

Environmental Noise Assessment Burnhamthorpe Road West Improvements City of Mississauga

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NOVUS PROJECT TEAM:

Scientist:	Stephanie Seebach, B.Eng.
Senior Specialist:	Chris Blaney, B.A.
Project Manager:	Jason Slusarczyk, P. Eng., Principal

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1.0 INTRODUCTION

Novus Environmental Inc. (Novus) (now part of SLR Consulting (Canada) Ltd.) was retained by CIMA to conduct an environmental noise impact assessment for the proposed Burnhamthorpe Road West Improvements. The study area extends from Loyalist Drive to the west City Limit at 9th Line in the City of Mississauga, Ontario.

The objectives of this study are as follows:

- to assess future “build” and “no-build” sound levels from road traffic noise sources in the area (i.e., noise levels with and without the proposed project taking place);
- to use these predictions to assess potential impacts according to the applicable guidelines;
- to specify mitigation measures where required; and
- to assess the potential for construction noise and provide a Code of Practice to minimize potential impacts.

A glossary of common terms and a description of transportation sound basics can be found in **Appendix A**.

1.1 Project Description (Nature of the Undertaking)

The proposed roadway improvements are in the City of Mississauga. The proposed improvements include the widening of Burnhamthorpe Road West, from two lanes to four lanes, within the approximately 1.50 km long Study Area.

The Study Area limits for the project are shown in **Figure 1**.

2.0 ROAD TRAFFIC NOISE IMPACTS (OPERATIONAL NOISE)

For roadway projects, operational noise is of primary importance. This section of the report provides an analysis of operational noise impacts from road traffic noise related to this undertaking.

2.1 Applicable Guidelines

There are several transportation noise guidelines that are applicable to this project. Ontario Provincial policies and guidelines from the Ontario Ministry of Transportation (MTO) and the Ontario Ministry of the Environmental and Climate Change (MOECC) are directly applicable under the Municipal Class EA process for transportation projects and are discussed in detail in this report.

2.1.1 Ontario Provincial Guidelines and Policies

Ontario has several guidelines and documents related to assessing road traffic noise impacts. The document most applicable to municipal roadway projects is:

- Ontario MOECC/MTO, “Joint Protocol”, *A Protocol for Dealing with Noise concerns during the Preparation, Review and Evaluation of Provincial Highway’s Environmental Assessments* (MTO & MOECC, 1986)

In May 2007, the MTO released the *Environmental Guide for Noise* (MTO, 2006) which supersedes the Joint Protocol and previous MTO *Quality and Standards Directive QST-A1 Noise Policy and Acoustic Standards for Provincial Highways* (MTO 1992). Currently the *Environmental Guide for Noise* (the Guide) has not been adopted by the MOECC for municipal projects. Therefore, the Joint Protocol has been used for this study. A summary of the effort required under the Joint Protocol is shown in **Table 1**.

The Joint Protocol sets out an Outdoor Objective sound level of 55 dBA L_{eq} , or the existing ambient. For sound levels less than 65 dBA either the Guide or the Joint Protocol assesses noise impacts in a similar manner. Only in the case where sound levels exceed 65 dBA, is the Guide more stringent. The evaluation of noise impacts is determined by the change in cumulative sound levels from the 2021 “no-build” scenario to the future 2041 “build” scenario. Assessments are based on a minimum 10-year future horizon year (i.e., traffic volumes 10 years after the completion of the project). Accordingly, a future design year of 2041 applies to this project, corresponding to the traffic forecasts provided by CIMA.

Noise mitigation is warranted when increases in sound level over the “no-build” ambient are greater than 5 dBA. Mitigation measures can include changes in vertical profiles and horizontal alignments, noise barriers, and noise reducing asphalts. Noise mitigation, where applied, must be administratively, economically, and technically feasible, and must provide at least 5 dBA of reduction averaged over the first row of noise-sensitive receivers. Mitigation measures are restricted to within the roadway right-of-way. Off right-of-way noise mitigation, such as window upgrades and air conditioning, is not considered.

Table 1: Summary of Mitigation Efforts Under the MOECC/MTO Joint Protocol

Future Sound Levels	Change in Noise Level Above Future “No-Build” Ambient (dBA)	Mitigation Effort Required
< 55 dBA	0 to 5	None
	> 5	
> 55 dBA	0 to 5	<ul style="list-style-type: none"> Investigate noise control measures within right-of-way Noise control measures where used must provide a minimum of 5 dBA of attenuation, averaged over the first row of receivers Mitigated to as close to ambient as possible, where technically, economically and administratively feasible
	> 5	

Notes: Values are L_{eq} (16h) levels for municipal roads

2.2 Location of Noise Sensitive Areas Within the Study Area

2.2.1 Definition of Noise Sensitive Areas

Noise impacts from transportation projects are evaluated at noise sensitive receptors commonly referred to as Noise Sensitive Areas (NSAs). Under the Joint Protocol, NSAs include the following land uses, provided they have an Outdoor Living Area (OLA) associated with them:

- Private homes (single family units and townhouses)
- Multiple unit buildings such as apartments, provided they have a communal OLA associated with them
- Ground floor units (e.g. apartments, townhouses) with unshielded balconies or walkout patio areas.
- Hospitals and nursing homes for the aged, provided they have an OLA for use by patients
- Schools, educational facilities, and daycare centres where there are OLAs for students

The following land uses are generally not considered to qualify as NSAs:

- Apartment balconies
- Educational faculties, except as noted above
- Churches
- Cemeteries
- Parks and picnic areas not part of a defined OLA
- Day care centres
- All commercial
- All industrial

2.2.2 Representative NSAs for Analysis

Several NSAs have been used in the analysis to represent worst-case potential noise impacts at all nearby noise sensitive land uses within the study area. NSAs were selected to assess areas

with similar overall noise levels and similar changes in noise (“build” versus “no-build”). These NSAs and modelled receptor locations are described in **Table 2**.

Table 2: Representative NSAs Considered in Analysis

Receptor Location	Description
Rec 1	4006 Rushton Crescent
Rec 2	3528 Ingram Road
Rec 3	4004 Renfrew Crescent
Rec 4	3623 Ingram Road
Rec 5	3974 Renfrew Crescent
Rec 6	3725 Colonial Drive
Rec 7	3260 Dolson Court
Rec 8	3719 Bangor Road
Rec 9	3970 Melfort Crescent
Rec 10	3721 Price Court

The OLA may be situated on any side of the receptor but is generally taken to be in the back yard. For assessment purposes, the OLA is taken as a point 3 m from the facade of the receptor, and 1.5 m (approximate head-height) above the ground surface to be consistent with MOECC policy. The locations of the representative noise receivers used in the analysis are shown in **Figure 2** and **Figure 3**. Zoning maps are shown in **Appendix B**. The lands within the Study Area are either zoned residential or commercial. It appears that the area is entirely built out with no future undeveloped lands.

2.3 Study Horizons

Under the Joint Protocol a “noise impact” is defined as the difference in projected noise level changes comparing the noise levels a minimum of 10 years after construction between the “no build” and “build” scenarios. The years 2021 and 2041 are the best available traffic volumes to model the future “no build” scenario and for the future “build” condition and to assess possible noise impacts.

2.4 Study Scenarios

As mentioned above, the “noise impact” for the study area is defined as the difference in projected noise levels between the “no build” and “build” scenarios.

2.5 Road Traffic Data

Traffic volumes for the 2021 “no-build” and 2041 “build” scenarios for multiple roadways were provided by CIMA and are found in **Appendix C**. The data is further summarized in **Table 3** and **Table 4**, respectively. Traffic data was provided in the form of Annual Average

Daily Traffic (AADT) or in AM and PM peak hour turning movement counts. Commercial vehicles percentages were derived from existing turning movements and were assumed to remain the same in the future years. A conservative Medium Truck / Heavy truck split of 50/50 was used in this study. These assumptions are based on historical information for these types of urban roadways.

Table 3: Road Traffic Data for 2021 Future “No-Build” Scenario

Road and Section	AADT	Day / Night Split ^[1]	Overall % Commercial Vehicles	Medium / Heavy Truck Split ^{[2], [3]}	Posted Speed Limit (km/h)
Burnhamthorpe Road West					
Ninth Line to Ridgeway Dr.	18,900	90/10	4.5	2.25/2.25	60
Ridgeway Dr. to Colonial Dr.	12,300	90/10	4.6	2.30/2.30	60
Colonial Dr. to Loyalist Dr.	15,000	90/10	4.1	2.05/2.05	60
Loyalist Dr. to Winston Churchill Blvd.	19,200	90/10	4.0	2.00/2.00	60
Ridgeway Drive					
North of Burnhamthorpe Rd. W	21,100	90/10	2.9	1.45/1.45	60
South of Burnhamthorpe Rd. W	20,600	90/10	2.6	1.30/1.30	60
Colonial Drive					
North of Burnhamthorpe Rd. W	3,400	90/10	5.0	2.50/2.50	50
South of Burnhamthorpe Rd. W	4,100	90/10	6.2	3.10/3.10	50
Loyalist Drive					
North of Burnhamthorpe Rd. W	3,400	90/10	5.7	2.85/2.85	50
South of Burnhamthorpe Rd. W	2,300	90/10	4.0	2.00/2.00	50

Notes: [1] XX / YY is the percentage of vehicle traffic in the 16-hour daytime and 8-hour night-time respectively.

[2] MM / HH is the percentage of medium trucks and heavy trucks used in the analysis, respectively.

[3] Medium / Heavy Truck Split of 50/50.

Table 4: Road Traffic Data for 2041 Future “Build” Scenario

Road and Section	AADT	Day / Night Split ^[1]	Overall % Commercial Vehicles	Medium / Heavy Truck Split ^{[2], [3]}	Posted Speed Limit (km/h)
Burnhamthorpe Road West					
Ninth Line to Ridgeway Dr.	23,100	90/10	4.5	2.25/2.25	60
Ridgeway Dr. to Colonial Dr.	19,400	90/10	4.6	2.30/2.30	60
Colonial Dr. to Loyalist Dr.	19,000	90/10	4.1	2.05/2.05	60
Loyalist Dr. to Winston Churchill Blvd.	22,400	90/10	4.0	2.00/2.00	60
Ridgeway Drive					
North of Burnhamthorpe Rd. W	23,600	90/10	2.9	1.45/1.45	60
South of Burnhamthorpe Rd. W	26,100	90/10	2.6	1.30/1.30	60
Colonial Drive					

Road and Section	AADT	Day / Night Split ^[1]	Overall % Commercial Vehicles	Medium / Heavy Truck Split ^{[2], [3]}	Posted Speed Limit (km/h)
North of Burnhamthorpe Rd. W	4,000	90/10	5.0	2.50/2.50	50
South of Burnhamthorpe Rd. W	5,600	90/10	6.2	3.10/3.10	50
Loyalist Drive					
North of Burnhamthorpe Rd. W	3,700	90/10	5.7	2.85/2.85	50
South of Burnhamthorpe Rd. W	3,100	90/10	4.0	2.00/2.00	50

Notes: [1] XX / YY is the percentage of vehicle traffic in the 16-hour daytime and 8 hour night-time respectively.
[2] MM / HH is the percentage of medium trucks and heavy trucks used in the analysis, respectively.
[3] Medium / Heavy Truck Split of 50/50.

2.6 Noise Model Used

The highway noise prediction model used is the United States Federal Highway Administration Method. The STAMINA 2.0 highway noise prediction model is a computerized version of this method. This model is jointly approved by the MTO and the MOECC.

The noise prediction model relies on the use of vehicle noise emission levels to generate a noise source that can then be assessed at the noise receptors based on the following factors:

- posted speeds for the roadways in the area used in the noise analysis. (In the case of roadways with a posted speed of less than 50 km/h a more conservative speed of 50 km/h is used as the approved models will not predict sound levels below that speed);
- pavement surface used for construction of the roadway (i.e. hot mix asphaltic pavement);
- elevations, contours and locations of all of the NSA's near the right-of-way;
- roadway grades;
- intervening rows of homes and barriers;
- type of ground cover, soft or hard ground;
- percentage of commercial traffic; and
- distance from the roadway.

The model uses the following vehicle classifications:

- Automobiles - Two axles and four wheels designed primarily for the transportation of nine or fewer passengers, or transportation of cargo (light trucks). This classification includes motorcycles. Generally, the gross vehicle weight is less than 4,500 kilograms.
- Medium trucks - Two axles and six wheels designed for the transportation of cargo. Generally, the gross vehicle weight is greater than 4,500 kilograms but less than 12,000 kilograms.
- Heavy trucks - Three or more axles and designed for the transportation of cargo. Generally, the gross vehicle weight is greater than 12,000 kilograms.

Distances, roadway heights and receptor locations were obtained from plan drawings supplied by CIMA and aerial photographs.

2.7 Detailed Modelling

Table 5 presents a comparison of “no build” versus future “build” sound levels at receptors in the study area during the 16-hour day. The STAMINA 2.0 input files and results can be found in **Appendix D**.

Table 5: 2021 “No Build” and 2041 “Build” Noise Levels

Receptor Location	“No Build” L_{eq} (16h)	“Build” L_{eq} (16h)	Change (“Build” minus “No-Build”)	Increase Above 5 dBA
Rec 1	59.7	60.9	1.2	No
Rec 2	58.1	59.4	1.3	No
Rec 3	57.2	59.3	2.1	No
Rec 4	54.7	56.6	1.9	No
Rec 5	57.4	59.2	1.8	No
Rec 6	59.2	60.4	1.2	No
Rec 7	57.9	58.9	1.0	No
Rec 8	57.2	58.2	1.0	No
Rec 9	58.2	59.1	0.9	No
Rec 10	57.9	59.0	1.1	No

2.8 Discussion of Impacts and Investigation of Noise Mitigation

The results show that changes in sound levels resulting from the proposed project are expected to be no higher than approximately 1 to 2 dBA. This slight increase in noise levels is caused by the minor widening of the roadway towards existing residences and the slight increase in traffic capacity due the increase in the number of lanes on Burnhamthorpe Road West. The design for the proposed widening was provided to us during a draft design stage. Should the final horizontal or vertical alignment of the undertaking change significantly, the noise levels and possible impacts should be confirmed.

Given that there were no changes in sound levels greater than the criteria set out in the Protocol, no investigation of noise mitigation was undertaken.

3.0 CONSTRUCTION NOISE IMPACTS

Construction noise impacts are temporary in nature, and largely unavoidable. Although for some periods and types of work, construction noise will be noticeable, with adequate controls, impacts can be minimized. This section of the report provides an examination of the City of

Mississauga noise bylaw and recommends a Code of Practice to minimize impacts.

3.1 Construction Noise Guidelines

3.1.1 Local Noise Control Bylaw

The proposed project lies within the local jurisdiction of the City of Mississauga. A bylaw restricting noise from construction activities exists within the City. Pertinent sections of the bylaw are shown in **Table 6**. A full copy of the bylaw can be found in **Appendix E**. If construction is required outside the times specified in the City of Mississauga Noise Control Bylaw 306-79, an exemption to the bylaw is required.

Table 6: City of Mississauga Noise Control Bylaw

Jurisdiction	Bylaw Number	Bylaw Provision
City of Mississauga	By-law 306-79	<p><u>GRANT OF EXEMPTION BY COUNCIL</u></p> <p>7. (1) Any person may apply for an exemption from the provisions of Sections 3 and 4 of this By-law, with respect to any source of sound or vibration. (299-08)</p> <p>(2) An application for exemption under Subsection (1) shall be in writing and shall contain:</p> <ul style="list-style-type: none"> (a) the name and address of the applicant, (b) a description of the source of sound or vibration in respect of which exemption is being sought, (c) a statement of the section of the by-law from which exemption is sought, (d) the period of time (not in excess of six (6) months) for which the exemption is sought, (e) the reasons why the exemption is being sought, (f) proof of publication for two consecutive days within the preceding ten (10) days in a newspaper of general circulation within the City, of a notice of intention to apply for any exemption to this by-law, received or by the distribution of a flyer as prescribed by the City to all residences within a 500 meter radius of the subject property containing the information required by Clauses (a) through (e) hereof, stating the date upon which objections may be submitted to City staff. (299-08) (g) the application fee. (299-08) <p>(3) An application for an exemption completed in accordance with section 7(2) shall be delivered to the Commissioner. (299-08)</p> <p>(4) The Commissioner may grant an exemption, in whole or in part, with terms and conditions, subject to the provisions of this By-law. (299-08)</p> <p>(5) In considering the completed application for any exemption, the Commissioner shall take into account the following: (299-08)</p> <ul style="list-style-type: none"> (a) If an exemption is granted, a time limit shall be specified, and an exemption shall not exceed six months. (b) The Commissioner shall consult with the affected Ward Councillor on an application for an exemption and the consultation shall include any terms and conditions that may be attached to an exemption. (c) Any correspondence received regarding the application as a result of the distribution of the Notice or newspaper advertisement referred to in Section 7(2)(f).

Jurisdiction	Bylaw Number	Bylaw Provision
		<p>(d) The proximity of the sound to a Residential Area and the likelihood that the sound for which an exemption is requested may negatively affect persons in a Residential Area.</p> <p>(e) Whether any negative impacts under clauses (c) or (d) can be reduced with the use of mitigation measures including limiting the sound to certain days or times of the day.</p> <p>(6) A breach by the applicant of any of the terms or conditions imposed by the Commissioner in granting an exemption shall immediately render the exemption null and void. (299-08)</p> <p>(7) Notwithstanding that the authority to grant an exemption is delegated to the Commissioner, and that he or she may have already exercised the delegated power, Council shall retain the right to exercise the authority to grant or deny an exemption in accordance with the conditions set out in section 7 (5) of this Bylaw. (299-08)</p>
<p align="center"><u>SCHEDULE 1 TO BY-LAW NUMBER 360-79</u> <u>GENERAL PROHIBITIONS</u></p>		
		<p>3. The operation of any combustion engine or pneumatic device without an effective exhaust or intake muffling device in good working order and in constant operation.</p> <p>7. The operation of any item of construction equipment in a Quiet Zone or Residential Area without effective muffling devices in good working order and in constant operation.</p>
<p align="center"><u>SCHEDULE 2 TO BY-LAW NUMBER 360-79</u> <u>PROHIBITED PERIODS OF TIME:</u></p>		
		<p>A - 23:00 hrs. of one day to 07:00 hrs. next day (09:00 hrs. Sundays)</p> <p>B - 19:00 hrs. of one day to 07:00 hrs. next day (09:00 hrs. Sundays)</p> <p>C - 17:00 hrs. of one day to 07:00 hrs. next day (09:00 hrs. Sundays)</p> <p>D - All Day Sundays and Statutory Holidays</p> <p>E - 17:00 hrs. of one day to 07:00 hrs. next day</p> <p>F - 19:00 hrs. of one day to 07:00 hrs. next day</p>
	<u>COLUMN 1</u>	<p><u>COLUMN 2</u> <u>PROHIBITED PERIOD OF TIME</u> <u>QUIET ZONE</u> <u>RESIDENTIAL</u> <u>AREA</u></p>
	5. The operation of any construction equipment in connection with construction.	E & D F & D

3.1.2 MOECC Model Municipal Noise Control Bylaw

The MOECC stipulates limits on noise emissions from individual items of equipment, rather than for overall construction noise. In the presence of persistent noise complaints, sound emission standards for the various types of construction equipment used on the project should be checked to ensure that they meet the specified limits contained in MOECC Publication NPC-115 – “Construction Equipment” (MOECC, 1997), as shown in **Table 7**:

Table 7: NPC-115 Maximum Noise Emission Levels for Typical Construction Equipment

Type of Unit	Maximum Sound Level ^[1] (dBA)	Distance (m)	Power Rating (kW)
Excavation Equipment ^[2]	83	15	< 75
	85	15	> 75
Pneumatic Equipment ^[3]	85	7	-
Portable Compressors	76	7	-

Notes: [1] Maximum permissible sound levels presented here are for equipment manufactured after Jan. 1, 1981.
[2] Excavation equipment includes bulldozers, backhoes, front end loaders, graders, excavators, steam rollers and other equipment capable of being used for similar applications.
[3] Pneumatic equipment includes pavement breakers.

3.2 Anticipated Construction Activities

The following construction activities are anticipated as part of this project:

- Removing existing surface pavements
- Earth grading
- Construction and rehabilitation of the base course
- Paving (and repaving) of the roadway surfaces
- Culvert construction or extensions
- Construction of new roadway including removal of overburden

3.3 Construction Code of Practice Requirements (Mitigation)

To minimize the potential for construction noise impacts, it is recommended that provisions be written into the contract documentation for the contractor, as outlined below:

- Where possible construction should be carried out during the daytime. If construction activities are required outside of these hours, the Contractor should try and minimize the amount of noise being generated.
- There should be explicit indication that Contractors are expected to comply with all applicable requirements of the contract.

- All equipment should be properly maintained to limit noise emissions. As such, all construction equipment should be operated with effective muffling devices that are in good working order.
- The Contract documents should contain a provision that any initial noise complaint will trigger verification that the general noise control measures agreed to be in effect.
- In the presence of persistent noise complaints, all construction equipment should be verified to comply with MOECC NPC-115 guidelines, as outlined in Section 3.1.2.
- In the presence of persistent complaints and subject to the results of a field investigation, alternative noise control measures may be required, where reasonably available. In selecting appropriate noise control and mitigation measures, consideration should be given to the technical, administrative and economic feasibility of the various alternatives.

4.0 CONCLUSIONS AND RECOMMENDATIONS

The potential environmental noise impacts of the proposed undertaking have been assessed. Both operational and construction noise impacts have been considered. The following are our conclusions and recommendations:

1. The design for the proposed widening was provided to us during a draft design stage. Should the final horizontal or vertical alignment of the undertaking change significantly, the noise levels and possible impacts should be confirmed.
2. The results show that changes in sound levels resulting from the proposed project are expected to be no higher than approximately 1 to 2 dBA.
3. No investigation of noise mitigation was undertaken because there were no changes in sound levels greater than the criteria set out in the Protocol.
4. Construction noise impacts are temporary in nature but will be noticeable at times at residential NSAs. Methods to minimize construction noise impacts should be included in the Construction Code of Practice.
5. If construction is required outside the times specified in the City of Mississauga Noise Control Bylaw 306-79, an exemption to the bylaw is required.

5.0 REFERENCES

Ontario Ministry of the Environment and Climate Change (MOECC), 1977b, *Model Municipal Noise Control Bylaw*, which includes Publication NPC-115 – Construction Equipment

Barry, T.M. and Reagan, J.A., "FHWA Highway Noise Prediction Model", U.S. Federal Highway Administration, Report FHWA RD-77 108, December 1978

Ontario Ministry of the Environment and Climate Change (MOECC), 1977c, *Model Municipal Noise Control Bylaw*, which includes Publication NPC-119 – Noise From Blasting

Ontario Ministry of the Environment and Climate Change (MOECC) / Ontario Ministry of Transportation (MTO), 1986, "Joint Protocol", *A Protocol for Dealing with Noise Concerns During the Preparation, Review and Evaluation of Provincial Highway's Environmental Assessments*

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

Ontario Ministry of Transportation (MTO), 1992a, Quality and Standards Directive QST-A1, Noise Policy and Acoustic Standards for Provincial Highways

Ontario Ministry of Transportation (MTO), Revised 2008, *Environmental Guide for Noise (2006)*.

City of Mississauga, Policy Number: 09-03-03, Effective Date April 13, 2011, *Noise Attenuation Barriers on Major Roadways*.

Figures

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Figure No. 1
Study Area

Burnhamthorpe Road Class EA Noise Assessment
Mississauga, Ontario

Scale: NTS
Date: 18/05/31
File No.: 17-0232
Drawn By: CB

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ENVIRONMENTAL

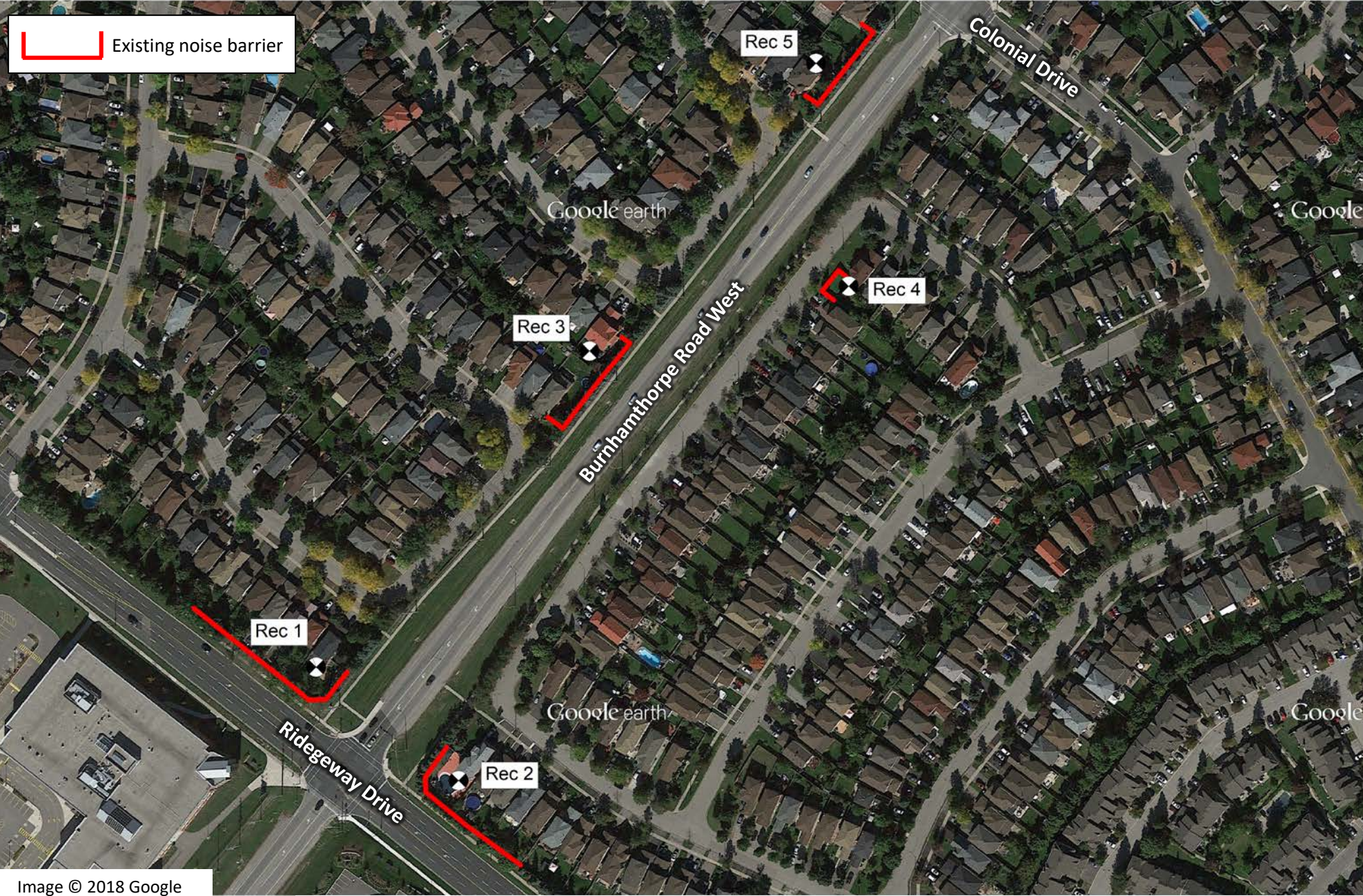


Image © 2018 Google

Figure No. 2
**Location of Representative Noise Sensitive
Receptors (South)**
Burnhamthorpe Road Class EA Noise Assessment
Mississauga, Ontario

Scale: 2,600
Date: 18/05/31
File No.: 17-0232
Drawn By: SS



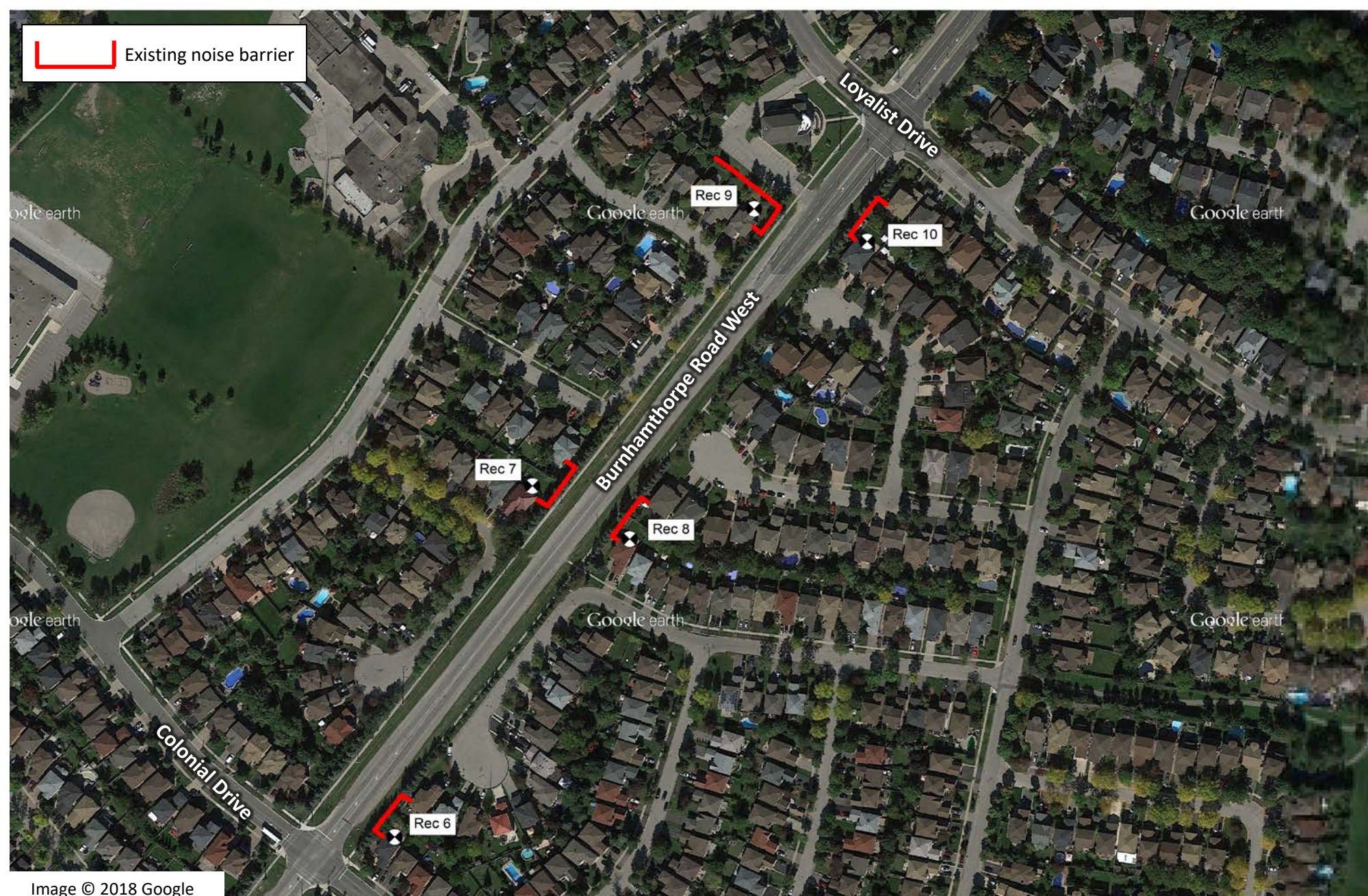


Figure No. 3

Location of Representative Noise Sensitive Receptors (North)

Burnhamthorpe Road Class EA Noise Assessment
Mississauga, Ontario

Scale: 2,750

Date: 18/05/31

File No.: 17-0232

Drawn By: SS

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Appendix A

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Glossary of Commonly Used Noise Terminology

Airborne Sound*: Sound that reaches the point of interest by propagation through air.

Ambient or Background Noise: The ambient noise from all sources other than the sound of interest (i.e. sound other than that being measured). Under most MOE guidelines, aircraft overflights and train noise, due to their transient nature, are normally excluded from measurements of background noise.

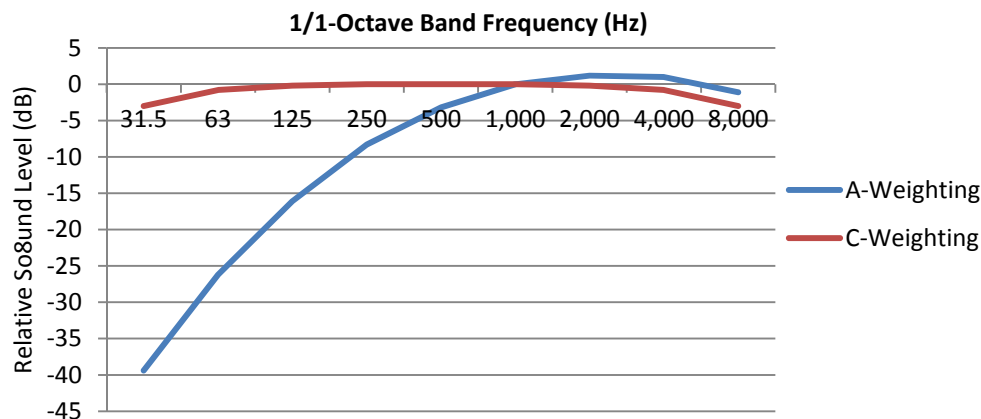
Articulation Index (AI)*: A numerically calculated measure of the intelligibility of transmitted or processed speech. It takes into account the limitations of the transmission path and the background noise. The articulation index can range in magnitude between 0 and 1.0. If the AI is less than 0.1, speech intelligibility is generally low. If it is above 0.6, speech intelligibility is generally high.

Attenuation*: The reduction of sound intensity by various means (e.g., air, humidity, porous materials, etc.).

dB -Decibel: The logarithmic units associated with sound pressure level, sound power level, or acceleration level. See sound pressure level, for example.

dBA -Decibel, A-Weighted: The logarithmic units associated with a sound pressure level, where the sound pressure signal has been filtered using a frequency weighting that mimics the response of the human ear to quiet sound levels. The resultant sound pressure level is therefore representative of the subjective response of the human ear. A-weighted sound pressure levels are denoted by the suffix 'A' (ie. dBA), and the term pressure is normally omitted from the description (i.e., sound level or noise level).

dB C-Weighted: The logarithmic units associated with a sound pressure level, where the sound pressure signal has been filtered using a frequency weighting that mimics the response of the human ear to loud sound levels. C-weighted sound pressure levels are denoted by the suffix 'C' (ie dB C). C-weighted levels are often used in low-frequency noise analysis, as the filtering effect is nearly flat at lower frequencies.



dB L or dBLin -Decibel, Linear: The logarithmic units associated with a sound pressure level, where the sound pressure signal is unfiltered, and represents the full spectrum of incoming noise.

Calibrator (Acoustical)*: A device which produces a known sound pressure on the microphone of a sound level measurement system, and is used to adjust the system to standard specifications.

Definitions with a "*" marker originally from "Noise Control Terms Made Somewhat Easier", by David Kelso (Minnesota Pollution Control Agency), and Al Perez (Northern Sound), Minneapolis, Minnesota May, 1983, as modified on the Noise Pollution Clearinghouse website www.nonoise.org.

Directivity Factor (Q) (also, **Directional** or **Directionality Factor**): A factor mathematically related to Directivity Index, used in calculating propagated sound levels to account for the effect of reflecting surfaces near to the source. For example, for a source in free space where the sound is radiating spherically, $Q = 1$. For a source located on or very near to a surface (such as the ground, a wall, rooftop, etc.), where the sound is radiating hemispherically, $Q = 2$. This accounts for the additional sound energy reflecting off the surface, and translates into a +3 dB add.

Directivity Index*: In a given direction from a sound source, the difference in decibels between (a) the sound pressure level produced by the source in that direction, and (b) the space-average sound pressure level of that source, measured at the same distance.

Energy Equivalent Sound Level (L_{eq}): An energy-average sound level taken over a specified period of time. It represents the average sound pressure encountered for the period. The time period is often added as a suffix to the label (i.e., $L_{eq}(24)$ for the 24-hour equivalent sound level). L_{eq} is usually A-weighted. An L_{eq} value expressed in dBA is a good, single value descriptor of the annoyance of noise.

Exceedance Noise Level (L_N): The noise level exceeded N% of the time. It is a statistical measure of the noise level. For highly varying sounds, the L_{90} represents the background noise level, L_{50} represents the median or typical noise level, and L_{10} represents the short term peak noise levels, such as those due to occasional traffic or a barking dog.

Far Field*: Describes a region in free space where the sound pressure level from a source obeys the inverse-square law (the sound pressure level decreases 6 dB with each doubling of distance from the source). Also, in this region the sound particle velocity is in phase with the sound pressure. Closer to the source where these two conditions do not hold constitutes the “near field” region.

Free Sound Field (Free Field)*: A sound field in which the effects of obstacles or boundaries on sound propagated in that field are negligible.

Frequency*: The number of times per second that the sine wave of sound or of a vibrating object repeats itself. Now expressed in hertz (Hz), formerly in cycles per second (cps).

Hertz (Hz)*: Unit of measurement of frequency, numerically equal to cycles per second.

Human Perception of Sound: The human perception of noise impact is an important consideration in qualifying the noise effects caused by projects. The following table presents a general guideline.

Subjective Human Perception of Changes in Sound Levels

Change in Broadband Sound Level (dB)	Human Perception of Change
<3	Imperceptible change
3	Just-perceptible change
4 to 5	Clearly noticeable change
6 to 9	Substantial change
>10 and more	Very substantial change (half or twice as loud)
>20 and more	Very substantial change (much quieter or louder)

Notes:

Adapted from Bies and Hansen, p53, and MOE Noise Guidelines for Landfill Sites, 1998. Applies to changes in broadband noise sources only (i.e., increases or decreases in the same noise or same type of noise only). Changes in frequency content or the addition of tonal or temporal changes would affect the perception of the change.

Impact Insulation Class (IC)*: A single-figure rating that compares the impact sound insulating capabilities of floor-ceiling assemblies to a reference contour.

Impact Sound*: The sound produced by the collision of two solid objects, e.g., footsteps, dropped objects, etc., on an interior surface (wall, floor, or ceiling) of a building. Typical industrial sources include punch presses, forging hammers, etc.

Impulsive Noise*: a) Single or multiple sound pressure peak(s) (with either a rise time less than 200 milliseconds or total duration less than 200 milliseconds) spaced at least by 500 millisecond pauses, b) A sharp sound pressure peak occurring in a short interval of time.

Infrasonic*: Sounds of a frequency lower than 20 hertz.

Insertion Loss (IL): The arithmetic difference between the sound level from a source before and after the installation of a noise mitigation measure, at the same location. Insertion loss is typically presented as a positive number, i.e., the post-mitigation sound level is lower than the pre-mitigation level. Insertion loss is expressed in dB and is usually specified per 1/1 octave band, per 1/3 octave band, or overall.

Intensity*: The sound energy flow through a unit area in a unit time.

Low Frequency Noise (LFN): Noise in the low frequency range, from infrasonic sounds (<20 Hz) up to 100 Hz.

Masking*: a) The process by which the threshold of audibility for a sound is raised by the presence of another (masking) sound, or b) The amount by which the threshold of audibility of a sound is raised by the presence of another (masking) sound.

Near Field*: The sound field very near to a source, where sound pressure does not obey the inverse-square law and the particle velocity is not in phase with the sound pressure.

Noise: Unwanted sound.

Noise Criteria (NC) Curves: A single number rating for noise in 1/1-octave frequency bands which is sensitive to the relative loudness and speech interference properties of a given sound spectrum. The method consists of a family of criteria curves extending from 63 Hz to 8000 Hz, and a tangency rating procedure. Originally proposed by Bernanek in 1957. While other more modern criteria curve rating schemes exist (NCB, RC, RC Mark II, RNC, etc.), NC curves are still widely used in determining acceptability of noise levels within spaces. Level of NC 25 to NC 35 are usually considered acceptable for residences, private offices, and schools.

Noise Isolation Class (NIC)*: A single number rating derived in a prescribed manner from the measured values of noise reduction between two areas or rooms. It provides an evaluation of the sound isolation between two enclosed spaces that are acoustically connected by one or more paths.

Noise Reduction (NR)*: The numerical difference, in decibels, of the average sound pressure levels in two areas or rooms. A measurement of "noise reduction" combines the effect of the sound transmission loss performance of structures separating the two areas or rooms, plus the effect of acoustic absorption present in the receiving room.

Noise Reduction Coefficient (NRC)*: A measure of the acoustical absorption performance of a material, calculated by averaging its sound absorption coefficients at 250, 500, 1000 and 2000 Hz, expressed to the nearest multiple of 0.05.

Noise Level: Same as Sound Level, except applied to unwanted sounds.

Noise Exposure Forecast (NEF): A calculated measure of aircraft noise based on the type of aircraft in use, the take-off and landing patterns of the aircraft, and times of operation. It represents the noise exposure over a typical 24 hour period. A penalty is applied to nighttime operation.

Peak Sound Pressure Level: Same as Sound Pressure Level except that peak (not peak-to-peak) sound pressure values are used in place of RMS pressures.

Quasi-Steady Impulsive Noise: Noise composed of a series of short, discrete events, characterized by rapid rise times, but with less than 0.5 seconds elapsing between events.

RMS Sound Pressure: The square-root of the mean-squared pressure of a sound (usually the result of an RMS detector on a microphone signal).

Reverberant Field*: The region in a room where the reflected sound dominates, as opposed to the region close to the noise source where the direct sound dominates.

Reverberation*: The persistence of sound in an enclosed space, as a result of multiple reflections, after the sound source has stopped.

Reverberation Time (RT)*: The reverberation time of a room is the time taken for the sound pressure level to decrease 60 dB from its steady-state value when the source of sound energy is suddenly interrupted. It is a measure of the persistence of an impulsive sound in a room as well as of the amount of acoustical absorption present inside the room. Rooms with long reverberation times are called live rooms.

Sabin*: A measure of the sound absorption of a surface; it is the equivalent of one square metre of a perfectly absorptive surface (or one square foot in imperial units).

Sound: a dynamic (fluctuating) pressure.

Sound Exposure Level (SEL): An L_{eq} referenced to a one second duration. Also known as the Single Event Level. It is a measure of the cumulative noise exposure for a single event. It provides a measure of the accumulation of sound energy over the duration of the event.

Sound Level (SL): The A-weighted Sound Pressure Level expressed in dBA.

Sound Level Meter*: An instrument comprised of a microphone, amplifier, output meter, and frequency-weighting networks which is used for the measurement of noise and sound levels.

Sound Pressure Level (SPL): The logarithmic ratio of the RMS sound pressure to the sound pressure at the threshold of hearing. The sound pressure level is defined by equation (1) where P is the RMS pressure due to a sound and P_0 is the reference pressure. P_0 is usually taken as 2.0×10^{-6} Pascals.

$$(1) \text{ SPL (dB)} = 20 \log(P_{\text{RMS}}/P_0)$$

Sound Power Level (PWL): The logarithmic ratio of the instantaneous sound power (energy) of a noise source to that of an international standard reference power. The sound power level is defined by equation (2) where W is the sound power of the source in watts, and W_0 is the reference power of 10^{-12} watts.

$$(2) \text{ PWL (dB)} = 10 \log(W/W_0)$$

Interrelationships between sound pressure level (SPL) and sound power level (PWL) depend on the location and type of source.

Sound Transmission Class (STC)*: The preferred single figure rating system designed to give an estimate of the sound insulation properties of a structure or a rank ordering of a series of structures.

Sound Transmission Loss (STL)*: A measure of sound insulation provided by a structural configuration. Expressed in decibels, it is 10 times the logarithm to the base 10 of the reciprocal of the sound transmission coefficient of the configuration.

Spectrum*: The description of a sound wave's resolution into its components of frequency and amplitude.

Speech Interference Level (SIL)*: A calculated quantity providing a guide to the interference of a noise with the reception of speech. The speech-interference level is the arithmetic average of the octave band levels of the interfering noise in the most important part of the speech frequency range. The levels in octave bands centered at 500, 1000, and 2000 Hz are commonly averaged to determine the speech-interference level.

Speed (Velocity) of Sound in Air*: 344 m/s (1128 ft/s) at 70°F (21°C) in air at sea level.

Threshold of Audibility (Threshold of Detectability)*: The minimum sound pressure level at which a person can hear a specified frequency of sound over a specified number of trials.

Transmission Loss: A measure of the reduction in sound energy resulting from incident sound waves striking a wall, partition or enclosure, and radiating through to the other side. Mathematically, the transmission coefficient t is the ratio of transmitted acoustic power to the incident acoustic power, and in decibels, the Transmission Loss (TL) of the wall is:

$$(3) \text{ TL} = 10\log(1 / t)$$

The TL of a wall varies by frequency. The associated noise reduction (NR) due to the TL of the wall is a function of the TL and the acoustical parameters of the receiving space. For noise radiating from an enclosure into the outdoors, $\text{NR} = (\text{TL} + 6)$.

TRANSPORTATION SOUND BASICS

Sound Levels

Sound is, in its simplest form, a dynamic, fluctuating pressure, in a fluid medium. That medium can be air, other gases, or liquids such as water. These fluctuations are transmitted by pressure waves through the medium from the source to the receiver. For the majority of transportation engineering purposes, the primary interest is with sound waves in air, with human beings as the receptor. Noise is defined as unwanted sound. The standard practice within the acoustical industry is to use these two terms interchangeably.

Decibels

A decibel (dB) is a logarithmic ratio of a value to a reference level. The general mathematical format is:

$$\text{Level in dB} = 10 \log (\text{Value} / \text{Reference})$$

Any value can be expressed in decibels. Decibels are very, very useful in performing comparisons where there are huge ranges in levels. For example, an acoustical engineer can expect to deal with acoustical energy values ranging from 0.00001 W to 100 W (sound power), and pressures ranging from 0.002 Pa to 200 Pa (sound pressure).¹ For completeness, decibels should always be stated with their reference level (e.g., 20 dB re: 20 µPa). However, in practice the reference level is often left out.

Sound Pressure Level

Sound pressure level is what humans experience as sound. Sound waves create small fluctuations around the normal atmospheric pressure. These pressure fluctuations come into contact with eardrums and create the sensation of sound. Sound pressure is measured in decibels, according to the following equation:

$$\text{Sound Pressure Level, dB} = 10 \log (p^2/p_0^2)$$

Where: p = root mean square (r.m.s.) sound pressure, in Pa
 p_0 = reference sound pressure, 20 µPa

The reference pressure represents the faintest sound that a “typical” human being can hear. The typical abbreviation for sound pressure level is SPL, although L_p is also often used in equations. “Sound level” or “noise level” are also sometimes used.

Octave Bands

Sounds are composed of varying frequencies or pitches. Human sensitivity to noise varies by frequency, with a greater sensitivity to higher frequency sounds. The propagation of sound also varies by frequency. The unit of frequency is Hertz (Hz), which refers the number of cycles per second (number of wave peaks per second of the propagating sound wave). The typical human hearing response runs from 20 Hz to 20,000 Hz. Frequencies below 20 Hz are generally inaudible, although response is variable, and some individuals may be able to hear or perceive them.

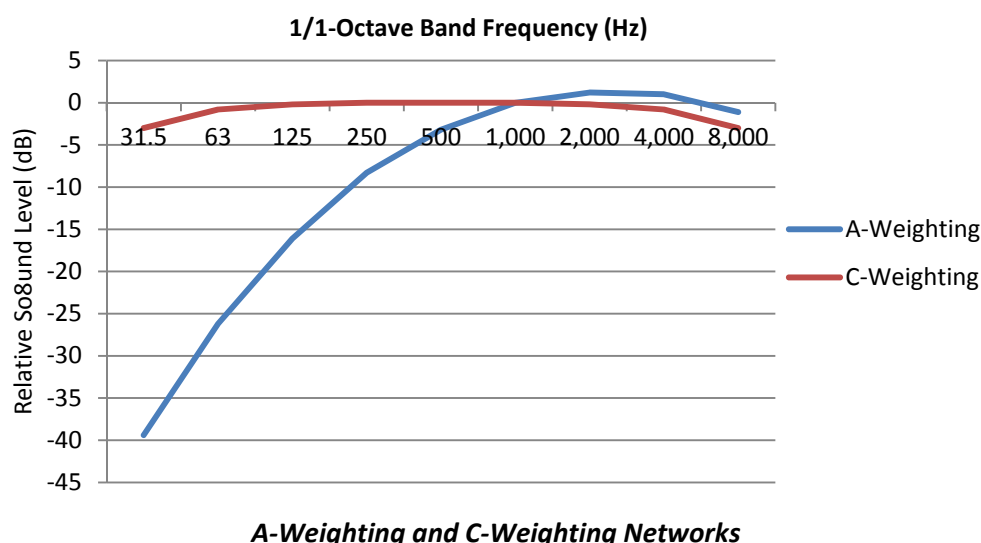
¹ Equivalent to Sound Power Levels ranging from 70 to 140 dB and Sound Pressure Levels ranging from 20 dB to 140 dB

Sound is typically analysed in octave bands or 1/3-octave bands. An octave band is defined as a band or range of sound frequencies where the frequency range doubles for succeeding octave (alternately, the highest frequency in the range is twice the value of the lowest frequency).

A-Weighting

When the overall sound pressure level is expressed as a single value (i.e., not expressed in frequency band levels) the variation in human frequency response must be accounted for. People do not hear low frequency noise as well as noise in mid or high frequencies. To account for this, frequency-weighting networks have been developed to better account for human hearing response. The most frequently used networks are the A-Weighting and C-Weighting.

The A-Weighting network was developed to correspond to how humans hear low to medium levels of noise. The A-Weighting is the most frequently used scheme, and the majority of noise guidelines are expressed in A-Weighted decibel values, denoted as “dBA” levels. C-Weighted “dBC” values are sometimes used in assessing low-frequency noise impacts, which are generally not of concern in transportation noise impact assessment. The A-Weighting and C-Weighting values are shown in the following figure.



Ranges of Sound Levels

People experience a wide range of sound levels in their daily activities. The table below presents a graphical comparison of “typical” noise levels which might be encountered, and the general human perception of the level. Sound levels from 40 to 65 dBA are in the faint to moderate range. The vast majority of the outdoor noise environment, even within the busiest city cores, will lie within this area. Sound levels from 65 to 90 are perceived as loud. This area includes very noisy commercial and industrial spaces. Sound levels greater than 90 dB are very loud to deafening, and may result in hearing damage.

Ranges of Sound Levels

Sound Levels		Sources of Noise
Human Perception	SPL in dBA	
Deafening	125	Sonic booms
	120	Threshold of Feeling / Pain
	115	Maximum level, hard rock band concert
	110	Accelerating Motorcycle at a few feet away
Very Loud	105	Loud auto horn at 3 m (10 ft) away
	100	Dance club / maximum human vocal output at 1 m (3 ft) distance
	95	Jack hammer at 15 m (50 ft) distance
	90	Indoors in a noisy factory
Loud	85	Heavy truck pass-by at 15 m (50 ft) distance
	80	School cafeteria / noisy bar; Vacuum cleaner at 1.5 m (5 ft)
	75	Near edge of major highway
	70	Inside automobile at 60 km/h
	65	Normal human speech (unraised voice) at 1 m (3 ft) distance
Moderate	60	Typical background noise levels in a large department store
	55	General objective for outdoor sound levels; typical urban sound level (24h)
	50	Typical suburban / semi-rural sound level (24h)
	45	Typical noise levels in an office due to HVAC; typical rural levels (24h)
Faint	40	Typical background noise levels in a library
	35	
	30	Broadcast Studio
	25	Average whisper
Very Faint	20	Deep woods on a very calm day
	15	
	10	
	5	Human breathing
	0	Quietest sound that can be heard

Transportation noise events, which vary with time, can also be considered in terms of their maximum noise level (L_{max}) during a vehicle pass-by, as shown in the following table:

Typical Pass-By Noise Level at 15 m from Noise Source

Event	Range of Noise Levels (dBA) at 15 m
Semi-Trailer Trucks	75 - 85
Aircraft	69 - 85 [1]
Conventional Light Rapid Transit (Streetcars)	72 - 80 [2]
Large Trucks	71 - 78
Street Motorcycle	76
Diesel or Natural Gas Bus	70 - 78
Trolley Bus	69 - 73
Small Motorcycle	67
General Busy Auto Traffic	66 - 70
Individual Automobiles	63 - 69

Notes: Source: BKL Consultants Ltd.

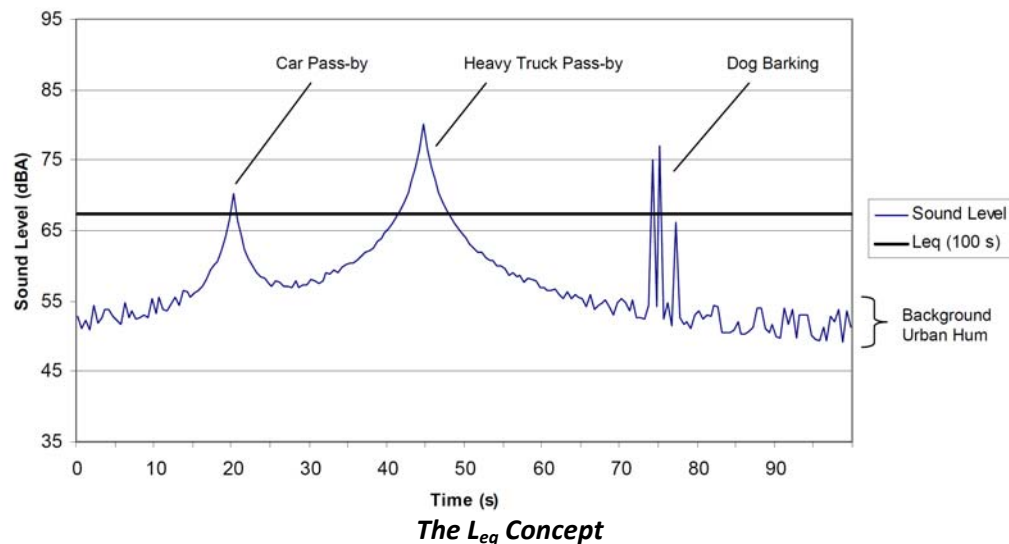
[1] Aircraft flyover not at 15 m distance

[2] Based on data provided for the Calgary, Edmonton and Portland LRT systems.

Noise Descriptors – L_{eq} Values

At this time, the best available research indicates that long-term human responses to noise are best evaluated using energy equivalent sound exposure levels (L_{eq} values), in A-Weighted decibels (L_{eq} values in dBA)^{2,3} including adjustments to account for particularly annoying characteristics of the sounds being analyzed.

Sound levels in the ambient environment vary each instant. In a downtown urban environment, the background noise is formed by an “urban hum”, composed of noise from distant road traffic and from commercial sources. As traffic passes near a noise receptor, the instantaneous sound level may increase as a vehicle approaches, and then decrease as it passes and travels farther away. The energy equivalent sound exposure level L_{eq} is the average sound level over the same period of time with same acoustical energy as the actual environment (i.e., it is the average of the sound energy measured over a time period T). As a time-average, all L_{eq} values must have a time period associated with them. This is typically placed in brackets beside the L_{eq} tag. For example, a thirty-minute L_{eq} measurement would be reported as an L_{eq} (30 min) value. The L_{eq} concept is illustrated in Figure 3, showing noise levels beside a small roadway, over a 100 second time period, with two vehicle pass-bys:



In this example, the background “urban hum” is between 47 and 53 dBA. A car passes by at 20 seconds. As it approaches, the noise level increases to a maximum, and then decreases as it speeds away. At 45 seconds, a heavy truck passes by. Near 75 seconds, a dog barks three times. The maximum sound level (L_{max}) over the period is 80 dBA and the minimum is 47 dBA. For almost 50 % of the time, the sound level is lower than 55 dBA.

The L_{eq} (100s) for the example is 67 dBA, which is much higher than the statistical mean sound level of 55 dBA. This illustrates that the L_{eq} value is very sensitive to loud noise events, which contain much more sound energy (as sound is ranked on a logarithmic scale) than the normal background. It is also sensitive to the number of events during the time period, and the duration of those events. If only the truck had passed by during the measurement (no car and no dog barks), the L_{eq} (100s) would be 66 dBA. If only the car and dog barks had occurred, the L_{eq} (100s) would be 61 dBA. This shows that the truck pass-by is the dominant event in our example, due to its level and duration.

² Berglund and Lindvall, Community Noise, 1995.

³ ISO 1996:2003(E), Acoustics – Description, measurement and assessment of environmental noise – Part 1: Basic quantities and assessment procedures.

The ability of the L_{eq} metric to account for the three factors of level, duration and frequency of events makes it a robust predictor of human response to noise. It is for this reason that the vast majority of noise standards are based on L_{eq} values.

Typical Durations for L_{eq} Analyses

For transportation noise impact analyses, the following durations are typically used:

L_{eq} (24h)	–	The sound exposure level over then entire 24-hour day
L_{eq} Day	–	Either: Leq (15h), from 7am to 10 pm; or Leq (16h), from 7am to 11 am
L_{eq} Night	–	Either: Leq (9h), from 10 pm to 7 am; or Leq (8h), from 11 pm to 7 am
L_{dn}	–	A special Leq (24h) value with a 10 dB night-time penalty applied to overnight sound levels (10pm to 7am)
L_{eq} (1-h)	–	The sound exposure over a 1-hour time period

L_{eq} (24h) values are appropriate for examining impacts of transportation noise sources with small changes in sound exposure levels over the 24-hour day. For example, freeway noise levels are generally consistent over the 24-hour day. Therefore, for freeways, there is little difference between L_{eq} (24h) values and the corresponding L_{eq} Day and L_{eq} Night values.

L_{eq} Day values, covering off the AM-peak and PM-peak travel periods, are generally appropriate for examining the impacts of non-freeway highways and municipal arterial roadways. The vast majority of noise associated with these sources is concentrated in the daytime hours, where typically, 85% to 90% of the daily road traffic will occur.⁴ Thus, if reasonable sound levels occur during the daytime (and appropriate guideline limits are met), they will also occur (and be met) at night.

To account for increased annoyance with noise overnight in a single value, the U.S. Environmental Protection Agency (U.S. EPA) developed the L_{dn} metric (also known as DNL). It is a special form of the L_{eq} (24h) with a +10 dB night-time penalty. L_{dn} values and a related metric, the day-evening-night level (Lden) are also used in some European guidelines. L_{dn} values are not used in Canadian Provincial jurisdictions in evaluating transportation noise. Instead, guideline limits for separate Leq Day and Leq Night periods are generally used.

L_{eq} (1-h) values are the average sound levels over a one-hour time period. These tend to fluctuate more over the day, as traffic levels can fluctuate significantly hour to hour. L_{eq} (1-h) values are useful in assessing the impact of transportation sources which also vary hourly, and which may vary in a different manner than the background traffic. These values are often used to assess haul route noise impacts, for example.

⁴ Based on research conducted by Ontario Ministry of Transportation, and provided in the *MTO Environmental Office Manual Technical Areas – Noise*. Daytime refers to a 16 hour day from 7am to 11 pm.

Some transportation noise sources may have significant traffic levels occurring overnight. For example, freight rail traffic in heavily used corridors can be shifted to over-night periods, with daytime track use being reserved for freight switcher traffic and passenger traffic. In situations such as this, an assessment of both daytime and night-time noise impacts may be appropriate.

Decibel Addition

Decibels are logarithmic numbers, and therefore have special properties of addition. Decibel values must be added logarithmically. If two sources, each emitting the same amount of sound energy, are placed side-by-side, then the total increase in sound level will only be 3 dB. If the difference in sound energy emitted is greater than 10 dB, then effectively the sound level will be the same as for the loudest unit (i.e., the increase in noise will be less than a decibel).

Decibel Addition Chart

dB Difference Of	dB Value to Add to Highest Number
0	3.0
1	2.5
2	2.1
3	1.8
4	1.5
5	1.2
6	1.0
7	0.8
8	0.6
9	0.5
10	0.4

This affects transportation noise from projects, as noise emission is logarithmically related to traffic volume. Doubling the traffic volume (essentially the same as adding a source with the same sound emission) will only result in a 3 dB increase over the original levels. The decibel increase in noise due to the increase in traffic volume, assuming all other factors remain the same, can be estimated by:

$$\text{dB increase} = 10 \log (\text{new volume} / \text{original volume}).$$

Human Response to Changes in Sound Levels

The human ear does not interpret changes in sound level in a linear manner. The general subjective human perception of changes in sound level is shown in the following table.

Subjective Human Perception of Changes in Sound Levels^{5,6}

Change in Broadband Sound Level (dB)	Human Perception of Change
<3	Imperceptible change
3	Just-perceptible change
4 to 5	Clearly noticeable change
6 to 9	Substantial change
>10 and more	Very substantial change (half or twice as loud)
>20 and more	Very substantial change (much quieter or louder)

Notes:

Adapted from Bies and Hansen, p53, and MOE Noise Guidelines for Landfill Sites, 1998. Applies to changes in broadband noise sources only (i.e., increases or decreases in the same noise or same type of noise only). Changes in frequency content or the addition of tonal or temporal changes would affect the perception of the change.

The above table is directly applicable to changes in sound level where the noise sources are of the same general character. For example, existing road traffic noise levels can be directly compared to future road traffic noise levels, using the above relationships. In comparing road traffic noise to road plus rail traffic noise, the different frequency and temporal nature of the noise means that the rail noise may be more noticeable. Adjustments for the nature of the new sound can be applied to better account for temporal and frequency differences.

For transportation noise sources, research conducted by the U.S. Environmental Protection Agency indicates that a 5 dB change in sound levels is required to trigger a change in large-scale community response to noise. This correlates to a clearly noticeable increase in noise levels.

Decay of Noise with Distance

Noise levels decrease with increasing distance from a source of noise. The rate of decay is partially dependent on the nature of the ground between the source: whether it is hard (acoustically reflective) or soft (acoustically absorptive). Transportation noise sources in general act as *line sources* of sound. For line sources, the rate of decay is approximately:

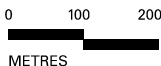
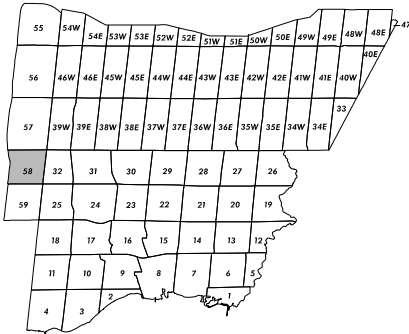
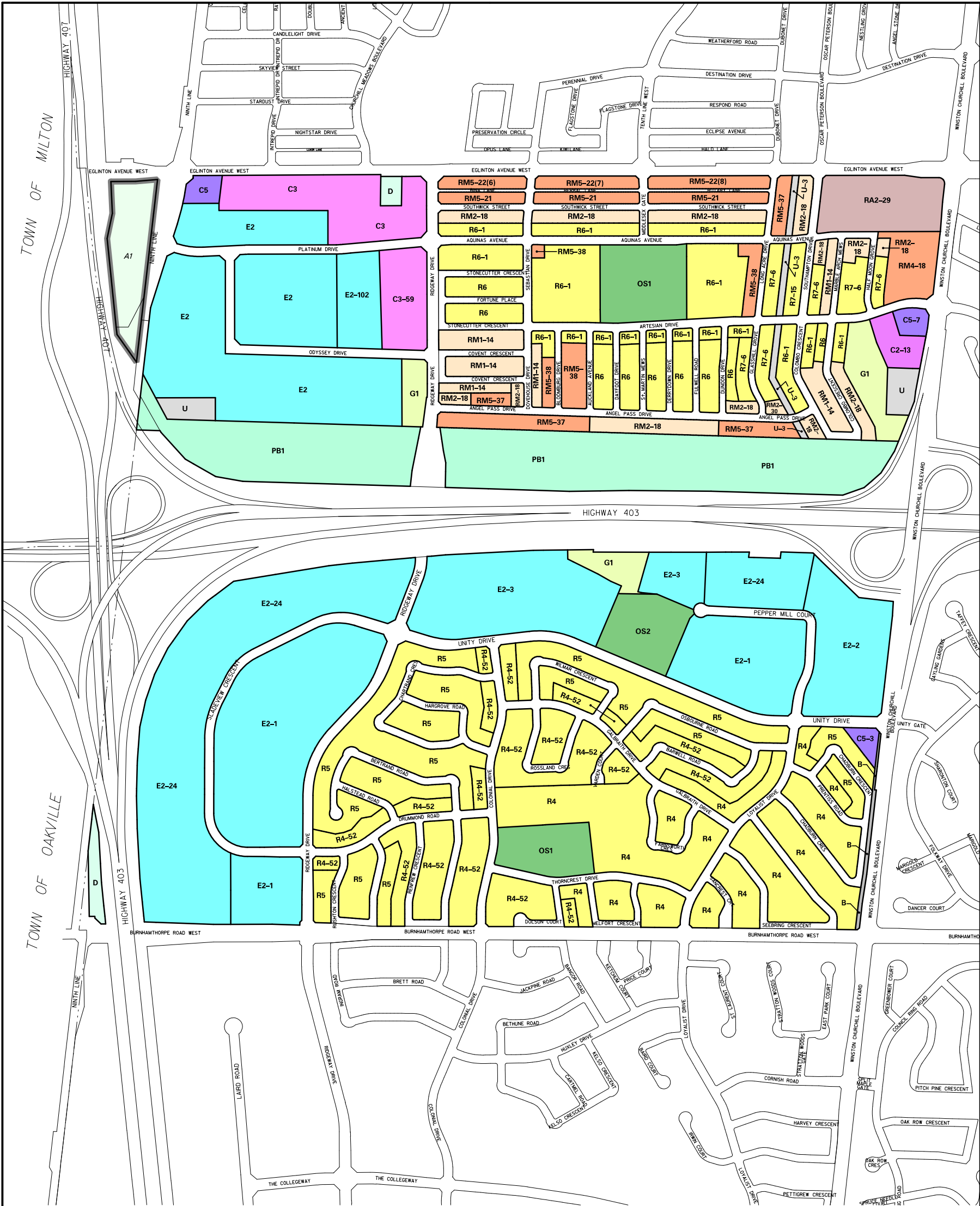
- Hard ground: 3 dB for each doubling of distance from the source
- Soft ground: 5 dB for each doubling of distance from the source

⁵ Bies, D.A., and C.H Hansen 1988. Engineering Noise – Theory and Practice, 2nd Ed. E & E & FN Spon, London, p 53.

⁶ Ontario Ministry of the Environment 1998. Noise Guidelines for Landfill Sites. Queen's Printer for Ontario.

Appendix B

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purposes



Milton By-law 144-2003

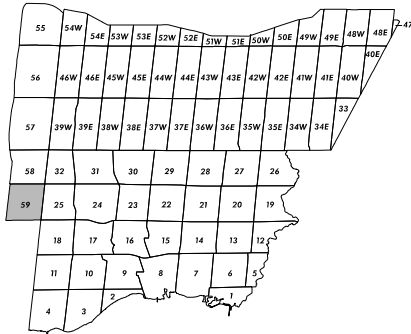
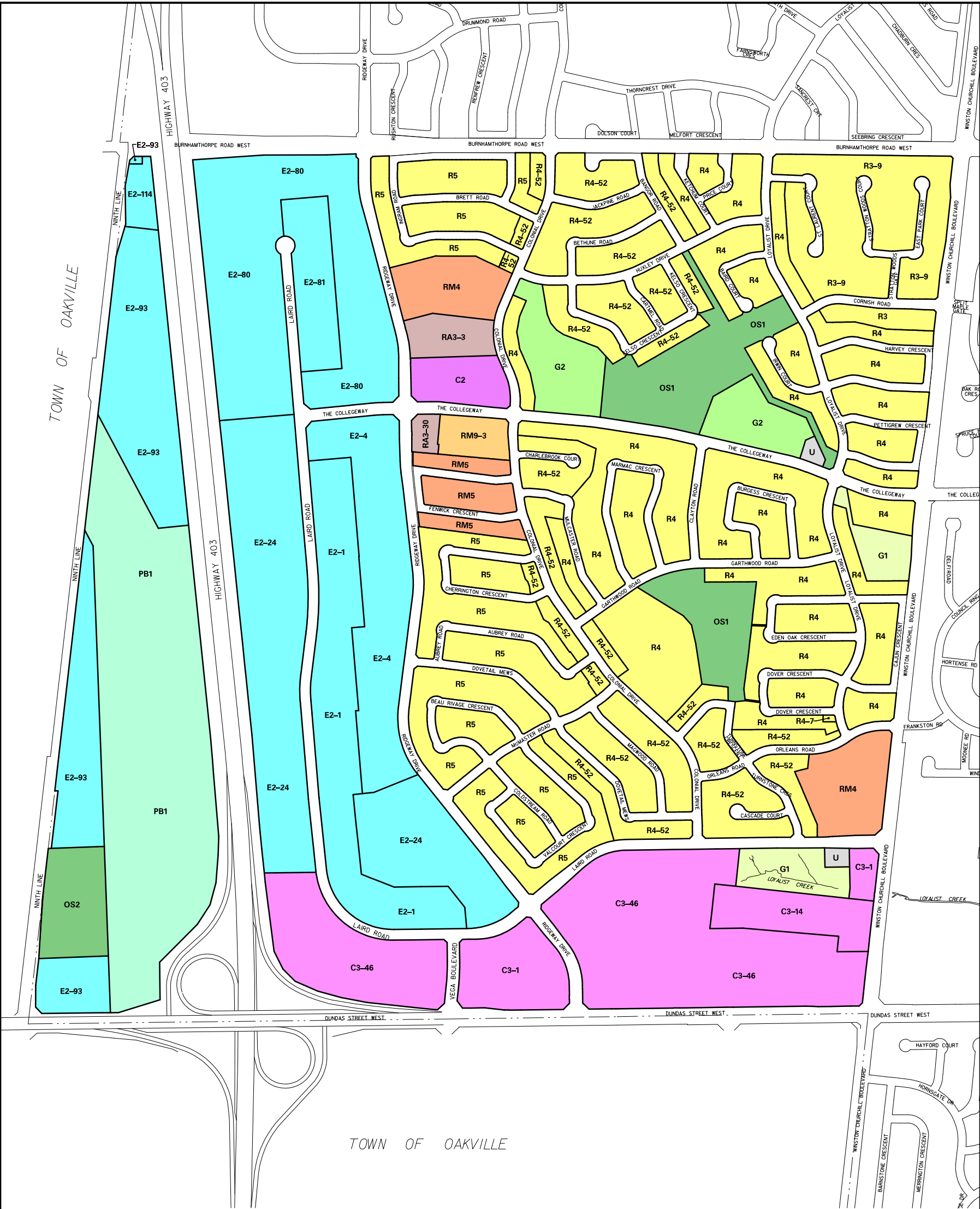
Greenlands Overlay


Zoning Notation Example:
R4-12 = R4-Exception 12

Zoning Map 58

Schedule "B" To
By-law No. 0225-2007

Revised: 2015 July 31



 Greenlands Overlay

Zoning Notation Example:
R4-12 = R4-Exception 12

Zoning Map 59

Schedule "B" To
By-law No. 0225-2007
Revised: 2015 October 31

ZONING BY-LAW 0225-2007

ZONING CATEGORIES

ZONES




ZONING DESCRIPTIONS

Residential		R1 – R16	Detached Dwellings
		RM1, RM2, RM3	Semi-Detached Dwellings
		RM7	Detached, Semi-Detached, Duplex, Triplex Dwellings
		RM4, RM5, RM6	Townhouse Dwellings
		RM8, RM9	Horizontal Multiple Dwellings
		RA1, RA2, RA3, RA4, RA5	Apartment, Long Term Care, Retirement Dwellings
Office		O	Office
Commercial		C1	Convenience Commercial
		C2	Neighbourhood Commercial
		C3	General Commercial
		C4	Mainstreet Commercial
		C5	Motor Vehicle Commercial
City Centre		CC1	Retail Core Commercial
		CC2	Mixed Use
		CC3	Mixed Use – Transition Area
		CC4	Mixed Use /Mixed Use – Transition Area
		CC0S	City Centre Open Space
Employment		E1	Business Employment in Nodes
		E2	Business Employment
		E3	Industrial
Open Space		OS1	Community Park
		OS2	City Park
		OS3	Cemetery
Greenlands		G1	Natural Hazards
		G2	Natural Features
			Greenlands Overlay
Parkway Belt		PB1, PB2	Parkway Belt
Utility		U	Utility
Institutional		I	Hospital and University /College
Development		D	Existing Use
Buffer		B	Buffer /Berm /Fence
Airport		AP	Lester B. Pearson International Airport

ZONING BY-LAW 5500

ZONES

ZONING DESCRIPTIONS

Residential		RR	Detached Dwellings
Agricultural		A	Agricultural
Greenbelt		G	Park, Conservation

MILTON ZONING BY-LAW 144-2003

ZONES

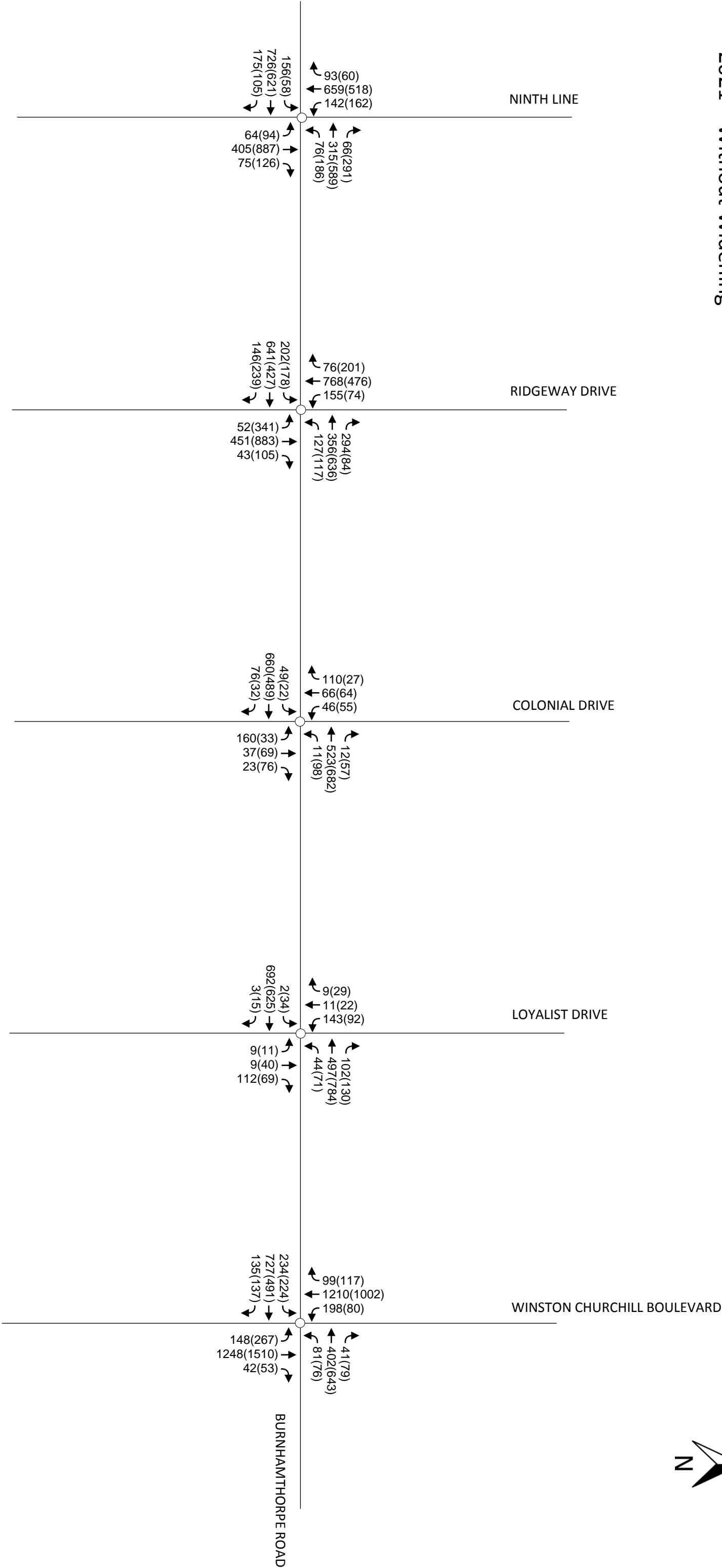
ZONING DESCRIPTIONS

Rural		A1	Agricultural
Greenlands		GA	Greenlands 'A'

Appendix C

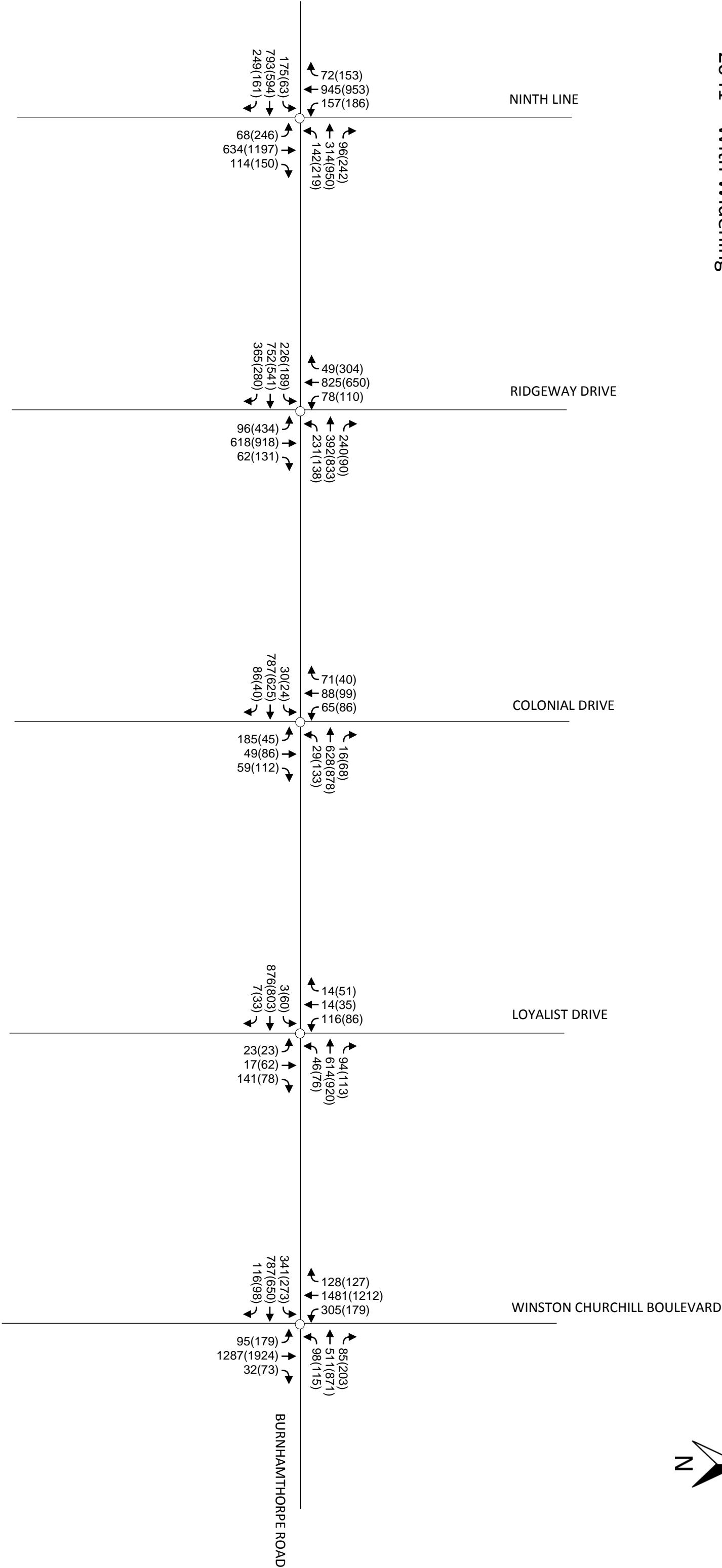
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purposes

2021 – Without Widening



Legend: AM (PM)

2041 – With Widening



Legend: AM (PM)

Appendix D

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purposes

**YYN

Burnhamthorpe Road West EA, 2021 Traff.,16 hr day, Existing Conditions, May 24,2018

1,3

2,16

RDWY 1 Burnhamthorpe Rd W EB East of Hwy 403

'CARS'	508	60			
'MT'	12	60			
'HT'	12	60			
'L' /					
'Seg 1'	603887.9	4819746.2	188.3	0	
'Seg 2'	603910.7	4819775.3	188.4	1	
'Seg 3'	603930.4	4819800.3	188.0	0	
'Seg 4'	603953.5	4819828.0	187.7	0	
'Seg 5'	603972.2	4819851.7	187.2	0	
'Seg 6'	603994.4	4819880.2	186.5	0	
'Seg 7'	604023.0	4819916.2	185.6	0	
'Seg 8'	604051.0	4819950.3	184.9	0	
'Seg 9'	604086.5	4819993.5	183.5	0	
'Seg 10'	604128.5	4820044.2	181.6	0	

'L' /

RDWY 2 Burnhamthorpe Rd W EB Ridgeway Dr. to Colonial Dr.

'CARS'	330	60			
'MT'	8	60			
'HT'	8	60			
'L' /					
'Seg 1'	604128.6	4820044.3	181.6	0	
'Seg 2'	604152.9	4820075.5	180.9	0	
'Seg 3'	604180.7	4820112.6	180.3	0	
'Seg 4'	604213.5	4820153.9	179.6	0	
'Seg 5'	604249.7	4820201.8	179.2	0	
'Seg 6'	604289.7	4820252.8	178.3	0	
'Seg 7'	604333.3	4820308.6	177.8	0	
'Seg 8'	604370.1	4820353.9	177.4	0	
'Seg 9'	604390.2	4820379.0	177.0	0	
'Seg 10'	604406.5	4820398.6	176.8	0	

'L' /

RDWY 3 Burnhamthorpe Rd W EB Colonial Dr. to Loyalist Dr.

'CARS'	405	60			
'MT'	9	60			
'HT'	9	60			
'L' /					
'Seg 1'	604406.6	4820398.7	176.8	0	
'Seg 2'	604425.0	4820421.5	176.5	0	
'Seg 3'	604447.8	4820451.6	176.0	0	
'Seg 4'	604470.9	4820482.8	175.5	0	
'Seg 5'	604498.0	4820517.7	174.9	0	
'Seg 6'	604536.0	4820566.9	174.8	0	
'Seg 7'	604571.1	4820611.6	175.0	1	
'Seg 8'	604600.9	4820648.8	175.4	1	
'Seg 9'	604634.1	4820689.6	175.3	0	
'Seg 10'	604670.2	4820734.5	175.7	1	
'Seg 11'	604701.9	4820774.4	175.7	1	
'Seg 12'	604723.5	4820800.2	175.6	0	
'Seg 13'	604734.8	4820814.4	175.5	0	

'L' /

RDWY 4 Burnhamthorpe Rd EB East of Loyalist Dr.

'CARS'	518	60			
'MT'	11	60			
'HT'	11	60			
'L' /					
'Seg 1'	604734.9	4820814.5	175.5	0	
'Seg 2'	604762.8	4820847.5	175.2	0	
'Seg 3'	604783.0	4820872.5	175.1	0	
'Seg 4'	604805.8	4820901.5	174.8	0	
'Seg 5'	604836.7	4820942.5	171.5	0	
'Seg 6'	604869.0	4820984.2	167.5	0	

'L' /

RDWY 5 Burnhamthorpe Rd WB East of Loyalist Dr.

'CARS'	518	60			
'MT'	11	60			
'HT'	11	60			
'L' /					
'Seg 1'	604863.2	4820987.8	167.1	0	
'Seg 2'	604829.4	4820947.3	171.6	1	
'Seg 3'	604797.2	4820910.7	174.8	1	
'Seg 4'	604774.5	4820881.7	175.0	1	
'Seg 5'	604753.7	4820855.7	175.3	1	
'Seg 6'	604726.7	4820822.2	175.5	1	

'L' /

RDWY 6 Burnhamthorpe Rd W WB Loyalist Dr. to Colonial Dr.

'CARS'	405	60			
'MT'	9	60			
'HT'	9	60			
'L' /					
'Seg 1'	604726.3	4820822.2	175.5	0	
'Seg 2'	604693.3	4820778.3	175.7	1	
'Seg 3'	604664.0	4820738.5	175.7	1	
'Seg 4'	604629.8	4820693.0	175.4	0	
'Seg 5'	604597.3	4820652.1	175.4	0	
'Seg 6'	604567.5	4820614.0	175.0	0	

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'Seg 7' 604532.8 4820570.1 174.8 0
'Seg 8' 604493.8 4820520.8 174.9 1
'Seg 9' 604466.2 4820486.3 175.3 1
'Seg 10' 604441.8 4820456.0 175.9 1
'Seg 11' 604418.0 4820427.0 176.6 1
'Seg 12' 604400.0 4820404.6 176.9 1
'L' /
RDWY 7 Burnhamthorpe Rd W WB Colonial Dr. to Ridgeway Dr.
'CARS' 330 60
'MT' 8 60
'HT' 8 60
'L' /
'Seg 1' 604399.9 4820404.5 176.9 1
'Seg 2' 604383.5 4820383.6 177.0 1
'Seg 3' 604364.0 4820357.8 177.2 1
'Seg 4' 604328.3 4820312.3 177.6 1
'Seg 5' 604285.6 4820255.9 178.2 1
'Seg 6' 604246.1 4820205.1 179.0 1
'Seg 7' 604208.3 4820157.6 179.6 1
'Seg 8' 604174.6 4820117.3 180.3 1
'Seg 9' 604145.8 4820080.4 180.9 0
'Seg 10' 604122.5 4820051.8 181.6 1
'L' /
RDWY 8 Burnhamthorpe Rd W WB Ridgeway Dr. to Hwy 403
'CARS' 508 60
'MT' 12 60
'HT' 12 60
'L' /
'Seg 1' 604122.4 4820051.7 181.6 1
'Seg 2' 604080.3 4819998.1 183.2 1
'Seg 3' 604046.8 4819953.4 184.4 1
'Seg 4' 604019.8 4819918.6 185.4 1
'Seg 5' 603991.3 4819882.7 186.3 1
'Seg 6' 603968.9 4819854.2 187.0 1
'Seg 7' 603950.4 4819830.1 187.6 1
'Seg 8' 603927.4 4819802.9 188.0 1
'Seg 9' 603908.3 4819778.1 188.4 1
'Seg 10' 603885.1 4819748.4 188.3 1
'L' /
RDWY 9 Loyalist Dr. North of Burnhamthorpe RD W both directions
'CARS' 180 50
'MT' 5 50
'HT' 5 50
'L' /
'Seg 1' 604647.6 4820945.2 175.3 1
'Seg 2' 604660.4 4820909.5 175.3 1
'Seg 3' 604671.2 4820885.5 175.3 1
'Seg 4' 604686.9 4820859.2 175.3 1
'Seg 5' 604705.6 4820840.5 175.5 1
'Seg 6' 604731.1 4820817.7 175.5 1
'L' /
RDWY 10 Loyalist Dr. South of Burnhamthorpe RD W both directions
'CARS' 124 50
'MT' 3 50
'HT' 3 50
'L' /
'Seg 1' 604731.2 4820817.5 175.5 0
'Seg 2' 604752.2 4820798.8 175.2 0
'Seg 3' 604774.7 4820779.8 175.5 1
'Seg 4' 604799.4 4820758.8 175.5 1
'Seg 5' 604821.4 4820739.8 175.5 1
'Seg 6' 604848.4 4820720.3 175.5 1
'L' /
RDWY 11 Colonial Dr. North of Burnhamthorpe RD W both directions
'CARS' 182 50
'MT' 5 50
'HT' 5 50
'L' /
'Seg 1' 604283.4 4820526.9 177.5 1
'Seg 2' 604313.4 4820485.9 177.5 1
'Seg 3' 604342.2 4820452.5 177.5 1
'Seg 4' 604372.8 4820427.3 177.3 0
'Seg 5' 604405.1 4820403.9 176.9 0
'L' /
RDWY 12 Colonial Dr. SB South of Burnhamthorpe RD W both directions
'CARS' 216 50
'MT' 7 50
'HT' 7 50
'L' /
'Seg 1' 604405.2 4820404.0 176.9 1
'Seg 2' 604434.1 4820378.4 176.8 0
'Seg 3' 604463.3 4820356.8 176.9 1
'Seg 4' 604491.3 4820332.6 176.9 0
'Seg 5' 604503.9 4820319.6 176.9 0
'Seg 6' 604525.7 4820280.5 176.8 0
'L' /
RDWY 13 Ridgeway Dr. NB North of Burnhamthorpe RD W
'CARS' 576 60
'MT' 9 60
'HT' 9 60

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'L' /
'Seg 1' 604128.4 4820052.2 181.5 0
'Seg 2' 604098.7 4820073.8 181.5 0
'Seg 3' 604067.2 4820098.8 181.5 0
'Seg 4' 604025.8 4820130.9 181.8 1
'Seg 5' 603990.9 4820159.1 181.9 1
'L' /
RDWY 14 Ridgeway Dr. SB North of Burnhamthorpe RD W
'CARS' 576 60
'MT' 9 60
'HT' 9 60
'L' /
'Seg 1' 603984.0 4820150.2 181.7 0
'Seg 2' 604019.2 4820122.7 181.7 0
'Seg 3' 604061.7 4820089.8 181.4 0
'Seg 4' 604092.3 4820066.2 181.4 0
'Seg 5' 604121.3 4820043.1 181.7 1
'L' /
RDWY 15 Ridgeway Dr. NB South of Burnhamthorpe RD W
'CARS' 564 60
'MT' 8 60
'HT' 8 60
'L' /
'Seg 1' 604389.1 4819903.8 182.2 0
'Seg 2' 604336.5 4819926.4 182.2 0
'Seg 3' 604276.5 4819952.1 182.2 0
'Seg 4' 604232.3 4819971.2 182.6 1
'Seg 5' 604216.7 4819980.2 182.6 0
'Seg 6' 604199.8 4819992.5 182.2 0
'Seg 7' 604165.6 4820019.5 181.5 0
'Seg 8' 604128.4 4820052.4 181.5 0
'L' /
RDWY 16 Ridgeway Dr. SB South of Burnhamthorpe RD W
'CARS' 564 60
'MT' 8 60
'HT' 8 60
'L' /
'Seg 1' 604121.5 4820043.3 181.7 1
'Seg 2' 604159.7 4820012.9 181.3 0
'Seg 3' 604194.0 4819986.1 182.0 1
'Seg 4' 604212.0 4819973.6 182.4 1
'Seg 5' 604228.9 4819965.2 182.5 1
'Seg 6' 604274.0 4819947.0 182.4 0
'Seg 7' 604333.8 4819921.4 182.2 0
'Seg 8' 604386.5 4819899.0 182.2 0
'L' /
3,10
Barrier 1 Barrier for Receiver 1
'Bar 1' 604055.5 4820124.5 184.3 182.4 0.0 0
'Bar 2' 604073.0 4820110.5 184.2 182.3
'Bar 3' 604087.5 4820099.1 184.1 182.2
'Bar 4' 604100.8 4820088.6 184.2 182.3
'Bar 5' 604108.2 4820082.5 184.1 182.2
'Bar 6' 604116.1 4820082.8 184.3 182.4
'Bar 7' 604125.8 4820095.3 183.4 181.5
'A' /
Barrier 2 Barrier for Receiver 2
'Bar 1' 604171.4 4820060.9 184.6 182.2 0.0 0
'Bar 2' 604161.5 4820047.1 184.8 182.3
'Bar 3' 604161.9 4820040.2 184.8 182.3
'Bar 4' 604173.1 4820031.0 184.7 182.3
'Bar 5' 604180.4 4820025.0 184.8 182.4
'Bar 6' 604188.1 4820019.3 185.0 182.6
'Bar 7' 604196.5 4820013.1 184.9 182.4
'Bar 8' 604205.1 4820006.7 185.4 183.0
'A' /
Barrier 3 Barrier for Receiver 3
'Bar 1' 604217.7 4820212.1 181.7 179.8 0.0 0
'Bar 2' 604224.6 4820207.1 181.5 179.6
'Bar 3' 604236.2 4820222.6 181.9 180.0
'Bar 4' 604242.6 4820230.6 181.8 179.9
'Bar 5' 604250.9 4820240.6 181.3 179.4
'Bar 6' 604255.4 4820246.1 181.2 179.3
'Bar 7' 604251.6 4820248.8 181.5 179.6
'A' /
Barrier 4 Barrier for Receiver 4
'Bar 1' 604354.2 4820276.8 181.0 178.6 0.0 0
'Bar 2' 604350.9 4820279.5 181.0 178.6
'Bar 3' 604343.4 4820269.9 181.1 178.7
'Bar 4' 604348.7 4820265.8 181.2 178.7
'A' /
Barrier 5 Barrier for Receiver 5
'Bar 1' 604335.6 4820359.7 179.9 178.0 0.0 0
'Bar 2' 604341.5 4820355.7 179.9 178.0
'Bar 3' 604351.4 4820368.5 179.9 178.0
'Bar 4' 604358.6 4820377.8 179.9 178.0
'Bar 5' 604366.9 4820388.7 179.5 177.6
'Bar 6' 604361.5 4820392.4 179.6 177.7
'A' /
Barrier 6 Barrier for Receiver 6

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'A' /

'Bar

'A' /

'Bar

'A' /

'Bar

'Bar

Barri

'A' /

Received

' Rec

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10*0

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7/

S T A M I N A P R O G R A M

TRAFFIC NOISE PREDICTION MODEL
STAMINA 2.0/BCR - FHWA VER. 3 (3/83)

(INPUT UNITS- METRIC, OUTPUT UNITS- METRIC)

Burnhamthorpe Road West EA, 2021 Traff.,16 hr day, Existing Conditions, May 24,2018
PROGRAM INITIALIZATION PARAMETERS

HEIGHT	CODE	DESCRIPTION
.00	1	RECEIVER HEIGHT ADJUSTMENT
1.00	2	A-WEIGHTED SOUND LEVEL ONLY
.00	3	HEIGHT ADJUSTMENT FOR PASSENGER CARS (CARS)
2.44	4	HEIGHT ADJUSTMENT FOR HEAVY TRUCKS (HT)
.70	5	HEIGHT ADJUSTMENT FOR MEDIUM TRUCKS (MT)

ROADWAY 1 RDWY 1 Burnhamthorpe Rd W EB East of Hwy 403

	VEHICLE TYPE	VEHICLES/HOUR	SPEED
	CARS	508.	60.
	HT	12.	60.
	MT	12.	60.

-----COORDINATES-----

	X	Y	Z	GRADE
Seg 1	603888.	4819746.	188.	0
Seg 2	603911.	4819775.	188.	1
Seg 3	603930.	4819800.	188.	0
Seg 4	603954.	4819828.	188.	0
Seg 5	603972.	4819852.	187.	0
Seg 6	603994.	4819880.	187.	0
Seg 7	604023.	4819916.	186.	0
Seg 8	604051.	4819950.	185.	0
Seg 9	604087.	4819994.	184.	0
Seg 10	604129.	4820044.	182.	0

ROADWAY 2 RDWY 2 Burnhamthorpe Rd W EB Ridgeway Dr. to Colonial Dr.

	VEHICLE TYPE	VEHICLES/HOUR	SPEED
	CARS	330.	60.
	HT	8.	60.
	MT	8.	60.

-----COORDINATES-----

	X	Y	Z	GRADE
Seg 1	604129.	4820044.	182.	0
Seg 2	604153.	4820076.	181.	0
Seg 3	604181.	4820113.	180.	0
Seg 4	604214.	4820154.	180.	0
Seg 5	604250.	4820202.	179.	0
Seg 6	604290.	4820253.	178.	0
Seg 7	604333.	4820309.	178.	0
Seg 8	604370.	4820354.	177.	0
Seg 9	604390.	4820379.	177.	0
Seg 10	604407.	4820399.	177.	0

ROADWAY 3 RDWY 3 Burnhamthorpe Rd W EB Colonial Dr. to Loyalist Dr.

	VEHICLE TYPE	VEHICLES/HOUR	SPEED
	CARS	405.	60.
	HT	9.	60.
	MT	9.	60.

-----COORDINATES-----

	X	Y	Z	GRADE
Seg 1	604407.	4820399.	177.	0
Seg 2	604425.	4820422.	177.	0
Seg 3	604448.	4820452.	176.	0
Seg 4	604471.	4820483.	176.	0
Seg 5	604498.	4820518.	175.	0
Seg 6	604536.	4820567.	175.	0
Seg 7	604571.	4820612.	175.	1
Seg 8	604601.	4820649.	175.	1
Seg 9	604634.	4820690.	175.	0
Seg 10	604670.	4820735.	176.	1
Seg 11	604702.	4820774.	176.	1
Seg 12	604724.	4820800.	176.	0
Seg 13	604735.	4820814.	176.	0

ROADWAY 4 RDWY 4 Burnhamthorpe Rd EB East of Loyalist Dr.

	VEHICLE TYPE	VEHICLES/HOUR	SPEED
	CARS	518.	60.
	HT	11.	60.
	MT	11.	60.

-----COORDINATES-----

	X	Y	Z	GRADE
Seg 1	604735.	4820815.	176.	0
Seg 2	604763.	4820848.	175.	0

Seg 3	604783.	4820873.	175.	0
Seg 4	604806.	4820902.	175.	0
Seg 5	604837.	4820943.	172.	0
Seg 6	604869.	4820984.	168.	0

ROADWAY	5	RDWY 5 Burnhamthorpe Rd WB East of Loyalist Dr.		
		VEHICLE TYPE	VEHICLES/HOUR	SPEED
		CARS	518.	60.
		HT	11.	60.
		MT	11.	60.
-----COORDINATES-----				
		X	Y	Z GRADE
Seg 1		604863.	4820988.	167. 0
Seg 2		604829.	4820947.	172. 1
Seg 3		604797.	4820911.	175. 1
Seg 4		604775.	4820882.	175. 1
Seg 5		604754.	4820856.	175. 1
Seg 6		604727.	4820822.	176. 1

ROADWAY	6	RDWY 6 Burnhamthorpe Rd W WB Loyalist Dr. to Colonial Dr.		
		VEHICLE TYPE	VEHICLES/HOUR	SPEED
		CARS	405.	60.
		HT	9.	60.
		MT	9.	60.
-----COORDINATES-----				
		X	Y	Z GRADE
Seg 1		604726.	4820822.	176. 0
Seg 2		604693.	4820778.	176. 1
Seg 3		604664.	4820739.	176. 1
Seg 4		604630.	4820693.	175. 0
Seg 5		604597.	4820652.	175. 0
Seg 6		604568.	4820614.	175. 0
Seg 7		604533.	4820570.	175. 0
Seg 8		604494.	4820521.	175. 1
Seg 9		604466.	4820486.	175. 1
Seg 10		604442.	4820456.	176. 1
Seg 11		604418.	4820427.	177. 1
Seg 12		604400.	4820405.	177. 1

ROADWAY	7	RDWY 7 Burnhamthorpe Rd W WB Colonial Dr. to Ridgeway Dr.		
		VEHICLE TYPE	VEHICLES/HOUR	SPEED
		CARS	330.	60.
		HT	8.	60.
		MT	8.	60.
-----COORDINATES-----				
		X	Y	Z GRADE
Seg 1		604400.	4820405.	177. 1
Seg 2		604384.	4820384.	177. 1
Seg 3		604364.	4820358.	177. 1
Seg 4		604328.	4820312.	178. 1
Seg 5		604286.	4820256.	178. 1
Seg 6		604246.	4820205.	179. 1
Seg 7		604208.	4820158.	180. 1
Seg 8		604175.	4820117.	180. 1
Seg 9		604146.	4820080.	181. 0
Seg 10		604123.	4820052.	182. 1

ROADWAY	8	RDWY 8 Burnhamthorpe Rd W WB Ridgeway Dr. to Hwy 403		
		VEHICLE TYPE	VEHICLES/HOUR	SPEED
		CARS	508.	60.
		HT	12.	60.
		MT	12.	60.
-----COORDINATES-----				
		X	Y	Z GRADE
Seg 1		604122.	4820052.	182. 1
Seg 2		604080.	4819998.	183. 1
Seg 3		604047.	4819953.	184. 1
Seg 4		604020.	4819919.	185. 1
Seg 5		603991.	4819883.	186. 1
Seg 6		603969.	4819854.	187. 1
Seg 7		603950.	4819830.	188. 1
Seg 8		603927.	4819803.	188. 1
Seg 9		603908.	4819778.	188. 1
Seg 10		603885.	4819748.	188. 1

ROADWAY	9	RDWY 9 Loyalist Dr. North of Burnhamthorpe RD W both directions		
		VEHICLE TYPE	VEHICLES/HOUR	SPEED
		CARS	180.	50.
		HT	5.	50.
		MT	5.	50.
-----COORDINATES-----				
		X	Y	Z GRADE
Seg 1		604648.	4820945.	175. 1
Seg 2		604660.	4820910.	175. 1

Seg 3	604671.	4820886.	175.	1
Seg 4	604687.	4820859.	175.	1
Seg 5	604706.	4820841.	176.	1
Seg 6	604731.	4820818.	176.	1

ROADWAY 10 RDWY 10 Loyalist Dr. South of Burnhamthorpe RD W both directions

	VEHICLE TYPE	VEHICLES/HOUR	SPEED	
	CARS	124.	50.	
	HT	3.	50.	
	MT	3.	50.	
-----COORDINATES-----				
	X	Y	Z	GRADE
Seg 1	604731.	4820818.	176.	0
Seg 2	604752.	4820799.	175.	0
Seg 3	604775.	4820780.	176.	1
Seg 4	604799.	4820759.	176.	1
Seg 5	604821.	4820740.	176.	1
Seg 6	604848.	4820720.	176.	1

ROADWAY 11 RDWY 11 Colonial Dr. North of Burnhamthorpe RD W both directions

	VEHICLE TYPE	VEHICLES/HOUR	SPEED	
	CARS	182.	50.	
	HT	5.	50.	
	MT	5.	50.	
-----COORDINATES-----				
	X	Y	Z	GRADE
Seg 1	604283.	4820527.	178.	1
Seg 2	604313.	4820486.	178.	1
Seg 3	604342.	4820453.	178.	1
Seg 4	604373.	4820427.	177.	0
Seg 5	604405.	4820404.	177.	0

ROADWAY 12 RDWY 12 Colonial Dr. SB South of Burnhamthorpe RD W both directions

	VEHICLE TYPE	VEHICLES/HOUR	SPEED	
	CARS	216.	50.	
	HT	7.	50.	
	MT	7.	50.	
-----COORDINATES-----				
	X	Y	Z	GRADE
Seg 1	604405.	4820404.	177.	1
Seg 2	604434.	4820378.	177.	0
Seg 3	604463.	4820357.	177.	1
Seg 4	604491.	4820333.	177.	0
Seg 5	604504.	4820320.	177.	0
Seg 6	604526.	4820281.	177.	0

ROADWAY 13 RDWY 13 Ridgeway Dr. NB North of Burnhamthorpe RD W

	VEHICLE TYPE	VEHICLES/HOUR	SPEED	
	CARS	576.	60.	
	HT	9.	60.	
	MT	9.	60.	
-----COORDINATES-----				
	X	Y	Z	GRADE
Seg 1	604128.	4820052.	182.	0
Seg 2	604099.	4820074.	182.	0
Seg 3	604067.	4820099.	182.	0
Seg 4	604026.	4820131.	182.	1
Seg 5	603991.	4820159.	182.	1

ROADWAY 14 RDWY 14 Ridgeway Dr. SB North of Burnhamthorpe RD W

	VEHICLE TYPE	VEHICLES/HOUR	SPEED	
	CARS	576.	60.	
	HT	9.	60.	
	MT	9.	60.	
-----COORDINATES-----				
	X	Y	Z	GRADE
Seg 1	603984.	4820150.	182.	0
Seg 2	604019.	4820123.	182.	0
Seg 3	604062.	4820090.	181.	0
Seg 4	604092.	4820066.	181.	0
Seg 5	604121.	4820043.	182.	1

ROADWAY 15 RDWY 15 Ridgeway Dr. NB South of Burnhamthorpe RD W

	VEHICLE TYPE	VEHICLES/HOUR	SPEED	
	CARS	564.	60.	
	HT	8.	60.	
	MT	8.	60.	
-----COORDINATES-----				
	X	Y	Z	GRADE
Seg 1	604389.	4819904.	182.	0
Seg 2	604337.	4819926.	182.	0
Seg 3	604277.	4819952.	182.	0
Seg 4	604232.	4819971.	183.	1

Seg 5	604217.	4819980.	183.	0
Seg 6	604200.	4819993.	182.	0
Seg 7	604166.	4820020.	182.	0
Seg 8	604128.	4820052.	182.	0

ROADWAY 16 RDWY 16 Ridgeway Dr. SB South of Burnhamthorpe RD W

VEHICLE TYPE	VEHICLES/HOUR	SPEED
CARS	564.	60.
HT	8.	60.
MT	8.	60.

-----COORDINATES-----

	X	Y	Z	GRADE
Seg 1	604122.	4820043.	182.	1
Seg 2	604160.	4820013.	181.	0
Seg 3	604194.	4819986.	182.	1
Seg 4	604212.	4819974.	182.	1
Seg 5	604229.	4819965.	183.	1
Seg 6	604274.	4819947.	182.	0
Seg 7	604334.	4819921.	182.	0
Seg 8	604387.	4819899.	182.	0

BARRIER 1 TYPE(A) Barrier 1 Barrier for Receiver 1

-----COORDINATES-----

	X	Y	Z	Z0	DELZ	P
Bar 1	604056.	4820125.	184.	182.	0.	0
Bar 2	604073.	4820111.	184.	182.		
Bar 3	604088.	4820099.	184.	182.		
Bar 4	604101.	4820089.	184.	182.		
Bar 5	604108.	4820083.	184.	182.		
Bar 6	604116.	4820083.	184.	182.		
Bar 7	604126.	4820095.	183.	182.		

BARRIER 2 TYPE(A) Barrier 2 Barrier for Receiver 2

-----COORDINATES-----

	X	Y	Z	Z0	DELZ	P
Bar 1	604171.	4820061.	185.	182.	0.	0
Bar 2	604162.	4820047.	185.	182.		
Bar 3	604162.	4820040.	185.	182.		
Bar 4	604173.	4820031.	185.	182.		
Bar 5	604180.	4820025.	185.	182.		
Bar 6	604188.	4820019.	185.	183.		
Bar 7	604197.	4820013.	185.	182.		
Bar 8	604205.	4820007.	185.	183.		

BARRIER 3 TYPE(A) Barrier 3 Barrier for Receiver 3

-----COORDINATES-----

	X	Y	Z	Z0	DELZ	P
Bar 1	604218.	4820212.	182.	180.	0.	0
Bar 2	604225.	4820207.	182.	180.		
Bar 3	604236.	4820223.	182.	180.		
Bar 4	604243.	4820231.	182.	180.		
Bar 5	604251.	4820241.	181.	179.		
Bar 6	604255.	4820246.	181.	179.		
Bar 7	604252.	4820249.	182.	180.		

BARRIER 4 TYPE(A) Barrier 4 Barrier for Receiver 4

-----COORDINATES-----

	X	Y	Z	Z0	DELZ	P
Bar 1	604354.	4820277.	181.	179.	0.	0
Bar 2	604351.	4820280.	181.	179.		
Bar 3	604343.	4820270.	181.	179.		
Bar 4	604349.	4820266.	181.	179.		

BARRIER 5 TYPE(A) Barrier 5 Barrier for Receiver 5

-----COORDINATES-----

	X	Y	Z	Z0	DELZ	P
Bar 1	604336.	4820360.	180.	178.	0.	0
Bar 2	604342.	4820356.	180.	178.		
Bar 3	604351.	4820369.	180.	178.		
Bar 4	604359.	4820378.	180.	178.		
Bar 5	604367.	4820389.	180.	178.		
Bar 6	604362.	4820392.	180.	178.		

BARRIER 6 TYPE(A) Barrier 6 Barrier for Receiver 6

-----COORDINATES-----

	X	Y	Z	Z0	DELZ	P
Bar 1	604458.	4820435.	180.	177.	0.	0
Bar 2	604454.	4820438.	179.	177.		
Bar 3	604448.	4820430.	179.	177.		
Bar 4	604442.	4820423.	180.	177.		
Bar 5	604438.	4820418.	180.	177.		
Bar 6	604443.	4820415.	180.	178.		

BARRIER 7 TYPE(A) Barrier 7 Barrier for Receiver 7

1	*	.0	.0	.0	.0	.0	.0	.0	.0
2	*	.0	.0	.0	.0	.0	.0	.0	.0
3	*	.0	.0	.0	.0	.0	.0	.0	.0
4	*	.0	.0	.0	.0	.0	.0	.0	.0
5	*	.0	.0	.0	.0	.0	.0	.0	.0
6	*	.0	.0	.0	.0	.0	.0	.0	.0
7	*	.0	.0	.0	.0	.0	.0	.0	.0

8 *	.0	.0	.0	.0	.0	.0	.0	.0	.0
9 *	.0	.0	.0	.0	.0	.0	.0	.0	.0
10 *	.0	.0	.0	.0	.0	.0	.0	.0	.0
11 *	.0	.0	.0	.0	.0	.0	.0	.0	.0
12 *	.0	.0	.0	.0	.0	.0	.0	.0	.0
13 *	.0	.0	.0	.0	.0	.0	.0	.0	.0
14 *	.0	.0	.0	.0	.0	.0	.0	.0	.0
15 *	.0	.0	.0	.0	.0	.0	.0	.0	.0
16 *	.0	.0	.0	.0	.0	.0	.0	.0	.0

RECEIVER LEQ(H) L10
 Rec 1 59.7 63.3
 ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING 40.0 DBA
 ROADWAY SEGMENT

1	8	9
	41.1	46.5
2	1	2
	46.4	47.3
7	7	8
	43.8	49.0
8	1	2
	47.5	41.3
13	1	2
	48.8	49.7
14	1	2
	40.6	45.5
15	6	7
	40.5	45.1
16	1	2
	44.0	40.1

RECEIVER LEQ(H) L10
 Rec 2 58.1 61.7
 ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING 40.0 DBA
 ROADWAY SEGMENT

1	8	9
	40.2	45.3
2	1	2
	44.6	47.8
7	7	8
	43.2	45.9
8	1	
	44.9	
13	1	
	42.3	
14	4	
	41.8	
15	3	5
	41.4	40.2
16	1	2
	46.3	45.2

RECEIVER LEQ(H) L10
 Rec 3 57.2 60.7
 ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING 40.0 DBA
 ROADWAY SEGMENT

2	3	4	5	6
	40.6	46.6	50.7	45.7
7	4	5	6	7
	46.2	51.4	46.9	40.8

RECEIVER LEQ(H) L10
 Rec 4 54.7 58.3
 ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING 40.0 DBA
 ROADWAY SEGMENT

2	5	6	7	8
	40.7	46.3	47.5	40.4
7	2	3	4	5
	40.0	46.1	45.3	40.5

RECEIVER LEQ(H) L10
 Rec 5 57.4 60.8
 ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING 40.0 DBA
 ROADWAY SEGMENT

2	6	7	8	9
	43.9	49.0	47.0	42.8
3	1			
	41.5			
6	10	11		
	40.1	41.9		
7	1	2	3	4
	43.7	48.1	49.8	44.1
11	3	4		
	41.4	41.5		

RECEIVER	LEQ(H)	L10		
Rec 6	59.2	62.6		
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING 40.0 DBA				
ROADWAY SEGMENT				
2	8	9		
	42.1	45.7		
3	1	2	3	4
	51.5	49.8	45.6	42.1
6	8	9	10	11
	41.9	45.2	48.5	48.6
7	1	2		
	45.0	41.7		
11	4			
	42.8			
12	1	2	3	
	49.0	46.8	41.6	

RECEIVER	LEQ(H)	L10		
Rec 7	57.9	61.4		
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING 40.0 DBA				
ROADWAY SEGMENT				
3	4	5	6	7
	40.0	48.4	50.9	46.2
6	4	5	6	7
	42.2	46.7	51.9	49.0

RECEIVER	LEQ(H)	L10		
Rec 8	57.2	60.7		
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING 40.0 DBA				
ROADWAY SEGMENT				
3	5	6	7	8
	47.5	51.4	45.9	42.2
6	4	5	6	7
	41.9	45.6	50.1	47.3

RECEIVER	LEQ(H)	L10		
Rec 9	58.2	61.6		
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING 40.0 DBA				
ROADWAY SEGMENT				
3	8	9	10	11
	42.4	48.6	50.4	45.2
4	1			
	41.5			
5	5			
	41.7			
6	1	2	3	4
	47.2	51.9	49.6	42.6

RECEIVER	LEQ(H)	L10		
Rec 10	57.9	61.3		
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING 40.0 DBA				
ROADWAY SEGMENT				
3	8	9	10	11
	40.1	47.4	52.6	45.6
4	1			
	42.6			
5	5			
	42.0			
6	1	2	3	
	45.9	50.2	46.7	

YYN

Burnhamthorpe Road West EA, 2041 Traff.,16 hr day, Future With the Widening, May 24,2018

1,3

2,16

RDWY 1 Burnhamthorpe Rd W EB East of Hwy 403

'CARS'	620	60		
'MT'	15	60		
'HT'	15	60		
'L' /				
'Seg 1'	603888.2	4819746.2	188.3	0
'Seg 2'	603911.4	4819775.0	188.4	1
'Seg 3'	603931.4	4819800.2	188.0	0
'Seg 4'	603953.5	4819828.0	187.7	0
'Seg 5'	603972.2	4819851.7	187.2	0
'Seg 6'	603995.0	4819880.2	186.5	0
'Seg 7'	604023.7	4819915.8	185.6	0
'Seg 8'	604052.2	4819950.0	184.9	0
'Seg 9'	604087.5	4819993.3	183.5	0
'Seg 10'	604128.5	4820044.2	181.6	0

'L' /

RDWY 2 Burnhamthorpe Rd W EB Ridgeway Dr. to Colonial Dr.

'CARS'	521	60		
'MT'	13	60		
'HT'	13	60		
'L' /				
'Seg 1'	604128.4	4820044.7	181.6	0
'Seg 2'	604153.8	4820075.6	180.9	0
'Seg 3'	604182.2	4820111.6	180.3	0
'Seg 4'	604213.9	4820154.0	179.6	0
'Seg 5'	604250.0	4820201.5	179.2	0
'Seg 6'	604290.4	4820252.2	178.3	0
'Seg 7'	604334.7	4820308.0	177.8	0
'Seg 8'	604371.8	4820352.7	177.4	0
'Seg 9'	604391.5	4820378.5	177.0	0
'Seg 10'	604406.9	4820398.1	176.8	0

'L' /

RDWY 3 Burnhamthorpe Rd W EB Colonial Dr. to Loyalist Dr.

'CARS'	512	60		
'MT'	11	60		
'HT'	11	60		
'L' /				
'Seg 1'	604407.1	4820398.2	176.8	0
'Seg 2'	604425.2	4820421.5	176.5	0
'Seg 3'	604448.3	4820451.0	176.0	0
'Seg 4'	604471.9	4820482.3	175.5	0
'Seg 5'	604498.8	4820517.3	174.9	0
'Seg 6'	604537.2	4820566.6	174.8	0
'Seg 7'	604572.6	4820611.5	175.0	1
'Seg 8'	604601.8	4820648.0	175.4	1
'Seg 9'	604634.6	4820689.3	175.3	0
'Seg 10'	604671.6	4820733.2	175.7	1
'Seg 11'	604704.1	4820773.5	175.7	1
'Seg 12'	604724.8	4820799.6	175.6	0
'Seg 13'	604736.4	4820814.1	175.5	0

'L' /

RDWY 4 Burnhamthorpe Rd EB East of Loyalist Dr.

'CARS'	605	60		
'MT'	13	60		
'HT'	13	60		
'L' /				
'Seg 1'	604736.2	4820813.5	175.5	0
'Seg 2'	604762.8	4820847.5	175.2	0
'Seg 3'	604783.0	4820872.5	175.1	0
'Seg 4'	604805.8	4820901.5	174.8	0
'Seg 5'	604836.7	4820942.5	171.5	0
'Seg 6'	604869.0	4820984.2	167.5	0

'L' /

RDWY 5 Burnhamthorpe Rd WB East of Loyalist Dr.

'CARS'	605	60		
'MT'	13	60		
'HT'	13	60		
'L' /				
'Seg 1'	604863.2	4820987.8	167.1	0
'Seg 2'	604829.4	4820947.3	171.6	1
'Seg 3'	604797.2	4820910.7	174.8	1
'Seg 4'	604774.5	4820881.7	175.0	1
'Seg 5'	604753.7	4820855.7	175.3	1
'Seg 6'	604726.7	4820822.2	175.5	1

'L' /

RDWY 6 Burnhamthorpe Rd W WB Loyalist Dr. to Colonial Dr.

'CARS'	512	60		
'MT'	11	60		
'HT'	11	60		
'L' /				
'Seg 1'	604726.3	4820822.2	175.5	0
'Seg 2'	604692.5	4820778.6	175.7	1
'Seg 3'	604662.5	4820738.8	175.7	1
'Seg 4'	604628.5	4820693.8	175.4	0
'Seg 5'	604596.4	4820652.9	175.4	0
'Seg 6'	604566.0	4820614.8	175.0	1

'Seg 7'	604531.5	4820571.2	174.8	0
'Seg 8'	604492.2	4820522.0	174.9	1
'Seg 9'	604464.4	4820487.4	175.3	1
'Seg 10'	604440.0	4820457.0	175.9	1
'Seg 11'	604416.5	4820428.1	176.6	1
'Seg 12'	604399.6	4820405.2	176.9	1

'L' /

RDWY 7 Burnhamthorpe Rd W WB Colonial Dr. to Ridgeway Dr.

'CARS'	521	60
'MT'	13	60
'HT'	13	60

'L' /

'Seg 1'	604398.7	4820404.6	176.9	1
'Seg 2'	604382.3	4820384.4	177.0	1
'Seg 3'	604362.5	4820358.6	177.2	1
'Seg 4'	604326.8	4820313.1	177.6	1
'Seg 5'	604284.7	4820256.6	178.2	1
'Seg 6'	604244.9	4820205.7	179.0	1
'Seg 7'	604206.7	4820158.4	179.6	1
'Seg 8'	604174.0	4820117.6	180.3	1
'Seg 9'	604144.6	4820081.8	180.9	0
'Seg 10'	604121.9	4820052.5	181.6	1

'L' /

RDWY 8 Burnhamthorpe Rd W WB Ridgeway Dr. to Hwy 403

'CARS'	620	60
'MT'	15	60
'HT'	15	60

'L' /

'Seg 1'	604121.1	4820052.2	181.6	1
'Seg 2'	604078.6	4819999.0	183.2	1
'Seg 3'	604044.1	4819954.3	184.4	1
'Seg 4'	604017.9	4819920.1	185.4	1
'Seg 5'	603989.5	4819884.4	186.3	1
'Seg 6'	603965.9	4819855.3	187.0	1
'Seg 7'	603947.7	4819831.9	187.6	1
'Seg 8'	603925.5	4819804.3	188.0	1
'Seg 9'	603906.0	4819779.9	188.4	1
'Seg 10'	603882.4	4819750.2	188.3	0

'L' /

RDWY 9 Loyalist Dr. North of Burnhamthorpe RD W both directions

'CARS'	196	50
'MT'	6	50
'HT'	6	50

'L' /

'Seg 1'	604647.6	4820945.2	175.3	1
'Seg 2'	604660.4	4820909.5	175.3	1
'Seg 3'	604671.2	4820885.5	175.3	1
'Seg 4'	604686.9	4820859.2	175.3	1
'Seg 5'	604705.6	4820840.5	175.5	1
'Seg 6'	604731.1	4820817.7	175.5	1

'L' /

RDWY 10 Loyalist Dr. South of Burnhamthorpe RD W both directions

'CARS'	167	50
'MT'	3	50
'HT'	3	50

'L' /

'Seg 1'	604731.2	4820817.5	175.5	0
'Seg 2'	604752.2	4820798.8	175.2	0
'Seg 3'	604774.7	4820779.8	175.5	1
'Seg 4'	604799.4	4820758.8	175.5	1
'Seg 5'	604821.4	4820739.8	175.5	1
'Seg 6'	604848.4	4820720.3	175.5	1

'L' /

RDWY 11 Colonial Dr. North of Burnhamthorpe RD W both directions

'CARS'	214	50
'MT'	6	50
'HT'	6	50

'L' /

'Seg 1'	604283.4	4820526.9	177.5	1
'Seg 2'	604313.4	4820485.9	177.5	1
'Seg 3'	604342.2	4820452.5	177.5	1
'Seg 4'	604372.8	4820427.3	177.3	0
'Seg 5'	604405.1	4820403.9	176.9	0

'L' /

RDWY 12 Colonial Dr. South of Burnhamthorpe RD W both directions

'CARS'	295	50
'MT'	10	50
'HT'	10	50

'L' /

'Seg 1'	604405.2	4820404.0	176.9	1
'Seg 2'	604434.1	4820378.4	176.8	0
'Seg 3'	604463.3	4820356.8	176.9	1
'Seg 4'	604491.3	4820332.6	176.9	0
'Seg 5'	604503.9	4820319.6	176.9	0
'Seg 6'	604525.7	4820280.5	176.8	0

'L' /

RDWY 13 Ridgeway Dr. NB North of Burnhamthorpe RD W

'CARS'	645	60
'MT'	10	60
'HT'	10	60

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'L' /
'Seg 1' 604128.4 4820052.2 181.5 0
'Seg 2' 604098.7 4820073.8 181.5 0
'Seg 3' 604067.2 4820098.8 181.5 0
'Seg 4' 604025.8 4820130.9 181.8 1
'Seg 5' 603990.9 4820159.1 181.9 1
'L' /
RDWY 14 Ridgeway Dr. SB North of Burnhamthorpe RD W
'CARS' 645 60
'MT' 10 60
'HT' 10 60
'L' /
'Seg 1' 603984.0 4820150.2 181.7 0
'Seg 2' 604019.2 4820122.7 181.7 0
'Seg 3' 604061.7 4820089.8 181.4 0
'Seg 4' 604092.3 4820066.2 181.4 0
'Seg 5' 604121.3 4820043.1 181.7 1
'L' /
RDWY 15 Ridgeway Dr. NB South of Burnhamthorpe RD W
'CARS' 715 60
'MT' 10 60
'HT' 10 60
'L' /
'Seg 1' 604389.1 4819903.8 182.2 0
'Seg 2' 604336.5 4819926.4 182.2 0
'Seg 3' 604276.5 4819952.1 182.2 0
'Seg 4' 604232.3 4819971.2 182.6 1
'Seg 5' 604216.7 4819980.2 182.6 0
'Seg 6' 604199.8 4819992.5 182.2 0
'Seg 7' 604165.6 4820019.5 181.5 0
'Seg 8' 604128.4 4820052.4 181.5 0
'L' /
RDWY 16 Ridgeway Dr. SB South of Burnhamthorpe RD W
'CARS' 715 60
'MT' 10 60
'HT' 10 60
'L' /
'Seg 1' 604121.5 4820043.3 181.7 1
'Seg 2' 604159.7 4820012.9 181.3 0
'Seg 3' 604194.0 4819986.1 182.0 1
'Seg 4' 604212.0 4819973.6 182.4 1
'Seg 5' 604228.9 4819965.2 182.5 1
'Seg 6' 604274.0 4819947.0 182.4 0
'Seg 7' 604333.8 4819921.4 182.2 0
'Seg 8' 604386.5 4819899.0 182.2 0
'L' /
3,10
Barrier 1 Barrier for Receiver 1
'Bar 1' 604055.5 4820124.5 184.3 182.4 0.0 0
'Bar 2' 604073.0 4820110.5 184.2 182.3
'Bar 3' 604087.5 4820099.1 184.1 182.2
'Bar 4' 604100.8 4820088.6 184.2 182.3
'Bar 5' 604108.2 4820082.5 184.1 182.2
'Bar 6' 604116.1 4820082.8 184.3 182.4
'Bar 7' 604125.8 4820095.3 183.4 181.5
'A' /
Barrier 2 Barrier for Receiver 2
'Bar 1' 604171.4 4820060.9 184.6 182.2 0.0 0
'Bar 2' 604161.5 4820047.1 184.8 182.3
'Bar 3' 604161.9 4820040.2 184.8 182.3
'Bar 4' 604173.1 4820031.0 184.7 182.3
'Bar 5' 604180.4 4820025.0 184.8 182.4
'Bar 6' 604188.1 4820019.3 185.0 182.6
'Bar 7' 604196.5 4820013.1 184.9 182.4
'Bar 8' 604205.1 4820006.7 185.4 183.0
'A' /
Barrier 3 Barrier for Receiver 3
'Bar 1' 604217.7 4820212.1 181.7 179.8 0.0 0
'Bar 2' 604224.6 4820207.1 181.5 179.6
'Bar 3' 604236.2 4820222.6 181.9 180.0
'Bar 4' 604242.6 4820230.6 181.8 179.9
'Bar 5' 604250.9 4820240.6 181.3 179.4
'Bar 6' 604255.4 4820246.1 181.2 179.3
'Bar 7' 604251.6 4820248.8 181.5 179.6
'A' /
Barrier 4 Barrier for Receiver 4
'Bar 1' 604354.2 4820276.8 181.0 178.6 0.0 0
'Bar 2' 604350.9 4820279.5 181.0 178.6
'Bar 3' 604343.4 4820269.9 181.1 178.7
'Bar 4' 604348.7 4820265.8 181.2 178.7
'A' /
Barrier 5 Barrier for Receiver 5
'Bar 1' 604335.6 4820359.7 179.9 178.0 0.0 0
'Bar 2' 604341.5 4820355.7 179.9 178.0
'Bar 3' 604351.4 4820368.5 179.9 178.0
'Bar 4' 604358.6 4820377.8 179.9 178.0
'Bar 5' 604366.9 4820388.7 179.5 177.6
'Bar 6' 604361.5 4820392.4 179.6 177.7
'A' /
Barrier 6 Barrier for Receiver 6

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'A' /

'Bar 1'	604530.5	4820604.7	178.0	176.1	0.0	0
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'A' /

'Bar 1'	604575.2	4820582.3	178.1	175.7	0.0	0
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'A' /

'Bar 1'	604652.3	4820758.9	178.2	176.3	0.0	0
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' Bar

Barrier 10 Barrier for Receiver 10

'A' /

Receivers

6.1

 $10^{*}0.66$

6.2

0.0

7/

S T A M I N A P R O G R A M

TRAFFIC NOISE PREDICTION MODEL
STAMINA 2.0/BCR - FHWA VER. 3 (3/83)

(INPUT UNITS- METRIC, OUTPUT UNITS- METRIC)

Burnhamthorpe Road West EA, 2041 Traff.,16 hr day, Future with the Widening Condition, May 24,2018
PROGRAM INITIALIZATION PARAMETERS

HEIGHT	CODE	DESCRIPTION
.00	1	RECEIVER HEIGHT ADJUSTMENT
1.00	2	A-WEIGHTED SOUND LEVEL ONLY
.00	3	HEIGHT ADJUSTMENT FOR PASSENGER CARS (CARS)
2.44	4	HEIGHT ADJUSTMENT FOR HEAVY TRUCKS (HT)
.70	5	HEIGHT ADJUSTMENT FOR MEDIUM TRUCKS (MT)

ROADWAY	1	RDWY 1 Burnhamthorpe Rd W EB East of Hwy 403		
		VEHICLE TYPE	VEHICLES/HOUR	SPEED
		CARS	620.	60.
		HT	15.	60.
		MT	15.	60.
		-----COORDINATES-----		
		X	Y	Z
Seg 1		603888.	4819746.	188.
Seg 2		603911.	4819775.	188.
Seg 3		603931.	4819800.	188.
Seg 4		603954.	4819828.	188.
Seg 5		603972.	4819852.	187.
Seg 6		603995.	4819880.	187.
Seg 7		604024.	4819916.	186.
Seg 8		604052.	4819950.	185.
Seg 9		604088.	4819993.	184.
Seg 10		604129.	4820044.	182.

ROADWAY	2	RDWY 2 Burnhamthorpe Rd W EB Ridgeway Dr. to Colonial Dr.		
		VEHICLE TYPE	VEHICLES/HOUR	SPEED
		CARS	521.	60.
		HT	13.	60.
		MT	13.	60.
		-----COORDINATES-----		
		X	Y	Z
Seg 1		604128.	4820045.	182.
Seg 2		604154.	4820076.	181.
Seg 3		604182.	4820112.	180.
Seg 4		604214.	4820154.	180.
Seg 5		604250.	4820202.	179.
Seg 6		604290.	4820252.	178.
Seg 7		604335.	4820308.	178.
Seg 8		604372.	4820353.	177.
Seg 9		604392.	4820379.	177.
Seg 10		604407.	4820398.	177.

ROADWAY	3	RDWY 3 Burnhamthorpe Rd W EB Colonial Dr. to Loyalist Dr.		
		VEHICLE TYPE	VEHICLES/HOUR	SPEED
		CARS	512.	60.
		HT	11.	60.
		MT	11.	60.
		-----COORDINATES-----		
		X	Y	Z
Seg 1		604407.	4820398.	177.
Seg 2		604425.	4820422.	177.
Seg 3		604448.	4820451.	176.
Seg 4		604472.	4820482.	176.
Seg 5		604499.	4820517.	175.
Seg 6		604537.	4820567.	175.
Seg 7		604573.	4820612.	175.
Seg 8		604602.	4820648.	175.
Seg 9		604635.	4820689.	175.
Seg 10		604672.	4820733.	176.
Seg 11		604704.	4820774.	176.
Seg 12		604725.	4820800.	176.
Seg 13		604736.	4820814.	176.

ROADWAY	4	RDWY 4 Burnhamthorpe Rd EB East of Loyalist Dr		
		VEHICLE TYPE	VEHICLES/HOUR	SPEED
		CARS	605.	60.
		HT	13.	60.
		MT	13.	60.
		-----COORDINATES-----		
		X	Y	Z
Seg 1		604736.	4820814.	176.
Seg 2		604763.	4820848.	175.
Seg 3		604783.	4820873.	175.
Seg 4		604806.	4820902.	175.
Seg 5		604837.	4820943.	172.
Seg 6		604869.	4820984.	168.

ROADWAY	5	RDWY 5 Burnhamthorpe Rd WB East of Loyalist Dr.		
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		VEHICLE TYPE	VEHICLES/HOUR	SPEED	
		CARS	605.	60.	
		HT	13.	60.	
		MT	13.	60.	
		-----COORDINATES-----			
		X	Y	Z	GRADE
Seg 1		604863.	4820988.	167.	0
Seg 2		604829.	4820947.	172.	1
Seg 3		604797.	4820911.	175.	1
Seg 4		604775.	4820882.	175.	1
Seg 5		604754.	4820856.	175.	1
Seg 6		604727.	4820822.	176.	1

ROADWAY 6 RDWY 6 Burnhamthorpe Rd W WB Loyalist Dr. to Colonial Dr.

		VEHICLE TYPE	VEHICLES/HOUR	SPEED	
		CARS	512.	60.	
		HT	11.	60.	
		MT	11.	60.	
		-----COORDINATES-----			
		X	Y	Z	GRADE
Seg 1		604726.	4820822.	176.	0
Seg 2		604693.	4820779.	176.	1
Seg 3		604663.	4820739.	176.	1
Seg 4		604629.	4820694.	175.	0
Seg 5		604596.	4820653.	175.	0
Seg 6		604566.	4820615.	175.	1
Seg 7		604532.	4820571.	175.	0
Seg 8		604492.	4820522.	175.	1
Seg 9		604464.	4820487.	175.	1
Seg 10		604440.	4820457.	176.	1
Seg 11		604417.	4820428.	177.	1
Seg 12		604400.	4820405.	177.	1

ROADWAY 7 RDWY 7 Burnhamthorpe Rd W WB Colonial Dr. to Ridgeway Dr.

		VEHICLE TYPE	VEHICLES/HOUR	SPEED	
		CARS	521.	60.	
		HT	13.	60.	
		MT	13.	60.	
		-----COORDINATES-----			
		X	Y	Z	GRADE
Seg 1		604399.	4820405.	177.	1
Seg 2		604382.	4820384.	177.	1
Seg 3		604363.	4820359.	177.	1
Seg 4		604327.	4820313.	178.	1
Seg 5		604285.	4820257.	178.	1
Seg 6		604245.	4820206.	179.	1
Seg 7		604207.	4820158.	180.	1
Seg 8		604174.	4820118.	180.	1
Seg 9		604145.	4820082.	181.	0
Seg 10		604122.	4820053.	182.	1

ROADWAY 8 RDWY 8 Burnhamthorpe Rd W WB Ridgeway Dr. to Hwy 403

		VEHICLE TYPE	VEHICLES/HOUR	SPEED	
		CARS	620.	60.	
		HT	15.	60.	
		MT	15.	60.	
		-----COORDINATES-----			
		X	Y	Z	GRADE
Seg 1		604121.	4820052.	182.	1
Seg 2		604079.	4819999.	183.	1
Seg 3		604044.	4819954.	184.	1
Seg 4		604018.	4819920.	185.	1
Seg 5		603990.	4819884.	186.	1
Seg 6		603966.	4819855.	187.	1
Seg 7		603948.	4819832.	188.	1
Seg 8		603926.	4819804.	188.	1
Seg 9		603906.	4819780.	188.	1
Seg 10		603882.	4819750.	188.	0

ROADWAY 9 RDWY 9 Loyalist Dr. North of Burnhamthorpe RD W both directions

		VEHICLE TYPE	VEHICLES/HOUR	SPEED	
		CARS	196.	50.	
		HT	6.	50.	
		MT	6.	50.	
		-----COORDINATES-----			
		X	Y	Z	GRADE
Seg 1		604648.	4820945.	175.	1
Seg 2		604660.	4820910.	175.	1
Seg 3		604671.	4820886.	175.	1
Seg 4		604687.	4820859.	175.	1
Seg 5		604706.	4820841.	176.	1
Seg 6		604731.	4820818.	176.	1

ROADWAY 10 RDWY 10 Loyalist Dr. South of Burnhamthorpe RD W both directions

		VEHICLE TYPE	VEHICLES/HOUR	SPEED	
		CARS	167.	50.	
		HT	3.	50.	
		MT	3.	50.	
		-----COORDINATES-----			
		X	Y	Z	GRADE

Seg 1	604731.	4820818.	176.	0
Seg 2	604752.	4820799.	175.	0
Seg 3	604775.	4820780.	176.	1
Seg 4	604799.	4820759.	176.	1
Seg 5	604821.	4820740.	176.	1
Seg 6	604848.	4820720.	176.	1

ROADWAY 11	RDWY 11 Colonial Dr. North of Burnhamthorpe RD W both directions			
	VEHICLE TYPE	VEHICLES/HOUR	SPEED	
	CARS	214.	50.	
	HT	6.	50.	
	MT	6.	50.	

	-----COORDINATES-----			
	X	Y	Z	GRADE
Seg 1	604283.	4820527.	178.	1
Seg 2	604313.	4820486.	178.	1
Seg 3	604342.	4820453.	178.	1
Seg 4	604373.	4820427.	177.	0
Seg 5	604405.	4820404.	177.	0

ROADWAY 12	RDWY 12 Colonial Dr. South of Burnhamthorpe RD W both directions			
	VEHICLE TYPE	VEHICLES/HOUR	SPEED	
	CARS	295.	50.	
	HT	10.	50.	
	MT	10.	50.	

	-----COORDINATES-----			
	X	Y	Z	GRADE
Seg 1	604405.	4820404.	177.	1
Seg 2	604434.	4820378.	177.	0
Seg 3	604463.	4820357.	177.	1
Seg 4	604491.	4820333.	177.	0
Seg 5	604504.	4820320.	177.	0
Seg 6	604526.	4820281.	177.	0

ROADWAY 13	RDWY 13 Ridgeway Dr. NB North of Burnhamthorpe RD W			
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	VEHICLE TYPE	VEHICLES/HOUR	SPEED	
	CARS	645.	60.	
	HT	10.	60.	
	MT	10.	60.	

	-----COORDINATES-----			
	X	Y	Z	GRADE
Seg 1	604128.	4820052.	182.	0
Seg 2	604099.	4820074.	182.	0
Seg 3	604067.	4820099.	182.	0
Seg 4	604026.	4820131.	182.	1
Seg 5	603991.	4820159.	182.	1

ROADWAY 14	RDWY 14 Ridgeway Dr. SB North of Burnhamthorpe RD W			
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	VEHICLE TYPE	VEHICLES/HOUR	SPEED	
	CARS	645.	60.	
	HT	10.	60.	
	MT	10.	60.	

	-----COORDINATES-----			
	X	Y	Z	GRADE
Seg 1	603984.	4820150.	182.	0
Seg 2	604019.	4820123.	182.	0
Seg 3	604062.	4820090.	181.	0
Seg 4	604092.	4820066.	181.	0
Seg 5	604121.	4820043.	182.	1

ROADWAY 15	RDWY 15 Ridgeway Dr. NB South of Burnhamthorpe RD W			
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	VEHICLE TYPE	VEHICLES/HOUR	SPEED	
	CARS	715.	60.	
	HT	10.	60.	
	MT	10.	60.	

	-----COORDINATES-----			
	X	Y	Z	GRADE
Seg 1	604389.	4819904.	182.	0
Seg 2	604337.	4819926.	182.	0
Seg 3	604277.	4819952.	182.	0
Seg 4	604232.	4819971.	183.	1
Seg 5	604217.	4819980.	183.	0
Seg 6	604200.	4819993.	182.	0
Seg 7	604166.	4820020.	182.	0
Seg 8	604128.	4820052.	182.	0

ROADWAY 16	RDWY 16 Ridgeway Dr. SB South of Burnhamthorpe RD W			
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	VEHICLE TYPE	VEHICLES/HOUR	SPEED	
	CARS	715.	60.	
	HT	10.	60.	
	MT	10.	60.	

	-----COORDINATES-----			
	X	Y	Z	GRADE
Seg 1	604122.	4820043.	182.	1
Seg 2	604160.	4820013.	181.	0
Seg 3	604194.	4819986.	182.	1
Seg 4	604212.	4819974.	182.	1
Seg 5	604229.	4819965.	183.	1
Seg 6	604274.	4819947.	182.	0

Seg 7	604334.	4819921.	182.	0
Seg 8	604387.	4819899.	182.	0

BARRIER	1	TYPE(A)	Barrier 1 Barrier for Receiver 1			
-----COORDINATES-----						
		X	Y	Z	Z0 DELZ P	
Bar 1		604056.	4820125.	184.	182. 0.	0
Bar 2		604073.	4820111.	184.	182.	
Bar 3		604088.	4820099.	184.	182.	
Bar 4		604101.	4820089.	184.	182.	
Bar 5		604108.	4820083.	184.	182.	
Bar 6		604116.	4820083.	184.	182.	
Bar 7		604126.	4820095.	183.	182.	

BARRIER	2	TYPE(A)	Barrier 2 Barrier for Receiver 2			
-----COORDINATES-----						
		X	Y	Z	Z0 DELZ P	
Bar 1		604171.	4820061.	185.	182. 0.	0
Bar 2		604162.	4820047.	185.	182.	
Bar 3		604162.	4820040.	185.	182.	
Bar 4		604173.	4820031.	185.	182.	
Bar 5		604180.	4820025.	185.	182.	
Bar 6		604188.	4820019.	185.	183.	
Bar 7		604197.	4820013.	185.	182.	
Bar 8		604205.	4820007.	185.	183.	

BARRIER	3	TYPE(A)	Barrier 3 Barrier for Receiver 3			
-----COORDINATES-----						
		X	Y	Z	Z0 DELZ P	
Bar 1		604218.	4820212.	182.	180. 0.	0
Bar 2		604225.	4820207.	182.	180.	
Bar 3		604236.	4820223.	182.	180.	
Bar 4		604243.	4820231.	182.	180.	
Bar 5		604251.	4820241.	181.	179.	
Bar 6		604255.	4820246.	181.	179.	
Bar 7		604252.	4820249.	182.	180.	

BARRIER	4	TYPE(A)	Barrier 4 Barrier for Receiver 4			
-----COORDINATES-----						
		X	Y	Z	Z0 DELZ P	
Bar 1		604354.	4820277.	181.	179. 0.	0
Bar 2		604351.	4820280.	181.	179.	
Bar 3		604343.	4820270.	181.	179.	
Bar 4		604349.	4820266.	181.	179.	

BARRIER	5	TYPE(A)	Barrier 5 Barrier for Receiver 5			
-----COORDINATES-----						
		X	Y	Z	Z0 DELZ P	
Bar 1		604336.	4820360.	180.	178. 0.	0
Bar 2		604342.	4820356.	180.	178.	
Bar 3		604351.	4820369.	180.	178.	
Bar 4		604359.	4820378.	180.	178.	
Bar 5		604367.	4820389.	180.	178.	
Bar 6		604362.	4820392.	180.	178.	

BARRIER	6	TYPE(A)	Barrier 6 Barrier for Receiver 6			
-----COORDINATES-----						
		X	Y	Z	Z0 DELZ P	
Bar 1		604458.	4820435.	180.	177. 0.	0
Bar 2		604454.	4820438.	179.	177.	
Bar 3		604448.	4820430.	179.	177.	
Bar 4		604442.	4820423.	180.	177.	
Bar 5		604438.	4820418.	180.	177.	
Bar 6		604443.	4820415.	180.	178.	

BARRIER	7	TYPE(A)	Barrier 7 Barrier for Receiver 7			
-----COORDINATES-----						
		X	Y	Z	Z0 DELZ P	
Bar 1		604531.	4820605.	178.	176. 0.	0
Bar 2		604536.	4820601.	178.	176.	
Bar 3		604543.	4820611.	178.	176.	
Bar 4		604549.	4820620.	178.	176.	
Bar 5		604552.	4820623.	178.	176.	
Bar 6		604547.	4820626.	178.	176.	

BARRIER	8	TYPE(A)	Barrier 8 Barrier for Receiver 8			
-----COORDINATES-----						
		X	Y	Z	Z0 DELZ P	
Bar 1		604575.	4820582.	178.	176. 0.	0
Bar 2		604573.	4820584.	178.	176.	
Bar 3		604577.	4820590.	178.	176.	
Bar 4		604581.	4820596.	178.	176.	
Bar 5		604585.	4820601.	178.	176.	
Bar 6		604589.	4820606.	178.	176.	
Bar 7		604593.	4820603.	178.	176.	

BARRIER	9	TYPE(A)	Barrier 9 Barrier for Receiver 9			
-----COORDINATES-----						
		X	Y	Z	Z0 DELZ P	
Bar 1		604652.	4820759.	178.	176. 0.	0

Bar 2	604657.	4820755.	178.	176.
Bar 3	604662.	4820762.	178.	176.
Bar 4	604667.	4820770.	178.	176.
Bar 5	604659.	4820776.	178.	176.
Bar 6	604649.	4820785.	178.	176.
Bar 7	604641.	4820791.	178.	176.
Bar 8	604631.	4820798.	178.	176.

BARRIER 10 TYPE(A) Barrier 10 Barrier for Receiver 10

	-----COORDINATES-----					
	X	Y	Z	Z0	DELZ	P
Bar 1	604727.	4820772.	179.	176.	0.	0
Bar 2	604723.	4820775.	179.	176.		
Bar 3	604715.	4820766.	179.	177.		
Bar 4	604707.	4820755.	179.	177.		
Bar 5	604710.	4820752.	179.	176.		

Receivers

	-----COORDINATES-----		
	X	Y	Z
Rec 1	604112.	4820098.	184.
Rec 2	604177.	4820046.	184.
Rec 3	604237.	4820243.	182.
Rec 4	604356.	4820272.	180.
Rec 5	604341.	4820374.	180.
Rec 6	604450.	4820414.	179.
Rec 7	604528.	4820613.	178.
Rec 8	604582.	4820583.	177.
Rec 9	604653.	4820769.	178.
Rec 10	604717.	4820751.	178.

ALPHA FACTORS - RECEIVER ACROSS, ROADWAY DOWN

1 *	.7	.7	.7	.7	.7	.7	.7	.7	.7
2 *	.7	.7	.7	.7	.7	.7	.7	.7	.7
3 *	.7	.7	.7	.7	.7	.7	.7	.7	.7
4 *	.7	.7	.7	.7	.7	.7	.7	.7	.7
5 *	.7	.7	.7	.7	.7	.7	.7	.7	.7
6 *	.7	.7	.7	.7	.7	.7	.7	.7	.7
7 *	.7	.7	.7	.7	.7	.7	.7	.7	.7
8 *	.7	.7	.7	.7	.7	.7	.7	.7	.7
9 *	.7	.7	.7	.7	.7	.7	.7	.7	.7
10 *	.7	.7	.7	.7	.7	.7	.7	.7	.7
11 *	.7	.7	.7	.7	.7	.7	.7	.7	.7
12 *	.7	.7	.7	.7	.7	.7	.7	.7	.7
13 *	.7	.7	.7	.7	.7	.7	.7	.7	.7
14 *	.7	.7	.7	.7	.7	.7	.7	.7	.7
15 *	.7	.7	.7	.7	.7	.7	.7	.7	.7
16 *	.7	.7	.7	.7	.7	.7	.7	.7	.7

SHIELDING FACTORS - RECEIVER ACROSS, ROADWAY DOWN

1 *	.0	.0	.0	.0	.0	.0	.0	.0	.0
2 *	.0	.0	.0	.0	.0	.0	.0	.0	.0
3 *	.0	.0	.0	.0	.0	.0	.0	.0	.0
4 *	.0	.0	.0	.0	.0	.0	.0	.0	.0
5 *	.0	.0	.0	.0	.0	.0	.0	.0	.0
6 *	.0	.0	.0	.0	.0	.0	.0	.0	.0
7 *	.0	.0	.0	.0	.0	.0	.0	.0	.0
8 *	.0	.0	.0	.0	.0	.0	.0	.0	.0
9 *	.0	.0	.0	.0	.0	.0	.0	.0	.0
10 *	.0	.0	.0	.0	.0	.0	.0	.0	.0
11 *	.0	.0	.0	.0	.0	.0	.0	.0	.0
12 *	.0	.0	.0	.0	.0	.0	.0	.0	.0
13 *	.0	.0	.0	.0	.0	.0	.0	.0	.0
14 *	.0	.0	.0	.0	.0	.0	.0	.0	.0
15 *	.0	.0	.0	.0	.0	.0	.0	.0	.0
16 *	.0	.0	.0	.0	.0	.0	.0	.0	.0

RECEIVER LEQ(H) L10
 Rec 1 60.9 64.5

ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING 40.0 DBA
 ROADWAY SEGMENT

1	8	9
	42.0	47.3
2	1	2
	48.5	49.1
7	6	7
	40.9	46.0
8	1	2
	48.5	42.3
13	1	2
	49.3	50.2
14	1	2
	41.1	46.0
15	6	7
	41.5	46.1
16	1	2
	45.0	41.1

RECEIVER	LEQ(H)	L10			
Rec 2	59.4	63.0			
ROADWAY SEGMENT	SOUND	LEVEL	CONTRIBUTIONS	EXCEEDING	40.0 DBA
ROADWAY SEGMENT					
1	8	9			
	41.1	46.2			
2	1	2	3	4	
	46.7	50.1	45.9	40.7	
7	6	7	8	9	
	40.6	45.2	47.6	44.9	
8	1	2			
	45.7	40.8			
13	1				
	42.7				
14	4				
	42.3				
15	3	5	6	7	
	42.4	41.2	47.5	48.7	
16	1	2	3	5	
	47.3	46.2	40.7	41.7	

RECEIVER	LEQ(H)	L10			
Rec 3	59.3	62.8			
ROADWAY SEGMENT	SOUND	LEVEL	CONTRIBUTIONS	EXCEEDING	40.0 DBA
ROADWAY SEGMENT					
2	3	4	5	6	7
	42.7	48.6	52.7	47.6	40.4
7	3	4	5	6	7
	40.6	48.4	53.6	49.0	42.9

RECEIVER	LEQ(H)	L10			
Rec 4	56.6	60.2			
ROADWAY SEGMENT	SOUND	LEVEL	CONTRIBUTIONS	EXCEEDING	40.0 DBA
ROADWAY SEGMENT					
2	5	6	7	8	
	42.8	48.6	49.9	42.5	
7	2	3	4	5	
	42.1	47.8	47.1	42.6	

RECEIVER	LEQ(H)	L10			
Rec 5	59.2	62.7			
ROADWAY SEGMENT	SOUND	LEVEL	CONTRIBUTIONS	EXCEEDING	40.0 DBA
ROADWAY SEGMENT					
2	6	7	8	9	
	45.9	50.8	48.9	44.7	
3	1	2			
	42.5	40.7			
6	10	11			
	41.0	42.7			
7	1	2	3	4	
	45.8	50.5	52.1	46.2	
11	3	4			
	42.2	42.2			
12	1				
	41.3				

RECEIVER	LEQ(H)	L10			
Rec 6	60.4	63.9			
ROADWAY SEGMENT	SOUND	LEVEL	CONTRIBUTIONS	EXCEEDING	40.0 DBA
ROADWAY SEGMENT					
2	7	8	9		
	42.0	44.3	47.7		
3	1	2	3	4	5
	52.6	50.7	46.6	43.1	40.4
6	7	8	9	10	11
	40.2	42.9	46.1	49.1	49.1
7	1	2	3		
	46.8	43.7	41.7		
11	4				
	43.6				
12	1	2	3		
	50.5	48.3	43.1		

RECEIVER	LEQ(H)	L10			
Rec 7	58.9	62.4			
ROADWAY SEGMENT	SOUND	LEVEL	CONTRIBUTIONS	EXCEEDING	40.0 DBA
ROADWAY SEGMENT					
3	4	5	6	7	8
	40.9	49.3	51.6	46.9	43.1
6	4	5	6	7	8
	43.2	47.7	53.2	50.2	41.1

RECEIVER	LEQ(H)	L10			
Rec 8	58.2	61.7			
ROADWAY SEGMENT	SOUND	LEVEL	CONTRIBUTIONS	EXCEEDING	40.0 DBA
ROADWAY SEGMENT					
3	4	5	6	7	8
	40.2	48.7	52.7	46.8	43.1
6	4	5	6	7	8

42.8 46.4 50.5 48.1 40.0

RECEIVER LEQ(H) L10
Rec 9 59.1 62.6

ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING 40.0 DBA
ROADWAY SEGMENT

3	8	9	10	11	12
	43.3	49.3	51.0	45.9	40.7
4	1				
	42.1				
5	5				
	42.4				
6	1	2	3	4	
	48.2	53.0	50.7	43.6	

RECEIVER LEQ(H) L10
Rec 10 59.0 62.4

ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING 40.0 DBA
ROADWAY SEGMENT

3	8	9	10	11	12
	41.1	48.4	54.3	46.6	41.5
4	1				
	43.3				
5	5				
	42.7				
6	1	2	3	4	
	46.8	50.8	47.4	40.8	

Appendix E

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**THE CORPORATION OF THE CITY OF MISSISSAUGA
NOISE CONTROL BY-LAW 360-79**

(Amended by 77-85, 1298-86, 755-87, 63-92, 230-94, 303-00, 495-03, 124-05, 110-06, 92-07, 120-07, 127-07, 248-07, 73-08, 99-08, 299-08, 325-09, 243-13, 43-15, 60-15, 120-17)

WHEREAS the Council of a local municipality is empowered under The Environmental Protection Act, 1971, as amended, to pass by-laws, subject to the approval of the Minister of the Environment, for regulating or prohibiting the emission of sounds or vibrations;

AND WHEREAS it is the policy of the Council to reduce and control unusual or unnecessary sounds or vibrations which may degrade the quality and tranquillity of the lives of the inhabitants of the City of Mississauga or cause nuisance.

NOW THEREFORE the Council of the Corporation of the City of Mississauga
ENACTS as follows:

INTERPRETATION

1. In this by-law, (303-00)

“City” means the City of Mississauga in the Regional Municipality of Peel

“Commissioner” means the Commissioner of Transportation and Works for the City or his or her designate; (299-08)

“construction” includes erection, alteration, repair, dismantling, demolition, structural maintenance, painting, moving, land clearing, earth moving, grading, excavating, the laying of pipe and conduit whether above or below ground level, street and highway building, concreting, equipment installation and alteration and the structural installation of construction components and materials in any form or for any purpose, and includes any work in connection therewith;

“construction equipment” means any equipment or device designed and intended for use in construction or material handling, including but not limited to, air compressors, pile drivers, pneumatic or hydraulic tools, bulldozers, tractors, excavators, trenchers, cranes, derricks, loaders, scrapers, pavers, generators, off-highway haulers or trucks, ditchers, compactors and rollers, pumps, concrete mixers, graders or other material handling equipment;

“Council” means the Council of the Corporation of the City of Mississauga;

“Minister” means the Minister of the Environment;

“Ministry” means the Ministry of the Environment;

“motor vehicle” includes an automobile, motorcycle, motor assisted bicycle unless otherwise indicated in The Highway Traffic Act, and any other vehicle propelled or driven otherwise than by muscular power, but does not include the cars of electric or steam railways, or other motor vehicles running only upon rails, or a motorized snow vehicle, traction engine, farm tractor, self-propelled implement of husbandry or road-building machine within the meaning of The Highway Traffic Act.

“motorized conveyance” includes a vehicle and any other device employed to transport a person or persons or goods from place to place, but does not include any such device or vehicle if operated only within the premises of a person or if propelled or driven only by muscular, gravitational or wind power;

“noise” means unwanted sound;

“Noise Control Officer” means a person designated by the Commissioner for the City as a noise control officer; (1298-86, 755-87, 299-08)

“point of reception” means any point on the premises of a person where sound or vibration originating from other than those premises is received;

“Quiet Zone” means those areas of the City where quiet is of particular importance and as more particularly designated in Schedule 4 to this By-law.

“Residential Area” means any area containing dwellings which are normally used for human habitation.

ADMINISTRATION

2. The Commissioner shall be responsible for the administration and enforcement of this by-law. (1298-86, 755-87, 495-03, 299-08)

GENERAL PROHIBITION

3. No person shall emit or cause or permit the emission of sound resulting from an act listed in Schedule 1 to this by-law and which sound is clearly audible at a point of reception.

PROHIBITION BY TIME AND PLACE

4. No person shall emit or cause or permit the emission of sound resulting from any act listed in Column 1 to Schedule 2 to this by-law if clearly audible at a point of reception located in a residential area or quiet zone within a prohibited period of time for such an area as set out in Column 2 to Schedule 2 to this By-law.

PUBLIC SAFETY EXEMPTION

5. The provisions of Section 3 and 4 do not apply to the emission of a sound or vibration in connection with emergency measures undertaken:
- (a) for the immediate health, safety or welfare of the inhabitants of the City or any of them; or
 - (b) for the preservation or restoration of property.

EXEMPTION OF TRADITIONAL FESTIVE OR RELIGIOUS ACTIVITIES

6. The provisions of Section 3 and 4 do not apply to the emission of sounds or vibrations made by persons in connection with any of the traditional, festive, religious or other activities set out in Schedule 3 to this by-law.

GRANT OF EXEMPTION BY COUNCIL

7. (1) Any person may apply for an exemption from the provisions of Sections 3 and 4 of this By-law, with respect to any source of sound or vibration. (299-08)
- (2) An application for exemption under Subsection (1) shall be in writing and shall contain:
- (a) the name and address of the applicant,
 - (b) a description of the source of sound or vibration in respect of which exemption is being sought,
 - (c) a statement of the section of the by-law from which exemption is sought,
 - (d) the period of time (not in excess of six (6) months) for which the exemption is sought,
 - (e) the reasons why the exemption is being sought,
 - (f) proof of publication for two consecutive days within the preceding ten (10) days in a newspaper of general circulation within the City, of a notice of intention to apply for any exemption to this by-law, received or by the distribution of a flyer as prescribed by the City to all residences within a 500 meter radius of the subject property containing the information required by Clauses (a) through (e) hereof, stating the date upon which objections may be submitted to City staff. (299-08)
 - (g) the application fee. (299-08)
- (3) An application for an exemption completed in accordance with section 7(2) shall be delivered to the Commissioner. (299-08)

- (4) The Commissioner may grant an exemption, in whole or in part, with terms and conditions, subject to the provisions of this By-law. (299-08)
- (5) In considering the completed application for any exemption, the Commissioner shall take into account the following: (299-08)
 - (a) If an exemption is granted, a time limit shall be specified, and an exemption shall not exceed six months.
 - (b) The Commissioner shall consult with the affected Ward Councillor on an application for an exemption and the consultation shall include any terms and conditions that may be attached to an exemption.
 - (c) Any correspondence received regarding the application as a result of the distribution of the Notice or newspaper advertisement referred to in Section 7(2)(f).
 - (d) The proximity of the sound to a Residential Area and the likelihood that the sound for which an exemption is requested may negatively affect persons in a Residential Area.
 - (e) Whether any negative impacts under clauses (c) or (d) can be reduced with the use of mitigation measures including limiting the sound to certain days or times of the day.
- (6) A breach by the applicant of any of the terms or conditions imposed by the Commissioner in granting an exemption shall immediately render the exemption null and void. (299-08)
- (7) Notwithstanding that the authority to grant an exemption is delegated to the Commissioner, and that he or she may have already exercised the delegated power, Council shall retain the right to exercise the authority to grant or deny an exemption in accordance with the conditions set out in section 7 (5) of this By-law. (299-08)

SEVERABILITY

- 8. If a court of competent jurisdiction declares any section or part of a section of this by-law invalid, such section or part of a section shall not be construed as having persuaded or influenced Council to pass the remainder of the by-law and it is hereby declared that the remainder of the by-law shall be valid and shall remain in force.

PENALTY

- 9. (1) Every person who contravenes any provision of this by-law is guilty of an offence. Pursuant to the provisions of the Provincial Offences Act, R. S. O. 1990, c.P. 33 upon conviction a person is liable to a fine of not more than \$5,000, exclusive of costs. (77-85, 63-92)

- (2) In addition to the provisions of Subsection (1), the Court in which the information is first laid and any court of competent jurisdiction thereafter, may issue an order prohibiting the contravention and repetition of the offence by the person convicted, and such order shall be in addition to any penalty imposed on the person convicted.
10. (1) By-law Number 7364 enacted by the former Town of Mississauga and any other by-law passed by the former Town of Mississauga to control noise is hereby repealed.
- (2) By-law Number 957, enacted by the former Village of Port Credit and any other by-law passed by the former Village of Port Credit to control noise is hereby repealed.
- (3) By-law Number 66-36, enacted by the former Town of Streetsville and any other by-law passed by the former Town of Streetsville to control noise is hereby repealed.
- (4) By-law 2370 enacted by the former Township of Toronto and any other by-law passed by the former Township of Toronto to control noise is hereby repealed.
- (5) Any Noise Control By-law, enacted by the Town of Oakville in that part of Oakville which was annexed by the City of Mississauga, and more particularly described in Section 2(1)(a) of The Regional Municipality of Peel Act, 1973, S.O. 1973, c. 60, is hereby repealed.

READ A FIRST AND SECOND TIME THIS 28TH DAY OF MAY, 1979.

READ A THIRD TIME AND FINALLY PASSED THIS 28TH DAY OF JANUARY 1980.

Signed by: "Hazel McCallion", Mayor "Terence L. Julian", Clerk

This by-law is approved pursuant to the provisions of The Environmental Protection Act, 1971, as amended, at Toronto, this 9th day of April, 1980.

Signed by: "Harry Parrott", Minister of the Environment

SCHEDULE 1 TO BY-LAW NUMBER 360-79
GENERAL PROHIBITIONS

1. The racing of any motorized conveyance other than in a racing event regulated by law.
2. The operation of a motor vehicle at a speed and in a manner which causes its tires to squeal.
3. The operation of any combustion engine or pneumatic device without an effective exhaust or intake muffling device in good working order and in constant operation.
4. The operation of a vehicle or a vehicle with a trailer resulting in banging, clanking, squealing or other like sounds due to improperly secured load or equipment, or inadequate maintenance.
5. The operation of an engine or motor in, or on, any motor vehicle or item of attached auxiliary equipment for a continuous period exceeding five minutes, while such vehicle is stationary in a Residential Area or a Quiet Zone unless:
 - (a) the original equipment manufacturer specifically recommends a longer idling period for normal and efficient operation of the motor vehicle in which case such recommended period shall not be exceeded; or,
 - (b) operation of such engine or motor is essential to a basic function of the vehicle or equipment, including but not limited to, operation of ready-mixed concrete trucks, lift platforms and refuse compactors; or,
 - (c) weather conditions justify the use of heating or refrigerating systems powered by the motor or engine for the safety and welfare of the operator, passengers or animals, or the preservation of perishable cargo, and the vehicle is stationary for purposes of delivery or loading; or,
 - (d) prevailing low temperatures make longer idling periods necessary immediately after starting the motor or engine; or,
 - (e) the idling is for the purpose of cleaning and flushing the radiator and associated circulation system for seasonal change of antifreeze, cleaning of the fuel system, carburettor or the like, when such work is performed other than for profit.
6. The operation of a motor vehicle horn or other warning device except when required or authorized by law or in accordance with good safety practices.
7. The operation of any item of construction equipment in a Quiet Zone or Residential Area without effective muffling devices in good working order and in constant operation.

SCHEDULE 2 TO BY-LAW NUMBER 360-79
PROHIBITED PERIODS OF TIME:

- A - 23:00 hrs. of one day to 07:00 hrs. next day (09:00 hrs. Sundays)**
- B - 19:00 hrs. of one day to 07:00 hrs. next day (09:00 hrs. Sundays)**
- C - 17:00 hrs. of one day to 07:00 hrs. next day (09:00 hrs. Sundays)**
- D - All Day Sundays and Statutory Holidays**
- E - 17:00 hrs. of one day to 07:00 hrs. next day**
- F - 19:00 hrs. of one day to 07:00 hrs. next day**

SCHEDULE 2 TO BY-LAW NUMBER 360-79
PROHIBITED PERIODS OF TIME:

COLUMN 1

COLUMN 2

PROHIBITED PERIOD OF TIME
QUIET ZONE **RESIDENTIAL**
AREA

- | | | | |
|----|--|-------------|---|
| 1. | The operation of any auditory signalling device, including but not limited to the ringing of bells or gongs and the blowing of horns or sirens or whistles, or the production, reproduction or amplification of any similar sounds by electronic means except where required or authorized by law or in accordance with good safety practices. | At Any Time | B & D |
| 2. | The operation of any electronic device or group of connected devices incorporating one or more loudspeakers or other electro-mechanical transducers, and intended for the production, reproduction or amplification of sound. | At Any Time | C |
| 3. | All selling or advertising by shouting or outcry or amplified sound. | At Any Time | B & D |
| 4. | Loading, unloading, delivering, packing, unpacking, or otherwise handling any containers, products, materials, or refuse, whatsoever, unless necessary for the maintenance of essential services or the moving of private household effects. | B | B & D |
| 5. | The operation of any construction equipment in connection with construction. | E & D | F & D |
| 6. | The detonation of fireworks or explosive devices not used in construction. | At Any Time | A - unless otherwise permitted in accordance with the provisions of By-law 160-74 or its successors |

SCHEDULE 2 TO BY-LAW NUMBER 360-79
PROHIBITED PERIODS OF TIME:

<u>COLUMN 1</u>		<u>COLUMN 2</u> <u>PROHIBITED PERIOD OF TIME</u>	
		<u>QUIET ZONE</u>	<u>RESIDENTIAL AREA</u>
7.	The discharge of firearms.	At Any Time	At Any time-unless in accordance with the provisions of By-law 331-77 or its successors.
8.	The operation of a combustion engine which (i) is, or (ii) is used in, or (iii) is intended to be used in, a toy, or a model or replica of any device, which model or replica has no function other than amusement and which is not a conveyance.	At Any Time	A
9.	The operation of any powered rail car including but not limited to refrigeration cars, locomotives or self-propelled passenger cars, while stationary on property not owned or controlled by a railway governed by The Canada Railway Act	At Any Time	A
10.	The operation of any motorized conveyance other than on a highway or other place intended for its operation.	At Any Time	B
11.	The venting, release or pressure relief of air, steam or other gaseous material, product or compound from any autoclave, boiler, pressure vessel, pipe, valve, machine, device or system.	At Any Time	A
12.	Persistent barking, calling or whining or other persistent noise making by any domestic pet.	At Any Time	At Any Time
13.	The operation of any powered or nonpowered tool for domestic purposes other than snow removal.	A	A

SCHEDULE 2 TO BY-LAW NUMBER 360-79
PROHIBITED PERIODS OF TIME:

<u>COLUMN 1</u>		<u>COLUMN 2</u>	
		<u>PROHIBITED PERIOD OF TIME</u>	
		<u>QUIET ZONE</u>	<u>RESIDENTIAL AREA</u>
14.	The operation of solid waste bulk lift or refuse compacting equipment.	B	A
15.	The operation of a commercial car wash with air drying equipment.	B	B
16.	Yelling, shouting, hooting, whistling or singing.	At Any Time	A

SCHEDULE 3 TO BY-LAW 360-79
ACTIVITIES TO WHICH THE BY-LAW DOES NOT APPLY

(amended by 230-94, 495-03, 124-05, 110-06, 92-07, 120-07, 127-07, 248-07, 73-08, 99-08, 325-09, 243-13, 43-15, 60-15, 120-17)

ACTIVITIES TO WHICH THE BY-LAW DOES NOT APPLY	LOCATION
Applewood Acres Homeowners Association - Annual Family Fun Day	West Acres Park 2166 Westfield Drive
Banares Museum - Exemption applies to all approved events and activities at this location.	Banares Museum 1507 Clarkson Road North
Bradley Museum - Exemption applies to all approved events and activities at this location.	Bradley Museum 1620 Orr Road
Can-Sikh Festival	Paul Coffey Park 3430 Derry Road West
Canada Day (various locations throughout the City) <ul style="list-style-type: none"> • Churchill Meadows Friends • Malton BIA and Partners • Port Credit Paint the Town Red • Streetsville BIA and Partners 	Churchill Meadows Park 3370 McDowell Drive West Wood Mall 7205 Goreway Drive Port Credit Memorial Park 32 Stavebank Rd N - (plus designated locations throughout Port Credit Village) Streetville Memorial Park 335 Church Street - (plus designated locations throughout the Village)
Caroling in the Park	Port Credit Memorial Park 32 Stavebank Road North
Cavalia	Hershey Centre 5399 Rose Cherry Place
Desh Bhagat	Paul Coffey Park 3430 Derry Road West

Filming Activities Authorized by the City's Film Unit via a Film Permit issued in accordance with Corporate Policy and Procedure No. 06-03-02 - "Filming on City of Mississauga Property"	Approved designated locations
Lakeside Park - Exemption applies to all approved events and activities at this location.	Lakeside Park 2268 Lakeshore Rd West
Leslie Log House - Exemption applies to all approved events and activities at this location.	Leslie Log House 4415 Mississauga Rd
Malton Festival	Paul Coffey Park 3430 Derry Road West
Mississauga Celebration Square Exemption applies to appropriately approved events and activities that appear on the MCS calendar of events, programs and activities	Civic Square 300 City Centre Drive, Library Square 301 Burnhamthorpe Road West Living Arts Centre Park 4141 Living Arts Centre Drive
Mississauga Marathon	City Centre Drive, Lakefront Promenade Park 800 Lakefront Promenade PLUS designated locations
Mississauga Waterfront Festival	Port Credit Memorial Park 32 Stavebank Road North PLUS Port Credit Library and Port Credit Arena
Mount Zion Apostolic Church - Picnic	Paul Coffey Park 3430 Derry Road West
Movies In The Park - Rotary Series	Port Credit Memorial Park 32 Stavebank Road North
Palestine House Educational and Cultural Centre	Mississauga Valley Park 1275 Mississauga Valley Boulevard
Port Credit Art Fest	Port Credit Memorial Park, 32 Stavebank Road North

Port Credit Busker Fest	Port Credit Memorial Park 32 Stavebank Road North PLUS event designated sites throughout Port Credit Village
Rebel – National Youth Week	Mississauga Celebration Square PLUS approved designated locations
Safe City Mississauga – Neighbours Night Out	Approved designated locations
Sherwood Forrest - Annual Family Fun Day	Sherwood Green Park 1864 Deer's Wold
St Gabriel Lebanese Festival	Streetsville Memorial Park 335 Church Street
Southside Shuffle – Blues and Jazz Festival	Port Credit Memorial Park 32 Stavebank Road North PLUS event designated sites throughout Port Credit Village
Streetsville Founders - Bread & Honey Festival	Streetsville Memorial Park 335 Church Street
Sunset Concert Series (Culture Division Program)	Port Credit Memorial Park 32 Stavebank Road North Lake Aquitaine 2750 Lake Aquitaine Avenue
University of Santos Thomas Alumni - Annual Picnic	Mississauga Valley Park 1275 Mississauga Valley Boulevard

THE CORPORATION OF THE CITY OF MISSISSAUGA
SCHEDULE 4 TO BY-LAW NUMBER 360-79

QUIET ZONES

The Quiet Zones are those areas contained within the dotted lines on Maps A, B, C and D which are attached to By-law 360-79

THE CORPORATION OF THE CITY OF MISSISSAUGA
THE NOISE CONTROL BY-LAW 360-79



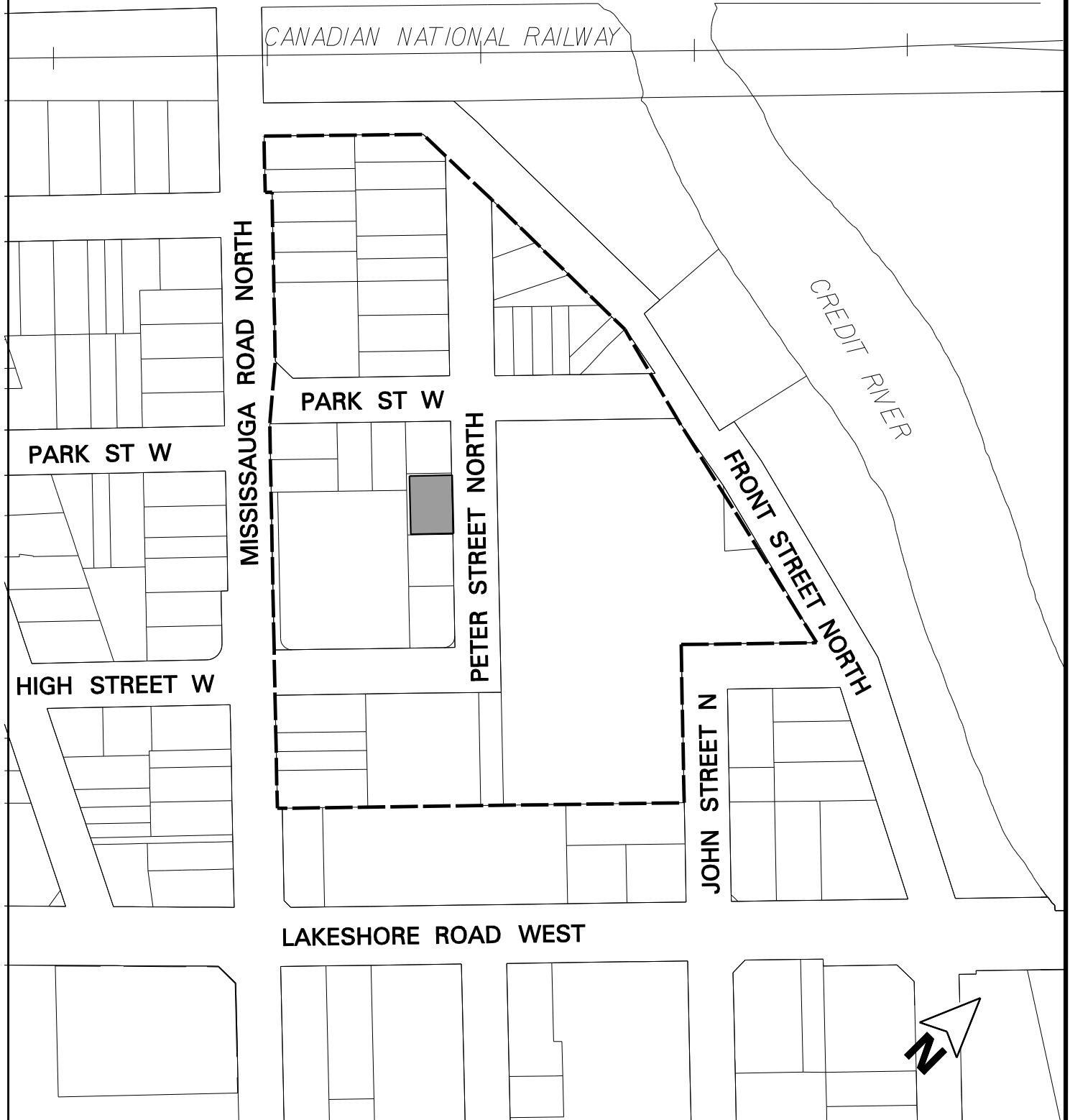
① TRILLIUM HEALTH CARE
100 THE QUEENSWAY WEST

② CHELSEY PARK NURSING HOME
2250 HURONTARIO STREET

③ EXTENDICARE NURSING HOME
55 THE QUEENSWAY WEST

MAP A- BY-LAW 360-79

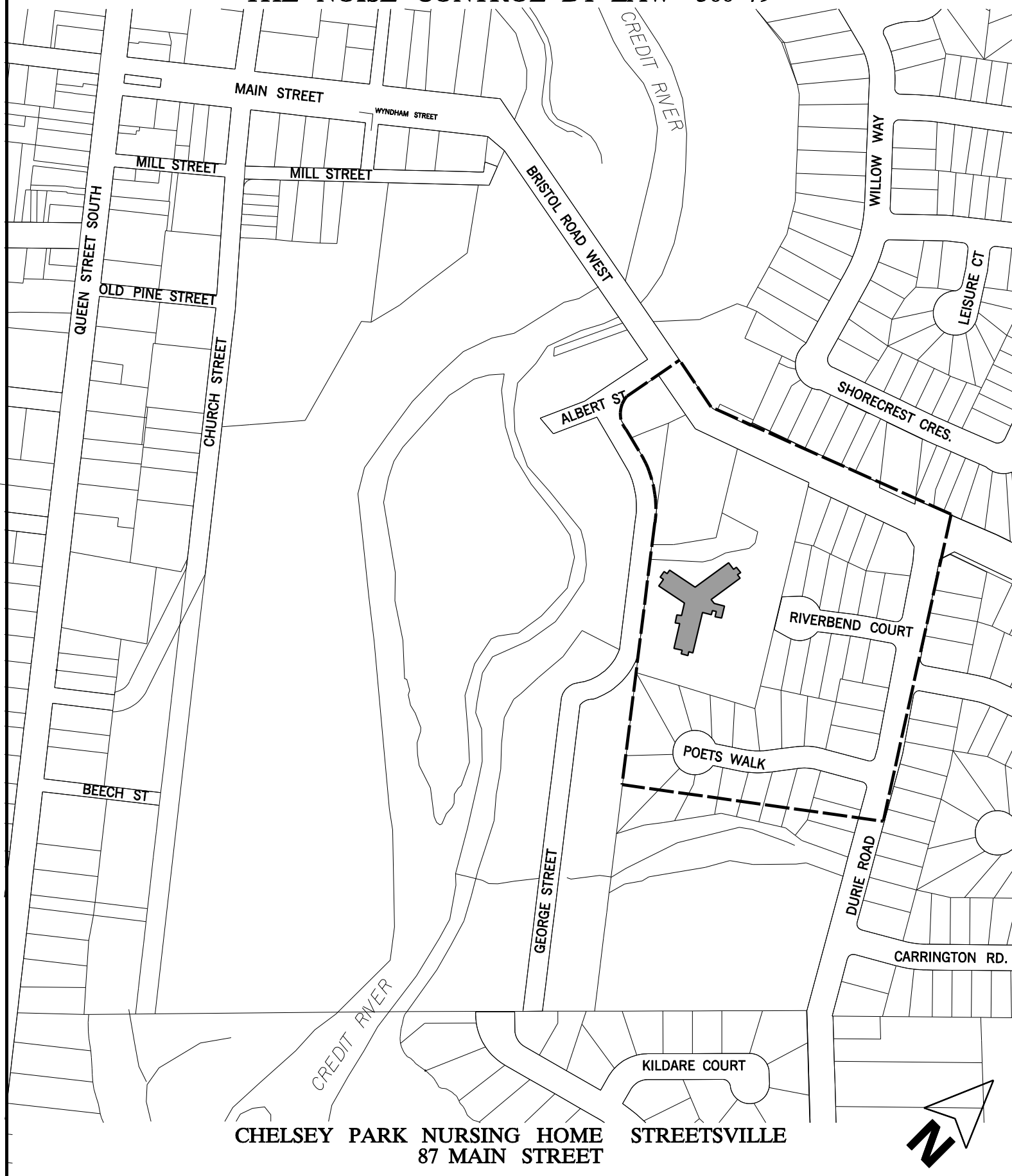
THE CORPORATION OF THE CITY OF MISSISSAUGA
THE NOISE CONTROL BY-LAW 360-79



TAARA NURSING HOME
26 PETER STREET NORTH

THE CORPORATION OF THE CITY OF MISSISSAUGA

THE NOISE CONTROL BY-LAW 360-79



THE CORPORATION OF THE CITY OF MISSISSAUGA
THE NOISE CONTROL BY-LAW 360-79

