   0.00 deg   Angle2 : 90.00 deg
Barrier height            :  27.00 m
Barrier receiver distance :  22.00 / 22.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: 174 (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 !       23.50 !       21.60 !        21.60

ROAD (0.00 + 58.99 + 0.00) = 58.99 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  83.16   0.00  -9.67   0.00   0.00   0.00 -14.50  58.99
-------------------------------------------------------------------------------

Segment Leq : 58.99 dBA


Results segment # 2: Blair (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 !       23.50 !       21.07 !        21.07

ROAD (0.00 + 46.90 + 0.00) = 46.90 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
     0     90   0.00  74.33   0.00 -11.23  -3.01   0.00   0.00 -13.18  46.90
-------------------------------------------------------------------------------

Segment Leq : 46.90 dBA

Total Leq All Segments: 59.25 dBA
```

```
Results segment # 1: 174 (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 !       23.50 !       21.60 !        21.60

ROAD (0.00 + 51.39 + 0.00) = 51.39 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  75.56   0.00  -9.67   0.00   0.00   0.00 -14.50  51.39
-------------------------------------------------------------------------------

Segment Leq : 51.39 dBA


Results segment # 2: Blair (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 !       23.50 !       21.07 !        21.07

ROAD (0.00 + 39.31 + 0.00) = 39.31 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
     0     90   0.00  66.73   0.00 -11.23  -3.01   0.00   0.00 -13.18  39.31
-------------------------------------------------------------------------------

Segment Leq : 39.31 dBA

Total Leq All Segments: 51.65 dBA
```

```
RT/Custom data, segment # 1: LRT (day/night)
-----------------------------------------
1 - 4-car SRT:
Traffic volume    :   540/60    veh/TimePeriod
Speed             :    70 km/h

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2          : -43.00 deg   73.00 deg
Wood depth               :      0       (No woods.)
No of house rows         :      0 / 0
Surface                  :      2       (Reflective ground surface)
Receiver source distance :  67.00 / 67.00  m
Receiver height          :  23.50 / 23.50  m
Topography               :      2       (Flat/gentle slope; with barrier)
Barrier angle1           : -43.00 deg   Angle2 : 73.00 deg
Barrier height           :  27.00 m
Barrier receiver distance :  11.00 / 11.00  m
Source elevation         :   0.00 m
Receiver elevation       :   0.00 m
Barrier elevation        :   0.00 m
Reference angle          :   0.00
```

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

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       0.50 !       23.50 !       19.72 !        19.72

RT/Custom (0.00 + 35.39 + 0.00) = 35.39 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -43     73   0.00  63.44  -6.50  -1.91   0.00   0.00 -19.64  35.39
-------------------------------------------------------------------------

Segment Leq : 35.39 dBA

Total Leq All Segments: 35.39 dBA


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

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       0.50 !       23.50 !       19.72 !        19.72

RT/Custom (0.00 + 28.86 + 0.00) = 28.86 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -43     73   0.00  56.91  -6.50  -1.91   0.00   0.00 -19.64  28.86
-------------------------------------------------------------------------

Segment Leq : 28.86 dBA

Total Leq All Segments: 28.86 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 59.27
                           (NIGHT): 51.67
```

APPENDIX B

FTA VIBRATION CALCULATIONS

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

GME19-109 11-Sep-19

Possible Vibration Impacts
Predicted using FTA General Assesment

Train Speed 70 km/h 43.5 mph

	Distance from C/L	
	(m)	(ft)
LRT	52.0	170.6

Vibration

From FTA Manual Fig 10-1

Vibration Levels at distance from track	63	dBV re 1 micro in/sec

Adjustment Factors FTA Table 10-1

Speed reference 50 mph	-1	Speed Limit of 70 km/h (43.5 mph)
Vehicle Parameters	0	Assume Soft primary suspension, Weels run true
Track Condition	0	None
Track Treatments	0	None
Type of Transit Structure	-5	Station
Efficient vibration Propagation	0	Propagation through rock
Vibration Levels at Fdn	57	
Coupling to Building Foundation	-10	Large masonry on piles
Floor to Floor Attenuation	-2.0	Ground Floor Ocupied
Amplification of Floor and Walls	6	
Total Vibration Level	50.8	dBV or 0.009 mm/s
Noise Level in dBA	15.8	dBA

Table 10-1. Adjustment Factors for Generalized Predictions of Ground-Borne Vibration and Noise

Factors Affecting Vibration Source

Source Factor	Adjustment to Propagation Curve			Comment
Speed		Reference Speed		Vibration level is approximately proportional to 20*log(speed/speed$_{ref}$). Sometimes the variation with speed has been observed to be as low as 10 to 15 log(speed/speed$_{ref}$).
	Vehicle Speed	50 mph	30 mph	
	60 mph	+1.6 dB	+6.0 dB	
	50 mph	0.0 dB	+4.4 dB	
	40 mph	-1.9 dB	+2.5 dB	
	30 mph	-4.4 dB	0.0 dB	
	20 mph	-8.0 dB	-3.5 dB	
Vehicle Parameters (not additive, apply greatest value only)				
Vehicle with stiff primary suspension	+8 dB			Transit vehicles with stiff primary suspensions have been shown to create high vibration levels. Include this adjustment when the primary suspension has a vertical resonance frequency greater than 15 Hz.
Resilient Wheels	0 dB			Resilient wheels do not generally affect ground-borne vibration except at frequencies greater than about 80 Hz.
Worn Wheels or Wheels with Flats	+10 dB			Wheel flats or wheels that are unevenly worn can cause high vibration levels. This can be prevented with wheel truing and slip-slide detectors to prevent the wheels from sliding on the track.
Track Conditions (not additive, apply greatest value only)				
Worn or Corrugated Track	+10 dB			If both the wheels and the track are worn, only one adjustment should be used. Corrugated track is a common problem. Mill scale on new rail can cause higher vibration levels until the rail has been in use for some time.
Special Trackwork	+10 dB			Wheel impacts at special trackwork will significantly increase vibration levels. The increase will be less at greater distances from the track.
Jointed Track or Uneven Road Surfaces	+5 dB			Jointed track can cause higher vibration levels than welded track. Rough roads or expansion joints are sources of increased vibration for rubber-tire transit.
Track Treatments (not additive, apply greatest value only)				
Floating Slab Trackbed	-15 dB			The reduction achieved with a floating slab trackbed is strongly dependent on the frequency characteristics of the vibration.
Ballast Mats	-10 dB			Actual reduction is strongly dependent on frequency of vibration.
High-Resilience Fasteners	-5 dB			Slab track with track fasteners that are very compliant in the vertical direction can reduce vibration at frequencies greater than 40 Hz.

Table 10-1. Adjustment Factors for Generalized Predictions of Ground-Borne Vibration and Noise (Continued)

Factors Affecting Vibration Path

Path Factor	Adjustment to Propagation Curve	Comment
Resiliently Supported Ties	-10 dB	Resiliently supported tie systems have been found to provide very effective control of low-frequency vibration.
Track Configuration (not additive, apply greatest value only)		
Type of Transit Structure	Relative to at-grade tie & ballast: Elevated structure -10 dB Open cut 0 dB	The general rule is the heavier the structure, the lower the vibration levels. Putting the track in cut may reduce the vibration levels slightly. Rock-based subways generate higher-frequency vibration.
	Relative to bored subway tunnel in soil: Station -5 dB Cut and cover -3 dB Rock-based - 15 dB	
Ground-borne Propagation Effects		
Geologic conditions that promote efficient vibration propagation	Efficient propagation in soil +10 dB	Refer to the text for guidance on identifying areas where efficient propagation is possible.
	Propagation in rock layer: Dist. / Adjust. 50 ft +2 dB 100 ft +4 dB 150 ft +6 dB 200 ft +9 dB	The positive adjustment accounts for the lower attenuation of vibration in rock compared to soil. It is generally more difficult to excite vibrations in rock than in soil at the source.
Coupling to building foundation	Wood Frame Houses -5 dB 1-2 Story Masonry -7 dB 3-4 Story Masonry -10 dB Large Masonry on Piles -10 dB Large Masonry on Spread Footings -13 dB Foundation in Rock 0 dB	The general rule is the heavier the building construction, the greater the coupling loss.

Factors Affecting Vibration Receiver

Receiver Factor	Adjustment to Propagation Curve	Comment
Floor-to-floor attenuation	1 to 5 floors above grade: -2 dB/floor 5 to 10 floors above grade: -1 dB/floor	This factor accounts for dispersion and attenuation of the vibration energy as it propagates through a building.
Amplification due to resonances of floors, walls, and ceilings	+6 dB	The actual amplification will vary greatly depending on the type of construction. The amplification is lower near the wall/floor and wall/ceiling intersections.
Conversion to Ground-borne Noise		
Noise Level in dBA	Peak frequency of ground vibration: Low frequency (<30 Hz): -50 dB Typical (peak 30 to 60 Hz): -35 dB High frequency (>60 Hz): -20 dB	Use these adjustments to estimate the A-weighted sound level given the average vibration velocity level of the room surfaces. See text for guidelines for selecting low, typical or high frequency characteristics. Use the high-frequency adjustment for subway tunnels in rock or if the dominant frequencies of the vibration spectrum are known to be 60 Hz or greater.