APPENDIX L

Noise Memorandum
MEMO

TO: Brent Gotts, P.Eng.
SUBJECT: Noise Assessment – McKay Road East Highway 400 Interchange, Lockhart Road/Salem Road Crossing
DATE: September 22, 2017

1. INTRODUCTION

The City of Barrie is undertaking a Class Environmental Assessment (Class EA) for a new Highway 400 Interchange at McKay Road (also known as 10th Line) and a new crossing of Highway 400 at Lockhart/Salem Road. The road improvements include widening of McKay Road and Lockhart/Salem Road from two to four basic lanes. McKay Road, within the study area, is currently posted at 80 km/h and in the future, with improvements it will be posted at 60 km/h. Lockhart/Salem Road, within the study area, currently operates at a posted speed 60 km/h which will be maintained under future conditions.

As part of the Class EA Study, a noise assessment was conducted to assess the potential increase in noise level to noise sensitive areas as a result of the proposed improvements to McKay Road and Lockhart/Salem Road. Existing land uses along McKay and Salem Roads are mainly farmland with some residential homes. The noise assessment was undertaken based on a selection of several private residential homes within the Study Area. These residential houses located adjacent to McKay and Salem Roads were selected to represent the potential noise impact to noise sensitive areas.

This memorandum summarizes the findings of the noise assessment.

2. METHODOLOGY

Noise levels are predicted in decibels in the A-weighted dBA scale, which best approximates the human perception of sound over a specified time period. An increase of 2 – 3 decibels in noise levels is considered to be just perceivable to the average person. It should be noted that a 3 dBA increase in noise equates to a doubling of traffic volumes.
Since roadway sound levels vary over time, the noise descriptor used in Ontario to assess noise is the “equivalent sound level” - $L_{eq}$. $L_{eq}$ is identified as the continuous sound level, which has the same energy as a time varying sound level over a specified time period. For the purposes of assessing municipal roadway noise, $L_{eq}$ is calculated on the basis of the 16 hour daytime period, 7:00 a.m. to 11:00 p.m (MTO uses 24 $L_{eq}$). For new residential development adjacent to existing roads, the provincial objective is 55 dBA in the outdoor living area (OLA) for the daytime period.

Based on the Ontario Ministry of Transportation (MTO)/Ministry of the Environment and Climate Change (MOECC) Noise Protocol, where an existing roadway is proposed to be modified / widened adjacent to a Noise Sensitive Area (NSA), MOECC requires that the future noise levels without the proposed improvements be compared to the future noise level with the proposed improvements. The assessment is done at the outdoor living area (typically backyards) of each NSA. The provision of noise mitigation is to be investigated should the future noise level with the proposed improvements result in a greater than 5 dBA increase over the future noise level without the proposed improvements. If noise mitigation is provided, the objective is a minimum 5 dBA reduction. Mitigation will attempt to achieve levels as close to, or lower than, the objective level as is technically, economically and administratively feasible. The technical, economic and administrative feasibility of providing mitigation is required to be reviewed as follows according to Ministry of Transportation Environmental Guide for Noise (October 2006) is as follows:

- **Technical Feasibility** – Review the constructability of the noise mitigation (i.e. design of wall, roadside safety, shadow effect, topography, achieve a 5 dBA reduction, ability to provide a continuous barrier. Etc.).

- **Economic Feasibility** – Carry out a cost/benefit assessment of the noise mitigation (i.e. determine cost per benefited receiver).

- **Administrative Feasibility** – Determine the ability to locate the noise mitigation on lands within public ownership (i.e. provincial or municipal right-of-way).

The mitigation effort required for project noise level with proposed improvements is summarized in Table 2-1

**Table 2-1 Summary of Mitigation Effort Required**

<table>
<thead>
<tr>
<th>Change in Noise Level Above Ambient / Projected Noise Levels with Proposed Improvements</th>
<th>Mitigation Effort Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 5 dBA Change &amp; &lt; 65 dBA</td>
<td>None</td>
</tr>
</tbody>
</table>
| ≥ 5 dBA change OR ≥ 65 dBA | • Investigate noise control measures on the right-of-way  
                              • Introduce noise control measures within the right-of-way and mitigate to ambient |
if technically, economically and administratively feasible.

- Noise control measures, where introduced, should achieve a minimum 5 dBA attenuation, over first row receivers.

Source: Ministry of Transportation Environmental Guide for Noise (October 2006)

The STAMSON 5.0 computer modelling program, which is approved for use in Ontario by the MOECC, was used to assess existing and future noise levels McKay and Lockhart/Salem Roads. This program is used to predict noise levels generated from the road at the outdoor living areas (typically backyards) of NSA’s.

**CITY OF BARRIE NOISE POLICY/BY-LAW**

The City of Barrie does not have any specific noise policy or guidelines as they pertain to the generation of traffic noise for new/proposed roadway projects and they currently rely on the MOECC/MTO Noise guidelines (as described in above) in relation to Environmental Assessment of Transportation Noise due to roadway widening, expansion or construction. The City of Barrie Noise by-law 2006-140 should be reviewed and adhered in terms of construction noise considerations (see construction noise section 7).

**FUTURE DEVELOPMENT**

It should be noted that the land along Salem Road (north of Salem Road and west of Highway 404) is anticipated to be developed in the future as employment lands.

### 3. ANALYSIS

Two scenarios were calculated:

1. Future noise levels without improvements to McKay and Lockhart/Salem Roads (Year 2031)
2. Future noise levels with improvements to McKay and Lockhart/Salem Roads (Year 2031)
3. Future noise levels with improvements with Noise Barrier in place (Year 2031) – in locations where warranted.

The major noise sources with the noise assessment area are Highway 400, McKay Road and Salem/Lockhart Road.

McKay Road and Salem/Lockhart Road, are considered the dominant noise sources in the study area as the noise contribution from each of these sources is expected to change with the proposed undertaking and as such traffic noise from these sources were used in the calculations of the noise levels for this study.

Highway 400 noise was not included in the calculations of noise levels for this study as its noise impact contribution is not expected to change due to the proposed undertaking.
Table 3-1 summarizes the main assumptions and factors used in the noise analysis. The traffic noise summary sheet completed for this analysis can be found in Appendix A of this memo.

**Table 3-1 Factors and Assumptions Used in Noise Analysis**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Assumptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise Descriptor</td>
<td>$L_{eq}$ (16 hour)</td>
</tr>
<tr>
<td>Traffic Speed</td>
<td>McKay Road</td>
</tr>
<tr>
<td></td>
<td>• Future without improvements = 80 km/h</td>
</tr>
<tr>
<td></td>
<td>• Future with improvements = 60 km/h</td>
</tr>
<tr>
<td></td>
<td>Lockhart/Salem Road</td>
</tr>
<tr>
<td></td>
<td>• Future with and without improvements = 60 km/h</td>
</tr>
<tr>
<td>Traffic Volumes</td>
<td><strong>Future (2031) Without Improvements</strong></td>
</tr>
<tr>
<td>AADT</td>
<td>• McKay Road</td>
</tr>
<tr>
<td></td>
<td>o Eastbound =</td>
</tr>
<tr>
<td></td>
<td>o Westbound =</td>
</tr>
<tr>
<td></td>
<td>• Salem Road</td>
</tr>
<tr>
<td></td>
<td>o Eastbound = 961(^1)</td>
</tr>
<tr>
<td></td>
<td>o Westbound = 961(^1)</td>
</tr>
<tr>
<td></td>
<td><strong>Future (2031) With Improvements</strong></td>
</tr>
<tr>
<td></td>
<td>• McKay Road</td>
</tr>
<tr>
<td></td>
<td>o Eastbound =</td>
</tr>
<tr>
<td></td>
<td>o Westbound =</td>
</tr>
<tr>
<td></td>
<td>• Salem Road</td>
</tr>
<tr>
<td></td>
<td>o Eastbound =</td>
</tr>
<tr>
<td></td>
<td>o Westbound =</td>
</tr>
<tr>
<td>Truck Percentages</td>
<td>• McKay Road</td>
</tr>
<tr>
<td>(Medium/Heavy)</td>
<td>o Eastbound =</td>
</tr>
<tr>
<td></td>
<td>o Westbound =</td>
</tr>
<tr>
<td></td>
<td>• Salem Road</td>
</tr>
<tr>
<td></td>
<td>(future with improvements)(^2)</td>
</tr>
<tr>
<td></td>
<td>o Eastbound =</td>
</tr>
<tr>
<td></td>
<td>o Westbound =</td>
</tr>
</tbody>
</table>
Receptor Height | 1.5 m above the ground
---|---
Noise Barrier | There are no existing noise barriers within the study limits.

Notes:
1) The existing traffic volumes along Salem Road are very low, thus the traffic volumes that have been used for the future no-build scenario are the minimum number required to run STAMSON (i.e. > 40 vph).
2) Truck percentages for Lockhart/Salem Road for future without improvements have been assumed to be 0 % due to the extremely low volume of existing traffic.

4. NOISE SENSITIVE AREAS

There are existing residential houses adjacent to McKay and Salem Roads within the study limits. Two locations, one on McKay Road and one on Salem Road, were selected to be included in the noise calculations as representatives to these residential houses. The selected receiver locations are summarized in Table 4-1 and are shown on Figure 4-1 and Figure 4-2.

<table>
<thead>
<tr>
<th>Receiver #</th>
<th>Location (City of Barrie)</th>
<th>Characteristic of Property in Relation to Roadway</th>
<th>Type of Residential Unit</th>
<th>Existing Noise Wall?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>36 McKay Road 10+296 Lt</td>
<td>Frontage</td>
<td>Detached House</td>
<td>No (N/A)</td>
</tr>
<tr>
<td>2</td>
<td>60 Salem Road 0+535 Lt</td>
<td>Frontage</td>
<td>Detached House</td>
<td>No (N/A)</td>
</tr>
</tbody>
</table>
McKay Road - Highway 400 Interchange, Lockhart Road/Salem Road Crossing and Associated Works

ENVIRONMENTAL STUDY REPORT

McKay Road

Scale 1:2000

RECEIVER LOCATIONS & RESULTS

**NOISE ANALYSIS**

**McKay Road**

<table>
<thead>
<tr>
<th>Location</th>
<th>Current Noise Level (dBA)</th>
<th>Future Noise Level (dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>McKay Road 36</td>
<td>51.3</td>
<td>54.4</td>
</tr>
</tbody>
</table>

**LEGEND**

- Receiver Location
- Projected Future Noise Levels without Improvements
- Projected Future Noise Levels with Improvements
**NOISE ANALYSIS**

**RECEIVER LOCATIONS & RESULTS**

**SALEM ROAD**

<table>
<thead>
<tr>
<th>Location</th>
<th>Projected Future Noise Levels without Improvements</th>
<th>Projected Future Noise Levels with Improvements</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 Salem Road</td>
<td>36.7 dBA</td>
<td>51.5 dBA</td>
</tr>
</tbody>
</table>

**ENVIRONMENTAL STUDY REPORT**

McKay Road East - Highway 400 Interchange, Lockhart Road/Salem Road Crossing and Associated Works

Exhibit 4-2

Scale 1:2000

**LEGEND**

- Receiver Location
- Projected Future Noise Levels without Improvements
- Projected Future Noise Levels with Improvements
5. RESULTS

Noise levels were calculated at the selected receiver locations for the future with and without improvement scenarios.

Table 5-1 and Figure 4-1 Noise Analysis Receiver Locations and Results

Table 5-1 summarises the predicted daytime noise levels at the 2 receivers reviewed, and the potential changes in future noise levels.

Table 5-2 summarises the noise barrier analysis for those receivers that resulted in either a noise level greater than 60 dBA and/or a noise level increase of greater than 5 dBA for the future (2031) conditions with improvements.

The following is noted for the review of noise mitigation:

- A maximum noise barrier height of 5 m was assessed for those locations that warranted a review of mitigation. A maximum noise barrier height of 5 m is generally accepted as the maximum noise barrier height used in Ontario.
- Noise mitigation measures be reviewed within the right-of-way.
- For calculation purposes, the lengths of the walls were determined by applying a 2.5:1 ratio to distance between the noise barrier and the receiver location (i.e. therefore the barrier length is 5 times the distance between the barrier and the receiver). For example, a distance between the noise barrier and the receiver being 100 m generally requires a 500 m noise wall length.

STAMSON output sheets for the 2 receivers reviewed are included in Appendix B of this memo.

Table 5-1 Summary of Calculated Noise Levels

<table>
<thead>
<tr>
<th>Receiver Location (see Figure 4-1)</th>
<th>Distance from Receiver Location to Noise Source (m)</th>
<th>Projected Noise Level dBA $L_{eq}$(16)</th>
<th>Consideration of Noise Mitigation Required Based on MTO/MOE Criteria (&gt;5 dBA change and/or ≥ 65 dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receiver 1 36 McKay Road</td>
<td>Future Without Improvements: 48 m (eastbound)</td>
<td>Future With Improvements: 53 m (eastbound)</td>
<td>Future Without Improvements: 51.3 54.4 +3.1  No</td>
</tr>
<tr>
<td>Receiver 2</td>
<td>Future Without Improvements: 70 m (eastbound)</td>
<td>Future With Improvements: 74 m (eastbound)</td>
<td>Future With Improvements: 36.7 51.5 +14.8 Yes (increase greater than 5 dBA)</td>
</tr>
</tbody>
</table>
60 Salem Road 66 m (westbound) 62 m (westbound)

Table 5-2 Noise Barrier Analysis

<table>
<thead>
<tr>
<th>Receiver Location (see Figure 4-1)</th>
<th>Projected Noise Level $L_{eq}$ (16) Future (2031) with Improvements (dBA)</th>
<th>Wall Height to achieve a minimum 5 dBA for future conditions or maximum wall Height of 5 m</th>
<th>Rationale Why Noise Barrier is Not Proposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receiver 2 60 Salem Road</td>
<td>51.5</td>
<td>5.0</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Projected Noise Level (dBA) with Noise Wall in Place</td>
<td>Reduction in Noise Level (dBA) with Wall in Place</td>
<td>Noise Barrier Proposed? (Y/N)</td>
</tr>
<tr>
<td></td>
<td>50.5</td>
<td>-1.0</td>
<td>No</td>
</tr>
</tbody>
</table>

6. FINDINGS/CONCLUSIONS

The findings of the noise assessment are as follows:

- The projected noise levels in Year 2031 at receivers 1 and 2, **without** improvements to McKay or Salem Roads, are 51.3 and 36.7 dBA.

- The projected noise levels in Year 2031 at receivers 1 and 2, **with** improvements to McKay or Salem Roads, are 54.4 and 51.5 dBA.

- The maximum potential increase in noise levels between the future without and the future with improvements at Receiver 1 is 3.1 dBA. Since the potential noise increase in the projected noise level is less than 5 dBA, the consideration of noise mitigation based on the MTO/MOECC Noise Protocol is not warranted at this receiver.

- The maximum potential increase in noise levels between the future without and the future with improvements at Receiver 1 is 14.8 dBA. Since the potential noise increase in the projected noise level is more than 5 dBA, the consideration of noise mitigation based on the MTO/MOECC Noise Protocol is warranted at this receiver. At this location a 5 m noise wall was reviewed; a noise wall is not recommended for this location for the following reasons:
  - A minimum reduction of 5 dBA could not be achieved with a noise wall in place at the right-of-way line.
○ This receiver is frontage to Salem Road with a driveway onto Salem Road a continuous barrier would not be feasible at this location.

○ This property is anticipated to be developed in the future as employment lands which would not be considered a NSA.
7. CONSTRUCTION NOISE

During construction of the improvements, the contractor will be required to abide by the Contract Operational Constraints and municipal noise control by-laws. The Contractor will be required to keep the idling of construction equipment to a minimum and to maintain equipment in good working order to reduce noise from construction activities.
APPENDIX A
TRAFFIC DATA SUMMARY
## Noise Analysis Traffic Data Summary

### Future (2031) Without Improvements

<table>
<thead>
<tr>
<th></th>
<th>AADT</th>
<th>AADT 16hr eq (90% of AADT)</th>
<th>Auto</th>
<th>Medium Trucks</th>
<th>Heavy Trucks</th>
</tr>
</thead>
<tbody>
<tr>
<td>McKay Road</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eastbound</td>
<td>2000</td>
<td>1850</td>
<td>1771</td>
<td>67</td>
<td>12</td>
</tr>
<tr>
<td>Westbound</td>
<td>2200</td>
<td>2035</td>
<td>1948</td>
<td>74</td>
<td>13</td>
</tr>
<tr>
<td>Salem Road*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eastbound</td>
<td>693</td>
<td>641</td>
<td>641</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Westbound</td>
<td>693</td>
<td>641</td>
<td>641</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

*The existing traffic volumes along Salem Road are very low, thus the traffic volumes that have been used for the future no-build scenario are the minimum number required to run STAMSON (i.e. > 40 vph). Truck volumes are negligible.*

### Future (2031) With Improvements

<table>
<thead>
<tr>
<th></th>
<th>AADT</th>
<th>AADT 16hr eq (90% of AADT)</th>
<th>Auto</th>
<th>Medium Trucks</th>
<th>Heavy Trucks</th>
</tr>
</thead>
<tbody>
<tr>
<td>McKay Road</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eastbound</td>
<td>10000</td>
<td>9250</td>
<td>8861</td>
<td>333</td>
<td>56</td>
</tr>
<tr>
<td>Westbound</td>
<td>8200</td>
<td>7585</td>
<td>7265</td>
<td>274</td>
<td>46</td>
</tr>
<tr>
<td>Salem Road*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eastbound</td>
<td>10200</td>
<td>9435</td>
<td>8783</td>
<td>538</td>
<td>114</td>
</tr>
<tr>
<td>Westbound</td>
<td>8200</td>
<td>7585</td>
<td>7060</td>
<td>433</td>
<td>92</td>
</tr>
</tbody>
</table>
APPENDIX B
STAMSON OUTPUT SHEETS
STAMSON 5.0        NORMAL REPORT        Date: 12-09-2017 14:43:04
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r1fw0.te             Time Period: 16 hours
Description:

Road data, segment # 1: EB
----------------------------
Car traffic volume : 1771 veh/TimePeriod
Medium truck volume : 67 veh/TimePeriod
Heavy truck volume : 12 veh/TimePeriod
Posted speed limit : 80 km/h
Road gradient : 2 %
Road pavement : 1 (Typical asphalt or concrete)

Data for Segment # 1: EB
------------------------
Angle1   Angle2           : -90.00 deg   -39.00 deg
Wood depth                : 0       (No woods.)
No of house rows          : 0
Surface                   : 1       (Absorptive ground surface)
Receiver source distance  : 48.00 m
Receiver height           : 1.50 m
Topography                : 3       (Elevated; no barrier)
Elevation                 : 0.10 m
Reference angle           : 0.00

Road data, segment # 2: EB
----------------------------
Car traffic volume : 1771 veh/TimePeriod
Medium truck volume : 67 veh/TimePeriod
Heavy truck volume : 12 veh/TimePeriod
Posted speed limit : 80 km/h
Road gradient : 2 %
Road pavement : 1 (Typical asphalt or concrete)

Data for Segment # 2: EB
------------------------
Angle1   Angle2           : 31.00 deg   90.00 deg
Wood depth                : 0       (No woods.)
No of house rows          : 0
Surface                   : 1       (Absorptive ground surface)
Receiver source distance  : 48.00 m
Receiver height           : 1.50 m
Topography                : 3       (Elevated; no barrier)
Elevation                 : 0.10 m
Reference angle           : 0.00

Road data, segment # 3: WB
----------------------------
Car traffic volume : 1948 veh/TimePeriod
Medium truck volume : 74 veh/TimePeriod
Heavy truck volume : 12 veh/TimePeriod
Posted speed limit : 80 km/h
Road gradient : 2 %
Road pavement : 1 (Typical asphalt or concrete)

Data for Segment # 3: WB
------------------------
Angle1   Angle2           : -90.00 deg   -39.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  44.00 m
Receiver height           :   1.50 m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   0.10 m
Reference angle           :   0.00

Road data, segment # 4: WB
-----------------------------------
Car traffic volume  :  1948 veh/TimePeriod
Medium truck volume :    74 veh/TimePeriod
Heavy truck volume  :    13 veh/TimePeriod
Posted speed limit  :    80 km/h
Road gradient      :  2 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 4: WB
-----------------------------------
Angle1   Angle2           :  31.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  44.00 m
Receiver height           :   1.50 m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   0.10 m
Reference angle           :   0.00

Results segment # 1: EB
-----------------------------------
Source height = 0.90 m
ROAD (0.00 + 44.24 + 0.00) = 44.24 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
-----------------------------------
-90   -39   0.66  60.81   0.00  -8.39  -8.18   0.00   0.00   0.00  44.24
-----------------------------------
Segment Leq : 44.24 dBA

Results segment # 2: EB
-----------------------------------
Source height = 0.90 m
ROAD (0.00 + 45.23 + 0.00) = 45.23 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
-----------------------------------
 31    90   0.66  60.81   0.00  -8.39  -7.19   0.00   0.00   0.00  45.23
-----------------------------------
Segment Leq : 45.23 dBA

Results segment # 3: WB
-----------------------------------
Source height = 0.88 m

Page 2
ROAD \((0.00 + 45.21 + 0.00) = 45.21\) dBA

<table>
<thead>
<tr>
<th>Angle1</th>
<th>Angle2</th>
<th>Alpha</th>
<th>RefLeq</th>
<th>P.Adj</th>
<th>D.Adj</th>
<th>F.Adj</th>
<th>W.Adj</th>
<th>H.Adj</th>
<th>B.Adj</th>
<th>SubLeq</th>
</tr>
</thead>
<tbody>
<tr>
<td>-90</td>
<td>-39</td>
<td>0.66</td>
<td>61.16</td>
<td>0.00</td>
<td>-7.76</td>
<td>-8.18</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>45.21</td>
</tr>
</tbody>
</table>

Segment Leq : 45.21 dBA

Results segment # 4: WB

Source height = 0.89 m

ROAD \((0.00 + 46.27 + 0.00) = 46.27\) 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>31</td>
<td>90</td>
<td>0.66</td>
<td>61.22</td>
<td>0.00</td>
<td>-7.76</td>
<td>-7.19</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>46.27</td>
</tr>
</tbody>
</table>

Segment Leq : 46.27 dBA

Total Leq All Segments: 51.32 dBA

TOTAL Leq FROM ALL SOURCES: 51.32
STAMSON 5.0        NORMAL REPORT        Date: 12-09-2017 15:22:42
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r1fw.te              Time Period: 16 hours

Description:

Road data, segment # 1: EB
----------------------------------
Car traffic volume :  8861 veh/TimePeriod
Medium truck volume :  333 veh/TimePeriod
Heavy truck volume :   56 veh/TimePeriod
Posted speed limit :   60 km/h
Road gradient :        2 %
Road pavement :            1 (Typical asphalt or concrete)

Data for Segment # 1: EB
------------------------
Angle1   Angle2           : -90.00 deg   -39.00 deg
Wood depth               : 0 (No woods.)
No of house rows         : 0
Surface                  : 1 (Absorptive ground surface)
Receiver source distance : 53.00 m
Receiver height          : 1.50 m
Topography               : 3 (Elevated; no barrier)
Elevation                : 0.10 m
Reference angle          : 0.00

Road data, segment # 2: EB
----------------------------------
Car traffic volume :  8861 veh/TimePeriod
Medium truck volume :  333 veh/TimePeriod
Heavy truck volume :   56 veh/TimePeriod
Posted speed limit :   60 km/h
Road gradient :        2 %
Road pavement :            1 (Typical asphalt or concrete)

Data for Segment # 2: EB
------------------------
Angle1   Angle2           :  31.00 deg   90.00 deg
Wood depth               : 0 (No woods.)
No of house rows         : 0
Surface                  : 1 (Absorptive ground surface)
Receiver source distance : 53.00 m
Receiver height          : 1.50 m
Topography               : 3 (Elevated; no barrier)
Elevation                : 0.10 m
Reference angle          : 0.00

Road data, segment # 3: WB
----------------------------------
Car traffic volume :  7265 veh/TimePeriod
Medium truck volume :  274 veh/TimePeriod
Heavy truck volume :   46 veh/TimePeriod
Posted speed limit :   60 km/h
Road gradient :        2 %
Road pavement :            1 (Typical asphalt or concrete)

Data for Segment # 3: WB
------------------------
Angle1   Angle2           : -90.00 deg   -39.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  42.00 m
Receiver height           :   1.50 m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   0.20 m
Reference angle           :   0.00

Road data, segment # 4: WB
-----------------------------------
Car traffic volume  :  7265 veh/TimePeriod
Medium truck volume :   274 veh/TimePeriod
Heavy truck volume  :    46 veh/TimePeriod
Posted speed limit   : 60 km/h
Road gradient        :   2 %
Road pavement         :     1 (Typical asphalt or concrete)

Data for Segment # 4: WB
-----------------------------------
Angle1   Angle2           :  31.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  42.00 m
Receiver height           :   1.50 m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   0.20 m
Reference angle           :   0.00

Results segment # 1: EB
-----------------------------------
Source height = 0.88 m
ROAD (0.00 + 47.43 + 0.00) = 47.43 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------
-90    -39  0.66  64.71   0.00  -9.10  -8.18   0.00   0.00   0.00  47.43
-----------------------------------
Segment Leq : 47.43 dBA

Results segment # 2: EB
-----------------------------------
Source height = 0.88 m
ROAD (0.00 + 48.42 + 0.00) = 48.42 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------
31     90  0.66  64.71   0.00  -9.10  -7.19   0.00   0.00   0.00  48.42
-----------------------------------
Segment Leq : 48.42 dBA

Results segment # 3: WB
-----------------------------------
Source height = 0.88 m

Page 3
ROAD (0.00 + 48.25 + 0.00) = 48.25 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>-39</td>
<td>0.66</td>
<td>63.86</td>
<td>0.00</td>
<td>-7.42</td>
<td>-8.18</td>
<td>0.00</td>
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<td>0.00</td>
<td>48.25</td>
</tr>
</tbody>
</table>

Segment Leq : 48.25 dBA

Results segment # 4: WB

Source height = 0.88 m

ROAD (0.00 + 49.24 + 0.00) = 49.24 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>31</td>
<td>90</td>
<td>0.66</td>
<td>63.86</td>
<td>0.00</td>
<td>-7.42</td>
<td>-7.19</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>49.24</td>
</tr>
</tbody>
</table>

Segment Leq : 49.24 dBA

Total Leq All Segments: 54.40 dBA

TOTAL Leq FROM ALL SOURCES: 54.40
Road data, segment # 1: EB
-------------------------------
Car traffic volume : 641 veh/TimePeriod
Medium truck volume : 0 veh/TimePeriod
Heavy truck volume : 0 veh/TimePeriod
Posted speed limit : 60 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

Data for Segment # 1: EB
------------------------
Angle1   Angle2           : -90.00 deg   -44.00 deg
Wood depth                : (No woods.)
No of house rows          : 0
Surface                   : 1 (Absorptive ground surface)
Receiver source distance  : 70.00 m
Receiver height           : 1.50 m
Topography                : 3 (Elevated; no barrier)
Elevation                 : 0.20 m
Reference angle           : 0.00

Road data, segment # 2: EB
-------------------------------
Car traffic volume : 641 veh/TimePeriod
Medium truck volume : 0 veh/TimePeriod
Heavy truck volume : 0 veh/TimePeriod
Posted speed limit : 60 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

Data for Segment # 2: EB
------------------------
Angle1   Angle2           : 43.00 deg   90.00 deg
Wood depth                : (No woods.)
No of house rows          : 0
Surface                   : 1 (Absorptive ground surface)
Receiver source distance  : 70.00 m
Receiver height           : 1.50 m
Topography                : 3 (Elevated; no barrier)
Elevation                 : 0.20 m
Reference angle           : 0.00
Wood depth                      :      0       (No woods.)
No of house rows                :      0
Surface                        :      1       (Absorptive ground surface)
Receiver source distance       :  66.00 m
Receiver height                :   1.50 m
Topography                     :      3       (Elevated; no barrier)
Elevation                      :   0.20 m
Reference angle                :   0.00

Road data, segment # 4: WB
----------------------------
Car traffic volume             :   641 veh/TimePeriod
Medium truck volume            :     0 veh/TimePeriod
Heavy truck volume             :     0 veh/TimePeriod
Posted speed limit             :    60 km/h
Road gradient                  :     0 %
Road pavement                  :     1 (Typical asphalt or concrete)

Data for Segment # 4: WB
------------------------
Angle1  Angle2           :  43.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  66.00 m
Receiver height           :   1.50 m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   0.20 m
Reference angle           :   0.00

Results segment # 1: EB
-----------------------
Source height = 0.50 m
ROAD (0.00 + 30.35 + 0.00) = 30.35 dBA
Angle1 Angle2 Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------
  -90   -44   0.66  50.35   0.00 -11.11  -8.90   0.00   0.00   0.00  30.35
-------------------------------
Segment Leq : 30.35 dBA

Results segment # 2: EB
-----------------------
Source height = 0.50 m
ROAD (0.00 + 30.50 + 0.00) = 30.50 dBA
Angle1 Angle2 Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------
  43     90   0.66  50.35   0.00 -11.11  -8.75   0.00   0.00   0.00  30.50
-------------------------------
Segment Leq : 30.50 dBA

Results segment # 3: WB
-----------------------
Source height = 0.50 m
## Results segment # 4: WB

Source height = 0.50 m

<table>
<thead>
<tr>
<th>Angle1</th>
<th>Angle2</th>
<th>Alpha</th>
<th>RefLeq</th>
<th>P.Adj</th>
<th>D.Adj</th>
<th>F.Adj</th>
<th>W.Adj</th>
<th>H.Adj</th>
<th>B.Adj</th>
<th>SubLeq</th>
</tr>
</thead>
<tbody>
<tr>
<td>-90</td>
<td>-44</td>
<td>0.66</td>
<td>50.35</td>
<td>0.00</td>
<td>-10.68</td>
<td>-8.90</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>30.78</td>
</tr>
</tbody>
</table>

Segment Leq : 30.78 dBA

Total Leq All Segments: 36.67 dBA

TOTAL Leq FROM ALL SOURCES: 36.67
Road data, segment # 1: EB

-------------
Car traffic volume : 8783 veh/TimePeriod
Medium truck volume : 538 veh/TimePeriod
Heavy truck volume : 114 veh/TimePeriod
Posted speed limit : 60 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

Data for Segment # 1: EB
-------------
Angle1   Angle2           : -90.00 deg   -44.00 deg
Wood depth                : 0 (No woods.)
No of house rows          : 0
Surface                   : 1 (Absorptive ground surface)
Receiver source distance  : 74.00 m
Receiver height           : 1.50 m
Topography                : 1 (Flat/gentle slope; no barrier)
Reference angle           : 0.00

Road data, segment # 2: EB

-------------
Car traffic volume : 8783 veh/TimePeriod
Medium truck volume : 538 veh/TimePeriod
Heavy truck volume : 114 veh/TimePeriod
Posted speed limit : 60 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

Data for Segment # 2: EB
-------------
Angle1   Angle2           : 43.00 deg   90.00 deg
Wood depth                : 0 (No woods.)
No of house rows          : 0
Surface                   : 1 (Absorptive ground surface)
Receiver source distance  : 74.00 m
Receiver height           : 1.50 m
Topography                : 1 (Flat/gentle slope; no barrier)
Reference angle           : 0.00

Road data, segment # 3: WB

-------------
Car traffic volume : 7060 veh/TimePeriod
Medium truck volume : 433 veh/TimePeriod
Heavy truck volume : 92 veh/TimePeriod
Posted speed limit : 60 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

Data for Segment # 3: WB
-------------
Angle1   Angle2           : -90.00 deg   -44.00 deg
Wood depth                : 0 (No woods.)
No of house rows          : 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 62.00 m
Receiver height : 1.50 m
Topography : 3 (Elevated; no barrier)
Elevation : 0.10 m
Reference angle : 0.00

Road data, segment # 4: WB

Car traffic volume : 7060 veh/TimePeriod
Medium truck volume : 433 veh/TimePeriod
Heavy truck volume : 92 veh/TimePeriod
Posted speed limit : 60 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

Data for Segment # 4: WB

<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>-44</td>
<td>0.66</td>
<td>65.64</td>
<td>0.00</td>
<td>-11.51</td>
<td>-8.90</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>45.24</td>
</tr>
</tbody>
</table>

Segment Leq : 45.24 dBA

Results segment # 1: EB

Source height = 1.05 m

ROAD (0.00 + 45.24 + 0.00) = 45.24 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>-44</td>
<td>0.66</td>
<td>65.64</td>
<td>0.00</td>
<td>-11.51</td>
<td>-8.90</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>45.24</td>
</tr>
</tbody>
</table>

Segment Leq : 45.24 dBA

Results segment # 2: EB

Source height = 1.05 m

ROAD (0.00 + 45.39 + 0.00) = 45.39 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>43</td>
<td>90</td>
<td>0.66</td>
<td>65.64</td>
<td>0.00</td>
<td>-11.51</td>
<td>-8.75</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>45.39</td>
</tr>
</tbody>
</table>

Segment Leq : 45.39 dBA

Results segment # 3: WB

Source height = 1.05 m

ROAD (0.00 + 45.58 + 0.00) = 45.58 dBA

<table>
<thead>
<tr>
<th>Angle1</th>
<th>Angle2</th>
<th>Alpha</th>
<th>RefLeq</th>
<th>P.Adj</th>
<th>D.Adj</th>
<th>F.Adj</th>
<th>W.Adj</th>
<th>H.Adj</th>
<th>B.Adj</th>
<th>SubLeq</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0.66</td>
<td>65.64</td>
<td>0.00</td>
<td>-11.51</td>
<td>-8.75</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>45.58</td>
</tr>
</tbody>
</table>
Segment Leq : 45.58 dBA

Results segment # 4: WB

Source height = 1.05 m

ROAD (0.00 + 45.72 + 0.00) = 45.72 dBA

Segment Leq : 45.72 dBA

Total Leq All Segments: 51.51 dBA

TOTAL Leq FROM ALL SOURCES: 51.51
Road data, segment # 1: EB

Car traffic volume : 8783 veh/TimePeriod
Medium truck volume : 538 veh/TimePeriod
Heavy truck volume : 114 veh/TimePeriod
Posted speed limit : 60 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

Data for Segment # 1: EB

Angle1   Angle2           : -90.00 deg   -57.00 deg
Wood depth                : 0         (No woods.)
No of house rows          : 0
Surface                   : 1         (Absorptive ground surface)
Receiver source distance  : 74.00 m
Receiver height           : 1.50 m
Topography                : 1         (Flat/gentle slope; no barrier)
Reference angle           : 0.00

Road data, segment # 2: WB

Car traffic volume : 7060 veh/TimePeriod
Medium truck volume : 433 veh/TimePeriod
Heavy truck volume : 92 veh/TimePeriod
Posted speed limit : 60 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

Data for Segment # 2: WB

Angle1   Angle2           : -90.00 deg   -57.00 deg
Wood depth                : 0         (No woods.)
No of house rows          : 0
Surface                   : 1         (Absorptive ground surface)
Receiver source distance  : 62.00 m
Receiver height           : 1.50 m
Topography                : 3         (Elevated; no barrier)
Elevation                 : 0.10 m
Reference angle           : 0.00

Road data, segment # 3: EB - WALL

Car traffic volume : 8783 veh/TimePeriod
Medium truck volume : 538 veh/TimePeriod
Heavy truck volume : 114 veh/TimePeriod
Posted speed limit : 60 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

Data for Segment # 3: EB - WALL

Angle1   Angle2           : -57.00 deg    57.00 deg
Wood depth                : 0         (No woods.)
No of house rows : 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 74.00 m
Receiver height : 1.50 m
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : -57.00 deg Angle2 : 57.00 deg
Barrier height : 5.00 m
Barrier receiver distance : 51.00 m
Source elevation : 310.80 m
Receiver elevation : 310.80 m
Barrier elevation : 310.80 m
Reference angle : 0.00

Road data, segment # 4: WB - WALL
---------------------------------------
Car traffic volume : 7060 veh/TimePeriod
Medium truck volume : 538 veh/TimePeriod
Heavy truck volume : 114 veh/TimePeriod
Posted speed limit : 60 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

Data for Segment # 4: WB - WALL
-------------------------------
Angle1 Angle2 : -57.00 deg 57.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 62.00 m
Receiver height : 1.50 m
Topography : 4 (Elevated; with barrier)
Barrier angle1 : -57.00 deg Angle2 : 57.00 deg
Barrier height : 5.00 m
Elevation : 0.10 m
Barrier receiver distance : 51.00 m
Source elevation : 310.90 m
Receiver elevation : 310.80 m
Barrier elevation : 310.80 m
Reference angle : 0.00

Road data, segment # 5: EB
--------------------------
Car traffic volume : 8783 veh/TimePeriod
Medium truck volume : 538 veh/TimePeriod
Heavy truck volume : 114 veh/TimePeriod
Posted speed limit : 60 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

Data for Segment # 5: EB
------------------------
Angle1 Angle2 : 57.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 74.00 m
Receiver height : 1.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

Road data, segment # 6: WB
Page 2
Car traffic volume : 7060 veh/TimePeriod
Medium truck volume : 433 veh/TimePeriod
Heavy truck volume : 92 veh/TimePeriod
Posted speed limit : 60 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

Data for Segment # 6: WB

Angle1   Angle2           : 57.00 deg   90.00 deg
Wood depth                : 0       (No woods.)
No of house rows          : 0
Surface                   : 1       (Absorptive ground surface)
Receiver source distance  : 62.00 m
Receiver height           : 1.50 m
Topography                : 3       (Elevated; no barrier)
Elevation                 : 0.10 m
Reference angle           : 0.00

Results segment # 1: EB

Source height = 1.05 m
ROAD (0.00 + 42.92 + 0.00) = 42.92 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>-57</td>
<td>0.66</td>
<td>65.64</td>
<td>0.00</td>
<td>-11.51</td>
<td>-11.22</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>42.92</td>
</tr>
</tbody>
</table>

Segment Leq : 42.92 dBA

Results segment # 2: WB

Source height = 1.05 m
ROAD (0.00 + 43.25 + 0.00) = 43.25 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>
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<td>0.66</td>
<td>64.70</td>
<td>0.00</td>
<td>-10.23</td>
<td>-11.22</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>43.25</td>
</tr>
</tbody>
</table>

Segment Leq : 43.25 dBA

Results segment # 3: EB - WALL

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>1.05</td>
<td>1.50</td>
<td>1.19</td>
<td>311.99</td>
</tr>
</tbody>
</table>

ROAD (0.00 + 40.40 + 0.00) = 40.40 dBA

Page 3
Results segment # 4: WB - WALL

Source height = 1.10 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>1.10</td>
<td>1.50</td>
<td>1.26</td>
<td>312.06</td>
</tr>
</tbody>
</table>

ROAD (0.00 + 39.01 + 0.00) = 39.01 dBA

Segment Leq : 39.01 dBA

Page 5

Results segment # 5: EB

Source height = 1.05 m

ROAD (0.00 + 42.92 + 0.00) = 42.92 dBA

Segment Leq : 42.92 dBA

Results segment # 6: WB

Source height = 1.05 m

ROAD (0.00 + 43.25 + 0.00) = 43.25 dBA

Segment Leq : 43.25 dBA

Total Leq All Segments: 50.02 dBA

TOTAL Leq FROM ALL SOURCES: 50.02