APPENDIX B.3

Noise and Vibration

DRAFT

NOISE AND VIBRATION IMPACT ASSESSMENT
PROPOSED LIGHT RAIL TRANSIT SYSTEM
CITY OF HAMILTON

FOR

SNC-LAVALIN INC.

PREPARED BY

____
SAM N. KULENDRAN, B.A.Sc.

CHECKED BY

____
JOHN E. COULTER, B.A.Sc., P. ENG.

J. E. COULTER ASSOCIATES LIMITED
1210 SHEPPARD AVENUE EAST, SUITE 211
TORONTO, ONTARIO
M2K 1E3

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TABLE OF CONTENTS

TABLE OF CONTENTS - continued

1.0 INTRODUCTION

The City of Hamilton has embarked on an aggressive plan to implement rapid transit, with a long-term vision encompassing five corridors connecting key destinations across the City. This proposed system is referred to as "B-L-A-S-T." Presently, the City's focus is on implementing Light Rail Transit (LRT) along the City's primary east/west B-Line corridor, Main/King between Eastgate Square and McMaster University and defining a potential corridor and rapid transit mode for future rapid transit implementation along the City's primary north/south A-Line corridor, James/Upper James between the Waterfront and the Airport.

J. E. Coulter Associates Limited was retained by SNC-Lavalin Inc. to conduct a noise and vibration impact assessment of the proposed City of Hamilton B-Line Light Rail Transit System as part of the Transit Project Assessment Process.

1.1 Project Description

The west terminus of the B-Line LRT is at McMaster University, just east of Cootes Drive. The route is a follows.

- Runs east along Main Street, primarily in the centre of the roadway right-of-way. Near Highway 403, the route swings to the north side of Main Street.
- It will use a new bridge structure to cross Highway 403 and connect the route to King Street, east of the highway.
- It remains on the south side of King Street from Highway 403 to Main Street in the east.
- The route completely displaces road traffic on King Street between Catharine Street and Wellington Street.
- It follows Main Street east from King Street to Queenston Road, remaining on the south side of Main Street.
- After that it continues east on Queenston Road from Main Street, mainly remaining in the centre of the roadway right-of-way.
- The route then terminates at Eastgate Square at the intersection of Centennial Parkway and Queenston Road.

1.2 Study Area

For potential noise and vibration impacts, the B-Line LRT (the project) can be divided into two separate study areas.

The primary study area encompasses the sensitive receptors immediately adjacent to the proposed LRT route, usually within 100m to either side of the proposed alignment. This area is evaluated for both noise and vibration impacts.

The secondary study area covers some parallel and intersecting routes that will experience increases or decreases in traffic as a result of the introduction of the LRT system. The nearest sensitive receptor, usually within 50m of the right-of-way, is evaluated for changes in sound levels as a result of the project.

2.0 NOISE AND VIBRATION IMPACT ASSESSMENT CRITERIA

The noise and vibration impact assessment criteria used to evaluate implications of the proposed LRT route are based on a set of draft protocols developed through the combined efforts of the Ministry of the Environment (MOE) and the Toronto Transit Commission (TTC). These protocols are used in the absence of any existing province-wide protocols for transit projects, specifically relating to light rail transit. The protocol that most directly relates to this project is the MOEE/TTC Draft Protocol for Noise and Vibration Assessment for the Proposed Waterfront West Light Rail Transit Line (November 11, 1993). This protocol is similar to many of the other protocols developed by the TTC and the MOE for other rapid transit projects within Ontario. The vibration limit of 0.1mm/s rms from the MOEE/TTC Draft Protocol for Noise and Vibration Assessment for the Proposed Scarborough Rapid Transit Extension is used, however, in lieu of the 0.14mm/s rms limit from the Waterfront LRT guidelines and ISO recommendations, as requested by the MOE.

The above protocols, created in the early 90s, have several outdated references. The protocols and other guidelines that are not easily accessible are provided in Appendix B. A more current list of references is provided in Appendix C. Additional definitions are provided in Appendix D.

The noise and vibration criteria, as outlined in the above mentioned document, are summarized below.

2.1 Definition of Sensitive Receptors

As per the MOE/TTC protocol, sensitive receptors are identified as those existing or municipally-approved residential developments, nursing homes, group homes, hospitals, and other such institutional land uses where people reside. Within the project area, the primary sensitive receptors are residential developments. Though there are some institutional uses located along the corridor, the primacy of residential development in those same locations implies that any evaluation at the residential receptors will be representative of other sensitive receptors. For this reason, as the residential receptors are expected to be most representative of the effects of the proposed LRT system, the impacts at residential receptors will be used as a proxy for other sensitive receptors (land uses) in the same area. Henceforth, any references to receptors or receivers will be in regard to residential development, unless otherwise noted.

For the assessment, the protocols dictate that sound and vibration levels need to be calculated at the point of reception or point of assessment. The point of reception or point of assessment is described in the protocols as being a sensitive receptor located no less than 15m from the centreline of the nearest track. There are many points along the route where the point of assessment at a house or apartment, for example, would be closer than 15m from the nearest track centreline. As a result, the point of assessment for receptors along the corridor is taken to be the closest sensitive receptor, regardless of whether or not it is 15m or more from the nearest track centreline. The calculations are adjusted accordingly for actual setbacks.

2.2 Noise Impact Criteria

There are two primary components to the noise impact assessment criteria.

- The first and most common component in transit projects is the noise impact as a result of changes to the roadway sound levels at the receptors. Essentially, this is a comparison of sound levels with and without the project's implementation. For this analysis, sound levels without the LRT are compared to the sound levels with the LRT. The horizon year used to project the traffic volumes on the affected streets is 2021 to allow for the project and its surrounding roadways to reach a mature level of use. The comparison is based on a daytime (0700-2300 hours) and nighttime (2300-0700 hours) equivalent sound level comparison, which is appropriate for non-highway projects. Where the sound levels with the project exceed the sound levels without the project by at least 5dB, noise control needs to be considered where it would be technologically, economically and administratively feasible.

- The second set of noise criteria applies to ancillary facilities. The ancillary facilities analyzed as part of this project are described in Section 3. These facilities are treated as stationary noise sources and are evaluated based on the Ministry of the Environment's *NPC-205* Publication "Sound Level Limits for Stationary Sources in Class 1 and 2 Areas (Urban)." The hourly equivalent (1hr L_{eq}) sound level from stationary sources is compared to the 1hr L_{eq} of the ambient sound or the minimum exclusion criteria (50dB daytime, 47dB evening, 45dB nighttime), whichever is greater. The ambient sound level is comprised of the noise generated from roadway sources and excludes sources such as railways and aircraft. Typically, the quietest ambient sound level period is used as an evaluation of the worst-case situation. If the facility's sound level can remain below the quietest ambient sound level during that period, then the facility is likely to meet the guidelines during all periods of the day. Where the facility exceeds the guidelines by any measurable amount, noise control needs to be implemented, as per *NPC205*.

Sound levels are calculated at the closest point of reception, which can be the closest façade or outdoor living area during the daytime and the closest façade during the nighttime. Nighttime sound levels are evaluated based usually on a second floor or higher (apartments) receptor.

2.3 Vibration Impact Criteria

The vibration impact criteria attempt to address two potential impacts from vibration generated by the LRT.

- First, the criteria consider perceptible (ground-borne) vibration levels. This addresses vibration that can be felt by residents in a building.
- Secondly, the criteria document also mentions the sound from vibration (vibration-induced sound) but does not set a limit.

The limit for perceptible vibration levels has been set to 0.1mm/s rms (root-mean-square) velocity. If absolute vibration levels are expected to exceed this limit, mitigation methods need to be determined during the detailed design phase to meet it to the extent technologically, economically and administratively feasible.

There are no specific criteria in Ontario that set limits for the sound resulting from vibration (vibration-induced sound). The relatively lower limit of 0.1mm/s instead of 0.14mm/s (suitable for hospital vibration levels) attempts to reduce this issue. The possibility for a noise impact as a result of vibration still exists. It is dependent on the frequency spectrum of the vibration as well as the levels. Based on the United States' Federal Transit Administration guidelines (2006), a guideline level of 35dBA is used in this report for residential rooms and other rooms (e.g. hospitals) where people generally sleep, for cases where the ground-borne, vibration-generated noise dominates the impression of the passby.

The vibration-induced noise criterion level of 35dBA should be taken into context along with the air-borne noise. New LRT vehicles typically exhibit maximum sound levels ranging from 78-80dBA at 7.5m while traveling at 40km/h, similar to a medium-sized truck. For rooms with exposure to the LRT and other traffic, outdoor sound levels in this range would indicate indoor sound levels of 48-50dBA, assuming a general 30dB noise reduction from closed windows. In this case, the contribution from vibration-induced noise would be negligible and often indistinguishable compared to the air-borne noise coming through the closed window. Thus, the criterion level for vibration induced noise is mainly applicable to those rooms with little or no window exposure to the LRT. Examples of these would be flanking apartments/houses with little or no window exposure, inset bedrooms separated from the LRT exposure by another room, or in basement apartments with small windows.

Vibration levels are evaluated at the nearest point of a residential or sensitive-use building. The review of vibration-induced noise potential involves identifying the locations where the rail system passes close to buildings, or where there is special track work prone to creating vibration (switches). Next is the identification of the uses in the buildings and the proximity of sensitive rooms to the source of vibration. Then, the vibration levels must be estimated and, where impacts are anticipated, a level of vibration control specified.

3.0 PROJECT SCOPE

The proposed LRT system features a variety of different facilities throughout its route. The following sections outline the aspects of this project that have been evaluated within the scope of this noise and vibration impact assessment.

3.1 Light Rail Vehicles and Vehicular Traffic

The noise and vibration impacts resulting from the introduction of light rail vehicles (LRVs) along the LRT route and from an increase in vehicular traffic along parallel streets have been reviewed. The traffic volumes used in the assessment consider the reduction in traffic caused by removing lanes of traffic along the route.

The vibration assessment applies only to the LRT corridor. The potential for switches, double-crossovers and double-ended pocket track is considered.

3.2 Bus Terminals

No new bus terminals will be constructed as a result of the introduction of the B-Line LRT. Existing terminals will not be expanded as part of this project and are not considered further.

3.3 Power Substations

Power substations will be required along the route to provide the transit system with the necessary power. There will be seven power substations, each rated at 750kW.

3.4 Maintenance and Storage Facility

A light rail maintenance and storage facility will be required for the light rail vehicles. A separate Environmental Assessment will be conducted for this facility as its location and specifics have not yet been determined.

3.5 Construction

The noise and vibration impact that results from the anticipated construction methods required to build the LRT system has also been examined. This will include the installation of tracks, the construction of ancillary facilities, road construction, and any bridge construction/modifications to accommodate the LRT. At the EA stage, only preliminary information regarding the construction methods is known. This report will serve to cite the basic construction noise and vibration guidelines as well as flag potential issues with the anticipated construction methods.

4.0 NOISE IMPACT ASSESSMENT

4.1 Identification of Sensitive Receptors

The B-Line LRT route runs through a variety of land uses. The most common sensitive receptors along the route are residential receptors. There are also schools and places of worship scattered throughout the corridor. Some areas with primarily commercial development at grade also incorporate 2^{nd}-storey residential dwellings. Prior to identifying representative Points of Reception (PORs), the corridor has been reviewed to identify the types of land uses located along various sections.

4.1.1 Description of Corridor

Table 1 outlines the various stretches along the corridor, the nature of adjacent land uses, and the track conditions along those stretches.

Table 1: Corridor Description

From	To	Roadway Name	Track Position	Land Uses	Distance to Closest Sensitive Receptor	POR
McMaster University	McMaster Medical	Cootes Drive/Main Street	Offset	Commercial, residential, institutional	80m	-
McMaster Medical	Highway 403 Ramp	Main Street	Centre	Residential, commercial, some institutional	20m	1
Highway 403 Ramp	Paradise Road	Main Street	Centre	Residential, commercial, some institutional	21m	2
Paradise Road	Highway 403	Main Street	Offset	Residential, commercial	26m	3
Highway 403	Queen Street	King Street	Offset	Residential, commercial	7m	4
Queen Street	James Street	King Street	Offset	Residential, commercial	8m	5
James Street	Catharine Street	King Street	Offset	Commercial, some residential	17m	-
Catharine Street	Wellington Street	King Street	Offset	Commercial, residential	8m	6
Wellington Street	Wentworth Street	King Street	Offset	Residential, commercial, some institutional	9m	7
Wentworth Street	Barnsdale Blvd	King Street	Offset	Residential, commercial	7m	8
Barnsdale Blvd	Main Street	King Street	Offset	Residential, commercial, some institutional	7m	9
King Street	Queenston Road	Main Street	Offset	Residential, commercial, some institutional	10m	10
Main Street	Parkdale Road	Queenston Road	Centre	Residential, commercial, some institutional	15m	11
Parkdale Road	Red Hill Valley Parkway	Queenston Road	Centre	Residential, commercial, some institutional	20m	12
Red Hill Valley Parkway	Woodman Drive	Queenston Road	Centre	Residential, commercial	17m	13
Woodman Drive	Centennial Parkway	Queenston Road	Centre	Residential, commercial	22m	14

4.1.2 Sensitive Receptors

Based on the LRT alignment, traffic volumes, and receptor characteristics, 14 representative Points of Reception have been identified. Table 1, above, generally identifies the locations of these sensitive receptors. These receptors have been chosen because they are the most sensitive to the noise from the proposed LRT route. The PORs evaluated here are different than those originally considered during the existing conditions' review. While the existing conditions' report shows the highest existing sound levels along the corridor, this review evaluates the areas most susceptible to increases in noise. Generally, receptors at intersections and adjacent to high-traffic roads are less sensitive, as the existing sound levels are higher than areas with lower road traffic. Hence, the greatest impact, if any, will be in areas with lower existing (or future "no project") sound levels. The specifics of each of these receptors are summarized in Table 2, below. Each of these receptors will help provide a representative indication of the change in sound levels resulting from the introduction of the LRT. Figures 2 through 15 in Appendix A show the locations of the PORs.

Table 2: Points of Reception

POR	Type	Dominant Noise Source
1	Low rise	Main Street
2	Low rise	Main Street
3	High rise	Main Street/Highway 403
4	Low rise	King Street
5	Mid rise	King Street
6	2nd floor residential	King Street
7	Low rise	King Street
8	Low rise	King Street
9	Low rise	King Street
10	Low rise	Main Street
11	Low rise	Queenston Road
12	High rise	Queenston Road/Red Hill Valley Parkway
13	High rise	Queenston Road
14	High rise	Queenston Road

In areas dominated by hard, reflective ground, receptors on the lower floors will generally be at least as sensitive to increases in adjacent road traffic as receptors on the upper floors. As the elevation of the receptor increases, the contribution to the overall noise from other roadways also increases. Primarily first- and second-storey levels are evaluated as an indication of the worst-case situation.

4.2 Light Rail Vehicles

The noise impact assessment compares the sound levels along the route under two different conditions for the design year of 2021. The sound levels without the project are higher than the current sound levels due to traffic growth within the corridor. The sound levels with the project will be comprised of existing car and truck traffic and the addition of the LRVs, as well as some minor bus traffic during the day.

Given the noise limits for the light rail vehicle and the traffic volumes (with and without the project) the noise impact of the LRV component of the project can be determined.

Sound levels are calculated using the Ministry of the Environment's *ORNAMENT* prediction procedure. The computer program used for this analysis is the MOE's *STAMSON 5.04* computer program, which incorporates both *ORNAMENT* (road) and STEAM (rail) prediction methods. Although on rail, the LRVs are treated as roadway sources and are evaluated based on the *ORNAMENT* procedure as medium trucks.

In order to confirm the modelled sound levels throughout the corridor, short term sound level measurements were taken during daytime hours at various locations. The details regarding the location and sound levels measured at these locations can be found in Appendix E.

Generally, because of the old sound data used in the models, areas with relatively higher truck traffic show higher modelled sound levels than measured sound levels. Because of the relatively low heavy and medium truck traffic along the proposed LRT route, the measured sound levels tended to be within 1dB of the modelled sound levels in most cases. In areas with densely packed buildings on either side of a road, the measured sound levels were actually about 2dB higher than the modelled sound levels. This is a result of the reflection of roadway noise off adjacent buildings, which is not incorporated into the model.

All absolute sound levels reported within this report should take into consideration the difference between modelled sound levels and measured sound levels. Measured sound levels are likely to be lower than modelled sound levels in areas with higher truck percentages, which likely occurs along streets parallel to the LRT route.

4.2.1 Light Rail Vehicle Noise Characteristics

Modern light rail vehicles come in a few different forms. They are often divided into modules, such as a passenger module or a motor module (also referred to as a passenger bogie or motor bogie). Commonly, a new LRV vehicle will have two motor bogies and maybe a passenger bogie in the middle, resulting in a vehicle length of 30-40m. These are also different from common streetcars in that they have wheel covers and are more modern in design, resulting in modestly lower sound levels. Newer, light rail wheels also have constrained damping, which, coupled with larger turning radii, greatly reduces wheel squeal noise on corners.

As the LRVs have not been selected as yet, specific noise data are unavailable. The noise impact assessments completed for some of the Toronto Transit Commission's Transit City LRT routes indicate sound levels of approximately 82dB at a distance of 7.5m for a comparable vehicle travelling at 40km/h on concrete. These are specifications only and not actual sound levels. Recently measured data from the Jerusalem LRT indicate maximum sound levels of *75dBA at 7.5m* for a 35m long two-motor bogie vehicle travelling at 40km/h. For the purposes of this assessment, the focus is on the sound level of an LRV in operation. According to the *ORNAMENT* procedure, a medium truck produces *71dB at 15m* while travelling at 40km/h. Thus, modelling each LRV consist (train) as two medium trucks slightly overestimates the LRT system noise, but can be representative of the actual sound levels that can be expected from this technology.

4.2.2 Traffic Volumes

Traffic volumes with and without the project have been supplied by Steers Davies Gleave (SDG) for the major sections in the corridor. These volumes have been determined based on traffic counts and predictions.

Table 3 outlines the 2021 without project traffic volumes along the project corridor. Table 4 outlines the 2021 with project traffic volumes along the project corridor.

Table 3: Future (2021) No Project Traffic Volumes

POR	Roadway	Intersection Description	Daytime (0700-2300)			Nighttime (2300-0700)		
			Cars	Heavy Trucks	Medium Trucks and Buses	Cars	Heavy Trucks	Medium Trucks and Buses
1	Main Street	Main and Dalewood	51,987	558	705	5,776	62	78
2	Main Street	Main and Paisley	41,725	468	624	4,636	52	69
3	Main Street	Main and Macklin	27,944	327	529	3,105	36	59
4	King Street	King and New	33,560	445	587	3,729	49	65
5	King Street	King and Hess	25,712	344	553	2,857	38	61
6	King Street	King and Walnut	20,964	276	403	2,329	31	45
7	King Street	King and Tisdale	21,866	226	357	2,430	25	40
8	King Street	King and Sherman	23,174	231	370	2,575	26	41
9	King Street	Gage and King	24,302	254	398	2,700	28	44
10	Main Street	Graham and Main	23,952	271	495	2,661	30	55
11	Queenston Road	Queenston and Walter	22,543	231	451	2,505	26	50
12	Queenston Road	Queenston and Reid	28,903	237	464	3,211	26	52
13	Queenston Road	Queenston and Potruff	25,520	265	473	2,836	29	53
14	Queenston Road	Nash and Queenston	21,077	214	428	2,342	24	48

Table 4: Future (2021) With Project Traffic Volumes

POR	Roadway	Intersection Description	Daytime (0700-2300)				Nighttime (2300-0700)			
			Cars	Heavy Trucks	Medium Trucks and Buses	LRT	Cars	Heavy Trucks	Medium Trucks and Buses	LRT
1	Main Street	Main and Dalewood	50,622	513	494	377	5,625	57	55	72
2	Main Street	Main and Paisley	37,519	383	377	377	4,169	43	42	72
3	Main Street	Main and Macklin	26,411	288	397	377	2,935	32	44	72
4	King Street	King and New	18,539	197	178	377	2,060	22	20	72
5	King Street	King and Hess	10,657	118	293	377	1,184	13	33	72
6	King Street	King and Walnut	0	0	0	377	0	0	0	72
7	King Street	King and Tisdale	5,402	17	56	377	600	2	6	72
8	King Street	King and Sherman	7,623	28	25	377	847	3	3	72
9	King Street	Gage and King	7,826	51	46	377	870	6	5	72
10	Main Street	Graham and Main	4,511	34	30	377	501	4	3	72
11	Queenston Road	Queenston and Walter	7,556	56	51	377	840	6	6	72
12	Queenston Road	Queenston and Reid	14,750	96	119	377	1,639	11	13	72
13	Queenston Road	Queenston and Potruff	19,656	203	207	377	2,184	23	23	72
14	Queenston Road	Nash and Queenston	15,777	158	142	377	1,753	18	16	72

The following assumptions were used in modelling the traffic data:

1. The B-Line LRT route is expected to displace traffic, resulting in an increase in traffic on other roads. The effect of the increase in traffic on parallel roads is reviewed in Section 4.2.3.
2. With the exception of the LRT volumes, daily traffic has been divided into daytime and nighttime volumes, using a typical 90% daytime/10% nighttime split.
3. Nighttime LRT operations are expected to stop between 0130 and 0500 hours for maintenance.
4. The speed limit for regular traffic is assumed to be 60km/h on Main Street, west of Highway 403, 60km/h on Queenston Road, between Reid Ave and Potruff Road, and 50km/h everywhere else
5. The operating speed of the LRT will be the same as regular traffic and 50km/h in the downtown section with no regular traffic.
6. Due to the nature of sound, changes in traffic volumes of +25%/-20% would change the overall sound levels by 1dB only.

4.2.3 Assessment Analysis and Results

Table 5 summarizes the “No Project” and “With Project” sound levels as well as the expected daytime and nighttime impacts.

Table 5: Expected LRT Sound Levels and Expected Impacts

POR	No Project Sound Levels (dB)		With Project Sound Levels (dB)						Impact (dB)	
	Daytime (16hr L_{eq})	Nightime (8hr L_{eq})	Daytime (16hr Leq)			Nighttime (8hr Leq)			Daytime	Nighttime
			Traffic Only	LRT Only	TOTAL[1]	Traffic Only	LRT Only	TOTAL[1]		
1	71	64	70	61	71	64	57	65	0	1
2	69	63	69	61	70	62	57	63	1	0
3	66	60	65	60	66	59	56	61	0	1
3 (Upper Floors)[2]	72	71	72	60	72	71	56	71	0	0
4	70	63	65	63	67	59	59	62	-3	-1
5	70	63	64	63	67	57	59	61	-3	-2
5 (Opposite)[3]	68	62	67	61	68	60	57	62	0	0
6	69	62	0	63	63	0	59	59	-6	-3
7	67	60	58	63	64	52	58	59	-3	-1
8	68	61	60	63	65	54	59	60	-3	-1
9	69	62	61	63	65	55	59	60	-4	-2
10	68	61	58	62	63	52	58	59	-5	-2
11	66	60	61	60	64	54	56	58	-2	-2
12	68	61	64	61	66	58	57	61	-2	0
12 (Upper Floors)[2]	70	65	68	61	69	63	57	65	-1	0
13	68	62	67	62	68	61	58	63	0	1
14	66	60	65	61	66	58	57	61	0	1

Notes
1. The "With Project Sound Levels" have been divided into Traffic Only and LRT Only sound levels to show the relative significance of each. They are then added together to obtain the TOTAL sound level, which is used to determine the potential impact.
2. Upper floors are evaluated in these cases are evaluated to demonstrate the relative impacts of upper floors compared to lower floors.
3. Opposite to POR5 are also sensitive receptors which are evaluated to show the effect of a shift in the alignment of the roadway in the sections where the LRT is offset, causing higher levels to one side of the road and lower levels on the other.

As can be seen from Table 5, the B-Line system generally results in a decrease or a small change in the sound levels along the corridor. Within the Downtown core, the sound level reductions would be noticeable, especially during the daytime. Between Catharine Street and Wellington Street, the LRT will completely displace traffic, resulting in a significant decrease in both daytime and nighttime sound levels. Overall, the sound level reductions along the LRT route are quite modest.

The displaced traffic from the main LRT corridor is expected to use streets running parallel to the corridor. As these streets will not be modified, the increase in sound levels will be directly proportional to their increase in traffic, regardless of topography. Table 6 outlines the anticipated sound level increases along various sections of parallel streets.

Table 6: Parallel Street Noise Impacts

Street Name	Intersection Description	Impact (dB)	
		Daytime	Nighttime
Cannon Street	Cannon and Bay	2	2
Cannon Street	Cannon and John	2	2
Cannon Street	Cannon and Catharine	1	1
Cannon Street	Cannon and Ferguson	1	1
Cannon Street	Cannon and Wellington	1	1
Cannon Street	Cannon and Victoria	2	2
Cannon Street	Cannon and Wentworth	2	2
Cannon Street	Cannon and Gage	3	3
Cannon Street	Cannon and Ottawa	2	2
King Street	King and Macklin	-1	-1
Main Street	Main and Queen	-1	-1
Main Street	Main and Bay	-1	-1
Main Street	Main and Wellington	-2	-2
Main Street	Main and Wentworth	-2	-2
Main Street	Main and Parkdale	1	1
York Boulevard	York and Hess	1	1
York Boulevard	York and Bay	0	0
Wilson Street	Wilson and John	1	1
Wilson Street	Wilson and Catharine	2	2
Wilson Street	Wilson and Wellington	2	2
Wilson Street	Wilson and Wentworth	1	1
Barton Street	Baron and James	0	0
Barton Street	Barton and Wellington	1	1
Barton Street	Barton and Victoria	2	2
Barton Street	Barton and Wentworth	1	1
Barton Street	Barton and Sanford	2	2
Barton Street	Barton and Strathearne	2	2
Barton Street	Barton and Centennial	1	1

As can be seen in Table 6, the effect of increased traffic on parallel streets is at the most 3dB in certain sections. More commonly, the increase in traffic results in sound level increases of 1-2dB, which would be hard to notice over the course of the next 10 years.

In no case does the introduction of the project generate a noise impact in excess of 5dB along either the primary route or parallel streets. Hence, no noise mitigation is warranted as per the MOE/TTC protocol.

Sample calculations are provided in Appendix F.

4.2.4 Wheel Squeal Issues

In early rail transit systems, wheel squeal issues were present whenever the route made a sharp turn. Wheel squeal was often exacerbated by relatively poor track maintenance. Since these issues first presented, transit agencies and vehicle manufacturers have developed methods to limit or eliminate wheel squeal.

Uncontrolled, wheel squeal noise can reach maximum sound levels of 100dBA at 15m or so. The introduction of resiliently mounting and/or constrained damping of the wheels reduces this sound by as much as 20dB. Proper track maintenance and rail lubrication (operational factors) can also reduce this sound level with varying levels of noise reduction.

Given that there are no sharp turns, and assuming modern light rail technology (constrained damping of the wheels) and proper operational maintenance (lubricated rails and slower speeds on turns), wheel squeal noise is not expected to be an issue along the B-Line LRT corridor.

4.3 Power Substations

At the current level of design, there will be seven 750kW power substations located along the LRT corridor. The locations of the power substations are shown in Appendix H. Each power station can be moved up to 200m from the positions shown in the figures. As with other stationary noise sources, the power substations are evaluated using the MOE's *NPC205* guidelines for stationary sources in Class 1 areas.

4.3.1 Assessment Method and Assumptions

As the details of the equipment to be used in the power substations have not yet been designed, the 1.5MW power station at Bayview Station on the Sheppard Subway line in Toronto has been used as a proxy. Measurements of the noise from the substation indicate that the sound from the cooling ventilation systems was the dominant source as opposed to the hum of the transformer. With some traffic noise present, the substation produced approximately 63dBA at 3m. Thus, a 750kW power substation can be expected to produce approximately 60dBA at 3m. During the detailed design phase, further analysis should be completed to determine the sound level of the substation systems more accurately.

The minimum exclusion criterion of 45dB 1hr L_{eq} has been used to evaluate the power substations. For there to be a concern, the substation would have to be very close to residences and be in a quiet area.

4.3.2 Power Substation Impact Analysis and Results

Provided that the power substations are located at least 20m away from a sensitive receptor, no further noise control should be required. Power substations closer than 20m from a sensitive receptor particularly should be reviewed in more detail during detailed design. A review of the potential locations of the power substations indicates that there should be enough flexibility in the siting to attain this minimum setback between the sensitive receptors and the power substations.

5.0 VIBRATION IMPACT ASSESSMENT

The vibration impact assessment is based on a prediction of future vibration levels due to the project in the corridor. The closest sensitive receptors to the corridor are considered, but vibration impacts will be negligible beyond 50m. As outlined in the criteria section, the upper limit for vibration levels is 0.10mm/s rms, based on the MOE/TTC Draft Protocol for the Scarborough Rapid Transit Extension. A limit of 35dBA in quiet sleeping quarters has been suggested for vibration-induced noise as per the FTA guidelines.

The effects of the light rail vehicles on the vibration and sound levels within adjacent structures have been considered between the two ends of the LRT route wherever there are sensitive receptors located adjacent to the tracks.

This analysis will evaluate primarily the effects from tangent track as well as special trackwork, such as switches, crossovers, and double ended pocket track.

5.1 Critical Factors and Assumptions

The unsprung mass per axle, the soil conditions, the distance from the track to the receiver, and the speed of the vehicle will all affect the vibration levels at the receiver. Although the technology is different, the basic factors controlling the vibration from the LRV will be comparable to those of the streetcars currently in use in the City of Toronto. It is assumed that, where the LRT is running along roadways, the track will be embedded in concrete.

The total weight of a 30-40m long light rail vehicle will be in the range of 40,000kg. The new vehicles' unsprung mass per axle, along with the stiffness of the suspension that dictates the nature of the vibration levels, will not be markedly different than that for the typical Canadian Light Rail Vehicles (CLRVs) currently in use in Toronto.

A general review of the soils in the City of Hamilton does not indicate the persistence of finely-compacted sandy soils. As a result, vibration propagation along the route is expected to be similar to that in Toronto. More detailed geotechnical data will need to be obtained for the detailed design as well as verification of the vibration propagation characteristics of the soils in critical areas.

In contrast to current CLRVs, the proposed light rail vehicles could include an additional two axles. This can be expected to increase the peak vibration levels by 50%.

Vibration levels typically increase linearly with speed. For sections on most roadway rights-of-way, the LRT can be expected to operate at the same posted speed limit as the adjacent traffic:

- 60km/h on Main Street, west of Highway 403,
- 60km/h on Queenston Road, between Reid Ave and Potruff Road, and
- 50km/h everywhere else).

Between Catharine Street and Wellington Street, in the Downtown core, the LRT will operate at a posted speed of 50km/h.

In the following sections, a decibel scale has been used to depict a change from one level of vibration to another. For example, a 10dB reduction means that the vibration levels are 1/3 of their otherwise expected levels. A 10dB reduction when the initial vibration levels are 1.0mm/s would result in a reduced vibration level of 0.33mm/s.

5.2 Measurement of Existing Streetcar Vibration Levels

Vibration levels of the existing streetcar lines have been taken by J. E. Coulter Associates Limited over the past several years at various locations in the Toronto area that are similar to areas along the proposed B-Line LRT route. The streetcar lines measured in the past typically operate at speeds in the range of 25-30km/h, so the measured vibration levels will have to be increased accordingly to suit the B-Line scenario. The B-Line LRT route can run as close as 6m from the façade of a building.

The measured peak vibration levels have been adjusted to reflect the presence of an additional two axles and the various speeds throughout the corridor.

5.3 Light Rail Vibration Isolation Systems

There are several forms of vibration isolation that can be used for light rail systems running on track embedded in concrete.

For rail embedded in concrete, the typical vibration isolation systems are:

- Rubber-embedded or encapsulated track (also referred to colloquially as the rubber boot). The rubber material reduces the vibration transmission into the concrete and subsequently into the adjacent structures. There are various embedded rail systems with differing properties.
- Another isolation method for rail in concrete is a floating slab system. This system floats on a concrete rail bed mounted on rubber isolators, reducing the transmission of vibration from the concrete into the soil and adjacent structures.

Table 7, below, outlines the various vibration isolation systems and their approximate benefits.

Table 7: Vibration Isolation Systems Description

Track Bed Type	Level	Required Reduction (dB)	Description of Isolation Method
Concrete	0	0	Embedded, stiff rubber, mostly for electrical insulation
	1	5	Embedded, softer rubber
	2	10	Embedded, more resilient that Level 2, thicker material
	3	15 to 20	Floating slab is most common, though other methods may provide the required reduction

For the purposes of the vibration impact assessment, it is assumed that there will be at least a Level 1 vibration isolation system installed(a simple embedded rail system with 5dB reduction in vibration levels).

5.4 Prediction of Vibration Levels

Both the ground-borne vibration(perceptible vibration) and the vibration-induced noise resulting from the proposed LRT system have been estimated. The perceptible vibration levels are evaluated based on the MOE/TTC Protocol's guideline limit of 0.10mm/s RMS. The vibration-induced noise from the LRT is evaluated at residences based on the FTA guideline level of 35dBA, wherever the air-borne noise would not dominate the vibration-induced sound..

The predicted vibration levels are based on the posted speed limits along the various sections.

5.4.1 Perceptible Vibration Levels on Concrete Track

On concrete-embedded track, the CLRVs were measured at various distances. Table 8, below, summarizes the measured vibration levels.

Table 8: Measured Vibration Levels on Concrete Track Bed

Distance from Track Centerline (m)	Vibration Levels (mm/s rms)
3	0.19
7	0.13
12	0.11

As discussed earlier, all new light rail systems include at least a basic (Level 1) version of the embedded rail. Considering the 5dB reduction (44% reduction) from this system, the increase in speed to 40km/h, and the addition of an extra axle, the vibration levels from the LRT in place can be estimated. Again, it is assumed that clayey soils persist throughout the areas with concrete-embedded track.

Table 9, below, summarizes the estimated vibration levels that would be present at various setbacks from the centreline of the nearest track.

Table 9: Expected LRT Vibration Levels on Concrete Track Bed

Distance from Track Centerline (m)	Vibration Levels at Various Speeds (mm/s rms)		
	20km/h	50km/h	60km/h
6	0.07	0.17	0.21
10	0.05	0.11	0.14
15	0.04	0.10	0.12
20	0.03	0.08	0.10

As can be seen from Table 9, any residential receptors located 20m or more from the centreline of the nearest track will meet the guideline limit of 0.10mm/s without any additional vibration control measures when the LRT is operating at a speed of 60km/h. Any residential receptors located 15m or more from the centreline of the nearest track will meet the guideline limit of 0.10mm/s when the LRT is operating at a speed of 50km/h. As there are no sensitive receptors within 5m of a track, the guideline limit of 0.10mm/s will always be met when the LRT is operating at a speed of 20km/h. Otherwise, residential receptors located closer than the setbacks listed above will require additional vibration isolation to reduce the vibration levels to 0.10mm/s rms. For concrete embedded track, however, vibration control to limit vibration-induced noise is more critical and will supersede the requirements for perceptible vibration mitigation.

5.4.2 Vibration-Induced Sound

For light rail on a concrete track bed, vibration-induced sound tends to be more of an issue than perceptible vibration, especially at close setbacks. At greater setbacks, vibration-induced sound becomes less critical as the damping characteristics of clayey soils reduce the vibration-levels in the octave bands that human hearing is sensitive too. At setbacks of 20m or more from the nearest track, perceptible (ground-borne vibration) is more critical than vibration-induced noise. The following analysis for vibration-induced noise is based on setbacks of 20m or less, which occurs primarily wherever the LRT is operating at 50km/h.

Based on the measurements taken from Table 8, the sound levels in various rooms within residences adjacent to the proposed LRT route can be determined. Table 10, below, summarizes the sound levels that can be expected in various rooms as a result of vibration-induced noise. It has generally been assumed that there is usually one room with window exposure to the LRT route, with a second bedroom room set back within the building that does not have any window exposure to the LRT route. As per the FTA guidelines, the recommended objective for vibration-induced noise in the otherwise quiet bedroom (i.e., back rooms) is 35dBA.

Table 10 depicts the various vibration-induced sound levels that can be expected under various circumstances, wherever the LRT is operating at 50km/h. The distances listed are based on the most common setbacks between the track centreline and sensitive receptors along the LRT corridor. The air-borne sound level is the sound level that can be expected in the first room with window exposure facing the LRT, where the air-borne noise always dominates the vibration-induced noise. Hence, the vibration-induced noise would not be noticeable in rooms with window exposure to the LRT corridor. In back rooms, the air-borne sound levels would generally be very low, as they may not be exposed to any road noise. These areas are the most critical, as it is where the vibration-induced noise would be audible.

Table 10: Expected Vibration-Induced Sound Levels at 50km/h

Distance from Track to Building Foundation	Floor	Room	Airborne Sound Level from LRT (dBA)	Vibration-Induced Sound Level Under Various Isolation Systems (dBA)		
				Level 1 Isolation	Level 2 Isolation	Level 3 Isolation
6m	1	1	54	52	47	37
		2	-	50	45	35
	2	1	54	47	42	37
		2	-	45	40	35
10m	1	1	51	46	41	36
		2	-	45	40	35
	2	1	51	42	37	-
		2	-	40	35	-
16m	1	1	50	41	36	-
		2	-	40	35	-
	2	1	50	37	-	-
		2	-	35	-	-

Generally, for the front rooms in each building, the air-borne noise is greater than the vibration-induced noise, so these are far less critical. Furthermore, with the exception of some apartments and other low-rise residential buildings, most first floors do not include sleeping quarters and are often dedicated to commercial uses, which are both usually far less sensitive to vibration-induced noise. Vibration control requirements, then, are based primarily on an evaluation of the back room impacts on the first or second floors. Any vibration control recommended to reduce the vibration-induced sound levels in these rooms will also have a benefit in other, less sensitive rooms. As a standard, all areas are assumed to have the basic, 5dB reduction, Level 1 Isolation system.

Buildings 6m from the closest track centreline:

For areas with first floor, back room sleeping quarters, Level 3 isolation will be required to reduce the vibration-induced noise by a further 15dB (in addition to the 5dB from Level 1 Isolation). Level 3 isolation will also be required to reduce the vibration-induced noise in second floor, back room sleeping quarters by a further 10dB. Level 3 isolation can be designed to have overall reductions of 15 to 20dB.

Buildings 10m from the closest track centreline:

For areas with first floor, back room sleeping quarters, Level 3 isolation will be required to reduce the vibration-induced noise by a further 10dB (in addition to the 5dB from Level 1 Isolation). Level 2 isolation will be required to reduce the vibration-induced noise in second floor, back room sleeping quarters by a further 5dB. Level 2 isolation can be designed to have overall reductions of up to 10dB. Second floor, back room sleeping quarters will require no additional vibration control measures.

Buildings 16m from the closest track centreline:

For areas with first floor, back room sleeping quarters, Level 2 isolation will be required to reduce the vibration-induced noise by a further 5dB. Level 1 isolation will remain sufficient for second floor, back room sleeping quarters.

Buildings more than 20m from the closest track centreline:

Level 1 isolation will be sufficient to limit the vibration-induced sound levels wherever the setback from the closest track centreline is more than 20m.

Although none was identified during a preliminary review, there may be basement apartments scattered throughout the corridor. These may require closer attention and should be reviewed during the detailed design.

To reduce the vibration-induced noise for receptors within 6m of the closest track, upgrades to the standard Level 1 isolation have been recommended. This improved performance will also reduce the ground-borne vibration (perceptible vibration) to levels below the guideline limit of 0.10mm/s. Hence, in no case will the ground-borne vibration levels exceed the MOE/TTC Protocol limit of 0.10mm/s at a sensitive receptor.

5.4.3 Summary of Recommended Vibration Isolation Measures

Based on the preliminary vibration impact assessment above, the areas that require additional vibration isolation have been identified. As mentioned, it is assumed that all areas will feature Level 1 isolation (a simple rubber boot with 5dB insertion loss/reduction). Table 11, below, summarizes the areas where various vibration mitigation measures are required. Figures 16 to 20 in Appendix A show the locations of the recommended vibration isolation measures. These recommendations are based on a preliminary vibration impact assessment and a more comprehensive review should be conducted during the detailed design.

Table 11: Summary of Preliminary Vibration Isolation Recommendations

From	To	Distance to Closest Receptor	Vibration Isolation Required	Insertion Loss (Reduction)	Critical Receptor Type	Expected Ground-Borne Vibration levels
McMaster University	Bowman Street	50m	Level 1 - Embedded	5dB	Low rise residential	<0.10 mm/s rms
Bowman Street	Macklin Road	17m	Level 1 - Embedded	5dB	Low rise residential	<0.10 mm/s rms
Macklin Road	Dundurn Street	25m	Level 1 - Embedded	5dB	Low rise residential	<0.10 mm/s rms
Dundurn Street	Margaret Street	6m	Level 3 - Floating	20dB	Low/mid rise residential	<0.10 mm/s rms
Margaret Street	Locke Street	-	Level 1 - Embedded	5dB	None	>0.10 mm/s rms
Locke Street	Ray Street	6m	Level 3 - Floating	15dB	Low rise residential	<0.10 mm/s rms
Ray Street	Hess Street	12m	Level 2 - Embedded	10dB	2nd storey residential	<0.10 mm/s rms
Hess Street	Caroline Street	7m	Level 3 - Floating	20dB	High rise residential	<0.10 mm/s rms
Caroline Street	Bay Street	13m	Level 2 - Embedded	10dB	2nd storey residential	<0.10 mm/s rms
Bay Street	Catharine Street	-	Level 1 - Embedded	5dB	None	>0.10 mm/s rms
Catharine Street	Wellington Street	6m	Level 3 - Floating	20dB	2nd storey residential	<0.10 mm/s rms
Wellington Street	West Avenue	-	Level 1 - Embedded	5dB	Commercial	<0.10 mm/s rms
West Avenue	Tisdale Street	12m	Level 2 - Embedded	10dB	Low rise/2nd storey residential	<0.10 mm/s rms
Tisdale Street	Wentworth Street	9m	Level 3 - Floating	15dB	Low and mid rise residential	<0.10 mm/s rms
Wentworth Street	Arthur Avenue	-	Level 1 - Embedded	5dB	None	>0.10 mm/s rms
Arthur Avenue	Farleigh Avenue	13m	Level 2 - Embedded	10dB	Mid rise residential	<0.10 mm/s rms
Farleigh Avenue	Holton Avenue	6m	Level 3 - Floating	20dB	Mid rise residential	<0.10 mm/s rms
Holton Avenue	Proctor Blvd	-	Level 1 - Embedded	5dB	None	>0.10 mm/s rms
Proctor Blvd	Belmont Avenue	7m	Level 3 - Floating	15dB	Low/mid rise residential	<0.10 mm/s rms
Belmont Avenue	Graham Avenue	10m	Level 2 - Embedded	10dB	Low rise residential	<0.10 mm/s rms
Graham Avenue	Kenilworth Avenue	-	Level 1 - Embedded	5dB	None	>0.10 mm/s rms
Kenilworth Avenue	Fairfield Avenue	10m	Level 2 - Embedded	10dB	Low rise residential	<0.10 mm/s rms
Fairfield Avenue	Potruff Road	15m	Level 1 - Embedded	5dB	Low rise residential	<0.10 mm/s rms
Potruff Road	50m east of Potruff	15m	Level 2 - Embedded	10dB	Mid rise residential	<0.10 mm/s rms
50m east of Potruff	Centennial Parkway	20m	Level 1 - Embedded	5dB	Low/mid/high rise residential	<0.10 mm/s rms

Notes:
- The recommendations in Table 11 are based on the findings in Section 5.4.3 and are based on the predominant receptor type along each section.
- There are some small areas where the vibration isolation achieved will be slightly better than required because of slightly higher setbacks for individual dwellings. These infrequent cases will need to be identified during detailed design.

5.5 Special Trackwork

Special trackwork includes switches, crossovers, and double-ended pocket track. There will be one double crossover at each terminus. There will also be a single crossover between Dundurn Street and Queen Street and another single crossover between Queen Street and Macnab Street. There will be a special bypass track system and associated switches at the Scott Park stop. Switches or crossovers will eventually be needed to allow access to the Maintenance and Storage Facility. The trackwork connecting the MSF to the main B-Line corridor will need to be reviewed as part of the MSF noise and vibration assessment.

Vibration levels immediately adjacent to special track structures can be up to 3 times (10dB) greater than vibration levels on tangent track (assuming the speed remains the same). The effects, however, are very local; thus, the vibration from special trackwork tends to affect only small areas.

The two double crossovers at each terminus are more than 40m away from the nearest residential receptor. Hence, despite the higher levels from the special trackwork, they should not need more than a basic (5dB) level of vibration isolation in order to meet the guidelines.

Depending on the exact locations, both of the single crossovers located between Dundurn Street and Macnab Street are likely to require more than the basic level of vibration isolation. For the crossover between Dundurn Street and Queen Street, the preferred location for the single crossover would be between Margaret Street and Locke Street. As there are no sensitive receptors in this stretch, the requirements for vibration isolation would be substantially lower. Similarly, for the crossover between Queen Street and Macnab Street, the preferred location for the single crossover would be east of Bay Street.

The special trackwork required for the Scott Park bypass is likely to need substantially more vibration isolation. Based on the preliminary review, this section of track may require a high performance floating slab system.

During the detailed design phase, it will be important to look at the above locations of the special trackwork and design for the locally higher vibration levels.

5.6 Detailed Soil Data

At the time of the assessment, specific soil data were unavailable. The nature of vibration propagation in an area will depend partly on the soil in the area. Typically, areas with well consolidated, fine sandy soils have higher propagation velocities than areas with clay-ey soils. During the detailed design phase, as additional geotechnical data become available, areas with sandy soils or soils with otherwise high propagation velocities should be noted. These areas may require further vibration isolation, especially if special track work is to be located on them.

5.7 Vibration-Sensitive Land Uses and Equipment

The MOE/TTC protocols generally consider only those sensitive receptors where people reside. This generally excludes commercial areas such as funeral homes, theatres, performance halls, courtrooms, lecture halls, etc. Because of higher ambient noise, these areas are generally less sensitive than residences or sleeping quarters. Areas where vibration-induced noise may affect the commercial viability of certain establishments (such as sleep clinics) should be identified during the detailed design phase. In these cases, upgraded vibration isolation may be advisable. It should be reiterated that airborne noise is likely to dominate wherever there is window exposure to the street; vibration-induced noise would not be as critical in those areas.

Specific aspects of institutional uses (church sanctuaries, lecture halls, etc.) are not addressed by the MOE/TTC protocol. The City has identified numerous commercial operations along the corridor which may be sensitive to vibration. While these areas are likely less sensitive than residential receptors, they should be investigated further during detailed design.

There are certain uses which contain equipment that is especially sensitive to vibration. These receivers could be affected by vibration levels well below perceptible levels. Vibration-sensitive equipment could include, but is not limited to, electron beam microscopes, research MRIs, photo lithography machines, and photo holography machines. The City of Hamilton has several institutions that may use such equipment and some of these may be especially sensitive to vibration. It is likely that, where is already mounted on some form of vibration isolation system, it will not be affected adversely by the introduction of light rail transit in the neighbourhood. Commonly, walking (the vibration from footfalls) causes higher local vibration levels than the LRT would under typical conditions. Vibration-sensitive equipment can be evaluated in more detail once the locations of potential sensitivity have been identified, during the detailed design phase.

6.0 CONSTRUCTION NOISE AND VIBRATION IMPACT ASSESSMENT

The impact of construction noise and vibration on nearby sensitive receptors has been reviewed. As the project has not reached the detailed design level, neither the specifics of equipment to be used in the construction process nor the construction process itself have been determined. The focus of the construction noise and vibration impact assessment is to develop a generic guideline to be further refined and expanded when more information becomes available during the detailed design phase. As the project is quite extensive, consideration is given not only to structural and health-related effects of construction noise and vibration, but also to community annoyance.

6.1 Identification of Noise and Vibration Sensitive Receptors

Construction noise- and vibration-sensitive receptors are identical to those identified for the main project's noise and vibration impact assessment. Residential receptors are the focus of this impact assessment as they are the predominant sensitive receptor in the corridor. Schools and other institutional uses are also considered as per the aforementioned guidelines. It is also recommended that for the long term construction areas, high-traffic commercial operations such as restaurants be treated as noise- and vibration-sensitive receptors.

Industrial and commercial sites are also considered with respect to structural vibration and noise impacts, although their sensitivity is normally much less than residential and institutional receivers.

6.2 General Construction Requirements

Provincial and municipal guidelines provide basic restrictions and recommendations with regard to construction noise and vibration. The City of Hamilton enforces a noise bylaw which prescribes appropriate hours of operation for construction activities.

The applicable guidelines can be found in the following documents:

1. MOE's Model Municipal Noise Control By-law;
2. The City of Hamilton By-Law No. 03-020, enacted January 22, 2003.
3. *NPC-115* 'Construction Equipment'
4. *NPC-205* 'Sound Level Limits for Stationary Sources in Class 1&2 (Urban) Areas'

The Provincial guidelines with regard to sound levels place specific restrictions on source equipment sound levels. The guidelines are written to restrict maximum allowable sound levels for equipment used in certain construction activities. The applicable guidelines can be found in *NPC-115*. *NPC-205* excludes noise sources related to construction activities.

6.3 Construction Scheduling Restrictions

By-Law No. 03-020 places restrictions on the hours of operation for all construction activity: in particular, construction is limited to between 7:00 a.m. and 7:00 p.m. on weekdays and Saturdays, with more stringent hours on Sundays and holidays. Due to the nature of the construction activities within the corridor, it is likely that much of the construction will need to be carried out through the night to minimize the impact on local traffic in the area. As such, special exemptions will need to be obtained where the construction is to occur. Because of the potential impact on receptors during the nighttime periods, it is recommended that the residents in the area be notified several weeks in advance of pending nighttime construction activities.

6.4 Potential Construction Impacts

Construction activity is by its nature, noisy. However, much of the construction required to build the B-Line LRT will use equipment similar to that required for road construction. A brief description of the various construction activities and the potential noise and vibration sources from those activities are summarized below. It is assumed that the normal construction by-laws are adhered to in all cases, unless otherwise noted.

6.4.1 General

Equipment that is expected to be used in all aspects of the construction of the LRT line will include vehicles such as dump trucks, dozers, concrete trucks, pavement breakers, and numerous other small conveyances and hand operated devices. Source-based guidelines can be found for much of this equipment in *NPC-115*.

6.4.2 LRT Construction

It is assumed that for the concrete-embedded sections, the LRT construction will be carried out in a manner similar to the other light rail projects in the country. Much of the noise resulting from this construction activity will be that which is typical of road construction, including utilities relocation. The total length of the construction activity will be long; however, the impact to a specific area will be comparatively short, as construction will progress from one area to the next. Intersections and areas with stops may be slightly longer in construction duration.

Some consideration should be given to employing the construction methods developed in Europe to construct light rail transit lines in heavily urbanized areas.

6.4.3 Ancillary Facility Construction

The construction of the power substations will be relatively quick and straight forward. They are not expected to generate much more noise than home construction and would be much shorter in duration. Most of the construction for ancillary facilities is expected to occur during the daytime, reducing the potential effects on nearby sensitive receptors.

6.4.4 Construction Staging Areas

All major construction projects necessitate a staging area to store materials and hardware and possibly engage in pre-assembly activities. If construction is to occur around the clock, these staging areas may also see continuous usage. While convenience in terms of proximity to the route is essential, nearby sensitive receptors should also be considered when selecting suitable staging areas. If they are located in an area with sensitive receptors, the staging areas are likely to cause an impact due to their extended presence in the neighborhood. The easiest way to reduce the impact is to ensure that the staging areas are located well away from nearby sensitive receptors. Alternatively, the construction of simple earth berms using waste material may also be a possibility where low-rise development is affected.

APPENDIX A: FIGURES

FIGURE 1
KEY PLAN

FIGURE 2
POR 1

FIGURE 3
POR 2

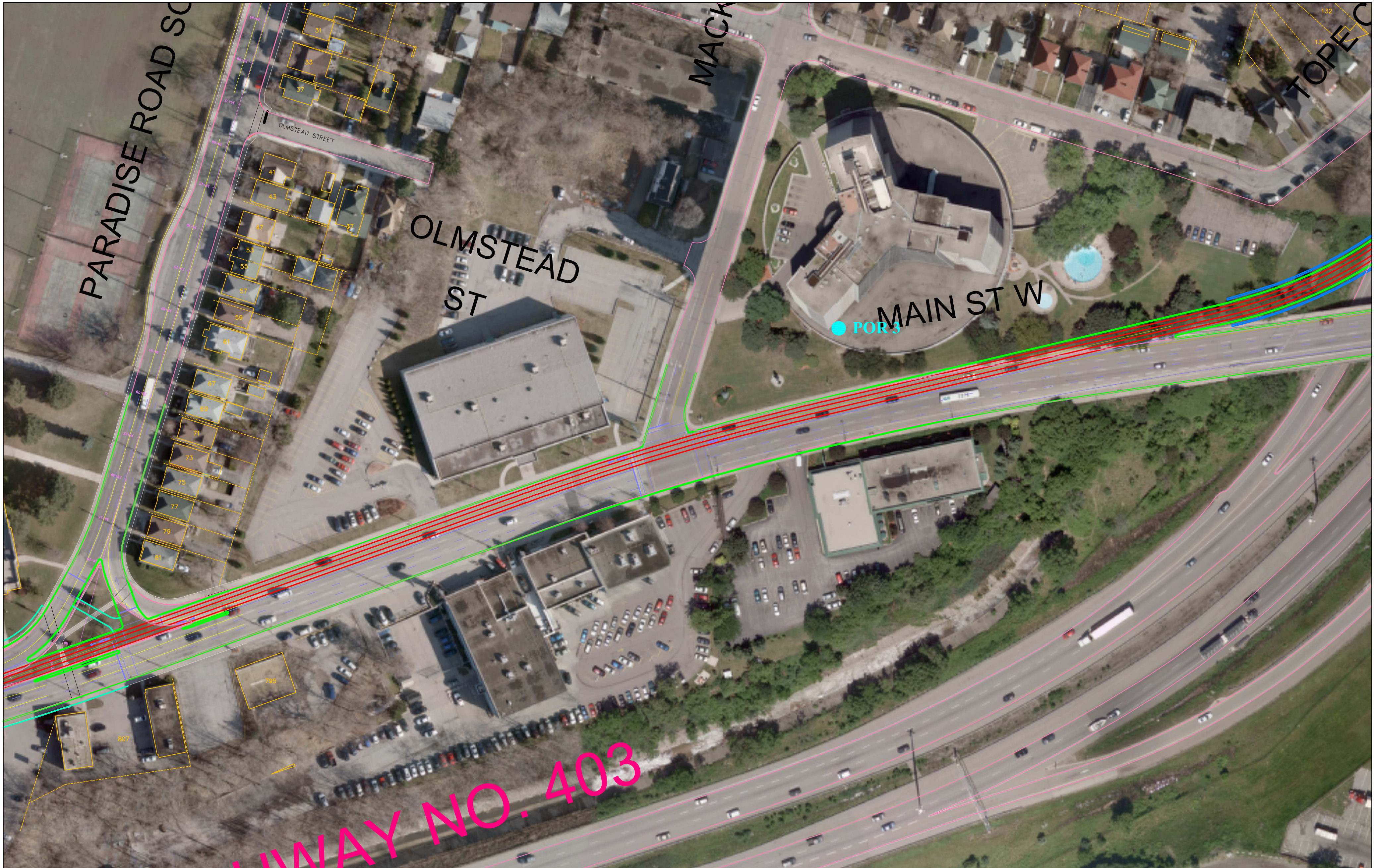


FIGURE 4
POR 3

FIGURE 5
POR 4

FIGURE 6
POR 5

FIGURE 7
POR 6

FIGURE 8
POR 7

FIGURE 9
POR 8

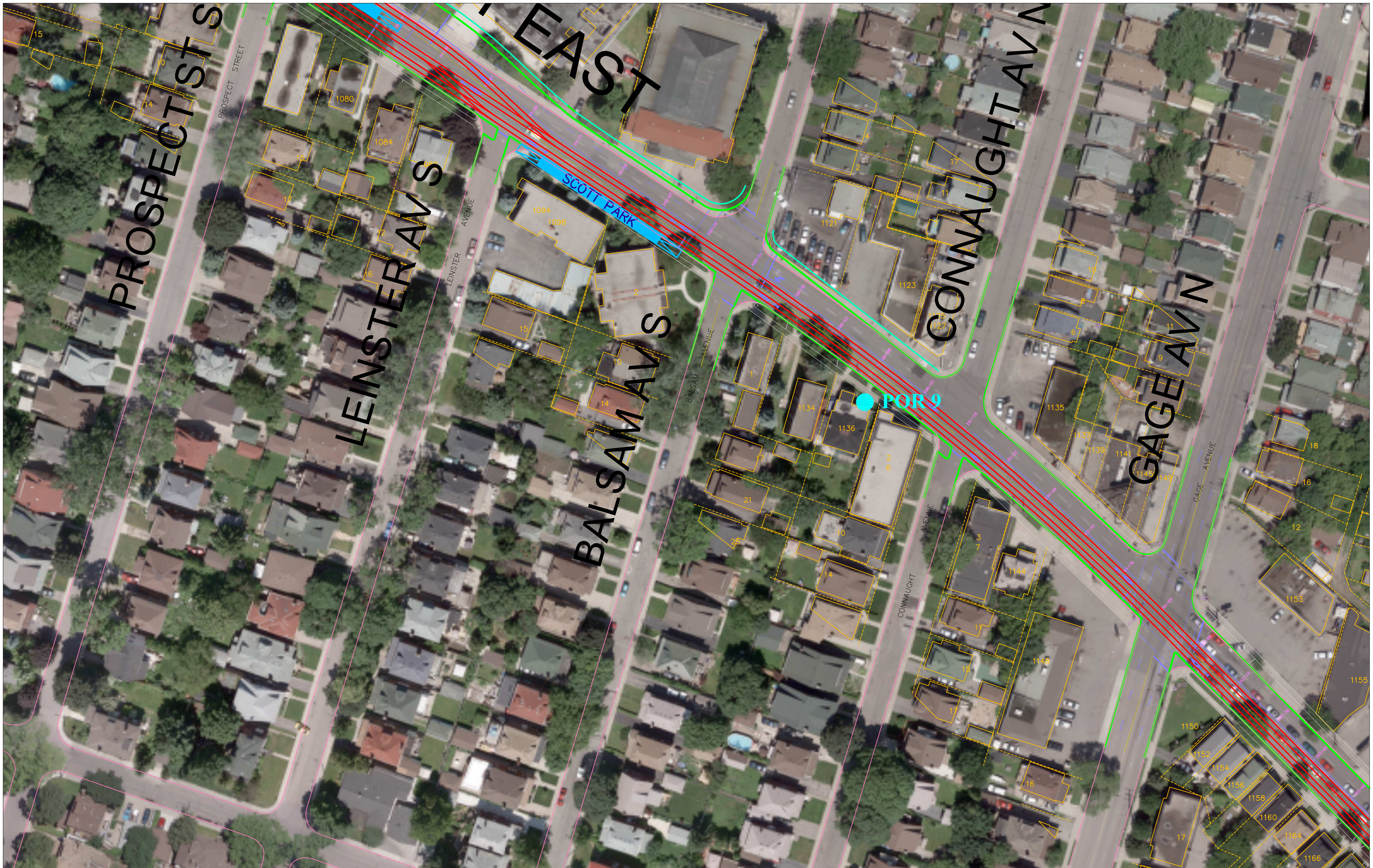


FIGURE 10
POR 9

FIGURE 11
POR 10

FIGURE 12
POR 11

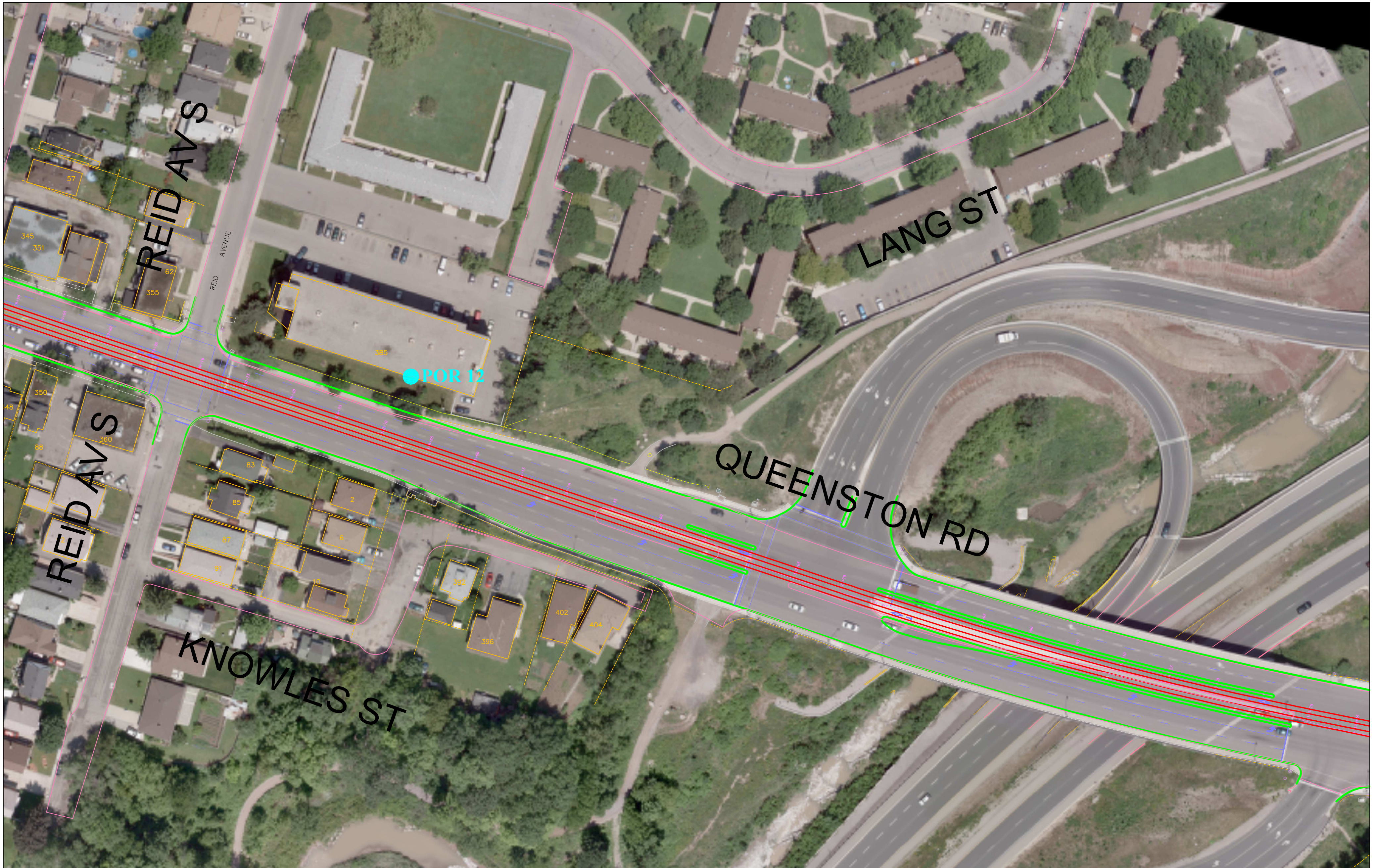


FIGURE 13
POR 12

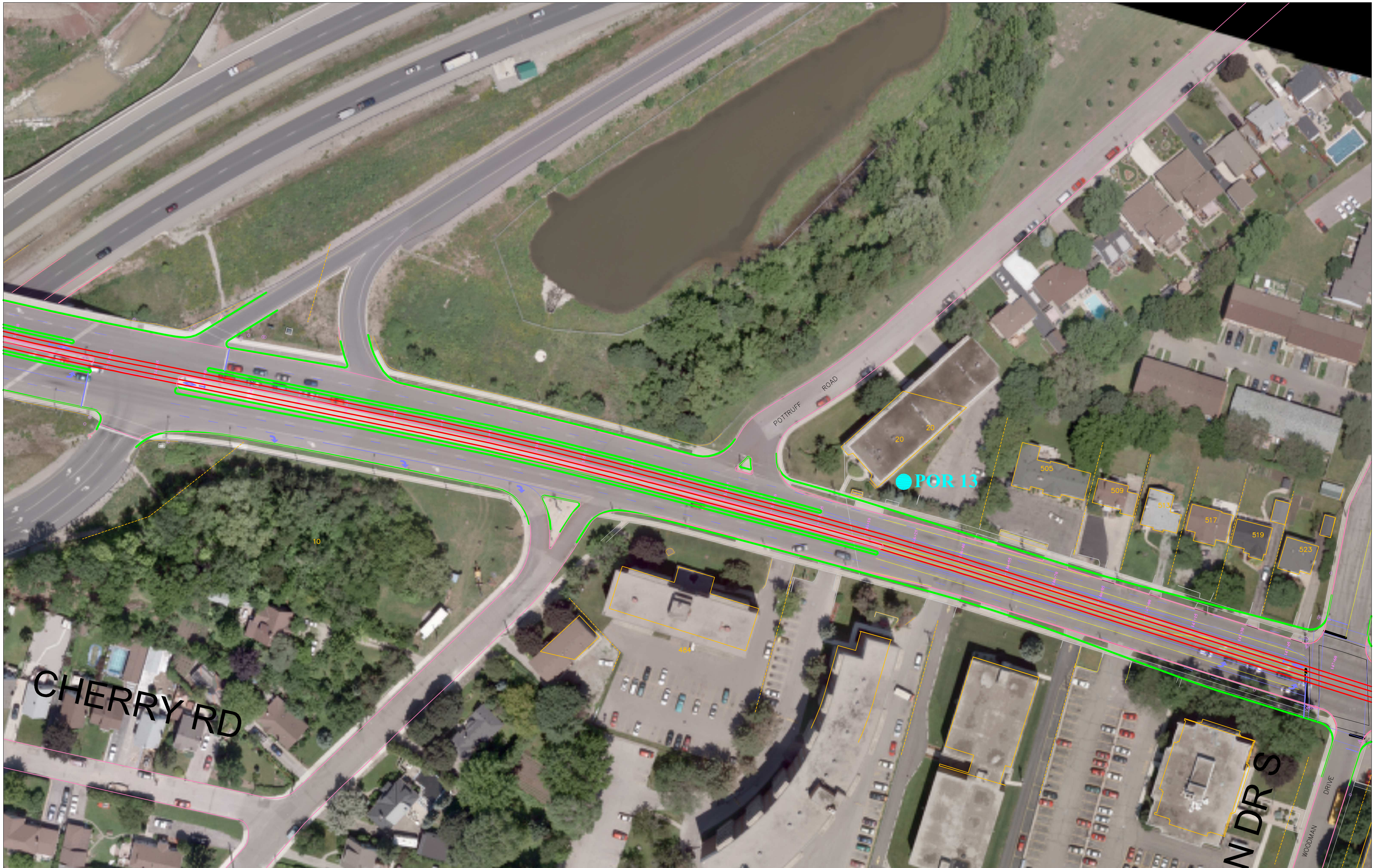


FIGURE 14
POR 13

FIGURE 15
POR 14

LEGEND

LEVEL 1 - EMBEDDED (5dB)

LEVEL 2 - EMBEDDED (10dB)

LEVEL 3 - FLOATING (15-20dB)

FIGURE 16
VIBRATION ISOLATION
McMASTER UNIVERSITY - LONGWOOD ROAD

LEGEND

LEVEL 1 - EMBEDDED (5dB)

LEVEL 2 - EMBEDDED (10dB)

LEVEL 3 - FLOATING (15-20dB)

FIGURE 17
VIBRATION ISOLATION
LONGWOOD ROAD - LOCKE STREET

LEGEND

LEVEL 1 - EMBEDDED (5dB)

LEVEL 2 - EMBEDDED (10dB)

LEVEL 3 - FLOATING (15-20dB)

FIGURE 18
VIBRATION ISOLATION
LOCKE STREET - HUGHSON STREET

LEGEND

LEVEL 1 - EMBEDDED (5dB)

LEVEL 2 - EMBEDDED (10dB)

LEVEL 3 - FLOATING (15-20dB)

FIGURE 19
VIBRATION ISOLATION
HUGHSON STREET - GRANT AVENUE

LEGEND

LEVEL 1 - EMBEDDED (5dB)

LEVEL 2 - EMBEDDED (10dB)

LEVEL 3 - FLOATING (15-20dB)

FIGURE 20
VIBRATION ISOLATION
GRANT AVENUE - CARRICK AVENUE

LEGEND

LEVEL 1 - EMBEDDED (5dB)	LEVEL 2 - EMBEDDED (10dB)	LEVEL 3 - FLOATING (15-20dB)

FIGURE 21
VIBRATION ISOLATION
CARRICK AVENUE - BELMONT AVENUE

LEGEND

LEVEL 1 - EMBEDDED (5dB)

LEVEL 2 - EMBEDDED (10dB)

LEVEL 3 - FLOATING (15-20dB)

FIGURE 22

VIBRATION ISOLATION

BELMONT AVENUE - WEIR STREET

LEGEND

LEVEL 1 - EMBEDDED (5dB)

LEVEL 2 - EMBEDDED (10dB)

LEVEL 3 - FLOATING (15-20dB)

FIGURE 23
VIBRATION ISOLATION
WEIR STREET - RED HILL VALLEY PARKWAY

LEGEND

LEVEL 1 - EMBEDDED (5dB)

LEVEL 2 - EMBEDDED (10dB)

LEVEL 3 - FLOATING (15-20dB)

FIGURE 24
VIBRATION ISOLATION
RED HILL VALLEY PARKWAY-
CENTENNIAL PARKWAY

APPENDIX B: GUIDELINES

MOEE/TTC
DRAFT
PROTOCOL FOR NOISE AND VIBRATION ASSESSMENT FOR THE PROPOSED SCARBOROUGH RAPID TRANSIT EXTENSION

May 11, 1993

TABLE OF CONTENTS

PROTOCOL FOR NOISE AND VIBRATION ASSESSMENT

PART A. PURPOSE

The Toronto Transit Commission (TTC) and the Ministry of the Environment and Energy (MOEE) recognize that transit facilities produce noise and vibration which may affect neighbouring properties within urbanized areas. This document identifies the framework within which criteria will be applied for limiting wayside air-borne noise and ground-borne noise and vibration from the TTC's proposed Scarborough Rapid Transit Line Extension (the "Line"). This proposed extension is to run from McCowan station to Markham Road and Sheppard Avenue East. The framework presented in this document is to be applied for planning purposes in order to address the requirements of the Environmental Assessment Act and is to be utilized during implementation of the Line.

The passby sound levels and vibration velocities in this protocol have been developed specifically for the Line and this protocol is not to be applied retroactively to existing TTC transit Lines, routes or facilities, including the existing SRT line, nor to transit authorities other than TTC. Further, the criteria specified for this project are not precedent setting for future projects.

Prediction and measurement methods are being developed by the TTC. This will be done in consultation with MOEE and the Ministry of Transportation (MTO). Studies pertaining to noise and vibration levels are also being conducted by TTC. Upon completion of these studies, the TTC may revisit the assessment criteria and methods in this protocol to modify them as required in consultation with MOEE and the Ministry of Transportation (MTO).

PART B. GENERAL

During design of the Line, predicted wayside sound levels and vibration velocities are to be compared to criteria given in this protocol. This will permit an impact assessment and help determine the type or extent of mitigation measures to reduce that impact. Sound levels and vibration velocities will be predicted from sound levels and velocities of TTC's existing rail technologies.

The criteria presented in this document are based on good operating conditions and the impact assessment assumes this condition. Good operating conditions exist when well maintained vehicles operate on well maintained continuous welded rail without significant rail corrugation. It is recognised that wheel flats or rail corrugations will inevitably occur and will temporarily increase sound and vibration levels until they are corrected. Levels in this protocol do not reflect these occasional events, nor do they apply to maintenance activities on the Line. TTC recognizes that wheel rail squeal is a potential source of noise which may pose a concern to the community. TTC is investigating and will continue to investigate measures to mitigate wheel rail squeal and will endeavour to mitigate this noise source. TTC endeavours to minimize the noise and vibration impacts associated with its transit operations and is committed to providing good operating conditions to the extent technologically, economically and administratively feasible.

It is recognised that levels of sound and vibration at special trackwork, such as at crossovers and turnouts, are inevitably higher than along tangent track. Also, there is a limit to the degree of mitigation that is feasible at special trackwork areas. This is to be taken into account in predicting sound and vibration levels near these features and in applying the levels in this protocol. Special trackwork, such as at crossovers and turnouts, is encompassed within the framework of this document.

This protocol applies to existing and proposed residential development having municipal approval on the date of this protocol. The protocol also applies to existing and municipally approved proposed nursing homes, group homes, hospitals and other such institutional land uses where people reside. This protocol does not apply to commercial and industrial land uses.

This protocol does not apply closer than 15 m to the centreLine of the nearest track. Any such cases shall be assessed on a case by case basis.

Part D of this document deals with airborne noise from the Line and its construction. Part E deals with groundborne noise and vibration from the Line.

PART C. DEFINITIONS

The following definitions apply to both parts D and E of this document.

Ancillary Facilities:

Subsidiary locations associated with either the housing of personnel or equipment engaged in TTC activities or associated with mainLine revenue operations. Examples of ancillary facilities include, but are not limited to, subway stations, bus terminals, emergency services buildings, fans, fan and vent shafts, substations, mechanical equipment plants, maintenance and storage facilities, and vehicle storage and maintenance facilities.

Passby Time Interval:

The passby time interval of a vehicle or train is given by its total length and its speed. The start of the pass-by is defined as that point in time when the leading wheels pass a reference point. The end of the pass-by is defined as that point in time when the last wheels of the vehicle or train pass the same reference point. The reference point is to be chosen to give the highest level at the point of reception or point of assessment, i.e. usually at the point of closest approach. From a signal processing perspective, the passby time interval will be defined in the prediction and measurement methods being developed.

PART D. AIR BORNE NOISE

1.0 DEFINITIONS

The following definitions are to be used only within the context of Part D of this document.

Ambient:

The ambient is the sound existing at the point of reception in the absence of all noise from the Line. In this protocol the ambient is taken to be the noise from road traffic and existing industry. The ambient specifically excludes transient noise from aircraft and railways, except for pre-existing TTC rail operations.

Daytime Equivalent Sound Level:

$L_{eq,16h}$ is the daytime equivalent sound level. The definition of equivalent sound level is provided in Reference 2. The applicable time period is from 07:00 to 23:00 hours.

Nighttime Equivalent Sound Level:

$L_{eq,8h}$ is the nighttime equivalent sound level. The applicable time period is from 23:00 to 07:00 hours.

Point of Reception:

Daytime: 07:00 - 23:00 hours

Any outdoor point on residential property, 15 m or more from the nearest track's centreLine, where sound originating from the Line is received.

Nighttime: 23:00 - 07:00 hours

The plane of any bedroom window, 15 m or more from the nearest track's centreLine, where sound originating from the Line is received. At the planning stage, this is usually assessed at the nearest facade of the premises.

Passby Sound Level, L_{passby} :

Within the context of this document, the passby sound level is defined as the A-weighted equivalent sound level, L_{eq} [Reference 2] over the passby time interval.

2.0 RAIL TRANSIT

In the assessment of noise impact, rail transit is considered to include the movement of trains between stations, the movement and idling of trains inside stations as well as the movement of trains between the mainline and ancillary facilities. Ancillary facilities are not considered part of the rail transit and are assessed as stationary sources. Trains idling in maintenance yards and storage facilitities are part of the stationary source.

The assessment of noise impact resulting from Line is to be performed in terms of the following sound level descriptors:

1) Daytime equivalent sound level, $L_{eq,16h}$,
2) Nighttime equivalent sound level, $L_{eq,8h}$,
3) Passby Sound Level, L_{passby}.

The predicted daytime and nighttime equivalent sound levels include the effects of both passby sound level and frequency of operation and are used to assess the noise impact of the Line. The Passby Sound Level criterion is used to assess the sound levels received during a single train passby. The criteria and methods to be used are discussed in Sections 2.1 and 2.2.

2.1 Criteria

Noise impact shall be predicted and assessed during design of the Line using the following sound level criteria:

DAYTIME EQUIVALENT SOUND LEVEL:

The limit at a point of reception for the predicted daytime equivalent sound levels for rail transit operating alone (excluding contributions from the ambient) is 55 dBA or the ambient $L_{eq,16h}$, whichever is higher.

NIGHTTIME EQUIVALENT SOUND LEVEL:

The limit at a point of reception for the predicted nighttime equivalent sound levels for rail transit operating alone (excluding contributions from the ambient) is 50 dBA or the ambient $L_{eq,8h}$, whichever is higher.

PASSBY SOUND LEVEL:

The limit at a point of reception for predicted L_{passby} for a single train operating alone and excluding contributions from other sources is 80 dBA. This limit is based on vehicles operating on tangent track. It does not apply within 100m of special trackwork and excludes wheel rail squeal.

Mitigating measures will be incorporated in the design of the Line when predictions show that any of the above limits are exceeded by more than 5 dB. All mitigating measures shall ensure that the predicted sound levels are as close to, or lower than, the respective limits as is technologically, economically, and administratively feasible.

2.2 Prediction

In most cases, a reasonable estimate of the ambient sound level can be made using a road traffic noise prediction method such as that described in Reference 9, and the minimum sound levels in Table 106-2 of Reference 6. Prediction of road traffic L_{eq} is preferred to individual measurements in establishing the ambient. Prediction techniques for the L_{eq} from road traffic and the L_{eq} or L_{passby} from transit shall be compatible with one another. Any impact assessment following this protocol shall include a description of the prediction method and the assumptions and sound level data inherent in it. Prediction and measurement methods compatible with MOEE guidelines and procedures are being developed by the TTC at the date of this protocol in consultation with MTO and MOEE.

3.0 ANCILLARY FACILITIES

Predicted noise impacts from ancillary facilities shall be assessed during the design of the Line in accordance with the stationary source guideLines detailed in Reference 5. The predictions used shall be compatible with and at least as accurate as CSA Standard Z107.55.

4.0 BUSES IN MIXED TRAFFIC

Where buses are part of the road traffic there are no additional criteria requirements beyond those presented in the Ministry of Transportation of Ontario Protocol for dealing with noise concerns during the preparation, review and evaluation of Provincial Highways Environmental Assessments [Reference 1]. Buses should be considered as medium trucks in the traffic noise prediction models.

5.0 CONSTRUCTION

Noise impacts from the construction of the Line are to be examined. For the purposes of impact assessment and identifying the need for mitigation, the Ministry of the Environment and Energy guideLines for construction presented in Reference 7 are to be referred to.

PART E. GROUND-BORNE VIBRATION

The assessment of ground-borne vibration impact is confined to the vibration that is produced by the operation of the Line and excludes vibration due to maintenance activities.

In recognition of the fact that the actual vibration response of a building is affected by its own structural characteristics, this document deals with the assessment of ground borne vibration only on the outside premises. Structural characteristics of buildings are beyond the scope of this protocol and beyond the control of the TTC.

1.0 DEFINITIONS

The following definitions are to be used only within the context of Part E of this document.

Point of Assessment:

A point of assessment is any outdoor point on residential property, 15 m or more from the nearest track's centreLine, where vibration originating from the Line is received.

Vibration Velocity:

Vibration Velocity is the root-mean-square (rms) vibration velocity assessed during a train pass-by. The unit of measure is metres per second (m/s) or millimetres per second (mm/s). For the purposes of this protocol only vertical vibration is assessed. The vertical component of transit vibration is usually higher than the horizontal. Human sensitivity to horizontal vibration at the frequencies of interest is significantly less than the sensitivity to vertical vibration.

2.0 VIBRATION ASSESSMENT

Vibration velocities at points of assessment shall be predicted during design of the Line. If the predicted rms vertical vibration velocity from the Line exceeds 0.1 mm/sec, mitigation methods shall be applied during the detailed design to meet this criterion to the extent technologically, economically, and administratively feasible.

Any impact assessment following this protocol shall include a description of the prediction method and the assumptions and data inherent in it. Prediction and measurement methods are being developed by the TTC at the date of this protocol in cooperation with MTO and MOEE.

References

1)**A Protocol for Dealing With Noise Concerns During the Preparation, Review and Evaluation of Provincial Highways Environmental Assessments**, Ministry of Transportation, February 1986.

2)**Model Municipal Noise Control By-Law, Final Report, Publication NPC-101 Technical Definitions**, Ministry of the Environment, August 1978.

3)**Model Municipal Noise Control By-Law, Final Report, Publication NPC-103 Procedures**, Ministry of the Environment, August 1978.

4)**Model Municipal Noise Control By-Law, Final Report, Publication NPC-104 Sound Level Adjustments**, Ministry of the Environment, August 1978.

5)**Model Municipal Noise Control By-Law, Final Report, Publication NPC-105 Stationary Sources**, Ministry of the Environment, August 1978.

6)**Model Municipal Noise Control By-Law, Final Report, Publication NPC-106 Sound Levels of Road Traffic**, Ministry of the Environment, August 1978.

7)**Noise Control GuideLine For Class Environmental Assessment of Undertakings**, February 1980, Ministry of the Environment.

8)**Toronto Subway System Track Vibration Isolation System (Double Tie) - Technical Report**, TTC Engineering Department, June 1982.

9)**STAMSON 4.1**, Ontario Ministry of the Environment Road and Rail Noise Prediction Software

MOEE/TTC

DRAFT

PROTOCOL FOR NOISE AND VIBRATION ASSESSMENT FOR THE PROPOSED WATERFRONT WEST LIGHT RAIL TRANSIT LINE

November 11, 1993

TABLE OF CONTENTS

PROTOCOL FOR NOISE AND VIBRATION ASSESSMENT

PART A. PURPOSE

The Toronto Transit Commission (TTC) and the Ministry of the Environment and Energy (MOEE) recognise that transit facilities produce noise and vibration which may affect neighbouring properties within urbanised areas. This document identifies the framework within which criteria will be applied for limiting wayside air-borne noise, ground-borne noise and vibration from the TTC's proposed Waterfront West Light Rail Transit Line (the "Line"). The proposed line is to run from Spadina and Queen's Quay West to the CNE Dufferin Street Gate and from the Humber Loop to Legion Road. The framework presented in this document is to be applied for planning purposes in order to address the requirements of the Environmental Assessment Act and is to be utilized during implementation of the Line.

The passby sound levels and vibration velocities in this protocol have been developed specifically for the Line and this protocol is not to be applied retroactively to existing TTC transit lines, routes or facilities, including the existing lines with which this line will intersect, nor to transit authorities other than TTC. Further, the criteria specified for this project are not precedent setting for future projects.

Prediction and measurement methods are being developed by the TTC. This will be done in consultation with MOEE and the Ministry of Transportation (MTO). Studies pertaining to noise and vibration levels are also being conducted by TTC. Upon completion of these studies, the TTC may revisit the assessment criteria and methods in this protocol to modify them as required in consultation with MOEE and the Ministry of Transportation (MTO).

PART B. GENERAL

During design of the Line, predicted wayside sound levels and vibration velocities are to be compared to criteria given in this protocol. This will permit an impact assessment and help determine the type or extent of mitigation measures to reduce that impact. Sound levels and vibration velocities will be predicted from sound levels and velocities of TTC's existing rail technologies.

The criteria presented in this document are based on good operating conditions and the impact assessment assumes this condition. Good operating conditions exist when well maintained vehicles operate on well maintained continuous welded rail without significant rail corrugation. It is recognised that wheel flats or rail corrugations will inevitably occur and will temporarily increase sound and vibration levels until they are corrected. Levels in this protocol do not reflect these occasional events, nor do they apply to maintenance activities on the Line. TTC recognizes that wheel rail squeal is a potential source of noise which may pose a concern to the community. TTC is investigating and will continue to investigate measures to mitigate wheel rail squeal and will endeavour to mitigate this noise source. TTC endeavours to minimize the noise and vibration impacts associated with its transit operations and is committed to providing good operating conditions to the extent technologically, economically and administratively feasible.

It is recognised that levels of sound and vibration at special trackwork, such as at crossovers and turnouts, are inevitably higher than along tangent track. Also, there is a limit to the degree of mitigation that is feasible at special trackwork areas. This is to be taken into account in predicting sound and vibration levels near these features and in applying the levels in this protocol. Special trackwork, such as at crossovers and turnouts, is encompassed within the framework of this document.

This protocol applies to existing and proposed residential development having municipal approval on the date of this protocol. The protocol also applies to existing and municipally approved proposed nursing homes, group homes, hospitals and other such institutional land uses where people reside. This protocol does not apply to commercial and industrial land uses.

This protocol does not apply closer than 15 m to the centreline of the nearest track. Any such cases shall be assessed on a case by case basis.

Part D of this document deals with air-borne noise from the Line and its construction. Part E deals with ground-borne noise and vibration from the Line.

PART C. DEFINITIONS

The following definitions apply to both parts D and E of this document.

Ancillary Facilities:

Subsidiary locations associated with either the housing of personnel or equipment engaged in TTC activities or associated with mainline revenue operations. Examples of ancillary facilities include, but are not limited to, subway stations, bus terminals, emergency services buildings, fans, fan and vent shafts, substations, mechanical equipment plants, maintenance and storage facilities, and vehicle storage and maintenance facilities.

Passby Time Interval:

The passby time interval of a vehicle is given by its total length and its speed. The start of the pass-by is defined as that point in time when the leading wheels pass a reference point. The end of the pass-by is defined as that point in time when the last wheels of the vehicle pass the same reference point. The reference point is to be chosen to give the highest level at the point of reception or point of assessment, i.e. usually at the point of closest approach. From a signal processing perspective, the passby time interval will be defined in the prediction and measurement methods being developed.

PART D. AIR-BORNE NOISE

1.0 DEFINITIONS

The following definitions are to be used only within the context of Part D of this document.

Ambient:

The ambient is the sound existing at the point of reception in the absence of all noise from the Line. In this protocol the ambient is taken to be the noise from road traffic and existing industry. The ambient specifically excludes transient noise from aircraft and railways, except for pre-existing TTC rail operations.

Daytime Equivalent Sound Level:

$L_{eq,16h}$, is the daytime equivalent sound level. The definition of equivalent sound level is provided in Reference 2. The applicable time period is from 07:00 to 23:00 hours.

Nighttime Equivalent Sound Level:

$L_{eq,8h}$ is the nighttime equivalent sound level. The applicable time period is from 23:00 to 07:00 hours.

Point of Reception:

Daytime: 07:00 - 23:00 hours

Any outdoor point on residential property, 15 m or more from the nearest track's centreline, where sound originating from the Line is received.

Nighttime: 23:00 - 07:00 hours

The plane of any bedroom window, 15 m or more from the nearest track's centreline, where sound originating from the Line is received. At the planning stage, this is usually assessed at the nearest facade of the premises.

Passby Sound Level, L_{passby} :

Within the context of this document, the passby sound level is defined as the A-weighted equivalent sound level, L_{eq} [Reference 2] over the passby time interval.

2.0 RAIL TRANSIT

In the assessment of noise impact, rail transit is considered to include the movement of vehicles between stations, the movement and idling of vehicles inside stations as well as the movement of vehicles between the mainline and ancillary facilities. Ancillary facilities are not considered part of the rail transit and are assessed as stationary sources. Vehicles idling in maintenance yards and storage facilities are part of the stationary source.

The assessment of noise impact resulting from the Line is to be performed in terms of the following sound level descriptors:

1) Daytime equivalent sound level, $L_{eq,16h}$,
2) Nighttime equivalent sound level, $L_{eq,8h}$,
3) Passby Sound Level, L_{passby}.

The predicted daytime and nighttime equivalent sound levels include the effects of both passby sound level and frequency of operation and are used to assess the noise impact of the Line. The Passby Sound Level criterion is used to assess the sound levels received during a single vehicle passby. The criteria and methods to be used are discussed in Sections 2.1 and 2.2.

2.1 Criteria

Noise impact shall be predicted and assessed during design of the Line using the following sound level criteria:

DAYTIME EQUIVALENT SOUND LEVEL:

The limit at a point of reception for the predicted daytime equivalent sound levels for rail transit operating alone (excluding contributions from the ambient) is 55 dBA or the ambient $L_{eq,16h}$, whichever is higher.

NIGHTTIME EQUIVALENT SOUND LEVEL:

The limit at a point of reception for the predicted nighttime equivalent sound levels for rail transit operating alone (excluding contributions from the ambient) is 50 dBA or the ambient $L_{eq,8h}$, whichever is higher.

PASSBY SOUND LEVEL:

The limit at a point of reception for predicted L_{passby} for a single vehicle operating alone and excluding contributions from other sources is 80 dBA. This limit is based on vehicles operating on tangent track. It does not apply within 100m of special trackwork and excludes wheel rail squeal.

Mitigating measures will be incorporated in the design of the Line when predictions show that any of the above limits are exceeded by more than 5 dB. All mitigating measures shall ensure that the predicted sound levels are as close to, or lower than, the respective limits as is technologically, economically, and administratively feasible.

2.2 Prediction

In most cases, a reasonable estimate of the ambient sound level can be made using a road traffic noise prediction method such as that described in Reference 8, and the minimum sound levels in Table 106-2 of Reference 6. Prediction of road traffic L_{eq} is preferred to individual measurements in establishing the ambient. Prediction techniques for the L_{eq} from road traffic and the L_{eq} or $L_{eq(day)}$ from transit shall be compatible with one another. Any impact assessment following this protocol shall include a description of the prediction method and the assumptions and sound level data inherent in it. Prediction and measurement methods compatible with MOEE guidelines and procedures are being developed by the TTC at the date of this protocol in consultation with MTO and MOEE.

3.0 ANCILLARY FACILITIES

Predicted noise impacts from ancillary facilities shall be assessed during the design of the Line in accordance with the stationary source guidelines detailed in Reference 6. The predictions used shall be compatible with and at least as accurate as CSA Standard Z107.55.

4.0 BUSES IN MIXED TRAFFIC

Where buses are part of the road traffic there are no additional criteria requirements beyond those presented in the Ministry of Transportation of Ontario Protocol for dealing with noise concerns during the preparation, review and evaluation of Provincial Highways Environmental Assessments [Reference 1]. Buses should be considered as medium trucks in the traffic noise prediction models.

5.0 CONSTRUCTION

Noise impacts from the construction of the Line are to be examined. For the purposes of impact assessment and identifying the need for mitigation, the Ministry of the Environment and Energy guidelines for construction presented in Reference 7 are to be referred to.

PART E. GROUND-BORNE VIBRATION

The assessment of ground-borne vibration impact is confined to the vibration that is produced by the operation of the Line and excludes vibration due to maintenance activities.

In recognition of the fact that the actual vibration response of a building is affected by its own structural characteristics, this document deals with the assessment of ground-borne vibration only on the outside premises. Structural characteristics of buildings are beyond the scope of this protocol and beyond the control of the TTC.

It is recognised that ground-borne vibration can produce air-borne noise inside a structure and there is a direct correlation between the two. The TTC can only control ground-borne noise by controlling ground-borne vibration. Accordingly, ground-borne noise will be predicted and assessed in terms of vibration measured at a point of assessment using the limit in Section 2.0, Vibration Assessment.

1.0 DEFINITIONS

The following definitions are to be used only within the context of Part E of this document.

Point of Assessment:

A point of assessment is any outdoor point on residential property, 15 m or more from the nearest track's centreline, where vibration originating from the Line is received.

Vibration Velocity:

Vibration Velocity is the root-mean-square (rms) vibration velocity assessed during a vehicle pass-by. The unit of measure is metres per second (m/s) or millimetres per second (mm/s). For the purposes of this protocol only vertical vibration is assessed. The vertical component of transit vibration is usually higher than the horizontal. Human sensitivity to horizontal vibration at the frequencies of interest is significantly less than the sensitivity to vertical vibration.

2.0 VIBRATION ASSESSMENT

Vibration velocities at points of assessment shall be predicted during design of the Line. If the predicted rms vertical vibration velocity from the Line exceeds 0.14 mm/sec, mitigation methods shall be applied during the detailed design to meet this criterion to the extent technologically, economically and administratively feasible.

Any impact assessment following this protocol shall include a description of the prediction method and the assumptions and data inherent in it. Prediction and measurement methods are being developed by the TTC at the date of this protocol in cooperation with MTO and MOEE.

NPC-115

Construction Equipment

1. **Scope**

   This Publication sets sound emission standards for various items of new construction equipment according to the date of manufacture of the equipment.

2. **Technical Definitions**

   The technical terms used in this Publication are defined in Publication NPC101 Technical Definitions.

3. **Sound Emission Standards**

   Tables 115-1 to 115-4 inclusive list Residential Area sound emission standards and Quiet Zone sound emission standards for specific items of new construction equipment measured in accordance with the procedures indicated.

TABLE 115-1

Quiet Zone and Residential Area Sound Emission Standards for Excavation Equipment, Dozers, Loaders, Backhoes or Other Equipment Capable of Being Used for Similar Application

Maximum Sound Level (dBA) as determined using Publication NPC - 103 - Procedures, section 6		
	dBA	
Date of Manufacture	Power Rating Less than 75 kW	Power Rating 75 kW and Larger
January 1, 1979 to December 31, 1980	85	88
January 1, 1981 and after	83	85

TABLE 115-2

Sound Emission Standards for Pneumatic Pavement Breakers

Standard	Date of Manufacture	Maximum Sound Level (dBA) as measured using Publication NPC - 103
Quiet Zone Sound Emission	January 1, 1979 and after	85
Residential Area Sound Emission Standard	January 1, 1979 to December 31, 1980	90
	January 1, 1981 and after	85

TABLE 115-3

Sound Emission Standards for Portable Air Compressors

Standard	Date of Manufacture	Maximum Sound Level (dBA) as measured using Publication NPC - 103
Quiet Zone Sound Emission Standard	January 1, 1979 to December 31, 1980	76
	January 1, 1981 and after	70
Residential Area Sound Emission	January 1, 1979 and after	76

NPC-115

TABLE 115-4

Sound Emission Standard for Tracked Drills

Standard	Date of Manufacture	Maximum Sound Level (dBA) as measured using Publication NPC - 103 Procedures, section 6
Quiet Zone and Residential Area Sound Emission Standard	January 1, 1981 and after	100

APPENDIX C: REFERENCES

1. Ministry of the Environment, "Model Municipal Noise Control By-Law, Final Report", August, 1978.

2. Ministry of the Environment, Noise Assessment Criteria in Land Use Planning, Publication *LU-131*, October 1997 and its Annex, October 1997.

3. Ministry of the Environment's *STAMSON* Computer Programme (Version 5.03).

4. Ministry of Transportation of Ontario, Provincial and Environmental Planning Office "Environmental Guide for Noise", October 2006.

5. Model Municipal Noise Control By-Law, Final Report, Publication *NPC-101* Technical Definitions, Ministry of the Environment, August 1978

6. Model Municipal Noise Control By-Law, Final Report, Publication *NPC-102* Instrumentation, Ministry of the Environment, August 1978

7. Model Municipal Noise Control By-Law, Final Report, Publication *NPC-103* Procedures, Ministry of the Environment, August 1978

8. Model Municipal Noise Control By-Law, Final Report, Publication *NPC-104* Sound Level Adjustments, August 1978

9. Ministry of the Environment, Sound Level Limits for Stationary Sources in Class 1 and 2 Areas (Urban), Publication NPC-205, October 1995

10. Ministry of the Environment, Sound Levels Due to Road Traffic, Publication *NPC-206*, October 1995

11. City of Toronto Municipal Code, Chapter 591, Noise, Amended December 2007

12. City of Toronto Municipal Code, Chapter 363, Building Construction and Demolition, December 2008

13. Model Municipal Noise Control By-Law, Final Report, Publication *NPC-115*, Construction Equipment, August 1978

APPENDIX D: DEFINITIONS

1 dB CHANGE (Noise)

For sounds experienced by a listener, one immediately following the other, a 1 dB change is the smallest increment which can be reliably detected by most people. If the time delay between experiencing the sounds is more than a few seconds, the change is not reliably detected (i.e., the listener is not sensitive to a 1 dB change occurring over 1 year's time). In environmental noise, a 1 dB change occurs with an increase in traffic of 25%.

3 dB CHANGE (Noise)

An increase in the L_{eq} of 3 dB is reliably detected by most listeners, and is the smallest change considered significant by most planning authorities. It is the smallest change in the overall L_{eq} (all sounds combined) which can be reliably detected by standard noise monitoring techniques. A doubling of traffic in a community will cause a 3 dB change, if traffic is the only major noise source.

5 dB CHANGE (Noise)

An increase in the overall L_{eq} of 5 dB represents a relatively significant impact in terms of overall Leq, particularly if an area is already at or above daytime L_{eq} of 55.

10 dB CHANGE (Noise)

A 10 dB increase in overall L_{eq} represents a doubling in the loudness of the sound, and represents a major impact on an urban community, especially if the levels are already above 50 L_{eq}.

Leq

L_{eq} is the sound pressure level averaged over the measurement period. It can be considered as the continuous steady sound pressure level that would have the same total acoustic energy as the real fluctuating noise over the same time period. This index is the most representative measure of community response to sound levels.

Ground-borne Vibration

Ground-borne vibration is vibration transmitted through the soil that is felt, rather than heard. Typically, vibration levels are most felt at frequencies below 50Hz.

Vibration-induced Noise

Vibration-induced noise is a result of ground-borne vibration being transmitted into the structure of a building and radiating as a “rumbly” sound that is more audible than “feelable” to the touch. Generally, vibration-induced noise is a concern at frequencies greater than 50Hz.

Vibration Velocity

Vibration velocity is the speed at which the building or ground moves up and down or sideways as it oscillates. It is does not relate to how fast the vibration wave is moving along in the soil.

Double Crossover

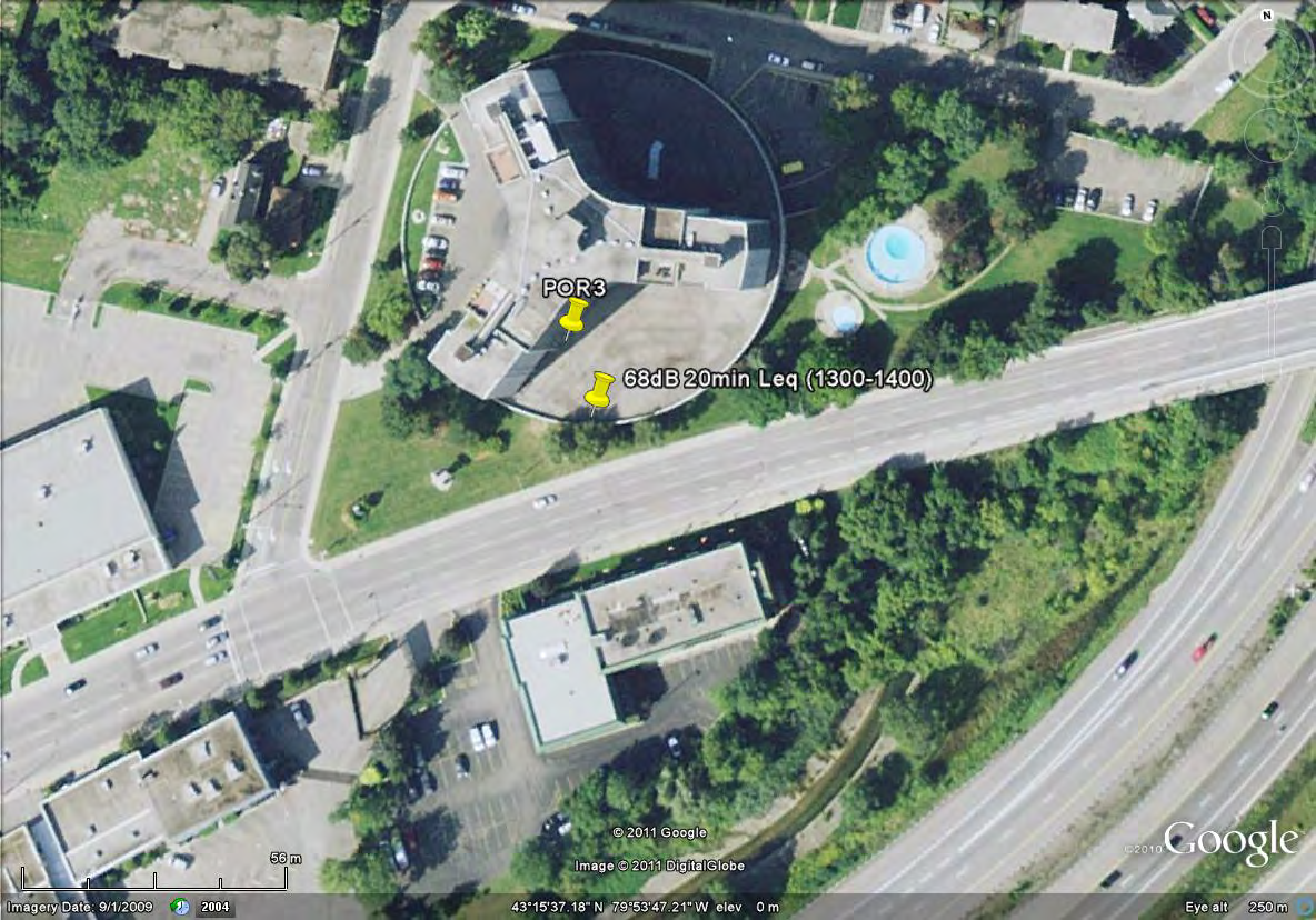
A type of special trackwork structure that allows a rail vehicle to switch directions, without the need for a loop.

Double-ended Pocket Track

A type of special trackwork structure that allows a vehicle to be stored in between two tracks in case of emergencies/vehicle breakdown.

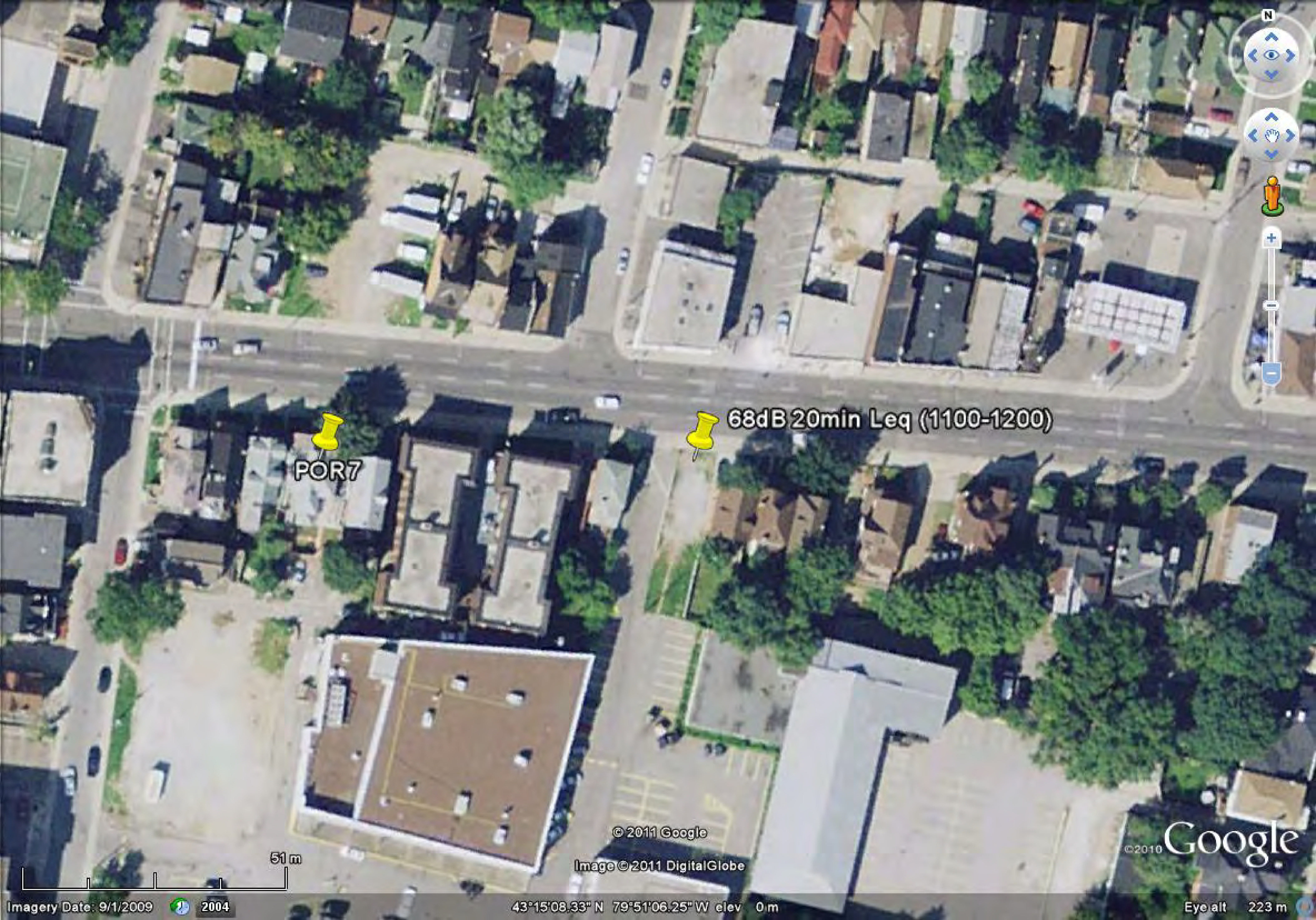
APPENDIX E: SOUND LEVEL MEASUREMENT DETAILS

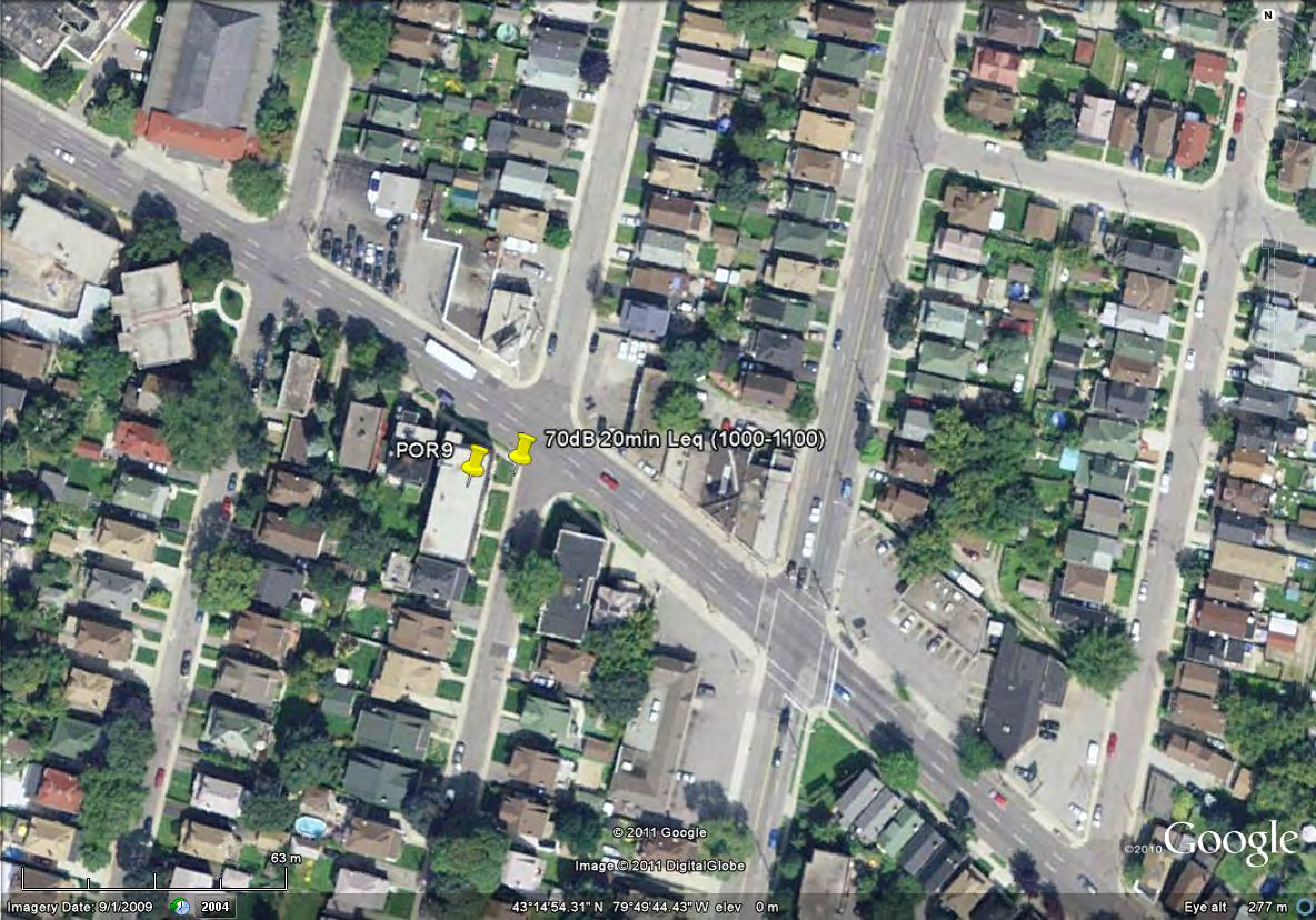
9/30/2009
N
71dB 20min Leq (1400-1500)
POR1
© 2011 Google
Image © 2011 DigitalGlobe
©2010 Google
56 m
Imagery Date: 9/1/2009
2004
43°15'27.91" N 79°54'49.97" W elev 0 m
Eye alt 242 m



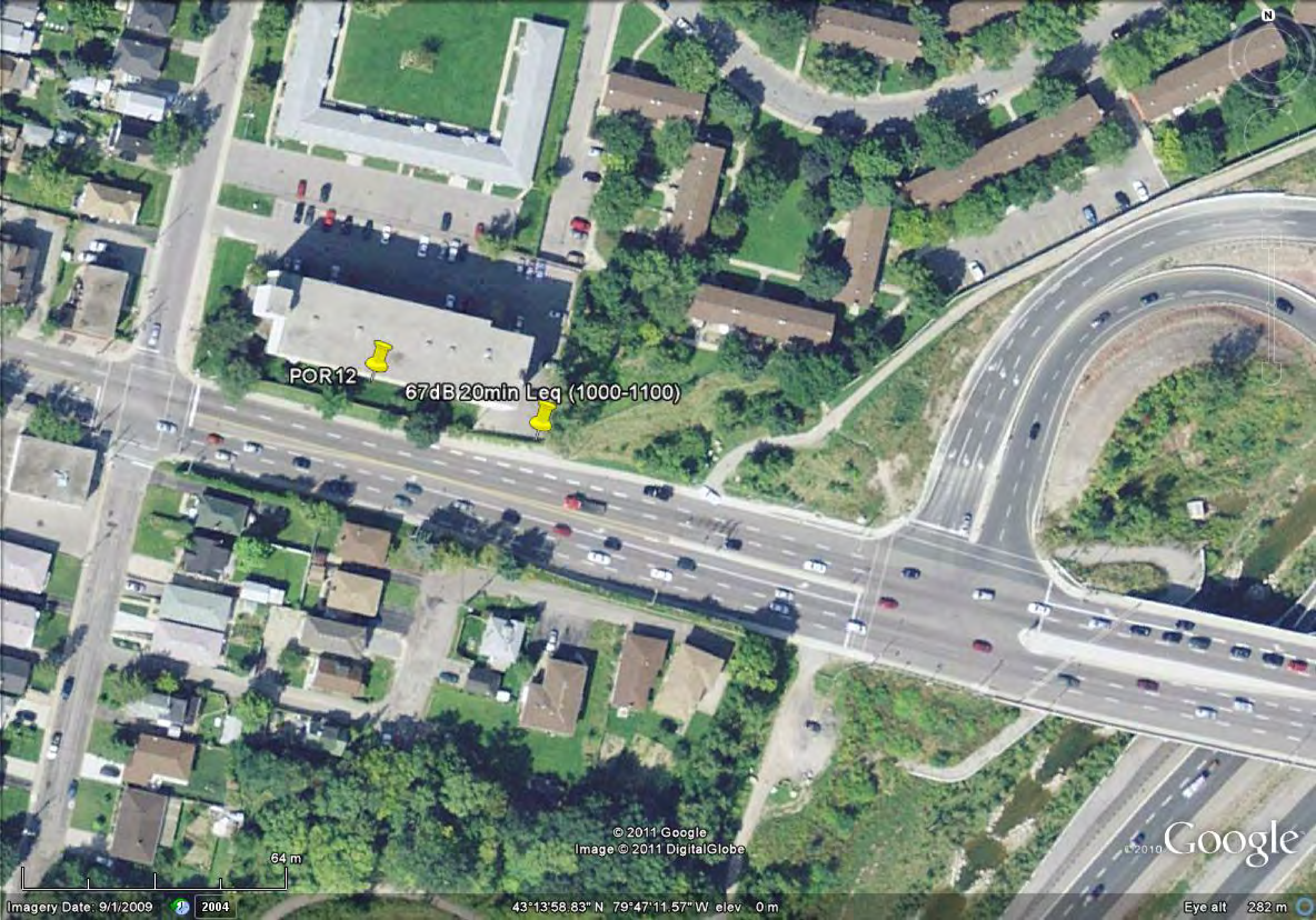
POR3
68dB 20min Leq (1300-1400)
© 2011 Google
Image © 2011 DigitalGlobe
Google
56 m
Imagery Date: 9/1/2009
2004
43°15'37.18" N 79°53'47.21" W elev 0 m
Eye alt 250 m

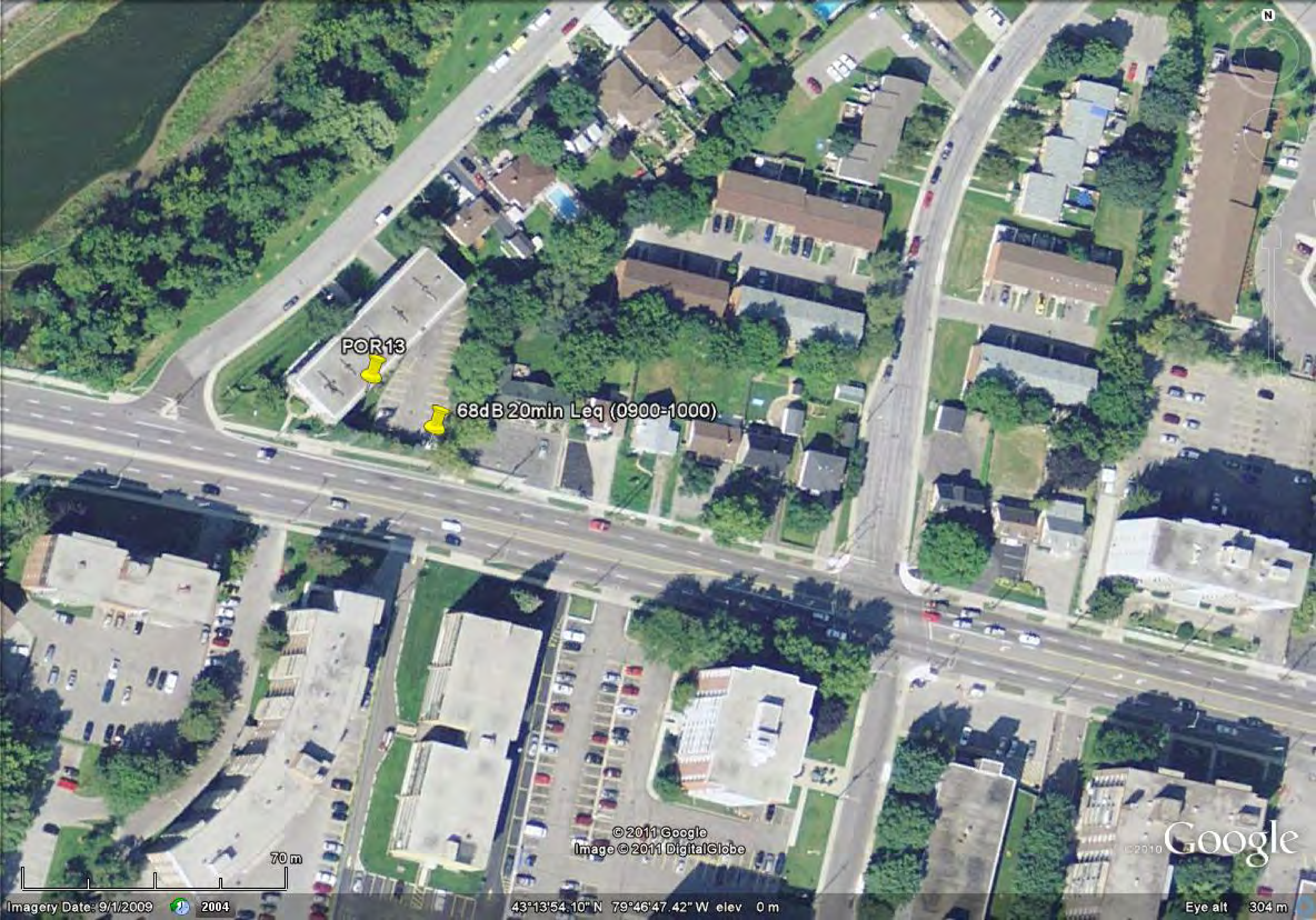

POR5
71dB 20min Leq (1100-1200)
© 2011 Google
Image © 2011 DigitalGlobe
©2010 Google
53 m
Imagery Date: 9/1/2009
2004
43°15'30.97" N 79°52'33.98" W elev 0 m
Eye alt 229 m


68dB 20min Leq (1100-1200)
POR7
© 2011 Google
Image © 2011 DigitalGlobe
©2010 Google
51 m
Imagery Date: 9/1/2009
2004
43°15'08.33" N 79°51'06.25" W elev 0 m
Eye alt 223 m
N



N
70dB 20min Leq (1000-1100)
POR9
© 2011 Google
Image © 2011 DigitalGlobe
©2010
Google
63 m
Imagery Date: 9/1/2009
2004
43°14'54.31" N 79°49'44.43" W elev 0 m
Eye alt 277 m


POR12
67dB 20min Leq (1000-1100)
© 2011 Google
Image © 2011 DigitalGlobe
64 m
Imagery Date: 9/1/2009
2004
43°13'58.83" N 79°47'11.57" W elev 0 m
Eye alt 282 m
©2010
Google


POR 13
68dB 20min Leq (0900-1000)
© 2011 Google
Image © 2011 DigitalGlobe
70 m
Imagery Date: 9/1/2009
2004
43°13'54.10" N 79°46'47.42" W elev 0 m
Eye alt 304 m
Google

APPENDIX F: SAMPLE CALCULATIONS

```
STAMSON 5.0        NORMAL REPORT        Date: 25-07-2011 14:39:18
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: lrtpor1.te           Time Period: Day/Night 16/8 hours
Description: POR 1 - LRT Only
```

NOTE: VOLUMES INCREASED x5

```
Road data, segment # 1:  (day/night)
------------------------------------
Car traffic volume  :     0/0     veh/TimePeriod
Medium truck volume :  3770/720   veh/TimePeriod
Heavy truck volume  :     0/0     veh/TimePeriod
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1:  (day/night)
----------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  20.00 / 20.00  m
Receiver height           :   1.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


Results segment # 1:  (day)
---------------------------

Source height = 0.50 m

ROAD (0.00 + 68.13 + 0.00) = 68.13 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------------
   -90     90   0.00  69.38   0.00  -1.25   0.00   0.00   0.00   0.00  68.13
-----------------------------------------------------------------------------

Segment Leq : 68.13 dBA

Total Leq All Segments: 68.13 dBA


Results segment # 1:  (night)
-----------------------------

Source height = 0.50 m

ROAD (0.00 + 63.95 + 0.00) = 63.95 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------------
   -90     90   0.00  65.20   0.00  -1.25   0.00   0.00   0.00   0.00  63.95
-----------------------------------------------------------------------------

Segment Leq : 63.95 dBA

Total Leq All Segments: 63.95 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 68.13
                         (NIGHT): 63.95
```

```
STAMSON 5.0        NORMAL REPORT        Date: 25-07-2011 14:40:22
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: nppor1.te            Time Period: Day/Night 16/8 hours
Description: POR 1 - No Project

Road data, segment # 1: Main (day/night)
----------------------------------------
Car traffic volume  : 51987/5776  veh/TimePeriod
Medium truck volume :   705/78    veh/TimePeriod
Heavy truck volume  :   558/62    veh/TimePeriod
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: Main (day/night)
--------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  20.00 / 20.00  m
Receiver height           :   1.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


Results segment # 1: Main (day)
-------------------------------

Source height = 1.01 m

ROAD (0.00 + 70.52 + 0.00) = 70.52 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------------
   -90     90   0.00  71.77   0.00  -1.25   0.00   0.00   0.00   0.00  70.52
-----------------------------------------------------------------------------

Segment Leq : 70.52 dBA

Total Leq All Segments: 70.52 dBA


Results segment # 1: Main (night)
---------------------------------

Source height = 1.01 m

ROAD (0.00 + 63.99 + 0.00) = 63.99 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------------
   -90     90   0.00  65.24   0.00  -1.25   0.00   0.00   0.00   0.00  63.99
-----------------------------------------------------------------------------

Segment Leq : 63.99 dBA

Total Leq All Segments: 63.99 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 70.52
                         (NIGHT): 63.99
```

```
STAMSON 5.0        NORMAL REPORT        Date: 25-07-2011 14:40:38
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: wppor1.te            Time Period: Day/Night 16/8 hours
Description: POR 1 - With Project


Road data, segment # 1: Main (day/night)
----------------------------------------
Car traffic volume  : 50622/5625  veh/TimePeriod
Medium truck volume :   494/55    veh/TimePeriod
Heavy truck volume  :   513/57    veh/TimePeriod
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: Main (day/night)
--------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  20.00 / 20.00  m
Receiver height           :   1.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00



Results segment # 1: Main (day)
-------------------------------

Source height = 1.00 m

ROAD (0.00 + 70.20 + 0.00) = 70.20 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------------
   -90     90   0.00  71.45   0.00  -1.25   0.00   0.00   0.00   0.00  70.20
-----------------------------------------------------------------------------

Segment Leq : 70.20 dBA

Total Leq All Segments: 70.20 dBA


Results segment # 1: Main (night)
---------------------------------

Source height = 1.00 m

ROAD (0.00 + 63.67 + 0.00) = 63.67 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------------
   -90     90   0.00  64.92   0.00  -1.25   0.00   0.00   0.00   0.00  63.67
-----------------------------------------------------------------------------

Segment Leq : 63.67 dBA

Total Leq All Segments: 63.67 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 70.20
                         (NIGHT): 63.67
```

```
STAMSON 5.0        NORMAL REPORT        Date: 25-07-2011 14:46:38
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: lrt.te               Time Period: Day/Night 16/8 hours
Description: POR 6 - LRT Only
```

NOTE: VOLUMES INCREASED X5, DISTANCES DOUBLED

```
Road data, segment # 1:  (day/night)
------------------------------------
Car traffic volume  :     0/0     veh/TimePeriod
Medium truck volume :  3770/720   veh/TimePeriod
Heavy truck volume  :     0/0     veh/TimePeriod
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1:  (day/night)
----------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  15.00 / 15.00  m
Receiver height           :   1.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00



Results segment # 1:  (day)
---------------------------

Source height = 0.50 m

ROAD (0.00 + 67.49 + 0.00) = 67.49 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.00  67.49   0.00   0.00   0.00   0.00   0.00   0.00  67.49
----------------------------------------------------------------------------

Segment Leq : 67.49 dBA

Total Leq All Segments: 67.49 dBA



Results segment # 1:  (night)
-----------------------------

Source height = 0.50 m

ROAD (0.00 + 63.31 + 0.00) = 63.31 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.00  63.31   0.00   0.00   0.00   0.00   0.00   0.00  63.31
----------------------------------------------------------------------------

Segment Leq : 63.31 dBA

Total Leq All Segments: 63.31 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 67.49
                         (NIGHT): 63.31
```

```
STAMSON 5.0        NORMAL REPORT        Date: 25-07-2011 14:47:08
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: np.te                Time Period: Day/Night 16/8 hours
Description: POR 6 - No Project
```

NOTE: DISTANCES DOUBLED

```
Road data, segment # 1: Main (day/night)
----------------------------------------
Car traffic volume  : 20964/2329  veh/TimePeriod
Medium truck volume :   403/45    veh/TimePeriod
Heavy truck volume  :   276/31    veh/TimePeriod
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: Main (day/night)
--------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  18.00 / 18.00  m
Receiver height           :   1.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


Results segment # 1: Main (day)
-------------------------------

Source height = 1.06 m

ROAD (0.00 + 65.72 + 0.00) = 65.72 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.00  66.51   0.00  -0.79   0.00   0.00   0.00   0.00  65.72
----------------------------------------------------------------------------

Segment Leq : 65.72 dBA

Total Leq All Segments: 65.72 dBA


Results segment # 1: Main (night)
---------------------------------

Source height = 1.07 m

ROAD (0.00 + 59.21 + 0.00) = 59.21 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.00  60.00   0.00  -0.79   0.00   0.00   0.00   0.00  59.21
----------------------------------------------------------------------------

Segment Leq : 59.21 dBA

Total Leq All Segments: 59.21 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 65.72
                         (NIGHT): 59.21
```

```
STAMSON 5.0        NORMAL REPORT        Date: 25-07-2011 14:47:27
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: wp.te                Time Period: Day/Night 16/8 hours
Description: POR 6 - With Project
```

NOTE: DISTANCES DOUBLED

```
Road data, segment # 1: Main (day/night)
----------------------------------------
Car traffic volume  : 10657/1184  veh/TimePeriod
Medium truck volume :   293/33    veh/TimePeriod
Heavy truck volume  :   118/13    veh/TimePeriod
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: Main (day/night)
--------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  30.00 / 30.00  m
Receiver height           :   1.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


Results segment # 1: Main (day)
-------------------------------

Source height = 1.02 m

ROAD (0.00 + 60.54 + 0.00) = 60.54 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.00  63.55   0.00  -3.01   0.00   0.00   0.00   0.00  60.54
----------------------------------------------------------------------------

Segment Leq : 60.54 dBA

Total Leq All Segments: 60.54 dBA


Results segment # 1: Main (night)
---------------------------------

Source height = 1.01 m

ROAD (0.00 + 54.01 + 0.00) = 54.01 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.00  57.02   0.00  -3.01   0.00   0.00   0.00   0.00  54.01
----------------------------------------------------------------------------

Segment Leq : 54.01 dBA

Total Leq All Segments: 54.01 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 60.54
                         (NIGHT): 54.01
```

```
STAMSON 5.0        NORMAL REPORT        Date: 25-07-2011 14:53:07
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: lrt.te               Time Period: Day/Night 16/8 hours
Description: POR 10 - LRT Only
```

NOTE: LRT VOLUMES INCREASED X5, DISTANCES DOUBLED

```
Road data, segment # 1:  (day/night)
------------------------------------
Car traffic volume  :     0/0     veh/TimePeriod
Medium truck volume :  3770/720   veh/TimePeriod
Heavy truck volume  :     0/0     veh/TimePeriod
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1:  (day/night)
----------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  19.00 / 19.00  m
Receiver height           :   1.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


Results segment # 1:  (day)
---------------------------

Source height = 0.50 m

ROAD (0.00 + 66.46 + 0.00) = 66.46 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.00  67.49   0.00  -1.03   0.00   0.00   0.00   0.00  66.46
----------------------------------------------------------------------------

Segment Leq : 66.46 dBA

Total Leq All Segments: 66.46 dBA


Results segment # 1:  (night)
-----------------------------

Source height = 0.50 m

ROAD (0.00 + 62.28 + 0.00) = 62.28 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.00  63.31   0.00  -1.03   0.00   0.00   0.00   0.00  62.28
----------------------------------------------------------------------------

Segment Leq : 62.28 dBA

Total Leq All Segments: 62.28 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 66.46
                         (NIGHT): 62.28
```

STAMSON 5.0   NORMAL REPORT   Date: 25-07-2011 14:53:24
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: np.te   Time Period: Day/Night 16/8 hours
Description: POR 10 - No Project

NOTE: DISTANCES DOUBLED

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

Car traffic volume	: 23952/2661 veh/TimePeriod
Medium truck volume	: 495/55 veh/TimePeriod
Heavy truck volume	: 271/30 veh/TimePeriod
Posted speed limit	: 50 km/h
Road gradient	: 0 %
Road pavement	: 1 (Typical asphalt or concrete)

Data for Segment # 1: Main (day/night)

Angle1 Angle2	: -90.00 deg 90.00 deg
Wood depth	: 0 (No woods.)
No of house rows	: 0 / 0
Surface	: 2 (Reflective ground surface)
Receiver source distance	: 26.00 / 26.00 m
Receiver height	: 1.50 / 4.50 m
Topography	: 1 (Flat/gentle slope; no barrier)
Reference angle	: 0.00

Results segment # 1: Main (day)

Source height = 1.02 m

ROAD (0.00 + 64.50 + 0.00) = 64.50 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	66.89	0.00	-2.39	0.00	0.00	0.00	0.00	64.50

Segment Leq : 64.50 dBA

Total Leq All Segments: 64.50 dBA

Results segment # 1: Main (night)

Source height = 1.02 m

ROAD (0.00 + 57.96 + 0.00) = 57.96 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	60.35	0.00	-2.39	0.00	0.00	0.00	0.00	57.96

Segment Leq : 57.96 dBA

Total Leq All Segments: 57.96 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 64.50
(NIGHT): 57.96

```
STAMSON 5.0        NORMAL REPORT        Date: 25-07-2011 14:53:38
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: wp.te                Time Period: Day/Night 16/8 hours
Description: POR 10 - With Project
```

NOTE: DISTANCES DOUBLED

```
Road data, segment # 1: Main (day/night)
----------------------------------------
Car traffic volume  :  4511/501   veh/TimePeriod
Medium truck volume :    30/3     veh/TimePeriod
Heavy truck volume  :    34/4     veh/TimePeriod
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: Main (day/night)
--------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  33.00 / 33.00  m
Receiver height           :   1.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


Results segment # 1: Main (day)
-------------------------------

Source height = 0.93 m

ROAD (0.00 + 55.14 + 0.00) = 55.14 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.00  58.56   0.00  -3.42   0.00   0.00   0.00   0.00  55.14
----------------------------------------------------------------------------

Segment Leq : 55.14 dBA

Total Leq All Segments: 55.14 dBA


Results segment # 1: Main (night)
---------------------------------

Source height = 0.94 m

ROAD (0.00 + 48.65 + 0.00) = 48.65 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.00  52.08   0.00  -3.42   0.00   0.00   0.00   0.00  48.65
----------------------------------------------------------------------------

Segment Leq : 48.65 dBA

Total Leq All Segments: 48.65 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 55.14
                         (NIGHT): 48.65
```

```
STAMSON 5.0        NORMAL REPORT        Date: 25-07-2011 14:57:27
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: lrt.te               Time Period: Day/Night 16/8 hours
Description: POR 14 - LRT Only
```

NOTE: VOLUMES INCREASED x5

```
Road data, segment # 1:  (day/night)
------------------------------------
Car traffic volume  :     0/0     veh/TimePeriod
Medium truck volume :  3770/720   veh/TimePeriod
Heavy truck volume  :     0/0     veh/TimePeriod
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1:  (day/night)
----------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  22.00 / 22.00  m
Receiver height           :   1.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


Results segment # 1:  (day)
---------------------------

Source height = 0.50 m

ROAD (0.00 + 67.72 + 0.00) = 67.72 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.00  69.38   0.00  -1.66   0.00   0.00   0.00   0.00  67.72
----------------------------------------------------------------------------

Segment Leq : 67.72 dBA

Total Leq All Segments: 67.72 dBA


Results segment # 1:  (night)
-----------------------------

Source height = 0.50 m

ROAD (0.00 + 63.54 + 0.00) = 63.54 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.00  65.20   0.00  -1.66   0.00   0.00   0.00   0.00  63.54
----------------------------------------------------------------------------

Segment Leq : 63.54 dBA

Total Leq All Segments: 63.54 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 67.72
                         (NIGHT): 63.54
```

```
STAMSON 5.0        NORMAL REPORT        Date: 25-07-2011 14:57:55
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: np.te                Time Period: Day/Night 16/8 hours
Description: POR 14 - No Project


Road data, segment # 1: Queenston (day/night)
---------------------------------------------
Car traffic volume  : 21077/2342  veh/TimePeriod
Medium truck volume :   428/48    veh/TimePeriod
Heavy truck volume  :   214/24    veh/TimePeriod
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: Queenston (day/night)
-------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  22.00 / 22.00  m
Receiver height           :   1.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


Results segment # 1: Queenston (day)
------------------------------------

Source height = 1.00 m

ROAD (0.00 + 66.35 + 0.00) = 66.35 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.00  68.01   0.00  -1.66   0.00   0.00   0.00   0.00  66.35
----------------------------------------------------------------------------

Segment Leq : 66.35 dBA

Total Leq All Segments: 66.35 dBA


Results segment # 1: Queenston (night)
--------------------------------------

Source height = 1.00 m

ROAD (0.00 + 59.83 + 0.00) = 59.83 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.00  61.50   0.00  -1.66   0.00   0.00   0.00   0.00  59.83
----------------------------------------------------------------------------

Segment Leq : 59.83 dBA

Total Leq All Segments: 59.83 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 66.35
                         (NIGHT): 59.83
```

```
STAMSON 5.0        NORMAL REPORT        Date: 25-07-2011 14:58:29
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: wp.te                Time Period: Day/Night 16/8 hours
Description: POR 14 - With Project


Road data, segment # 1: Queenston (day/night)
---------------------------------------------
Car traffic volume  : 15777/1753  veh/TimePeriod
Medium truck volume :   142/16    veh/TimePeriod
Heavy truck volume  :   158/18    veh/TimePeriod
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: Queenston (day/night)
-------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  21.00 / 21.00  m
Receiver height           :   1.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


Results segment # 1: Queenston (day)
------------------------------------

Source height = 1.00 m

ROAD (0.00 + 64.88 + 0.00) = 64.88 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.00  66.34   0.00  -1.46   0.00   0.00   0.00   0.00  64.88
----------------------------------------------------------------------------

Segment Leq : 64.88 dBA

Total Leq All Segments: 64.88 dBA


Results segment # 1: Queenston (night)
--------------------------------------

Source height = 1.00 m

ROAD (0.00 + 58.38 + 0.00) = 58.38 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.00  59.85   0.00  -1.46   0.00   0.00   0.00   0.00  58.38
----------------------------------------------------------------------------

Segment Leq : 58.38 dBA

Total Leq All Segments: 58.38 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 64.88
                         (NIGHT): 58.38
```

APPENDIX G: TRAFFIC DATA

Route Name	Route No	Intersection Description	Node	AM BAU 2021						PM BAU 2021						AM LRT 2021						PM LRT 2021					
				Cars		Trucks		Buses		Cars		Trucks		Buses		Cars		Trucks		Buses		Cars		Trucks		Buses	
				WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB
York, Cannon, Britania	1	Dundurn and York	220	1293	2023	34	31	1	1	1763	1665	39	26	1	1	1482	2021	40	30	1	1	2442	1643	50	25	1	1
York, Cannon, Britania	1	-	1034	0	2136	0	36	0	1	0	1757	0	34	0	1	0	2023	0	32	0	1	0	1693	0	26	0	1
York, Cannon, Britania	1	Locke and York	221	0	2200	0	39	0	5	0	1812	0	35	0	5	0	2299	0	39	0	5	0	1796	0	28	0	5
York, Cannon, Britania	1	-	1035	0	2434	0	46	0	5	0	2113	0	41	0	5	0	2591	0	51	0	5	0	2107	0	33	0	5
York, Cannon, Britania	1	Cannon and Queen/ York	198	0	2434	0	45	0	5	0	1949	0	41	0	5	0	2604	0	51	0	5	0	1955	0	33	0	5
York, Cannon, Britania	1	-	1036	1537	2211	56	40	5	5	1881	1511	46	35	5	5	2486	2433	87	44	5	5	3692	1497	83	27	5	5
York, Cannon, Britania	1	Cannon and Hess	199	1754	0	59	0	5	0	2244	0	56	0	5	0	2819	0	92	0	5	0	3866	0	88	0	5	0
York, Cannon, Britania	1	Cannon and Bay	200	1732	0	55	0	5	0	2242	0	56	0	5	0	2821	0	92	0	5	0	3807	0	83	0	5	0
York, Cannon, Britania	1	-	1037	1356	0	41	0	0	0	1733	0	41	0	0	0	2350	0	74	0	0	0	2958	0	67	0	0	0
York, Cannon, Britania	1	Cannon and MacNab	201	1356	0	41	0	0	0	1733	0	41	0	0	0	2350	0	74	0	0	0	2958	0	67	0	0	0
York, Cannon, Britania	1	James and Cannon	4	1620	0	40	0	0	0	1834	0	42	0	0	0	2582	0	70	0	0	0	2943	0	66	0	0	0
York, Cannon, Britania	1	Cannon and Hughson	202	1753	0	39	0	5	0	2175	0	48	0	5	0	2609	0	68	0	5	0	3095	0	66	0	5	0
York, Cannon, Britania	1	Cannon and John	203	1702	0	38	0	5	0	2039	0	47	0	5	0	2544	0	67	0	5	0	2897	0	64	0	5	0
York, Cannon, Britania	1	Cannon and Catharine	204	1714	0	36	0	5	0	2098	0	50	0	5	0	2274	0	56	0	5	0	2768	0	63	0	5	0
York, Cannon, Britania	1	-	1038	1679	0	36	0	5	0	2051	0	47	0	5	0	2292	0	55	0	5	0	2607	0	59	0	5	0
York, Cannon, Britania	1	Cannon and Ferguson	205	1751	0	38	0	5	0	2142	0	47	0	5	0	2333	0	56	0	5	0	2703	0	60	0	5	0
York, Cannon, Britania	1	Cannon and Wellington	206	1765	0	37	0	5	0	2108	0	47	0	5	0	2350	0	56	0	5	0	2640	0	59	0	5	0
York, Cannon, Britania	1	-	1039	1743	0	35	0	5	0	2194	0	43	0	5	0	2641	0	59	0	5	0	3052	0	63	0	5	0
York, Cannon, Britania	1	Cannon and Victoria	207	1756	0	35	0	6	0	2178	0	43	0	6	0	2643	0	58	0	5	0	3029	0	63	0	5	0
York, Cannon, Britania	1	-	1040	1526	0	29	0	6	0	1978	0	37	0	6	0	2417	0	54	0	5	0	2795	0	57	0	5	0
York, Cannon, Britania	1	Cannon and Wentworth	208	1484	0	27	0	5	0	1878	0	34	0	5	0	2360	0	51	0	4	0	2695	0	54	0	4	0
York, Cannon, Britania	1	Cannon and Sanford	209	1361	0	25	0	5	0	1567	0	29	0	5	0	2157	0	46	0	4	0	2435	0	49	0	4	0
York, Cannon, Britania	1	-	1041	1336	0	25	0	5	0	1500	0	28	0	5	0	2021	0	43	0	4	0	2206	0	44	0	4	0
York, Cannon, Britania	1	Cannon and Birch	210	1311	0	23	0	5	0	1428	0	26	0	5	0	1992	0	41	0	4	0	2127	0	42	0	4	0
York, Cannon, Britania	1	Cannon and Sherman	211	1103	0	12	0	5	0	1044	0	17	0	5	0	1764	0	31	0	4	0	1715	0	35	0	4	0
York, Cannon, Britania	1	Cannon and Lottridge	212	815	236	9	6	5	3	715	768	13	11	5	3	1551	506	29	17	5	3	1304	950	29	9	5	3
York, Cannon, Britania	1	Cannon and Gage	213	771	259	9	7	5	3	506	767	11	10	5	3	1425	434	27	16	5	3	1143	931	27	9	5	3
York, Cannon, Britania	1	Cannon and Belmont	214	789	276	11	12	5	3	454	815	8	12	5	3	1370	448	26	17	5	3	954	1286	21	15	5	3
York, Cannon, Britania	1	Cannon and Balmoral (Peds)	215	763	240	12	7	5	3	434	687	9	8	5	3	1330	412	26	12	5	3	916	1208	20	13	5	3
York, Cannon, Britania	1	Cannon and Ottawa	216	764	239	11	7	5	3	434	687	8	9	5	3	1331	412	25	12	5	3	917	1209	20	13	5	3
York, Cannon, Britania	1	Cannon and Frederick	217	579	286	10	9	5	3	404	579	8	6	5	3	1138	436	24	13	5	3	968	1126	21	12	5	3
York, Cannon, Britania	1	Cannon and Kenilworth	218	561	278	11	7	5	3	377	646	10	4	5	3	1080	393	23	9	6	3	892	1181	20	10	6	3
York, Cannon, Britania	1	-	2046	391	279	6	7	5	3	410	415	8	6	5	3	703	424	10	11	6	3	719	621	18	7	6	3
York, Cannon, Britania	1	Barons and Cannon	219	391	287	6	8	5	3	410	476	8	6	5	3	703	480	10	12	6	3	719	774	18	8	6	3
York, Cannon, Britania	1	-	2043	459	288	7	7	5	3	438	476	9	6	5	3	769	480	12	12	6	3	741	774	18	8	6	3
York, Cannon, Britania	1	Britania and Strathearne	404	446	300	7	9	5	3	418	452	8	7	5	3	756	480	12	13	6	3	721	781	17	10	6	3
York, Cannon, Britania	1	-	1042	302	201	6	8	0	0	338	271	5	5	0	0	348	219	7	8	0	0	362	584	10	7	0	0
King Street	2	-	473	623	242	16	4	0	0	586	401	6	3	0	0	641	225	17	3	0	0	610	408	8	4	0	0
King Street	2	-	472	798	306	20	11	0	0	926	346	16	3	0	0	1060	251	28	8	0	0	735	213	9	2	0	0
King Street	2	-	471	725	351	18	12	0	0	777	397	16	3	0	0	1005	297	25	9	0	0	643	221	8	2	0	0
King Street	2	-	470	1085	448	23	11	11	15	1052	900	17	7	11	15	1282	407	29	11	12	13	825	672	9	3	12	13
King Street	2	King and Paradise	497	995	411	30	10	11	0	1161	706	21	9	11	0	1158	239	35	10	13	0	1171	598	19	9	13	0
King Street	2	King and Macklin	112	1808	0	53	0	23	0	1898	0	34	0	23	0	1634	0	45	0	17	0	1705	0	26	0	17	0
King Street	2	King and Ontario403	494	1811	0	52	0	23	0	1961	0	32	0	23	0	1681	0	46	0	17	0	1890	0	27	0	17	0
King Street	2	King and Dundurn	113	3266	0	97	0	23	0	4441	0	75	0	23	0	2781	0	84	0	18	0	3350	0	51	0	18	0
King Street	2	King and New	602	2976	0	79	0	23	0	4219	0	64	0	23	0	1644	0	35	0	0	0	2246	0	24	0	0	0
King Street	2	King and Strathcona	114	2976	0	78	0	23	0	4219	0	64	0	23	0	1644	0	35	0	18	0	2246	0	25	0	18	0
King Street	2	King and Locke	115	2876	0	78	0	23	0	4074	0	62	0	23	0	1614	0	35	0	0	0	2352	0	23	0	0	0
King Street	2	-	1075	2583	0	74	0	23	0	3476	0	56	0	23	0	1300	0	31	0	0	0	1975	0	22	0	0	0
King Street	2	-	1076	2584	0	74	0	23	0	3428	0	57	0	23	0	1278	0	31	0	16	0	1894	0	21	0	16	0
King Street	2	King and Queen	117	2579	0	75	0	23	0	3436	0	58	0	23	0	1266	0	31	0	17	0	1797	0	21	0	17	0
King Street	2	King and Hess	118	2280	0	61	0	30	0	3338	0	60	0	30	0	945	0	21	0	23	0	1238	0	12	0	23	0
King Street	2	King and Caroline	119	2179	0	64	0	30	0	3092	0	60	0	30	0	710	0	22	0	0	0	1026	0	14	0	0	0
King Street	2	King and Bay	120	2319	0	71	0	31	0	3157	0	59	0	31	0	544	0	18	0	24	0	970	0	13	0	24	0
King Street	2	-	1077	2198	0	70	0	32	0	3166	0	61	0	32	0	222	0	15	0	0	0	936	0	14	0	0	0
King Street	2	King and Summers (ped)	121	1944	0	54	0	32	0	2231	0	46	0	32	0	0	0	0	0	25	0	0	0	0	0	25	0
King Street	2	-	1078	1944	0	54	0	33	0	2231	0	46	0	33	0	0	0	0	0	0	0	0	0	0	0	0	0
King Street	2	King and MacNab	122	2139	0	58	0	33	0	2384	0	51	0	33	0	185	0	3	0	0	0	137	0	4	0	0	0
King Street	2	James and King	8	1766	0	49	0	77	0	1919	0	44	0	77	0	73	0	2	0	2	0	63	0	2	0	2	0
King Street	2	Hughson and King	123	1623	0	44	0	82	0	1648	0	37	0	82	0	58	0	1	0	0	0	28	0	1	0	0	0
King Street	2	John and King	124	1814	0	44	0	82	0	1529	0	35	0	82	0	204	0	2	0	71	0	31	0	1	0	71	0
King Street	2	Catharine and King	125	1602	0	42	0	19	0	1331	0	30	0	19	0	100	0	1	0	8	0	98	0	1	0	8	0
King Street	2	King and Mary (ped)	126	1779	0	45	0	19	0	1656	0	36	0	19	0	0	80	0	4	0	0	0	245	0	4	0	0
King Street	2	King and Walnut	127	1859	0	49	0	19	0	1902	0	39	0	19	0	0	0	0	0	0	0	0	0	0	0	0	0
King Street	2	Ferguson and King (ped)	128	1757	0	45	0	19	0	1532	0	35	0	19	0	0	52	0	4	0	0	0	177	0	5	0	0
King Street	2	Jarvis and King (ped)	129	1795	0	48	0	19	0	1556	0	38	0	19	0	24	119	1	6	0	0	11	260	1	6	0	0
King Street	2	King and Wellington	130	1794	0	48	0	19	0	1556	0	38	0	19	0	24	119	1	6	0	0	11	260	1	6	0	0
King Street	2	King and West	603	2214	0	53	0	19	0	2146	0	47	0	19	0	472	0	8	0	0	0	592	0	8	0	0	0
King Street	2	King and Victoria	131	2214	0	53	0	19	0	2146	0	47	0	19	0	472	0	8	0	0	0	592	0	8	0	0	0
King Street	2	King and East	604	1844	0	40	0	19	0	1688	0	40	0	19	0	378	0	4	0	5	0	482	0	6	0	5	0
King Street	2	Emerald and King	132	1843	0	40	0	19	0	1689	0	39	0	19	0	378	0	4	0	0	0	482	0	6	0	0	0
King Street	2	King and Tisdale	133	1939	0	40	0	19	0	1637	0	38	0	19	0	479	0	3	0	5	0	427	0	4	0	5	0
King Street	2	King and Grant	605	1978	0	39	0	19	0	1608	0	37	0	19	0	502	0	3	0	0	0	410	0	4	0	0	0
King Street	2	King and Wentworth	134	1978	0	39	0	19	0	1608	0	37	0	19	0	503	0	3	0	5	0	410	0	5	0	5	0
King Street	2	King and Sanford	135	2010	0	41	0	19	0	1781	0	39	0	19	0	529	0	4	0	0	0	442	0	6	0	0	0
King Street	2	King and Arthur	606	1908	0	39	0	19	0	1823	0	39	0	19	0	530	0	4	0	5	0	624	0	9	0	5	0
King Street	2	Holton and King	136	1907	0	40	0	20	0	1824	0	39	0	20	0	530	0	4	0	5	0	624	0	8	0	5	0
King Street	2	King and Sherman	137	2055	0	41	0	20	0	1760	0	39	0	20	0	676	0	5	0	0	0	561	0	9	0	0	0

King Street	2	King and Barnesdale	607	2264	0	43	0	21	0	1856	0	42	0	21	0	809	0	6	0	0	0	749	0	14	0	0	0
King Street	2	King and Melrose	138	2263	0	43	0	20	0	1856	0	42	0	20	0	810	0	6	0	0	0	749	0	14	0	0	0
King Street	2	King and Balsam	608	2155	0	46	0	21	0	1819	0	44	0	21	0	693	0	9	0	0	0	715	0	16	0	0	0
King Street	2	Gage and King	139	2155	0	45	0	21	0	1819	0	44	0	21	0	694	0	9	0	0	0	715	0	16	0	0	0
King Street	2	King and Dunsmure	609	2057	0	39	0	21	0	1627	0	36	0	21	0	674	0	7	0	0	0	690	0	14	0	0	0
King Street	2	Glendale and King	140	2057	0	39	0	21	0	1627	0	36	0	21	0	675	0	7	0	6	0	690	0	14	0	6	0
King Street	2	King and Main East	72	2070	0	39	0	21	0	1637	0	36	0	21	0	696	0	8	0	6	0	762	0	15	0	6	0
King Street	2	King and Balmoral (ped)	141	1181	605	23	21	6	3	631	1242	17	27	6	3	458	1229	6	33	6	6	484	1555	10	43	6	6
King Street	2	King & Ottawa	142	1181	604	24	21	6	3	630	1242	17	28	6	3	458	1229	6	33	6	6	484	1554	10	43	6	6
King Street	2	King and Edgemount (ped)	143	1156	697	21	23	9	6	688	1320	20	25	9	6	620	1275	10	33	9	9	607	1785	13	44	9	9
King Street	2	King & Graham	144	1155	698	21	23	9	6	688	1320	19	25	9	6	620	1275	10	33	9	10	608	1785	13	44	9	10
King Street	2	King and Kenilworth	2032	1114	706	22	24	11	14	820	1334	19	26	11	14	653	1265	12	33	10	15	744	1809	14	51	10	15
King Street	2	-	2042	1135	875	23	26	11	11	1290	1090	20	29	11	11	679	1471	13	35	10	12	1199	1819	15	55	10	12
King Street	2	King and Rosedale	145	1133	872	23	26	11	11	1217	1094	18	29	11	11	638	1424	11	35	10	12	1075	1752	12	55	10	12
King Street	2	King and Rodgers (ped)	146	1124	872	24	26	11	6	1216	1250	19	29	11	6	627	1420	12	35	10	8	1074	1909	13	55	10	8
King Street	2	King and Cochrane	147	1124	873	24	26	11	6	1216	1250	19	29	11	6	627	1420	12	35	10	8	1073	1909	13	55	10	8
King Street	2	King and Glenholme	148	1241	881	28	28	6	6	1245	1283	20	31	6	6	814	1398	17	37	6	8	1283	1863	15	51	6	8
King Street	2	King and Parkdale	149	1234	869	27	28	6	6	1216	1289	18	31	6	6	843	1369	16	35	6	8	1278	1866	14	52	6	8
King Street	2	King and RHVP West Ramp	150	1293	899	26	26	9	9	930	1410	15	36	9	9	1095	1298	17	35	9	7	1168	1830	15	48	9	7
King Street	2	-	2055	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
King Street	2	King and RHVP East Ramp	151	608	0	9	0	0	0	407	0	9	0	0	0	870	0	13	0	0	0	687	0	29	0	0	0
King Street	2	King and Potruff Road	152	1362	910	23	14	6	6	1157	1141	20	25	6	6	1301	1096	24	16	4	4	1359	1007	25	19	4	4
King Street	2	King and Quigley	153	1103	898	22	13	6	6	1088	1060	18	25	6	6	1107	977	22	15	4	4	1289	896	22	20	4	4
King Street	2	King and Nash	154	1105	791	20	10	8	11	1392	1246	14	22	8	11	1200	963	21	12	7	9	1627	1110	20	17	7	9
King Street	2	King and Greenhill	155	1015	817	24	10	3	6	1171	1349	19	23	3	6	1057	969	21	12	2	4	1460	1084	22	17	2	4
King Street	2	King and Centennial	156	974	748	22	10	3	3	834	1129	17	23	3	3	975	809	19	11	2	2	1148	907	20	18	2	2
Main Street	3	Main and Cootes/Leland	40	641	1448	11	18	6	10	1483	1119	12	17	6	10	638	1456	11	18	4	4	1492	1115	11	17	4	4
Main Street	3	Main and Emerson	41	1741	2728	35	42	6	10	2319	2391	28	49	6	10	1652	2699	30	39	4	4	2296	2308	25	44	4	4
Main Street	3	Main and McMaster Stop	600	1894	2664	38	57	11	14	2062	2469	31	51	11	14	1824	2618	34	54	4	0	1976	2413	25	47	4	0
Main Street	3	Main and Bowman	42	1894	2664	38	56	11	14	2062	2469	31	51	11	14	1824	2618	34	53	4	4	1976	2413	25	47	4	4
Main Street	3	Main and Dalewood	43	1960	2650	41	58	11	14	2100	2463	33	54	11	14	1887	2602	36	55	4	0	2052	2445	27	50	4	0
Main Street	3	Main and Haddon	44	1825	2680	39	58	11	14	1675	2620	23	55	11	14	1533	2702	29	59	0	4	1791	2687	26	52	0	4
Main Street	3	Main and Hwy 403	45	1889	2625	40	58	10	14	1848	2592	24	55	10	14	1586	2655	31	58	4	0	1861	2657	25	52	4	0
Main Street	3	Main and Paisley (ped)	46	1340	2360	33	50	10	15	1482	2358	22	50	10	15	1046	2281	23	45	0	4	1468	2365	21	47	0	4
Main Street	3	Main and Longwood	47	1537	2319	33	50	11	14	1480	2350	21	50	11	14	1284	2281	24	45	0	4	1478	2366	20	46	0	4
Main Street	3	Main and Longwood Stop	601	967	2221	21	46	12	29	732	1894	11	49	12	29	476	2103	11	41	4	0	536	1777	8	43	4	0
Main Street	3	Main and Paradise	498	967	2221	21	46	12	30	732	1894	11	49	12	30	476	2103	11	41	4	0	536	1777	8	43	4	0
Main Street	3	Main and Macklin	48	0	2478	0	58	0	29	0	2604	0	59	0	29	0	2342	0	51	0	17	0	2373	0	51	0	17
Main Street	3	Main and Ontario403	496	0	2490	0	60	0	29	0	2640	0	61	0	29	0	2398	0	55	0	17	0	2529	0	55	0	17
Main Street	3	Main and Dundurn	49	0	3760	0	91	0	29	0	4258	0	96	0	29	0	3664	0	86	0	17	0	4015	0	90	0	17
Main Street	3	-	1098	0	3441	0	66	0	29	0	3929	0	71	0	29	0	3452	0	64	0	17	0	3618	0	70	0	17
Main Street	3	Main and Locke	50	0	3417	0	65	0	29	0	3914	0	71	0	29	0	3425	0	62	0	17	0	3624	0	70	0	17
Main Street	3	-	1099	0	3013	0	54	0	33	0	3321	0	62	0	33	0	2920	0	49	0	21	0	3108	0	64	0	21
Main Street	3	Main and Queen	51	0	2987	0	50	0	33	0	3130	0	59	0	33	0	2863	0	43	0	21	0	2892	0	61	0	21
Main Street	3	Main and Hess	52	0	2996	0	44	0	33	0	2816	0	52	0	33	0	2786	0	37	0	21	0	2629	0	56	0	21
Main Street	3	Main and Caroline	53	0	3136	0	45	0	39	0	2895	0	54	0	39	0	2897	0	39	0	27	0	2930	0	61	0	27
Main Street	3	Main and Bay	54	0	3486	0	57	0	39	0	3720	0	67	0	39	0	3220	0	46	0	27	0	3476	0	67	0	27
Main Street	3	Main and Summers (ped)	55	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Main Street	3	Main and MacNab	56	0	2689	0	59	0	35	0	3665	0	69	0	35	0	2322	0	46	0	23	0	3281	0	68	0	23
Main Street	3	James and Main	9	0	2543	0	63	0	81	0	3514	0	72	0	81	0	2247	0	54	0	68	0	3375	0	74	0	68
Main Street	3	Hughson and Main	57	0	2285	0	66	0	30	0	3332	0	73	0	30	0	1861	0	52	0	18	0	2901	0	72	0	18
Main Street	3	John and Main	58	0	2273	0	68	0	29	0	3328	0	76	0	29	0	1791	0	54	0	18	0	2864	0	74	0	18
Main Street	3	Catharine and Main	59	0	2297	0	77	0	32	0	3418	0	82	0	32	0	1756	0	60	0	17	0	2993	0	81	0	17
Main Street	3	Main and Walnut	60	0	2499	0	81	0	32	0	3653	0	83	0	32	0	1810	0	63	0	17	0	3195	0	84	0	17
Main Street	3	Main and Wellington	61	0	2481	0	84	0	31	0	3525	0	84	0	31	0	1758	0	61	0	16	0	3183	0	80	0	16
Main Street	3	Main and Victoria	62	0	2308	0	63	0	22	0	3111	0	68	0	22	0	1791	0	46	0	10	0	2742	0	60	0	10
Main Street	3	East and Main	63	0	2363	0	62	0	18	0	3050	0	61	0	18	0	1805	0	41	0	6	0	2320	0	51	0	6
Main Street	3	Emerald and Main	64	0	2360	0	61	0	18	0	3042	0	61	0	18	0	1803	0	41	0	6	0	2314	0	51	0	6
Main Street	3	Main and Tisdale	65	0	2358	0	65	0	19	0	3059	0	65	0	19	0	1807	0	45	0	6	0	2346	0	54	0	6
Main Street	3	Main and Wentworth	66	0	2358	0	65	0	19	0	3051	0	65	0	19	0	1771	0	45	0	6	0	2321	0	54	0	6
Main Street	3	Main and Sanford	67	0	2318	0	69	0	19	0	3059	0	66	0	19	0	1816	0	52	0	6	0	2470	0	59	0	6
Main Street	3	Fairleigh and Main	68	0	2438	0	72	0	19	0	3091	0	68	0	19	0	1800	0	55	0	6	0	2450	0	60	0	6
Main Street	3	Main and Sherman	69	0	2285	0	67	0	19	0	3079	0	64	0	19	0	1640	0	50	0	6	0	2447	0	57	0	6
Main Street	3	Main and Springer	70	0	2084	0	70	0	19	0	3091	0	65	0	19	0	1608	0	52	0	6	0	2540	0	60	0	6
Main Street	3	-	2001	0	2053	0	68	0	19	0	3102	0	66	0	19	0	1601	0	51	0	6	0	2529	0	59	0	6
Main Street	3	Gage and Main	71	0	1970	0	66	0	20	0	2962	0	66	0	20	0	1519	0	50	0	6	0	2382	0	59	0	6
Main Street	3	King and Main East	72	0	1894	0	56	0	18	0	2726	0	59	0	18	0	1230	0	33	0	6	0	1596	0	44	0	6
Main Street	3	Balmoral and Main (ped)	74	843	1243	15	35	15	16	1006	1483	19	31	15	16	238	0	2	0	0	0	237	0	4	0	0	0
Main Street	3	Main and Ottawa	75	886	1218	16	33	15	15	1039	1405	19	31	15	15	288	0	3	0	0	0	359	0	4	0	0	0
Main Street	3	Graham and Main	76	973	1151	17	31	15	16	1182	1378	22	30	15	16	400	0	6	0	0	0	359	0	6	0	0	0
Main Street	3	Kenilworth and Main	77	1094	1128	21	30	15	15	1273	1420	22	31	15	15	457	0	10	0	0	0	648	0	10	0	0	0
Main Street	3	Cameron and Main (ped)	78	913	1292	21	28	15	15	1363	1646	24	33	15	15	325	0	10	0	0	0	730	0	9	0	0	0
Main Street	3	Cope and Main	79	898	1211	19	28	15	15	1323	1528	22	34	15	15	325	0	10	0	0	0	730	0	9	0	0	0
Main Street	3	Fairfield and Main (ped)	80	895	1183	19	27	15	15	1301	1568	22	34	15	15	321	0	10	0	0	0	709	0	9	0	0	0
Main Street	3	Main and Queenston	495	917	1193	21	27	15	15	1365	1558	24	34	15	15	343	0	12	0	0	0	775	0	10	0	0	0
Main Street	3	-	2002	190	217	4	3	0	0	241	94	6	2	0	0	343	138	8	1	0	0	376	22	6	1	0	0
Main Street	3	Main and Parkdale	418	155	242	2	2	0	0	256	179	3	5	0	0	175	170	6	2	0	0	268	64	3	4	0	0
York, Wilson	4	-	1036	1537	2211	56	40	5	5	1881	1511	46	35	5	5	2486	2433	87	44	5	5	3692	1497	83	27	5	5
York, Wilson	4	York and Hess	222	0	2428	0	43	0	5	0	1874	0	45	0	5	0	2766	0	50	0	5	0	1672	0	32	0	5
York, Wilson	4	-	1044	0	2251	0	44	0	0	0	2187	0	45	0	0	0	2593	0	52	0	0	0	1955	0	33	0	0
York, Wilson	4	York and Bay	223	0	1624	0	40	0	5	0	1525	0	33	0	5	0	1823	0	44	0	5	0	1544	0	25	0	5

York, Wilson	4	York and Park	224	1	1642	0	43	0	16	32	1402	0	29	0	16	168	1798	5	48	0	16	331	1569	6	22	0	16
York, Wilson	4	York and MacNab	225	1	1759	0	53	0	16	32	1920	0	37	0	16	165	1899	5	58	0	16	323	2076	6	30	0	16
York, Wilson	4	Wilson and Hughson	226	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
York, Wilson	4	Wilson and John	227	139	1260	2	39	0	0	85	1602	1	29	0	0	309	1554	4	46	0	0	392	1917	6	28	0	0
York, Wilson	4	Wilson and Catharine	228	32	1178	1	32	0	0	141	1404	3	26	0	0	401	1500	6	40	0	0	404	1573	7	20	0	0
York, Wilson	4	-	1045	45	966	1	27	0	0	45	1193	1	25	0	0	400	1394	8	36	0	0	439	1275	9	20	0	0
York, Wilson	4	Wilson and Ferguson	229	31	980	0	28	0	0	30	1223	0	26	0	0	385	1408	7	37	0	0	423	1304	7	21	0	0
York, Wilson	4	Wilson and Wellington	230	39	801	0	27	0	0	5	1207	0	25	0	0	400	1234	8	36	0	0	432	1294	8	19	0	0
York, Wilson	4	Wilson and Victoria	231	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
York, Wilson	4	Wilson and Steven	232	0	935	0	22	0	4	0	989	0	15	0	4	0	1213	0	32	0	3	0	1487	0	19	0	3
York, Wilson	4	Wilson and Wentworth	233	0	889	0	21	0	4	0	1094	0	14	0	4	0	1176	0	31	0	3	0	1589	0	18	0	3
York, Wilson	4	Wilson and Sanford	234	0	960	0	22	0	4	0	1180	0	15	0	4	0	1121	0	28	0	3	0	1491	0	17	0	3
York, Wilson	4	Wilson and Birch	235	0	957	0	20	0	4	0	1182	0	16	0	4	0	1256	0	26	0	3	0	1454	0	17	0	3
York, Wilson	4	-	1047	0	1034	0	23	0	4	0	1389	0	18	0	4	0	1336	0	29	0	3	0	1790	0	21	0	3
York, Wilson	4	Wilson and Sherman	236	0	879	0	20	0	4	0	1463	0	18	0	4	0	1181	0	27	0	3	0	1864	0	21	0	3
Barton Street	5	-	107801	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Barton Street	5	Barton and Bay	163	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Barton Street	5	-	1001	400	330	7	8	0	0	420	473	9	7	0	0	339	358	6	8	0	0	438	451	9	7	0	0
Barton Street	5	Baron and James	3	268	314	5	10	0	0	329	528	6	8	0	0	322	335	6	10	0	0	428	511	7	9	0	0
Barton Street	5	-	1002	279	509	5	17	9	0	414	684	8	13	9	0	464	561	9	17	9	0	595	597	11	10	9	0
Barton Street	5	Barton and John	164	276	513	5	17	9	0	411	797	7	14	9	0	461	565	10	17	9	0	564	712	11	11	9	0
Barton Street	5	-	1003	304	683	6	22	9	7	349	992	9	16	9	7	711	648	17	19	9	7	501	863	12	13	9	7
Barton Street	5	Barton and Mary	165	310	608	6	21	9	7	555	895	14	15	9	7	824	576	18	18	9	7	921	761	20	11	9	7
Barton Street	5	Barton and Wellington	166	316	622	6	21	9	7	514	1056	13	17	9	7	836	570	18	18	9	7	867	882	18	14	9	7
Barton Street	5	Barton and Victoria	167	306	399	6	15	9	7	586	653	13	10	9	7	828	459	17	15	9	7	894	682	18	11	9	7
Barton Street	5	Barton and Smith (ped)	168	330	476	6	17	9	7	594	734	15	11	9	7	762	525	14	17	9	7	718	798	15	13	9	7
Barton Street	5	Barton and Wentworth	169	354	439	6	18	9	7	585	770	14	14	9	7	798	489	15	18	9	7	710	834	14	16	9	7
Barton Street	5	Barton and Sanford	170	498	296	9	12	9	7	914	647	19	10	9	7	1046	391	23	12	8	7	1145	716	23	11	8	7
Barton Street	5	-	1004	500	287	8	12	9	7	747	686	17	10	9	7	1032	403	22	12	9	7	1003	849	21	12	9	7
Barton Street	5	Barton and Birch	171	530	286	9	12	9	6	755	717	17	11	9	6	1065	403	23	13	9	7	1019	904	21	13	9	7
Barton Street	5	Barton and Sherman	172	721	320	13	17	10	6	842	1062	21	16	10	6	1298	434	26	18	9	7	1137	1112	22	16	9	7
Barton Street	5	Barton and Ruth (ped)	173	796	610	14	26	9	6	857	1211	22	16	9	6	1359	572	27	23	9	6	1139	1455	23	19	9	6
Barton Street	5	Barton and Lottridge	174	760	613	15	23	9	6	851	1027	22	15	9	6	1324	578	28	21	9	6	1134	1269	24	19	9	6
Barton Street	5	Barton and Gage	175	783	608	15	23	9	6	983	1092	24	16	9	6	1422	664	30	23	9	6	1221	1306	27	19	9	6
Barton Street	5	-	1005	827	621	20	24	9	6	1106	1100	32	17	9	6	1442	834	33	32	9	6	1390	1661	32	23	9	6
Barton Street	5	Barton and Lincoln	176	831	624	21	25	9	5	1107	1102	32	17	9	5	1442	836	34	32	9	6	1390	1670	32	24	9	6
Barton Street	5	Barton and Ottawa	177	832	604	20	23	8	5	1094	1116	31	17	8	5	1442	819	33	32	8	6	1380	1683	32	24	8	6
Barton Street	5	Barton and Fraser (ped)	178	849	631	20	23	9	5	1104	1111	31	16	9	5	1437	845	32	31	8	5	1371	1703	31	23	8	5
Barton Street	5	Barton and Frederick	179	843	642	20	23	9	5	1092	1161	31	16	9	5	1426	857	31	31	9	5	1363	1765	31	23	9	5
Barton Street	5	Barton and Kenilworth	180	783	668	19	25	9	5	1139	1082	34	13	9	5	1376	877	30	32	9	5	1398	1694	33	21	9	5
Barton Street	5	Barton and Cope	181	893	674	23	25	9	4	1229	1188	32	16	9	4	1644	1026	41	30	9	5	1424	1658	32	21	9	5
Barton Street	5	Barton and Strathearne	182	907	691	24	26	9	4	1185	1249	31	18	9	4	1639	1043	40	32	9	5	1366	1722	31	23	9	5
Barton Street	5	Barton and Walter	183	924	733	25	28	9	4	1137	1467	30	20	9	4	1575	910	40	33	9	5	1331	1607	31	22	9	5
Barton Street	5	Barton and Parkdale	184	926	728	27	27	9	4	1133	1433	32	18	9	4	1566	912	40	33	9	5	1330	1573	32	20	9	5
Barton Street	5	Barton and Woodward	185	980	880	23	40	9	4	1112	1536	29	30	9	4	1653	1034	39	43	9	4	1354	1765	31	36	9	4
Barton Street	5	Barton and RHVP West	186	1145	862	28	45	13	9	1018	1418	28	40	13	9	1809	1045	43	50	14	9	1247	1794	30	47	14	9
Barton Street	5	Barton and RHVP East	187	1185	738	52	55	14	9	1475	1248	59	46	14	9	1742	847	63	61	14	9	1657	1462	61	52	14	9
Barton Street	5	Barton and Nash	188	958	1167	56	64	14	8	1407	1402	71	53	14	8	1032	1323	57	66	14	8	1447	1619	68	61	14	8
Barton Street	5	Barton and Kenora	189	805	857	35	33	9	3	1222	1176	48	26	9	3	917	1082	38	31	14	8	1182	1297	45	24	14	8
Barton Street	5	Barton and Centennial	190	801	644	30	26	9	3	895	1035	32	25	9	3	815	809	31	25	14	8	889	1155	31	24	14	8
Queenston Road	6	Cochrane and Queenston	82	876	1037	17	24	15	15	1182	1524	17	29	15	15	491	261	8	4	0	0	797	508	12	4	0	0
Queenston Road	6	Queenston and Walter	83	903	1096	17	24	15	15	1389	1541	18	30	15	15	415	255	7	3	0	0	983	749	11	10	0	0
Queenston Road	6	Parkdale and Queenston	84	917	1051	16	23	16	15	1332	1548	17	28	16	15	492	325	6	3	0	0	979	834	10	12	0	0
Queenston Road	6	Queenston and Reid	85	1358	1205	20	22	16	15	1458	1719	21	31	16	15	793	515	12	5	0	4	1029	874	14	11	0	4
Queenston Road	6	Queenston and RHVP West	86	1399	1308	22	24	16	13	1613	1882	22	33	16	13	836	621	13	6	3	0	1066	1021	14	12	3	0
Queenston Road	6	Queenston and RHVP East	87	1572	1092	29	26	16	13	1731	1579	22	31	16	13	1002	487	17	8	3	0	1254	957	15	14	3	0
Queenston Road	6	Queenston and Potruff	610	1163	1100	31	16	16	13	1593	1337	21	19	16	13	1060	683	26	10	0	3	1249	1138	16	13	0	3
Queenston Road	6	Queenston and Woodman	88	1163	1100	31	17	16	13	1592	1336	21	18	16	13	1059	684	26	10	0	3	1248	1138	16	13	0	3
Queenston Road	6	Nash and Queenston	89	966	903	26	12	16	13	1390	1225	13	17	16	13	781	618	20	8	0	0	1114	1063	8	11	0	0
Queenston Road	6	Greenford and Queenston	90	1016	938	25	20	16	12	1584	1259	9	24	16	12	861	596	21	14	6	8	1274	1082	7	19	6	8

APPENDIX H: POWER SUBSTATION LOCATIONS

DIMENSIONS SHOWN ON THIS PLAN ARE IN METRES UNLESS OTHERWISE NOTED	CONTRACT No. DRAWING No. 503795-1000-41DD-001 FILE No.	SHEET No. 1 OF 10

LEGEND:
- PROPOSED LINE "B"
- STOP LOCATION
- RANGE OF TPSS LOCATION (±200m)
- DESIRED TPSS LOCATION

PRELIMINARY
SUBJECT TO APPROVAL BY SDG

NO.	REVISIONS	INITIAL	DATE

DRAWN BY: Initials DATE:
REFERENCE MATERIAL:
Surveyed By:
Sewer Plans:
Watermain Plans:
Survey Plans:
Geodetic Bench Mark Index Elevation = 000.000
Borehole Report –

SCALES
0 20 40 60 80 100m

Project Manager (Design)
Jerry Parisotto, P.Eng.
Manager of Design
Gary Moore, P.Eng.

SNC·LAVALIN steer davies gleave DIALOG

DRAWN DRAWN
CHECKED ATI MINCHEV P.Eng.
APPROVED STEPHAN MEHR P.Eng.

Hamilton Public Works
RAPIDTransit moving HAMILTON forward
METROLINX An agency of the Government of Ontario

HAMILTON LRT 'B' LINE

KEYPLAN STA 0+000 TO 1+400
PRELIMINARY TPSS LOCATION

LAST SAVE: 2011/07/18 – 6:34am
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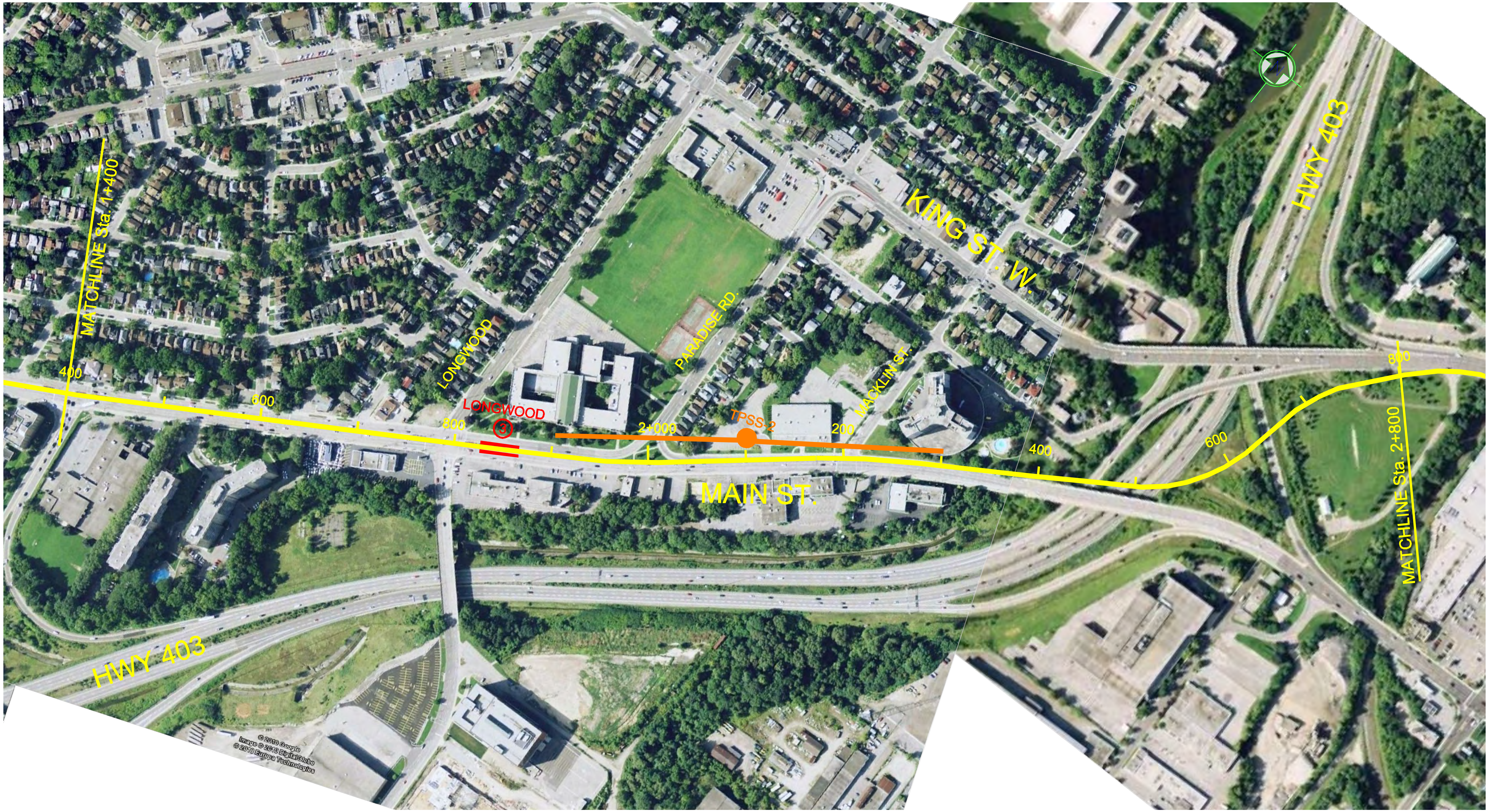

LEGEND:
- PROPOSED LINE "B"
- STOP LOCATION
- RANGE OF TPSS LOCATION (±200m)
- DESIRED TPSS LOCATION

PRELIMINARY
SUBJECT TO APPROVAL BY SDG

LAST SAVE: 2011/07/18 - 6:38am
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NO.	REVISIONS	INITIAL	DATE

DRAWN BY: Initials DATE:
REFERENCE MATERIAL:
Surveyed By:
Sewer Plans:
Watermain Plans:
Survey Plans:
Geodetic Bench Mark Index Elevation = 000.000
Borehole Report -

SCALES
0 20 40 60 80 100m

Project Manager (Design)
Jerry Parisotto, P.Eng.
Manager of Design
Gary Moore, P.Eng.

SNC·LAVALIN steer davies gleave DIALOG

DRAWN DRAWN
CHECKED ATI MINCHEV P.Eng.
APPROVED STEPHAN MEHR P.Eng.

Hamilton Public Works
RAPIDTransit moving HAMILTON forward
METROLINX An agency of the Government of Ontario

HAMILTON LRT 'B' LINE

KEYPLAN STA 1+400 TO 2+800
PRELIMINARY TPSS LOCATION

LEGEND:
- PROPOSED LINE "B"
- STOP LOCATION
- RANGE OF TPSS LOCATION (±200m)
- DESIRED TPSS LOCATION

PRELIMINARY
SUBJECT TO APPROVAL BY SDG

LAST SAVE: 2011/07/18 - 6:41am
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NO.	REVISIONS	INITIAL	DATE

DRAWN BY: Initials DATE:
REFERENCE MATERIAL:
Surveyed By:
Sewer Plans:
Watermain Plans:
Survey Plans:
Geodetic Bench Mark Index Elevation = 000.000
Borehole Report -

SCALES
0 20 40 60 80 100m

Project Manager (Design)
Jerry Parisotto, P.Eng.
Manager of Design
Gary Moore, P.Eng.

SNC·LAVALIN
steer davies gleave
DIALOG

DRAWN ____ DRAWN
CHECKED ____ ATI MINCHEV P.Eng.
APPROVED ____ STEPHAN MEHR P.Eng.

Hamilton Public Works
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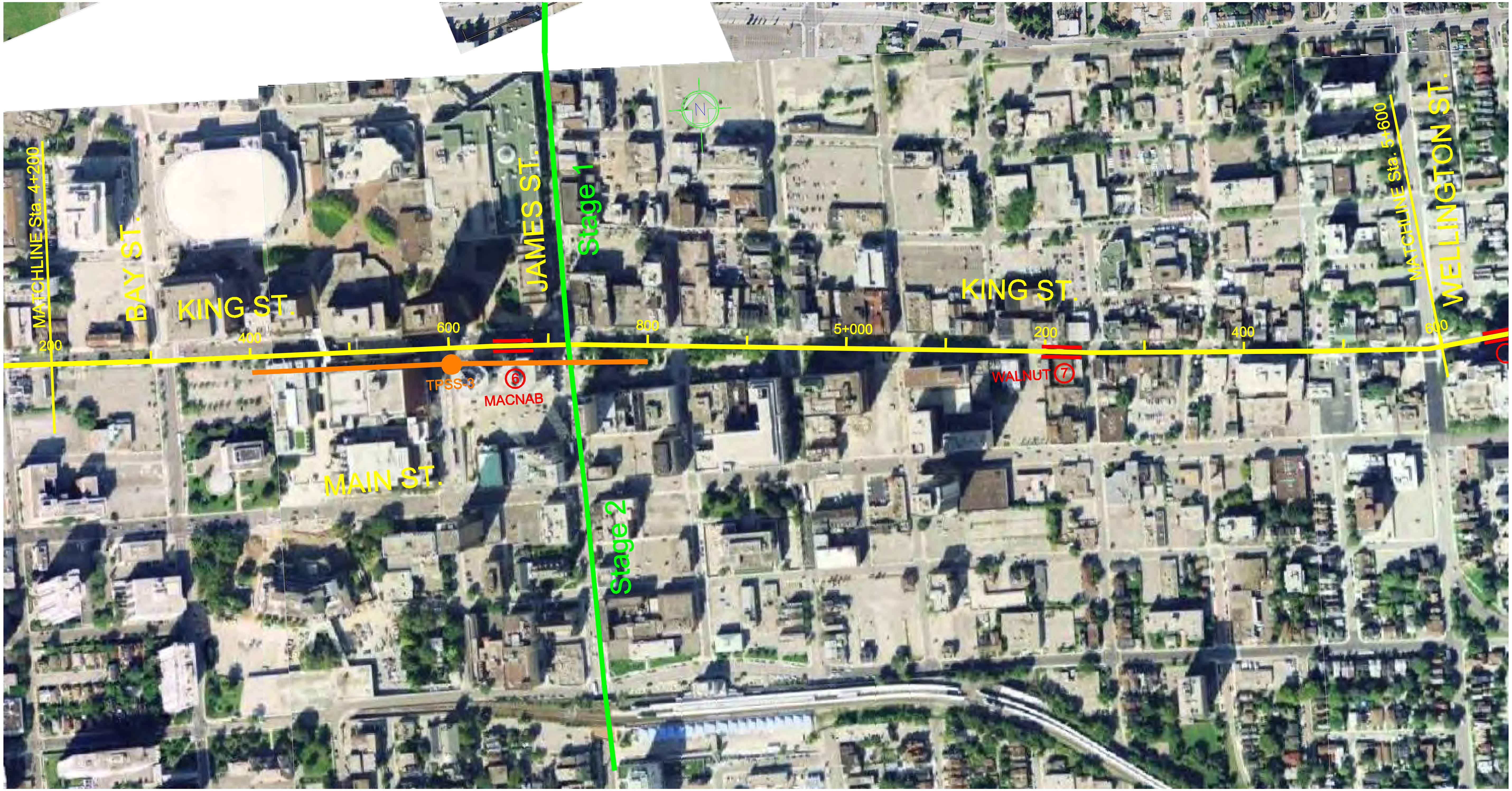
METROLINX An agency of the Government of Ontario

HAMILTON LRT 'B' LINE

KEYPLAN STA 2+800 TO 4+200
PRELIMINARY TPSS LOCATION

DIMENSIONS SHOWN ON THIS PLAN ARE IN METRES UNLESS OTHERWISE NOTED	CONTRACT No. DRAWING No. 503795-1000-41DD-004 FILE No.	SHEET No. 4 OF 10



LEGEND:

- PROPOSED LINE "B"
- FUTURE LINE "A"
- STOP LOCATION
- RANGE OF TPSS LOCATION (±200m)
- DESIRED TPSS LOCATION

PRELIMINARY
SUBJECT TO APPROVAL BY SDG

NO.	REVISIONS	INITIAL	DATE

DRAWN BY: Initials DATE:
REFERENCE MATERIAL:
Surveyed By:
Sewer Plans:
Watermain Plans:
Survey Plans:
Geodetic Bench Mark Index Elevation = 000.000
Borehole Report –

SCALES
0 20 40 60 80 100m

Project Manager (Design)
Jerry Parisotto, P.Eng.
Manager of Design
Gary Moore, P.Eng.

SNC·LAVALIN steer davies gleave DIALOG

DRAWN DRAWN
CHECKED ATI MINCHEV P.Eng.
APPROVED STEPHAN MEHR P.Eng.

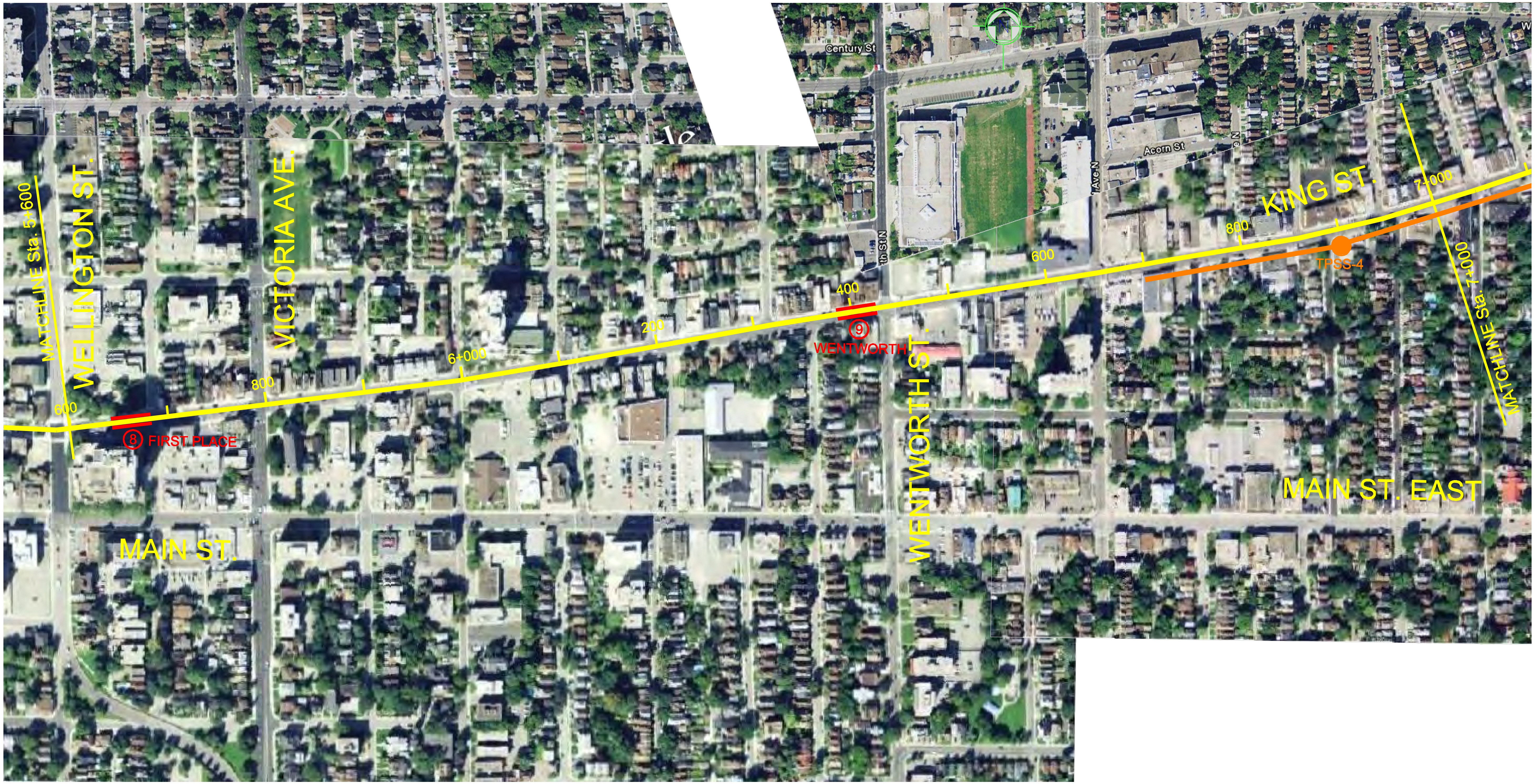
Hamilton Public Works RAPIDTransit moving HAMILTON forward METROLINX An agency of the Government of Ontario

HAMILTON LRT 'B' LINE

KEYPLAN STA 4+200 TO 5+600
PRELIMINARY TPSS LOCATION

LAST SAVE: 2011/07/18 – 6:52am
PATH: P:\503795\Trans\2000-Temp\Bill\OLDKEYPLANS\TPSSLocationPlan.dwg

DIMENSIONS SHOWN ON THIS PLAN ARE IN METRES UNLESS OTHERWISE NOTED	CONTRACT No. DRAWING No. 503795-1000-41DD-005 FILE No.	SHEET No. 5 OF 10



LEGEND:

- PROPOSED LINE "B"
- STOP LOCATION
- RANGE OF TPSS LOCATION (±200m)
- DESIRED TPSS LOCATION

PRELIMINARY
SUBJECT TO APPROVAL BY SDG

NO.	REVISIONS	INITIAL	DATE

DRAWN BY: Initials DATE:

REFERENCE MATERIAL:
Surveyed By:
Sewer Plans:
Watermain Plans:
Survey Plans:
Geodetic Bench Mark Index Elevation = 000.000
Borehole Report –

SCALES
0 20 40 60 80 100m

Project Manager (Design)
Jerry Parisotto, P.Eng.
Manager of Design
Gary Moore, P.Eng.

SNC·LAVALIN steer davies gleave DIALOG

DRAWN DRAWN
CHECKED ATI MINCHEV P.Eng.
APPROVED STEPHAN MEHR P.Eng.

Hamilton Public Works RAPIDTransit moving HAMILTON forward METROLINX An agency of the Government of Ontario

HAMILTON LRT 'B' LINE

KEYPLAN STA 5+600 TO 7+000
PRELIMINARY TPSS LOCATION

DIMENSIONS SHOWN ON THIS PLAN ARE IN METRES UNLESS OTHERWISE NOTED	CONTRACT No. DRAWING No. 503795-1000-41DD-006 FILE No.	SHEET No. 6 OF 10

LEGEND:
- PROPOSED LINE "B"
- STOP LOCATION
- RANGE OF TPSS LOCATION (±200m)
- DESIRED TPSS LOCATION

PRELIMINARY
SUBJECT TO APPROVAL BY SDG

NO.	REVISIONS	INITIAL	DATE

DRAWN BY: Initials DATE:
REFERENCE MATERIAL:
Surveyed By:
Sewer Plans:
Watermain Plans:
Survey Plans:
Geodetic Bench Mark Index Elevation = 000.000
Borehole Report –

SCALES
0 20 40 60 80 100m

Project Manager (Design)
Jerry Parisotto, P.Eng.
Manager of Design
Gary Moore, P.Eng.

SNC·LAVALIN steer davies gleave DIALOG

DRAWN DRAWN
CHECKED ATI MINCHEV P.Eng.
APPROVED STEPHAN MEHR P.Eng.

Hamilton Public Works
RAPIDTransit moving HAMILTON forward
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HAMILTON LRT 'B' LINE
KEYPLAN STA 7+000 TO 8+400
PRELIMINARY TPSS LOCATION

LAST SAVE: 2011/07/18 – 7:07am
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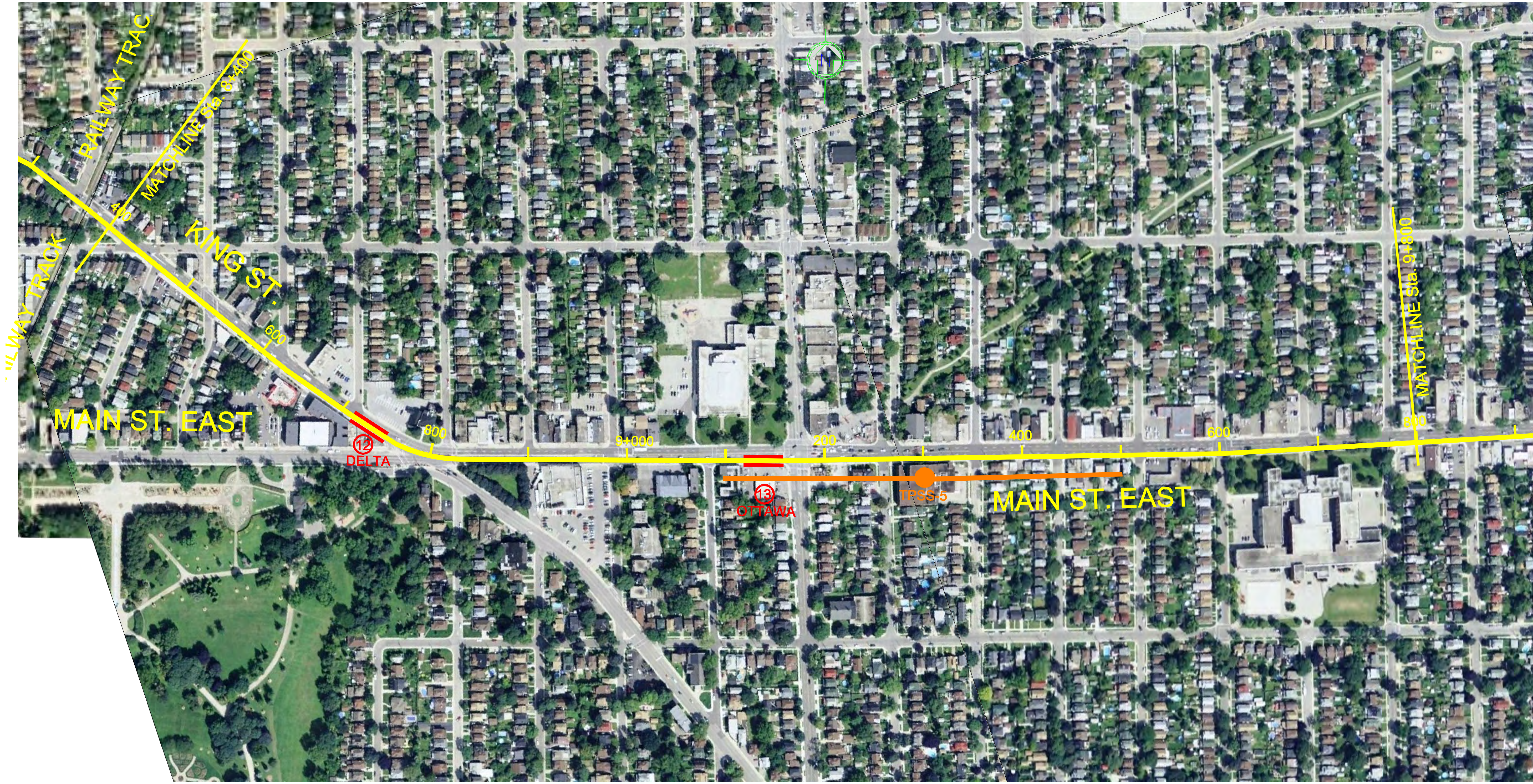

LEGEND:
- PROPOSED LINE "B"
- STOP LOCATION
- RANGE OF TPSS LOCATION (±200m)
- DESIRED TPSS LOCATION

PRELIMINARY
SUBJECT TO APPROVAL BY SDG

LAST SAVE: 2011/07/18 - 7:17am
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NO.	REVISIONS	INITIAL	DATE

DRAWN BY: Initials
DATE:
REFERENCE MATERIAL:
Surveyed By:
Sewer Plans:
Watermain Plans:
Survey Plans:
Geodetic Bench Mark Index Elevation = 000.000
Borehole Report -

SCALES
0 20 40 60 80 100m

Project Manager (Design)
Jerry Parisotto, P.Eng.
Manager of Design
Gary Moore, P.Eng.

SNC·LAVALIN
steer davies gleave
DIALOG

DRAWN DRAWN
CHECKED ATI MINCHEV P.Eng.
APPROVED STEPHAN MEHR P.Eng.

Hamilton Public Works
RAPIDTransit moving HAMILTON forward
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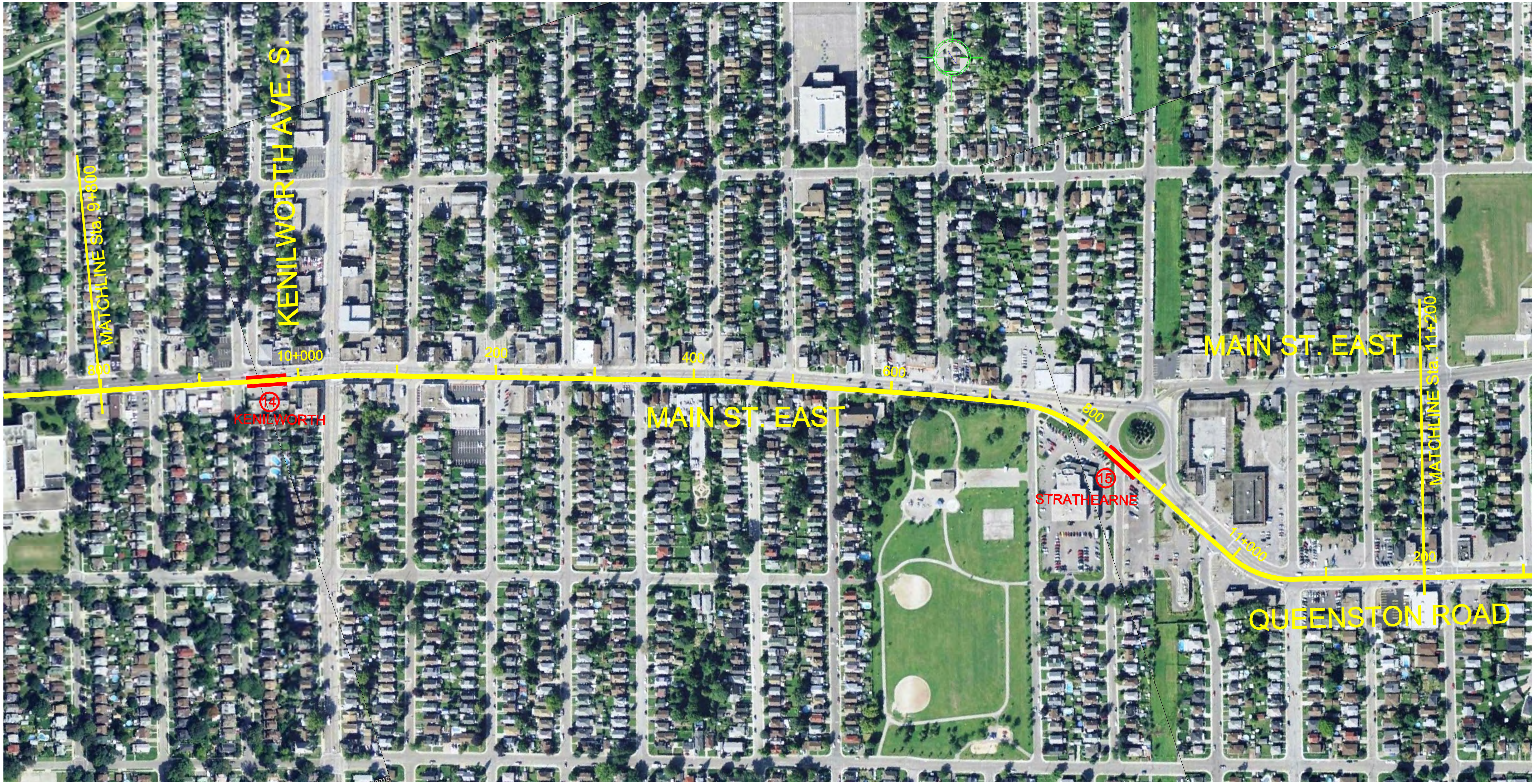
HAMILTON LRT 'B' LINE

KEYPLAN STA 8+400 TO 9+800
PRELIMINARY TPSS LOCATION

DIMENSIONS SHOWN ON THIS PLAN ARE IN METRES UNLESS OTHERWISE NOTED

CONTRACT No.
DRAWING No. 503795-1000-41DD-008
FILE No.

SHEET No.
8 OF 10



LEGEND:
PROPOSED LINE "B"
STOP LOCATION
RANGE OF TPSS LOCATION (±200m)
DESIRED TPSS LOCATION

PRELIMINARY
SUBJECT TO APPROVAL BY SDG

NO.	REVISIONS	INITIAL	DATE

DRAWN BY: Initials DATE:
REFERENCE MATERIAL:
Surveyed By:
Sewer Plans:
Watermain Plans:
Survey Plans:
Geodetic Bench Mark Index Elevation = 000.000
Borehole Report -

SCALES
0 20 40 60 80 100m

Project Manager (Design)
Jerry Parisotto, P.Eng.
Manager of Design
Gary Moore, P.Eng.

SNC·LAVALIN
steer davies gleave
DIALOG

DRAWN DRAWN
CHECKED ATI MINCHEV P.Eng.
APPROVED STEPHAN MEHR P.Eng.

Hamilton Public Works
RAPIDTransit moving HAMILTON forward
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HAMILTON LRT 'B' LINE
KEYPLAN STA 9+800 TO 11+200
PRELIMINARY TPSS LOCATION

LAST SAVE: 2011/07/18 - 7:21am
PATH: P:\503795\Trans\2000-Temp\Bill\OLDKEYPLANS\TPSSLocationPlan.dwg

DIMENSIONS SHOWN ON THIS PLAN ARE IN METRES UNLESS OTHERWISE NOTED

CONTRACT No.
DRAWING No. 503795-1000-41DD-009
FILE No.

LEGEND:
- PROPOSED LINE "B"
- STOP LOCATION
- RANGE OF TPSS LOCATION (±200m)
- DESIRED TPSS LOCATION

PRELIMINARY
SUBJECT TO APPROVAL BY SDG

NO.	REVISIONS	INITIAL	DATE

DRAWN BY: Initials DATE:

REFERENCE MATERIAL:
Surveyed By:
Sewer Plans:
Watermain Plans:
Survey Plans:
Geodetic Bench Mark Index Elevation = 000.000
Borehole Report –

SCALES
0 20 40 60 80 100m

Project Manager (Design)
Jerry Parisotto, P.Eng.
Manager of Design
Gary Moore, P.Eng.

SNC·LAVALIN steer davies gleave DIALOG

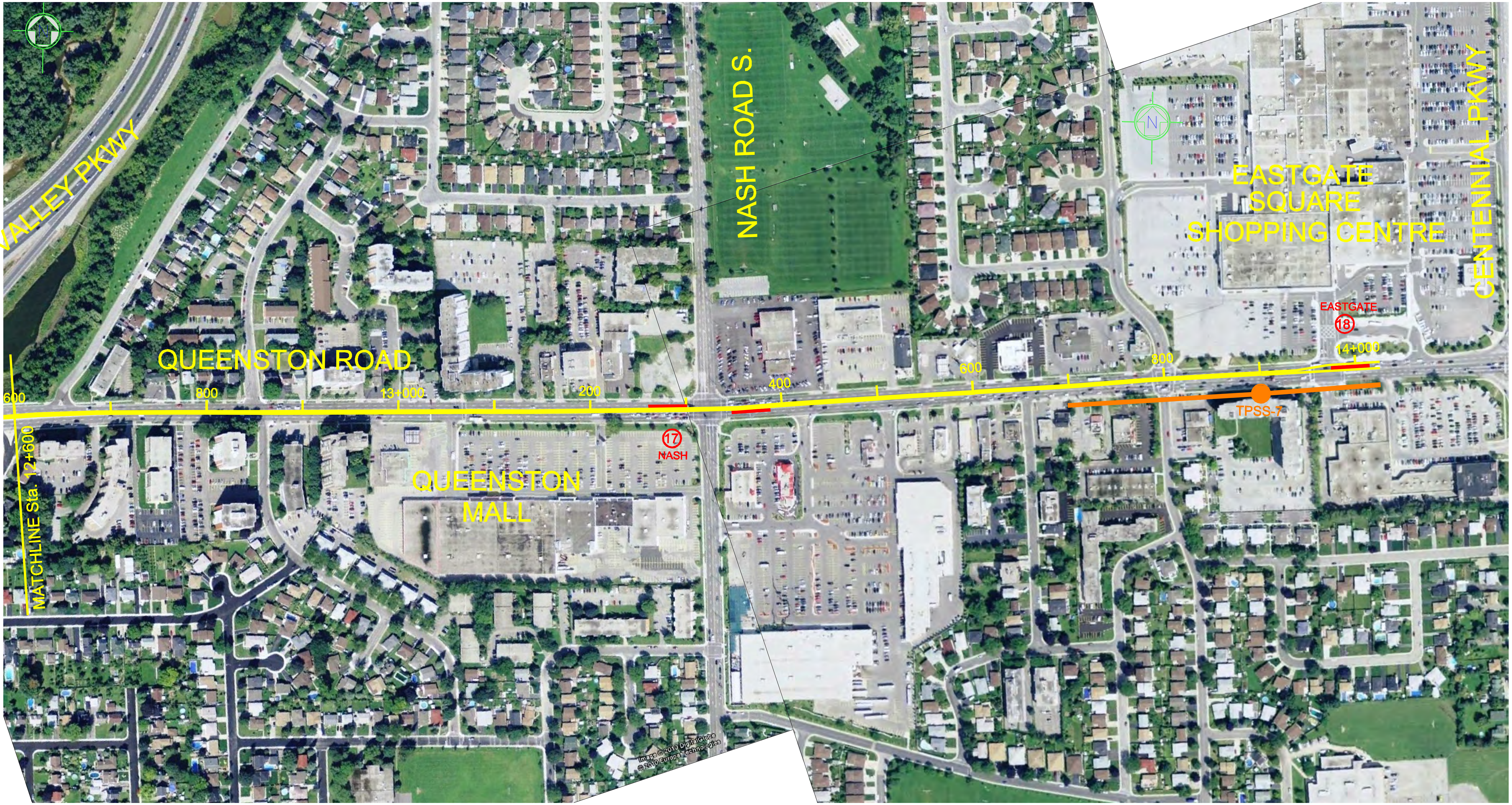
DRAWN DRAWN
CHECKED ATI MINCHEV P.Eng.
APPROVED STEPHAN MEHR P.Eng.

Hamilton Public Works
RAPIDTransit moving HAMILTON forward
METROLINX An agency of the Government of Ontario

HAMILTON LRT 'B' LINE

KEYPLAN STA 11+200 TO 12+600
PRELIMINARY TPSS LOCATION

LAST SAVE: 2011/07/18 – 7:27am
PATH: P:\503795\Trans\2000-Temp\Bill\OLDKEYPLANS\TPSSLocationPlan.dwg



LEGEND:
PROPOSED LINE "B"
STOP LOCATION
RANGE OF TPSS LOCATION (±200m)
DESIRED TPSS LOCATION

PRELIMINARY
SUBJECT TO APPROVAL BY SDG

LAST SAVE: 2011/07/18 - 7:33am
PATH: P:\503795\Trans\2000-Temp\Bill\OLDKEYPLANS\TPSSLocationPlan.dwg

NO.	REVISIONS	INITIAL	DATE

DRAWN BY: Initials DATE:
REFERENCE MATERIAL:
Surveyed By:
Sewer Plans:
Watermain Plans:
Survey Plans:
Geodetic Bench Mark Index Elevation = 000.000
Borehole Report -

SCALES
0 20 40 60 80 100m

Project Manager (Design)
Jerry Parisotto, P.Eng.
Manager of Design
Gary Moore, P.Eng.

SNC-LAVALIN
steer davies gleave
DIALOG

DRAWN DRAWN
CHECKED ATI MINCHEV P.Eng.
APPROVED STEPHAN MEHR P.Eng.

Hamilton Public Works
RAPIDTransit
METROLINX
An agency of the Government of Ontario

HAMILTON LRT 'B' LINE
KEYPLAN STA 12+600 TO 14+000
PRELIMINARY TPSS LOCATION

Noise/Vibration Sensitive Uses Adjacent to B-Line LRT Corridor

Private URL to access this listing as a Google Map:
http://batchgeo.com/map/c882aa1f614d3261ad2e177b7428f971

Name	Address	City	Province
Ibrahim Jame Mosque	778 King St. E	Hamilton	Ontario
Pentecostal Church of Christ	466 King St. E	Hamilton	Ontario
St. Patrick's Roman Catholic Church	420 King St. E	Hamilton	Ontario
New Westminster Presbyterian Church	1025 King St. E	Hamilton	Ontario
Psychic Readings	984 King St. E	Hamilton	Ontario
Maplecrest Manor Long Term Care Facility	904 King St. E	Hamilton	Ontario
East Hamilton United Pentecostal Church	887 King St. E	Hamilton	Ontario
Filipino Community Centre and Church	1273 King St. E	Hamilton	Ontario
Christadelphian Hall	1107 Main St. E	Hamilton	Ontario
Memorial School	1175 Main St. E	Hamilton	Ontario
All Nations Full Gospel Church	1209 Main St. E	Hamilton	Ontario
Delta School	1284 Main St. E	Hamilton	Ontario
Iglesia Pentecostal Unida	1360 Main St. E	Hamilton	Ontario
Unicare Limited Partnership	1500 Main St. E	Hamilton	Ontario
St. Columbia Presbyterian Church	1540 Main St. E	Hamilton	Ontario
Dalewood School	1150 Main St. W	Hamilton	Ontario
Grace Evangelical Lutheran Church	1107 Main St. W	Hamilton	Ontario
Columbia International College	1015 Main St. W	Hamilton	Ontario
Fred Astaire Dance Studio	1092 Main St. W	Hamilton	Ontario
Retirement Home	1605 Main St. E	Hamilton	Ontario
The Lord's Ministry House	55 Queenston Rd.	Hamilton	Ontario
Knights of Columbus Council 1454	222 Queenston Rd.	Hamilton	Ontario
St. Eugene Church	232 Queenston Rd.	Hamilton	Ontario
The Terraces	284 King St. E	Hamilton	Ontario
Columbia International College Residences	1029-1033 Main St. W	Hamilton	Ontario
Visitors Inn	649 Main St. W	Hamilton	Ontario
Residence	81 Paradise Rd. S	Hamilton	Ontario
Residence	1277 Main St. W	Hamilton	Ontario
Residence	1263 Main St. W	Hamilton	Ontario
Residence	1261 Main St. W	Hamilton	Ontario
Residence	1253 Main St. W	Hamilton	Ontario
Residence	1245 Main St. W	Hamilton	Ontario
Residence	1237 Main St. W	Hamilton	Ontario
Residence	2 Stroud Rd.	Hamilton	Ontario
Residence	78 Dalewood Ave. S	Hamilton	Ontario
Residence	71 Dalewood Ave. S	Hamilton	Ontario
Residence	2 Gary Ave.	Hamilton	Ontario
Residence	1 Gary Ave.	Hamilton	Ontario
Residence	90 Haddon Ave. S	Hamilton	Ontario
Residence	1127 Main St. W	Hamilton	Ontario
Residence	94 Cline Ave. S	Hamilton	Ontario
Residence	1098 Main St. W	Hamilton	Ontario
Residence	1 Dow Ave.	Hamilton	Ontario
Residence	87 Newton Ave.	Hamilton	Ontario
Residence	1028 Main St. W	Hamilton	Ontario
Residence	1024 Main St. W	Hamilton	Ontario
Residence	1020 Main St. W	Hamilton	Ontario
Residence	1014 Main St. W	Hamilton	Ontario

Residence	1006 Main St. W	Hamilton	Ontario
Residence	1002 Main St. W	Hamilton	Ontario
Residence	998 Main St. W	Hamilton	Ontario
Residence	992 Main St. W	Hamilton	Ontario
Residence	988 Main St. W	Hamilton	Ontario
Residence	984 Main St. W	Hamilton	Ontario
Residence	980 Main St. W	Hamilton	Ontario
Residence	972 Main St. W	Hamilton	Ontario
Residence	85 Paisley Ave. S	Hamilton	Ontario
Residence	160 Bond St. S	Hamilton	Ontario
Residence	621 King St. W	Hamilton	Ontario
Residence	595 King St. W	Hamilton	Ontario
Residence	581 King St. W	Hamilton	Ontario
Residence	577 King St. W	Hamilton	Ontario
Residence	575 King St. W	Hamilton	Ontario
Residence	573 King St. W	Hamilton	Ontario
Residence	2 Strathcona Ave. S	Hamilton	Ontario
Residence	547 King St. W	Hamilton	Ontario
Residence	545 King St. W	Hamilton	Ontario
Residence	455 King St. W	Hamilton	Ontario
Residence	453 King St. W	Hamilton	Ontario
Residence	431 King St. W	Hamilton	Ontario
Residence	417 King St. W	Hamilton	Ontario
Residence	413 King St. W	Hamilton	Ontario
Residence	403 King St. W	Hamilton	Ontario
Residence	391 King St. W	Hamilton	Ontario
Residence	2 Ray St. S	Hamilton	Ontario
Residence	285 King St. W	Hamilton	Ontario
Residence	241 King St. W	Hamilton	Ontario
Residence	6 Tisdale St.	Hamilton	Ontario
Residence	514 King St. E	Hamilton	Ontario
Residence	538 King St. E	Hamilton	Ontario
Residence	520 King St. E	Hamilton	Ontario
Residence	522 King St. E	Hamilton	Ontario
Residence	524 King St. E	Hamilton	Ontario
Residence	526 King St. E	Hamilton	Ontario
Residence	540 King St. E	Hamilton	Ontario
Residence	556 King St. E	Hamilton	Ontario
Residence	560 King St. E	Hamilton	Ontario
Residence	562 King St. E	Hamilton	Ontario
Residence	564 King St. E	Hamilton	Ontario
Residence	566 King St. E	Hamilton	Ontario
Residence	570 King St. E	Hamilton	Ontario
Residence	608 King St. E	Hamilton	Ontario
Residence	610 King St. E	Hamilton	Ontario
Residence	612 King St. E	Hamilton	Ontario
Residence	614 King St. E	Hamilton	Ontario
Residence	620 King St. E	Hamilton	Ontario
Residence	652 King St. E	Hamilton	Ontario
Residence	656 King St. E	Hamilton	Ontario
Residence	692 King St. E	Hamilton	Ontario
Residence	832 King St. E	Hamilton	Ontario

Noise/Vibration Sensitive Uses Adjacent to B-Line LRT Corridor

Residence	902 King St. E	Hamilton	Ontario
Residence	908 King St. E	Hamilton	Ontario
Residence	928 King St. E	Hamilton	Ontario
Residence	930 King St. E	Hamilton	Ontario
Residence	932 King St. E	Hamilton	Ontario
Residence	946 King St. E	Hamilton	Ontario
Residence	948 King St. E	Hamilton	Ontario
Residence	950 King St. E	Hamilton	Ontario
Residence	968 King St. E	Hamilton	Ontario
Residence	970 King St. E	Hamilton	Ontario
Residence	972 King St. E	Hamilton	Ontario
Residence	974 King St. E	Hamilton	Ontario
Residence	976 King St. E	Hamilton	Ontario
Residence	978 King St. E	Hamilton	Ontario
Residence	980 King St. E	Hamilton	Ontario
Residence	982 King St. E	Hamilton	Ontario
Residence	986 King St. E	Hamilton	Ontario
Residence	992 King St. E	Hamilton	Ontario
Residence	1018 King St. E	Hamilton	Ontario
Residence	1024 King St. E	Hamilton	Ontario
Residence	1026 King St. E	Hamilton	Ontario
Residence	1044 King St. E	Hamilton	Ontario
Residence	1048 King St. E	Hamilton	Ontario
Residence	1080 King St. E	Hamilton	Ontario
Residence	1084 King St. E	Hamilton	Ontario
Residence	1088 King St. E	Hamilton	Ontario
Residence	1094 King St. E	Hamilton	Ontario
Residence	1098 King St. E	Hamilton	Ontario
Residence	1134 King St. E	Hamilton	Ontario
Residence	1136 King St. E	Hamilton	Ontario
Residence	1144 King St. E	Hamilton	Ontario
Residence	1152 King St. E	Hamilton	Ontario
Residence	1154 King St. E	Hamilton	Ontario
Residence	1156 King St. E	Hamilton	Ontario
Residence	1158 King St. E	Hamilton	Ontario
Residence	1160 King St. E	Hamilton	Ontario
Residence	1164 King St. E	Hamilton	Ontario
Residence	1166 King St. E	Hamilton	Ontario
Residence	1168 King St. E	Hamilton	Ontario
Residence	1170 King St. E	Hamilton	Ontario
Residence	1172 King St. E	Hamilton	Ontario
Residence	1174 King St. E	Hamilton	Ontario
Residence	1176 King St. E	Hamilton	Ontario
Residence	1184 King St. E	Hamilton	Ontario
Residence	1186 King St. E	Hamilton	Ontario
Residence	1188 King St. E	Hamilton	Ontario
Residence	1190 King St. E	Hamilton	Ontario
Residence	1194 King St. E	Hamilton	Ontario
Residence	3 Barnesdale Ave. S	Hamilton	Ontario
Residence	2 Connaught Ave. S	Hamilton	Ontario
Residence	3 Connaught Ave. S	Hamilton	Ontario
Residence	2 Balsam Ave. S	Hamilton	Ontario

Noise/Vibration Sensitive Uses Adjacent to B-Line LRT Corridor

Residence	1 Balsam Ave. S	Hamilton	Ontario
Residence	1 Prospect St. S	Hamilton	Ontario
Residence	1258 King St. E	Hamilton	Ontario
Residence	1260 King St. E	Hamilton	Ontario
Residence	1262 King St. E	Hamilton	Ontario
Residence	1264 King St. E	Hamilton	Ontario
Residence	1266 King St. E	Hamilton	Ontario
Residence	1276 King St. E	Hamilton	Ontario
Residence	3 Balmoral Ave. S	Hamilton	Ontario
Residence	4 Grosvenor Ave. S	Hamilton	Ontario
Residence	3 Grosvenor Ave. S	Hamilton	Ontario
Residence	1208 Main St. E	Hamilton	Ontario
Residence	1210 Main St. E	Hamilton	Ontario
Residence	1260 Main St. E	Hamilton	Ontario
Residence	1262 Main St. E	Hamilton	Ontario
Residence	1266 Main St. E	Hamilton	Ontario
Residence	1268 Main St. E	Hamilton	Ontario
Residence	1276 Main St. E	Hamilton	Ontario
Residence	1278 Main St. E	Hamilton	Ontario
Residence	1280 Main St. E	Hamilton	Ontario
Residence	1282 Main St. E	Hamilton	Ontario
Residence	1428 Main St. E	Hamilton	Ontario
Residence	1468 Main St. E	Hamilton	Ontario
Residence	1480 Main St. E	Hamilton	Ontario
Residence	1482 Main St. E	Hamilton	Ontario
Residence	1484 Main St. E	Hamilton	Ontario
Residence	1486 Main St. E	Hamilton	Ontario
Residence	1492 Main St. E	Hamilton	Ontario
Residence	1494 Main St. E	Hamilton	Ontario
Residence	1496 Main St. E	Hamilton	Ontario
Residence	1504 Main St. E	Hamilton	Ontario
Residence	1508 Main St. E	Hamilton	Ontario
Residence	1510 Main St. E	Hamilton	Ontario
Residence	1512 Main St. E	Hamilton	Ontario
Residence	1514 Main St. E	Hamilton	Ontario
Residence	1518 Main St. E	Hamilton	Ontario
Residence	1526 Main St. E	Hamilton	Ontario
Residence	1530 Main St. E	Hamilton	Ontario
Residence	1532 Main St. E	Hamilton	Ontario
Residence	1554 Main St. E	Hamilton	Ontario
Residence	1 Edgemont St. S	Hamilton	Ontario
Residence	2 Park Row S.	Hamilton	Ontario
Residence	2 Modena Ct.	Hamilton	Ontario
Residence	1 Modena Ct.	Hamilton	Ontario
Residence	2 Termoli Ct.	Hamilton	Ontario
Residence	1 Termoli Ct.	Hamilton	Ontario
Residence	169 Queenston Rd.	Hamilton	Ontario
Residence	181 Queenston Rd.	Hamilton	Ontario
Residence	50 Isabel Ave.	Hamilton	Ontario
Residence	51 Isabel Ave.	Hamilton	Ontario
Residence	320 Queenston Rd.	Hamilton	Ontario
Residence	351 Queenston Rd.	Hamilton	Ontario

Queenston Manor Retirement Centre	346 Queenston Rd.	Hamilton	Ontario
Residence	83 Reid Ave.	Hamilton	Ontario
Residence	2 Knowles St.	Hamilton	Ontario
Residence	385 Queenston Rd.	Hamilton	Ontario
Residence	392 Queenston Rd.	Hamilton	Ontario
Residence	396 Queenston Rd.	Hamilton	Ontario
Residence	402 Queenston Rd.	Hamilton	Ontario
Residence	404 Queenston Rd.	Hamilton	Ontario
Residence	484 Queenston Rd.	Hamilton	Ontario
Residence	20 Pottruff Rd. N	Hamilton	Ontario
Residence	494 Queenston Rd.	Hamilton	Ontario
Residence	505 Queenston Rd.	Hamilton	Ontario
Residence	510 Queenston Rd.	Hamilton	Ontario
Residence	513 Queenston Rd.	Hamilton	Ontario
Residence	517 Queenston Rd.	Hamilton	Ontario
Residence	519 Queenston Rd.	Hamilton	Ontario
Residence	523 Queenston Rd.	Hamilton	Ontario
Residence	8 Woodman Dr. S	Hamilton	Ontario
Residence	531 Queenston Rd.	Hamilton	Ontario
Residence	11 Woodman Dr. S	Hamilton	Ontario
Residence	542 Queenston Rd.	Hamilton	Ontario
Residence	543 Queenston Rd.	Hamilton	Ontario
Residence	575 Queenston Rd.	Hamilton	Ontario
Residence	770 Queenston Rd.	Hamilton	Ontario
Bizclip Inc.	323 King St. E	Hamilton	Ontario
Blue Cross Animal Hospital	612 King St. W	Hamilton	Ontario
Downtown Animal Hospital	780 King St. E	Hamilton	Ontario
Dr. David Levy Sports Medicine Clinic	810 King St. E	Hamilton	Ontario
Dr. Radulescu Adina (Dentist)	505 King St. W	Hamilton	Ontario
Gamma Dynacare Medical Laboratories	505 King St. W	Hamilton	Ontario
Grand Health Academy Training Centre	760 King St. E	Hamilton	Ontario
Grant Avenue Medical Centre	2 Grant Ave.	Hamilton	Ontario
Hamilton Suzuki School of Music	2 King St. W	Hamilton	Ontario
Hamilton Wentworth Emergency Veterinary	505 King St. W	Hamilton	Ontario
International Tour and Tech Academy	227 King St. E	Hamilton	Ontario
King West Medical Associates	505 King St. W	Hamilton	Ontario
MJM Productions	440 King St. W	Hamilton	Ontario
Nova Multimedia & Video Production	1429 Main St. E	Hamilton	Ontario
Pearl Company	16 Steven St.	Hamilton	Ontario
The Printing House	372 King St. E	Hamilton	Ontario
King East Medical Building (Ultrasound, Laboratory, Pharmacy)	987 King St. E	Hamilton	Ontario
Hydro-Electric Substation	996 King St. E	Hamilton	Ontario
Dr. D. Savelli - Respirologist / Neurologist / Internal Medicine	910 King St. E	Hamilton	Ontario
DTI Dental Laboratory Ltd.	900 King St. E	Hamilton	Ontario
Oral and Maxillofacial Surgery Clinic	850 King St. E	Hamilton	Ontario
Bell Utility Building	1212 Main St. E	Hamilton	Ontario
Main St. Dental Office	1361 Main St. E	Hamilton	Ontario
Levy Medical Clinic	1390 Main St. E	Hamilton	Ontario
Red Hill Orthodontics	1451 Main St. E	Hamilton	Ontario
Dr. N. Chan Family Practice	1515 Main St. E	Hamilton	Ontario
McMaster University Hospital	1280 Main St. W	Hamilton	Ontario
Shakti Medical Centre	1309 Main St. W	Hamilton	Ontario

Noise/Vibration Sensitive Uses Adjacent to B-Line LRT Corridor

Hamilton Assistive Reproductive Technologies	1057 Main St. W	Hamilton	Ontario
Westdale Dental Centre	875 Main St. W	Hamilton	Ontario
Radio Station Offices	875 Main St. W	Hamilton	Ontario
Lifemark Physiotherapy	875 Main St. W	Hamilton	Ontario
Westdale Family Medical Centre	1100 Main St. W	Hamilton	Ontario
Dr. R. W. Hillis Dental Surgeon	1062 Main St. W	Hamilton	Ontario
Hamilton Healthcare Urgent Care Centre	690 Main St. W	Hamilton	Ontario
Dr. A. P. Olivieri, Dentist	117 Queenston Rd.	Hamilton	Ontario
Family Dental Care	289 Queenston Rd.	Hamilton	Ontario
Queenston Dental	321 Queenston Rd.	Hamilton	Ontario
Zimmerman Denture Clinic	509 Queenston Rd.	Hamilton	Ontario
Dr. Marco Renelli, Chiropractor	535 Queenston Rd.	Hamilton	Ontario
Queenston Medical Dental Centre	631 Queenston Rd.	Hamilton	Ontario
Art Gallery of Hamilton	123 King St. W	Hamilton	Ontario
Arts Hamilton	279 King St. E	Hamilton	Ontario
Casbah Lounge	306 King St. W	Hamilton	Ontario
Club Absinthe	233 King St. E	Hamilton	Ontario
FreeWay Coffee House	333 King St. E	Hamilton	Ontario
Hamilton Place	10 MacNab St. S	Hamilton	Ontario
Hamilton Urban Theatre	2 King St. W	Hamilton	Ontario
Lincoln Alexander Centre	160 King St. E	Hamilton	Ontario
TJ King Karaoke	214 King St. E	Hamilton	Ontario
Waltz Live Music Club	2 King St. W	Hamilton	Ontario
Westside Concert Theatre	434 King St. W	Hamilton	Ontario
Peter's Banquet Centre	345 Queenston Rd.	Hamilton	Ontario

Country	Source	Type
Canada	Observations	Institutional
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Noise/Vibration Sensitive Uses Adjacent to B-Line LRT Corridor

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Canada	Creative Industries List	Sensitive Equipment
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