REPORT

SANDALWOOD SQUARE

MISSISSAUGA, ONTARIO

NOISE IMPACT STUDY

RWDI # 19012012

March 19, 2019

SUBMITTED TO

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EXECUTIVE SUMMARY

RWDI completed a Noise Impact Study for the proposed Sandalwood Square development to be located southeast of the Hurontario Street and Bristol Road East intersection in Mississauga, Ontario. Road and air traffic was identified as the main sources of sound with the potential to affect the proposed development. The noise emissions were assessed at the proposed development using the applicable guidance to determine required noise control measures.

The following noise control measures are required for this development:

- Acoustical barriers with heights ranging from 1.8 m to 2.5 m around OLAs
- Suite window glazing with sound isolation performance up to STC 38
- Suite exterior doors with sound isolation performance up to STC 29
- Installation of air-conditioning for all suites to allow windows to remain closed
- The inclusion of noise warning clauses related to:
  - Transportation noise in outdoor amenity areas and indoor spaces
  - Stationary noise sources at plane of suite windows

At this stage in design, the impact of development on itself and its surroundings could not be quantitatively assessed. However, the impact on both itself and its surroundings is expected to be insignificant, provided best practices in the acoustical design are followed.

The objective of this assessment was to determine the feasibility of the proposed mixed-use development that is surrounded by existing sources of environmental noise. This assessment was based on design drawings dated February 14th, 2019. Since these drawings are preliminary, further noise assessment will be undertaken as the design develops.

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1 INTRODUCTION

RWDI was retained to prepare a Noise Impact Study (NIS) for the proposed Sandalwood Square development to be located southeast of the Hurontario Street and Bristol Road East intersection in Mississauga, Ontario. The proposed development consists of two residential towers (Tower A – 25 Storeys, Tower B – 16 Storeys) on top of a podium as shown in **Figure 1** below.

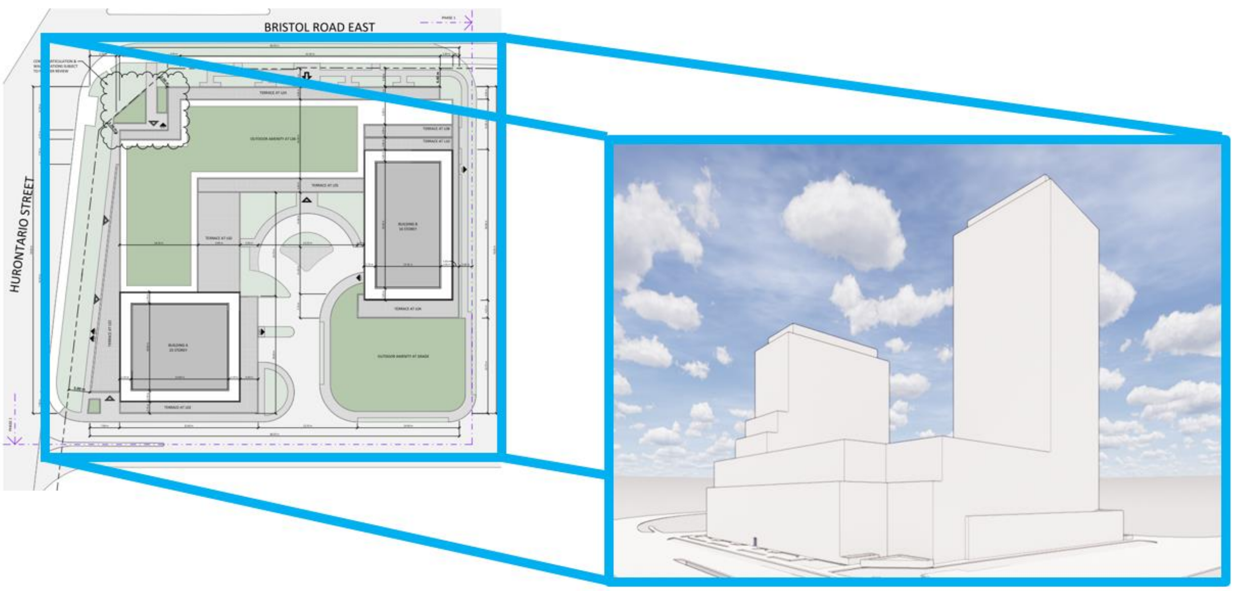


Figure 1 – Sandalwood Square Development

The site is exposed to noise from road traffic on Hurontario Street to the west, Bristol Road East to north and aircraft noise from Toronto Pearson International Airport. No other sources of noise or vibration were considered to have a potential impact on the proposed development.

While there are several other retail and commercial office facilities in the area, due to the masking sound generated by surrounding roads, noise from these commercial facilities is expected to comply with applicable noise guidelines. Therefore, noise from these stationary sources was not assessed in detail as part of this study.

Due to the limitations of the ORNAMENT / STAMSON road traffic noise prediction methods with respect to the geometry of the site (e.g. shielding from other buildings, high-rise buildings), it was not deemed suitable for the assessment of this development. Instead the RLS-90 model for road traffic as implemented in Cadna/A 2018 were utilized.

This assessment was completed in support of a Zoning By-law Amendment application as required by the City of Mississauga. The objective of this assessment was to determine the feasibility of the proposed mixed-use development that is surrounded by existing sources of environmental noise. This assessment was based on available drawings dated February 14th, 2019. Since these drawings are preliminary, further noise assessment will be undertaken as the design develops.

2 IMPACT OF ENVIRONMENT ON THE PROPOSED DEVELOPMENT

RWDI assessed the impact of the future noise environment surrounding the development based on road traffic volumes, airport noise contours, and noise prediction models. This section describes the applicable criteria used for the assessment, the details of the traffic volume data, the points of noise reception considered within the development, the prediction results, and recommendations.

2.1 Applicable Criteria

Applicable criteria for transportation noise sources (road and aircraft) and stationary noise sources (rooftop equipment on adjacent buildings) will be described in this section.

2.1.1 Transportation Noise Sources

Guidance from the Ministry of Environment and Climate Change (MOECC)[1] NPC-300 Environmental Noise Guideline was used to assess environmental noise generated by transportation-related sources including road. There are three aspects to consider, which include the following:

1. Road and aircraft traffic noise at the plane of window, which determines HVAC system requirements.
2. Road and aircraft traffic noise in indoor living areas, which determines façade sound isolation requirements.
3. Road and aircraft traffic noise in Outdoor Living Areas (OLAs), which determines development feasibility and OLA noise barrier requirements.

For assessing sound originating from transportation sources, NPC-300 defines sound level criteria as summarized in **Table 1** for two types of locations: outdoor living areas (OLAs), and indoor areas of sensitive uses. Outdoor sound level limits are specified for OLAs, which include terraces and balconies with a minimum depth of 4 m (provided they are the only OLA available to suite occupant) and common amenity areas of a multi-unit dwelling. Indoor living areas include living rooms and sleeping quarters.

[1] Currently identified as The Ministry of The Environment, Conservation and Parks (MECP). MOECC is used in this report for consistency with guidelines referenced.

Table 1 – NPC-300 Limits for Transportation Sources

Assessment Location	Time Period	NPC-300 Limit L_{EQ} (averaged over time period)		Requirement
		Road	Aircraft	
Indoor Living Quarters	16 hr Daytime 0700-2300h	45 dBA	NEF 5	Façade components should be specified to achieve the indicated indoor sound levels based on the assumption of a closed window.
	8 hr Nighttime 2300-0700h			
Indoor Sleeping Quarters	16 hr Daytime 0700-2300h	45 dBA	NEF 5	
	8 hr Nighttime 2300-0700h	40 dBA	NEF 0	
Outdoor Living Areas	16 hr Daytime 0700-2300h	55 – 60 dBA	NEF 30	If required and technically and economically feasible, noise barriers should be used to achieve 55 dBA sound levels due to road traffic in OLAs. Otherwise, sound levels up to 60 dBA may be considered acceptable. Separation distance and location from the airport are the only means possible to control noise from aircraft.

Ventilation and warning clauses requirements for residential buildings are determined based on predicted levels of transportation noise at the exterior Plane of Window (POW) as summarized in **Tables 2** and **3** below.

Table 2 – NPC-300 Ventilation, Building Component, and Warning Clauses Requirements for Roads

Assessment Location	Transportation Noise Level		NPC-300 Requirements
	Daytime Leq,16-hr	Nighttime Leq,8-hr	
Plane of Window	Equal or greater than 65 dBA	Equal or greater than 60 dBA	• Building components including windows, walls and doors, where applicable, should be designed so that the indoor sound levels comply with the sound level limits • Central air conditioning required to allow windows to remained closed • Warning clause "Type D" required
	Between 55 dBA and 65 dBA	Between 50 dBA and 60 dBA	• Provision for the installation of central air-conditioning • Warning clause "Type C" is required
	Less than 55 dBA	Less than 50 dBA	• Noise control measures may not be required
Outdoor Living Areas	Greater than 60 dBA	Not Applicable	• Noise controls (barriers) should be implemented to meet the 55-60 dBA limit. • Warning Clause "Type B" required
	Between 55 dBA and 60 dBA	Not Applicable	• Noise controls (barriers) should be considered, if feasible • Warning Clause "Type A" required
	Less than 55 dBA	Not Applicable	• Noise control measures may not be required

Table 3 – NPC-300 Ventilation, Building Component, and Warning Clauses Requirements for Aircraft

Assessment Location	Transportation Noise Level Daytime Leq,24-hr	NPC-300 Requirements
Plane of Window	Equal or greater than NEF 30	• Central air conditioning required to allow windows to remained closed • Building components including windows, walls and doors, where applicable, should be designed so that the indoor sound levels comply with the sound level limits • Warning clause "Type D" required
	Between NEF 25 and NEF 30	• Provision for the installation of central air-conditioning • Building components including windows, walls and doors, where applicable, should be designed so that the indoor sound levels comply with the sound level limits • Warning clause "Type C" is required
	Less than NEF 25	• Noise control measures not required
Outdoor Living Areas	Greater than NEF 25	• Development is in an area with high aircraft noise levels • Warning Clause "Type B" required
	Less than NEF 25	• Aircraft noise control measures not required

2.1.2 Stationary Noise Sources

Guidance from the MOECC NPC-300 Environmental Noise Guideline was used to evaluate the need to assess noise from stationary noise sources for this development. Sound level limits for stationary noise sources are based on one-hour equivalent sound levels (Leq,1hr) at the Plane of Windows (POW) of residential building. For urban environments, sound level limits for stationary noise sources are typically determined relative to predicted hourly equivalent (Leq,1h) levels of road traffic noise; however, NPC-300 also includes the minimum exclusion limits of 50 dBA during the daytime or 45 dBA during the nighttime.

Based on experience with the area, it is expected that applicable stationary source sound level limits would depend on exposure to surrounding roads but for building façade's less exposed would be in the range of minimum exclusion limits of 50dBA during the day and 45 dBA during the night.

2.2 Road Traffic Data

The main roadways with the potential to influence noise levels within the proposed residential development are Hurontario Street to the west and Bristol Road to the north. Road traffic volumes were obtained from the Region of Peel (ROP, 2012) planning document, which provides Ultimate AADT road traffic data based on the number of lanes for a road. These were found to exceed AADT estimates based on turning movement counts. However, the turning movement counts were used to estimate the percentage of (heavy) trucks and bus. A summary of the traffic data used is included in **Table 4** below.

Table 4 – Road Traffic Data Summary

Roadway	Ultimate (AADT)	% Day	% Night	Post Speed Limit (km/hr)	% Heavy Trucks
Hurontario Street	48,100	90	10	60	10
Bristol Road	16,200	90	10	50	2

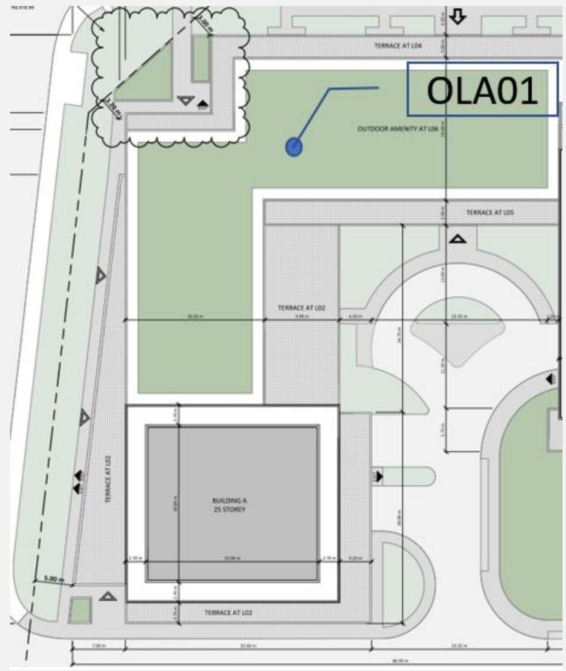
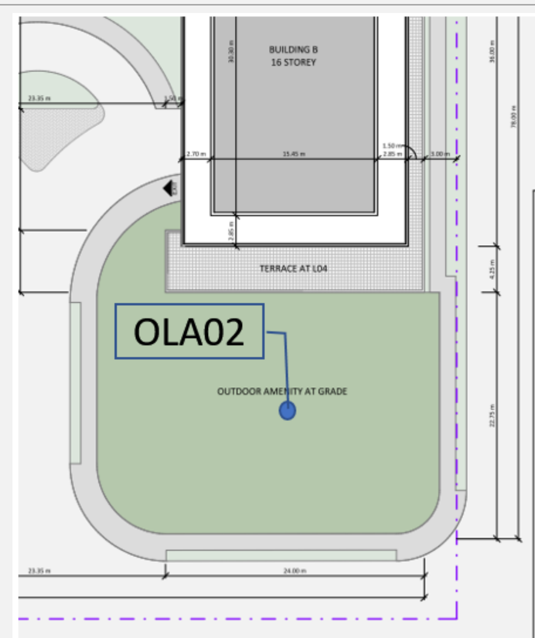
2.3 Representative Receptors for Transportation Sources

The selection of receptors affected by transportation noise sources was based on drawings dated February 14th, 2019, which show massing of the towers and designated OLAs.

Using the "building evaluation" feature of Cadna/A, noise levels across each façade of the residential towers were assessed. For this study, the assessment was based on the range of sound levels predicted in each façade direction.

Daytime sound levels were assessed in qualifying OLAs, which include common outdoor amenity as summarized in **Table 5** below. As per the NPC-300 definition of OLAs, private terraces were not considered as these are not the only OLAs available to occupants.

Table 5 – Outdoor Living Area Receptor Locations

ID	Location	
OLA01	Tower A – Level 6 Outdoor Amenity	
OLA02	Tower B – Outdoor Amenity at Grade	

2.4 Methods & Results

Methods and results for the prediction of transportation noise are presented in this section.

2.4.1 Transportation Noise

Sound levels due to the adjacent road traffic were predicted using models in the Cadna/A software package. Modelling of the road traffic noise was conducted using the RLS-90 standard (RLS,1990). This allows for full 3-D geometry to be considered along with shielding and reflections from neighbouring buildings that are adjacent to the development. These effects would otherwise not be considered in a traditional ORNAMENT / STAMSON calculation.

To assess the impact of transportation noise on suites, ranges of sound levels across each façade were determined with the results summarized in **Table 6.** Predicted sound levels above 60 dBA nighttime and 65 dBA were highlighted in **Table 6** as these are above the NPC-300 thresholds where building components must be specified to control noise transmission into interior spaces. Also, for the daytime case, predicted levels of road traffic noise across the north and west facades are illustrated in **Figure 2**.

Table 6 – Predicted Levels of Transportation Noise on Facades

Portion of Development	Façade Direction	Maximum Road Traffic Facade Sound Levels (dBA)	
		Daytime L_{EQ}, 16hr	Nighttime L_{EQ}, 8hr
Podium	North	70	64
	East	59	54
	South	67	60
	West	72	65
Tower A	North	67	61
	East	57	51
	South	67	60
	West	70	64
Tower B	North	65	58
	East	59	54
	South	59	53
	West	64	58

Figure 2 – Daytime Road Traffic Noise Levels (LEQ,16hr) across North and East Facades

To assess the impact of transportation noise on qualifying OLAs for the development, predicted sound level results are summarized in **Figure 3** below.

Figure 3 – OLA Daytime Sound levels ($L_{EQ,16hr}$) Sound Levels due to Road Traffic

To assess noise from the Toronto Pearson International Aiport, the official noise contours were used. These are included as **Figure 4** with the development location indicated. Since the development is closest to the NEF 30 contour, this sound level will be used for the assessment of aircraft noise.

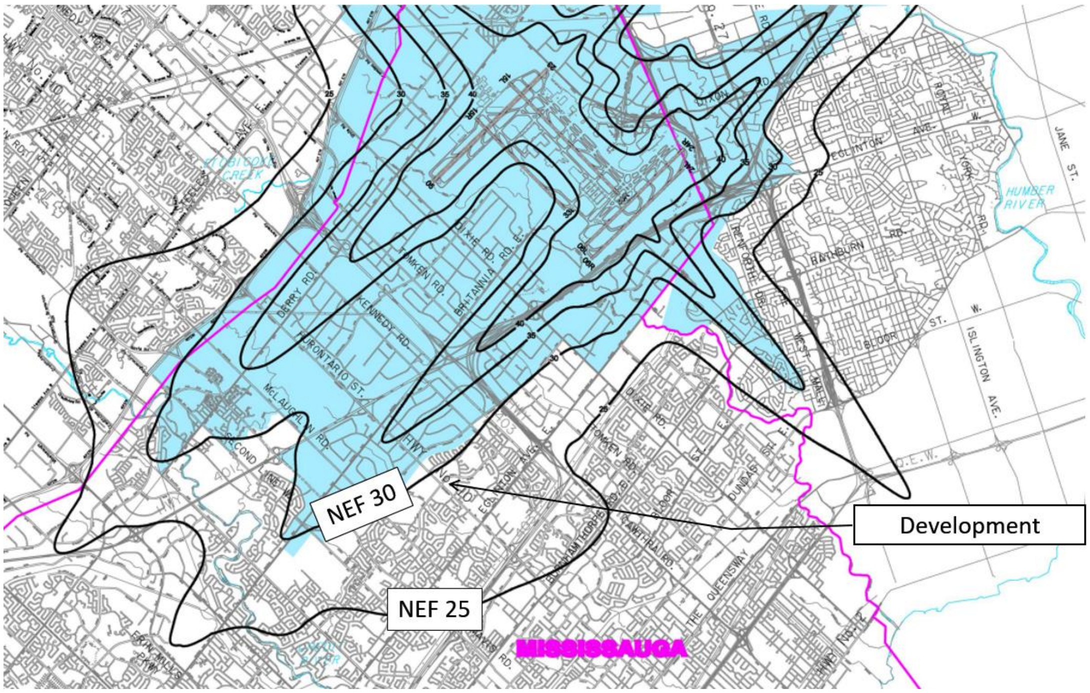


Figure 4 – Noise Impact of Toronto Pearson International Airport

2.5 Recommendations and Requirements

Based on an analysis of the predicted noise levels, the following recommendations and requirements were determined for the project.

2.5.1 Ventilation Requirements

Since the predicted time-averaged road noise levels exceed 65 dBA during the day and 60 dBA during the night, central air conditioning is a mandatory requirement for this development. This will allow windows to remain closed in the warmer months reducing noise transfer into interior space. Since air-conditioning is a standard feature of this development, this requirement is considered feasible and will be readily achieved.

2.5.2 Building Façade Components

Due to the high road and air traffic noise levels in the area, upgraded façade components including window glazing and exterior doors, are required for the development.

To assess the development's feasibility, preliminary window and door sound isolation requirements were determined. These were based on following assumptions:

- Worst-case estimates of window glazing and exterior door area relative to room floor area (determined from the provided drawings)
    - 100% window glazing to floor area ratio for bedrooms on corners
    - 60% window glazing to floor area ratio for bedrooms
    - 35% window glazing and 14% exterior door to floor area ratio for living rooms
    - 5% spandrel to floor area ratio for both living rooms and bedrooms
- Acoustical character of rooms
    - Soft acoustical finishes/furniture for bedrooms
    - Intermediate acoustical finishes/furniture for living rooms
- Spandrel assembly achieving a minimum STC 45 rating

Based on the predicted road traffic sound levels, exposure to NEF 30 airport noise levels, and the assumptions listed above, maximum window glazing and exterior door sound isolation requirements were determined using the BPN-56 method. The maximum requirement for the window glazing was determined to be **STC 38**, which is considered feasible using commercial available glazing systems. The maximum requirement for exterior doors was determined to be **STC 29**, which is achievable with a well-sealed solid exterior doors.

With building components meeting these requirements, the indoor transportation source sound level limits in **Table 1** are predicted to be achieved. We recommend that the window and door suppliers provide noise insulation test reports to confirm compliance with the minimum STC rating requirements.

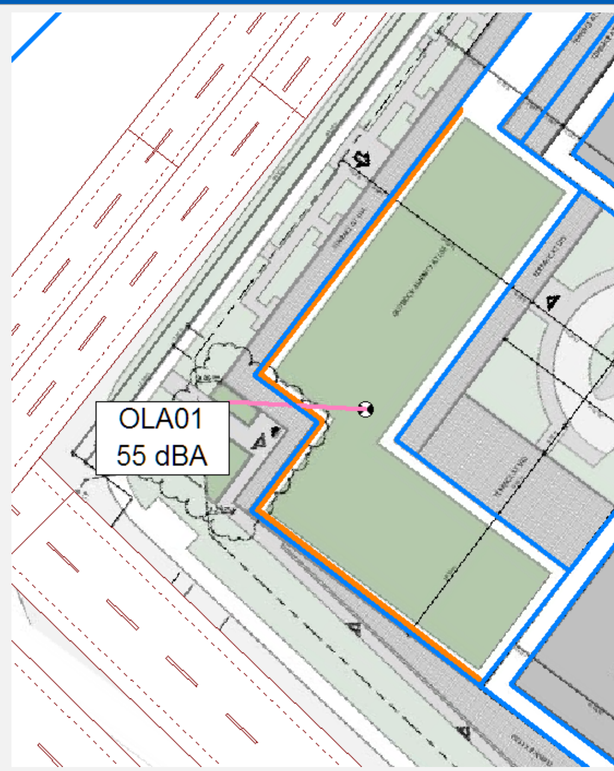
2.5.3 Outdoor Living Areas

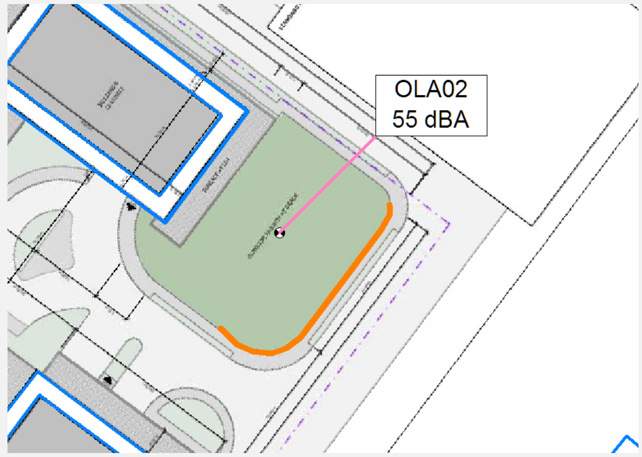
Due to exposure from the adjacent roads, noise levels in OLAs were predicted to be within the acceptable (with a warning clause) range of 55 to 60 dBA but higher than the NPC-300 preferred 55 dBA target. As such, if barriers are not technically or economically feasible, they may be omitted from the design; however, a warning clause Type A would be required for all units.

To reduce OLA noise levels to meet the NPC-300 recommended sound level limit of 55 dBA, the barriers indicated in **Table 7** as orange lines at the edge of the OLAs are predicted to be required. The construction of the barriers should be of a solid material without any gaps or openings and with a minimum surface weight of 20 kg/m^2.

Shorter height and/or variants in geometry of the proposed noise barriers indicated in **Table 7** would be acceptable if the proposed noise barriers are not technically or economically feasible; however, a warning clause Type B would then be required for all units.

Table 7 - Outdoor Living Area Barrier Requirements

ID	Location / Barrier Requirement	
OLA01	Tower A – Level 6 Outdoor Amenity **1.8 m tall acoustical barrier installed around the edge of the amenity area**	

ID	Location / Barrier Requirement	
OLA02	Tower B – Outdoor Amenity at Grade **2.5 m tall acoustical barrier installed around the edge of the amenity area**	

2.5.4 Stationary Sound Sources

Based on an aerial photography review of the rooftops of the existing commercial facilities surrounding the development, no significant impact from existing stationary noise sources is expected at the development. While there are other stationary noise sources in the area (e.g., small rooftop units on retail stores), they are far enough away and/or surrounded existing residential receptors. It is therefore expected that their noise impact will remain in compliance at the new development since they are required to comply at existing residential receptors.

Because the development will be for mixed-use with commercial/retail on the ground level, a warning clause Type E would be appropriate for all residential suites.

2.5.5 Warning Clauses

Warning clauses must be included on all development agreements, offers of purchase and agreements of purchase and sale or lease. Warning clauses may be used individually or in combination.

The following warning clauses are recommended by the MOECC relating to transportation sources:

<u>Type A: required to address transportation noise in OLAs</u>

"Purchasers/tenants are advised that sound levels due to increasing road and air traffic may occasionally interfere with some activities of the dwelling occupants as the sound levels exceed the sound level limits of the Municipality and the Ministry of the Environment."

<u>Type B: required to address transportation noise in indoor spaces</u>

" Purchasers/tenants are advised that despite the inclusion of noise control features in the development and within the building units, sound levels due to increasing road traffic and air traffic may on occasions interfere with some activities of the dwelling occupants as the sound levels exceed the sound level limits of the Municipality and the Ministry of the Environment."

Type D: required to address transportation noise in indoor spaces

"This dwelling unit has been supplied with a central air conditioning system which will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the sound level limits of the Municipality and the Ministry of the Environment."

Type E: required to address stationary noise sources

"*Purchasers/tenants are advised that due to the proximity of the adjacent commercial facilities, noise from the commercial facilities may at times be audible."*

3 IMPACT OF PROPOSED DEVELOPMENT ON ITS SURROUNDINGS

3.1 Applicable Criteria

The noise produced by stationary noise sources associated with the development itself would be evaluated based on the MOECC NPC-300 Environmental Noise Guideline. The requirements were described in Section 2.1.2.

3.2 Recommendations

The impact of noise from the development on its surroundings is expected to be insignificant. Traffic noise related to the proposed development will be insignificant in relation to the traffic noise on the major roads immediately adjacent to the development. Traffic noise is therefore not of concern.

On-site stationary sources for the development are expected to consist of HVAC related equipment in the roof-top mechanical penthouse as well as various exhaust fans. As the design is currently in progress, a detailed assessment of the noise impact by the development on the surrounding environment is not possible.

Provided that best practices for the acoustical design of the building are followed, noise from mechanical equipment associated with the development is expected to be insignificant due to the nature of the proposed development.

4 IMPACT OF THE PROPOSED DEVELOPMENT ON ITSELF

4.1 Applicable Criteria

The noise produced by stationary noise sources associated with the development itself would be evaluated based on the MOECC NPC-300 Environmental Noise Guideline. The requirements were described in Section 2.1.2.

4.2 Recommendations

Consideration should be given to control air-borne and structure-born noise generated within the proposed development. Within the development itself, the main sources of noise that are likely to affect the uses of the building are the mechanical systems.

Provided that best practices for the acoustical design of the building are followed, noise from mechanical equipment associated with the development is expected to be insignificant due to the nature of the proposed development.

5 CONCLUSIONS

RWDI completed a Noise Impact Study for the proposed Sandalwood Square development to be located sortheast of the Hurontario Street and Bristol Road East intersection in Mississauga, Ontario. Road and air traffic was identified as the main sources of sound with the potential to affect the proposed development. The noise emissions were assessed at the proposed development using the applicable guidance to determine required noise control measures.

The following noise control measures are required for this development:

- Acoustical barriers with heights ranging from 1.8 m to 2.5 m around OLAs
- Suite window glazing with sound isolation performance up to STC 38
- Suite exterior doors with sound isolation performance up to STC 29
- Installation of air-conditioning for all suites to allow windows to remain closed
- The inclusion of noise warning clauses related to:
  - Transportation noise in outdoor amenity areas and indoor spaces
  - Stationary noise sources at plane of suite windows

At this stage in design the impact of development on itself and its surroundings could not be quantitatively assessed. However, the impact on both itself and its surroundings is expected to be insignificant, provided best practices in the acoustical design are followed.

Based on the results of this assessment, the development is feasible with respect to meeting the environmental noise criteria.

This assessment was based on design drawings dated February 14th, 2019. Since these drawings are preliminary, further noise assessment will be undertaken as the design develops.

6 REFERENCES

1. RLS, 1990 (RLS). Richtlinien für den Lärmschutz an Strassen. BM für Verkehr, Bonn, 1990.

2. Ontario Ministry of the Environment and Climate Change (MOECC), August 2013, Publication NPC-300, Environmental Noise Guideline Stationary and Transportation Sources – Approval and Planning

3. General Guidelines for the Preparation of Acoustical Reports in The Region of Peel, The Region of Peel, November 2012.

4. Controlling Sound Transmission into Buildings (BPN-56), National Research Council Canada (NRCC), 1985.

APPENDIX A

LEA Consulting Ltd.
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Count Name: 19320_Hurontario&Bristol-AM
Site Code: 19320
Start Date: 01/30/2019

Turning Movement Data

Start Time	Hurontario Street Southbound						Bristol Road East Westbound						Hurontario Street Northbound						Bristol Road West Eastbound						
	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Int. Total
6:30 AM	7	96	6	0	7	109	23	7	13	0	1	43	4	236	2	2	1	244	7	24	48	0	1	79	475
6:45 AM	13	84	6	0	1	103	21	12	17	0	5	50	1	195	4	2	4	202	3	31	52	0	4	86	441
Hourly Total	20	180	12	0	8	212	44	19	30	0	6	93	5	431	6	4	5	446	10	55	100	0	5	165	916
7:00 AM	17	132	8	0	2	157	27	11	16	0	0	54	3	237	12	1	9	253	11	30	43	0	9	84	548
7:15 AM	14	141	10	0	7	165	25	21	16	0	4	62	5	242	18	0	8	265	16	38	73	0	3	127	619
7:30 AM	11	151	7	0	13	169	32	28	23	0	6	83	0	254	14	0	18	268	33	57	69	0	19	159	679
7:45 AM	19	133	9	2	12	163	31	67	25	0	19	123	0	259	25	2	50	286	55	91	70	0	17	216	788
Hourly Total	61	557	34	2	34	654	115	127	80	0	29	322	8	992	69	3	85	1072	115	216	255	0	48	586	2634
8:00 AM	21	167	12	0	28	200	50	92	31	0	21	173	2	254	28	2	71	286	82	105	71	0	28	258	917
8:15 AM	25	179	9	0	8	213	33	40	19	0	6	92	7	289	13	1	31	310	73	92	82	0	17	247	862
8:30 AM	6	180	15	0	8	201	47	32	29	0	2	108	5	294	9	1	11	309	18	94	103	0	3	215	833
8:45 AM	18	213	19	0	6	250	38	37	25	0	4	100	8	311	8	0	2	327	17	84	90	0	4	191	868
Hourly Total	70	739	55	0	50	864	168	201	104	0	33	473	22	1148	58	4	115	1232	190	375	346	0	52	911	3480
9:00 AM	12	193	21	0	2	226	34	35	35	0	1	104	10	268	8	0	6	286	12	48	73	0	5	133	749
9:15 AM	21	222	17	0	4	260	31	25	19	0	2	75	8	211	14	1	3	234	14	40	54	0	4	108	677
9:30 AM	1	1	0	0	0	2	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	4
Grand Total	185	1892	139	2	98	2218	392	407	268	0	71	1067	53	3052	155	12	214	3272	341	734	828	0	114	1903	8460
Approach %	8.3	85.3	6.3	0.1	-	-	36.7	38.1	25.1	0.0	-	-	1.6	93.3	4.7	0.4	-	-	17.9	38.6	43.5	0.0	-	-	-
Total %	2.2	22.4	1.6	0.0	-	26.2	4.6	4.8	3.2	0.0	-	12.6	0.6	36.1	1.8	0.1	-	38.7	4.0	8.7	9.8	0.0	-	22.5	-
Lights	175	1713	136	2	-	2026	386	387	263	0	-	1036	52	2951	150	12	-	3165	327	714	824	0	-	1865	8092
% Lights	94.6	90.5	97.8	100.0	-	91.3	98.5	95.1	98.1	-	-	97.1	98.1	96.7	96.8	100.0	-	96.7	95.9	97.3	99.5	-	-	98.0	95.7
Buses	9	89	0	0	-	98	5	19	4	0	-	28	0	71	4	0	-	75	9	20	4	0	-	33	234
% Buses	4.9	4.7	0.0	0.0	-	4.4	1.3	4.7	1.5	-	-	2.6	0.0	2.3	2.6	0.0	-	2.3	2.6	2.7	0.5	-	-	1.7	2.8
Trucks	1	90	3	0	-	94	1	1	1	0	-	3	1	30	1	0	-	32	5	0	0	0	-	5	134
% Trucks	0.5	4.8	2.2	0.0	-	4.2	0.3	0.2	0.4	-	-	0.3	1.9	1.0	0.6	0.0	-	1.0	1.5	0.0	0.0	-	-	0.3	1.6
Bicycles on Road	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0
% Bicycles on Road	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	0.0	-	-	-	-	-	0.0	-	-	-	-	-	0.0	-	-	-	-	-	0.0	-	-
Pedestrians	-	-	-	-	98	-	-	-	-	-	71	-	-	-	-	-	214	-	-	-	-	-	114	-	-
% Pedestrians	-	-	-	-	100.0	-	-	-	-	-	100.0	-	-	-	-	-	100.0	-	-	-	-	-	100.0	-	-

LEA Consulting Ltd.
625 Cochrane Drive

Markam, Ontario, Canada L3R 9R9
905-470-0015 x240 akung@LEA.ca

Count Name: 19320_Hurontario&Bristol-AM
Site Code: 19320
Start Date: 01/30/2019
Page No: 2

Hurontario Street [N]		
Out	In	Total
4163	2026	6189
80	98	178
31	94	125
0	0	0
0	0	0
4274	**2218**	**6492**

175	1713	136	2	0
9	89	0	0	0
1	90	3	0	0
0	0	0	0	0
0	0	0	0	98
185	**1892**	**139**	**2**	**98**
R	T	L	U	P

Bristol Road West [W]		
Out	In	Total
712	1865	2577
32	33	65
3	5	8
0	0	0
0	0	0
747	**1903**	**2650**

U	L	T	R	P
0	824	714	327	0
0	4	20	9	0
0	0	0	5	0
0	0	0	0	0
0	0	0	0	114
0	**828**	**734**	**341**	**114**

01/30/2019 6:30 AM
Ending At
01/30/2019 9:45 AM

Lights
Buses
Trucks
Bicycles on Road
Other

R	T	L	U	P
392	**407**	**268**	**0**	**71**
0	0	0	0	71
0	0	0	0	0
1	1	1	0	0
5	19	4	0	0
386	387	263	0	0

Bristol Road East [E]		
Out	In	Total
902	1036	1938
20	28	48
4	3	7
0	0	0
0	0	0
926	**1067**	**1993**

U	L	T	R	P
12	150	2951	52	0
0	4	71	0	0
0	1	30	1	0
0	0	0	0	0
0	0	0	0	214
12	**155**	**3052**	**53**	**214**

2315	3165	5480
102	75	177
96	32	128
0	0	0
0	0	0
2513	**3272**	**5785**
Out	In	Total
Hurontario Street [S]		

Turning Movement Data Plot

LEA Consulting Ltd.
625 Cochrane Drive

Markam, Ontario, Canada L3R 9R9
905-470-0015 x240 akung@LEA.ca

Count Name: 19320_Hurontario&Bristol-AM
Site Code: 19320
Start Date: 01/30/2019

Turning Movement Peak Hour Data (8:00 AM)

	Hurontario Street						Bristol Road East						Hurontario Street						Bristol Road West						
	Southbound						Westbound						Northbound						Eastbound						
Start Time	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Int. Total
8:00 AM	21	167	12	0	28	200	50	92	31	0	21	173	2	254	28	2	71	286	82	105	71	0	28	258	917
8:15 AM	25	179	9	0	8	213	33	40	19	0	6	92	7	289	13	1	31	310	73	92	82	0	17	247	862
8:30 AM	6	180	15	0	8	201	47	32	29	0	2	108	5	294	9	1	11	309	18	94	103	0	3	215	833
8:45 AM	18	213	19	0	6	250	38	37	25	0	4	100	8	311	8	0	2	327	17	84	90	0	4	191	868
Total	70	739	55	0	50	864	168	201	104	0	33	473	22	1148	58	4	115	1232	190	375	346	0	52	911	3480
Approach %	8.1	85.5	6.4	0.0	-	-	35.5	42.5	22.0	0.0	-	-	1.8	93.2	4.7	0.3	-	-	20.9	41.2	38.0	0.0	-	-	-
Total %	2.0	21.2	1.6	0.0	-	24.8	4.8	5.8	3.0	0.0	-	13.6	0.6	33.0	1.7	0.1	-	35.4	5.5	10.8	9.9	0.0	-	26.2	-
PHF	0.700	0.867	0.724	0.000	-	0.864	0.840	0.546	0.839	0.000	-	0.684	0.688	0.923	0.518	0.500	-	0.942	0.579	0.893	0.840	0.000	-	0.883	0.949
Lights	68	685	55	0	-	808	168	195	104	0	-	467	21	1113	57	4	-	1195	185	368	343	0	-	896	3366
% Lights	97.1	92.7	100.0	-	-	93.5	100.0	97.0	100.0	-	-	98.7	95.5	97.0	98.3	100.0	-	97.0	97.4	98.1	99.1	-	-	98.4	96.7
Buses	2	27	0	0	-	29	0	6	0	0	-	6	0	25	1	0	-	26	3	7	3	0	-	13	74
% Buses	2.9	3.7	0.0	-	-	3.4	0.0	3.0	0.0	-	-	1.3	0.0	2.2	1.7	0.0	-	2.1	1.6	1.9	0.9	-	-	1.4	2.1
Trucks	0	27	0	0	-	27	0	0	0	0	-	0	1	10	0	0	-	11	2	0	0	0	-	2	40
% Trucks	0.0	3.7	0.0	-	-	3.1	0.0	0.0	0.0	-	-	0.0	4.5	0.9	0.0	0.0	-	0.9	1.1	0.0	0.0	-	-	0.2	1.1
Bicycles on Road	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0
% Bicycles on Road	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	0.0	-	-	-	-	-	0.0	-	-	-	-	-	0.0	-	-	-	-	-	0.0	-	-
Pedestrians	-	-	-	-	50	-	-	-	-	-	33	-	-	-	-	-	115	-	-	-	-	-	52	-	-
% Pedestrians	-	-	-	-	100.0	-	-	-	-	-	100.0	-	-	-	-	-	100.0	-	-	-	-	-	100.0	-	-

LEA Consulting Ltd.
625 Cochrane Drive

Markam, Ontario, Canada L3R 9R9
905-470-0015 x240 akung@LEA.ca

Count Name: 19320_Hurontario&Bristol-AM
Site Code: 19320
Start Date: 01/30/2019

Peak Hour Data

01/30/2019 8:00 AM
Ending At
01/30/2019 9:00 AM

Lights
Buses
Trucks
Bicycles on Road
Other

Hurontario Street [N]

Out	In	Total
1624	808	2432
28	29	57
10	27	37
0	0	0
0	0	0
1662	**864**	**2526**

R	T	L	U	P
68	685	55	0	0
2	27	0	0	0
0	27	0	0	0
0	0	0	0	0
0	0	0	0	50
70	**739**	**55**	**0**	**50**

Bristol Road West [W]

Out	In	Total
320	896	1216
9	13	22
0	2	2
0	0	0
0	0	0
329	**911**	**1240**

U	L	T	R	P
0	343	368	185	0
0	3	7	3	0
0	0	0	2	0
0	0	0	0	0
0	0	0	0	52
0	**346**	**375**	**190**	**52**

Bristol Road East [E]

R	T	L	U	P
168	195	104	0	0
0	6	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	33
168	**201**	**104**	**0**	**33**

Out	In	Total
444	467	911
7	6	13
1	0	1
0	0	0
0	0	0
452	**473**	**925**

U	L	T	R	P
4	57	1113	21	0
0	1	25	0	0
0	0	10	1	0
0	0	0	0	0
0	0	0	0	115
4	**58**	**1148**	**22**	**115**

Out	In	Total
978	1195	2173
30	26	56
29	11	40
0	0	0
0	0	0
1037	**1232**	**2269**

Hurontario Street [S]

Turning Movement Peak Hour Data Plot (8:00 AM)

APPENDIX B

LEA CONSULTING LTD

625 Cochrane Drive 9th Floor
Markham, Ontario, L3R 9R9

Project No.: 19320
Location: Hurontario St & Bristol Rd E
Weather: Light Snow
Surveyor: Natalie Law & May Yue

File Name : Hurontario&Bristol-PM
Site Code : 19320129
Start Date : 2019-02-20
Page No : 1

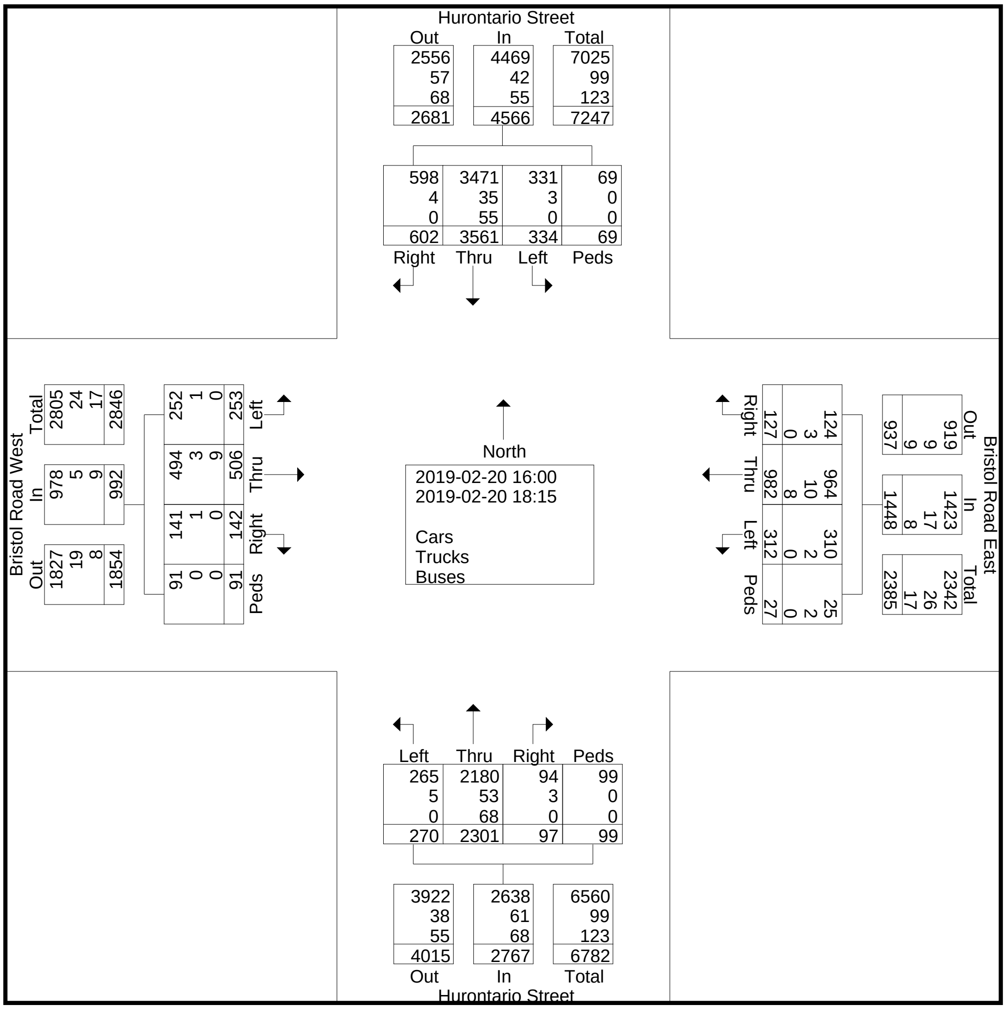
Groups Printed- Cars - Trucks - Buses

	Hurontario Street Southbound					Bristol Road East Westbound					Hurontario Street Northbound					Bristol Road West Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
16:00	26	351	60	8	445	21	77	19	5	122	20	228	5	19	272	23	45	14	15	97	936
16:15	28	313	54	14	409	32	78	23	8	141	18	206	9	11	244	29	58	14	15	116	910
16:30	36	419	61	11	527	30	96	6	2	134	26	234	14	11	285	22	52	10	12	96	1042
16:45	39	400	69	9	517	35	129	14	2	180	23	251	13	9	296	23	50	15	16	104	1097
Total	129	1483	244	42	1898	118	380	62	17	577	87	919	41	50	1097	97	205	53	58	413	3985
17:00	33	407	59	5	504	31	106	14	0	151	41	229	6	6	282	34	48	17	6	105	1042
17:15	38	412	77	6	533	31	122	8	1	162	24	269	9	10	312	15	52	12	8	87	1094
17:30	35	350	68	9	462	32	117	9	3	161	32	212	11	5	260	24	46	16	4	90	973
17:45	29	271	52	0	352	32	99	11	5	147	27	226	11	10	274	32	55	18	6	111	884
Total	135	1440	256	20	1851	126	444	42	9	621	124	936	37	31	1128	105	201	63	24	393	3993
18:00	42	309	54	5	410	31	90	9	0	130	28	230	9	12	279	30	54	16	6	106	925
18:15	28	329	48	2	407	37	68	14	1	120	31	216	10	6	263	21	46	10	3	80	870
Grand Total	334	3561	602	69	4566	312	982	127	27	1448	270	2301	97	99	2767	253	506	142	91	992	9773
Apprch %	7.3	78	13.2	1.5		21.5	67.8	8.8	1.9		9.8	83.2	3.5	3.6		25.5	51	14.3	9.2		
Total %	3.4	36.4	6.2	0.7	46.7	3.2	10	1.3	0.3	14.8	2.8	23.5	1	1	28.3	2.6	5.2	1.5	0.9	10.2	
Cars	331	3471	598	69	4469	310	964	124	25	1423	265	2180	94	99	2638	252	494	141	91	978	9508
% Cars	99.1	97.5	99.3	100	97.9	99.4	98.2	97.6	92.6	98.3	98.1	94.7	96.9	100	95.3	99.6	97.6	99.3	100	98.6	97.3
Trucks	3	35	4	0	42	2	10	3	2	17	5	53	3	0	61	1	3	1	0	5	125
% Trucks	0.9	1	0.7	0	0.9	0.6	1	2.4	7.4	1.2	1.9	2.3	3.1	0	2.2	0.4	0.6	0.7	0	0.5	1.3
Buses	0	55	0	0	55	0	8	0	0	8	0	68	0	0	68	0	9	0	0	9	140
% Buses	0	1.5	0	0	1.2	0	0.8	0	0	0.6	0	3	0	0	2.5	0	1.8	0	0	0.9	1.4

LEA CONSULTING LTD

625 Cochrane Drive 9th Floor
Markham, Ontario, L3R 9R9

File Name : Hurontario&Bristol-PM
Site Code : 19320129
Start Date : 2019-02-20
Page No : 2



LEA CONSULTING LTD

625 Cochrane Drive 9th Floor
Markham, Ontario, L3R 9R9

File Name : Hurontario&Bristol-PM
Site Code : 19320129
Start Date : 2019-02-20
Page No : 3

	Hurontario Street Southbound					Bristol Road East Westbound					Hurontario Street Northbound					Bristol Road West Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 16:00 to 18:15 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 16:30																					
16:30	36	**419**	61	**11**	527	30	96	6	**2**	134	26	234	**14**	**11**	285	22	**52**	10	12	96	1042
16:45	**39**	400	69	9	517	**35**	**129**	**14**	2	**180**	23	251	13	9	296	23	50	15	**16**	104	**1097**
17:00	33	407	59	5	504	31	106	14	0	151	**41**	229	6	6	282	**34**	48	**17**	6	**105**	1042
17:15	38	412	**77**	6	**533**	31	122	8	1	162	24	**269**	9	10	**312**	15	52	12	8	87	1094
Total Volume	146	1638	266	31	2081	127	453	42	5	627	114	983	42	36	1175	94	202	54	42	392	4275
% App. Total	7	78.7	12.8	1.5		20.3	72.2	6.7	0.8		9.7	83.7	3.6	3.1		24	51.5	13.8	10.7		
PHF	.936	.977	.864	.705	.976	.907	.878	.750	.625	.871	.695	.914	.750	.818	.942	.691	.971	.794	.656	.933	.974
Cars	145	1606	263	31	2045	126	445	42	5	618	112	937	41	36	1126	94	197	54	42	387	4176
% Cars	99.3	98.0	98.9	100	98.3	99.2	98.2	100	100	98.6	98.2	95.3	97.6	100	95.8	100	97.5	100	100	98.7	97.7
Trucks	1	10	3	0	14	1	5	0	0	6	2	18	1	0	21	0	2	0	0	2	43
% Trucks	0.7	0.6	1.1	0	0.7	0.8	1.1	0	0	1.0	1.8	1.8	2.4	0	1.8	0	1.0	0	0	0.5	1.0
Buses	0	22	0	0	22	0	3	0	0	3	0	28	0	0	28	0	3	0	0	3	56
% Buses	0	1.3	0	0	1.1	0	0.7	0	0	0.5	0	2.8	0	0	2.4	0	1.5	0	0	0.8	1.3