Taunton Road/Reg. Rd. 57
Intersection and Bridge over Bowmanville Creek
Reconstruction Traffic Noise Impact Assessment

Cambium Reference Number: 5512-001

2018-09-14

Prepared for:
The Municipal Infrastructure Group (TMIG)
Table of Contents

1.0 Introduction ......................................................... 1

2.0 Noise Guidelines ..................................................... 2
  2.1 Provincial ............................................................... 2
  2.2 Municipal .............................................................. 2

3.0 Noise receptors (Noise Sensitive Areas) ............................................. 4

4.0 Traffic Noise Impact Assessment .................................................... 5
  4.1 Methodology ............................................................. 5
  4.2 Calculation Assumptions .............................................. 6

5.0 Predicted Noise Levels ..................................................... 7

6.0 Municipal Considerations .................................................. 9

7.0 Construction Noise and Vibration ................................................. 11
  7.1 Construction Vibration ................................................ 11

8.0 Recommendation Summary .................................................. 14
  8.1 Traffic Noise Impacts ................................................ 14
  8.2 Construction Noise ................................................... 14
  8.2.1 Construction Vibration ............................................ 15

9.0 Conclusions .................................................................. 16

References

List of Appended Figures
Figure 1  Site Location Map
Figure 2  Site Plan
List of Appendices

Appendix A: Clarington Zoning Maps
Appendix B: Clarington Zoning Maps
Appendix C: Durham Regional Noise Barrier Policy
Appendix D: Traffic Data and STAMSON Data
1.0 Introduction

Cambium Inc. (Cambium) was retained by The Municipal Infrastructure Group to undertake a traffic noise assessment of the intersection of Taunton Road and Regional Road 57 (Reg. Rd. 57), the project includes the reconstruction of the bridge over Bowmanville Creek on Taunton Road in Clarington, Ontario (Site). The assessment is part of a Municipal Class Environmental Assessment (EA) and detailed design project tendered by the Durham Region for the bridge over Bowmanville Creek replacement and the reconstruction of the intersection of Taunton Road and Reg. Rd. 57.

At the time of the assessment it was understood that the intersection reconstruction will incorporate auxiliary lanes, improved radii to accommodate truck traffic turning movements, and redesign of the existing lanes to accommodate current and future traffic volumes (storage, taper, and deceleration lengths). In addition to this plan, a second reconstruction option was included in the study: construction of a roundabout at the intersection.

The bridge over Bowmanville Creek, located approximately 115 m west of the intersection, requires replacement to accommodate the additional turn lanes. It is understood that the proposed bridge design will accommodate four (4) lanes of traffic (two through lanes and a left and right turn lane). The new bridge will be located in the same location as the existing bridge, with widening occurring to the south side of the existing bridge so that traffic can be maintained during construction.

The traffic noise assessment is required to evaluate the noise impacts that would result from future expansions, with respect to provincial and municipal noise guidelines.

A traffic vibration assessment is not included in this report, generally speaking the rubber tires and suspension systems of road vehicles provide sufficient vibration isolation and impacts would not be expected from operating on roadways.
2.0 Noise Guidelines

2.1 Provincial

Generally speaking, Taunton Road and Reg. Rd. 57 are considered Arterial Type A roadways as per Durham Region roadway classifications which indicates a highly volume of traffic. This assessment of road traffic noise has been conducted following the guidance included in the Ontario Ministry of Transportation (MTO) Environmental Guide for Noise (Ministry of Transportation Ontario, 2008).

Under the MTO and the Ministry of the Environment, Conservation, and Parks (MECP) guidance, noise assessments are based on traffic noise impacts predicted 10 years after construction of the modification. Overall traffic noise assessments are compared to a 16 hour daytime period from 07:00 hours to 23:00 hours. The assessment is generally completed using the 16 hour equivalent A-weighted sound level (LAeq 16 hour). The noise impact of a proposed modification is generally defined as the difference in noise level above the predicted future noise level, if there are no changes to the roadway. Which is to say that the proposed change, is compared to the “do nothing” scenario, and the difference between the two (2) is assessed.

Under the MTO and MECP guidance, noise mitigation should be investigated in cases where the predicted increase is greater than 5 decibels (dB). Mitigation measures should achieve a reduction of 5 dB and reduce the predicted future levels to either the future “do-nothing” sound levels, or 55 A-weighted decibels (dBA) representing the LAeq 16 hour, whichever is higher.

2.2 Municipal

Cambium conducted a search for local noise bylaws. The municipality of Clarington has a noise by-law however, it is based on a prescriptive approach, with specific requirements for controlling noise that may disturb residents, and does not address typical road traffic noise.
Durham Region has a policy for regional roads whereby it is expected that noise mitigation will be considered for new construction or expansion of a regional road, when predicted noise levels at existing dwellings exceed 60 dBA, or exceed 55 dBA and the difference between existing and projected noise levels is five (5) dBA or more. It should be noted that in this project, the future traffic volumes provided to Cambium are the same regardless of intersection design (IE “do nothing” and proposed option traffic numbers are the same).

Note that the municipal rules specifically apply to the backyard outdoor living areas (OLA). Thus, analysis for this criteria will consider existing noise levels, compared to future predicted noise levels in the backyards of the representative noise receptors.
3.0 Noise receptors (Noise Sensitive Areas)

As per MECP and MTO guidance, noise impacts are generally assessed in the outdoor living area of a noise sensitive land-use. Per the guidance document, this includes private homes, townhouses, apartment buildings with outdoor living areas, hospitals and nursing homes.

Noise receptors are generally identified using the acronym Point of Reception (POR), noise impacts at PORs may be calculated at the OLA and/or in the plane of window of the noise sensitive space.

For this project, PORs have been selected to represent the worst-case noise impacts. The following have been selected:

- POR1: A residential dwelling located at 5034 Reg. Rd. 57, north of the intersection;
- POR2: A residential dwelling located at 2486 Taunton Road, east of the intersection;
- POR3: A residential dwelling located at 4774 Reg. Rd. 57, south of the intersection;
- POR4: a residential dwelling located at 2423 Taunton Road, west of the intersection; and,
- POR5: a residential dwelling located a 2432 Taunton Road, west of the intersection.

The following uses are not considered Noise Sensitive Areas (NSA), shallow apartment balconies, churches, cemeteries, parks and picnic areas that are not part of NSA, commercial and industrial land uses.

Educational facilities and daycare centres, campgrounds, and hotels and motels may be considered for a new freeway or highway corridor.
4.0 Traffic Noise Impact Assessment

In this case, the project is focused on a single intersection. Due to this fact, the future traffic volumes are identical between the “do nothing” scenario, and the preferred scenario. Which is to say, as this is not a general road expansion project, the predicted future traffic is the same regardless of intersection layout. This is relevant due to the dependence of noise analysis for traffic noise on the relative impacts between different proposed options.

The main point of analysis that changes with the proposed update is the layout and number of lanes, which in some case will change the setback distance between the NSA and the road traffic lanes. This is the main consideration in this study of different impacts.

The current intersection layout includes only 3 lanes in each cardinal direction at the intersection, this project is proposing to increase the number of lanes in all directions by adding additional turning lanes, which may modify the setback distance between the roadway and the sensitive receptors nearest the intersection.

4.1 Methodology

All traffic noise levels were predicted using the Ontario Road Noise Analysis Method for Environment and Transportation (ORNAMENT) prediction method which is accepted by the MECP and MTO for traffic noise prediction. The method was implemented using the MECP published STAMSON software Version 5.04.

NSA were modelled as per the MECP and MTO guidance, as outdoor living areas located 3 meters from the building façade and 1.5 metres above grade to represent an outdoor point of reception.

The assessment initially considered the most exposed side of each receptor, as per the guidance. If the predicted noise levels at the most exposed receptor are either more than 5 dB greater than the “do nothing” scenario, or if the general level predicted is over 65 dBA then additional analysis is to be completed at the outdoor living area, typically in the back yard.
In addition to provincial guidance, Durham Region has guidance which requires analysis of the outdoor living area in the back yard, and requires mitigation consideration if the predicted increase is more than 5 dB than the “do nothing” scenario, or the predicted noise level is over 60 dBA.

4.2 Calculation Assumptions

In order to complete all calculations some assumptions must be made. All assumptions were generally confirmed either through the ORNAMENT method or through the confirmation with the professionals who completed the traffic reporting:

- Average Annual Daily Traffic (AADT) was estimated by assuming that combined peak AM and PM hours would be 20% of the AADT;

- The day-night traffic split was assumed to be 90% - 10% as recommended in ORNAMENT for regional roads;

- Trucking percentage was provided by the traffic study, however it does not break down the composition of Medium and Heavy trucks, in order to be conservative Cambium has assumed that Medium trucks account for 25% of truck traffic values for all roads.

- Cambium ignored foliage attenuation, since in most cases it does not appear to meet the 30 metre depth requirement.
5.0 Predicted Noise Levels

As per the MECP and MTO guidance documents, the initial assessment considered the most exposed side of each of the representative noise sensitive receptors. The guideline requires that if the most exposed area has a predicted sound level either greater than 5 dB different from the “do nothing” scenario, or above 65 dBA overall, then the analysis should move to the actual outdoor living area in the back yard of the building.

Three (3) scenarios have been modelled for this project. Note that future traffic levels are predicted to be the same regardless of the intersection style selected. Therefore, the main differences occur due to changes in setback distance from the centerline of the roadway to the noise sensitive area.

A summary of the predicted sound levels is provided in Table 1. Three (3) scenarios have been predicted, including the ambient “do nothing” scenario assuming no changes to the intersection. Option 1 represents the proposal to use a signalized intersection with new lane layouts, and option 2 represents the proposal to use a roundabout. It should be noted here that the ORNAMENT (Ministry of Transportation Ontario, 2008) calculation method required by the Province does not take intersections or the related braking and acceleration into account for traffic noise predictions, however given that this is a relative impact comparison it is still a reasonable tool for assessments.

Table 1 Summary of Predicted 2028 Sound Levels at Most Exposed Side

<table>
<thead>
<tr>
<th>Noise Sensitive Area ID</th>
<th>Ambient (do nothing) (dBA)</th>
<th>Option 1 (dBA)</th>
<th>Option 2 (dBA)</th>
<th>Change Option 1 (dB)</th>
<th>Change Option 2 (dB)</th>
<th>MTO/MECP Mitigation (&gt;5 dB change)</th>
<th>Work Required (&gt; 65 dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>POR1</td>
<td>67.0</td>
<td>68.0</td>
<td>67.0</td>
<td>1.0</td>
<td>0.0</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>POR2</td>
<td>54.7</td>
<td>54.7</td>
<td>54.7</td>
<td>0.0</td>
<td>0.0</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>POR3</td>
<td>61.2</td>
<td>61.1</td>
<td>61.2</td>
<td>-0.1</td>
<td>-0.1</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>POR4</td>
<td>63.9</td>
<td>64.1</td>
<td>64.6</td>
<td>0.2</td>
<td>0.8</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>
The results above have been based on each dwelling’s most exposed façade as a conservative initial screening method. It should be noted that the changes predicted between the “do nothing” ambient scenario and both options are not considered significant and by themselves do not warrant investigation of mitigation measure.

However, sound levels are predicted to exceed 65 dBA in the front yards of POR1 and POR5 based on the guideline this requires further investigation. As per Figure 7.1 of the guideline (Ministry of Transportation Ontario, 2008) if levels at the most exposed façade are over 65 dBA assessment should be made for the dwelling’s specific outdoor living area.

Both dwellings have back yard areas that will be screened from the nearest road by the dwelling itself, Therefore predictions of the sound levels in the outdoor living area will be completed with consideration for that screening.

Table 2 Predicted 2028 Noise Levels Outdoor Living Areas Select Receptors

<table>
<thead>
<tr>
<th>Noise Sensitive Area ID</th>
<th>Ambient (dBA)</th>
<th>Option 1 (dBA)</th>
<th>Option 2 (dBA)</th>
<th>Change Option 1 (dB)</th>
<th>Change Option 2 (dB)</th>
<th>MTO/MECP Mitigation (&gt;5 dB change)</th>
<th>Work Required (&gt; 65 dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>POR1 OLA</td>
<td>60.1</td>
<td>60.4</td>
<td>60.1</td>
<td>0.3</td>
<td>-0.1</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>POR5 OLA</td>
<td>57.2</td>
<td>56.9</td>
<td>56.6</td>
<td>-0.3</td>
<td>-0.6</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

As can be seen in Table 2 once the initial assessment is updated to reflect the outdoor living areas of the two (2) receptors, both locations are within compliance with the guidelines.

Based on these results, on the basis of provincial guidance, consideration of noise controls is not required for either of the proposed options for the intersection.
6.0 Municipal Considerations

Durham Region has a specific policy for guidelines for the installation and maintenance of noise attenuation barriers associated with regional road expansion projects (Report 2012-W-83). This policy sets a guideline level of 60 dBA for consideration of mitigation measures, or if noise levels are above 55 dBA and represent a 5 dB increase over existing levels then mitigation measures should be considered.

<table>
<thead>
<tr>
<th>Noise Sensitive Area ID</th>
<th>2018 Ambient (dBA)</th>
<th>Option 1 (dBA)</th>
<th>Option 2 (dBA)</th>
<th>Change Option 1 (dB)</th>
<th>Change Option 2 (dB)</th>
<th>Durham Mitigation (&gt;5 dB change)</th>
<th>Mitigation Required (&gt; 60 dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>POR1 OLA</td>
<td>59.13</td>
<td>60.4</td>
<td>60.1</td>
<td>1.3</td>
<td>0.9</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>POR2 OLA</td>
<td>48.24</td>
<td>50.1</td>
<td>50.1</td>
<td>1.8</td>
<td>1.9</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>POR3 OLA</td>
<td>54.3</td>
<td>55.6</td>
<td>55.6</td>
<td>1.3</td>
<td>1.3</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>POR4 OLA</td>
<td>53.95</td>
<td>55.3</td>
<td>55.5</td>
<td>1.3</td>
<td>1.6</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>POR5 OLA</td>
<td>56</td>
<td>56.9</td>
<td>56.6</td>
<td>0.9</td>
<td>0.6</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

As you can see from these results, Durham Region has taken a more aggressive approach to noise mitigation than the province, therefore as per the policy, noise mitigation measures must be considered for POR1 which is representative of the worst case homes along the west side of the northern section of Reg. Rd. 57 within the project area.

The policy requires that noise mitigation must achieve at least a 6 dB reduction. Based on preliminary analysis Cambium predicts that to achieve a 6 dB reduction would require a continuous 5 metre high noise barrier along the west side of Reg. Rd. 57. In addition, the barrier must turn west and follow Taunton Road for approximately 140 metres to obtain a reduction on the order of 6 dB. Such a large barrier, combined with the distances required, and
the significant number of openings required for driveway access is not thought by Cambium to be technically or economically feasible.

Specifically, the openings required in the barrier for driveway access would undermine the performance of the barrier significantly, especially since the openings would typically be directly in front of the homes. In order for a barrier to perform as determined in the theoretical calculations it must be constructed with no cracks or gaps, and it must break line of sight with the noise source (traffic). The Durham Region policy requires that in the event that mitigation measures meeting the 6 dB reduction are not feasible, that enhanced vegetative screening be considered.

Cambium would note that the properties along the west side of Reg. Rd. 57 north of Taunton Road are located within 18 metres of the road, this will severely limit the ability of a vegetative screen to achieve meaningful mitigation levels.
7.0 Construction Noise and Vibration

With respect to noise, all construction equipment used on site should comply with NPC-115 (Ontario Ministry of the Environment, Conservation, and Parks, 1981) and silencing equipment should be maintained. In order to minimize construction noise impacts it is recommended to limit construction operations to daytime hours.

In addition, the Municipality of Clarington Noise bylaw will apply to the site, requiring that excavation and construction activities may only occur from 7 am to 9 pm on weekdays and Saturdays, and between the hours of 10 am and 4 pm on Sundays. In addition, earth moving and excavating equipment may not operate on Sundays.

The bylaw allows applications for exemptions if work is of “urgent necessity” which may be possible to argue for in the case of a bridge replacement.

7.1 Construction Vibration

The following evaluations are made for the construction vibrations related to the proposed modifications.

For evaluating the potential damage effects due to vibration from construction activities at the site, the calculation procedure was used as defined in Chapter 12 of the “Transit Noise and Vibration Impact Assessment” (US Department of Transportation, 2006). The assessment criteria defined in this document is less conservative than as defined in the “City of Toronto by-law Number 514-2008” (City of Toronto, 2008), therefore the City of Toronto criteria was used as a local best practice. The City of Toronto criteria defines the ‘zone of influence’ as the area potentially impacted by vibrations emanating from the construction activity where the peak particle velocity measured at the point of reception is equal to or greater than 5 mm/sec.

The required setbacks can be calculated using the reference vibration source levels given in Chapter 12 of the “Transit Noise and Vibration Impact Assessment” and the associated equation:

\[ PPV_{equiv} = PPV_{ref} \times \left(\frac{25}{D}\right)^{1.5} \]
Where:

- PPV (equip) is the peak particle velocity in in/sec of the equipment adjusted for distance
- PPV (ref) is the reference vibration level in in/sec at 25 feet (7.6 metres) from Table 12-2
- D is the setback distance from the equipment to the receiver.

The following table summarizes the vibration impact of various potential construction processes and the resulting zone of influence setback distances in order to maintain compliance with the construction vibration criteria. Note that these setbacks should be re-assessed using the actual construction methods and equipment when the construction stage of the project commences. These values are included to provide a general estimate of potential vibration issues.

<table>
<thead>
<tr>
<th>Standard Potential Equipment</th>
<th>PPV_{ref} at 25 ft (in/sec)</th>
<th>Zone of Influence Setback (m) ¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pile Driver (impact, upper range)</td>
<td>1.518</td>
<td>29.93</td>
</tr>
<tr>
<td>Pile Driver (Sonic, upper range)</td>
<td>0.734</td>
<td>18.44</td>
</tr>
<tr>
<td>Clam shovel drop (slurry wall)</td>
<td>0.202</td>
<td>7.80</td>
</tr>
<tr>
<td>Vibratory Roller</td>
<td>0.210</td>
<td>8.01</td>
</tr>
<tr>
<td>Hoe Ram</td>
<td>0.089</td>
<td>4.52</td>
</tr>
<tr>
<td>Large bulldozer</td>
<td>0.089</td>
<td>4.52</td>
</tr>
<tr>
<td>Caisson drilling</td>
<td>0.089</td>
<td>4.52</td>
</tr>
<tr>
<td>Loaded trucks</td>
<td>0.076</td>
<td>4.07</td>
</tr>
<tr>
<td>Jackhammer</td>
<td>0.035</td>
<td>2.42</td>
</tr>
<tr>
<td>Hydromill (slurry wall, in rock)</td>
<td>0.017</td>
<td>1.50</td>
</tr>
<tr>
<td>Hydromill (slurry wall, in soil)</td>
<td>0.008</td>
<td>0.91</td>
</tr>
<tr>
<td>Small bulldozer</td>
<td>0.003</td>
<td>0.47</td>
</tr>
</tbody>
</table>

¹ Criteria of PPV = 5 mm/sec (0.195 in/sec), as per City of Toronto by-law Number 514-2008.

Once the construction methods of the proposed bridge upgrade have been decided, the locations of specific activities should be reviewed along with the above zone of influence.
setbacks to confirm whether or not pre-construction condition surveys and vibration monitoring are required.

The nearest existing structure, relative to the bridge appears to be an older barn at approximately 41 metres distant from the bridge. Note also that the barn is within 7.5 metres of the existing shoulder, and so may be affected by vibratory compactors often used in road construction activities.

Again, it should be noted that the setbacks indicated here are the zone of influence setbacks as defined in the City of Toronto Bylaw (City of Toronto, 2008). This bylaw was selected based on the fact that a search for local Bylaws did not indicate specific vibration bylaw locally.

These setback distance do not preclude construction and only indicate that if a structure is within this distance it should be considered for pre-construction survey and monitoring during construction. The City of Toronto limits for construction vibration are provided below:

<table>
<thead>
<tr>
<th>Frequency of Vibration (Hz)</th>
<th>Vibration Peak Particle Velocity (PPV) (mm/sec)</th>
<th>PPV (in/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 4</td>
<td>8</td>
<td>0.31</td>
</tr>
<tr>
<td>4 to 10</td>
<td>15</td>
<td>0.59</td>
</tr>
<tr>
<td>More than 10</td>
<td>25</td>
<td>0.98</td>
</tr>
</tbody>
</table>

It is Cambium’s opinion that construction vibration should be re-visited once specific construction methods and equipment use locations are known. The most likely locations requiring pre-construction condition surveys and vibration monitoring would be the nearby barn structure.

Cambium has only assessed visible above grade structures, it is possible that there are below grade utilities that should be considered. However, below grade utilities are typically capable of withstanding elevated vibration levels associated with road works.
8.0 Recommendation Summary

8.1 Traffic Noise Impacts

As noted above, the proposed modification scenarios comply with provincial MECP and MTO guidance for new roadway projects. However, it has been shown that one (1) receptor location (POR1) will slightly exceed the Durham Region Policy on noise barriers for regional road projects. Cambium’s preliminary analysis indicates that without significant modification of the current area layout it is likely not feasible to meet the Policy’s required 6 dB reduction for consideration of noise barriers. Note that Cambium has not completed formal feasibility analysis of the 6 dB barrier, if the Region and project wish to proceed with noise barriers, the recommended barrier layout is as follows:

- 5 metre barrier along the west side of Reg. Rd. 57 extending from the corner of the intersection approximately 110 metres north;
- 5 metre barrier along the north side of Taunton Road extending from the corner of the intersection approximately 140 metres to the west.

It should be noted that in order to be most effective, there should be minimal openings in the barriers. There are many dwellings along the west side of Reg. Rd. 57 whose entrances would reduce the effectiveness of any barrier.

Therefore, noise barriers are not required by Provincial guidance, and are not feasible technically would not comply with the Durham Region Policy Requirements.

The Durham Region Policy does indicate that in these cases where physical noise barriers are not feasible, that vegetative screening be considered. Cambium would recommend that this site would fit within the definition of the policy for that consideration.

8.2 Construction Noise

The following should be considered for construction activities
• Comply with the local noise by-law, including potentially applying for exemptions where required;

• Proper maintenance of equipment to prevent unnecessary noise;

• Muffler systems must be maintained and must be installed;

• Idling should be minimized;

• It is recommended that a noise complaint response procedure be implemented;

• Equipment should comply with MECP Noise Pollution Control Document NPC-115

Noise complaint response procedures would typically include recording and reporting procedures, as well as steps to be taken such as confirming mufflers are installed, and possibly measuring equipment to confirm NPC-115 compliance.

8.2.1 Construction Vibration

As noted construction vibration should be revisited once final construction methods are determined. It appears likely that pre-condition surveys and vibration monitoring may be required for the nearest structures, including the barn, depending on construction methods chosen for the bridge.
9.0 Conclusions

Cambium Inc. was retained by The Municipal Infrastructure Group to prepare a Noise Impact Assessment the project includes the reconstruction of the bridge over Bowmanville Creek on Taunton Road in Clarington, Ontario. The assessment is part of a Municipal Class Environmental Assessment and detailed design project tendered by Durham Region for the bridge over Bowmanville Creek replacement and the reconstruction of the intersection of Taunton Road and Reg. Rd. 57. The purpose of this report is to provide an assessment of the feasibility of the proposed project options with respect to noise.

Cambium has conducted traffic noise predictions based on future traffic counts for three (3) scenarios in addition to the current 2018 traffic noise levels; future 2028 traffic noise levels with no change to the existing intersection, future noise levels for a signalized intersection, and future noise levels for a roundabout intersection. All 2028 future scenarios assumed the same traffic levels will be present regardless of intersection design.

The increase in noise impacts predicted at all assessed nearby receptors due to the proposed project alternatives, are predicted to be minor or negligible. As per the Provincial Guidance noise mitigation investigations are not required.

It was noted that at POR1 the noise levels slightly (less than one dB) exceed Durham Region’s 60 dBA threshold policy for noise mitigation consideration. The Durham Region policy requires that if a noise barrier is implemented it must provide a 6 dB reduction. Based on preliminary calculations, Cambium does not believe that 6 dB reduction is achievable either technically or economically given the current layout of the property entrances. Therefore it is recommended that vegetative screening be considered as required in the Policy document.
Construction noise impacts will be controlled through compliance with the municipal noise bylaw, and compliance with provincial guidelines. Construction vibrations should be considered in detail once construction methods are finalized. Given the proximity of a barn structure to the roadway and the bridge, it may require pre-condition surveys and vibration monitoring during construction depending on equipment selection.

Respectfully submitted,

Cambium Inc.

[Signature]

Trevor Copeland, P.Eng.

Project Coordinator

[Signature]

Trevor Ross, E.I.T.

Project Specialist
References


Taunton Road/Reg. Rd. 57 Intersection and Bridge over Bowmanville Creek
Reconstruction Traffic Noise Impact Assessment
TMIG The Municipal Infrastructure Group
Ref. No.: 5512-001
2018-09-14

Appended Figures

Figures
Figure 1  Site Location Map
Figure 2  Site Plan
Appendix A: Clarington Zoning Maps
Appendix B: Clarington Noise Bylaw
THE CORPORATION OF THE
MUNICIPALITY OF CLARINGTON
BY-LAW 2007-071

Being a By-law to prohibit noises likely to disturb the inhabitants of the Municipality of Clarington and to repeal By-law 89-184 and its amendments

Passed by Council on: April 2, 2007
Consolidated as of: June 17, 2013

Amendments:

<table>
<thead>
<tr>
<th>AMENDING BY-LAW</th>
<th>DATE</th>
<th>AMENDMENT DETAILS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011-068</td>
<td>July 4, 2011</td>
<td>Amend Section 1.1, 3.1, 3.3</td>
</tr>
<tr>
<td>2012-022</td>
<td>March 26, 2012</td>
<td>Adding Section 3.3.1</td>
</tr>
</tbody>
</table>

Disclaimer:

The following consolidated by-law is an electronic reproduction made available for information only. It is not an official version of the By-law. The format may be different, and plans, pictures, other graphics or text may be missing or altered. The Municipality of Clarington does not warrant the accuracy of this electronic version.

Official versions of all By-laws may be obtained from the Municipal Clerk’s Department.
Being a By-law to prohibit noises likely to disturb the inhabitants of the Municipality of Clarington and to repeal By-law 89-184 and its amendments

WHEREAS Section 129 of the Municipal Act, 2001, S.O. 2001, Chapter 25 states that a local municipality may prohibit and regulate noise matters;

AND WHEREAS The Council of the Corporation of the Municipality of Clarington deems it appropriate to enact a by-law to regulate and control noise levels within the Municipality of Clarington;

NOW THEREFORE the Council of the Corporation of the Municipality of Clarington enacts as follows:

1. GENERAL PROVISIONS

1.1 No person shall ring any bell, blow or sound any horn or cause the same to be rung, blown or sounded, or shout or create, cause or permit any unusual or excessive noises which, at the point of reception, are likely to disturb any other inhabitant of the Municipality of Clarington.

1.2 Without limiting the generality of section 1.1 the following are deemed to be noises likely to disturb the inhabitants of the Municipality of Clarington:

   (a) the ringing of bells, blowing of horns or sounding of sirens on any motor vehicle except to the extent that such ringing, blowing or sounding is required by law or by the requirements of safety;

   (b) the sound or noise from or created by a radio or phonograph, or any musical or sound-producing instrument of whatsoever kind when such radio or phonograph or instrument is played or operated in such manner or with such volume as to annoy or disturb the peace, quiet, comfort or repose of any individual in any dwelling house, apartment house, hotel or other type of residence outside the premises where the instrument is being played;
(c) the grating, grinding or rattling noise or sound caused by a condition of disrepair or maladjustment of any motor vehicle, motorcycle, or other vehicle whatsoever or part or accessory thereof;

(d) the blowing of any steam or air whistle attached to or used in connection with any stationary boiler or other machine or mechanism, except for the purpose of giving notice to workmen of the time to commence or cease work or as a warning of danger;

(e) the noise made by power lawnmowers, outboard motors or similar power motors;

(f) the noise made by the discharge into the open air of the exhaust of any steam engine, stationary internal combustion engine, motor vehicle or motorcycle except through a muffler or other device which effectively prevents loud or explosive noise;

(g) any noise which may be heard beyond the lot upon which it is made at sufficient volume to disturb persons beyond such lot;

(h) the persistent barking, calling or whining, or other similar persistent noise made by any domestic pet, or any other animal kept, or used for any purpose other than agriculture.

2. EXEMPTIONS

2.1 Notwithstanding the other provisions of this By-law, the restrictions listed in sections 1.1 and 1.2 shall not apply to prevent:

(a) the use, in a reasonable manner, of any apparatus or mechanism for the amplification of the human voice or music in a public place within the limits of the Municipality;

(b) any military or other band or any parade operating with written permission having been first obtained from the Municipality;

(c) any police, fire, public or emergency service vehicle or ambulance in the lawful discharge of its assigned duties;

(d) any sound arising from the operation of any railway which operates under the Railway Act of Canada or from any plant or work in connection with any such railway;

(e) the sound of church bells or carillons; and
the making by any person upon his or her own property, noise which is reasonable and necessary taking into account the volume and time of day, for his or her enjoyment and use of such property provided that such noise does not interfere with the lawful enjoyment of any adjoining property owner or occupant.

2.2 Notwithstanding the other provisions of this By-law, the restrictions listed in sections 1.1 and 1.2 shall not apply to a person who permits or causes the emission of sound in connection with any traditional, festive, or religious activities, and to such activities listed hereunder:

(a) the Bowmanville Foundry Co. Ltd., manufacturing;
(b) Goodyear Canada Inc., manufacturing;
(c) Oshawa Ski Club, recreational snowmaking;
(d) Mosport Park, automobile and motorcycle racing;
(e) Blue Circle Canada Inc., its licensed pit and quarry operations and all accessory uses related thereto.

3. CURFEWS

3.1 A noise curfew shall apply to the following shooting ranges within the Municipality of Clarington:

(a) the Orono Fish and Hunt Club;
(b) the Union Rod and Gun Club; and

This curfew shall be from 9:00 p.m. until 8:00 a.m. the following day (Monday through Saturday), 9:00 p.m. Saturday until 10:00 a.m. Sunday, and 4:00 p.m. Sunday until 8:00 a.m. Monday.

3.1.1 During non-curfew times, any noise emanating from the use of a shooting range shall not exceed:

(a) 70 dBAI at the point of reception for any shooting range which began operation prior to January 1st 1980; or
(b) 50 dBAI at the point of reception for any shooting range which began operation after January 1st 1980.

3.1.2 Notwithstanding section 3.1 above, all approved indoor shooting ranges within the Municipality shall be exempt from the noise curfew.
3.2 With respect to a licensed canine kennel there shall be a noise curfew imposed, to wit:

(a) evenings - Sunday to Friday inclusive, there shall be a curfew commencing at 11:00 p.m. and continuing until 7:00 a.m. of the following day; Saturday, the curfew shall commence at 11:00 p.m. and shall continue until 8:00 a.m. Sunday morning;

(b) during the periods identified as the curfew hours, any kennel noise, more particularly the barking of dogs, which carries beyond the boundary of the property upon which the licensed kennel is situated shall be deemed to be a contravention; and

(c) that during non-curfew hours, that is from 7:00 a.m. to 11:00 p.m., Monday to Saturday inclusive, and from 8:00 a.m. to 11:00 p.m. Sunday, continuous barking for a period in excess of 1 hour at any time shall be deemed to be a contravention.

3.3 A noise curfew shall apply to any noise from any excavation or construction work whatsoever, including the erection, demolition, alteration or repair of any building from 9:00 p.m. until 7:00 a.m. the following day, (Monday through Saturday), 9:00 p.m. Saturday until 10:00 a.m. Sunday, and from 4:00 p.m. Sunday until 7:00 a.m. Monday.

3.3.1 Notwithstanding anything contained in this By-law, a noise curfew shall apply (a) from 7:00 p.m. to 7:00 a.m., Monday to Saturday; (b) from 5:00 p.m. Saturday to 7:00 a.m., Monday; and (c) all day on statutory holidays, to any noise in relation to work undertaken pursuant to a permit issued under Site Alteration By-law 2008-114.

3.3.2 For the purposes of this by-law, noise related to construction work shall be interpreted to include the starting, idling and warming up of any truck or mechanically powered excavation or earth moving equipment.

3.3.3 Noises emanating from the operations described in section 3.3 and 3.3.1 shall not be considered to be a violation under this by-law when said operations are carried on outside the time periods set out by a curfew.

3.3.4 Notwithstanding any other provision to contrary, appropriate staff may authorize construction work to be carried on outside the curfew restrictions set out in this By-law only in the case of urgent necessity and then only under prior authorization from appropriate staff.
3.4 During the time when construction, excavation or demolition work is permitted on Sunday as outlined in Section 3.3 above, such work shall not include the operation of any mechanically powered excavation or earth moving equipment.

3.5 A noise curfew shall apply to the use of propane guns and other such similar devices used to protect agricultural produce from predation by any animal, reptile or bird. This curfew shall be commence at 11:00 p.m. and continue until 7:00 a.m. seven days per week.

3.6 Time restrictions as set out above in this by-law for Sundays shall apply in the same manner for all statutory holidays.

3.7 No person shall cause, create or permit any noise in contravention of the curfew times as outlined throughout Section 3.

4. ENFORCEMENT

4.1 This By-law shall apply to all property within the limits of the Municipality and shall be enforced on a complaint basis only by the Durham Regional Police Service and the Clarington Municipal Law Enforcement Officers and, where applicable, the Clarington Animal Services Officers.

4.2 The complaint shall include the name, address and telephone number or other contact information of the complainant. Failure to provide the required complainant information shall render the complaint incomplete and it will not be investigated.

4.3 Anonymous complaints or third party complaints which attempt to obscure the identity of the complainant will not be investigated.

4.4 Where an officer has determined that a complaint has been filed for a malicious or vexatious reason or as part of an ongoing pattern of harassment, the officer may, after conferring and confirming with the Manager of Municipal Law Enforcement, cease the investigation and close the file with no further action taken. The officer shall then advise the complainant of this in writing.

4.5 Where the subject matter of an investigation is the same or the circumstances are substantially similar to that for which charges or other court actions have already been initiated, no additional court action pursuant to this By-law will be initiated by the Municipality.

4.6 Nothing in this By-law prevents any individual from privately initiating a charge for an alleged offence.
5. **PENALTY**

5.1 Every person who contravenes any provision of this by-law is guilty of an offence and upon conviction liable to a fine as set out in the *Provincial Offences Act*.

5.2 Should any section, clause, or provision of this By-law be declared by a court of competent jurisdiction to be invalid, the same shall not affect the validity of this By-law as a whole or any part thereof, other than the part so declared to be invalid.

5.3 The provisions of this by-law shall come into full force and effect immediately upon its final passing by Council.

5.4 By-law 89-184 and its amendments are hereby repealed.

BY-LAW read a first, second and third time and finally passed this 2\(^{nd}\) day of April 2007.
Appendix C: Durham Regional Noise Barrier Policy
The Regional Municipality of Durham
To: The Works Committee
From: Commissioner of Works
Report: 2012-W-83
Date: June 13, 2012

SUBJECT:
Report on the Guidelines for the Installation and Maintenance of Noise Attenuation Barriers Associated with Regional Road Expansion Projects

RECOMMENDATIONS:
THAT subject to the approval of the Finance and Administration Committee, the Works Committee recommends to Regional Council that:

a) A noise attenuation policy be approved which identifies that a noise level threshold of 60 decibels, based on a mature state of development, will trigger the installation of a noise attenuation barrier for new road expansion construction projects, provided that a minimum sound level reduction of six decibels is achieved, and it is technically and economically feasible; and

b) The cost for the installation of any noise attenuation barriers be further refined on a case by case basis, and included in the annual Regional business planning and budget process for consideration.

REPORT:
Attachment No. 1: Works Committee Report 2003-W-104

1. BACKGROUND

The Regional Municipality of Durham (Region) currently does not have a guideline or policy that addresses the installation or long-term maintenance of noise attenuation barriers abutting Regional road right-of-ways (ROW), except as associated with new development applications.

Recently, several situations, including the construction and/or widening of Regional roadways, have prompted the consideration of such guidelines. The Transportation Master Plan (approved in 2005) process has reinforced this need with the following recommended action:
"Develop and implement a Regional Road Noise Abatement Policy to establish noise level thresholds and a range of applicable mitigation measures that address concerns stemming from road improvement projects."

Report 2003-W-104 (Attachment No. 1) was presented at the July 9, 2003, Regional Council meeting and was released for consultation and comment by the various stakeholders. The report proposed guidelines for the installation and maintenance of noise attenuation barriers on a site-specific basis and based on specific criteria.

Since that time, the annual Transportation Servicing and Financing Study, along with comments received from residents has drawn attention to noise attenuation barriers and/or the need for an updated noise abatement policy.

The 2012 Transportation Servicing and Financing Study included the following recommendation:

Regional Works and Finance staff develop a formal policy and identify the associated financial implications for noise attenuation barriers associated only with road expansion projects based on the following principles, with staff to report back the final policy to Regional Council for approval:

- Similar to other municipalities, and in addition to current requirements, the use of a proposed noise level threshold of 60 decibels that would trigger the investigation into potentially installing a noise attenuation barrier.
- The minimum required sound level reduction must be 6 decibels to warrant implementation, to ensure that implementing noise mitigation actually achieves noticeable improvements, and
- The associated financial implications and costs be estimated, and considered within the context of the overall financial needs of the transportation program.

2. CURRENT PROCESSES

As part of the development process, the applicant provides the Region and the area municipality with a noise study. As a condition of development, the proponent may be required to construct a noise attenuation barrier or wall.

In advance of a road widening, the Region completes a Municipal Class Environmental Assessment (EA) study. The Works Department conducts noise studies following the Ministry of the Environment (MOE) / Ministry of Transportation (MTO) noise protocol as part of the project. The protocol states that no mitigation is required if the predicted noise levels do not increase by more than five decibels (dBA). There is no minimum threshold or minimum noise level specified making it difficult to warrant a barrier when noise levels exceed
acceptable conditions. It is generally accepted that road noise will increase three
dBA as the traffic volume doubles. Therefore, a significant increase in traffic
demand is required in order to justify a noise barrier under this protocol.

regarding noise mitigation associated with road improvements. This Protocol
was first published in 1986 and has not been updated or revised since that date.
The Region analyzes noise impacts of proposed projects as a component of the
EA process. However, since standard MOE criteria are not typically exceeded,
noise attenuation measures are rarely implemented, leaving local residents
extremely unsatisfied. After almost 20 years of applying the methodology to
Regional road projects, there has only been one location where installation of
noise attenuation fence has ever met the provincial warrant (Salem Road
(Regional Road 41), in the Town of Ajax).

3. POLICIES AND GUIDELINES FROM OTHER MUNICIPALITIES

Many municipalities have adopted traffic noise mitigation policies that have
established a less onerous noise level threshold to be met before noise
attenuation measures are required. Jurisdictions that have adopted these
policies include York Region, the Regional Municipality of Waterloo, the City of
Ottawa, the City of London, Halton Region, and the City of Calgary. These
policies enable noise mitigation measures to be implemented on a more frequent
basis, which ultimately serves to meet the needs of impacted residents.
Similarly, MTO has adopted a new Environmental Guide for Noise, which also
includes a threshold approach to justify mitigation measures.

4. PROPOSED GUIDELINE / POLICY

Several local and regional municipalities have developed guidelines and/or
policies related to the installation and maintenance of noise attenuation barriers.

The following proposed policy / guideline considers criteria related to the
provision and long-term maintenance of noise barriers as part of a Regional road
expansion project.

4.1 New Construction or Expansion of a Regional Road

New construction or expansion of a Regional road in close proximity to existing
residential development may cause increased noise levels. The need for noise
attenuation in these circumstances would normally be established through the
EA process that precedes the detailed design and construction of any project.

Analysis and recommendations related to noise impacts on existing residential
development areas (outdoor living area) adjacent to the new construction or
expansion of a Regional road will follow the MOE methodology and current
publications on Noise Assessment Criteria. Existing residential development will
be considered for noise mitigation based on the projected noise level being based on a mature state of development when:

- The projected noise level exceeds 60 dBA, or;
- The projected noise level exceeds 55 dBA and the difference between the existing and projected noise levels is five dBA or more.

In addition, proposed noise attenuation measures must achieve a six dBA or more reduction in noise levels in the outdoor living areas of the affected properties.

All costs associated with the analysis, design and provision of noise attenuation measures will be the responsibility of the Region with the exception of partnership projects, where costs will be shared as per the partnership agreement.

Some candidate sites may not be suitable for a noise attenuation wall due to technical or economical factors that may include, but not be limited to, not meeting the specified sound level criteria, site topography, physical limitations, excessive costs, etc. In these situations, mitigation in the form of enhanced vegetative screening will be considered.

5. Proposed General Criteria

5.1 Location

Noise attenuation walls may be located within the ROW, on the property line, on a Regional easement immediately adjacent to a Regional road allowance or on private property contingent on the circumstances of each location. Location will be determined through consultation with the local area municipality.

5.2 Construction Types

Noise attenuation walls abutting Regional roads shall be constructed of either wood or approved composite materials with due consideration to streetscape, and future maintenance requirements satisfactory to the Region. In specific cases, noise attenuation may be provided by the use of an earth berm or combination earth berm and wall.

The type of construction will be determined through consultation with the local area municipality and be as per the recommendations of the noise assessment study.

5.3 Ownership/Maintenance

All noise attenuation measures installed subsequent to the adoption of these guidelines and located within a Regional ROW or on a property line bounding a
Regional road or on an easement granted to which the Region has access, shall be owned and maintained by the Region.

Noise attenuation walls located outside of a Regional road ROW, on private property (unless located on a Regional easement) shall be owned and maintained by the local municipality or the private property owner.

5.4 **Outdoor Living Area**

The outdoor living area is defined as part of an outdoor area on a privately owned residential property easily accessible from the residential dwelling and designed for the quiet enjoyment of the outdoor environment. The outdoor living area is an unenclosed area with a minimum 4.0 metres depth located in the rear yard of the property outside the rear exterior building facade.

5.5 **Analysis and Recommendations on Noise Impacts**

The analysis of noise impacts will be completed by a qualified, independent noise consultant and documented in a technical report. The report will include the analysis of noise levels based on a mature state of development, which is considered to be the future build-out of development based on the ultimate population and traffic capacity forecasts as defined in Durham Region’s Official Plan. Based on this analysis, the report will make recommendations related to site specific conditions.

Analysis and recommendations related to noise impacts on new residential development areas, which are located adjacent to a Regional roadway, will be as per the MOE current publication on Noise Assessment Criteria.

6. **FINANCIAL IMPLICATIONS**

This report proposes guidelines that see the Region taking on responsibilities for the installation and maintenance of noise attenuation barriers in specific circumstances. These responsibilities would be new to the Region and will require additional financial resources and engineering effort. The additional engineering effort associated with noise mitigation can be accommodated within existing staff resources.

A preliminary review of planned road expansion projects that have yet to be built over the 2013 to 2020 timeframe suggests that the upper estimate is the installation of 10 kilometres of potential new noise attenuation barriers utilizing a premium product, at a total estimated capital cost of $10.0 million ($1,000 per linear metre), including incidental costs. In addition to this initial capital cost, there would also be life cycle costs and potential maintenance costs that will be further refined when the cost to implement noise barriers on a case by case basis are undertaken.
The scope of noise mitigation requirements are unique to each road expansion project and require study on a case by case basis. If noise attenuation barriers are required for a road expansion project, Regional staff will identify the associated costs and they will be included in the annual Regional business planning and budget process for consideration.

7. CONCLUSION

These proposed guidelines have been developed on the premise that residential areas that are or will be subjected to significant noise levels should be considered for noise attenuation. Although it is not the intent of these guidelines to provide noise attenuation for all sites, it provides guidelines that allow for the review of each site based on specific criteria.

Staff, therefore, recommends adoption of these guidelines and that the cost for the installation of any potential noise barriers will be identified on a case by case basis, and included in the annual Regional business planning and budget process for consideration.

This report has been reviewed by the Finance Department and the Commissioner of Finance concurs with the financial recommendations.

Clifford Curtis, P.Eng., MBA
Commissioner of Works

Recommended for Presentation to Committee

G.H. Cubitt, M.S.W.
Chief Administrative Officer

TD4/em/ms
Regional Municipality of Durham
To: The Works Committee
From: Commissioner of Works
Report: 2003-W-104
Date: June 25, 2003

SUBJECT:
Report on Works Committee Correspondence No. WC-64-2002 - Guidelines for the installation and maintenance of noise attenuation barriers and privacy fencing on or adjacent to Regional road right-of-ways

RECOMMENDATIONS:
THAT the Works Committee recommends to Regional Council that this report be received for information and be forwarded to the area municipalities and to the Durham Chapter of Urban Development Institute (UDI) for information and comment by September 5, 2003.

REPORT:
Attachment No. 1: Results of Survey of Noise Wall/Privacy Fencing Policies In Ontario Municipalities
Attachment No. 2: Works Committee Correspondence No. WC-64-2002 from Residents of Millington Crescent requesting a Noise Abatement Fence

1. BACKGROUND
Currently the Region of Durham does not have guidelines or policy that addresses the installation or long-term maintenance of noise attenuation barriers or privacy fencing abutting Regional road right-of-ways (ROW), except as associated with new development applications. Recently, several situations, including the construction and/or widening of Regional roadways, have prompted the consideration of such guidelines. The Transportation Master Plan process has reinforced the need with the following recommended action:

'Develop and implement a Regional Road Noise Abatement Policy to establish noise level thresholds and a range of applicable mitigation measures that address concerns stemming from road improvement projects.'
The following proposed policies/guidelines consider various criteria related to the provision and long-term maintenance of noise barriers.

2.1 New Development Areas

The Region has several policy statements in place that relate to noise impacts on new residential development. This report does not recommend any change to the current process related to the analysis of noise impact or the implementation of noise attenuation measures in new development areas.

On November 10, 1982, Regional Council adopted the following policy:

THAT the Planning Department be authorized to assume the noise assessment functions and related matters from the Ministry of the Environment (MOE) in the review of plans of subdivision and other noise related concerns to the Region.

On March 20, 1991, Regional Council adopted the following policy:

a) THAT the impact of noise on residential development proceeding by plan of subdivision and condominium be considered as a factor determining the design of the plan;

b) THAT application for approval of plans of subdivision and condominium abutting Regional or arterial roads as designated in the Durham Regional Official Plan be accompanied by an acoustical report prepared by a qualified engineer. The acoustical report shall address noise impact following Ministry of Environment methodology on the basis of traffic volumes projected for the mature state of development designated in the Official Plan;

c) THAT acoustical fences and "warning clauses" be accepted as attenuation measures only where it has been demonstrated that alternative design solutions are not feasible;

d) THAT prior to draft approval of the plan of subdivision or condominium, satisfactory acoustical reports be forwarded to the respective area municipality for its acceptance of the attenuation measures; and

e) THAT if the Planning Department is in doubt about a noise report, the Commissioner of Planning be authorized to engage a qualified professional engineer at the developer's expense to verify noise impact and attenuation solutions.

Through the approvals process for new residential development, the Region requires the provision of a detailed noise study for any proposed development of lands in close proximity to an arterial roadway as designated in the Regional Official Plan. There are other new development circumstances that may require the provision of a noise study such as development in close proximity to a railway line, freeway or some types of commercial activity.
The Region of Durham Planning Department is responsible for the review and approval of these studies as well as the implementation of mitigation measures including noise barriers and building material requirements used to achieve acceptable indoor sound levels as per the MOE criteria. These studies also address all noise sources within 300 metres of the proposed development, including road, rail, aircraft and stationary noise sources.

Analysis and recommendations related to noise impacts on new residential development areas, located adjacent to a Regional roadway, are as per the MOE methodology and current publications on Noise Assessment Criteria, as well as Regional Policy as noted above. In general terms, new residential development will require noise attenuation measures when traffic volumes based on the mature state of development, as designated in the Regional Official Plan result in projected sound levels that exceed 60dBA in the outdoor living area of residential properties in the daytime or when the projected sound level is greater than 50dBA in the plane of bedroom windows during the nighttime.

All costs associated with the analysis and provision of noise attention measures for new residential development are the responsibility of the developer.

Any attenuation requiring noise barriers should be incorporated into the Region’s subdivision or servicing agreements.

2.2 Retrofit Situations

As communities in the Region continue to grow, so do traffic volumes on Regional roads. Areas of existing residential development in close proximity to Regional roadways may experience increased noise levels due to increased traffic volumes. In specific circumstances, a retrofit noise barrier may be appropriate. This proposed guideline for the retrofit of noise attenuation measures applies to sites where new road expansion/construction is not included in the four (4) year forecast and does not apply to other noise sources such as railways, freeways and commercial activities.

There is no legislation compelling the Region to undertake any work related to the provision of noise attenuation measures in a retrofit situation. It is at the Region’s discretion to determine when, where and how any retrofit work may be undertaken. However, Ontario Regulation 119/03 under the Municipal Act 2001 (O. Reg. 119/03), formerly the Local Improvement Act, specifically notes that “constructing noise abatement works on a highway” is work that may be undertaken as a local improvement.
It is recommended that the process for initiating, implementing and cost sharing noise attenuation measures in the retrofit situation follow the provisions of this legislation and will be considered when all of the following criteria have been met:

- A petition requesting noise attenuation measures must be signed by two-thirds (2/3) of the property owners representing at least one half of the value of the lots liable to be specifically charged for the work. This requirement is as per O. Reg. 119/03. The cost of the improvement is shared proportionately by all of the benefiting owners. (In order for a noise attenuation barrier to be effective, it must be continuous across the rear of all the properties being protected.)

- Candidate locations must be immediately adjacent to a regional road with traffic volumes exceeding an AADT of 10,000 vehicles and having a cross-section of four (4) or more traffic lanes.

- Candidate locations will include existing residential areas with reversed frontage on a Regional road (lots which flank a Regional road may also be considered) and experiencing a daytime noise level equivalent (from 7:00 a.m. to 11:00 p.m.) greater than 60dBA in the outdoor living area.

- Proposed noise attenuation measures must achieve 5dBA or more reduction in noise levels in the outdoor living areas of the affected properties.

Candidate sites, which meet these criteria, will be prioritized with the implementation of noise attenuation measures contingent on the availability of funding and subject to discussion and agreement with the local municipality.

It is proposed that all costs associated with the analysis, design and provision of noise attenuation measures in retrofit situations will be shared equally between the Region and the benefiting property owners. Each property owner’s individual share will be assessed based on the width of the property at the location of the installation. However, as per O. Reg. 119/03, irregularly shaped lots will be dealt with in on a just and equitable basis.

In retrofit situations the right of way will often be occupied by utility plant and other infrastructure. When the installation of a noise attenuation barrier requires the relocation of existing infrastructure, any associated costs will be cost shared on the same basis of all other elements of the project.
2.3 **New Construction or Expansion of a Regional Road**

New construction or expansion of a Regional road in close proximity to existing residential development may cause increased noise levels. The need for noise attenuation in these circumstances would normally be established through the Environmental Assessment (EA) process that precedes the detailed design and construction phases of any project.

Analysis and recommendations related to noise impacts on existing residential development areas adjacent to the new construction or expansion of a Regional road will be as per the MOE methodology and current publications on Noise Assessment Criteria. In general terms, existing residential development will require noise attenuation measures when;

- ten (10) year projections (after the scheduled completion of the road project) anticipate noise levels of 60dBA or more in the outdoor living areas of a residential property, and;

- when the new construction or expansion of a roadway will increase noise levels by more than 5dBA.

In addition, proposed noise attenuation measures must achieve a 5dBA or more reduction in noise levels in the outdoor living areas of the affected properties.

All costs associated with the analysis, design and provision of noise attenuation measures will be the responsibility of the Region with the exception of partnership projects, where costs will be shared as per the partnership agreement.

3. **PROPOSED GENERAL CRITERIA**

3.1 **Location**

Noise Attenuation Walls may be located within the ROW, on the Property Line, on a Regional easement immediately adjacent to a Regional road allowance or on private property contingent on the circumstances of each location. Location will be determined through consultation with the local area municipality.

3.2 **Construction Types**

Noise attenuation walls abutting Regional roads shall be constructed of either wood or approved composite materials with due consideration to streetscape, and future maintenance requirements satisfactory to the Region. In specific cases, noise attenuation may be provided by the use of an earth berm or combination earth berm and wall.
The type of construction will be determined through consultation with the local area municipality and be as per the recommendations of the noise assessment study.

3.3 Ownership/Maintenance

All noise attenuation measures installed subsequent to the adoption of these guidelines and located within a Regional road ROW, on a property line bounding a Regional road or on an easement granted to which the Region has access, shall be owned and maintained by the Region.

Noise Walls located outside of a Regional road ROW, on private property (unless located on a Regional easement) shall be owned and maintained by the local municipality or the private property owner.

3.4 Outdoor Living Area

The outdoor living area is defined as part of an outdoor area on a privately owned residential property easily accessible from the residential dwelling and designed for the quiet enjoyment of the outdoor environment. The outdoor living area is an unenclosed area with a minimum 4.0 metre depth located in the rear yard of the property outside the rear exterior building facade.

3.5 Analysis and Recommendations on Noise Impacts

The analysis of noise impacts will be completed by a qualified, independent noise consultant and documented in a technical report. Based on this analysis, the report will make recommendations related to site specific conditions.

In retrofit situations the report will include the analysis of current noise levels and the effectiveness of noise attenuation measures.

For road expansion or new road construction projects, the report will include the analysis of noise levels based on ten (10) year traffic projections and the effectiveness of noise attenuation measures. The traffic projections and resulting noise levels will be based on a ten (10) year time frame commencing after the completion of the road construction project.

Analysis and recommendations related to noise impacts on new residential development areas, which are located adjacent to a Regional roadway, will be as per the MOE current publication on Noise Assessment Criteria.
3.6 Privacy Fencing

Privacy fencing may be installed as a requirement of a development application or at the discretion of a property owner. In all cases, privacy fencing shall be owned and maintained by the local municipality or the private property owner and shall be located on the property line or on private property.

4. FUTURE IMPACTS OF NOISE BARRIER CONSTRUCTION AND ASSET MANAGEMENT

This report proposes guidelines that see the Region taking on responsibilities for the installation and maintenance of noise attenuation barriers in specific circumstances. These responsibilities would be new to the Region and will require both financial and staffing resources.

Currently approximately twenty (20) kilometres of rear lot property lines adjacent to a Regional road meet the minimum criteria for consideration under the proposed retrofit guidelines. This equates to approximately $8,000,000 in costs, ($400 per metre) to be shared with the property owners, associated with the installation of attenuation barriers. However, it is not likely that all of the sites adjacent to these sections of road would benefit from the installation of noise attenuation measures. This estimate is based on the use of a wooden noise attenuation barrier. The use of other products would increase the cost.

Other Regional municipalities, which have taken on similar responsibilities, set an annual budget for the activities associated with the installation and maintenance of noise barriers. Priority projects are identified and as funding allows, the highest priorities are addressed each year.

Similarly there are a number of new road construction projects and road expansion projects in the twenty (20) year capital forecast that, subject to analysis, may require noise attenuation measures as an element of the project. Should analysis qualify all of these projects for the inclusion of these measures, approximately $8,000,000 in additional costs will be recognized in the completion of the forecasted projects.

If $16,000,000 of noise attenuation infrastructure is constructed, with an assumed useful life of 20 years, an additional cost of approximately $800,000 per year will be required for maintenance and/or replacement.
5. **CONCLUSIONS**

These proposed guidelines have been developed on the premise that residential areas that are or will be subjected to significant noise levels should be considered for noise attenuation. Although it is not the intent of these guidelines to provide noise attenuation for all sites, it provides guidelines that allow for review of each site based on specific criteria.

It is recommend that this report be received for information at this time and, further, that this report be forwarded to the local area municipalities and the Durham Chapter of UDI for comment by September 5, 2003.

/J.R. McCorkell, P.Eng.
Commissioner of Works

CAM1/cb/ra
## Results of Survey of Noise Wall/Privacy Fencing Policies in Ontario Municipalities

<table>
<thead>
<tr>
<th>QUESTION</th>
<th>RESPONSES</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Is it your municipality's standard practice to consider noise mitigation through road reconstruction projects?</td>
<td>Yes 8 No 9</td>
<td>Most No's from smaller, local municipalities</td>
</tr>
<tr>
<td>2. Does your municipality have its own policies, procedures, or guidelines regarding the construction of acoustical barriers?</td>
<td>Yes 10 No 7</td>
<td>Concrete incl. Durisol products. Other includes berms</td>
</tr>
<tr>
<td>3. What materials/products do you typically use?</td>
<td>Concrete 7 Wood 11 Other 5</td>
<td></td>
</tr>
<tr>
<td>4. If you construct noise walls, or require noise walls to be constructed by others, what methodology or procedures do you rely on to determine need and provide design parameters?</td>
<td>MOE guidelines 16 Noise Policy 2 Other 1</td>
<td></td>
</tr>
<tr>
<td>5. Is a Noise Study required as part of the approvals process for new residential development?</td>
<td>Yes 16 No 1</td>
<td>Only 'No' in rural municipality</td>
</tr>
<tr>
<td>6. If yes, what forecast year is used for traffic volumes for the noise modeling work?</td>
<td>10 years from now 10 years from build out 2 OP planning horizon (2021, 2031) 3 Ultimate traffic 1</td>
<td>Some use more than 1. Some local mun. did not specify</td>
</tr>
<tr>
<td>Source of traffic volume data</td>
<td>Demand Forecasting 8 Std guide for road type 3 Count/growth rates 9 Other 2</td>
<td></td>
</tr>
<tr>
<td>7. Does your municipality install privacy fencing along municipal road rights-of-way?</td>
<td>Yes 2 No 15</td>
<td></td>
</tr>
<tr>
<td>If yes, do you have a policy, procedures, or guidelines regarding the placement, construction and maintenance of this fencing?</td>
<td>Yes 1 No 1</td>
<td></td>
</tr>
<tr>
<td>8. Who is generally responsible for the maintenance/repair of noise walls?</td>
<td>Municipality 9 Property Owners 9</td>
<td>If within RoW then Municipal ownership and maintenance</td>
</tr>
<tr>
<td>Who is generally responsible for the maintenance/repair of privacy fencing?</td>
<td>Municipality 1 Property Owners 11</td>
<td></td>
</tr>
<tr>
<td>Who is the owner of noise walls that border private property?</td>
<td>Municipality 10 Property Owners 8</td>
<td></td>
</tr>
<tr>
<td>Who is the owner of fences that border private property?</td>
<td>Municipality 2 Property Owners 11</td>
<td></td>
</tr>
</tbody>
</table>
Direction Memorandum

TO: J.R. McCorkell, Commissioner of Works
Works Department

FROM: Carol Smitton, Committee Secretary
Clerk's Department

DATE: November 8, 2002

RE: Direction as per minutes of:

WORKS COMMITTEE

OCTOBER 30, 2002

ITEM 6 d)

6. CORRESPONDENCE - WORKS

d) CORRESPONDENCE DATED SEPTEMBER 5, 2002, FROM RESIDENTS OF MILLINGTON CRESCENT, AJAX, REQUESTING A NOISE ABATEMENT FENCE (WC-64-2002)

Councillor Crawford requested that Mr. Milton be advised as to when the staff report would be considered by the Committee in order to allow for him to attend as a delegation.

MOVED by Councillor Crawford,
(283) "THAT Correspondence Item #WC-64-2002, be referred to staff for report."

CARRIED

Carol Smitton, A.M.C.T.
Committee Secretary

"Service Excellence for our Community"
SEPT 5, 2002

WE THE EIGHT UNDERSIGNED RESIDENTS OF AJAY, LIVING ON MILLINGTON CRES, WHOSE BACK YARDS BOARDER ON THE EAST SIDE OF WESTNEY RD N. FEEL THAT SINCE WESTNEY RD HAS BEEN EXPANDED TO FOUR LANES AND ALSO SINCE THE VOLUME OF TRAFFIC AND NOISE LEVEL HAS INCREASED SIGNIFICANTLY AND PLANS ARE IN THE WORKS FOR FURTHER NORTHERN DEVELOPMENT, WE FEEL THAT WE SHOULD BE CONSIDERED FOR A NOISE ABATEMENT FENCE.

Jennifer Arseneau J. Arseneau 109
Craig Arseneau 905-683-5226

Kay Milton 113
Chief Milton 905-619-2375

Tammy Marshall J. Marshall 115
Ian Buckley 416-290-8164

Bunty Hewitt Hewitt 107
905 683 6008

CHRIS ENGRAVE
HILTON WILLIAMS

Ken Masterton 905-428-7326 105 Millington CR

Daniel McDonald 905-426-2713 - 111 Millington
Don Mitchell
Trena McDonald

WC-64-2002
Appendix D: Traffic Data and STAMSON Data
<table>
<thead>
<tr>
<th>Time</th>
<th>Ped.</th>
<th>Cars</th>
<th>Trucks</th>
<th>PHF</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AM Peak:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7:30 am</td>
<td>0</td>
<td>0</td>
<td>562</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td>51</td>
<td>739</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.64</td>
<td>18%</td>
<td>15</td>
<td>67</td>
</tr>
<tr>
<td></td>
<td>0.84</td>
<td>7%</td>
<td>23</td>
<td>291</td>
</tr>
<tr>
<td></td>
<td>0.70</td>
<td>10%</td>
<td>4</td>
<td>35</td>
</tr>
<tr>
<td><strong>PM Peak:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5:00 pm</td>
<td>0</td>
<td>12</td>
<td>430</td>
<td>0.68</td>
</tr>
<tr>
<td></td>
<td>0.76</td>
<td>4%</td>
<td>3</td>
<td>82</td>
</tr>
<tr>
<td></td>
<td>0.97</td>
<td>2%</td>
<td>20</td>
<td>963</td>
</tr>
<tr>
<td></td>
<td>0.70</td>
<td>1%</td>
<td>1</td>
<td>92</td>
</tr>
<tr>
<td><strong>MD Peak:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12:15 pm</td>
<td>0</td>
<td>48</td>
<td>432</td>
<td>0.57</td>
</tr>
<tr>
<td></td>
<td>0.91</td>
<td>18%</td>
<td>15</td>
<td>69</td>
</tr>
<tr>
<td></td>
<td>0.69</td>
<td>10%</td>
<td>38</td>
<td>327</td>
</tr>
<tr>
<td></td>
<td>0.72</td>
<td>13%</td>
<td>7</td>
<td>48</td>
</tr>
<tr>
<td><strong>Total Count 8 hours</strong></td>
<td>0</td>
<td>344</td>
<td>3714</td>
<td>0.68</td>
</tr>
<tr>
<td></td>
<td>0.76</td>
<td>4%</td>
<td>35</td>
<td>510</td>
</tr>
<tr>
<td></td>
<td>0.97</td>
<td>2%</td>
<td>198</td>
<td>3571</td>
</tr>
<tr>
<td></td>
<td>0.70</td>
<td>1%</td>
<td>31</td>
<td>454</td>
</tr>
<tr>
<td><strong>Total Count 8 hours</strong></td>
<td>0</td>
<td>2030</td>
<td>1437</td>
<td>0.68</td>
</tr>
<tr>
<td></td>
<td>1.88</td>
<td>7%</td>
<td>75</td>
<td>73</td>
</tr>
<tr>
<td></td>
<td>1.88</td>
<td>6%</td>
<td>9</td>
<td>69</td>
</tr>
</tbody>
</table>

---

**Count Date:** 6/16/2016  
**TMC No.:** 0042200000  
**Intersection ID:** 2711  
**Count ID:** TAUNTON RD (R.R.04) @ REGIONAL ROAD 57
Figure 3 Future 2028 Traffic Volumes

Taunton Rd.

Legend:
- X Weekday AM
- (X) Weekday Midday
- (X) Weekday PM
Figure 2-1  Future 2018 Traffic Volumes

Legend:
- X  Weekday AM
- (X) Weekday Midday
- (X) Weekday PM
Sample Calculation

STAMSON 5.0 COMPREHENSIVE REPORT Date: 30-05-2018 14:29:05
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: 551201dn.te Time Period: Day/Night 16/8 hours
Description: OLA Sound levels for R1 Do Nothing

Road data, segment # 1: 57N (day/night)

- Car traffic volume : 8249/917 veh/TimePeriod *
- Medium truck volume : 187/21 veh/TimePeriod *
- Heavy truck volume : 560/62 veh/TimePeriod *
- Posted speed limit : 80 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): 9995
  Percentage of Annual Growth : 0.00
  Number of Years of Growth : 0.00
  Medium Truck % of Total Volume : 2.08
  Heavy Truck % of Total Volume : 6.22
  Day (16 hrs) % of Total Volume : 90.00

Data for Segment # 1: 57N (day/night)

- Angle1 Angle2 : -90.00 deg 72.00 deg
- Wood depth : 0 (No woods.)
- No of house rows : 0 / 0
- Surface : 1 (Absorptive ground surface)
- Receiver source distance : 33.00 / 33.00 m
- Receiver height : 1.50 / 1.50 m
- Topography : 2 (Flat/gentle slope; with barrier)
- Barrier angle1 : -56.00 deg Angle2 : 56.00 deg
- Barrier height : 3.00 m
- Barrier receiver distance : 3.00 / 3.00 m
- Source elevation : 0.00 m
- Receiver elevation : 0.00 m
- Barrier elevation : 0.00 m
- Reference angle : 0.00

Road data, segment # 2: 57S (day/night)

- Car traffic volume : 8746/972 veh/TimePeriod *
- Medium truck volume : 167/19 veh/TimePeriod *
- Heavy truck volume : 501/56 veh/TimePeriod *
- Posted speed limit : 80 km/h
- Road gradient : 2%
- Road pavement : 1 (Typical asphalt or concrete)

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

  24 hr Traffic Volume (AADT or SADT): 10460
  Percentage of Annual Growth : 0.00
  Number of Years of Growth : 0.00
  Medium Truck % of Total Volume : 1.77
  Heavy Truck % of Total Volume : 5.32
  Day (16 hrs) % of Total Volume : 90.00

Data for Segment # 2: 57S (day/night)

- Angle1 Angle2 : 72.00 deg 90.00 deg
- Wood depth : 0 (No woods.)
- No of house rows : 0 / 0

Cambium Inc.
### Traffic Data Summary

Traffic Data used in STAMSON

<table>
<thead>
<tr>
<th>Road</th>
<th>AADT</th>
<th>Truck % 2028 Predicted</th>
<th>Medium %</th>
<th>Speed Limit (km/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tauton East</td>
<td>13915</td>
<td>7</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Tauton West</td>
<td>15780</td>
<td>8</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>57 North</td>
<td>9995</td>
<td>8</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>57 South</td>
<td>10460</td>
<td>7</td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>

#### 2018 Traffic

<table>
<thead>
<tr>
<th>Road</th>
<th>AADT</th>
<th>Truck % 2028 Predicted</th>
<th>Medium %</th>
<th>Speed Limit (km/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tauton East</td>
<td>12780</td>
<td>7</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Tauton West</td>
<td>14720</td>
<td>8</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>57 North</td>
<td>6635</td>
<td>8</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>57 South</td>
<td>7265</td>
<td>7</td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>

### STAMSON INPUT SUMMARY MOST EXPOSED SIDE

#### Do nothing

<table>
<thead>
<tr>
<th>POR</th>
<th>RR57N</th>
<th>Distance to Road (m)</th>
<th>Center of intersection (m)</th>
<th>57N Angles</th>
<th>57S angles</th>
<th>RR4E angles</th>
<th>RR4W angles</th>
</tr>
</thead>
<tbody>
<tr>
<td>POR1</td>
<td>21</td>
<td>21</td>
<td>94</td>
<td>4</td>
<td>-90</td>
<td>-90</td>
<td>-11</td>
</tr>
<tr>
<td>POR2</td>
<td>318</td>
<td>318</td>
<td>149.5</td>
<td>318</td>
<td>90</td>
<td>-25</td>
<td>-90</td>
</tr>
<tr>
<td>POR3</td>
<td>50</td>
<td>50</td>
<td>164</td>
<td>60</td>
<td>-70</td>
<td>5</td>
<td>90</td>
</tr>
<tr>
<td>POR4</td>
<td>211</td>
<td>211</td>
<td>32</td>
<td>212</td>
<td>-90</td>
<td>-9</td>
<td>81</td>
</tr>
<tr>
<td>POR5</td>
<td>202</td>
<td>202</td>
<td>19</td>
<td>203</td>
<td>5</td>
<td>90</td>
<td>-85</td>
</tr>
</tbody>
</table>

#### New Signalized Option 1

<table>
<thead>
<tr>
<th>POR</th>
<th>RR57N</th>
<th>Distance to Road (m)</th>
<th>Center of intersection (m)</th>
<th>57N Angles</th>
<th>57S angles</th>
<th>RR4E angles</th>
<th>RR4W angles</th>
</tr>
</thead>
<tbody>
<tr>
<td>POR1</td>
<td>18</td>
<td>18</td>
<td>97.5</td>
<td>5</td>
<td>-90</td>
<td>-90</td>
<td>-11</td>
</tr>
<tr>
<td>POR2</td>
<td>319.5</td>
<td>319.5</td>
<td>149.5</td>
<td>318</td>
<td>90</td>
<td>-25</td>
<td>-90</td>
</tr>
<tr>
<td>POR3</td>
<td>51</td>
<td>51</td>
<td>161</td>
<td>60</td>
<td>-70</td>
<td>5</td>
<td>90</td>
</tr>
<tr>
<td>POR4</td>
<td>209</td>
<td>213</td>
<td>31</td>
<td>212</td>
<td>-90</td>
<td>-9</td>
<td>81</td>
</tr>
<tr>
<td>POR5</td>
<td>201</td>
<td>205</td>
<td>21</td>
<td>203</td>
<td>5</td>
<td>90</td>
<td>-85</td>
</tr>
</tbody>
</table>

#### Roundabout Option 2

<table>
<thead>
<tr>
<th>POR</th>
<th>RR57N</th>
<th>Distance to Road (m)</th>
<th>Center of intersection (m)</th>
<th>57N Angles</th>
<th>57S angles</th>
<th>RR4E angles</th>
<th>RR4W angles</th>
</tr>
</thead>
<tbody>
<tr>
<td>POR1</td>
<td>21</td>
<td>21</td>
<td>96</td>
<td>4</td>
<td>-90</td>
<td>-90</td>
<td>-11</td>
</tr>
<tr>
<td>POR2</td>
<td>316</td>
<td>316</td>
<td>149.5</td>
<td>316</td>
<td>90</td>
<td>-25</td>
<td>-90</td>
</tr>
<tr>
<td>POR3</td>
<td>51</td>
<td>51</td>
<td>160</td>
<td>60</td>
<td>-70</td>
<td>5</td>
<td>90</td>
</tr>
<tr>
<td>POR4</td>
<td>213</td>
<td>213</td>
<td>28.7</td>
<td>212</td>
<td>-90</td>
<td>-9</td>
<td>81</td>
</tr>
<tr>
<td>POR5</td>
<td>205</td>
<td>205</td>
<td>23.1</td>
<td>203</td>
<td>5</td>
<td>90</td>
<td>-85</td>
</tr>
</tbody>
</table>
### STAMSON INPUT SUMMARY OUTDOOR LIVING AREA

<table>
<thead>
<tr>
<th>POR</th>
<th>RR57N</th>
<th>Distance to Road (m)</th>
<th>Center of intersection (m)</th>
<th>57N Angles</th>
<th>57S angles</th>
<th>RR4E angles</th>
<th>RR4W angles</th>
<th>Barrier Angles (home)</th>
<th>Barrier Height</th>
<th>Barrier Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>POR1</td>
<td>31</td>
<td>31</td>
<td>94</td>
<td>30.6</td>
<td>94</td>
<td>-90</td>
<td>72</td>
<td>72</td>
<td>90</td>
<td>-90</td>
</tr>
<tr>
<td>POR2</td>
<td>318</td>
<td>318</td>
<td>162.5</td>
<td>318</td>
<td>162.5</td>
<td>90</td>
<td>-27</td>
<td>-27</td>
<td>-90</td>
<td>-90</td>
</tr>
<tr>
<td>POR3</td>
<td>65</td>
<td>65</td>
<td>164</td>
<td>75</td>
<td>164</td>
<td>-90</td>
<td>-65</td>
<td>-65</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td>POR4</td>
<td>211</td>
<td>211</td>
<td>45</td>
<td>212</td>
<td>45</td>
<td>-90</td>
<td>-12</td>
<td>-12</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td>POR5</td>
<td>202</td>
<td>202</td>
<td>35.7</td>
<td>203</td>
<td>35.7</td>
<td>-90</td>
<td>-10</td>
<td>-10</td>
<td>90</td>
<td>-90</td>
</tr>
</tbody>
</table>

### STAMSON INPUT SUMMARY OUTDOOR LIVING AREA

<table>
<thead>
<tr>
<th>POR</th>
<th>RR57N</th>
<th>Distance to Road (m)</th>
<th>Center of intersection (m)</th>
<th>57N Angles</th>
<th>57S angles</th>
<th>RR4E angles</th>
<th>RR4W angles</th>
<th>Barrier Angles (home)</th>
<th>Barrier Height</th>
<th>Barrier Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>POR1</td>
<td>30</td>
<td>30</td>
<td>97.5</td>
<td>30.6</td>
<td>94</td>
<td>-90</td>
<td>72</td>
<td>72</td>
<td>90</td>
<td>-90</td>
</tr>
<tr>
<td>POR2</td>
<td>319.5</td>
<td>319.5</td>
<td>162.5</td>
<td>318</td>
<td>162.5</td>
<td>90</td>
<td>-27</td>
<td>-27</td>
<td>-90</td>
<td>-90</td>
</tr>
<tr>
<td>POR3</td>
<td>66</td>
<td>66</td>
<td>161</td>
<td>76</td>
<td>164</td>
<td>-90</td>
<td>-65</td>
<td>-65</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td>POR4</td>
<td>209</td>
<td>213</td>
<td>44</td>
<td>212</td>
<td>44</td>
<td>-90</td>
<td>-12</td>
<td>-12</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td>POR5</td>
<td>201</td>
<td>205</td>
<td>37.7</td>
<td>203</td>
<td>35.7</td>
<td>-90</td>
<td>-10</td>
<td>-10</td>
<td>90</td>
<td>-90</td>
</tr>
</tbody>
</table>

### STAMSON INPUT SUMMARY OUTDOOR LIVING AREA

<table>
<thead>
<tr>
<th>POR</th>
<th>RR57N</th>
<th>Distance to Road (m)</th>
<th>Center of intersection (m)</th>
<th>57N Angles</th>
<th>57S angles</th>
<th>RR4E angles</th>
<th>RR4W angles</th>
<th>Barrier Angles (home)</th>
<th>Barrier Height</th>
<th>Barrier Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>POR1</td>
<td>33</td>
<td>33</td>
<td>96</td>
<td>30.6</td>
<td>94</td>
<td>-90</td>
<td>72</td>
<td>72</td>
<td>90</td>
<td>-90</td>
</tr>
<tr>
<td>POR2</td>
<td>316</td>
<td>316</td>
<td>162.5</td>
<td>316</td>
<td>162.5</td>
<td>90</td>
<td>-27</td>
<td>-27</td>
<td>-90</td>
<td>-90</td>
</tr>
<tr>
<td>POR3</td>
<td>66</td>
<td>66</td>
<td>160</td>
<td>76</td>
<td>164</td>
<td>-90</td>
<td>-65</td>
<td>-65</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td>POR4</td>
<td>213</td>
<td>213</td>
<td>41.7</td>
<td>212</td>
<td>41.7</td>
<td>-90</td>
<td>-11</td>
<td>-11</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td>POR5</td>
<td>205</td>
<td>205</td>
<td>39.8</td>
<td>203</td>
<td>35.7</td>
<td>-90</td>
<td>-10</td>
<td>-10</td>
<td>90</td>
<td>-90</td>
</tr>
</tbody>
</table>
### STAMSON OUTPUT MOST EXPOSED SIDE (DBA)

<table>
<thead>
<tr>
<th></th>
<th>2018</th>
<th>Do nothing</th>
<th>Option 1</th>
<th>Option 2</th>
<th>Change Option 1</th>
<th>Change Option 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>POR1</td>
<td>nr</td>
<td>67.0</td>
<td>68.0</td>
<td>67.0</td>
<td>1.0</td>
<td>0.0</td>
</tr>
<tr>
<td>POR2</td>
<td>nr</td>
<td>54.7</td>
<td>54.7</td>
<td>54.7</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>POR3</td>
<td>nr</td>
<td>61.2</td>
<td>61.1</td>
<td>61.2</td>
<td>-0.1</td>
<td>-0.1</td>
</tr>
<tr>
<td>POR4</td>
<td>nr</td>
<td>63.9</td>
<td>64.1</td>
<td>64.6</td>
<td>0.2</td>
<td>0.8</td>
</tr>
<tr>
<td>POR5</td>
<td>nr</td>
<td>67.5</td>
<td>66.8</td>
<td>66.2</td>
<td>-0.7</td>
<td>-1.4</td>
</tr>
</tbody>
</table>

### STAMSON OUTPUT OUTDOOR LIVING AREAS (DBA)

<table>
<thead>
<tr>
<th>POR</th>
<th>2018</th>
<th>Do nothing</th>
<th>Option 1</th>
<th>Option 2</th>
<th>2018/ Option 1</th>
<th>2018/ Option 2</th>
<th>Do Nothing/Option 1</th>
<th>Do Nothing/Option 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>OLA1</td>
<td>59.04</td>
<td>60.1</td>
<td>60.4</td>
<td>60.1</td>
<td>1.4</td>
<td>1.0</td>
<td>0.3</td>
<td>-0.1</td>
</tr>
<tr>
<td>OLA2</td>
<td>48.33</td>
<td>nr</td>
<td>50.1</td>
<td>50.1</td>
<td>1.7</td>
<td>1.8</td>
<td>nr</td>
<td>nr</td>
</tr>
<tr>
<td>OLA3</td>
<td>54.59</td>
<td>nr</td>
<td>55.6</td>
<td>55.6</td>
<td>1.0</td>
<td>1.0</td>
<td>nr</td>
<td>nr</td>
</tr>
<tr>
<td>OLA4</td>
<td>54.49</td>
<td>nr</td>
<td>55.3</td>
<td>55.5</td>
<td>0.8</td>
<td>1.0</td>
<td>nr</td>
<td>nr</td>
</tr>
<tr>
<td>OLA5</td>
<td>56.99</td>
<td>57.2</td>
<td>56.9</td>
<td>56.6</td>
<td>-0.1</td>
<td>-0.4</td>
<td>-0.3</td>
<td>-0.6</td>
</tr>
</tbody>
</table>
### Sample Calculation

<table>
<thead>
<tr>
<th>Surface</th>
<th>1 (Absorptive ground surface)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receiver source distance</td>
<td>33.00 / 33.00 m</td>
</tr>
<tr>
<td>Receiver height</td>
<td>1.50 / 1.50 m</td>
</tr>
<tr>
<td>Topography</td>
<td>1 (Flat/gentle slope; no barrier)</td>
</tr>
<tr>
<td>Reference angle</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Road data, segment # 3: RR4E (day/night)

<table>
<thead>
<tr>
<th>Car traffic volume</th>
<th>11647/1294 veh/TimePeriod *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium truck volume</td>
<td>219/24 veh/TimePeriod *</td>
</tr>
<tr>
<td>Heavy truck volume</td>
<td>657/73 veh/TimePeriod *</td>
</tr>
<tr>
<td>Posted speed limit</td>
<td>80 km/h</td>
</tr>
<tr>
<td>Road gradient</td>
<td>2 %</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:

<table>
<thead>
<tr>
<th>24 hr Traffic Volume (AADT or SADT):</th>
<th>13915</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of Annual Growth</td>
<td>0.00</td>
</tr>
<tr>
<td>Number of Years of Growth</td>
<td>0.00</td>
</tr>
<tr>
<td>Medium Truck % of Total Volume</td>
<td>1.75</td>
</tr>
<tr>
<td>Heavy Truck % of Total Volume</td>
<td>5.25</td>
</tr>
<tr>
<td>Day (16 hrs) % of Total Volume</td>
<td>90.00</td>
</tr>
</tbody>
</table>

Data for Segment # 3: RR4E (day/night)

<table>
<thead>
<tr>
<th>Angle1 Angle2</th>
<th>-90.00 deg -18.00 deg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood depth</td>
<td>0 (No woods.)</td>
</tr>
<tr>
<td>No of house rows</td>
<td>0 / 0</td>
</tr>
<tr>
<td>Surface</td>
<td>1 (Absorptive ground surface)</td>
</tr>
<tr>
<td>Receiver source distance</td>
<td>94.00 / 94.00 m</td>
</tr>
<tr>
<td>Receiver height</td>
<td>1.50 / 1.50 m</td>
</tr>
<tr>
<td>Topography</td>
<td>1 (Flat/gentle slope; no barrier)</td>
</tr>
<tr>
<td>Reference angle</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Road data, segment # 4: RR4W (day/night)

<table>
<thead>
<tr>
<th>Car traffic volume</th>
<th>13094/1455 veh/TimePeriod *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium truck volume</td>
<td>277/31 veh/TimePeriod *</td>
</tr>
<tr>
<td>Heavy truck volume</td>
<td>831/92 veh/TimePeriod *</td>
</tr>
<tr>
<td>Posted speed limit</td>
<td>60 km/h</td>
</tr>
<tr>
<td>Road gradient</td>
<td>2 %</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:

<table>
<thead>
<tr>
<th>24 hr Traffic Volume (AADT or SADT):</th>
<th>15780</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of Annual Growth</td>
<td>0.00</td>
</tr>
<tr>
<td>Number of Years of Growth</td>
<td>0.00</td>
</tr>
<tr>
<td>Medium Truck % of Total Volume</td>
<td>1.95</td>
</tr>
<tr>
<td>Heavy Truck % of Total Volume</td>
<td>5.85</td>
</tr>
<tr>
<td>Day (16 hrs) % of Total Volume</td>
<td>90.00</td>
</tr>
</tbody>
</table>

Data for Segment # 4: RR4W (day/night)

<table>
<thead>
<tr>
<th>Angle1 Angle2</th>
<th>-18.00 deg 90.00 deg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood depth</td>
<td>0 (No woods.)</td>
</tr>
<tr>
<td>No of house rows</td>
<td>0 / 0</td>
</tr>
<tr>
<td>Surface</td>
<td>1 (Absorptive ground surface)</td>
</tr>
<tr>
<td>Receiver source distance</td>
<td>94.00 / 94.00 m</td>
</tr>
<tr>
<td>Receiver height</td>
<td>1.50 / 1.50 m</td>
</tr>
<tr>
<td>Topography</td>
<td>1 (Flat/gentle slope; no barrier)</td>
</tr>
<tr>
<td>Reference angle</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Cambium Inc.
Sample Calculation

Segment # 1: 57N (day)

Source height = 1.58 m

Barrier height for grazing incidence

<table>
<thead>
<tr>
<th>Source Height (m)</th>
<th>Receiver Height (m)</th>
<th>Barrier Height (m)</th>
<th>Elevation of Barrier Top (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.58</td>
<td>1.50</td>
<td>1.51</td>
<td>1.51</td>
</tr>
</tbody>
</table>

ROAD \((53.76 + 50.13 + 51.87) = 56.94\) 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>-90</td>
<td>-56</td>
<td>0.66</td>
<td>70.43</td>
<td>0.00</td>
<td>-5.68</td>
<td>-11.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>53.76</td>
</tr>
<tr>
<td>-56</td>
<td>56</td>
<td>0.48</td>
<td>70.43</td>
<td>0.00</td>
<td>-5.06</td>
<td>-2.42</td>
<td>0.00</td>
<td>0.00</td>
<td>-12.83</td>
<td>50.13</td>
</tr>
<tr>
<td>56</td>
<td>72</td>
<td>0.66</td>
<td>70.43</td>
<td>0.00</td>
<td>-5.68</td>
<td>-12.89</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>51.87</td>
</tr>
</tbody>
</table>

Segment Leq : 56.94 dBA

Segment # 2: 57S (day)

Source height = 1.52 m

ROAD \((0.00 + 49.57 + 0.00) = 49.57\) 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>72</td>
<td>90</td>
<td>0.66</td>
<td>70.78</td>
<td>0.00</td>
<td>-5.68</td>
<td>-15.54</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>49.57</td>
</tr>
</tbody>
</table>

Segment Leq : 49.57 dBA

Segment # 3: RR4E (day)

Source height = 1.51 m

ROAD \((0.00 + 52.88 + 0.00) = 52.88\) 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>-90</td>
<td>-18</td>
<td>0.66</td>
<td>71.98</td>
<td>0.00</td>
<td>-13.23</td>
<td>-5.87</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>52.88</td>
</tr>
</tbody>
</table>

Segment Leq : 52.88 dBA

Segment # 4: RR4W (day)

Source height = 1.56 m

ROAD \((0.00 + 53.97 + 0.00) = 53.97\) 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>-18</td>
<td>90</td>
<td>0.66</td>
<td>70.59</td>
<td>0.00</td>
<td>-13.22</td>
<td>-3.40</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>53.97</td>
</tr>
</tbody>
</table>

Segment Leq : 53.97 dBA

Cambium Inc.
Sample Calculation

Total Leq All Segments: 60.12 dBA

Segment # 1: 57N (night)

Source height = 1.58 m

Barrier height for grazing incidence

<table>
<thead>
<tr>
<th>Source Height (m)</th>
<th>Receiver Height (m)</th>
<th>Barrier Height (m)</th>
<th>Elevation of Barrier Top (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.58</td>
<td></td>
<td>1.51</td>
<td>1.51</td>
</tr>
</tbody>
</table>

ROAD (47.22 + 43.59 + 45.33) = 50.40 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>-90</td>
<td>-56</td>
<td>0.66</td>
<td>63.89</td>
<td>0.00</td>
<td>-5.68</td>
<td>-11.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>47.22</td>
</tr>
<tr>
<td>-56</td>
<td>56</td>
<td>0.48</td>
<td>63.89</td>
<td>0.00</td>
<td>-5.06</td>
<td>-2.42</td>
<td>0.00</td>
<td>0.00</td>
<td>-12.83</td>
<td>43.59</td>
</tr>
<tr>
<td>56</td>
<td>72</td>
<td>0.66</td>
<td>63.89</td>
<td>0.00</td>
<td>-5.68</td>
<td>-12.89</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>45.33</td>
</tr>
</tbody>
</table>

Segment Leq: 50.40 dBA

Segment # 2: 57S (night)

Source height = 1.52 m

ROAD (0.00 + 43.06 + 0.00) = 43.06 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>72</td>
<td>90</td>
<td>0.66</td>
<td>64.28</td>
<td>0.00</td>
<td>-5.68</td>
<td>-15.54</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>43.06</td>
</tr>
</tbody>
</table>

Segment Leq: 43.06 dBA

Segment # 3: RR4E (night)

Source height = 1.51 m

ROAD (0.00 + 46.34 + 0.00) = 46.34 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>-90</td>
<td>-18</td>
<td>0.66</td>
<td>65.44</td>
<td>0.00</td>
<td>-13.23</td>
<td>-5.87</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>46.34</td>
</tr>
</tbody>
</table>

Segment Leq: 46.34 dBA

Segment # 4: RR4W (night)

Source height = 1.55 m

ROAD (0.00 + 47.43 + 0.00) = 47.43 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>-18</td>
<td>90</td>
<td>0.66</td>
<td>64.05</td>
<td>0.00</td>
<td>-13.22</td>
<td>-3.40</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>47.43</td>
</tr>
</tbody>
</table>
Sample Calculation

Segment Leq: 47.43 dBA
Total Leq All Segments: 53.58 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 60.12
(NIGHT): 53.58

Cambium Inc.