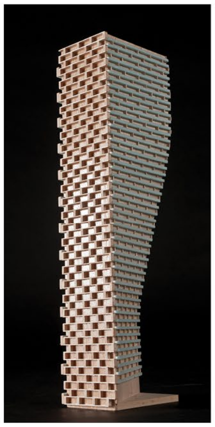
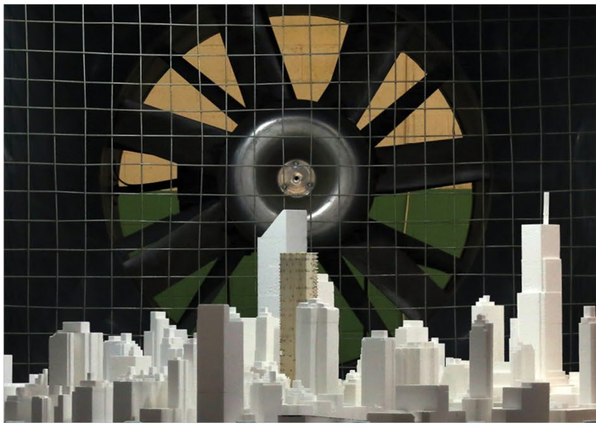
ENVIRONMENTAL NOISE & VIBRATION FEASIBILITY ASSESSMENT

35 Laurel Street
Ottawa, Ontario

REPORT: GW21-147-Noise & Vibration R2





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EXECUTIVE SUMMARY

This report describes an environmental noise & vibration feasibility assessment in support of the Zoning By-law Amendment (ZBA) application for the proposed residential development at 35 Laurel Street in Ottawa, Ontario. The proposed development comprises two buildings, Building A (27 storeys) and Building B (29 storeys), situated to the north and south, respectively, along the east elevation of the subject site. The major sources of transportation noise are Highway 417 and the Trillium Line LRT. The primary property impacting the study site for stationary noise is the Canadian Bank Note (CBN) facility located at 975 Gladstone Avenue, south of the study site. Sources of stationary noise include rooftop mechanical equipment and a loading dock. Figure 1 illustrates a site plan with surrounding context.

The assessment is based on (i) theoretical noise prediction methods that conform to the Ministry of the Environment, Conservation and Parks (MECP) and City of Ottawa requirements; (ii) noise level criteria as specified by the City of Ottawa's Environmental Noise Control Guidelines (ENCG); (iii) architectural drawings prepared by Roderick Lahey Architects in April 2025, and; (iv) mechanical information assumed by Gradient Wind based on experience with nearby projects.

The results of the current analysis indicate that transportation noise levels will range between 53 and 70 dBA during the daytime period (07:00-23:00) and between 47 and 62 dBA during the nighttime period (23:00-07:00). The highest noise level (i.e. 70 dBA) occurs along the south façade of Building B, which has the most exposure to Highway 417 to the south. Noise levels at the Building B podium terraces exceed the criteria for outdoor living areas. It is expected that a noise screen will be required. Building components with a higher Sound Transmission Class (STC) rating will be required on façades where noise levels exceed 65 dBA.

In addition to upgraded windows, the development will require the installation of central air conditioning (or similar mechanical system) will be required for all units in the development, which will allow occupants to keep windows closed and maintain a comfortable living environment. Warning Clauses will be required in all Agreements of Lease, Purchase and Sale.

Specific transportation noise control measures will be determined as part of a detailed study conducted at the time of Site Plan Application (SPA).

Due to the influence of existing stationary sources associated with the adjacent Canadian Bank Note (CBN) facility on the site, which exceed the Class 1 area sound level limits, it is recommended that the new development be considered as a Class 4 area. For infill situations under the ENCG, new noise sensitive buildings that have ventilation systems to allow windows and doors to remain closed as an integral part of their design can apply to be deemed a Class 4 designation, which has applicable sound level limits of 60 and 55 dBA during the daytime and nighttime, respectively. Once approved by council, existing landowners should be notified of the designation which they can use in dealing with their MECP approval applications. A stationary Warning Clause will be required in all Agreements of Lease, Purchase and Sale of residential units, as summarized in Section 6.

Stationary noise impacts from the development on the surroundings can be minimized by judicious placement mechanical equipment such as its placement on a roof or in a mechanical penthouse, or the incorporation of silencers and noise screens as necessary. It is recommended that any large pieces of HVAC equipment be placed in the middle of the roof, avoiding line of site with the surrounding residential dwellings. A stationary noise assessment for on-site equipment will be conducted during detailed design.

The estimated ground vibration level at the nearest point of reception is expected to be 0.02 mm/s RMS (57.8 dBV) based on the FTA protocol. Since predicted vibration levels are below the criterion of 0.10 mm/s RMS, no mitigation will be required. Since estimated vibration levels were found to be less than 0.10 mm/s peak partial velocity (ppv), ground borne noise levels are also expected to be below the ground borne noise criteria of 35 dB.

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ENGINEERS & SCIENTISTS

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1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by The Estate of Carson Unsworth to undertake an environmental noise & vibration feasibility assessment in support of the Zoning By-law Amendment (ZBA) application for the proposed residential development at 35 Laurel Street in Ottawa, Ontario. This report summarizes the methodology, results and recommendations related to an environmental noise feasibility assessment.

The present scope of work involves assessing exterior noise and ground vibration levels at the study site generated by the surrounding industrial properties and transportation sources. The assessment was performed based on theoretical noise calculation methods conforming to the City of Ottawa[1] and Ministry of the Environment, Conservation and Parks (MECP) NPC-300[2] guidelines, architectural drawings prepared by Roderick Lahey Architects in April 2025, mechanical information assumed by Gradient Wind based on experience with nearby projects, surrounding street layouts obtained from the City of Ottawa, and recent site imagery.

2. TERMS OF REFERENCE

The subject site is located at 35 Laurel Street in Ottawa, situated to the north at the intersection of Laurel Street and Loretta Avenue North, on a 'L'-shaped parcel of land bounded by Laurel Street to the south, Breezehill Avenue North and low-rise buildings to the west, a low-rise building to the north, and the O-Train Line 2 to the east. Throughout this report, Laurel Street is considered project south. The proposed development comprises two buildings, Building A (27 storeys) and Building B (29 storeys), situated to the north and south, respectively, along the east elevation of the subject site. Each building includes a six-storey podium, and the buildings are topped with a mechanical penthouse (MPH) and share two below-grade parking levels. The podium of Building B is rectangular, and the podium of Building A has a parallelogram planform, in parallel to the north side of Building B and with the trillium line LRT. A proposed parkland is located at the northwest corner of the subject site.

[1] City of Ottawa Environmental Noise Control Guidelines, January 2016
[2] Ministry of the Environment, Conservation and Parks (MECP), Environmental Noise Guideline – Publication NPC-300, August 2013

Above the below-grade parking, the ground floor of Building A includes a residential main entrance to the west, an indoor amenity at the northwest corner, residential units along the east elevation, and an indoor pool at the southwest corner. An exterior amenity is situated to the west of Building A. Access to the shared underground parking is provided by a ramp to the north of Building A via a laneway from Laurel Street. Levels 2-6 are reserved for residential use. The planform of the first 6 levels follows the outline of a parallelogram parallel to the Trillium line and Building B. Level 7 includes indoor amenities to the north and south and residential units throughout the remainder of the level. At Level 7, the building steps back from the north and south elevations and from the east and west elevations to accommodate common amenity terraces and private terraces, respectively. Levels 8-27 rise above the podium with a nominally rectangular planform and comprise residential units.

The ground floor of Building B includes a residential main entrance to the south, retail spaces to the southeast and southwest, a commercial garbage and recycling space at the northwest corner, bike storage spaces to the north, and an indoor amenity at the northeast corner. Levels 2-6 are reserved for residential use. Level 7 includes indoor amenities to the east and west and residential units throughout the remainder of the level. At Level 7, the building steps back from the east and west elevations and from the north and south elevations to accommodate common amenity terraces and private terraces, respectively. Levels 8-29 rise above the podium with a nominally rectangular planform and comprise residential units.

The near-field surroundings include low-rise massing from the southeast clockwise to the northeast with a high-rise building and a mid-rise residential building to the west, and a green space to the east. To the east of the site, the O-Train Line 2 and the Trillium Pathway extend from the northwest to the southeast. Notably, a 30-storey development is approved (Site Plan Control) at 1040 Somerset Street West, approximately 75 m to the north-northwest, a 28-storey development is approved (ZBLA) at 1050 Somerset West, approximately 90 m to the northwest, a development comprising mixed-use residential mid- and high-rise buildings (ranging from 9 to 30 storeys) and townhouse blocks is approved (ZBLA) at 933 Gladstone Avenue, to the east across the O-Train Line 2, and a development comprising three mixed-use towers (30, 33, and 35 storeys) is approved (ZBLA) at 951 Gladstone Avenue and 145 Loretta Avenue North, approximately 85 m to the southeast.

The major sources of transportation noise are Highway 417 and the Trillium Line LRT. The primary property impacting the study site for stationary noise is the Canadian Bank Note (CBN) facility located at

975 Gladstone Avenue, south of the study site. The CBN facility is expected to operate 24 hours a day. However, certain sources are likely to have reduced operation during the nighttime period between 23:00 and 07:00. Sources of stationary noise include rooftop mechanical equipment and a loading dock.

Other stationary noise sources surrounding the study comprise small rooftop units associated with the surrounding commercial properties. A review of satellite imagery does not reveal any sources that would not be mitigated by setback distance to the study site. Further analysis of these sources will not be required. The commercial properties east of Loretta Avenue North are expected to cease operations, as the land is slated for redevelopment. The Public Works Canada Yard to the north does not contain any significant sources of stationary noise. Vehicles idling on nearby roadways are not classified as sources of stationary noise, as these are not within the property line of the proposed development. As such these other sources of noise were ruled insignificant. Figure 1 illustrates a complete site plan with surrounding context. Figure 3 illustrates the location of all stationary noise sources included in this study.

3. OBJECTIVES

The main goals of this work are to (i) calculate the future noise levels on the study building produced by local transportation and stationary sources, (ii) calculate the future vibration levels on the study building produced by local LRT traffic, and (iii) ensure that interior noise levels and vibration levels do not exceed the allowable limits specified by the City of Ottawa's Environmental Noise Control Guidelines as outlined in Section 4 of this report.

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 Transportation Noise

4.2.1 Criteria for Transportation Noise

For vehicle traffic, the equivalent sound energy level, L_{eq}, provides a measure of the time varying noise levels, which is well correlated with the annoyance of sound. It is defined as the continuous sound level that has the same energy as a time varying noise level over a period of time. For roadways, the L_{eq} is commonly calculated on the basis of a 16-hour (L_{eq16}) daytime (07:00-23:00) / 8-hour (L_{eq8}) nighttime (23:00-07:00) split to assess its impact on residential buildings. The City of Ottawa's Environmental Noise Control Guidelines (ENCG) specifies that the recommended indoor noise limit range (that is relevant to this study) is 50, 45 and 40 dBA for retail, living rooms and sleeping quarters, respectively, as listed in Table 1. However, to account for deficiencies in building construction and control peak noise, these levels should be targeted toward 47, 42 and 37 dBA.

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

Type of Space	Time Period	L_{eq} (dBA)	
		Road	Rail
General offices, reception areas, retail stores, etc.	07:00 – 23:00	50	45
Living/dining/den areas of residences, hospitals, schools, nursing/retirement homes, day-care centres, theatres, places of worship, libraries, individual or semi-private offices, conference rooms, etc.	07:00 – 23:00	45	40
Sleeping quarters of hotels/motels	23:00 – 07:00	45	40
Sleeping quarters of residences, hospitals, nursing/retirement homes, etc.	07:00 - 23:00	45	40
Sleeping quarters of residences, hospitals, nursing/retirement homes, etc.	23:00 – 07:00	40	35

[3] Adapted from ENCG 2016 – Tables 2.2b and 2.2c

Predicted noise levels at the plane of window (POW) dictate the action required to achieve the recommended sound levels. An open window is considered to provide a 10 dBA reduction in noise while a standard closed window is capable of providing a minimum 20 dBA noise reduction[4]. Therefore, where noise levels exceed 55 dBA daytime and 50 dBA nighttime, the ventilation for the building should consider the need for having windows and doors closed, which normally triggers the need for central air conditioning (or similar systems). Where noise levels exceed 65 dBA daytime and 60 dBA nighttime building components will require higher levels of sound attenuation[5].

Noise levels at outdoor living areas should be limited to 55 dBA where technically and administratively feasible. The City of Ottawa preferences for noise control prescribe the following hierarchy:

(i) Increased distance setback with absorptive ground cover (vegetation)
(ii) Relocation of noise sensitive areas away from roadways (provide blockage with building massing)
(iii) Earth berms
(iv) Acoustic barriers

4.2.2 Roadway and LRT Traffic Volumes

The ENCG dictates that noise calculations should consider future sound levels based on a roadway's classification at the mature state of development. Therefore, traffic volumes are based on the roadway classifications outlined in the City of Ottawa's Official Plan (OP) and Transportation Master Plan[6] which provide additional details on future roadway expansions. Average Annual Daily Traffic (AADT) volumes are then based on data in Table B1 of the ENCG for each roadway classification. Trillium Line LRT volumes and speed are based on Gradient Wind's past experience with the Trillium Line on other projects. Table 2 (below) summarizes the AADT values used for each roadway and LRT line included in this assessment.

[4] Burberry, P.B. (2014). Mitchell's Environment and Services. Routledge, Page 125
[5] MECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.1.3
[6] City of Ottawa Transportation Master Plan, November 2013

TABLE 2: ROADWAY AND RAILWAY TRAFFIC DATA

Segment	Roadway Traffic Data	Speed Limit (km/h)	Traffic Volumes
Highway 417	8-Lane Freeway	100	146,664
Trillium Line	LRT	50	192/24*

*-Daytime/nighttime volumes

4.2.3 Theoretical Transportation Noise Predictions

Noise predictions were performed with the aid of the MECP computerized noise assessment program, STAMSON 5.04, for road and rail analysis. Appendix A includes the STAMSON 5.04 input and output data.

Roadway noise calculations were performed by treating each road segment as a separate line source of noise, and by using existing building locations as noise barriers. In addition to the traffic volumes summarized in Table 4, theoretical noise predictions were based on the following parameters:

- Truck traffic on all roadways was taken to comprise 5% heavy trucks and 7% medium trucks, as per ENCG requirements for noise level predictions.
- The day/night split was taken to be 92%/8% respectively for all streets.
- Ground surfaces were taken to be absorptive and reflective based on specific source-receiver path ground characteristics.
- Site topography is considered as gently sloping.
- LRT was modelled using 4-car SRT vehicle type in STAMSON.

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

4.3 Stationary Noise

4.3.1 Criteria for Stationary Noise

For stationary sources, the L_{eq} is commonly calculated on an hourly interval, while for roadways, the L_{eq} is calculated on the basis of a 16-hour daytime/8-hour nighttime split as previously mentioned in Section 4.2.1

Stationary sources are defined in the ENCG as "all sources of sound and vibration, whether fixed or mobile, that exist or operate on a premises, property or facility, the combined sound and vibration levels of which are emitted beyond the property boundary of the premises, property or facility, unless the source(s) is (are) due to construction" [7]. This applies to the plane of window and outdoor amenity spaces serving the development.

The surrounding area of the development would typically be defined as a Class 1 (Urban) environment, as background noise levels are dominated by human activities such as roadway and transit sources. The ENCG and NPC-300 also allow for the consideration of a Class 4 area for new proposed noise sensitive land uses where air conditioning will form an integral part of the design. For a development to be considered a Class 4 area, the planning authority must agree to the condition, which requires city council approval. Once the development has been approved as a Class 4 area, the surrounding source owners will be notified and can then use the Class 4 designation for their approval process with the MECP. In the case of this development, Class 4 has been granted for properties being impacted by the CBN facility, therefore Class 4 will be used for the basis of this study. The exclusionary sound level limits for Class 1 and 4 areas are summarized in Table 3 below. The applicable sound level limit is the higher of either the values in Table 3 or background noise levels due to sources such as transportation.

TABLE 3: EXCLUSIONARY LIMITS FOR CLASS 1/4 AREA

Time of Day	Class 1		Class 4	
	Outdoor Points of Reception	Plane of Window	Outdoor Points of Reception	Plane of Window
07:00 – 19:00	50	50	55	60
19:00 – 23:00	50	50	55	60
23:00 – 07:00	N/A	45	N/A	55

4.3.2 Assumptions

Gradient Wind has assumed mechanical information of the development based on experience with similar developments, and available noise reports on the City of Ottawa's development applications website, such as the Noise & Vibration Impacts Feasibility Study 145 Loretta Ave & 951 Gladstone Avenue Ottawa,

[7] City of Ottawa Environmental Noise Control Guidelines, page 10

Ontario, prepared by J.E. Coulter Associates Limited, dated August 8, 2019. The following assumptions have been made in the analysis:

(i) The locations and quantity of rooftop units are based on a review of satellite imagery and Gradient Wind's experience with similar developments and the J.E. Coulter Associates Limited report.
(ii) Sound data for rooftop units are based on manufacturer's data.
(iii) The rooftop mechanical units are assumed to operate continuously over a 1-hour period during the daytime and nighttime period.
(iv) Screening effects of the parapets have been conservatively excluded in the modelling.

4.3.3 Determination of Noise Source Power Levels

Mechanical information for the CBN facility has been based on Gradient Wind's experience with similar developments and a review of satellite imagery. Gradient Wind also considered information presented in other noise reports prepared for other developments in the area, such as Noise & Vibration Impacts Feasibility Study 145 Loretta Ave & 951 Gladstone Avenue Ottawa, Ontario, prepared by J.E. Coulter Associates Limited, dated August 8, 2019. Based on our assumptions, Gradient Wind had good correlation with the J.E. coulter noise results.

4.3.1 Stationary Source Noise Predictions

The impact of the surrounding stationary noise sources on the 35 Laurel Street development was determined by computer modelling. Stationary noise source modelling is based on the software program *Predictor-Lima* developed from the International Standards Organization (ISO) standard 9613 Parts 1 and 2. This computer program is capable of representing three-dimensional surfaces and first reflections of sound waves over a suitable spectrum for human hearing. The methodology has been used on numerous assignments and has been accepted by the MECP as part of Environmental Compliance Approvals applications.

Three individual noise sensor locations were selected in the *Predictor-Lima* model to measure the noise impact at points of reception (POR) during the daytime (07:00 – 19:00) and nighttime (19:00 – 07:00) periods (see Figure 4). For each location, various heights were examined. POR locations included the outdoor living areas (OLA's) and the plane of windows (POW's) of the 35 Laurel Street development. All mechanical equipment was represented as point sources in the model. Air temperature, pressure and humidity were set to 10°C, 101.3 kPA and 70%, respectively. Ground absorption over the study area was determined based on topographical features (such as water, concrete, grassland, etc.). A coefficient of 0 was used for hard surfaces, such as concrete and paved areas, and 1 for soft surfaces, such as grass and vegetative areas. Existing and proposed buildings were added to the model to account for screening and reflection effects from building façades. Modelling files and outputs are available upon request.

4.4 Ground Vibration & Ground-borne Noise

Transit systems and heavy vehicles on roadways can produce perceptible levels of ground vibrations, especially when they are in close proximity to residential neighbourhoods or vibration-sensitive buildings. Similar to sound waves in air, vibrations in solids are generated at a source, propagated through 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. Repetitive motion of the wheels on the track or rubber tires passing over an uneven surface causes vibrations 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.

4.4.1 Ground Vibration Criteria

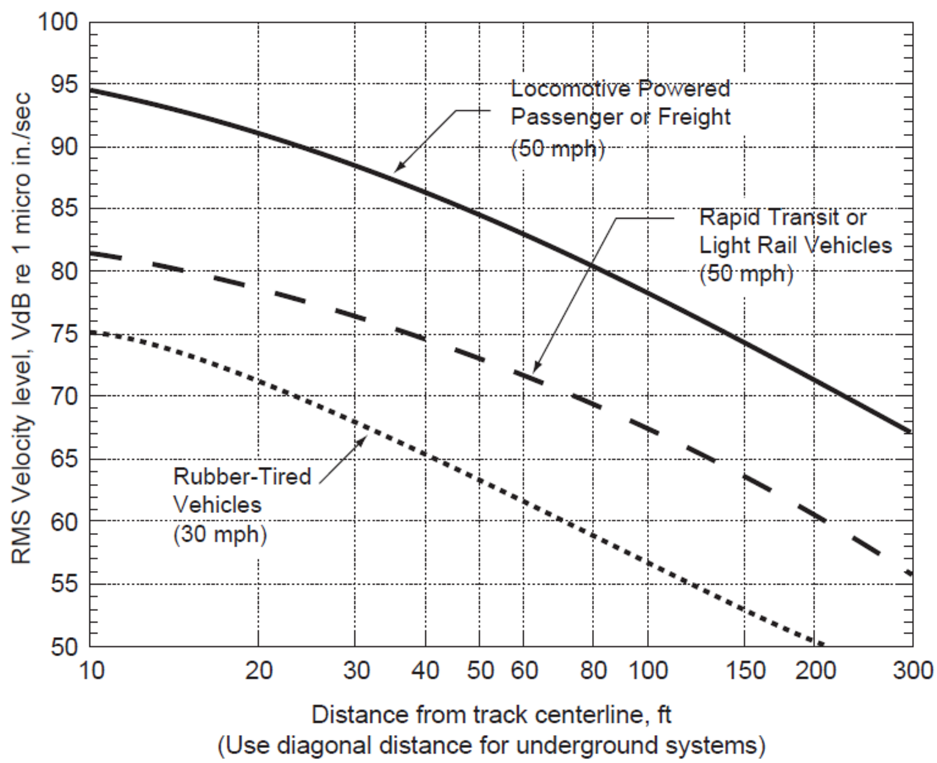
In the United States, the Federal Transportation Authority (FTA) has set vibration criteria for sensitive land uses next to transit corridors. Similar standards have been developed by a partnership between the MECP and the Toronto Transit Commission[8]. These standards indicate that the appropriate criteria for residential buildings is 0.10 mm/s RMS for vibrations. For main line railways, a document titled Guidelines for New Development in Proximity to Railway Operations[9], indicates that vibration conditions should not exceed 0.14 mm/s RMS averaged over a one second time-period at the first floor and above of the proposed building. As the main vibration source is due to the LRT lines, which will have frequent events, the 0.10 mm/s RMS (72 dBV) vibration criteria and 35 dBA ground borne noise criteria were adopted for this study.

4.4.2 Theoretical Ground Vibration Prediction Procedure

Potential vibration impacts of the future Confederation LRT rail line, currently under construction, were predicted using the FTA's Transit Noise and Vibration Impact Assessment[10] protocol. The FTA general vibration assessment is based on an upper bound generic set of curves that show vibration level attenuation with distance. These curves, illustrated in the figure below, are based on ground vibration measurements at various transit systems throughout North America. Vibration levels at points of reception are adjusted by various factors to incorporate known characteristics of the system being analyzed, such as operating speed of vehicle, conditions of the track, construction of the track and geology, as well as the structural type of the impacted building structures. Based on the setback distance of the closest building, initial vibration levels were deduced from a curve for light rail trains at 50 miles per hour (mph) and applying an adjustment factor of -1.2 dBV to account for an operational speed of 43.4

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

mph (70 km/h). The track was assumed to be jointed with no welds. Details of the vibration calculations are presented in Appendix B.



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

5. RESULTS AND DISCUSSION

5.1 Transportation Noise Levels

The results of the roadway noise calculations are summarized in Table 6 below. A complete set of input and output data from all STAMSON 5.04 calculations are available in Appendix A.

TABLE 4: EXTERIOR NOISE LEVELS DUE TO TRANSPORTATION SOURCES

Receptor Number	Receptor Height Above Grade (m)	Receptor Location	STAMSON Roadway Noise Level (dBA)	
			Day	Night
1	83.5	Building A – East Façade	53	47
2	89.5	Building B – South Façade	70	62
3	20.5	Building B – Podium Terrace	65	N/A*
4	89.5	Building B – East Façade	67	60
5	20.5	Building B – Podium Terrace	65	N/A*
6	20.5	Building A – Podium Terrace	60	N/A*
7	85	Building A – Rooftop Terrace	32	N/A*
8	91	Building B – Rooftop Terrace	62	N/A*

**Noise levels during the nighttime are not considered for OLAs*

The results of the current analysis indicate that transportation noise levels will range between 53 and 70 dBA during the daytime period (07:00-23:00) and between 47 and 62 dBA during the nighttime period (23:00-07:00). The highest noise level (i.e. 70 dBA) occurs along the south façade of Building B, which has the most exposure to Highway 417 to the south.

5.2 Stationary Noise Levels

Noise levels from existing stationary sources across the study site were found to be as high as 54 dBA during the nighttime period. These levels exceed the Class 1 criteria but are below the Class 4 limits. The anticipated sound levels across the development are summarized in Table 5 and are based on the assumptions outlined in Section 4.3.2.

TABLE 5: NOISE LEVELS FROM STATIONARY SOURCES

Receptor Number	Receptor Height Above Grade/Roof (m)	Receptor Location	Noise Level (dBA)		Exclusionary Limits		Meets ENCG Class 4 Criteria	
			Day	Night	Day	Night	Day	Night
R1	1.5	Building B Podium South Façade	54	54	60	55	YES	YES
R2	30	Building B Tower South Façade	54	54	60	55	YES	YES
	60		53	53	60	55	YES	YES
	88		52	52	60	55	YES	YES
R3	1.5	Building B Podium Terrace	52	52	60	55	YES	YES
R4	1.5	Building B Rooftop Terrace	34	34	60	55	YES	YES
R5	1.5	Building A Rooftop Terrace	28	28	60	55	YES	YES

Noise contours throughout the study site can be seen in Figure 5 and 6 for daytime and nighttime conditions. The main contributor of noise at these locations are the chiller units. The most impacted area of the development is the south façade of Building B, which has direct exposure to and the least setback from the CBN facility.

5.3 Ground Vibrations & Ground-borne Noise Levels

Based on an offset distance of 27 metres between the Trillium Line railway centerline and the nearest building foundation, the estimated ground vibration level at the nearest point of reception is expected to be 0.02 mm/s RMS (57.8 dBV) based on the FTA protocol. Details of the calculation are provided in Appendix B. Since predicted vibration levels are below the criterion of 0.10 mm/s RMS, no mitigation will be required.

According to the United States Federal Transit Authority's vibration assessment protocol, ground borne noise can be estimated by subtracting 35 dB from the velocity vibration level in dBV. Since estimated ground vibration levels were found to be less than 0.10 mm/s peak partial velocity (ppv), ground borne noise levels are also expected to be below the ground borne noise criteria of 35 dB.

6. CONCLUSIONS AND RECOMMENDATIONS

The results of the current analysis indicate that transportation noise levels will range between 53 and 70 dBA during the daytime period (07:00-23:00) and between 47 and 62 dBA during the nighttime period (23:00-07:00). The highest noise level (i.e. 70 dBA) occurs along the south façade of Building B, which has the most exposure to Highway 417 to the south. Noise levels at the Building B podium terraces exceed the criteria for outdoor living areas. It is expected that a noise screen will be required. Building components with a higher Sound Transmission Class (STC) rating will be required on façades where noise levels exceed 65 dBA.

In addition to upgraded windows, the development will require the installation of central air conditioning (or similar mechanical system) will be required for all units in the development, which will allow occupants to keep windows closed and maintain a comfortable living environment. Warning Clauses will be required in all Agreements of Lease, Purchase and Sale.

Specific transportation noise control measures will be determined as part of a detailed study conducted at the time of Site Plan Application (SPA).

Due to the influence of existing stationary sources associated with the adjacent Canadian Bank Note (CBN) facility on the site, which exceed the Class 1 area sound level limits, it is recommended that the new development be considered as a Class 4 area. For infill situations under the ENCG, new noise sensitive buildings that have ventilation systems to allow windows and doors to remain closed as an integral part of their design can apply to be deemed a Class 4 designation, which has applicable sound level limits of 60 and 55 dBA during the daytime and nighttime, respectively. Once approved by council, existing landowners should be notified of the designation which they can use in dealing with their MECP approval applications. The following stationary Warning Clause will be required in all Agreements of Lease, Purchase and Sale of residential units.

"Purchasers/tenants are advised that sound levels due to the adjacent commercial facilities may interfere with outdoor activities as the sound levels may exceed the sound level limits of the City of Ottawa and the Ministry of the Environment.

Purchasers/tenants are further advised that sound levels due to the adjacent commercial facility are required to comply with sound level limits that are protective of indoor areas and are based on the assumption that windows and exterior doors are closed. This dwelling unit has been supplied with a ventilation/air conditioning system which will allow windows and exterior doors to remain closed."

Stationary noise impacts from the development on the surroundings can be minimized by judicious placement mechanical equipment such as its placement on a roof or in a mechanical penthouse, or the incorporation of silencers and noise screens as necessary. It is recommended that any large pieces of HVAC equipment be placed in the middle of the roof, avoiding line of site with the surrounding residential dwellings. A stationary noise assessment for on-site equipment will be conducted during detailed design.

The estimated ground vibration level at the nearest point of reception is expected to be 0.02 mm/s RMS (57.8 dBV) based on the FTA protocol. Since predicted vibration levels are below the criterion of 0.10 mm/s RMS, no mitigation will be required. Since estimated vibration levels were found to be less than 0.10 mm/s peak partial velocity (ppv), ground borne noise levels are also expected to be below the ground borne noise criteria of 35 dB.

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

Sincerely,

Gradient Wind Engineering Inc.

LICENSED PROFESSIONAL ENGINEER
J. R. FOSTER
100155655
May 30, 2025
PROVINCE OF ONTARIO

Michael Pantano

Michael Pantano, M. ASc.
Junior ANV Engineer
Gradient Wind File #21-147-Noise & Vibration R2

Joshua Foster, P.Eng.
Lead Engineer

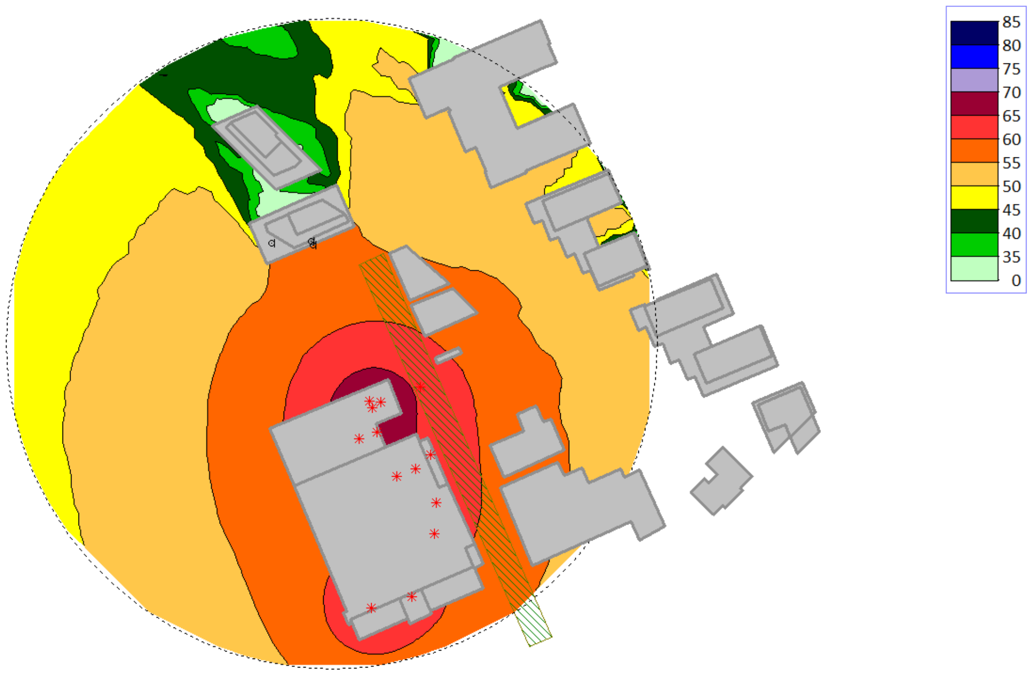


FIGURE 5: DAYTIME/NIGHTTIME STATIONARY NOISE CONTOURS (20 M ABOVE GRADE)

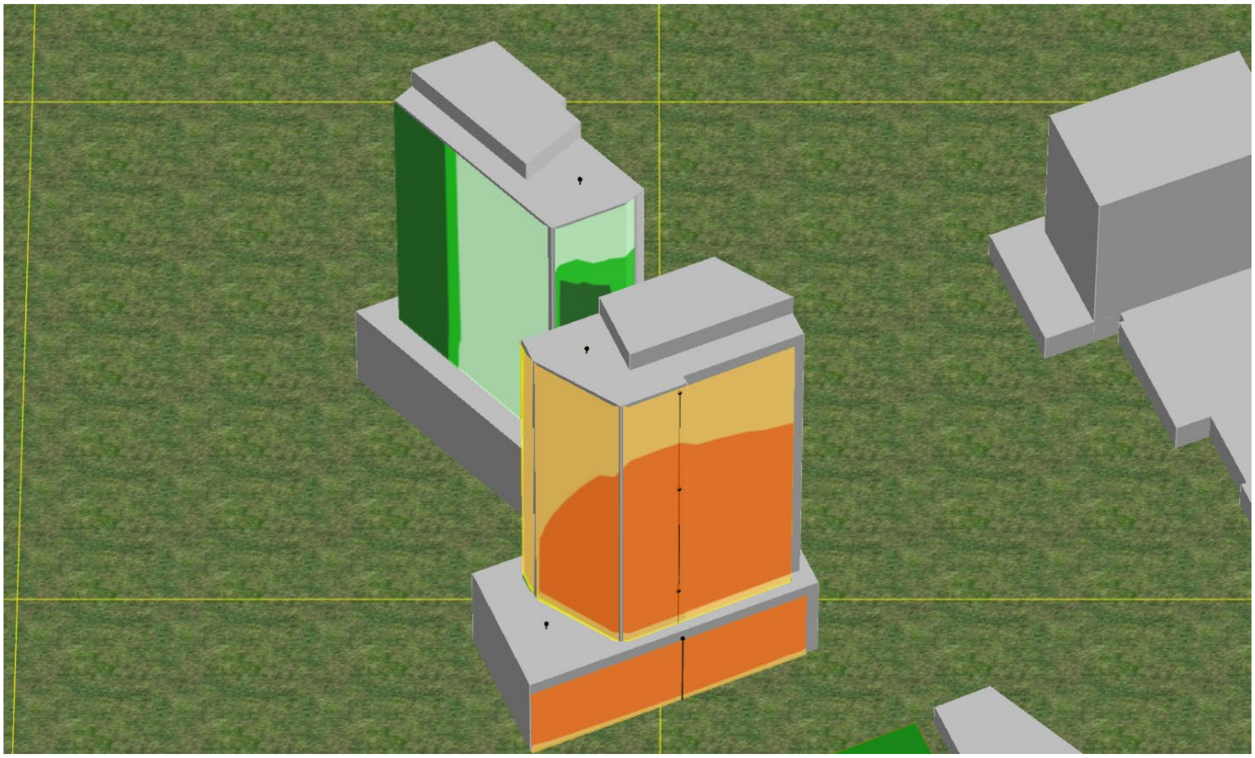
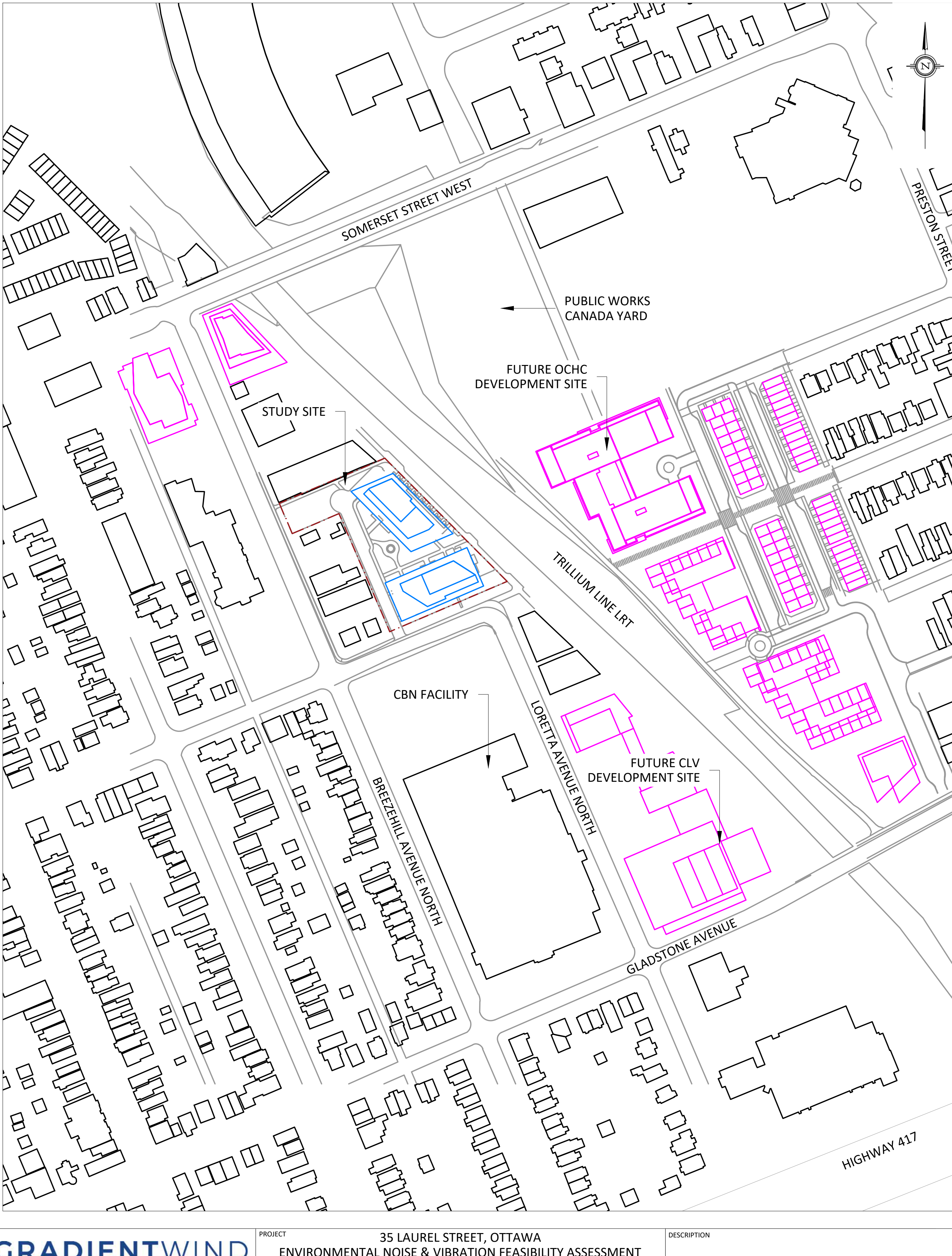


FIGURE 6: DAYTIME/NIGHTTIME STATIONARY NOISE CONTOURS (ISO VIEW)

80 – 85 dB
75 – 80 dB
70 – 75 dB
65 – 70 dB
60 – 65 dB
55 – 60 dB
50 – 55 dB
45 – 50 dB
40 – 45 dB
35 – 40 dB
0 – 35 dB



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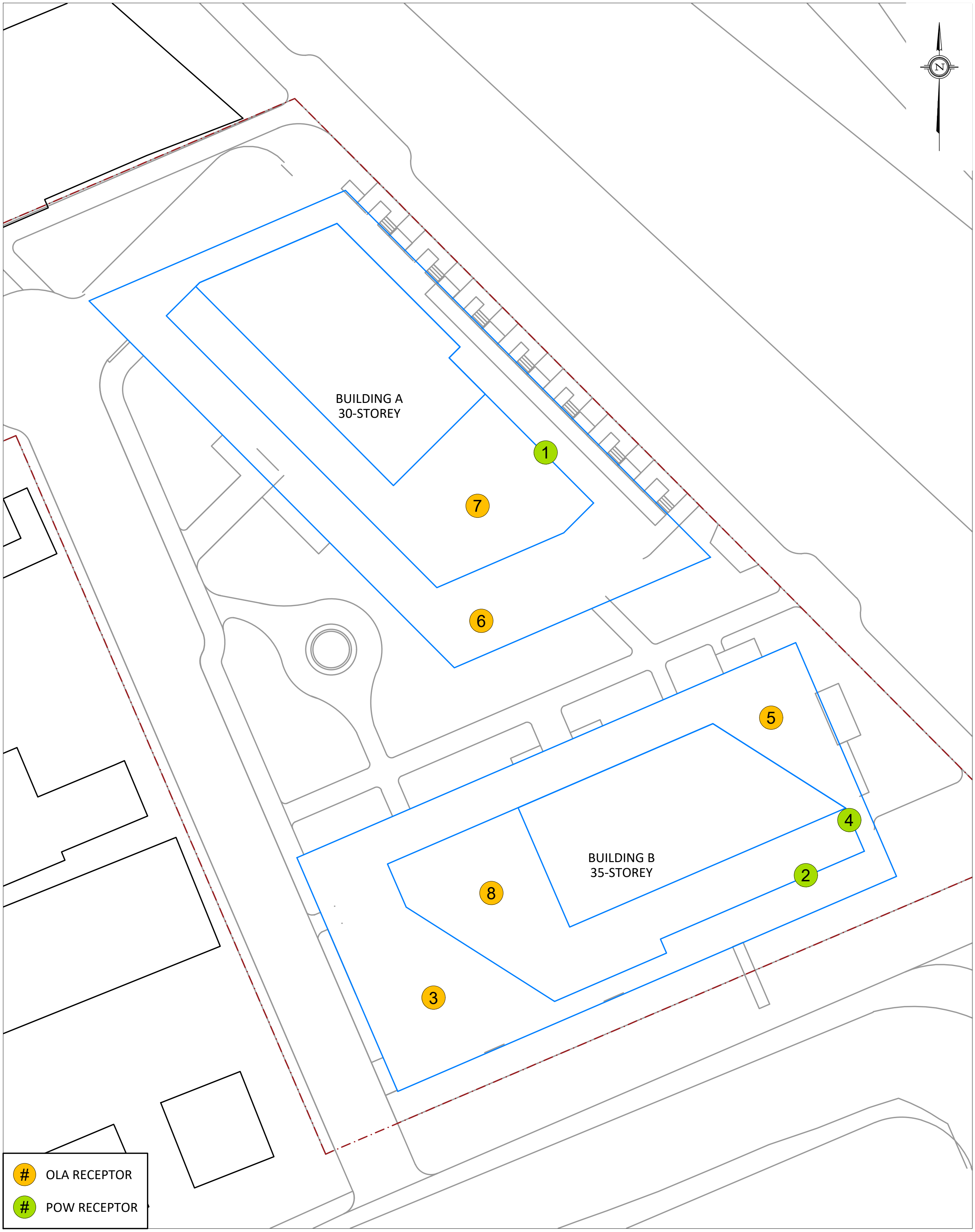
PROJECT: 35 LAUREL STREET, OTTAWA ENVIRONMENTAL NOISE & VIBRATION FEASIBILITY ASSESSMENT		DESCRIPTION: FIGURE 1: SITE PLAN AND SURROUNDING CONTEXT
SCALE: 1:3000 (APPROX.)	DRAWING NO.: GW21-147-1	
DATE: MAY 29, 2025	DRAWN BY: A.B.	



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PROJECT	35 LAUREL STREET, OTTAWA ENVIRONMENTAL NOISE & VIBRATION FEASIBILITY ASSESSMENT		DESCRIPTION
SCALE	1:500 (APPROX.)	DRAWING NO. GW21-147-2	FIGURE 2: TRANSPORTATION NOISE RECEPTOR LOCATIONS
DATE	MAY 30, 2025	DRAWN BY A.B.	

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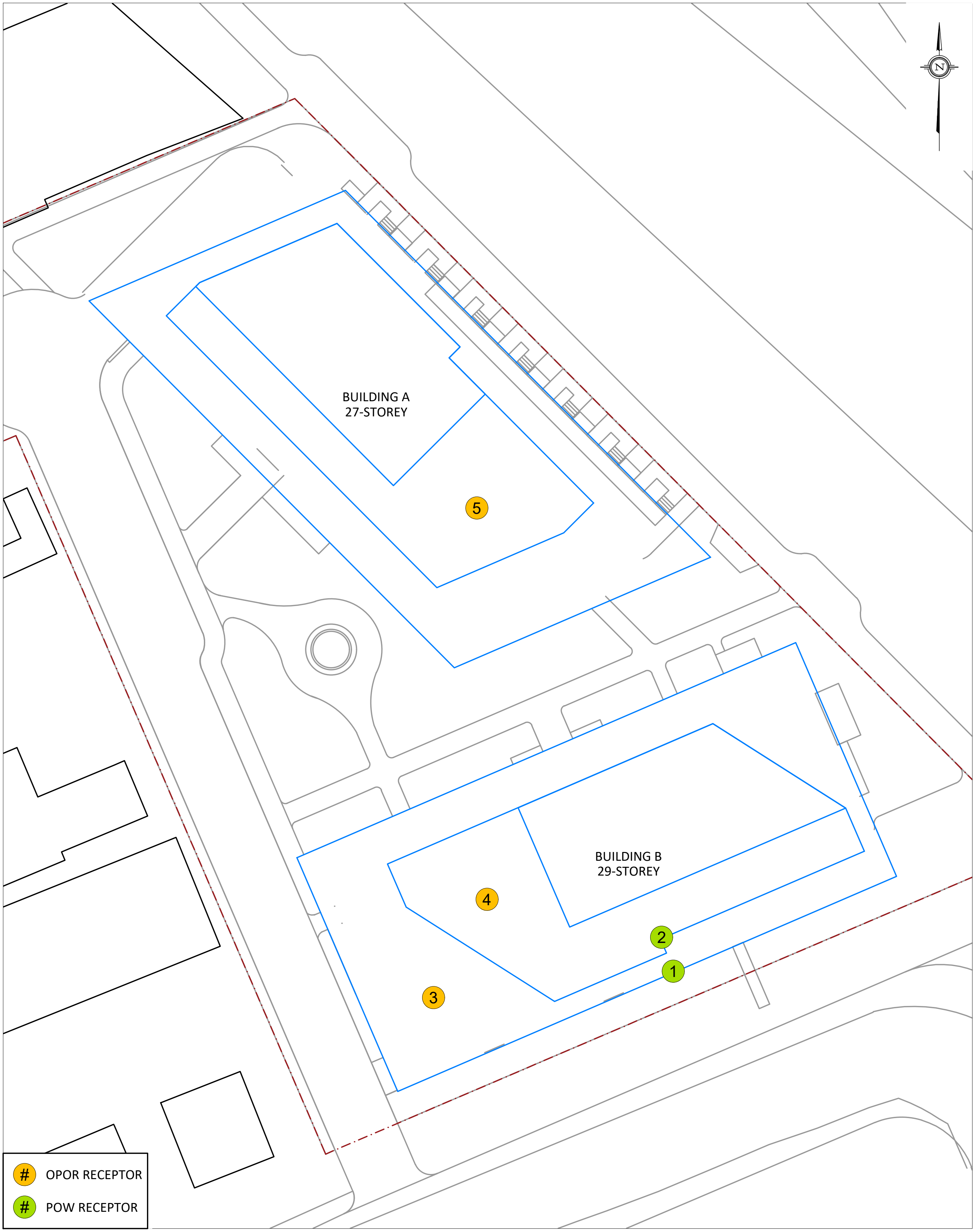
PROJECT	35 LAUREL STREET, OTTAWA ENVIRONMENTAL NOISE & VIBRATION FEASIBILITY ASSESSMENT
SCALE	1:1000 (APPROX.)
DRAWING NO.	GW21-147-3
DATE	NOVEMBER 20, 2023
DRAWN BY	A.B.
DESCRIPTION	FIGURE 3: STATIONARY NOISE SOURCE LOCATIONS



GRADIENTWIND ENGINEERS & SCIENTISTS	PROJECT: 35 LAUREL STREET, OTTAWA ENVIRONMENTAL NOISE & VIBRATION FEASIBILITY ASSESSMENT		DESCRIPTION: FIGURE 4: STATIONARY NOISE RECEPTOR LOCATIONS
127 WALGREEN ROAD , OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM	SCALE: 1:500 (APPROX.)	DRAWING NO.: GW21-147-4	
	DATE: MAY 30, 2025	DRAWN BY: A.B.	

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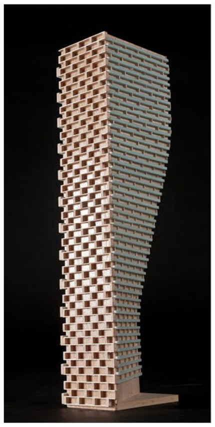

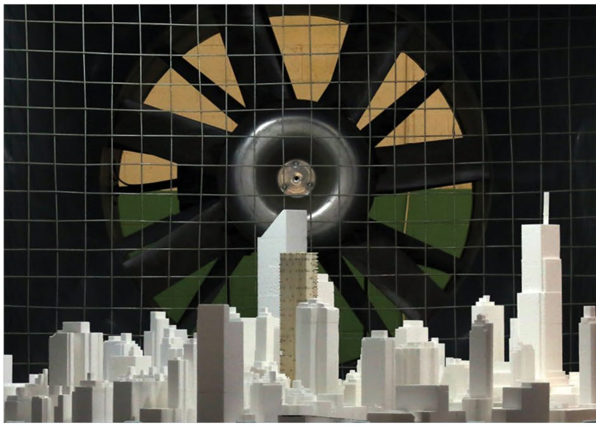

APPENDIX A

STAMSON INPUT AND OUTPUT DATA

127 WALGREEN ROAD, OTTAWA, ON, CANADA K0A 1L0 | 613 836 0934
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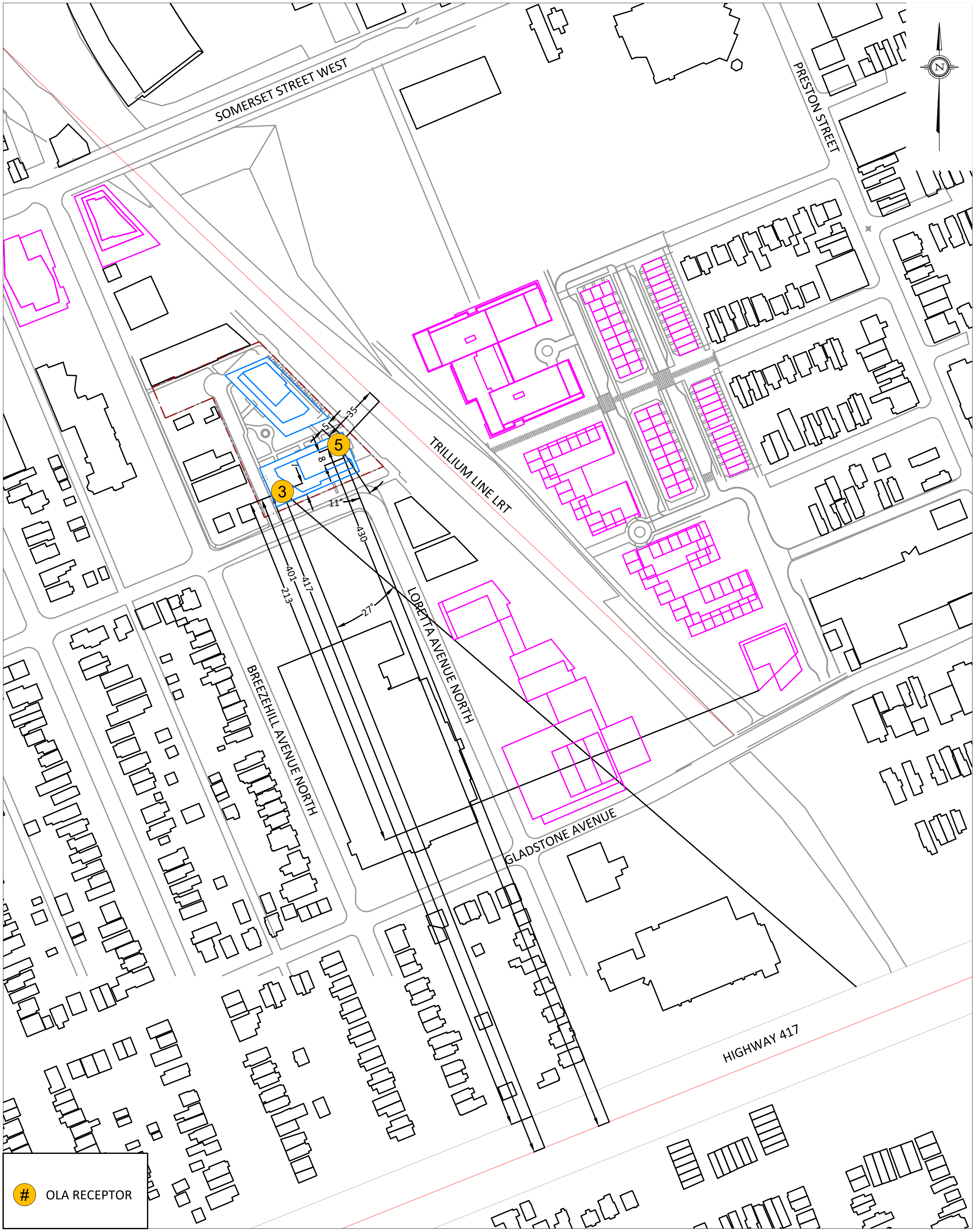
PROJECT	35 LAUREL STREET, OTTAWA ENVIRONMENTAL NOISE & VIBRATION FEASIBILITY ASSESSMENT			DESCRIPTION
SCALE	1:3000 (APPROX.)	DRAWING NO.	GW21-147-A1	FIGURE A1: STAMSON INPUT PARAMETERS - R1,2
DATE	MAY 29, 2025	DRAWN BY	A.B.	



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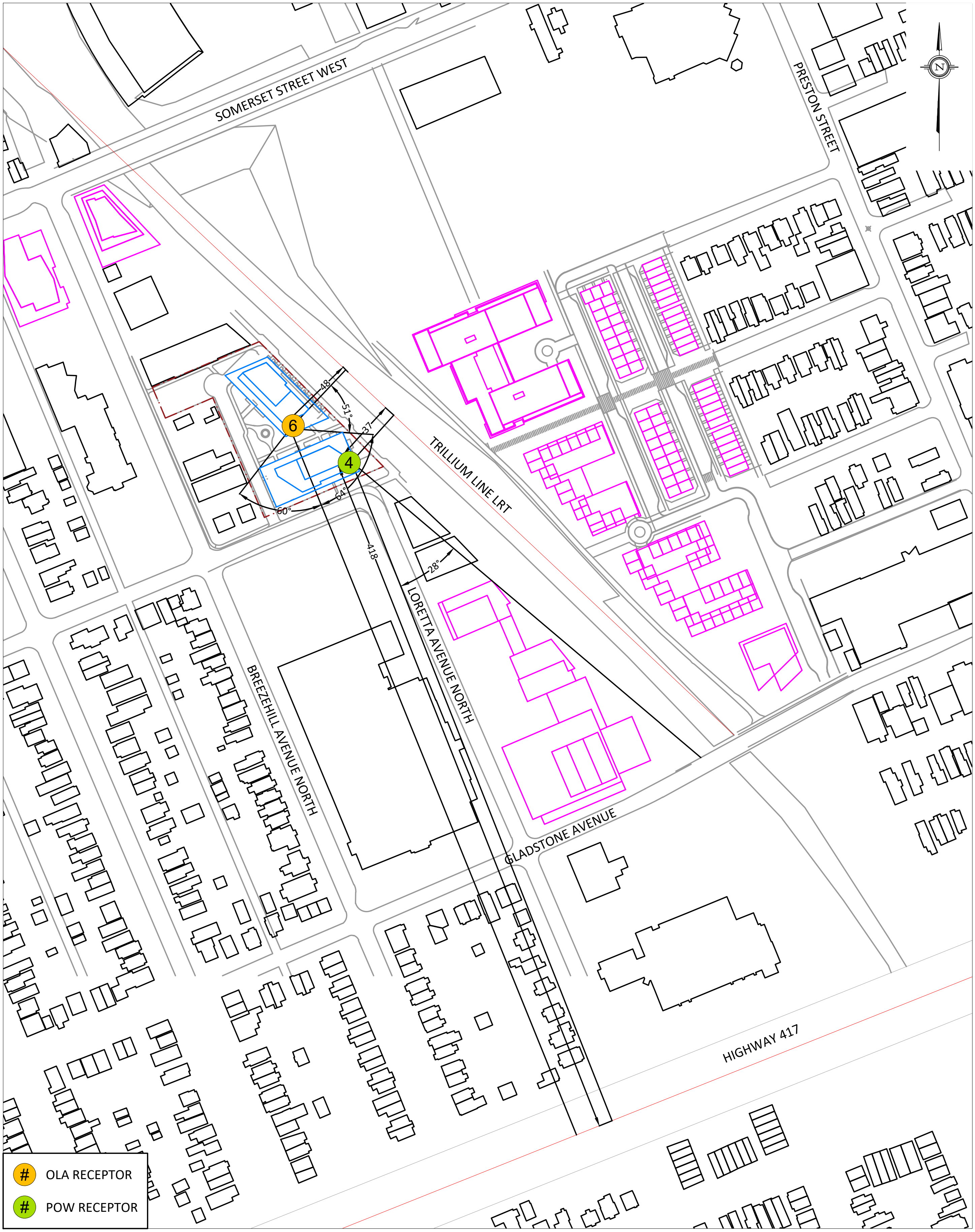
PROJECT: 35 LAUREL STREET, OTTAWA ENVIRONMENTAL NOISE & VIBRATION FEASIBILITY ASSESSMENT		DESCRIPTION: FIGURE A2: STAMSON INPUT PARAMETERS - R3,5
SCALE: 1:3000 (APPROX.)	DRAWING NO.: GW21-147-A2	
DATE: MAY 29, 2025	DRAWN BY: A.B.	



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PROJECT: 35 LAUREL STREET, OTTAWA ENVIRONMENTAL NOISE & VIBRATION FEASIBILITY ASSESSMENT		DESCRIPTION: FIGURE A3: STAMSON INPUT PARAMETERS - R4,6
SCALE: 1:3000 (APPROX.)	DRAWING NO.: GW21-147-A3	
DATE: MAY 29, 2025	DRAWN BY: A.B.	

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PROJECT: 35 LAUREL STREET, OTTAWA ENVIRONMENTAL NOISE & VIBRATION FEASIBILITY ASSESSMENT		DESCRIPTION: FIGURE A3: STAMSON INPUT PARAMETERS - R7,8
SCALE: 1:3000 (APPROX.)	DRAWING NO.: GW21-147-A4	
DATE: MAY 30, 2025	DRAWN BY: M.P.	

```
STAMSON 5.0        NORMAL REPORT        Date: 19-10-2023 14:10:49
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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

RT/Custom data, segment # 1: LRT (day/night)
--------------------------------------------
1 - 4-car SRT:
Traffic volume     :   192/24    veh/TimePeriod
Speed              :    50 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   :  31.00 / 31.00  m
Receiver height            :  91.50 / 91.50  m
Topography                 :      1       (Flat/gentle slope; no barrier)
Reference angle            :   0.00

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

Source height = 0.50 m

RT/Custom (0.00 + 52.87 + 0.00) = 52.87 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.00  56.02  -3.15   0.00   0.00   0.00   0.00  52.87
----------------------------------------------------------------------

Segment Leq : 52.87 dBA

Total Leq All Segments: 52.87 dBA

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

Source height = 0.50 m

RT/Custom (0.00 + 46.85 + 0.00) = 46.85 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.00  50.00  -3.15   0.00   0.00   0.00   0.00  46.85
----------------------------------------------------------------------

Segment Leq : 46.85 dBA
```

```
Total Leq All Segments: 46.85 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 52.87
                         (NIGHT): 46.85
```

```
STAMSON 5.0        NORMAL REPORT        Date: 19-10-2023 14:10:01
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Highway 417 (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: Highway 417 (day/night)
---------------------------------------------
Angle1   Angle2            : -90.00 deg   90.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   : 414.00 / 414.00 m
Receiver height            : 106.50 / 106.50 m
Topography                 :      2       (Flat/gentle slope; with
barrier)
Barrier angle1             : -23.00 deg   Angle2 : 90.00 deg
Barrier height             :   4.50 m
Barrier receiver distance  : 400.00 / 400.00 m
Source elevation           :   0.00 m
Receiver elevation         :   0.00 m
Barrier elevation          :   0.00 m
Reference angle            :   0.00

Results segment # 1: Highway 417 (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 !       106.50 !         5.05 !          5.05

ROAD (65.71 + 67.98 + 0.00) = 70.00 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------
   -90    -23   0.00  84.41   0.00 -14.41  -4.29   0.00   0.00   0.00  65.71
-----------------------------------------------------------------------
   -23     90   0.00  84.41   0.00 -14.41  -2.02   0.00   0.00  -4.60  63.37*
   -23     90   0.00  84.41   0.00 -14.41  -2.02   0.00   0.00   0.00  67.98
-----------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 70.00 dBA

Total Leq All Segments: 70.00 dBA

Results segment # 1: Highway 417 (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 !       106.50 !         5.05 !          5.05

ROAD (58.11 + 60.38 + 0.00) = 62.40 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------
   -90    -23   0.00  76.81   0.00 -14.41  -4.29   0.00   0.00   0.00  58.11
-----------------------------------------------------------------------
   -23     90   0.00  76.81   0.00 -14.41  -2.02   0.00   0.00  -4.60  55.78*
   -23     90   0.00  76.81   0.00 -14.41  -2.02   0.00   0.00   0.00  60.38
-----------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 62.40 dBA
Total Leq All Segments: 62.40 dBA
```

```
RT/Custom data, segment # 1: LRT (day/night)
--------------------------------------------
1 - 4-car SRT:
Traffic volume    :   192/24    veh/TimePeriod
Speed             :    50  km/h

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2           :  23.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  44.00 / 44.00  m
Receiver height           : 106.50 / 106.50 m
Topography                :      1       (Flat/gentle slope; no
barrier)
Reference angle           :   0.00

Results segment # 1: LRT (day)
------------------------------
Source height = 0.50 m

RT/Custom (0.00 + 47.06 + 0.00) = 47.06 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
    23     90   0.00  56.02  -4.67  -4.29   0.00   0.00   0.00  47.06
----------------------------------------------------------------------

Segment Leq : 47.06 dBA

Total Leq All Segments: 47.06 dBA

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

Source height = 0.50 m

RT/Custom (0.00 + 41.04 + 0.00) = 41.04 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
    23     90   0.00  50.00  -4.67  -4.29   0.00   0.00   0.00  41.04
----------------------------------------------------------------------

Segment Leq : 41.04 dBA

Total Leq All Segments: 41.04 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 70.02
                         (NIGHT): 62.43
```

```
STAMSON 5.0        NORMAL REPORT        Date: 12-07-2023 16:16:18
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: 417A (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: 417A (day/night)
--------------------------------------
Angle1   Angle2           : -90.00 deg   -27.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 417.00 / 417.00 m
Receiver height           :  20.50 / 20.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -46.00 deg
Barrier height            :   0.00 m
Barrier receiver distance : 213.00 / 213.00 m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 2: 417B (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: 417B (day/night)
--------------------------------------
Angle1   Angle2           : -27.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 417.00 / 417.00 m
Receiver height           :  20.50 / 20.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -27.00 deg   Angle2 : 90.00 deg
Barrier height            :   4.50 m
Barrier receiver distance : 401.00 / 401.00 m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Results segment # 1: 417A (day)
-------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver     ! Barrier      ! Elevation of
Height  (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
------------+--------------+--------------+--------------
       1.50 !        20.50 !        10.79 !        10.79
```

```
ROAD (0.00 + 62.06 + 58.81) = 63.74 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
--------------------------------------------------------------------------
   -90    -46   0.09  84.41   0.00 -15.74  -6.61   0.00   0.00  -0.31  61.75*
   -90    -46   0.09  84.41   0.00 -15.74  -6.61   0.00   0.00   0.00  62.06
--------------------------------------------------------------------------
   -46    -27   0.09  84.41   0.00 -15.74  -9.85   0.00   0.00   0.00  58.81
--------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 63.74 dBA

Results segment # 2: 417B (day)
--------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
-------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       20.50 !        2.22 !         2.22

ROAD (0.00 + 59.30 + 0.00) = 59.30 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
--------------------------------------------------------------------------
   -27     90   0.00  84.41   0.00 -14.44  -1.87   0.00   0.00  -8.80  59.30
--------------------------------------------------------------------------

Segment Leq : 59.30 dBA

Total Leq All Segments: 65.07 dBA

Results segment # 1: 417A (night)
----------------------------------

Source height = 1.50 m
```

```
Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.50 !       20.50 !       10.79 !        10.79

ROAD (0.00 + 54.46 + 51.22) = 56.14 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
--------------------------------------------------------------------------
   -90    -46   0.09  76.81   0.00 -15.74  -6.61   0.00   0.00  -0.31  54.15*
   -90    -46   0.09  76.81   0.00 -15.74  -6.61   0.00   0.00   0.00  54.46
--------------------------------------------------------------------------
   -46    -27   0.09  76.81   0.00 -15.74  -9.85   0.00   0.00   0.00  51.22
--------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 56.14 dBA

Results segment # 2: 417B (night)
---------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.50 !       20.50 !        2.22 !         2.22

ROAD (0.00 + 51.70 + 0.00) = 51.70 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
--------------------------------------------------------------------------
   -27     90   0.00  76.81   0.00 -14.44  -1.87   0.00   0.00  -8.80  51.70
--------------------------------------------------------------------------

Segment Leq : 51.70 dBA

Total Leq All Segments: 57.47 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 65.07
                         (NIGHT): 57.47
```

```
STAMSON 5.0        NORMAL REPORT        Date: 19-10-2023 14:13:32
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Highway 417 (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: Highway 417 (day/night)
---------------------------------------------
Angle1   Angle2           : -90.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 418.00 / 418.00 m
Receiver height           : 106.50 / 106.50 m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -28.00 deg   Angle2 : 0.00 deg
Barrier height            :   4.50 m
Barrier receiver distance : 403.00 / 403.00 m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Results segment # 1: Highway 417 (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 !       106.50 !         5.26 !          5.26

ROAD (65.33 + 61.88 + 0.00) = 66.95 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
--------------------------------------------------------------------------
   -90    -28   0.00  84.41   0.00 -14.45  -4.63   0.00   0.00   0.00  65.33
--------------------------------------------------------------------------
   -28      0   0.00  84.41   0.00 -14.45  -8.08   0.00   0.00  -3.97  57.90*
   -28      0   0.00  84.41   0.00 -14.45  -8.08   0.00   0.00   0.00  61.88
--------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 66.95 dBA

Total Leq All Segments: 66.95 dBA

Results segment # 1: Highway 417 (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 !       106.50 !         5.26 !          5.26

ROAD (57.73 + 54.28 + 0.00) = 59.35 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
--------------------------------------------------------------------------
   -90    -28   0.00  76.81   0.00 -14.45  -4.63   0.00   0.00   0.00  57.73
--------------------------------------------------------------------------
   -28      0   0.00  76.81   0.00 -14.45  -8.08   0.00   0.00  -3.97  50.31*
   -28      0   0.00  76.81   0.00 -14.45  -8.08   0.00   0.00   0.00  54.28
--------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 59.35 dBA

Total Leq All Segments: 59.35 dBA
```

```
RT/Custom data, segment # 1: LRT (day/night)
--------------------------------------------
1 - 4-car SRT:
Traffic volume    :   192/24    veh/TimePeriod
Speed             :    50  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  :  38.00 / 38.00  m
Receiver height            : 106.50 / 106.50 m
Topography                 :      1       (Flat/gentle slope; no barrier)
Reference angle            :   0.00

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

Source height = 0.50 m

RT/Custom (0.00 + 51.99 + 0.00) = 51.99 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.00  56.02  -4.04   0.00   0.00   0.00   0.00  51.99
----------------------------------------------------------------------

Segment Leq : 51.99 dBA

Total Leq All Segments: 51.99 dBA

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

Source height = 0.50 m

RT/Custom (0.00 + 45.97 + 0.00) = 45.97 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.00  50.00  -4.04   0.00   0.00   0.00   0.00  45.97
----------------------------------------------------------------------

Segment Leq : 45.97 dBA

Total Leq All Segments: 45.97 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 67.09
                         (NIGHT): 59.54
```

```
STAMSON 5.0        NORMAL REPORT        Date: 12-07-2023 16:14:35
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: 417 (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: 417 (day/night)
-------------------------------------
Angle1   Angle2           : -90.00 deg   -11.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 430.00 / 430.00 m
Receiver height           :  20.50 / 20.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -11.00 deg
Barrier height            :  19.00 m
Barrier receiver distance :   8.00 / 8.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Results segment # 1: 417 (day)
------------------------------

Source height = 1.50 m
```

```
Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.50 !       20.50 !       20.15 !        20.15

ROAD (0.00 + 64.65 + 0.00) = 64.65 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -90    -11   0.00  84.41   0.00 -14.57  -3.58   0.00   0.00  -1.43  64.83*
   -90    -11   0.09  84.41   0.00 -15.89  -3.87   0.00   0.00   0.00  64.65
-------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 64.65 dBA

Total Leq All Segments: 64.65 dBA

Results segment # 1: 417 (night)
--------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.50 !       20.50 !       20.15 !        20.15

ROAD (0.00 + 57.05 + 0.00) = 57.05 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -90    -11   0.00  76.81   0.00 -14.57  -3.58   0.00   0.00  -1.43  57.23*
   -90    -11   0.09  76.81   0.00 -15.89  -3.87   0.00   0.00   0.00  57.05
-------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 57.05 dBA

Total Leq All Segments: 57.05 dBA

RT/Custom data, segment # 1: LRT (day/night)
--------------------------------------------
1 - 4-car SRT:
Traffic volume     :   192/24    veh/TimePeriod
Speed              :    50  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                   :      1       (Absorptive ground surface)
Receiver source distance  :  35.00 / 35.00  m
Receiver height           :  20.50 / 20.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :  19.00 m
Barrier receiver distance :   5.00 / 5.00   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 !       20.50 !       17.64 !        17.64

RT/Custom (0.00 + 44.05 + 0.00) = 44.05 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.00  56.02  -3.68   0.00   0.00   0.00  -8.29  44.05
----------------------------------------------------------------------

Segment Leq : 44.05 dBA

Total Leq All Segments: 44.05 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 !       20.50 !       17.64 !        17.64

RT/Custom (0.00 + 38.03 + 0.00) = 38.03 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.00  50.00  -3.68   0.00   0.00   0.00  -8.29  38.03
----------------------------------------------------------------------

Segment Leq : 38.03 dBA

Total Leq All Segments: 38.03 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 64.69
                         (NIGHT): 57.10
```

```
STAMSON 5.0        NORMAL REPORT        Date: 12-07-2023 16:24:40
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: 417 (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: 417 (day/night)
-------------------------------------
Angle1   Angle2           : -90.00 deg   60.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 450.00 / 450.00 m
Receiver height           :  20.50 / 20.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -61.00 deg   Angle2 : 60.00 deg
Barrier height            :  80.00 m
Barrier receiver distance :  15.00 / 15.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Results segment # 1: 417 (day)
------------------------------

Source height = 1.50 m
```

```
Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
-------------+--------------+--------------+---------------
        1.50 !        20.50 !        19.87 !         19.87

ROAD (59.73 + 47.91 + 0.00) = 60.01 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
--------------------------------------------------------------------------
   -90    -61   0.09  84.41   0.00 -16.10  -8.58   0.00   0.00   0.00  59.73
--------------------------------------------------------------------------
   -61     60   0.00  84.41   0.00 -14.77  -1.72   0.00   0.00 -20.00  47.91
--------------------------------------------------------------------------

Segment Leq : 60.01 dBA

Total Leq All Segments: 60.01 dBA

Results segment # 1: 417 (night)
--------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
-------------+--------------+--------------+---------------
        1.50 !        20.50 !        19.87 !         19.87

ROAD (52.13 + 40.31 + 0.00) = 52.41 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
--------------------------------------------------------------------------
   -90    -61   0.09  76.81   0.00 -16.10  -8.58   0.00   0.00   0.00  52.13
--------------------------------------------------------------------------
   -61     60   0.00  76.81   0.00 -14.77  -1.72   0.00   0.00 -20.00  40.31
--------------------------------------------------------------------------

Segment Leq : 52.41 dBA

Total Leq All Segments: 52.41 dBA

RT/Custom data, segment # 1: LRT (day/night)
--------------------------------------------
1 - 4-car SRT:
Traffic volume     :   192/24    veh/TimePeriod
Speed              :    50  km/h
```

```
Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2           :   0.00 deg   54.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  45.00 / 45.00  m
Receiver height           :  20.50 / 20.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :   0.00 deg   Angle2 : 54.00 deg
Barrier height            :  19.00 m
Barrier receiver distance :  18.00 / 18.00  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 !       20.50 !       12.50 !        12.50

RT/Custom (0.00 + 27.26 + 0.00) = 27.26 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
     0     54   0.00  56.02  -4.77  -5.23   0.00   0.00 -18.76  27.26
----------------------------------------------------------------------

Segment Leq : 27.26 dBA

Total Leq All Segments: 27.26 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 !        20.50 !        12.50 !         12.50

RT/Custom (0.00 + 21.24 + 0.00) = 21.24 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------
     0     54   0.00  50.00  -4.77  -5.23   0.00   0.00 -18.76  21.24
-----------------------------------------------------------------------

Segment Leq : 21.24 dBA

Total Leq All Segments: 21.24 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 60.01
                         (NIGHT): 52.41
```

```
STAMSON 5.0        NORMAL REPORT        Date: 30-05-2025 19:34:17
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


RT/Custom data, segment # 1: LRT (day/night)
---------------------------------------------
1 - 4-car SRT:
Traffic volume    :   192/24    veh/TimePeriod
Speed             :    50  km/h

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2           : -39.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  40.00 / 40.00  m
Receiver height           :  85.00 / 85.00  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -39.00 deg   Angle2 : 90.00 deg
Barrier height            :  83.50 m
Barrier receiver distance :   8.00 / 8.00   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 !       85.00 !       68.10 !        68.10

RT/Custom (0.00 + 32.40 + 0.00) = 32.40 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------
   -39     90   0.00  56.02  -4.26  -1.45   0.00   0.00 -17.92  32.40
-----------------------------------------------------------------------

Segment Leq : 32.40 dBA

Total Leq All Segments: 32.40 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 !       85.00 !       68.10 !        68.10

RT/Custom (0.00 + 26.38 + 0.00) = 26.38 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -39     90   0.00  50.00  -4.26  -1.45   0.00   0.00 -17.92  26.38
----------------------------------------------------------------------

Segment Leq : 26.38 dBA

Total Leq All Segments: 26.38 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 32.40
                         (NIGHT): 26.38
```

```
STAMSON 5.0        NORMAL REPORT        Date: 30-05-2025 18:29:47
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r8.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            : -45.00 deg   90.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   : 424.00 / 424.00 m
Receiver height            :  91.00 / 91.00  m
Topography                 :      2       (Flat/gentle slope; with barrier)
Barrier angle1             : -45.00 deg   Angle2 : 90.00 deg
Barrier height             :  89.50 m
Barrier receiver distance  :  12.00 / 12.00  m
Source elevation           :   0.00 m
Receiver elevation         :   0.00 m
Barrier elevation          :   0.00 m
Reference angle            :   0.00

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 !        91.00 !        88.47 !         88.47

ROAD (0.00 + 62.23 + 0.00) = 62.23 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -45     90   0.00  84.41   0.00 -14.51  -1.25   0.00   0.00  -6.42
62.23
--------------------------------------------------------------------------
--

Segment Leq : 62.23 dBA

Total Leq All Segments: 62.23 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 !        91.00 !        88.47 !         88.47

ROAD (0.00 + 54.63 + 0.00) = 54.63 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -45     90   0.00  76.81   0.00 -14.51  -1.25   0.00   0.00  -6.42
54.63
--------------------------------------------------------------------------
--

Segment Leq : 54.63 dBA

Total Leq All Segments: 54.63 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 62.23
                         (NIGHT): 54.63
```

APPENDIX B

FTA VIBRATION CALCULATIONS

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

GW21-147 26-Oct-23

Possible Vibration Impacts on 35 Laurel Street
Perdicted using FTA General Assesment

Train Speed 50 km/h 31 mph

	Distance from C/L	
	(m)	(ft)
CN	27.0	88.6

		Vibration		
From FTA Manual Fig 10-1				
	Vibration Levels at distance from track	68	dBV re 1 micro in/sec	
Adjustment Factors FTA Table 10-1				
	Speed reference 50 mph	-4	Speed Limit of 50 km/h (31 mph)	
	Vehicle Parameters	0	Assume Soft primary suspension, Wheels run true	
	Track Condition	0	None	
	Track Treatments	0	None	
	Type of Transit Structure	0	None	
	Efficient vibration Propagation	0	Propagation through rock	
	Vibration Levels at Fdn	64		0.040
	Coupling to Building Foundation	-10	Large Massonry on Piles	
	Floor to Floor Attenuation	-2.0	Ground Floor Ocupied	
	Amplification of Floor and Walls	6		
	Total Vibration Level	57.84783	dBV or	0.020 mm/s
	Noise Level in dBA	22.84783	dBA	

Table 6-11 Source Adjustment Factors for Generalized Predictions of GB Vibration and Noise

Source Factor	Adjustment to Propagation Curve			Comment
		Reference Speed		
	Vehicle Speed	50 mph	30 mph	
Speed	60 mph	+1.6 dB	+6.0 dB	Vibration level is approximately proportional to $20\log(speed/speed_{ref})$, see Eq. 6-4.
	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.
Track Conditions (not additive, apply greatest value only)				
Worn or Corrugated Track	+10 dB			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. If there are adjustments for vehicle parameters and the track is worn or corrugated, only include one adjustment.
Special Trackwork within 200 ft	+10 dB (within 100 ft) +5 dB (between 100 and 200 ft)			Wheel impacts at special trackwork will greatly increase vibration levels. The increase will be less at greater distances from the track. Do not include an adjustment for special trackwork more than 200 ft away.
Jointed Track	+5 dB			Jointed track can cause higher vibration levels than welded track.
Uneven Road Surfaces	+5 dB			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.

*Mill scale on a new rail is a slightly corrugated condition caused by certain steel mill techniques.

Table 6-12 Path Adjustment Factors for Generalized Predictions of GB Vibration and Noise

Path Factor	Adjustment to Propagation Curve			Comment
Resiliently Supported Ties (Low-Vibration Track, LVT)	-10 dB			Resiliently supported tie systems have been found to provide very effective control of low-frequency vibration.
Track Structure (not additive, apply greatest value only)				
Type of Transit Structure	Relative to at-grade tie & ballast:			In general, 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.
	Elevated structure		-10 dB	
	Open cut		0 dB	
	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.	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.
		50 ft	+2 dB	
		100 ft	+4 dB	
		150 ft	+6 dB	
		200 ft	+9 dB	
Coupling to building foundation	Wood-Frame Houses		-5 dB	In general, the heavier the building construction, the greater the coupling loss.
	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	