Date June 11, 2019

To Chair and Members
Committee of the Whole – Operations and Administration

From E. (Beth) Goodger, General Manager
Public Works Commission

1.0 Type of Report

Consent Item [X]
Item for Consideration [ ]

2.0 Topic Colborne Street West – Noise Study [Financial Impact - None]

3.0 Recommendation

THAT report 2019-317 “Colborne Street West - Noise Study” regarding the noise study conducted on Colborne Street West near the intersection of Oakhill Drive BE RECEIVED.

4.0 Purpose and Overview

To provide City Council with the results of the 2018 noise study conducted on Colborne Street West near Oakhill Drive.

5.0 Background

City Council, at their meeting held September 26, 2017, approved the following resolution:

1. THAT Staff BE DIRECTED to conduct a noise study along Colborne Street West for the neighbourhood to the north, up to 300 m east and 300 m west of the intersection at Oakhill Drive; and
2. THAT funding in the amount of $15,000 BE TRANSFERRED from the Council Priorities Reserve Fund to hire a consultant to conduct a noise study; and

3. THAT staff report back on the findings of the study.

The City retained a consultant, Aercoustics Engineering Limited to undertake a noise study in the neighbourhood along Colborne Street West near Oakhill Drive. The study scope included determination of existing noise sources, noise levels, potential mitigation options for the neighbourhood, and potential costs to the City to implement options identified in the study.

6.0 Corporate Policy Context

The following long term desired outcome from the Strategic Plan is addressed with the recommendation:

- Brantford will be supported by well-developed and maintained transportation and servicing infrastructure.

7.0 Input from Other Sources

Prior to the study commencement, a letter dated October 6, 2017, was delivered to the 76 properties that are located within the study area bounded by Colborne Street West, Oakhill Drive, Walsh Court, and Madison Avenue as illustrated in Figure 1.
The letter, as attached in Appendix “A”, informed residents of the noise study commencing, and requested input on the noise that residents experience in their homes. Twenty-two (22) residents, of the 76 properties circulated, provided a response. Comments regarding noise are summarized as follows:

- Road / traffic noise – Colborne Street West is like a speedway or drag strip. The traffic volume and frequency of noise has increase substantially. Noise from modified cars and motorcycles, squealing tires, loud mufflers, revving engines, and accelerating from the traffic signal and up the hill. Transport trucks traveling uphill or using their engine brake as they come down the hill.

- Fast food restaurants – crowds gather in the parking lot beside the restaurants and yell, play loud music, party, rev their vehicle’s engine, honk horn, squeal tires and race on Colborne Street West. Traffic noise has increased because of delivery trucks and the volume of traffic to/from the restaurants.

- Emergency vehicle noise from the fire and ambulance facilities

- Factory noise – trucks, horns and steel hammering
Traffic noise is generally worst during peak travel times between 5:00 a.m. and 9:00 a.m., and 3:00 p.m. to 6:00 p.m. Noise from the restaurant parking lots begins in the evening and goes to the early morning hours. Spring and summer are the worst seasons for undesirable noise levels.

Following the completion of the noise study, a public meeting was held on October 16, 2018 to present the study findings. Twelve (12) residents attended the meeting. Staff from Engineering Services and Aercoustics Engineering Limited provided a summary of the noise concerns, as well as an overview of the noise study results and conclusions. Following the presentation, the residents asked questions regarding the noise monitoring equipment used for the study, the types and properties of the noise experienced, and the proposed noise barrier locations and their effectiveness to mitigate noise. The noise study findings are further discussed in the analysis section of this report.

A follow-up letter dated January 3, 2019, was delivered to residents within the study area after the public meeting to provide a link to the public meeting presentation and outline key findings of the noise study. The letter also encouraged feedback and attendance at a future Committee of the Whole – Operations and Administration (COW-OA) meeting when this report is presented. Five (5) residents provided a response; four (4) supporting noise mitigation with three (3) indicating interest in attending the COW-OA meeting. One (1) resident did not support further consideration of noise mitigation. The letter is attached as Appendix “B”.

8.0 Analysis

8.1 Noise Study

The City of Brantford retained Aercoustics Engineering Limited to conduct a noise study of current noise levels in the study area at the intersection of Colborne Street West and Oakhill Drive. The scope of the noise study includes an acoustical investigation into the background noise levels, above average noise disturbances, and sound sources in the study area. The purpose of the noise study was to provide the City with information that can be used to help respond to noise-related complaints from the residential community to the north of Colborne Street West in the study area and to gain a deeper understanding of noise sources in the study area.

Multiple long-term sound monitors were deployed near the residential neighbourhood on Colborne Street West from August 22 through September 6, 2018. Sound monitoring locations are shown in Figure 2. The primary purpose of the monitor locations was to establish sound levels in all areas of the study area from possible different sources.
The results from noise monitoring indicate that the dominant noise source in the area is traffic noise from Colborne Street West. Measured background noise levels agree with background noise levels calculated from measured traffic volumes in the study area.

Short term noise disturbances significantly higher than background level occur and were investigated and determined to be primarily from loud vehicles or from emergency vehicle sirens travelling on Colborne Street West.

Existing levels were compared with potentially relevant guidelines (as applicable) to determine further recommendations to the City. Based on the results of the monitoring, the measured noise is at levels Aercoastics recommends investigating mitigation.

A computer model was developed to assist in considering various mitigation models. Initially, road-side barriers are the suggested mitigation recommendation. The model was used to demonstrate the potential noise reduction for various barrier heights.

### 8.2 Noise Measurement Results

The World Health Organization (WHO) guideline recommends not exceeding 55 dBA (decibels adjusted to provide a loudness measurement that takes into account how the human ear actually perceives sound) for urban areas. Ontario Ministry of Transportation and Ministry of Environment, Conservation and Parks
guidelines, while not directly applicable to the impact of noise on existing residential developments from existing roads, recommends either 60 dBA or 65 dBA for assessing new roads, depending on the document referenced.

A sample of the background sound level trends are provided below:

- Weekday daytime noise levels reach 70 dBA at approximately 7:00 a.m. and stayed in that range until approximately 5:00 p.m.
- Weekend daytime noise levels reach 65 dBA at approximately 9:00 a.m. and stayed in that range until approximately 11:00 p.m.
- Noise levels drop to a minimum of 55 dBA in the night time hours
- Night time noise levels are lowest between 4:00 - 5:00 a.m. and increase more quickly to peak levels on weekdays than on weekends and holidays, presumably due to morning commuter traffic and business-related traffic
- Weekend night time levels are marginally higher than the same time period during the weekdays
- The only time periods the sound level is below 65 dBA occurred between midnight and 6:00 a.m. on weekdays, and 9:00 a.m. on weekends, respectively
- The holiday sound levels generally follow the weekend sound levels

To determine the cause of above average noise in the area, a selection of the loudest noise disturbances over the two-week monitoring program were reviewed. The most predominant noise disturbance was loud vehicle pass-by (47 occurrences), followed by emergency vehicle siren (12 occurrences) and loud vehicle racing (3 occurrences). Almost 65% of the noise disturbances are caused by loud vehicle pass-by in the study area.

The results of the noise monitoring data in the study area are above the guidelines stated above. The guidelines (WHO and Ontario Ministries), while not a limit, suggested that mitigation measures should be investigated for the study area. The following sections discuss the mitigative measures investigated in this study and their effectiveness.

### 8.3 Computer Modelling

To assess the feasibility of mitigation, Aercoustics developed a computer model of the study area. The computer model allows for the comparison of various mitigation layouts.
Once the model was developed and calibrated, the impact at receptors along Colborne Street West was predicted at a two (2) heights:

- Ground height at 1.5 metres, typical of a person standing outside in their backyard; and
- Second floor height at 4.5 metres, typical of a 2nd storey bedroom window.

Table 1 below shows the calculated impact from road noise:

**Table 1 - Calculated Impact from Road Noise (Computer Model)**

<table>
<thead>
<tr>
<th>Location</th>
<th>Sound Level at 1.5 m (typical backyard)</th>
<th>Sound Level at 4.5 m (typical 2nd storey window)</th>
</tr>
</thead>
<tbody>
<tr>
<td>East of Oakhill Dr. North of Colborne St. W.</td>
<td>66 dBA</td>
<td>68 dBA</td>
</tr>
<tr>
<td>West of Oakhill Dr. North of Colborne St. W.</td>
<td>66 dBA</td>
<td>68 dBA</td>
</tr>
<tr>
<td>West of Oakhill Dr. South of Colborne St. W.</td>
<td>66 dBA</td>
<td>68 dBA</td>
</tr>
</tbody>
</table>

**8.4 Noise Mitigation – Barrier Layout**

The most feasible mitigation strategy is a road barrier. Since the road and the houses currently exist, little can be done to the source of the noise (road or vehicles) or to the houses. Barriers, which block line of sight to the road, offer the most practical mitigation strategy, provided it can be feasibly installed. The land requirements for noise mitigation alternatives (e.g. earth berms or combination of earth berms and barrier walls) would be considered at the detailed design stage.

Barrier heights have a practical limit and as such, receptors having a line of sight to the source (above the barrier) will not experience any reduction in sound. Receptor heights above 4.5 metres (more than 2-storey buildings) were not assessed as the expected change in sound level will not be very significant.

The potential locations for barriers are as follows:

- Barrier 1 – North of Colborne Street, west of Oakhill Drive, approximately 250 metres;
- Barrier 2 – North of Colborne Street, east of Oakhill Drive, approximately 415 metres; and
- Barrier 3 – South of Colborne Street, east of Oakhill Drive, beyond the commercial development, approximately 80 metres.

Figure 3 illustrates the potential barrier locations.

**Figure 3 - Aerial showing Barrier Locations (in blue)**

Acoustic barriers may consist of an acoustic fence, an earth berm, or a combination of an acoustic fence and earth berm. Barriers can also be absorptive or reflective. When placing a barrier there may be the inadvertent effect of reflecting noise to other receptors, thus increasing the noise. As such, care should be taken to ensure that this scenario does not occur.

### 8.5 Barrier Effectiveness

In general, the following relationship between a quantitative change in sound pressure level and qualitative rating of the increase/decrease perceived is shown in Table 2 below.
Table 2 - Relationship between Changes in Sound Level & Human Perception

<table>
<thead>
<tr>
<th>Sound Level Changes (dBA)</th>
<th>Qualitative Rating of Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 3</td>
<td>Insignificant</td>
</tr>
<tr>
<td>3 – 5</td>
<td>Noticeable Change</td>
</tr>
<tr>
<td>5 – 9</td>
<td>Significant Change</td>
</tr>
<tr>
<td>10+</td>
<td>Very Significant Change</td>
</tr>
</tbody>
</table>

To determine the barrier effectiveness, the reduction in sound with a barrier is compared without a barrier and changes presented in the following tables below. Three (3) scenarios were evaluated:

Scenario 1 – Barrier height of 2 metres;
Scenario 2 – Barrier height of 3 metres; and
Scenario 3 – Barrier height of 4.5 metres.

The results of each scenario are presented in Table 3 below. It should be noted that reduction of noise varies depending on location. In general, the change in noise level becomes smaller as the distance from the barrier increases. This is further discussed below.

Table 3 - Predicted change in sound level, due to barrier

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Predicted reduction in sound (height of 1.5 m)</th>
<th>Predicted reduction in sound (at height of 4.5 m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barrier height: 2 metres</td>
<td>6 to 7 dBA</td>
<td>3 to 4 dBA</td>
</tr>
<tr>
<td>Barrier height: 3 metres</td>
<td>7 to 8 dBA</td>
<td>5 to 7 dBA</td>
</tr>
<tr>
<td>Barrier height: 4.5 metres</td>
<td>8 to 10 dBA</td>
<td>7 to 10 dBA</td>
</tr>
</tbody>
</table>

As soon as the line of sight between the noise source and receptor is broken, there is a reduction in sound of at least 5 dBA for the outdoor height and approximately 3 dBA for the second story windows. This can be considered perceptible.

At a barrier height of 3 metres, the reduction is at a level that is noticeable. At a barrier height of 4.5 metres, the reduction is within the noticeable to significant range. This demonstrates that a barrier’s effectiveness is, qualitatively, noticeable to significant when the road is shielded, per Table 2.

The absolute value of the road noise impact on houses is less accurate due to the nature of computer modeling but has been provided in Table 4 to Table 6 below.
Table 4 - Calculated Sound level with a 2 metre tall Barrier

<table>
<thead>
<tr>
<th>Location</th>
<th>Sound Level at 1.5 m (typical backyard)</th>
<th>Sound Level at 4.5 m (typical 2nd storey window)</th>
</tr>
</thead>
<tbody>
<tr>
<td>East of Oakhill Dr. North of Colborne St. W.</td>
<td>60 dBA</td>
<td>65 dBA</td>
</tr>
<tr>
<td>West of Oakhill Dr. North of Colborne St. W.</td>
<td>60 dBA</td>
<td>65 dBA</td>
</tr>
<tr>
<td>West of Oakhill Dr. South of Colborne St. W.</td>
<td>60 dBA</td>
<td>65 dBA</td>
</tr>
</tbody>
</table>

Table 5 - Calculated Sound level with a 3 metre tall Barrier

<table>
<thead>
<tr>
<th>Location</th>
<th>Sound Level at 1.5 m (typical backyard)</th>
<th>Sound Level at 4.5 m (typical 2nd storey window)</th>
</tr>
</thead>
<tbody>
<tr>
<td>East of Oakhill Dr. North of Colborne St. W.</td>
<td>59 dBA</td>
<td>62 dBA</td>
</tr>
<tr>
<td>West of Oakhill Dr. North of Colborne St. W.</td>
<td>59 dBA</td>
<td>62 dBA</td>
</tr>
<tr>
<td>West of Oakhill Dr. South of Colborne St. W.</td>
<td>59 dBA</td>
<td>62 dBA</td>
</tr>
</tbody>
</table>

Table 6 - Calculated Sound level with a 4.5 metre tall Barrier

<table>
<thead>
<tr>
<th>Location</th>
<th>Sound Level at 1.5 m (typical backyard)</th>
<th>Sound Level at 4.5 m (typical 2nd storey window)</th>
</tr>
</thead>
<tbody>
<tr>
<td>East of Oakhill Dr. North of Colborne St. W.</td>
<td>57 dBA</td>
<td>60 dBA</td>
</tr>
<tr>
<td>West of Oakhill Dr. North of Colborne St. W.</td>
<td>57 dBA</td>
<td>60 dBA</td>
</tr>
<tr>
<td>West of Oakhill Dr. South of Colborne St. W.</td>
<td>57 dBA</td>
<td>60 dBA</td>
</tr>
</tbody>
</table>

It should be noted that the calculated sound levels will be most noticeable change experienced at the first row of houses closest to the noise barrier, and less noticeable at homes a greater distance from the barrier. Figure 4 illustrates the sound level reduction with a 4.5 metre barrier and the diminished effectiveness for homes at greater distance from the barrier.
8.6 Barrier Cost Estimates

Barrier costs vary, predominantly based on height and if they are absorptive or reflective. The major impact on cost is the amount of material, the height and the post spacing between panels. To provide estimated pricing, an approximate cost of $187.50 per square metre has been used for a reflective barrier, and an approximate cost of $237.50 per square metre has been used for an absorptive barrier. Based on these estimates, Table 7 and Table 8 below provide the approximate costs for each of barrier. Numbers have been rounded to the nearest thousand.

Table 7 - Estimated Barrier Costs for Absorptive Barrier (including Construction)

<table>
<thead>
<tr>
<th>Barrier Height (m)</th>
<th>Barrier #1</th>
<th>Barrier #2</th>
<th>Barrier #3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 metre</td>
<td>$100,000</td>
<td>$170,000</td>
<td>$32,000</td>
<td>$302,000</td>
</tr>
<tr>
<td>3 metre</td>
<td>$300,000</td>
<td>$503,000</td>
<td>$100,000</td>
<td>$903,000</td>
</tr>
<tr>
<td>4.5 metre</td>
<td>$454,000</td>
<td>$754,000</td>
<td>$146,000</td>
<td>$1,354,000</td>
</tr>
</tbody>
</table>
### Table 8 - Estimated Barrier Costs for Reflective Barrier (including Construction)

<table>
<thead>
<tr>
<th>Barrier Height (m)</th>
<th>Barrier #1</th>
<th>Barrier #2</th>
<th>Barrier #3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 metre</td>
<td>$80,000</td>
<td>$132,000</td>
<td>$26,000</td>
<td>$238,000</td>
</tr>
<tr>
<td>3 metre</td>
<td>$240,000</td>
<td>$400,000</td>
<td>$77,000</td>
<td>$717,000</td>
</tr>
<tr>
<td>4.5 metre</td>
<td>$360,000</td>
<td>$595,000</td>
<td>$115,000</td>
<td>$1,070,000</td>
</tr>
</tbody>
</table>

#### 8.7 Summary and Considerations

The noise analysis concludes that a continuous noise barrier placed adjacent to the residential properties would reduce the unwanted noise to approximately one third (30 homes) of the adjacent neighbourhood. Further studies are required to determine the design, constructability, land requirements and ongoing maintenance needs/responsibilities of the sound barrier are still required if the City wishes to implement the barrier. The additional investigations, as outlined below, would determine the overall cost for the barriers in addition to the estimated $1.35 million for three barriers identified in Table 7.

1. A geotechnical investigation would be necessary to determine the foundation requirements for the sound barrier. The height of the barrier requires an excavation for foundations to ensure the wall's stability. The investigation would also include identification of any underground utilities in the construction area that may require relocation.

2. Detailed design of the barrier including selection of materials, site drainage, utility coordination/relocation, landscaping and contract administration/professional services for the project would have to be determined.

3. Possible acquisition of lands and/or utility access agreement for the sound barrier.

4. Development of an ongoing maintenance plan would be needed to monitor the structural stability of the wall to be included in operating budget and capital budget allocation for any major wall repairs and replacement at the end of its life cycle.

Based on the study findings, a noise barrier would have limited benefit for the majority of the homes in the study area and require significant resources that the City does not have at this time.

It should be noted that a noise study is typically undertaken as part of Class Environmental Assessment (EA) process and for select developments that may have noise related issues. If Colborne Street West requires an EA study in the
future, a noise assessment would be undertaken to identify opportunity to mitigate the existing concerns.

The complete study report prepared by Aercoustics Engineering Limited is attached in Appendix “C”.

9.0 Financial Implications

There are no financial implications resulting from the recommendation of this report. The estimated cost for the installation of three barriers ranges from $240,000 to $1.35 million depending on the height and materials. However a detailed design would be necessary to assess the additional costs (i.e. property acquisition and geotechnical investigations) and annual operating budget impacts for on-going maintenance needs.

10.0 Conclusion

Aercoustics Engineering Limited was retained by the city to complete a noise study of current noise levels near the intersection of Colborne Street West and Oakhill Drive, to provide the City with information that can be used to help respond to noise-related complaints from the residential community.

Multiple sound monitors were deployed and the results from noise monitoring indicate that the dominant noise source in the area is traffic noise from Colborne Street West. Aercoustics investigated potential mitigation based on the measured noise levels.

A computer model was developed to assist in considering various mitigation models assuming typical road-side barriers. The model was used to demonstrate the potential noise reduction for various barrier heights. The data shows the barriers, based on heights, will reduce the noise from the road between 3 and 10 dBA. A barrier will reduce average sound levels for select homes. Furthermore, a barrier will be ineffective against peak noises such as loud vehicles and sirens.

The most effective noise mitigation method, a noise barrier at a height of 4.5 metres, is estimated to cost $1.35 M for materials and construction. This estimate does not include property required nor engineering costs such as geotechnical investigation, design, contract administration and annual maintenance required.

R. Loukes, P. Eng
Director, Engineering Services

E. (Beth) Goodger
General Manager, Public Works Commission
In adopting this report, is a by-law or agreement required? If so, it should be referenced in the recommendation section.

By-law required  [ ] yes  [X] no
Agreement(s) or other documents to be signed by Mayor and/or City Clerk  [ ] yes  [X] no
Is the necessary by-law or agreement being sent concurrently to Council?  [ ] yes  [X] no
APPENDIX “A”

Colborne Street West Noise Study
(300 metres east and west of Oakhill Drive)

Dear Resident:

At the Council meeting on Tuesday, September 26, 2017, the members of City Council approved a noise study along Colborne Street West in the vicinity of Oakhill Drive. The purpose of the study is to assess the noise level and its source, and determine potential mitigation measures to reduce the noise impact to the adjacent residential neighbourhood.

Prior to the commencement of the noise study, you are kindly requested to provide comment on your concerns as it relates to the noise you experience in your home. Details such as the time of day, type of noise, and the source of the noise (eg. traffic, commercial businesses, etc.) are some specifics that will help staff determine the scope of the noise study.

Please provide your comments by Friday, October 27, 2017 to Rob Smith, C.E.T., Transportation Technologist directly at 519-759-4150 Ext. 5683 or E-mail at rsmith@brantford.ca

Yours truly,

TK:RS

Ting K, P. Eng., PTOE
Manager, Transportation & Parking Services

cc: Councillor R. Weaver
    Councillor L. Kiags
    E. (Beth) Goodger, General Manager, Public Works Commission
    R. Loukes, P. Eng., PTOE, Director of Engineering Services

PUBLIC WORKS COMMISSION
City Hall, 100 Wellington Square, Brantford, ON N3T 2M2
(Mailing Address: P.O. Box 818, Brantford, ON N3T 5R7)
Phone: 519-759-4150       www.brantford.ca       Fax: 519-754-0724
APPENDIX “B”

Follow-up to Colborne Street West – Noise Study
Public Meeting held October 16, 2018

Dear Resident:

Aercoustics Engineering Limited was retained by the city to conduct a noise study in the area of Colborne Street West and Oakhill Drive. The scope of the noise study includes an acoustical investigation into the noise levels and sources within the study area.

In October 2018, a public meeting was held to provide residents with a study update. The public meeting presentation is available for download at:

http://www.brantford.ca/govr/projects/Pages/ColborneStreetWestNoiseStudy.aspx

Key findings of the study are summarized below:

- The recorded noise confirmed that the primary source is from traffic on Colborne Street West.
- Short-term noise disturbances are significantly louder than background noises. They are mostly from loud vehicles or sirens on Colborne Street West.
- There are no explicit guidelines or noise regulations for existing dwellings affected by pre-established roadways. While not directly applicable to this situation, there are related guidelines that recommend either 60 decibels or 65 decibels as the trigger threshold for mitigation.
- Based on the results of the study, the consultant recommended investigation of potential mitigation measures.
- Noise barrier is the most common mitigation measure. A noise model was used to estimate effectiveness for different barriers with varying heights.
- A barrier will only reduce average sound levels of vehicles for select homes. Peak incidents such as loud vehicles or sirens will still be noticeable and disruptive.
- Barrier costs can range between $300,000 to $1,300,000. The estimated range does not include engineering or other potential extras such as property acquisition, utility relocations, etc.