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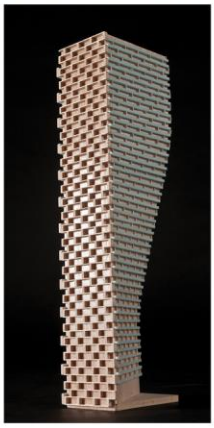
TRANSPORTATION NOISE & VIBRATION FEASIBILITY ASSESSMENT

400 Coventry Road
Ottawa, Ontario

Report: 22-272- Traffic Noise and Vibration Feasibility



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EXECUTIVE SUMMARY

This report describes a transportation noise and vibration feasibility assessment undertaken to satisfy the requirements for Zoning By-Law Amendment (ZBA) application for the proposed multi-building residential development located at 400 Coventry Road in Ottawa, Ontario. The primary sources of transportation traffic noise are the Queensway, Coventry Road, Belfast Road, and the Confederation Line Light Rail Transitway (LRT). As the site is in proximity to the Ottawa-Carleton Regional Transit Commission (OC Transpo) LRT Confederation Line, a ground vibration impact assessment from the LRT system on the development was conducted following the procedures outlined in the Federal Transit Authorities (FTA) protocol. Figure 1 illustrates a complete site plan with surrounding context.

The assessment is based on (i) theoretical noise prediction methods that conform to the Ministry of the Environment, Conservation and Parks (MECP) NPC-300, Ministry of Transportation Ontario (MTO), and City of Ottawa Environmental Noise Control Guidelines (ENCG) guidelines; (ii) future vehicular traffic volumes corresponding to roadway classification, roadway traffic volumes obtained from the City of Ottawa, and LRT information from Gradient Wind's previous experience; (iii) architectural drawings provided by NEUF architect(e)s, in October 2022; and (iv) ground borne vibration criteria as specified by the Federal Transit Authority (FTA) Protocol.

The results of the current analysis indicate that POW noise levels will range between 57 and 79 dBA during the daytime period (07:00-23:00) and between 49 and 71 dBA during the nighttime period (23:00-07:00). The highest noise level (79 dBA) occurs at the south façades of Tower B and Tower C1, which are nearest and most exposed to the Queensway.

Upgraded building components will be required for all towers in this development as noise levels predicted due to transportation traffic exceed the criteria of 65 dBA during the daytime as listed in ENCG. Due to the limited information available at the time of the study, which was prepared for a ZBA application submission, detailed STC calculations could not be performed at this time. 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 each building.

Results of the calculations also indicate that all towers included in this 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 Clause Type D will also be required on all Lease, Purchase and Sale Agreements for all buildings.

The results also indicate that noise levels at the podium roofs are expected to be between 42 dBA and 68 dBA. The noise levels exceed NPC-300 criteria for OLAs at the podium roofs of Towers A/B, C1, C2, and D. If these areas are to be configured as outdoor amenity areas, it is recommended that they be positioned away from the transportation noise sources, with intermediate building massing where feasible, to reduce noise levels. Furthermore, noise barriers or perimeter guards can be used to reduce noise levels to limits defined in the NPC-300. If the need arises for OLA noise mitigation, this can be addressed during the site plan control application.

Estimated vibration levels at the foundation nearest to the OC Transpo LRT Confederation Line are expected to be 0.017 mm/s RMS (57 dBV), based on the FTA protocol and an offset distance of 74 m to the nearest track centerline. Details of the calculation are provided in Appendix B. Since predicted vibration levels do not exceed the criterion of 0.14 mm/s RMS at the foundation, concerns due to vibration impacts on the site are not expected. As vibration levels are acceptable, correspondingly, regenerated noise levels are also expected to be acceptable.

With regard to stationary noise impacts, a stationary noise study is recommended for the site during the detailed design once mechanical plans become available. This study would assess impacts of stationary noise from rooftop mechanical units serving the proposed block onto surrounding noise sensitive areas. This study will include recommendations for any noise control measures that may be necessary to ensure noise levels fall below NPC-300 limits. As the mechanical equipment is expected to reside primarily in the mechanical level located on the high roof on each building, noise levels on the surrounding noise sensitive properties are expected to be negligible. In the event that noise levels exceed the NPC-300 criteria, noise impacts can generally be minimized by judicious selection and placement of the equipment.

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1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by 400 Coventry Investments Inc. to undertake a transportation noise and vibration feasibility assessment, to satisfy the requirements for Zoning By-Law Amendment (ZBA) application submission for the proposed development located at 400 Coventry Road in Ottawa, Ontario. This report summarizes the methodology, results, and recommendations related to the assessment of exterior noise and vibration levels generated by local transportation traffic.

This assessment is based on theoretical noise calculation methods conforming to the Ministry of the Environment, Conservation and Parks (MECP) NPC-300[1], Ministry of Transportation Ontario (MTO)[2], and City of Ottawa Environmental Noise Control Guidelines (ENCG)[3] guidelines. Noise calculations were based on architectural drawings provided by NEUF architect(e)s, in October 2022, with future traffic volumes corresponding to roadway classification and theoretical roadway capacities, and recent satellite imagery.

2. TERMS OF REFERENCE

The subject site is located at 400 Coventry Road in Ottawa; situated at the southwest intersection of Coventry Road and Belfast Road and bordered by Highway 417 to the south and existing low-rise commercial buildings and parking lots to the west. A central east-west laneway is proposed to extend from Belfast Road to the existing parking lots.

Architectural Rendering, Northwest Perspective (Courtesy of NEUF architect(e)s)

The proposed development comprises seven nominally rectangular towers; beginning from the west and rotating counter-clockwise around the site, the towers are referred to as Tower A, B, C1, C2, D, E1, and E2. Tower A, B, C1 and C2 are situated to

[1] Ontario Ministry of the Environment and Climate Change – Environmental Noise Guidelines, Publication NPC-300, Queens Printer for Ontario, Toronto, 2013
[2] Ministry of Transportation Ontario, "*Environmental Guide for Noise*", August 2021
[3] City of Ottawa Environmental Noise Control Guidelines, January 2016

the south of the central laneway and share two below-grade parking levels. Tower D, E1, and E2 are situated to the north of the central laneway and share two below-grade parking levels. A parkland is situated to the west of the subject site, bordered by Tower E2 to the north, Tower D to the east, the central laneway to the south, and the existing parking lot to the west.

Tower A (23 storeys) and Tower B (30 storeys) share a common six-storey podium. Above below-grade parking, the ground floor of the shared podium includes a main entrance and drop off zone to the east, elevator core to the south, residential units from the southeast corner clockwise to the west, elevator core to the north, and lobby/indoor amenity from the northwest corner clockwise to the east. Surface parking is provided along the south side of the central laneway and along the laneway situated in between Tower A and Tower C2. Access to below-grade parking (shared by Tower A, B, C1 and C2) is provided by a ramp at the northwest corner of the shared podium via the central laneway from Belfast Road. Levels 2-23 of Tower A and Levels 2-30 of Tower B are reserved for residential use.

Tower C1 (27 storeys) and Tower C2 (27 storeys) share a common six-storey podium. Above below-grade parking, the ground floor of the shared podium includes a main entrance and drop off zone to the west, lobby/indoor amenity from the west clockwise to the northeast, elevator core to the north, residential units from the northeast corner clockwise to the southwest corner, and elevator core to the south. Levels 2-27 of Tower C1 and Tower C2 are reserved for residential use. A floorplate setback is situated to the west at Level 4.

Tower D (25 storeys) rises above a six-storey podium. Above below-grade parking, Tower D comprises a near rectangular planform with insets at the northwest and northeast corners, and includes a main entrance to the north, residential units from the northeast clockwise to the southeast, a main entrance and lobby/indoor amenity to the south, residential units from the southwest clockwise to the northwest, and a central elevator core. Levels 2-25 are reserved for residential use. A floorplate setback is situated to the north at Level 4 and in all compass directions at Level 7.

Tower E1 (20 storeys) and Tower E2 (18 storeys) share a common six-storey podium. Above below-grade parking, the ground floor of the shared podium includes retail space to the north, main entrance, lobby/indoor amenity, and elevator core to the east, townhouse units to the south, and lobby/indoor amenity and elevator core to the west with main entrances at the southwest and northwest corners.

Levels 2-20 of Tower E1 and Levels 2-18 of Tower E1 are reserved for residential use. Floorplate setbacks are situated to the north at Level 2 and to the south at Level 3.

The shortest distance between the podium serving Towers A and B and the podium serving Towers C1 and C2 is approximately 18.4 metres (m). The shortest distance between the podium serving Tower C1 and Tower C2 and the podium serving Tower D is approximately 19.3 m, while the shortest distance between Tower C2 and Tower D above the podia is approximately 25.1 m. The shortest distance between the podium serving Tower D and the podium serving Tower E1 and Tower E2 is approximately 13.2 m. The shortest distance between Tower A and Tower B, between Tower C1 and Tower C2, between Tower D and Tower E1, and between Tower E1 and Tower E2 above the podia is approximately 24 m.

The near-field surroundings, defined as an area within 200-m of the subject site, include low-rise commercial buildings from the west clockwise to the east, with parking lots to the west, Presland Park approximately 150 m to the north, and Highway 417 extending from the southeast to the southwest.

The primary source of ground borne vibration is the OC Transpo LRT line located to the south of the subject site. As per the City of Ottawa's Official Plan, the LRT system is situated within 75 m from the nearest property line. As a result, a ground vibration impact assessment from the underground LRT system on the proposed development was conducted following the procedures outlined in the Federal Transit Authorities (FTA) protocol. Airborne noise transmission from the LRT onto the development was considered in this assessment as the segment considered is located above ground.

At the time of the Site Plan Control application (SPA), an updated detailed transportation noise assessment would be conducted, if necessary. Based on noise levels at the building façades, the update will include an evaluation of indoor noise levels for comparison against indoor noise criteria. This would be performed for a typical unit, assuming building wall details satisfy the minimum Ontario Building Code (OBC) requirements. For areas where the indoor noise criteria are not met, construction details such as the required sound transmission class (STC) rating for windows would be specified to ensure comfort of indoor living areas. Furthermore, ventilation requirements and warning clauses will be provided.

With regard to stationary noise impacts, a stationary noise study is recommended for the site during the detailed design once mechanical plans become available. This study would assess impacts of stationary

noise from rooftop mechanical units serving the proposed block onto surrounding noise sensitive areas. This study will include recommendations for any noise control measures that may be necessary to ensure noise levels fall below NPC-300 limits. As the mechanical equipment is expected to reside primarily in the mechanical level located on the high roof on each building, noise levels on the surrounding noise sensitive properties are expected to be negligible. In the event that noise levels exceed the NPC-300 criteria, noise impacts can generally be minimized by judicious selection and placement of the equipment.

3. OBJECTIVES

The principal objectives of this study are to (i) calculate the future noise levels on the study building produced by local transportation sources, (ii) predict vibration levels on the study building produced from the LRT system, and (iii) explore potential noise mitigation where required.

4. METHODOLOGY

4.1 Background

Noise can be defined as any obtrusive sound. It is created at a source, transmitted through a medium, such as air, and intercepted by a receiver. Noise may be characterized in terms of the power of the source or the sound pressure at a specific distance. While the power of a source is characteristic of that particular source, the sound pressure depends on the location of the receiver and the path that the noise takes to reach the receiver. Measurement of noise is based on the decibel unit, dBA, which is a logarithmic ratio referenced to a standard noise level (2×10^{-5} Pascals). The 'A' suffix refers to a weighting scale, which better represents how the noise is perceived by the human ear. With this scale, a doubling of power results in a 3 dBA increase in measured noise levels and is just perceptible to most people. An increase of 10 dBA is often perceived to be twice as loud.

4.2 Roadway Traffic Noise

4.2.1 Criteria for Roadway Traffic Noise

For surface roadway traffic noise, the equivalent sound energy level, L_{eq}, provides a measure of the time varying noise levels, which is well correlated with the annoyance of sound. It is defined as the continuous sound level, which has the same energy as a time varying noise level over a period of time. For roadways, the L_{eq} is commonly calculated on the basis of a 16-hour (L_{eq16}) daytime (07:00-23:00) / 8-hour (L_{eq8})

nighttime (23:00-07:00) split to assess its impact on residential buildings. NPC-300 specifies that the recommended indoor noise limit range (that is relevant to this study) is 50, 45 and 40 dBA for retail/office/indoor amenity space, living rooms, and sleeping quarters, respectively, as listed in Table 1. However, to account for deficiencies in building construction and to control peak noise, these levels should be targeted toward 47, 42, and 37 dBA.

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

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

Predicted noise levels at the plane of window (POW) dictate the action required to achieve the recommended sound levels. An open window is considered to provide a 10 dBA reduction in noise, while a standard closed window is capable of providing a minimum 20 dBA noise reduction[5]. A closed window due to a ventilation requirement will bring noise levels down to achieve an acceptable indoor environment[6]. Therefore, where noise levels exceed 55 dBA daytime and 50 dBA nighttime, the ventilation for the building should consider the need for having windows and doors closed, which triggers the need for forced air heating with provision for central air conditioning. Where noise levels exceed 65 dBA daytime and 60 dBA nighttime, air conditioning will be required and building components will require higher levels of sound attenuation[7].

[4] MOECP, Environmental Noise Guidelines, NPC 300 – Part C, Table C-9
[5] Burberry, P.B. (2014). Mitchell's Environment and Services. Routledge, Page 125
[6] MOECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.8
[7] MOECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.1.3

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 should be provided to reduce noise levels where technically and administratively feasible to acceptable levels at or below the criterion. In this study, the podium roofs in this development were considered as outdoor amenity areas, and as such, defined as OLAs.

4.2.2 Roadway Traffic Volumes

The ENCG dictates that noise calculations should consider future sound levels based on a roadway's classification at the mature state of development. Therefore, traffic volumes are based on the roadway classifications outlined in the City of Ottawa's Official Plan (OP) and Transportation Master Plan[8] which provide additional details on future roadway expansions. Average Annual Daily Traffic (AADT) volumes are then based on data in Table B1 of the ENCG for each roadway classification. Volumes for the LRT are based on Gradient Wind's previous experience. Table 2 (below) summarizes the AADT values used for each roadway included in this assessment.

TABLE 2: TRANSPORTATION TRAFFIC DATA

Segment	Classification	Speed Limit (km/h)	Traffic Volumes
Queensway	8-Lane Highway	100	**146,664**
Coventry Road	2-Lane Urban Arterial (2-UAU)	50	**15,000**
Belfast Road	2-Lane Major Collector (2-UMCU)	40	**12,000**
Confederation Line 2	Light Rail Transit	70	**540/60***

*Daytime/Nighttime traffic volumes.

4.2.3 Theoretical Roadway Traffic 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

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

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.
- A difference in elevation for Queensway and the LRT was measured to be approximately 2 meters below grade and 3 meters below grade, respectively.
- Noise receptors were strategically placed at 20 locations around the study area (see Figure 2).
- For select sources where appropriate, receptors considered the existing buildings as a barrier partially or fully obstructing exposure to the source as illustrated by exposure angles in Figures 3-5.
- Receptor distances and exposure angles are illustrated in Figures 3-5.

4.3 Ground Vibration and 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 a 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, such as from a train or subway. 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 0.5 mm/s RMS (or 85 dBV), five 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 perception threshold level.

4.3.1 Ground Vibration Criteria

The Canadian Railway Association and Canadian Association of Municipalities have set standards for new sensitive land developments within 300 metres of a railway right-of-way, as published in their document *Guidelines for New Development in Proximity to Railway Operations*[9], which indicate 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.

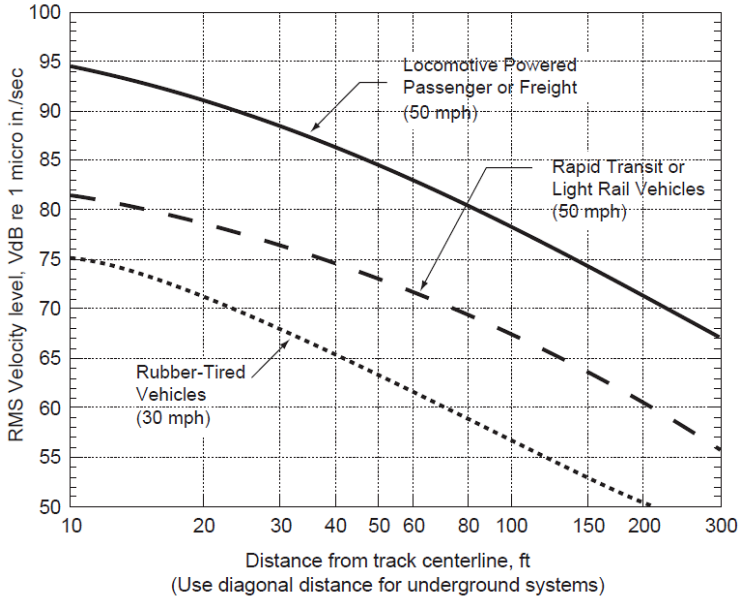
4.3.2 Theoretical Ground Vibration Prediction Procedure

Potential vibration impacts of the trains were predicted using the Federal Transit Authority's (FTA) *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 on the following page, 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 vehicle, conditions of the track, construction of the track and geology, as well as the structural type of the impacted building structures. The vibration impact on the building was determined using a set of curves

[9] Dialog and J.E. Coulter Associates Limited, prepared for The Federation of Canadian Municipalities and The Railway Association of Canada, May 2013
[10] John A. Volpe National Transportation Systems Center, Transit Noise and Vibration Impact Assessment, Federal Transit Administration, September 2018

for Rapid Transit at a speed of 50 mph. Adjustment factors were considered based on the following information:

- The maximum operating speed of the LRT line is 43 mph (70 km/h) at peak.
- The setback distance between the development and the closest track is 74 m.
- The vehicles are assumed to have soft primary suspensions.
- Tracks are not welded, though in otherwise good condition.
- Soil conditions do not efficiently propagate vibrations.
- The building's foundation will bear on bedrock.
- Type of transit structure is "Rock Based".



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

5. RESULTS

5.1 Roadway Traffic Noise Levels

The results of the roadway traffic noise calculations are summarized in Table 3 below.

TABLE 3: EXTERIOR NOISE LEVELS DUE TO ROADWAY TRAFFIC SOURCES

Receptor Number	Tower	Receptor Height Above Grade	Receptor Location	Roadway Noise Level (dBA)	
				Day	Night
R1	E1	58.5	POW – Level 20 – North Façade	69	61
R2	E1	58.5	POW – Level 20 – East Façade	66	59
R3	E1	58.5	POW – Level 20 – South Façade	58	50
R4	E2	52.5	POW – Level 18 – North Façade	67	59
R5	E2	52.5	POW – Level 18 – West Façade	62	54
R6	E2	52.5	POW – Level 18 – East Façade	62	54
R7	D	73.5	POW – Level 25 – North Façade	60	52
R8	D	73.5	POW – Level 25 – East Façade	72	64
R9	D	73.5	POW – Level 25 – South Façade	56	49
R10	C2	79.5	POW – Level 27 – North Façade	57	49
R11	C1	79.5	POW – Level 27 – East Façade	75	68
R12	C1	79.5	POW – Level 27 – South Façade	79	71
R13	C1	79.5	POW – Level 27 – West Façade	74	66
R14	B	88.5	POW – Level 30 – South Façade	79	71
R15	B	88.5	POW – Level 30 – West Façade	75	68
R16	C1/C2	19.5	OLA – Level 6 Podium	57	N/A*
R17	A/B	19.5	OLA – Level 6 Podium	57	N/A*
R18	D	19.5	OLA – Level 6 Podium	68	N/A*
R19	E1/E2	19.5	OLA – Level 6 Podium	42	N/A*
R20	A	67.5	POW – Level 23 – West Facade	71	64

*Noise levels during the nighttime are not considered for OLAs

The results of the current analysis indicate that POW noise levels will range between 57 and 79 dBA during the daytime period (07:00-23:00) and between 49 and 71 dBA during the nighttime period (23:00-07:00). The highest noise level (79 dBA) occurs at the south façades of Tower B and Tower C1, which are nearest and most exposed to Queensway.

5.1.1 Noise Control Measures

The results indicate that upgraded building components and central air conditioning will be required for all towers in this development as noise levels predicted due to roadway traffic exceed the criteria of 65 dBA during the daytime listed in ENCG. Upgraded building components will be required for building facades where noise levels exceed 65 dBA. Due to the limited information available at the time of the study, which was prepared for a ZBA application submission, detailed STC calculations could not be performed at this time. A detailed review of the window and wall assemblies should be performed by a qualified engineer with expertise in acoustics during the detailed stage of each building.

Results of the calculations also indicate that all towers included in this 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 on all Lease, Purchase and Sale Agreements for all buildings.

The results also indicate that noise levels at the podium roofs are expected to be between 42 dBA and 68 dBA. The noise levels exceed NPC-300 criteria for OLAs at the podium roofs of Towers A/B, C1, C2, and D. If these areas are to be configured as outdoor amenity areas, it is recommended that they be positioned away from the transportation noise sources, with intermediate building massing where feasible, to reduce noise levels. Furthermore, noise barriers or perimeter guards can be used to reduce noise levels to limits defined in the NPC-300. If the need arises for OLA noise mitigation, this can be addressed during site plan control.

5.2 Ground Vibrations and Ground-Borne Noise Levels

Estimated vibration levels at the foundation nearest to the OC Transpo LRT Confederation Line are expected to be 0.017 mm/s RMS (57 dBV), based on the FTA protocol and an offset distance of 74 m to the nearest track centerline. Details of the calculation are provided in Appendix B. Since predicted vibration levels do not exceed the criterion of 0.14 mm/s RMS at the foundation, concerns due to vibration

impacts on the site are not expected. As vibration levels are acceptable, correspondingly, regenerated noise levels are also expected to be acceptable.

6. CONCLUSIONS AND RECOMMENDATIONS

The results of the current analysis indicate that POW noise levels will range between 57 and 79 dBA during the daytime period (07:00-23:00) and between 49 and 71 dBA during the nighttime period (23:00-07:00). The highest noise level (79 dBA) occurs at the south façades of Tower B and Tower C1, which are nearest and most exposed to Queensway.

Upgraded building components will be required for all towers in this development as noise levels predicted due to transportation traffic exceed the criteria of 65 dBA during the daytime as listed in ENCG. Upgraded building components will be required for building facades where noise levels exceed 65 dBA. Due to the limited information available at the time of the study, which was prepared for a ZBA application submission, detailed STC calculations could not be performed at this time. A detailed review of the window and wall assemblies should be performed by a qualified engineer with expertise in acoustics during the detailed stage of each building.

Results of the calculations also indicate that all towers included in this 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 Clause Type D will also be required on all Lease, Purchase and Sale Agreements for all buildings, as summarized below:

Type D:

> *"This dwelling unit has been supplied with a central air conditioning system which will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the sound level limits of the Municipality and the Ministry of the Environment."*

As the development is adjacent to a LRT line and station, the Rail Construction Program Office recommends that the warning clause identified below be included in all Lease, Purchase and Sale Agreements.

> *"The Owner hereby acknowledges and agrees:*

i) *The proximity of the proposed development of the lands described in Schedule "A" hereto (the "Lands") to the City's existing and future transit operations, may result in noise, vibration, electromagnetic interferences, stray current transmissions, smoke and particulate matter (collectively referred to as "Interferences") to the development;*

ii) *It has been advised by the City to apply reasonable attenuation measures with respect to the level of the Interferences on and within the Lands and the proposed development; and*

iii) *The Owner acknowledges and agrees all agreements of purchase and sale and lease agreements, and all information on all plans and documents used for marketing purposes, for the whole or any part of the subject lands, shall contain the following clauses which shall also be incorporated in all transfer/deeds and leases from the Owner so that the clauses shall be covenants running with the lands for the benefit of the owner of the adjacent road:*

'The Transferee/Lessee for himself, his heirs, executors, administrators, successors and assigns acknowledges being advised that a public transit light-rail rapid transit system (LRT) is proposed to be located in proximity to the subject lands, and the construction, operation and maintenance of the LRT may result in environmental impacts including, but not limited to noise, vibration, electromagnetic interferences, stray current transmissions, smoke and particulate matter (collectively referred to as the Interferences) to the subject lands. The Transferee/Lessee acknowledges and agrees that despite the inclusion of noise control features within the subject lands, Interferences may continue to be of concern, occasionally interfering with some activities of the occupants on the subject lands.

The Transferee covenants with the Transferor and the Lessee covenants with the Lessor that the above clauses verbatim shall be included in all subsequent lease agreements, agreements of purchase and sale and deeds conveying the lands

described herein, which covenants shall run with the lands and are for the benefit of the owner of the adjacent road.'"

The results also indicate that noise levels at the podium roofs are expected to be between 42 dBA and 68 dBA. The noise levels exceed NPC-300 criteria for OLAs at the podium roofs of Towers A/B, C1, C2, and D. If these areas are to be configured as outdoor amenity areas, it is recommended that they be positioned away from the transportation noise sources, with intermediate building massing where feasible, to reduce noise levels. Furthermore, noise barriers or perimeter guards can be used to reduce noise levels to limits defined in the NPC-300. If the need arises for OLA noise mitigation, this can be addressed during site plan control.

Estimated vibration levels at the foundation nearest to the OC Transpo LRT Confederation Line are expected to be 0.017 mm/s RMS (57 dBV), based on the FTA protocol and an offset distance of 74 m to the nearest track centerline. Details of the calculation are provided in Appendix B. Since predicted vibration levels do not exceed the criterion of 0.14 mm/s RMS at the foundation, concerns due to vibration impacts on the site are not expected. As vibration levels are acceptable, correspondingly, regenerated noise levels are also expected to be acceptable.

With regard to stationary noise impacts, a stationary noise study is recommended for the site during the detailed design once mechanical plans become available. This study would assess impacts of stationary noise from rooftop mechanical units serving the proposed block onto surrounding noise sensitive areas. This study will include recommendations for any noise control measures that may be necessary to ensure noise levels fall below NPC-300 limits. As the mechanical equipment is expected to reside primarily in the mechanical level located on the high roof on each building, noise levels on the surrounding noise sensitive properties are expected to be negligible. In the event that noise levels exceed the NPC-300 criteria, noise impacts can generally be minimized by judicious selection and placement of the equipment.

This concludes our transportation noise and vibration feasibility 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.

Essraa Alqassab, B.A.Sc
Junior Environmental Scientist

Joshua Foster, P.Eng.
Lead Engineer

Gradient Wind File 22-272- Transportation Noise and Vibration Feasibility

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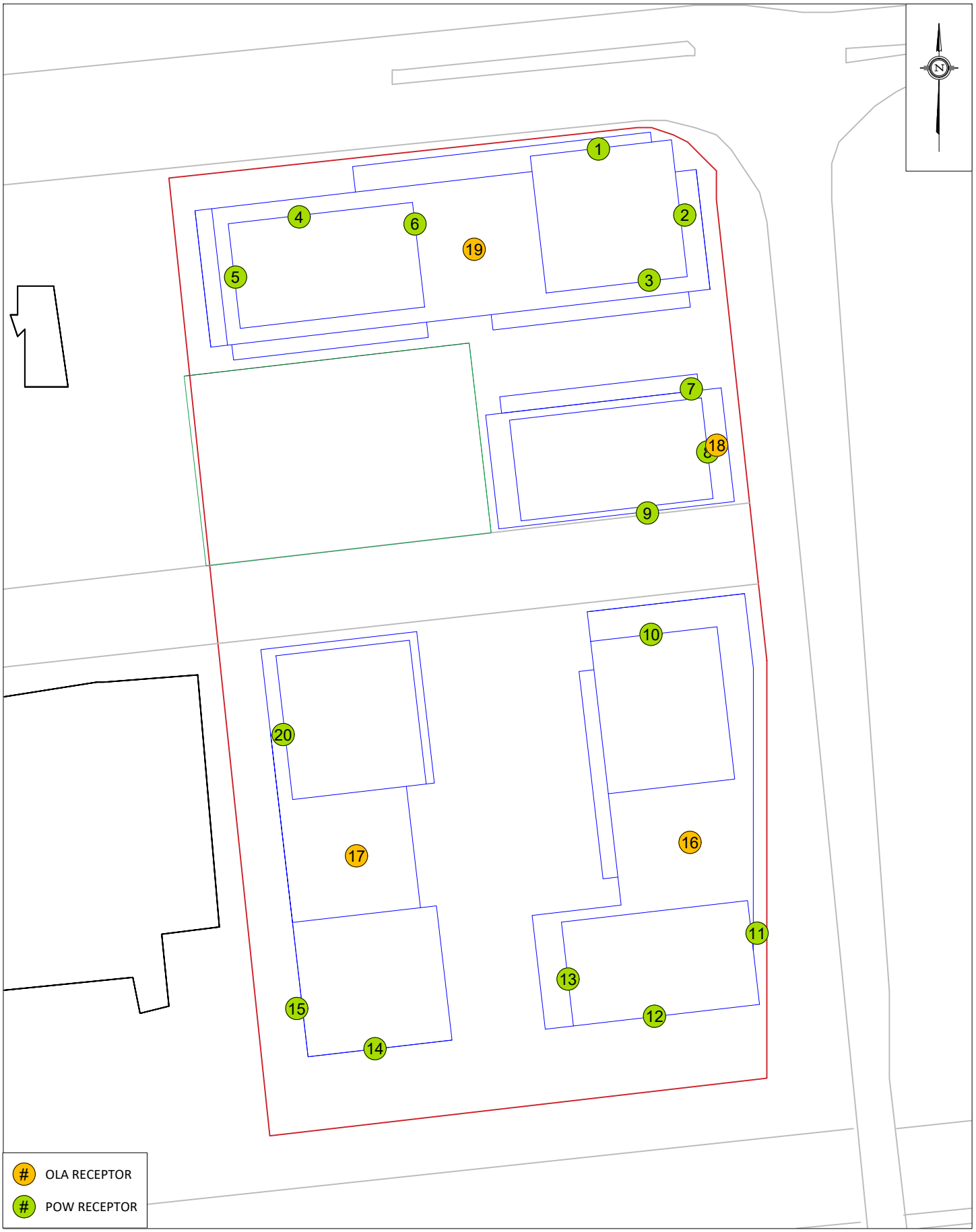
PROJECT	400 COVENTRY ROAD, OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT		
SCALE	1:4000 (APPROX.)	DRAWING NO.	GW22-272-1
DATE	SEPTEMBER 21, 2022	DRAWN BY	E.A.

DESCRIPTION

FIGURE 1:
SITE PLAN AND SURROUNDING CONTEXT



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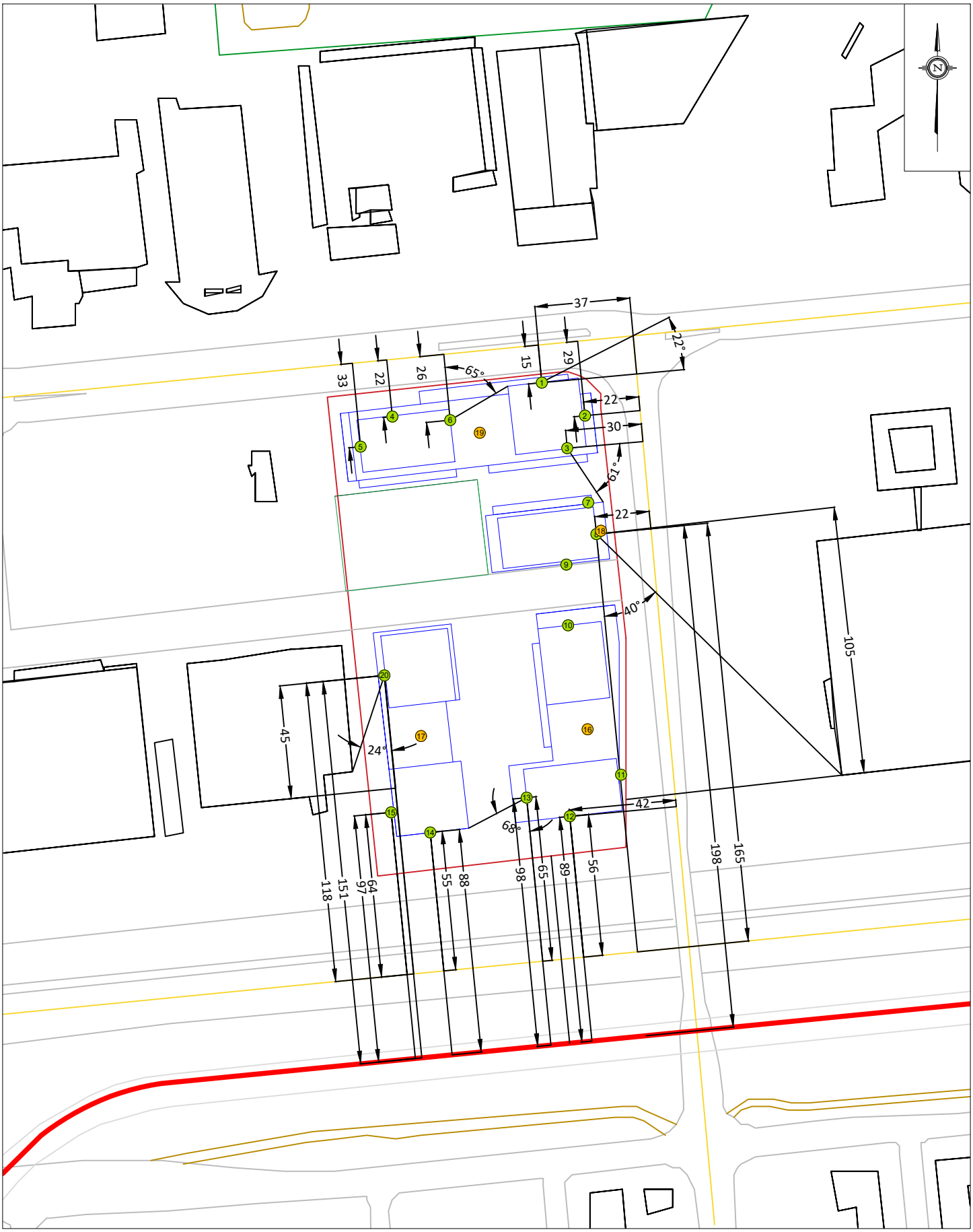
SCALE	1:1000 (APPROX.)
DRAWING NO.	GW22-272-2
DATE	SEPTEMBER 21, 2022
DRAWN BY	E.A.

DESCRIPTION

FIGURE 2:
RECEPTOR LOCATIONS



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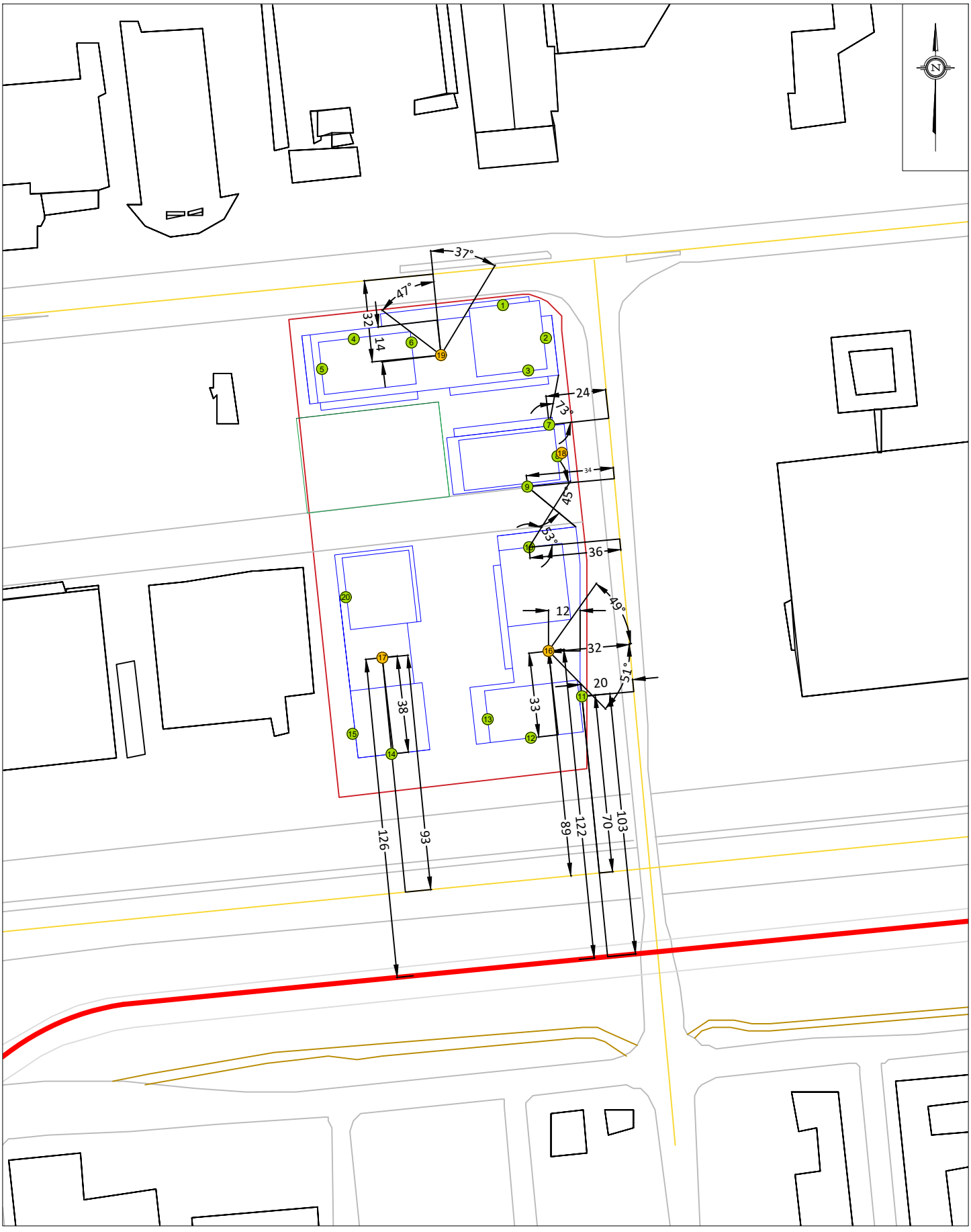
PROJECT	400 COVENTRY ROAD, OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT
SCALE	1:1000 (APPROX.)
DRAWING NO.	GW22-272-3
DATE	SEPTEMBER 21, 2022
DRAWN BY	E.A.

DESCRIPTION

FIGURE 3:
STAMSON PARAMETERS (1)



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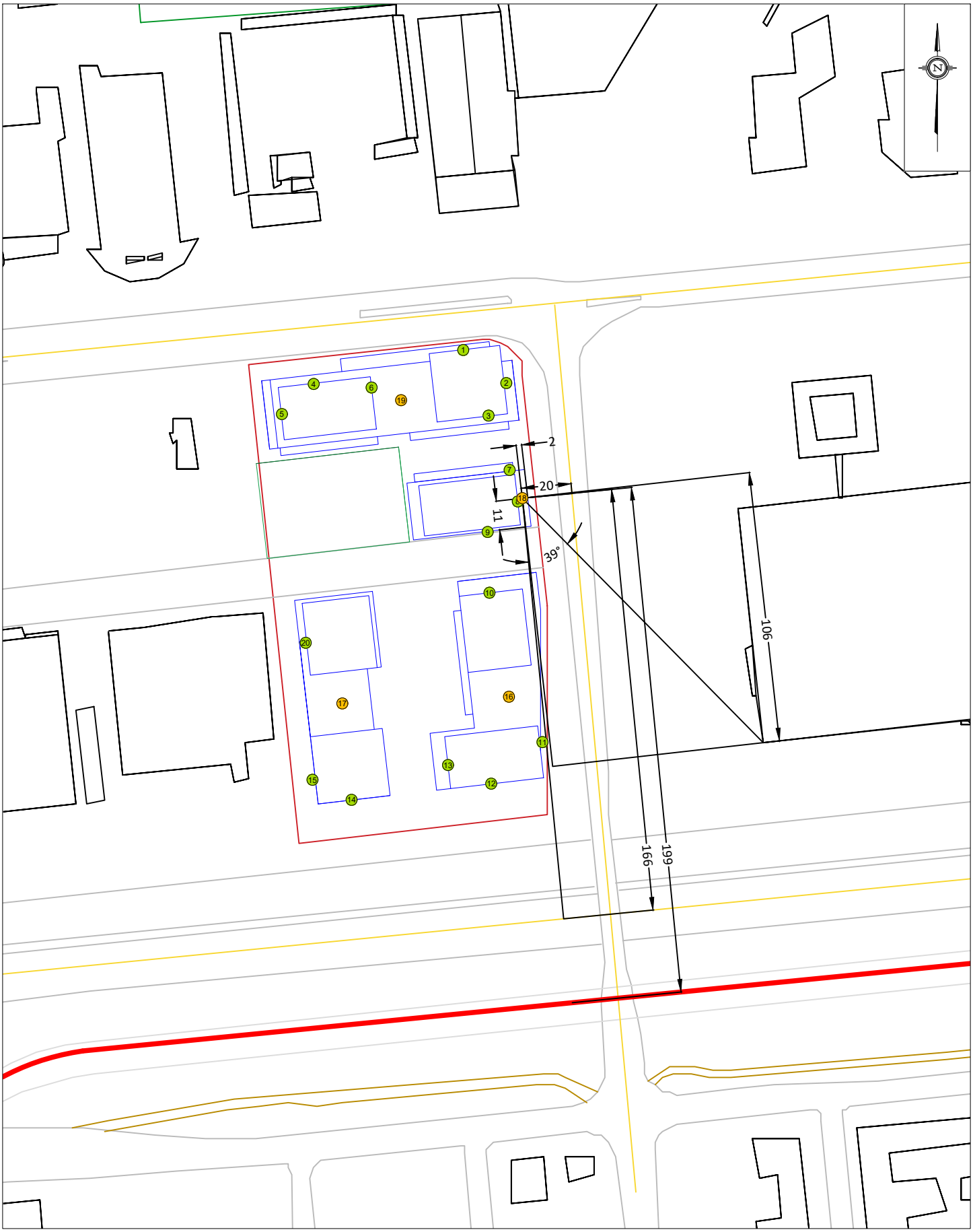
PROJECT	400 COVENTRY ROAD, OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT
SCALE	1:2000 (APPROX.)
DRAWING NO.	GW22-272-4
DATE	SEPTEMBER 21, 2022
DRAWN BY	E.A.

DESCRIPTION

FIGURE 4:
STAMSON PARAMETERS (2)



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PROJECT	400 COVENTRY ROAD, OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT
SCALE	1:2000 (APPROX.)
DRAWING NO.	GW22-272-5
DATE	SEPTEMBER 21, 2022
DRAWN BY	E.A.

DESCRIPTION

FIGURE 5:
STAMSON PARAMETERS (3)

APPENDIX A

STAMSON 5.04 – INPUT AND OUTPUT DATA

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

```
STAMSON 5.0         NORMAL REPORT         Date: 20-09-2022 15:13:02
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Coventry (day/night)
---------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Coventry (day/night)
-------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  15.00 / 15.00  m
Receiver height           :  58.50 / 58.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


Road data, segment # 2: Belfast (day/night)
---------------------------------------------
Car traffic volume  :  9715/845   veh/TimePeriod  *
Medium truck volume :   773/67    veh/TimePeriod  *
Heavy truck volume  :   552/48    veh/TimePeriod  *
Posted speed limit  :    40 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  12000
    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: Belfast (day/night)
-----------------------------------------
Angle1   Angle2           : -22.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  37.00 / 37.00  m
Receiver height           :  58.50 / 58.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


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

Source height = 1.50 m

ROAD (0.00 + 68.48 + 0.00) = 68.48 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  68.48   0.00   0.00   0.00   0.00   0.00   0.00  68.48
-------------------------------------------------------------------------------

Segment Leq : 68.48 dBA


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

Source height = 1.50 m

ROAD (0.00 + 52.67 + 0.00) = 52.67 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -22      0   0.00  65.72   0.00  -3.92  -9.13   0.00   0.00   0.00  52.67
-------------------------------------------------------------------------------

Segment Leq : 52.67 dBA

Total Leq All Segments: 68.59 dBA


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

Source height = 1.50 m

ROAD (0.00 + 60.88 + 0.00) = 60.88 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  60.88   0.00   0.00   0.00   0.00   0.00   0.00  60.88
-------------------------------------------------------------------------------
```

```
Segment Leq : 60.88 dBA


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

Source height = 1.50 m

ROAD (0.00 + 45.07 + 0.00) = 45.07 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -22      0   0.00  58.12   0.00  -3.92  -9.13   0.00   0.00   0.00  45.07
-------------------------------------------------------------------------------

Segment Leq : 45.07 dBA

Total Leq All Segments: 60.99 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 68.59
                           (NIGHT): 60.99
```

```
STAMSON 5.0         NORMAL REPORT         Date: 21-09-2022 10:31:55
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Belfast (day/night)
-------------------------------------------
Car traffic volume  :  9715/845   veh/TimePeriod  *
Medium truck volume :   773/67    veh/TimePeriod  *
Heavy truck volume  :   552/48    veh/TimePeriod  *
Posted speed limit  :    40 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  12000
    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: Belfast (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  :  22.00 / 22.00  m
Receiver height           :  58.50 / 58.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


Road data, segment # 2: Coventry (day/night)
--------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00
```

```
Data for Segment # 2: Coventry (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  :  29.00 / 29.00  m
Receiver height           :  58.50 / 58.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


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

Source height = 1.50 m

ROAD (0.00 + 64.05 + 0.00) = 64.05 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  65.72   0.00  -1.66   0.00   0.00   0.00   0.00  64.05
-------------------------------------------------------------------------------

Segment Leq : 64.05 dBA


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

Source height = 1.50 m

ROAD (0.00 + 62.61 + 0.00) = 62.61 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
     0     90   0.00  68.48   0.00  -2.86  -3.01   0.00   0.00   0.00  62.61
-------------------------------------------------------------------------------

Segment Leq : 62.61 dBA

Total Leq All Segments: 66.40 dBA


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

Source height = 1.50 m

ROAD (0.00 + 56.45 + 0.00) = 56.45 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  58.12   0.00  -1.66   0.00   0.00   0.00   0.00  56.45
-------------------------------------------------------------------------------
```

```
Segment Leq : 56.45 dBA


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

Source height = 1.50 m

ROAD (0.00 + 55.01 + 0.00) = 55.01 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
     0     90   0.00  60.88   0.00  -2.86  -3.01   0.00   0.00   0.00  55.01
-------------------------------------------------------------------------------

Segment Leq : 55.01 dBA

Total Leq All Segments: 58.80 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 66.40
                           (NIGHT): 58.80
```

```
STAMSON 5.0        NORMAL REPORT        Date: 20-09-2022 15:15:03
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Belfast (day/night)
-------------------------------------------
Car traffic volume  :  9715/845   veh/TimePeriod  *
Medium truck volume :   773/67    veh/TimePeriod  *
Heavy truck volume  :   552/48    veh/TimePeriod  *
Posted speed limit  :    40 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  12000
    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: Belfast (day/night)
-----------------------------------------
Angle1   Angle2           :   0.00 deg   61.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  30.00 / 30.00  m
Receiver height           :  58.50 / 58.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


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

Source height = 1.50 m

ROAD (0.00 + 58.01 + 0.00) = 58.01 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
     0     61   0.00  65.72   0.00  -3.01  -4.70   0.00   0.00   0.00  58.01
-------------------------------------------------------------------------------

Segment Leq : 58.01 dBA

Total Leq All Segments: 58.01 dBA
```

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

Source height = 1.50 m

ROAD (0.00 + 50.41 + 0.00) = 50.41 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
     0     61   0.00  58.12   0.00  -3.01  -4.70   0.00   0.00   0.00  50.41
-------------------------------------------------------------------------------

Segment Leq : 50.41 dBA

Total Leq All Segments: 50.41 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 58.01
                           (NIGHT): 50.41
```

```
STAMSON 5.0        NORMAL REPORT        Date: 20-09-2022 15:15:56
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Coventry (day/night)
----------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Coventry (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  :  22.00 / 22.00  m
Receiver height           :  52.50 / 52.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


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

Source height = 1.50 m

ROAD (0.00 + 66.82 + 0.00) = 66.82 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  68.48   0.00  -1.66   0.00   0.00   0.00   0.00  66.82
-------------------------------------------------------------------------------

Segment Leq : 66.82 dBA

Total Leq All Segments: 66.82 dBA
```

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

Source height = 1.50 m

ROAD (0.00 + 59.22 + 0.00) = 59.22 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  60.88   0.00  -1.66   0.00   0.00   0.00   0.00  59.22
-------------------------------------------------------------------------------

Segment Leq : 59.22 dBA

Total Leq All Segments: 59.22 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 66.82
                           (NIGHT): 59.22
```

```
STAMSON 5.0        NORMAL REPORT        Date: 20-09-2022 15:16:24
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Coventry (day/night)
----------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Coventry (day/night)
----------------------------------------
Angle1   Angle2           : -90.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  33.00 / 33.00  m
Receiver height           :  52.50 / 52.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


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

Source height = 1.50 m

ROAD (0.00 + 62.05 + 0.00) = 62.05 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90      0   0.00  68.48   0.00  -3.42  -3.01   0.00   0.00   0.00  62.05
-------------------------------------------------------------------------------

Segment Leq : 62.05 dBA

Total Leq All Segments: 62.05 dBA
```

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

Source height = 1.50 m

ROAD (0.00 + 54.45 + 0.00) = 54.45 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90      0   0.00  60.88   0.00  -3.42  -3.01   0.00   0.00   0.00  54.45
-------------------------------------------------------------------------------

Segment Leq : 54.45 dBA

Total Leq All Segments: 54.45 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 62.05
                           (NIGHT): 54.45
```

```
STAMSON 5.0        NORMAL REPORT        Date: 20-09-2022 15:17:14
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Coventry (day/night)
----------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Coventry (day/night)
----------------------------------------
Angle1   Angle2           :   0.00 deg   65.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  26.00 / 26.00  m
Receiver height           :  52.50 / 52.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


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

Source height = 1.50 m

ROAD (0.00 + 61.67 + 0.00) = 61.67 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
     0     65   0.00  68.48   0.00  -2.39  -4.42   0.00   0.00   0.00  61.67
-------------------------------------------------------------------------------

Segment Leq : 61.67 dBA

Total Leq All Segments: 61.67 dBA
```

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

Source height = 1.50 m

ROAD (0.00 + 54.07 + 0.00) = 54.07 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
     0     65   0.00  60.88   0.00  -2.39  -4.42   0.00   0.00   0.00  54.07
-------------------------------------------------------------------------------

Segment Leq : 54.07 dBA

Total Leq All Segments: 54.07 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 61.67
                           (NIGHT): 54.07
```

```
STAMSON 5.0        NORMAL REPORT        Date: 20-09-2022 15:17:35
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Belfast (day/night)
----------------------------------------
Car traffic volume  :  9715/845   veh/TimePeriod  *
Medium truck volume :   773/67    veh/TimePeriod  *
Heavy truck volume  :   552/48    veh/TimePeriod  *
Posted speed limit  :    40 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  12000
    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: Belfast (day/night)
----------------------------------------
Angle1   Angle2           : -73.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  24.00 / 24.00  m
Receiver height           :  73.50 / 73.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


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

Source height = 1.50 m

ROAD (0.00 + 59.76 + 0.00) = 59.76 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -73      0   0.00  65.72   0.00  -2.04  -3.92   0.00   0.00   0.00  59.76
-------------------------------------------------------------------------------

Segment Leq : 59.76 dBA

Total Leq All Segments: 59.76 dBA
```

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

Source height = 1.50 m

ROAD (0.00 + 52.16 + 0.00) = 52.16 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -73      0   0.00  58.12   0.00  -2.04  -3.92   0.00   0.00   0.00  52.16
-------------------------------------------------------------------------------

Segment Leq : 52.16 dBA

Total Leq All Segments: 52.16 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 59.76
                           (NIGHT): 52.16
```

```
STAMSON 5.0        NORMAL REPORT        Date: 20-09-2022 15:17:55
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Belfast (day/night)
-------------------------------------------
Car traffic volume  :  9715/845   veh/TimePeriod  *
Medium truck volume :   773/67    veh/TimePeriod  *
Heavy truck volume  :   552/48    veh/TimePeriod  *
Posted speed limit  :    40 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  12000
    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: Belfast (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  :  22.00 / 22.00  m
Receiver height           :  73.50 / 73.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


Road data, segment # 2: Queens Way (day/night)
----------------------------------------------
Car traffic volume  : 118739/10325 veh/TimePeriod  *
Medium truck volume :  9445/821   veh/TimePeriod  *
Heavy truck volume  :  6747/587   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): 146664
    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: Queens Way (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 165.00 / 165.00 m
Receiver height           :  73.50 / 73.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -40.00 deg
Barrier height            :  14.00 m
Barrier receiver distance : 105.00 / 105.00 m
Source elevation          :  -2.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00


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

Source height = 1.50 m

ROAD (0.00 + 64.05 + 0.00) = 64.05 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  65.72   0.00  -1.66   0.00   0.00   0.00   0.00  64.05
-------------------------------------------------------------------------------

Segment Leq : 64.05 dBA


Results segment # 2: Queens Way (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 !       73.50 !       26.41 !        26.41

ROAD (0.00 + 68.43 + 67.46) = 70.98 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     -40   0.00  84.41   0.00 -10.41  -5.56   0.00   0.00  -0.09  68.34*
   -90     -40   0.00  84.41   0.00 -10.41  -5.56   0.00   0.00   0.00  68.43
-------------------------------------------------------------------------------
   -40       0   0.00  84.41   0.00 -10.41  -6.53   0.00   0.00   0.00  67.46
-------------------------------------------------------------------------------
```

```
 * Bright Zone !

Segment Leq : 70.98 dBA

Total Leq All Segments: 71.78 dBA


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

Source height = 1.50 m

ROAD (0.00 + 56.45 + 0.00) = 56.45 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  58.12   0.00  -1.66   0.00   0.00   0.00   0.00  56.45
-------------------------------------------------------------------------------

Segment Leq : 56.45 dBA


Results segment # 2: Queens Way (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 !       73.50 !       26.41 !        26.41

ROAD (0.00 + 60.83 + 59.86) = 63.39 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     -40   0.00  76.81   0.00 -10.41  -5.56   0.00   0.00  -0.09  60.74*
   -90     -40   0.00  76.81   0.00 -10.41  -5.56   0.00   0.00   0.00  60.83
-------------------------------------------------------------------------------
   -40       0   0.00  76.81   0.00 -10.41  -6.53   0.00   0.00   0.00  59.86
-------------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 63.39 dBA

Total Leq All Segments: 64.19 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           : -90.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 198.00 / 198.00 m
Receiver height           :   1.50 / 4.50   m
Topography                :      4       (Elevated; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -40.00 deg
Barrier height            :  14.00 m
Elevation                 :   0.00 m
Barrier receiver distance : 105.00 / 105.00 m
Source elevation          :  -3.00 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 !        1.50 !       -0.62 !        -0.62

RT/Custom (0.00 + 32.34 + 45.70) = 45.90 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -90    -40   0.00  63.44 -11.21  -5.56   0.00   0.00 -14.33  32.34
-------------------------------------------------------------------------
   -40      0   0.00  63.44 -11.21  -6.53   0.00   0.00   0.00  45.70
-------------------------------------------------------------------------

Segment Leq : 45.90 dBA

Total Leq All Segments: 45.90 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 !        4.50 !        0.79 !         0.79

RT/Custom (0.00 + 26.47 + 39.17) = 39.39 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -90    -40   0.00  56.91 -11.21  -5.56   0.00   0.00 -13.67  26.47
-------------------------------------------------------------------------
   -40      0   0.00  56.91 -11.21  -6.53   0.00   0.00   0.00  39.17
-------------------------------------------------------------------------

Segment Leq : 39.39 dBA

Total Leq All Segments: 39.39 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 71.79
                           (NIGHT): 64.20
```

```
STAMSON 5.0         NORMAL REPORT         Date: 20-09-2022 15:25:50
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Belfast (day/night)
-------------------------------------------
Car traffic volume  :  9715/845   veh/TimePeriod  *
Medium truck volume :   773/67    veh/TimePeriod  *
Heavy truck volume  :   552/48    veh/TimePeriod  *
Posted speed limit  :    40 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  12000
    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: Belfast (day/night)
-----------------------------------------
Angle1   Angle2           :   0.00 deg   45.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  34.00 / 34.00  m
Receiver height           :  73.50 / 73.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


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

Source height = 1.50 m

ROAD (0.00 + 56.14 + 0.00) = 56.14 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
     0     45   0.00  65.72   0.00  -3.55  -6.02   0.00   0.00   0.00  56.14
-------------------------------------------------------------------------------

Segment Leq : 56.14 dBA

Total Leq All Segments: 56.14 dBA


Results segment # 1: Belfast (night)
```

```
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 48.54 + 0.00) = 48.54 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
     0     45   0.00  58.12   0.00  -3.55  -6.02   0.00   0.00   0.00  48.54
-------------------------------------------------------------------------------

Segment Leq : 48.54 dBA

Total Leq All Segments: 48.54 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 56.14
                           (NIGHT): 48.54
```

```
STAMSON 5.0        NORMAL REPORT        Date: 20-09-2022 15:27:26
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r10.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Belfast (day/night)
-------------------------------------------
Car traffic volume  :  9715/845   veh/TimePeriod  *
Medium truck volume :   773/67    veh/TimePeriod  *
Heavy truck volume  :   552/48    veh/TimePeriod  *
Posted speed limit  :    40 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  12000
    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: Belfast (day/night)
-----------------------------------------
Angle1   Angle2           : -53.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  36.00 / 36.00  m
Receiver height           :  79.50 / 79.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


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

Source height = 1.50 m

ROAD (0.00 + 56.60 + 0.00) = 56.60 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -53      0   0.00  65.72   0.00  -3.80  -5.31   0.00   0.00   0.00  56.60
-------------------------------------------------------------------------------

Segment Leq : 56.60 dBA

Total Leq All Segments: 56.60 dBA


Results segment # 1: Belfast (night)
```

```
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 49.01 + 0.00) = 49.01 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -53      0   0.00  58.12   0.00  -3.80  -5.31   0.00   0.00   0.00  49.01
-------------------------------------------------------------------------------

Segment Leq : 49.01 dBA

Total Leq All Segments: 49.01 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 56.60
                           (NIGHT): 49.01
```

```
STAMSON 5.0        NORMAL REPORT        Date: 20-09-2022 15:28:27
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r11.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Belfast (day/night)
-------------------------------------------
Car traffic volume  :  9715/845   veh/TimePeriod  *
Medium truck volume :   773/67    veh/TimePeriod  *
Heavy truck volume  :   552/48    veh/TimePeriod  *
Posted speed limit  :    40 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  12000
    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: Belfast (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  :  20.00 / 20.00  m
Receiver height           :  79.50 / 79.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


Road data, segment # 2: QueensWay (day/night)
---------------------------------------------
Car traffic volume  : 118739/10325 veh/TimePeriod  *
Medium truck volume :  9445/821   veh/TimePeriod  *
Heavy truck volume  :  6747/587   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): 146664
    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: QueensWay (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  70.00 / 70.00  m
Receiver height           :  79.50 / 79.50  m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   2.00 m
Reference angle           :   0.00


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

Source height = 1.50 m

ROAD (0.00 + 64.47 + 0.00) = 64.47 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  65.72   0.00  -1.25   0.00   0.00   0.00   0.00  64.47
-------------------------------------------------------------------------------

Segment Leq : 64.47 dBA


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

Source height = 1.50 m

ROAD (0.00 + 74.71 + 0.00) = 74.71 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90      0   0.00  84.41   0.00  -6.69  -3.01   0.00   0.00   0.00  74.71
-------------------------------------------------------------------------------

Segment Leq : 74.71 dBA

Total Leq All Segments: 75.10 dBA


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

Source height = 1.50 m

ROAD (0.00 + 56.87 + 0.00) = 56.87 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  58.12   0.00  -1.25   0.00   0.00   0.00   0.00  56.87
```

```
--------------------------------------------------------------------------------

Segment Leq : 56.87 dBA


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

Source height = 1.50 m

ROAD (0.00 + 67.11 + 0.00) = 67.11 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
--------------------------------------------------------------------------------
   -90      0   0.00  76.81   0.00  -6.69  -3.01   0.00   0.00   0.00  67.11
--------------------------------------------------------------------------------

Segment Leq : 67.11 dBA

Total Leq All Segments: 67.50 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           : -90.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 103.00 / 103.00 m
Receiver height           :  79.50 / 79.50  m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   3.00 m
Reference angle           :   0.00


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

Source height = 0.50 m

RT/Custom (0.00 + 52.06 + 0.00) = 52.06 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
--------------------------------------------------------------------------------
   -90      0   0.00  63.44  -8.37  -3.01   0.00   0.00   0.00  52.06
--------------------------------------------------------------------------------

Segment Leq : 52.06 dBA

Total Leq All Segments: 52.06 dBA
```

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

Source height = 0.50 m

RT/Custom (0.00 + 45.53 + 0.00) = 45.53 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -90      0   0.00  56.91  -8.37  -3.01   0.00   0.00   0.00  45.53
-------------------------------------------------------------------------

Segment Leq : 45.53 dBA

Total Leq All Segments: 45.53 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 75.12
                           (NIGHT): 67.53
```

```
STAMSON 5.0         NORMAL REPORT         Date: 20-09-2022 15:29:05
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r12.te                Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Belfast (day/night)
-------------------------------------------
Car traffic volume  :  9715/845   veh/TimePeriod  *
Medium truck volume :   773/67    veh/TimePeriod  *
Heavy truck volume  :   552/48    veh/TimePeriod  *
Posted speed limit  :    40 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  12000
    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: Belfast (day/night)
-----------------------------------------
Angle1   Angle2           : -90.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  42.00 / 42.00  m
Receiver height           :  79.50 / 79.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


Road data, segment # 2: Queensway (day/night)
---------------------------------------------
Car traffic volume  : 118739/10325 veh/TimePeriod  *
Medium truck volume :  9445/821   veh/TimePeriod  *
Heavy truck volume  :  6747/587   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): 146664
    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: Queensway (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  :  56.00 / 56.00  m
Receiver height           :  79.50 / 79.50  m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   2.00 m
Reference angle           :   0.00


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

Source height = 1.50 m

ROAD (0.00 + 58.23 + 0.00) = 58.23 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90      0   0.00  65.72   0.00  -4.47  -3.01   0.00   0.00   0.00  58.23
-------------------------------------------------------------------------------

Segment Leq : 58.23 dBA


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

Source height = 1.50 m

ROAD (0.00 + 78.69 + 0.00) = 78.69 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  84.41   0.00  -5.72   0.00   0.00   0.00   0.00  78.69
-------------------------------------------------------------------------------

Segment Leq : 78.69 dBA

Total Leq All Segments: 78.73 dBA


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

Source height = 1.50 m

ROAD (0.00 + 50.64 + 0.00) = 50.64 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90      0   0.00  58.12   0.00  -4.47  -3.01   0.00   0.00   0.00  50.64
-------------------------------------------------------------------------------
```

```
Segment Leq : 50.64 dBA


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

Source height = 1.50 m

ROAD (0.00 + 71.09 + 0.00) = 71.09 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  76.81   0.00  -5.72   0.00   0.00   0.00   0.00  71.09
-------------------------------------------------------------------------------

Segment Leq : 71.09 dBA

Total Leq All Segments: 71.13 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           : -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  :  89.00 / 89.00  m
Receiver height           :  79.50 / 79.50  m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   3.00 m
Reference angle           :   0.00


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

Source height = 0.50 m

RT/Custom (0.00 + 55.70 + 0.00) = 55.70 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -90     90   0.00  63.44  -7.73   0.00   0.00   0.00   0.00  55.70
-------------------------------------------------------------------------

Segment Leq : 55.70 dBA

Total Leq All Segments: 55.70 dBA
```

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

Source height = 0.50 m

RT/Custom (0.00 + 49.17 + 0.00) = 49.17 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -90     90   0.00  56.91  -7.73   0.00   0.00   0.00   0.00  49.17
-------------------------------------------------------------------------

Segment Leq : 49.17 dBA

Total Leq All Segments: 49.17 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 78.75
                           (NIGHT): 71.16
```

```
STAMSON 5.0        NORMAL REPORT        Date: 20-09-2022 15:31:22
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r13.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Queensway (day/night)
----------------------------------------------
Car traffic volume  : 118739/10325 veh/TimePeriod  *
Medium truck volume :  9445/821   veh/TimePeriod  *
Heavy truck volume  :  6747/587   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): 146664
    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: Queensway (day/night)
--------------------------------------------
Angle1   Angle2           :   0.00 deg   68.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  65.00 / 65.00  m
Receiver height           :  79.50 / 65.00  m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   2.00 m
Reference angle           :   0.00


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

Source height = 1.50 m

ROAD (0.00 + 73.81 + 0.00) = 73.81 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
     0     68   0.00  84.41   0.00  -6.37  -4.23   0.00   0.00   0.00  73.81
-------------------------------------------------------------------------------

Segment Leq : 73.81 dBA

Total Leq All Segments: 73.81 dBA
```

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

Source height = 1.50 m

ROAD (0.00 + 66.22 + 0.00) = 66.22 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
     0     68   0.00  76.81   0.00  -6.37  -4.23   0.00   0.00   0.00  66.22
-------------------------------------------------------------------------------

Segment Leq : 66.22 dBA

Total Leq All Segments: 66.22 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           :   0.00 deg   68.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  98.00 / 98.00  m
Receiver height           :  79.50 / 79.50  m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   3.00 m
Reference angle           :   0.00


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

Source height = 0.50 m

RT/Custom (0.00 + 51.06 + 0.00) = 51.06 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
     0     68   0.00  63.44  -8.15  -4.23   0.00   0.00   0.00  51.06
-------------------------------------------------------------------------

Segment Leq : 51.06 dBA

Total Leq All Segments: 51.06 dBA


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

```
Source height = 0.50 m

RT/Custom (0.00 + 44.53 + 0.00) = 44.53 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
     0     68   0.00  56.91  -8.15  -4.23   0.00   0.00   0.00  44.53
-------------------------------------------------------------------------

Segment Leq : 44.53 dBA

Total Leq All Segments: 44.53 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 73.83
                           (NIGHT): 66.25
```

```
STAMSON 5.0         NORMAL REPORT         Date: 20-09-2022 15:32:10
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r15.te                Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Queenway (day/night)
-------------------------------------------
Car traffic volume  : 118739/10325 veh/TimePeriod  *
Medium truck volume :  9445/821   veh/TimePeriod  *
Heavy truck volume  :  6747/587   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): 146664
    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: Queenway (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  :  64.00 / 64.00  m
Receiver height           :  88.50 / 88.50  m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   2.00 m
Reference angle           :   0.00


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

Source height = 1.50 m

ROAD (0.00 + 75.10 + 0.00) = 75.10 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
     0     90   0.00  84.41   0.00  -6.30  -3.01   0.00   0.00   0.00  75.10
-------------------------------------------------------------------------------

Segment Leq : 75.10 dBA

Total Leq All Segments: 75.10 dBA
```

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

Source height = 1.50 m

ROAD (0.00 + 67.50 + 0.00) = 67.50 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
     0     90   0.00  76.81   0.00  -6.30  -3.01   0.00   0.00   0.00  67.50
-------------------------------------------------------------------------------

Segment Leq : 67.50 dBA

Total Leq All Segments: 67.50 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           :   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  :  97.00 / 97.00  m
Receiver height           :  88.50 / 88.50  m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   3.00 m
Reference angle           :   0.00


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

Source height = 0.50 m

RT/Custom (0.00 + 52.32 + 0.00) = 52.32 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
     0     90   0.00  63.44  -8.11  -3.01   0.00   0.00   0.00  52.32
-------------------------------------------------------------------------

Segment Leq : 52.32 dBA

Total Leq All Segments: 52.32 dBA


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

```
Source height = 0.50 m

RT/Custom (0.00 + 45.79 + 0.00) = 45.79 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
     0     90   0.00  56.91  -8.11  -3.01   0.00   0.00   0.00  45.79
-------------------------------------------------------------------------

Segment Leq : 45.79 dBA

Total Leq All Segments: 45.79 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 75.12
                           (NIGHT): 67.53
```

```
STAMSON 5.0         NORMAL REPORT         Date: 20-09-2022 15:32:27
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r16.te                Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Belfast (day/night)
-------------------------------------------
Car traffic volume  :  9715/845   veh/TimePeriod  *
Medium truck volume :   773/67    veh/TimePeriod  *
Heavy truck volume  :   552/48    veh/TimePeriod  *
Posted speed limit  :    40 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  12000
    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: Belfast (day/night)
-----------------------------------------
Angle1   Angle2           : -49.00 deg   51.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  32.00 / 32.00  m
Receiver height           :  19.50 / 19.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -49.00 deg   Angle2 : 51.00 deg
Barrier height            :  18.00 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: Queensway (day/night)
---------------------------------------------
Car traffic volume  : 118739/10325 veh/TimePeriod  *
Medium truck volume :  9445/821   veh/TimePeriod  *
Heavy truck volume  :  6747/587   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): 146664
    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: Queensway (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  :  89.00 / 89.00  m
Receiver height           :  19.50 / 19.50  m
Topography                :      4       (Elevated; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :  81.00 m
Elevation                 :   2.00 m
Barrier receiver distance :  33.00 / 33.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00


Results segment # 1: Belfast (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 !       19.50 !       12.75 !        12.75

ROAD (0.00 + 41.72 + 0.00) = 41.72 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -49     51   0.00  65.72   0.00  -3.29  -2.55   0.00   0.00 -18.15  41.72
-------------------------------------------------------------------------------

Segment Leq : 41.72 dBA


Results segment # 2: Queensway (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 !       19.50 !       12.82 !        12.82

ROAD (0.00 + 56.85 + 0.00) = 56.85 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  84.41   0.00  -7.73   0.00   0.00   0.00 -19.82  56.85
-------------------------------------------------------------------------------

Segment Leq : 56.85 dBA

Total Leq All Segments: 56.98 dBA


Results segment # 1: Belfast (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 !       19.50 !       12.75 !        12.75

ROAD (0.00 + 34.12 + 0.00) = 34.12 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -49     51   0.00  58.12   0.00  -3.29  -2.55   0.00   0.00 -18.15  34.12
-------------------------------------------------------------------------------

Segment Leq : 34.12 dBA


Results segment # 2: Queensway (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 !       19.50 !       12.82 !        12.82

ROAD (0.00 + 49.25 + 0.00) = 49.25 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  76.81   0.00  -7.73   0.00   0.00   0.00 -19.82  49.25
-------------------------------------------------------------------------------
```

```
Segment Leq : 49.25 dBA

Total Leq All Segments: 49.38 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           : -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  : 112.00 / 15.00  m
Receiver height           :  19.50 / 4.50   m
Topography                :      4       (Elevated; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :  81.00 m
Elevation                 :   3.00 m
Barrier receiver distance :  33.00 / -64.00 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 !       19.50 !       13.90 !        13.90

RT/Custom (0.00 + 34.90 + 0.00) = 34.90 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------
   -90     90   0.00  63.44  -8.73   0.00   0.00   0.00 -19.81  34.90
-----------------------------------------------------------------------

Segment Leq : 34.90 dBA

Total Leq All Segments: 34.90 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 !        4.50 !       21.57 !        21.57

RT/Custom (0.00 + 56.91 + 0.00) = 56.91 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -90     90   0.00  56.91   0.00   0.00   0.00   0.00  99.00 155.91
   -90     90   0.00  56.91   0.00   0.00   0.00   0.00   0.00  56.91
-------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 56.91 dBA

Total Leq All Segments: 56.91 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 57.01
                           (NIGHT): 57.62
```

```
STAMSON 5.0         NORMAL REPORT         Date: 20-09-2022 15:32:45
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r17.te                Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Queensway (day/night)
----------------------------------------------
Car traffic volume  : 118739/10325 veh/TimePeriod  *
Medium truck volume :  9445/821   veh/TimePeriod  *
Heavy truck volume  :  6747/587   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): 146664
    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: Queensway (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  :  93.00 / 93.00  m
Receiver height           :  16.50 / 19.50  m
Topography                :      4       (Elevated; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :  90.00 m
Elevation                 :   0.00 m
Barrier receiver distance :  38.00 / 38.00  m
Source elevation          :  -2.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00


Results segment # 1: Queensway (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 !       16.50 !        9.55 !         9.55

ROAD (0.00 + 56.63 + 0.00) = 56.63 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  84.41   0.00  -7.92   0.00   0.00   0.00 -19.86  56.63
-------------------------------------------------------------------------------

Segment Leq : 56.63 dBA

Total Leq All Segments: 56.63 dBA


Results segment # 1: Queensway (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 !       19.50 !       11.33 !        11.33

ROAD (0.00 + 49.04 + 0.00) = 49.04 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  76.81   0.00  -7.92   0.00   0.00   0.00 -19.85  49.04
-------------------------------------------------------------------------------

Segment Leq : 49.04 dBA

Total Leq All Segments: 49.04 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           : -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  : 126.00 / 126.00 m
Receiver height           :  19.50 / 19.50  m
Topography                :      4       (Elevated; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :  90.00 m
Elevation                 :   0.00 m
```

```
Barrier receiver distance :  38.00 / 38.00  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 !       19.50 !       13.77 !        13.77

RT/Custom (0.00 + 34.37 + 0.00) = 34.37 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -90     90   0.00  63.44  -9.24   0.00   0.00   0.00 -19.83  34.37
-------------------------------------------------------------------------

Segment Leq : 34.37 dBA

Total Leq All Segments: 34.37 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 !       19.50 !       13.77 !        13.77

RT/Custom (0.00 + 27.83 + 0.00) = 27.83 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -90     90   0.00  56.91  -9.24   0.00   0.00   0.00 -19.83  27.83
-------------------------------------------------------------------------

Segment Leq : 27.83 dBA

Total Leq All Segments: 27.83 dBA
TOTAL Leq FROM ALL SOURCES (DAY): 56.66
                           (NIGHT): 49.07
```

```
STAMSON 5.0        NORMAL REPORT        Date: 20-09-2022 15:32:59
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r18.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Belfast (day/night)
-------------------------------------------
Car traffic volume  :  9715/845   veh/TimePeriod  *
Medium truck volume :   773/67    veh/TimePeriod  *
Heavy truck volume  :   552/48    veh/TimePeriod  *
Posted speed limit  :    40 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  12000
    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: Belfast (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  :  20.00 / 20.00  m
Receiver height           :  19.50 / 19.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :  18.00 m
Barrier receiver distance :   2.00 / 2.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00


Road data, segment # 2: Queensway (day/night)
---------------------------------------------
Car traffic volume  : 118739/10325 veh/TimePeriod  *
Medium truck volume :  9445/821   veh/TimePeriod  *
Heavy truck volume  :  6747/587   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): 146664
    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: Queensway (day/night)
-------------------------------------------
Angle1   Angle2           : -90.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 166.00 / 166.00 m
Receiver height           :  14.00 / 19.50  m
Topography                :      4       (Elevated; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -39.00 deg
Barrier height            :  14.00 m
Elevation                 :   0.00 m
Barrier receiver distance : 106.00 / 106.00 m
Source elevation          :  -2.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00


Results segment # 1: Belfast (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 !       19.50 !       17.70 !        17.70

ROAD (0.00 + 59.11 + 0.00) = 59.11 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  65.72   0.00  -1.25   0.00   0.00   0.00  -5.36  59.11
-------------------------------------------------------------------------------

Segment Leq : 59.11 dBA


Results segment # 2: Queensway (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 !       14.00 !        4.74 !         4.74

ROAD (0.00 + 56.24 + 67.32) = 67.65 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90    -39   0.00  84.41   0.00 -10.44  -5.48   0.00   0.00 -12.25  56.24
-------------------------------------------------------------------------------
   -39      0   0.00  84.41   0.00 -10.44  -6.64   0.00   0.00   0.00  67.32
-------------------------------------------------------------------------------

Segment Leq : 67.65 dBA

Total Leq All Segments: 68.22 dBA


Results segment # 1: Belfast (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 !       19.50 !       17.70 !        17.70

ROAD (0.00 + 51.51 + 0.00) = 51.51 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  58.12   0.00  -1.25   0.00   0.00   0.00  -5.36  51.51
-------------------------------------------------------------------------------

Segment Leq : 51.51 dBA


Results segment # 2: Queensway (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 !       19.50 !        6.73 !         6.73

ROAD (0.00 + 50.09 + 59.73) = 60.18 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
```

```
   -90    -39   0.00  76.81   0.00 -10.44  -5.48   0.00   0.00 -10.80  50.09
-------------------------------------------------------------------------------
   -39      0   0.00  76.81   0.00 -10.44  -6.64   0.00   0.00   0.00  59.73
-------------------------------------------------------------------------------

Segment Leq : 60.18 dBA

Total Leq All Segments: 60.73 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           : -90.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 199.00 / 199.00 m
Receiver height           :  19.50 / 19.50  m
Topography                :      4       (Elevated; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 0.00 deg
Barrier height            :  18.00 m
Elevation                 :   0.00 m
Barrier receiver distance :  11.00 / 11.00  m
Source elevation          :  -3.00 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 !       19.50 !       18.28 !        18.28

RT/Custom (0.00 + 49.20 + 0.00) = 49.20 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90      0   0.00  63.44 -11.23  -3.01   0.00   0.00  -4.87  44.33*
   -90      0   0.00  63.44 -11.23  -3.01   0.00   0.00   0.00  49.20
-------------------------------------------------------------------------------
```

```
 * Bright Zone !

Segment Leq : 49.20 dBA

Total Leq All Segments: 49.20 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 !       19.50 !       18.28 !        18.28

RT/Custom (0.00 + 42.67 + 0.00) = 42.67 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -90      0   0.00  56.91 -11.23  -3.01   0.00   0.00  -4.87  37.80*
   -90      0   0.00  56.91 -11.23  -3.01   0.00   0.00   0.00  42.67
-------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 42.67 dBA

Total Leq All Segments: 42.67 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 68.27
                           (NIGHT): 60.80
```

```
STAMSON 5.0        NORMAL REPORT        Date: 21-09-2022 10:32:26
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r19.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Coventry (day/night)
----------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Coventry (day/night)
----------------------------------------
Angle1   Angle2           : -47.00 deg   27.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  32.00 / 32.00  m
Receiver height           :  19.50 / 19.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -47.00 deg   Angle2 : 27.00 deg
Barrier height            :  18.00 m
Barrier receiver distance :  14.00 / 14.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00


Results segment # 1: Coventry (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 !       19.50 !       11.62 !        11.62

ROAD (0.00 + 41.64 + 0.00) = 41.64 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -47     27   0.00  68.48   0.00  -3.29  -3.86   0.00   0.00 -19.69  41.64
-------------------------------------------------------------------------------

Segment Leq : 41.64 dBA

Total Leq All Segments: 41.64 dBA


Results segment # 1: Coventry (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 !       19.50 !       11.62 !        11.62

ROAD (0.00 + 34.04 + 0.00) = 34.04 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -47     27   0.00  60.88   0.00  -3.29  -3.86   0.00   0.00 -19.69  34.04
-------------------------------------------------------------------------------

Segment Leq : 34.04 dBA

Total Leq All Segments: 34.04 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 41.64
                           (NIGHT): 34.04

STAMSON 5.0        NORMAL REPORT        Date: 20-09-2022 15:47:27
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r20.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Queensway (day/night)
---------------------------------------------
Car traffic volume  : 118739/10325 veh/TimePeriod  *
Medium truck volume :  9445/821   veh/TimePeriod  *
Heavy truck volume  :  6747/587   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): 146664
    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: Queensway (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  : 151.00 / 151.00 m
Receiver height           :  67.50 / 67.50  m
Topography                :      4       (Elevated; with barrier)
Barrier angle1            :  24.00 deg   Angle2 : 90.00 deg
Barrier height            :   8.00 m
Elevation                 :   0.00 m
Barrier receiver distance :  45.00 / 45.00  m
Source elevation          :  -2.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00


Results segment # 1: Queensway (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 !       67.50 !       47.23 !        47.23

ROAD (65.63 + 70.02 + 0.00) = 71.37 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
     0     24   0.00  84.41   0.00 -10.03  -8.75   0.00   0.00   0.00  65.63
-------------------------------------------------------------------------------
    24     90   0.00  84.41   0.00 -10.03  -4.36   0.00   0.00  -0.01  70.01*
    24     90   0.00  84.41   0.00 -10.03  -4.36   0.00   0.00   0.00  70.02
-------------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 71.37 dBA
```

```
Total Leq All Segments: 71.37 dBA


Results segment # 1: Queensway (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 !       67.50 !       47.23 !        47.23

ROAD (58.03 + 62.42 + 0.00) = 63.77 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
     0     24   0.00  76.81   0.00 -10.03  -8.75   0.00   0.00   0.00  58.03
-------------------------------------------------------------------------------
    24     90   0.00  76.81   0.00 -10.03  -4.36   0.00   0.00  -0.01  62.42*
    24     90   0.00  76.81   0.00 -10.03  -4.36   0.00   0.00   0.00  62.42
-------------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 63.77 dBA

Total Leq All Segments: 63.77 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           :   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  : 151.00 / 151.00 m
Receiver height           :  67.50 / 67.50  m
Topography                :      4       (Elevated; with barrier)
Barrier angle1            :  24.00 deg   Angle2 : 90.00 deg
Barrier height            :   8.00 m
Elevation                 :   0.00 m
Barrier receiver distance :  45.00 / 45.00  m
Source elevation          :  -3.00 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 !       67.50 !       46.64 !        46.64

RT/Custom (44.66 + 49.05 + 0.00) = 50.40 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
     0     24   0.00  63.44 -10.03  -8.75   0.00   0.00   0.00  44.66
-------------------------------------------------------------------------
    24     90   0.00  63.44 -10.03  -4.36   0.00   0.00  -0.01  49.04*
    24     90   0.00  63.44 -10.03  -4.36   0.00   0.00   0.00  49.05
-------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 50.40 dBA

Total Leq All Segments: 50.40 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 !       67.50 !       46.64 !        46.64

RT/Custom (38.13 + 42.52 + 0.00) = 43.87 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
     0     24   0.00  56.91 -10.03  -8.75   0.00   0.00   0.00  38.13
-------------------------------------------------------------------------
    24     90   0.00  56.91 -10.03  -4.36   0.00   0.00  -0.01  42.51*
    24     90   0.00  56.91 -10.03  -4.36   0.00   0.00   0.00  42.52
-------------------------------------------------------------------------

 * Bright Zone !
```

```
Segment Leq : 43.87 dBA

Total Leq All Segments: 43.87 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 71.40
                           (NIGHT): 63.81
```

APPENDIX B

FTA VIBRATION CALCULATIONS

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

GWE22-272 20-Oct-22

Possible Vibration Impacts on 400 Coventry Road
Perdicted using FTA General Assesment

Train Speed 70 km/h 43 mph

	Distance from C/L	
	(m)	(ft)
LRT	74.0	242.8

Vibration

From FTA Manual Fig 10-1

Vibration Levels at distance from track	57	dBV re 1 micro in/sec

Adjustment Factors FTA Table 10-1

Speed reference 50 mph	-1	Operating speed 43 mph
Vehicle Parameters	0	Assume Soft primary suspension, Weels run true
Track Condition	0	Worn or Corrugated Track
Track Treatments	0	None
Type of Transit Structure	-15	Rock Based
Efficient vibration Propagation	10	Propagation through rock
Vibration Levels at Fdn	51	0.009
Coupling to Building Foundation	0	Foundation in rock
Floor to Floor Attenuation	0.0	Ground Floor occupied
Amplification of Floor and Walls	6	
Total Vibration Level	56.68997	dBV or 0.017 mm/s
Noise Level in dBA	21.68997	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.