TRAFFIC NOISE ASSESSMENT

90 Champagne Avenue South
Ottawa, Ontario

REPORT: GWE19-019 – Traffic Noise

PREPARED FOR
Loretta Apartments Inc.
50 Bayswater Avenue
Ottawa, Ontario
K1Y 2E9

PREPARED BY
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EXECUTIVE SUMMARY

This report describes a traffic noise assessment in support of a rezoning application for a proposed residential development located at 90 Champagne Avenue South in Ottawa, Ontario. The development is a fifteen-storey building with 2 levels of underground parking. At grade there are two amenity spaces, lobby and residential units, as well as the entrance to the underground parking which fronts onto Champagne Avenue South. The remaining floorplates are comprised of residential units. A mixture of inset and cantilevered balconies are present on Floor 2 to Floor 15, except for variations at Level 13 and 14. Balconies and terraces are considered to be noise sensitive outdoor living areas (OLA) if they are greater than or equal to 4-meters in depth. Since these proposed balconies do not exceed this value, they are not considered to be noise sensitive spaces and were not included in the assessment. The major sources of transportation noise on the development are the O-train light rail line (LRT) to the east and the Queensway (Highway 417) to the north. 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) and City of Ottawa requirements; (ii) noise level criteria as specified by the City of Ottawa’s Environmental Noise Control Guidelines (ENCG); (iii) future vehicular traffic volumes based on the City of Ottawa’s Official Plan roadway classifications; and (iv) site plan drawings prepared by Roderick Lahey Architect dated February 2019.

The results of the current analysis indicate that noise levels will range between 38 and 66 dBA during the daytime period (07:00-23:00) and between 32 and 59 dBA during the nighttime period (23:00-07:00). The highest noise level (66 dBA) occurs at the north façade, which is nearest and most exposed to the Queensway. Building components with a higher Sound Transmission Class (STC) rating will be required where exterior noise levels exceed 65 dBA, as indicated in Figure 5.

Results of the calculation also indicate the development will require air conditioning, or similar mechanical ventilation, which will allow occupants to keep windows closed to maintain a comfortable indoor living environment. A Warning Clause will also be required to be placed on all Lease, Purchase and Sale Agreements, as summarized in Section 6.
With regard to ground-borne vibration noise from the nearby rail line, the City of Ottawa’s Official Plan Section 4.8.7 indicates that railway lines within 75 meters from the nearest façade of the development require a vibration noise assessment. Since the O-Train light rail line exceeds this criterion (approximately 103 meters from the nearest façade), a noise vibration assessment was not included in this report.

During the time of site plan application, the stationary noise impacts of the building on the surroundings would be considered. Stationary noise sources associated with the development could include rooftop air handling units, cooling towers or dry coolers, and emergency generators. Noise from these sources however can be controlled to acceptable limits established by MECP by judicious selection of the equipment, locating the equipment on high roof away from nearby residential receptors, and where necessary installing silencers or noise screens.
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1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Loretta Apartments Incorporated to undertake a roadway traffic noise assessment in support of a rezoning application for a proposed residential development at 90 Champagne Avenue South in Ottawa, Ontario. This report summarizes the methodology, results, and recommendations related to the assessment of exterior and interior noise levels generated by local transportation.

Our work is based on theoretical noise calculation methods conforming to the City of Ottawa\(^1\) and Ministry of the Environment, Conservation and Parks (MECP)\(^2\) guidelines. Noise calculations were based on architectural drawings prepared by Roderick Lahey Architect dated February 2019, with future traffic volumes corresponding to the City of Ottawa’s Official Plan (OP) roadway classifications.

2. TERMS OF REFERENCE

The focus of this traffic noise assessment is a proposed residential development at 90 Champagne Avenue South in Ottawa, Ontario. The study site is located on the west side of Champagne Avenue South, approximately mid-block between Beech Street to the north and Hickory Street to the south. Ev Tremblay Park is located directly northeast of the site, across Champagne Avenue South.

The proposed development is a fifteen-storey residential building of rectangular planform, with the long axis oriented along Champagne Avenue South. The primary building entrances are located along the east elevation. A vehicle entrance to two levels of underground parking is located at a sunken inset at the northwest corner of the site, accessed from Champagne Avenue South by a parking ramp along the north side of the building. At Level 2, the floorplate extends at the north, east and south sides to overhang ground floor, and a mixture of inset and cantilevered balconies are featured along the façades. A rectangular inset also occurs at the central east side of Levels 2 and above. The building continues with this floorplan until Level 15, except for balcony variations at Levels 13 and 14. From the parapet height at the west corners (1.2 metres), the roof parapets approximately raise an additional 2.4 metres towards the

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\(^1\) City of Ottawa Environmental Noise Control Guidelines, January 2016

\(^2\) Ontario Ministry of the Environment and Climate Change – Environmental Noise Guidelines, Publication NPC-300, Queens Printer for Ontario, Toronto, 2013

Loretta Apartments Inc. / Roderick Lahey Architect Inc.
90 CHAMPAGNE AVENUE SOUTH, OTTAWA: TRAFFIC NOISE ASSESSMENT
east corners. Note, as per ENCG, balconies less than 4 m in depth are not considered as outdoor living areas. There are no rooftop terraces or other OLA’s planned.

The site is bound by high-rise residential buildings to the west, south, and east with low-rise residential buildings beyond. The major sources of transportation noise on the development are the O-train light rail line (LRT) to the east and the Queensway (Highway 417) to the north. Figure 1 illustrates a complete site plan with surrounding context.

3. OBJECTIVES

The principal objectives of this study are to (i) calculate the future noise levels on the study buildings produced by local roadway traffic, and (ii) ensure that interior and exterior noise levels do not exceed the allowable limits specified by the City of Ottawa’s Environmental Noise Control Guidelines as outlined in Section 4.2 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 ($2 \times 10^{-5}$ 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, $L_{\text{eq}}$, 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 $L_{\text{eq}}$ is commonly calculated on the basis of a 16-hour ($L_{\text{eq16}}$) daytime (07:00-23:00) / 8-hour ($L_{\text{eq8}}$) nighttime (23:00-07:00) split to assess its impact on residential buildings. The City of Ottawa’s Environmental Noise Control Guidelines (ENCG) specifies that the recommended indoor noise limit range (that is relevant to this study) is 45 and 40 dBA for living rooms and sleeping quarters respectively for roadway as listed in Table 1. Based on Gradient Wind’s experience, more comfortable indoor noise levels should be targeted, towards 47, 42, and 37 dBA, respectively, to control peak noise and deficiencies in building envelope construction.

**TABLE 1: INDOOR SOUND LEVEL CRITERIA (ROAD)**

<table>
<thead>
<tr>
<th>Type of Space</th>
<th>Time Period</th>
<th>Leq (dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>General offices, reception areas, retail stores, etc.</td>
<td>07:00 – 23:00</td>
<td>50</td>
</tr>
<tr>
<td>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.</td>
<td>07:00 – 23:00</td>
<td>45</td>
</tr>
<tr>
<td>Sleeping quarters of hotels/motels</td>
<td>23:00 – 07:00</td>
<td>45</td>
</tr>
<tr>
<td>Sleeping quarters of residences, hospitals, nursing/retirement homes, etc.</td>
<td>23:00 – 07:00</td>
<td>40</td>
</tr>
</tbody>
</table>

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. A closed window due to a ventilation requirement will bring noise levels down to achieve an acceptable indoor noise level.

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3 Adapted from ENCG 2016 – Tables 2.2b and 2.2c
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.

The sound level criterion for outdoor living areas is 55 dBA, which applies during the daytime (07:00 to 23:00). When noise levels exceed 55 dBA, mitigation must be provided to reduce noise levels where technically and administratively feasible to acceptable levels at or below the criterion.

### 4.2.2 Theoretical Roadway Noise Predictions

Noise predictions were performed with the aid of the MECP computerized noise assessment program, STAMSON 5.04, for road analysis. Appendix A includes the STAMSON 5.04 input and output data. Roadway traffic noise calculations were performed by treating each roadway segment as separate line sources of noise. In addition to the traffic volumes summarized in Table 2, theoretical noise predictions were based on the following parameters:

- Truck traffic on all roadways was taken to comprise 5% heavy trucks and 7% medium trucks, as per ENCG requirements for noise level predictions.
- The day/night split for all streets was taken to be 92%/8%, respectively.
- Ground surfaces were taken to be reflective due to the presence of hard (paved) ground.
- Topography was assumed to be a flat/gentle slope surrounding the study building.
- A difference in elevation for the Queensway and LRT was measured to be approximately 8 meters above grade and 9 meters below grade respectively.
- Receptor height was taken to be 40.55 meters above grade for the centre of the plane of window (POW) for Levels 14.
- The nearby buildings surrounding the site were considered as noise barriers (Figure 3 and 4)
- Noise receptors were strategically placed at 4 locations around the study area (see Figure 2).
- Receptor distances and exposure angles are illustrated in Figures 3 and 4.

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5 MECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.8
6 MECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.1.3
4.2.1 Roadway Traffic Volumes

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

**TABLE 2: ROADWAY TRAFFIC DATA**

<table>
<thead>
<tr>
<th>Segment</th>
<th>Roadway Traffic Data</th>
<th>Speed Limit (km/h)</th>
<th>Traffic Volumes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Queensway (Highway 417 - East Bound)</td>
<td>4 Lane Freeway</td>
<td>100</td>
<td>18,333 / Lane</td>
</tr>
<tr>
<td>Queensway (Highway 417 - West Bound)</td>
<td>4 Lane Freeway</td>
<td>100</td>
<td>18,333 / Lane</td>
</tr>
<tr>
<td>O-Train Rail Line</td>
<td>(LRT)</td>
<td>50</td>
<td>192/24*</td>
</tr>
</tbody>
</table>

* Daytime/Nighttime volumes based on the City of Ottawa’s Environmental Assessment for the LRT Project

4.3 Indoor Noise Calculations

The difference between outdoor and indoor noise levels is the noise attenuation provided by the building envelope. According to common industry practice, complete walls and individual wall elements are rated according to the Sound Transmission Class (STC). The STC ratings of common residential walls built in conformance with the Ontario Building Code (2012) typically exceed STC 35, depending on exterior cladding, thickness and interior finish details. For example, brick veneer walls can achieve STC 50 or more. Standard commercially sided exterior metal stud walls have around STC 45. Standard good quality double-glazed non-operable windows can have STC ratings ranging from 25 to 40, depending on the window manufacturer, pane thickness and inter-pane spacing. As previously mentioned, the windows are the known weak point in a partition.

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\(^7\) City of Ottawa Transportation Master Plan, November 2013
As per Section 4.2, when daytime noise levels (from road and rail sources) at the plane of the window exceed 65 dBA, calculations must be performed to evaluate the sound transmission quality of the building components to ensure acceptable indoor noise levels. The calculation procedure\(^8\) considers:

- Window type and total area as a percentage of total room floor area
- Exterior wall type and total area as a percentage of the total room floor area
- Acoustic absorption characteristics of the room
- Outdoor noise source type and approach geometry
- Indoor sound level criteria, which varies according to the intended use of a space

Based on published research\(^9\), exterior walls possess specific sound attenuation characteristics that are used as a basis for calculating the required STC ratings of windows in the same partition. Due to the limited information available at the time of the study, which was prepared for site plan approval, detailed floor layouts and building elevations have not been finalized; therefore, detailed STC calculations could not be performed at this time. As a guideline, the anticipated STC requirements for windows have been estimated based on the overall noise reduction required for each intended use of space (STC = outdoor noise level – targeted indoor noise levels).

5. RESULTS AND DISCUSSION

5.1 Roadway Traffic Noise Levels

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

\(^8\) Building Practice Note: Controlling Sound Transmission into Buildings by J.D. Quirt, National Research Council of Canada, September 1985

\(^9\) CMHC, Road & Rail Noise: Effects on Housing
TABLE 3: EXTERIOR NOISE LEVELS DUE TO ROAD TRAFFIC

<table>
<thead>
<tr>
<th>Receptor Number</th>
<th>Receptor Height Above Grade (m)</th>
<th>Receptor Location</th>
<th>STAMSON 5.04 Noise Level (dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Day</td>
</tr>
<tr>
<td>1</td>
<td>40.5</td>
<td>POW – 14th Floor – East Façade</td>
<td>64</td>
</tr>
<tr>
<td>2</td>
<td>40.5</td>
<td>POW – 14th Floor – South Façade</td>
<td>38</td>
</tr>
<tr>
<td>3</td>
<td>40.5</td>
<td>POW – 14th Floor – West Façade</td>
<td>62</td>
</tr>
<tr>
<td>4</td>
<td>40.5</td>
<td>POW – 14th Floor – North Façade</td>
<td>66</td>
</tr>
</tbody>
</table>

The results of the current analysis indicate that noise levels will range between 38 and 66 dBA during the daytime period (07:00-23:00) and between 32 and 59 dBA during the nighttime period (23:00-07:00). The highest noise level (66 dBA) occurs at the north façade, which is nearest and most exposed to the Queensway.

5.2 Noise Control Measures

The noise levels predicted due to roadway traffic exceed the criteria listed in Section 4.2 for building components. As discussed in Section 4.3, the anticipated STC requirements for windows have been estimated based on the overall noise reduction required for each intended use of space (STC = outdoor noise level – targeted indoor noise levels). As per city of Ottawa requirements, detailed STC calculations will be required to be completed prior to building permit application for each unit type. The STC requirements for the windows are summarized below for various units within the development (see Figure 5):

- **Bedroom/Living Room Windows**
  1. Bedroom/living room windows facing north will require a minimum STC of 29
  2. All other bedroom windows are to satisfy Ontario Building Code (OBC 2012) requirements
• Exterior Walls

(i) Exterior wall components on the north, east, south and west façades will require a minimum STC of 45, which will be achieved with brick cladding or an acoustical equivalent according to NRC test data.10

The STC requirements apply to windows and doors elements. Exterior wall components on these façades are recommended to have a minimum STC of 45, where a window/wall system is used. A review of window supplier literature indicates that the specified STC ratings can be achieved by a variety of window systems having a combination of glass thickness and inter-pane spacing. We have specified an example window configuration, however several manufacturers and various combinations of window components, such as those proposed, will offer the necessary sound attenuation rating. It is the responsibility of the manufacturer to ensure that the specified window achieves the required STC. This can only be assured by using window configurations that have been certified by laboratory testing. The requirements for STC ratings assume that the remaining components of the building are constructed and installed according to the minimum standards of the Ontario Building Code. The specified STC requirements also apply to swinging and/or sliding patio doors.

Results of the calculations also indicate the development will require air conditioning (or similar mechanical system), which will allow occupants to keep windows closed and maintain a comfortable living environment. In addition to ventilation requirements, Warning Clauses will also be required in all Lease, Purchase and Sale Agreements, as summarized in Section 6.

6. CONCLUSIONS AND RECOMMENDATIONS

The results of the current analysis indicate that noise levels will range between 38 and 66 dBA during the daytime period (07:00-23:00) and between 32 and 59 dBA during the nighttime period (23:00-07:00). The highest noise level (66 dBA) occurs at the north façade, which is nearest and most exposed to the Queensway. Building components with a higher Sound Transmission Class (STC) rating will be required for the north façade where exterior noise levels exceed 65 dBA, as indicated in Figure 5.

Results of the calculation also indicate the development will require air conditioning, or similar mechanical ventilation, which will allow occupants to keep windows closed to maintain a comfortable indoor living environment. A Warning Clause will also be required to be placed on all Lease, Purchase and Sale Agreements, as summarized below:

“Purchasers/tenants are advised that sound levels due to increasing road/light rail traffic will interfere with indoor activities as the sound levels exceed the sound level limits of the City and the Ministry of the Environment, Conservation and Parks.

To help address the need for sound attenuation this development includes:

- STC rated multi-pane glazing elements
  - North façade bedroom/living room: STC 29
- STC rated exterior walls
  - North, east, south and west façade: STC 45

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

This dwelling unit has been supplied with a central air conditioning system and other measures 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 City and the Ministry of the Environment, Conservation and Parks.”
This concludes our traffic noise assessment and report. If you have any questions or wish to discuss our findings, please advise us. In the interim, we thank you for the opportunity to be of service.

Sincerely,

Gradient Wind Engineering Inc.

Giuseppe Garro, MASc.
Junior Environmental Scientist
GWE19-019 – Traffic Noise

Joshua Foster, P.Eng.
Principal
FIGURE 1: SITE PLAN AND SURROUNDING CONTEXT
FIGURE 2: RECEPTOR LOCATIONS

POW RECEPTOR

STUDY BUILDING

PROPERTY LINE

127 WALGREEN ROAD, OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM
FIGURE 3: STAMSON RECEPTOR 1-3 INPUT PARAMETERS
FIGURE 5:
BEDROOM AND LIVING ROOM STC REQUIREMENTS

BEDROOM WINDOWS: STC 29
LIVING ROOM WINDOWS: STC 29
APPENDIX A

STAMSON 5.04 – INPUT AND OUTPUT DATA
STAMSON 5.0          NORMAL REPORT          Date: 19-03-2019 15:38:52
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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

Road data, segment # 1: hyw 417 EB (day/night)
----------------------------------------------
Car traffic volume : 59370/5163 veh/TimePeriod *
Medium truck volume : 4723/411 veh/TimePeriod *
Heavy truck volume : 3373/293 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): 73333
  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: hyw 417 EB (day/night)
----------------------------------------------
Angle1   Angle2           :   0.00 deg   38.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 374.00 / 374.00 m
Receiver height           : 40.55 / 40.55 m
Topography                : 3       (Elevated; no barrier)
Elevation                 : 8.00 m
Reference angle           : 0.00

#          #
Road data, segment # 2: hyw 417 WB (day/night)

<table>
<thead>
<tr>
<th>Car traffic volume</th>
<th>59370/5163 veh/TimePeriod</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium truck volume</td>
<td>4723/411 veh/TimePeriod</td>
</tr>
<tr>
<td>Heavy truck volume</td>
<td>3373/293 veh/TimePeriod</td>
</tr>
<tr>
<td>Posted speed limit</td>
<td>100 km/h</td>
</tr>
<tr>
<td>Road gradient</td>
<td>0 %</td>
</tr>
<tr>
<td>Road pavement</td>
<td>1 (Typical asphalt or concrete)</td>
</tr>
</tbody>
</table>

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

- 24 hr Traffic Volume (AADT or SADT): 73332
- 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: hyw 417 WB (day/night)

<table>
<thead>
<tr>
<th>Angle1</th>
<th>Angle2</th>
<th>Wood depth</th>
<th>No of house rows</th>
<th>Surface</th>
<th>Receiver source distance</th>
<th>Receiver height</th>
<th>Topography</th>
<th>Elevation</th>
<th>Reference angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>38.00</td>
<td>0</td>
<td>0 / 0</td>
<td>2</td>
<td>394.00 / 394.00 m</td>
<td>40.55 / 40.55 m</td>
<td>3</td>
<td>8.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Results segment # 1: hyw 417 EB (day)

Source height = 1.50 m

ROAD (0.00 + 60.67 + 0.00) = 60.67 dBA

<table>
<thead>
<tr>
<th>Angle1</th>
<th>Angle2</th>
<th>SubLeq</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>38</td>
<td>0</td>
</tr>
<tr>
<td>0.00</td>
<td>81.40</td>
<td>-13.97</td>
</tr>
<tr>
<td>60.67</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Segment Leq : 60.67 dBA
Results segment # 2: hyw 417 WB (day)
-------------------------------------
Source height = 1.50 m

ROAD (0.00 + 60.45 + 0.00) = 60.45 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj  SubLeq
--  0     38   0.00  81.40   0.00 -14.19  -6.75   0.00   0.00   0.00
60.45
--

Segment Leq : 60.45 dBA
Total Leq All Segments: 63.57 dBA

Results segment # 1: hyw 417 EB (night)
---------------------------------------
Source height = 1.49 m

ROAD (0.00 + 53.08 + 0.00) = 53.08 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj  SubLeq
--  0     38   0.00  73.80   0.00 -13.97  -6.75   0.00   0.00   0.00
53.08
--

Segment Leq : 53.08 dBA

#     #
Results segment # 2: hyw 417 WB (night)

Source height = 1.49 m

ROAD (0.00 + 52.85 + 0.00) = 52.85 dBA

---

<table>
<thead>
<tr>
<th>Angle1</th>
<th>Angle2</th>
<th>Alpha</th>
<th>RefLeq</th>
<th>P.Adj</th>
<th>D.Adj</th>
<th>F.Adj</th>
<th>W.Adj</th>
<th>H.Adj</th>
<th>B.Adj</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>38</td>
<td>0.00</td>
<td>73.80</td>
<td>0.00</td>
<td>-14.19</td>
<td>-6.75</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>52.85</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

Segment Leq : 52.85 dBA

Total Leq All Segments: 55.98 dBA

RT/Custom data, segment # 1: OTrain (day/night)

---

1 - 4-car SRT:
Traffic volume : 192/24 veh/TimePeriod
Speed : 50 km/h

---

<table>
<thead>
<tr>
<th>Angle1</th>
<th>Angle2</th>
</tr>
</thead>
<tbody>
<tr>
<td>-53.00 deg</td>
<td>7.00 deg</td>
</tr>
</tbody>
</table>

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 : 40.55 / 40.55 m
Topography : 3 (Elevated; no barrier)
Elevation : 9.00 m
Reference angle : 0.00
Results segment # 1: OTrain (day)

Source height = 0.50 m

RT/Custom (0.00 + 42.89 + 0.00) = 42.89 dBA

<table>
<thead>
<tr>
<th>Angle1</th>
<th>Angle2</th>
<th>Alpha</th>
<th>RefLeq</th>
<th>D.Adj</th>
<th>F.Adj</th>
<th>W.Adj</th>
<th>H.Adj</th>
<th>B.Adj</th>
<th>SubLeq</th>
</tr>
</thead>
<tbody>
<tr>
<td>-53</td>
<td>7</td>
<td>0.00</td>
<td>56.02</td>
<td>-8.37</td>
<td>-4.77</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>42.89</td>
</tr>
</tbody>
</table>

Segment Leq : 42.89 dBA

Total Leq All Segments: 42.89 dBA

Results segment # 1: OTrain (night)

Source height = 0.50 m

RT/Custom (0.00 + 36.86 + 0.00) = 36.86 dBA

<table>
<thead>
<tr>
<th>Angle1</th>
<th>Angle2</th>
<th>Alpha</th>
<th>RefLeq</th>
<th>D.Adj</th>
<th>F.Adj</th>
<th>W.Adj</th>
<th>H.Adj</th>
<th>B.Adj</th>
<th>SubLeq</th>
</tr>
</thead>
<tbody>
<tr>
<td>-53</td>
<td>7</td>
<td>0.00</td>
<td>50.00</td>
<td>-8.37</td>
<td>-4.77</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>36.86</td>
</tr>
</tbody>
</table>

Segment Leq : 36.86 dBA

Total Leq All Segments: 36.86 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 63.61

(NIGHT): 56.03
STAMSON 5.0 NORMAL REPORT  
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT 

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

Description:

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

Data for Segment # 1: Otrain (day/night)
----------------------------------------

<table>
<thead>
<tr>
<th>Angle1</th>
<th>Angle2</th>
<th>Wood depth</th>
<th>No of house rows</th>
<th>Surface</th>
<th>Receiver source distance</th>
<th>Receiver height</th>
<th>Topography</th>
<th>Barrier angle1</th>
<th>Barrier height</th>
<th>Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00 deg</td>
<td>90.00 deg</td>
<td>0 (No woods.)</td>
<td>0 / 0</td>
<td>2 (Reflective ground surface)</td>
<td>107.00 / 107.00 m</td>
<td>40.55 / 40.55 m</td>
<td>4 (Elevated; with barrier)</td>
<td>0.00 deg</td>
<td>69.00 m</td>
<td>9.00 m</td>
</tr>
<tr>
<td>Barrier receiver distance</td>
<td>79.00 / 79.00 m</td>
<td>Source elevation</td>
<td>0.00 m</td>
<td>Receiver elevation</td>
<td>0.00 m</td>
<td>Barrier elevation</td>
<td>0.00 m</td>
<td>Reference angle</td>
<td>0.00</td>
<td></td>
</tr>
</tbody>
</table>
Results segment # 1: Otrain (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 !       40.55 !       10.98 !        10.98

RT/Custom (0.00 + 23.26 + 38.36) = 38.49 dBA

Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------
0     68   0.00  56.02  -8.53  -4.23   0.00   0.00 -20.00  23.26
-----------------------------------------------------------------------
68     90   0.00  56.02  -8.53  -9.13   0.00   0.00   0.00  38.36
-----------------------------------------------------------------------
Segment Leq : 38.49 dBA
Total Leq All Segments: 38.49 dBA

Results segment # 1: Otrain (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 !       40.55 !       10.98 !        10.98

RT/Custom (0.00 + 17.24 + 32.34) = 32.47 dBA

Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------
0     68   0.00  50.00  -8.53  -4.23   0.00   0.00 -20.00  17.24
-----------------------------------------------------------------------
68     90   0.00  50.00  -8.53  -9.13   0.00   0.00   0.00  32.34
-----------------------------------------------------------------------
Segment Leq : 32.47 dBA
Total Leq All Segments: 32.47 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 38.49
(NIGHT): 32.47
Road data, segment # 1: hwy 417 EB (day/night)

Car traffic volume : 59370/5163 veh/TimePeriod *
Medium truck volume : 4723/411 veh/TimePeriod *
Heavy truck volume : 3373/293 veh/TimePeriod *

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

24 hr Traffic Volume (AADT or SADT): 73332
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: hwy 417 EB (day/night)

Angle1 Angle2 : -25.00 deg 0.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 378.00 / 378.00 m
Receiver height : 40.55 / 40.55 m
Topography : 3 (Elevated; no barrier)
Elevation : 8.00 m
Reference angle : 0.00
Road data, segment # 2: hwy 417 WB (day/night)
----------------------------------------------
Car traffic volume : 59370/5163 veh/TimePeriod *
Medium truck volume : 4723/411 veh/TimePeriod *
Heavy truck volume : 3373/293 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): 73332
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: hwy 417 WB (day/night)
--------------------------------------------
Angle1 Angle2 : -25.00 deg 0.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 398.00 / 398.00 m
Receiver height : 40.55 / 40.55 m
Topography : 3 (Elevated; no barrier)
Elevation : 8.00 m
Reference angle : 0.00

Results segment # 1: hwy 417 EB (day)
-------------------------------------
Source height = 1.50 m
ROAD (0.00 + 58.81 + 0.00) = 58.81 dBA

<table>
<thead>
<tr>
<th>Angle1</th>
<th>Angle2</th>
<th>Alpha</th>
<th>RefLeq</th>
<th>P.Adj</th>
<th>D.Adj</th>
<th>F.Adj</th>
<th>W.Adj</th>
<th>H.Adj</th>
<th>B.Adj</th>
<th>SubLeq</th>
</tr>
</thead>
<tbody>
<tr>
<td>-25</td>
<td>0</td>
<td>0.00</td>
<td>81.40</td>
<td>0.00</td>
<td>-14.01</td>
<td>-8.57</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>58.81</td>
</tr>
</tbody>
</table>

Segment Leq : 58.81 dBA

#
Results segment # 2: hwy 417 WB (day)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 58.59 + 0.00) = 58.59 dBA

<table>
<thead>
<tr>
<th>Angle1</th>
<th>Angle2</th>
<th>Alpha</th>
<th>RefLeq</th>
<th>P.Adj</th>
<th>D.Adj</th>
<th>F.Adj</th>
<th>W.Adj</th>
<th>H.Adj</th>
<th>B.Adj</th>
</tr>
</thead>
<tbody>
<tr>
<td>-25</td>
<td>0</td>
<td>0.00</td>
<td>81.40</td>
<td>0.00</td>
<td>-14.24</td>
<td>-8.57</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

SubLeq: 58.59

Segment Leq : 58.59 dBA

Total Leq All Segments: 61.71 dBA

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

Source height = 1.49 m

ROAD (0.00 + 51.21 + 0.00) = 51.21 dBA

<table>
<thead>
<tr>
<th>Angle1</th>
<th>Angle2</th>
<th>Alpha</th>
<th>RefLeq</th>
<th>P.Adj</th>
<th>D.Adj</th>
<th>F.Adj</th>
<th>W.Adj</th>
<th>H.Adj</th>
<th>B.Adj</th>
</tr>
</thead>
<tbody>
<tr>
<td>-25</td>
<td>0</td>
<td>0.00</td>
<td>73.80</td>
<td>0.00</td>
<td>-14.01</td>
<td>-8.57</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

SubLeq: 51.21

Segment Leq : 51.21 dBA
Results segment # 2: hwy 417 WB (night)
----------------------------------------

Source height = 1.49 m

ROAD (0.00 + 50.99 + 0.00) = 50.99 dBA

<table>
<thead>
<tr>
<th>Angle1</th>
<th>Angle2</th>
<th>Alpha</th>
<th>RefLeq</th>
<th>P.Adj</th>
<th>D.Adj</th>
<th>F.Adj</th>
<th>W.Adj</th>
<th>H.Adj</th>
<th>B.Adj</th>
<th>SubLeq</th>
</tr>
</thead>
<tbody>
<tr>
<td>-25</td>
<td>0</td>
<td>0.00</td>
<td>73.80</td>
<td>0.00</td>
<td>-14.24</td>
<td>-8.57</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>50.99</td>
</tr>
</tbody>
</table>

Segment Leq: 50.99 dBA

Total Leq All Segments: 54.11 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 61.71
(NIGHT): 54.11
STAMSON 5.0 NORMAL REPORT Date: 19-03-2019 15:39:32
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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

Road data, segment # 1: hwy 417 EB (day/night)

Road traffic volume: 59370/5163 veh/TimePeriod *
Medium truck volume: 4723/4111 veh/TimePeriod *
Heavy truck volume: 3373/293 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): 73332
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: hwy 417 EB (day/night)

Angle1 Angle2: -30.00 deg 40.00 deg
Wood depth: 0 (No woods.)
No of house rows: 0 / 0
Surface: 2 (Reflective ground surface)
Receiver source distance: 370.00 / 370.00 m
Receiver height: 40.55 / 40.55 m
Topography: 3 (Elevated; no barrier)
Elevation: 8.00 m
Reference angle: 0.00

# #
Road data, segment # 2: hwy 417 WB (day/night)

- Car traffic volume: 59370/5163 veh/TimePeriod
- Medium truck volume: 4723/411 veh/TimePeriod
- Heavy truck volume: 3373/293 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): 73332
  - 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: hwy 417 WB (day/night)

- Angle1 Angle2: -30.00 deg 40.00 deg
- Wood depth: 0 (No woods.)
- No of house rows: 0 / 0
- Surface: 2 (Reflective ground surface)
- Receiver source distance: 389.00 / 389.00 m
- Receiver height: 40.55 / 40.55 m
- Topography: 3 (Elevated; no barrier)
- Elevation: 8.00 m
- Reference angle: 0.00

Results segment # 1: hwy 417 EB (day)

- Source height = 1.50 m

ROAD (0.00 + 63.37 + 0.00) = 63.37 dBA

<table>
<thead>
<tr>
<th>Angle1</th>
<th>Angle2</th>
<th>Alpha</th>
<th>RefLeq</th>
<th>P.Adj</th>
<th>D.Adj</th>
<th>F.Adj</th>
<th>W.Adj</th>
<th>H.Adj</th>
<th>B.Adj</th>
<th>SubLeq</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>-30.00</td>
<td>81.40</td>
<td>0.00</td>
<td>-13.92</td>
<td>-4.10</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>63.37</td>
</tr>
</tbody>
</table>

Segment Leq: 63.37 dBA

#
Results segment # 2: hwy 417 WB (day)
-------------------------------------
Source height = 1.50 m

<table>
<thead>
<tr>
<th>Angle1</th>
<th>Angle2</th>
<th>Alpha</th>
<th>RefLeq</th>
<th>P.Adj</th>
<th>D.Adj</th>
<th>F.Adj</th>
<th>W.Adj</th>
<th>H.Adj</th>
<th>B.Adj</th>
<th>SubLeq</th>
</tr>
</thead>
<tbody>
<tr>
<td>-30</td>
<td>40</td>
<td>0.00</td>
<td>81.40</td>
<td>0.00</td>
<td>-14.14</td>
<td>-4.10</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>63.16</td>
</tr>
</tbody>
</table>

Segment Leq : 63.16 dBA

Total Leq All Segments: 66.28 dBA

Results segment # 1: hwy 417 EB (night)
---------------------------------------
Source height = 1.49 m

<table>
<thead>
<tr>
<th>Angle1</th>
<th>Angle2</th>
<th>Alpha</th>
<th>RefLeq</th>
<th>P.Adj</th>
<th>D.Adj</th>
<th>F.Adj</th>
<th>W.Adj</th>
<th>H.Adj</th>
<th>B.Adj</th>
<th>SubLeq</th>
</tr>
</thead>
<tbody>
<tr>
<td>-30</td>
<td>40</td>
<td>0.00</td>
<td>73.80</td>
<td>0.00</td>
<td>-13.92</td>
<td>-4.10</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>55.78</td>
</tr>
</tbody>
</table>

Segment Leq : 55.78 dBA
Results segment # 2: hwy 417 WB (night)
----------------------------------------

Source height = 1.49 m

ROAD (0.00 + 55.56 + 0.00) = 55.56 dBA

<table>
<thead>
<tr>
<th>Angle1</th>
<th>Angle2</th>
<th>Alpha</th>
<th>RefLeq</th>
<th>P.Adj</th>
<th>D.Adj</th>
<th>F.Adj</th>
<th>W.Adj</th>
<th>H.Adj</th>
<th>B.Adj</th>
<th>SubLeq</th>
</tr>
</thead>
<tbody>
<tr>
<td>-30</td>
<td>40</td>
<td>0.00</td>
<td>73.80</td>
<td>0.00</td>
<td>-14.14</td>
<td>-4.10</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>55.56</td>
</tr>
</tbody>
</table>

Segment Leq : 55.56 dBA

Total Leq All Segments: 58.68 dBA

RT/Custom data, segment # 1: OTrain (day/night)
-----------------------------------------------

1 - 4-car SRT:
Traffic volume : 192/24 veh/TimePeriod
Speed : 50 km/h

Data for Segment # 1: OTrain (day/night)
----------------------------------------

<table>
<thead>
<tr>
<th>Angle1</th>
<th>Angle2</th>
<th>Wood depth</th>
<th>No of house rows</th>
<th>Surface</th>
<th>Receiver source distance</th>
<th>Receiver height</th>
<th>Topography</th>
<th>Elevation</th>
<th>Reference angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>-50.00</td>
<td>0.00</td>
<td>0</td>
<td>0 / 0</td>
<td>2</td>
<td>108.00 / 108.00 m</td>
<td>40.55 / 40.55 m</td>
<td>3</td>
<td>9.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>
Results segment # 1: OTrain (day)  
---------------------------------  
Source height = 0.50 m  

RT/Custom (0.00 + 41.89 + 0.00) = 41.89 dBA  

<table>
<thead>
<tr>
<th>Angle1</th>
<th>Angle2</th>
<th>Alpha</th>
<th>RefLeq</th>
<th>D.Adj</th>
<th>F.Adj</th>
<th>W.Adj</th>
<th>H.Adj</th>
<th>B.Adj</th>
<th>SubLeq</th>
</tr>
</thead>
<tbody>
<tr>
<td>-50</td>
<td>0</td>
<td>0.00</td>
<td>56.02</td>
<td>-8.57</td>
<td>-5.56</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>41.89</td>
</tr>
</tbody>
</table>

Segment Leq : 41.89 dBA  
Total Leq All Segments: 41.89 dBA  

Results segment # 1: OTrain (night)  
-----------------------------------  
Source height = 0.50 m  

RT/Custom (0.00 + 35.87 + 0.00) = 35.87 dBA  

<table>
<thead>
<tr>
<th>Angle1</th>
<th>Angle2</th>
<th>Alpha</th>
<th>RefLeq</th>
<th>D.Adj</th>
<th>F.Adj</th>
<th>W.Adj</th>
<th>H.Adj</th>
<th>B.Adj</th>
<th>SubLeq</th>
</tr>
</thead>
<tbody>
<tr>
<td>-50</td>
<td>0</td>
<td>0.00</td>
<td>50.00</td>
<td>-8.57</td>
<td>-5.56</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>35.87</td>
</tr>
</tbody>
</table>

Segment Leq : 35.87 dBA  
Total Leq All Segments: 35.87 dBA  

TOTAL Leq FROM ALL SOURCES (DAY): 66.29  
(NIGHT): 58.70