Environmental Noise Feasibility Study

Georgian Court Redevelopment

Proposed Residential Development

City of Burlington

September 20, 2017
Project: 116-0448

Prepared for

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VALCOUSTICS
Canada Ltd.

Document Version Index:

Version	Date	Description of Changes
1.0	July14, 2017	Final - Issued to Client
2.0	September 20, 2017	Revised to add detail about STC calculation

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Environmental Noise Feasibility Study

Georgian Court Redevelopment

Proposed Residential Development

City of Burlington

EXECUTIVE SUMMARY

Valcoustics Canada Ltd. (VCL) was retained to prepare an Environmental Noise Feasibility Study for the proposed re-development of Georgian Court in the City of Burlington. The site is currently occupied by townhouse blocks. The re-developed site will be a mix of townhouse blocks and high-rise buildings.

The significant noise source in the vicinity is road traffic on Plains Road East, King Road, Queen Elizabeth Way (QEW) and the internal roadways.

The sound levels on site have been determined and compared with the applicable Ministry of the Environment and Climate Change (MOE) noise guideline limits to determine the need for noise mitigation.

To meet the applicable transportation noise source guideline limits:

- All residential suites in the high-rise towers require mandatory air conditioning.
- The townhouse units adjacent to King Road require the provision for adding air conditioning.
- The high rise buildings require upgraded exterior wall and window construction on facades exposed to the QEW. With upgraded exterior wall construction meeting a Sound Transmission Class (STC) rating of 54, exterior windows with STC ratings up to 38 may be required.
- Final requirements should be checked when detailed building plans are available. This is usually done as a condition for obtaining a building permit.
- Sound barriers are not required as part of this development.

1.0 INTRODUCTION

VCL was retained to prepare an Environmental Noise Feasibility Study for the proposed re-development of Georgian Court in support of the Zoning By-Law Amendment (ZBA) and Official Plan Amendment (OPA) submissions to the City of Burlington.

The site is currently occupied by a townhouse complex. The site will be re-developed with 3-storey townhouse units, as well as mid to high rise towers ranging from 8 to 20 storeys.

The potential sound levels and noise mitigation measures needed for the proposed development to comply with the MOE noise guideline requirements are outlined herein.

1.1 THE SITE AND SURROUNDING AREA

The site is located on the east side of King Road, south of Plains Road East, in the City of Burlington.

The site is bounded by:

- existing high-rise residential development, with Plains Road East beyond, to the north;
- Francis Road Bikeway, with existing residential dwellings beyond, to the east;
- Marley Road, with existing residential dwellings to the south; and
- King Road, with existing residential dwellings beyond, to the west.

The QEW is located approximately 400 m to the east of the site.

A Key Plan is included as Figure 1. The study is based on the Georgian Court Masterplan, prepared by Urban Strategies Inc., dated June 28, 2017. The Masterplan is included as Figure 2.

1.2 THE PROPOSED DEVELOPMENT

The proposed development will consist of a mix of 3-storey townhouse blocks (located along the south and west sides of the site) and mid to high rise towers ranging in height from 8 to 20 storeys. There will be public open space at the centre of the site.

2.0 NOISE SOURCES

The noise source with potential to impact the proposed development is road traffic on Plains Road East, King Road, the QEW and the internal roadways. Traffic volumes on the other surrounding roadways are anticipated to be minor and no significant noise impact is expected at the subject site. Thus, the surrounding roadways have not been included in the assessment.

The traffic data is shown in Appendix A and summarized in Table 1.

There are no stationary noise sources in the vicinity that are expected to have a significant noise impact at the subject site.

2.1 ROAD TRAFFIC

Turning movement count data (year 2015) for Plains Road East at King Road was obtained from the City of Burlington. A day/night split of 90%/10% was used as is typical for well-travelled roadways. A growth rate of 2%, compounded annually, was used to obtain future (year 2027) traffic volumes. Truck percentages were obtained from the turning movement counts. The ratio of medium trucks to heavy trucks was assumed to be 60%/40%.

Future traffic volumes for Plains Road East, King Road and Surrey Lane (the internal roadway) were obtained from BA Group, the traffic consultants for this development. The traffic volumes are a 12-year projection based on 2017 counts. Since the future traffic volumes for Plains Road East and King Road were lower than those obtained by projecting the City of Burlington data, to be conservative, the City of Burlington data was used for these two roadways.

Ultimate road traffic volumes for the QEW were obtained from the Ministry of Transportation (MTO). As recommended by the MTO, the ratio of heavy/medium trucks was assumed to be 75%/25%.

3.0 ENVIRONMENTAL NOISE GUIDELINES

3.1 MOE PUBLICATION NPC-300

The applicable noise guidelines for new residential development are those in MOE Publication NPC-300, *"Environmental Noise Guideline, Stationary and Transportation Sources – Approval and Planning"*.

MOE Publication NPC-300 noise guideline (released October 2013) has replaced four existing noise guidelines (Publications LU-131, NPC-205 and NPC-232, as well as Noise Assessment Criteria in Land Use Planning: Requirements, Procedures and Implementation) in Ontario.

The environmental noise guidelines of the MOE, as provided in Publication NPC-300, are discussed briefly below and summarized in Appendix B.

3.1.1 Transportation Noise Sources

3.1.1.1 Architectural Elements

In the daytime, the indoor criterion for road noise is $L_{eq\ Day}$(1) of 45 dBA for sensitive spaces such as living/dining rooms, dens and bedrooms. At night, the indoor criterion for road noise is $L_{eq\ Night}$(2) of 45 dBA for sensitive spaces such as living/dining rooms and dens and 40 dBA for bedrooms.

The architectural design of the building envelope (walls, windows, etc.) must provide adequate sound isolation to achieve these indoor sound level limits, based on the applicable outdoor sound level on the facades.

(1) $L_{eq\ Day}$ - 16 hour energy equivalent continuous sound level (0700-2300 hours).
(2) $L_{eq\ Night}$ - 8 hour energy equivalent continuous sound level (2300-0700 hours).

3.1.1.2 Ventilation

In accordance with the MOE noise guideline for road traffic sources, if the daytime sound level, $L_{eq\ Day}$, at the exterior face of a noise sensitive window is greater than 65 dBA, means must be provided so that windows can be kept closed for noise control purposes and central air conditioning is required. For daytime sound levels between 56 dBA and 65 dBA inclusive, there need only be the provision for adding air conditioning at a later date. A warning clause advising the occupant of the potential interference with some activities is also required. At nighttime, air conditioning would be required when the sound level exceeds 60 dBA ($L_{eq\ Night}$) at a noise sensitive window (provision for adding air conditioning is required when the sound level is greater than 50 dBA or less than or equal to 60 dBA).

3.1.1.3 Outdoors

For outdoor amenity areas ("Outdoor Living Area's" - OLA's), the guideline is 55 dBA $L_{eq\ Day}$ (0700 to 2300 hours), with an excess not exceeding 5 dBA considered acceptable if it is technically not practicable to achieve the 55 dBA objective, provided warning clauses are registered on title. Note that for road traffic sources, a balcony is not considered an OLA, unless it is the only OLA for the occupant and it is:

- at least 4 m in depth; and
- unenclosed.

3.2 REGION OF HALTON

The site is not located adjacent to any Regional Roads. Thus, there are no regional requirements over and above those of the MOE that apply.

4.0 NOISE IMPACT ASSESSMENT

Using the road traffic data in Table 1, the sound levels, in terms of $L_{eq\ Day}$ and $L_{eq\ Night}$, were determined using STAMSON V5.04 – ORNAMENT, the computerized road traffic noise prediction model of the MOE.

The daytime and nighttime sound levels at the building facades were calculated at the top floor windows, the worst case location.

There is currently public space with a cycling trail leading to the lake at the east side of the site. New public open space (common amenity space) that connects to the trail will be added to the centre of the site. Daytime sound levels at the OLA's were assessed at a height of 1.5 m above grade at the centre of this common amenity space. Inherent screening of each building due to its orientation to the noise source was taken into account.

The highest unmitigated daytime/nighttime sound levels of 71 dBA/71 dBA are predicted to occur on the exterior plane of windows facing east towards the QEW, at the easternmost high-rise towers (represented by Location I on Figure 2).

The common amenity space is completely screened from the noise sources. The predicted daytime sound level at this area is well below 55 dBA.

All balconies and terraces in the development are anticipated to be less than 4 m in depth and therefore the sound level limits for OLA's do not apply. If the building design is revised to include terraces that are greater than 4 m in depth, the analysis should be updated to include these locations.

Table 2 summarizes the unmitigated daytime and nighttime sound level predictions.

5.0 NOISE ABATEMENT REQUIREMENTS

The noise control measures can generally be classified into two categories which are interrelated, but which the designer can treat separately for the most part:

(a) Architectural elements to achieve acceptable indoor noise guidelines;

(b) Design features to protect the OLA's.

Noise abatement requirements are summarized on Figure 2 and in Table 3 along with the notes to Table 3.

5.1 INDOORS

5.1.1 Architectural Elements

The indoor noise level guidelines can be achieved by using appropriate construction for exterior walls, windows and doors. In determining the worst-case architectural requirements for the residential units, wall and window areas at the high rise towers were *assumed* to be 20% and 80%, respectively, of the associated floor area on each facade of a corner room with both facades exposed to the noise source. The wall and window areas at the townhouse blocks were *assumed* to be 80% and 30%, respectively, of the associated floor area on each facade of a corner room with both facades exposed to the noise source.

For the high rise towers, exterior wall construction meeting an STC of 54 and window construction with STC ratings up to 38 may be required at facades with exposure to the QEW. Note that the STC requirements may be lower if the window area is smaller than the assumptions. The STC requirements are also anticipated to be lower at lower floors that are screened from the QEW.

For the townhouse units, exterior wall and window construction meeting the minimum non-acoustical requirements of the OBC will be sufficient to achieve the indoor noise criteria.

Note that the wall and window areas used in this assessment are based on typical assumptions for townhouse dwellings and high rise units, as current building plans are currently unavailable. If the units are designed with smaller window areas relative to the floor area, the STC requirements will likely be lower than those presented above.

The final detailed sound isolation requirements should be determined when the architectural plans are available. Exterior wall and window constructions should also be reviewed at this point to ensure that they will meet the required sound isolation performance. This is typically required by the City at the time of building permit application.

Note, the STC rating applies to the window as a whole, including frame elements, gasketing, etc. Acoustical test data from an accredited laboratory indicating the window assemblies can meet the required STC ratings should be submitted by the window supplier for review.

5.1.2 Ventilation Requirements

Based on the predicted daytime and nighttime sound levels, suites in the high-rise towers require mandatory air conditioning to allow windows to remain closed for noise control purposes.

The townhouse units adjacent to King Road require the provision for adding air conditioning. This typically takes the form of a ducted, forced air heating system, suitably sized to accommodate central air conditioning.

5.2 OUTDOORS

The unmitigated daytime sound levels at the common outdoor amenity space at the centre of the site is predicted to be below the 55 dBA objective. Therefore, sound barriers are not required at this location.

5.3 WARNING CLAUSES

Where the sound level guidelines are exceeded, appropriate warning clauses should be registered on title to make future occupants aware of the potential noise situation. Locations requiring warning clauses and the appropriate wording are given in Table 3 and in the notes to Table 3, respectively.

6.0 CONCLUSIONS

With appropriate acoustical design of the development, a suitable acoustical environment can be provided and the applicable MOE noise guideline requirements met.

The approvals and administrative procedures are available to ensure that the acoustical requirements are implemented.

7.0 REFERENCES

1. PC STAMSON 5.04, “Computer Program for Road Traffic Noise Assessment", Ontario Ministry of the Environment and Climate Change.

2. Building Practice Note No. 56: “Controlling Sound Transmission into Buildings”, by J. D. Quirt, Division of Building Research, National Council of Canada, September 1985.

3. “Environmental Noise Assessment in Land-Use Planning 1987", Ontario Ministry of the Environment, February 1987, ISBN 0-7729-2804-5.

4. “Road and Rail Noise: Effects on Housing”, Canada Mortgage and Housing Corporation, Publication NHA 5156, 81/10.

5. “Environmental Noise Guideline, Stationary and Transportation Sources - Approval and Planning”, Ontario Ministry of the Environment, Publication NPC-300, August 2013.

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TABLE 1

ROAD TRAFFIC DATA

Roadway	AADT[1]	% Trucks		Speed Limit (kph)	Day/Night Split (%)
		Medium	Heavy		
King Road [2]	8 728	2.2	1.5	50	90/10
Plains Road East[2]	25 904	3.4	2.2	60	90/10
QEW[3]	218 000	3.25	9.75	100	67/33
Surrey Lane[4]	3 050	0.6	0.4	50	90/10

Notes:

(1) AADT - Annual Average Daily Traffic
(2) Obtained from the City of Burlington for the year 2015. Traffic volumes were projected to the year 2027 using a growth rate of 2%, compounded annually. The day/night split was assumed to be 90%/10%, as is typical for well travelled roadways. The ratio of medium trucks to heavy trucks was assumed to be 60%/40%.
(3) Ultimate traffic volumes obtained from the MTO. The ratio of medium trucks to heavy trucks was assumed to be 25%/75%, as recommended by the MTO.
(4) Future traffic volumes (a 12-year projection based on 2017 traffic counts) were obtained from BA Group. The day/night split was assumed to be 90%/10%, as is typical for well travelled roadways. The ratio of medium trucks to heavy trucks was assumed to be 60%/40%.

TABLE 2

PREDICTED UNMITIGATED SOUND LEVELS AT BUILDING FACADE(1)

Location(2)	Source	Distance (m)(3)	$L_{eq\ Day}$ (dBA)	$L_{eq\ Night}$ (dBA)
Location A (West Facade)	King Road	25	59	53
Location A (South Facade)	Surrey Lane	18	53	47
Location B (West Facade)	King Road	158	53	47
	Plains Road East	332	54	47
	Surrey Lane	30	53	46
	TOTAL	**–**	**58**	**51**
Location B (East Facade)	QEW (Northbound)	631	58	58
	QEW (Southbound)	602	58	58
	TOTAL	**–**	**61**	**61**
Location C (East Facade)	Plains Road East	331	54	47
	QEW (Northbound)	534	67	67
	QEW (Southbound)	506	67	67
	TOTAL	**–**	**70**	**70**
Location D (East Facade)	Plains Road East	264	55	49
	QEW (Northbound)	472	68	68
	QEW (Southbound)	445	68	68
	TOTAL	**–**	**71**	**71**
Location E (East Facade)	Plains Road East	338	54	47
	QEW (Northbound)	475	67	67
	QEW (Southbound)	447	68	68
	TOTAL	**–**	**71**	**70**

.../cont

TABLE 2 (continued)

PREDICTED UNMITIGATED SOUND LEVELS AT BUILDING FACADE(1)

Location(2)	Source	Distance (m)(3)	$L_{eq\ Day}$ (dBA)	$L_{eq\ Night}$ (dBA)
Location F (East Facade)	QEW (Northbound)	576	66	66
	QEW (Southbound)	546	66	66
	TOTAL	**–**	**69**	**69**
Location G (East Facade)	QEW (Northbound)	614	59	59
	QEW (Southbound)	580	59	59
	TOTAL	**–**	**62**	**62**
Location H (East Facade)	QEW (Northbound)	534	61	61
	QEW (Southbound)	501	62	62
	TOTAL	**–**	**64**	**64**
Location I (East Facade)	QEW (Northbound)	465	67	67
	QEW (Southbound)	431	68	68
	TOTAL	**–**	**71**	**71**

Notes:

(1) See Figure 2.
(2) Distance indicated is taken from the centreline of the noise source to the point of reception.

TABLE 3

MINIMUM NOISE ABATEMENT MEASURES

Location	Air Conditioning[1]	Exterior Wall[2]	Exterior Window[3]	Sound Barrier[4]	Warning Clauses[5]
Townhouse blocks adjacent to King Road	Provision for adding	No special acoustical requirements		none	A + B
High rise towers	Mandatory	STC 54	up to STC 38	none	A + C
All other dwellings	No special acoustical requirements				

Notes:

(1) Provision for adding air conditioning typically takes the form of a ducted ventilation system suitably sized to permit the addition of central air conditioning by the occupant.

(2) STC - Sound Transmission Class Rating (Reference ASTM-E413). The upgraded construction is only required on the three facades with exposure to the rail line.

The requirements are based on assumed percentages of wall and window area to associated floor area and should be checked once building plans are finalized.

(3) STC - Sound Transmission Class Rating (Reference ASTM-E413). A sliding glass walkout door should be considered as a window and be included in the percentage of glazing.

The requirements are based on assumed percentages of wall and window area to associated floor area and should be checked once building plans are finalized.

(4) Sound barriers must be of solid construction with no gaps, cracks or holes and must have a minimum surface density of 20 kg/m². A variety of materials are available including wood, masonry, composites, plastics, earth berms, or a combination of materials.

(5) Warning clauses to be registered on title and be included in Offers of Purchase and Sale for designated lots:

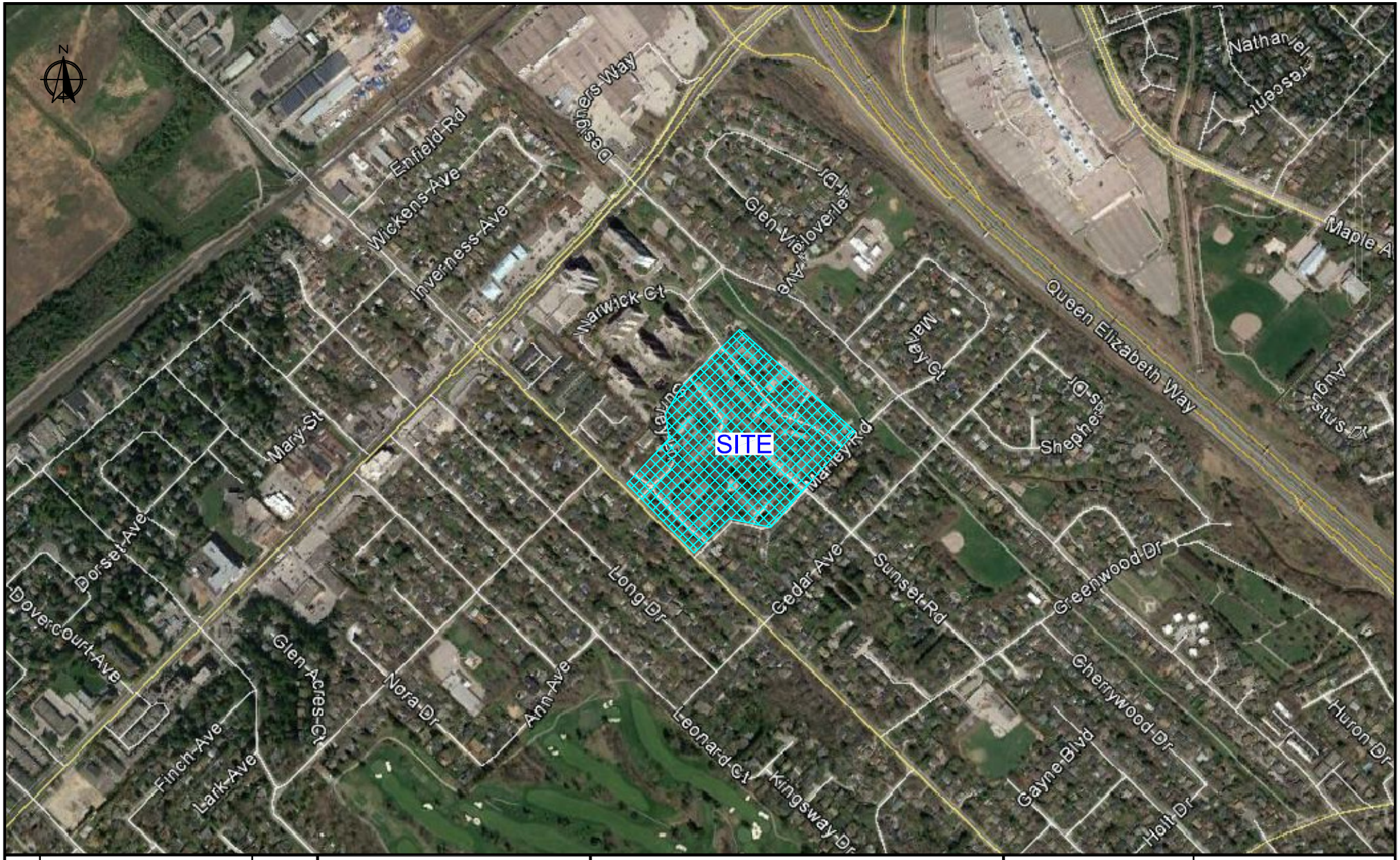
A. "Purchasers/tenants are advised that despite the inclusion of noise control features in the development and within the building units, sound levels due to increasing road traffic may occasionally interfere with some activities of the dwelling occupants as the sound levels exceed the sound level limits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

B. "This dwelling has been designed with the provision for adding central air conditioning at the occupant's discretion. Installation of central air conditioning by the occupant in low and medium density developments will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the sound level limits of the Municipality and the Ministry of the Environment."

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

(6) Conventional ventilated attic roof construction meeting OBC requirements is satisfactory.

(7) All exterior doors shall be fully weatherstripped.



No.	Revision/Issue	Date

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Phone: (905) 764-5223
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Title
Key Plan

Project No.
116-0448

Date
July 20, 2017

Project Name
Georgian Court Redevelopment

Scale
N.T.S.

Figure
1



BASE DRAWING BY URBAN STRATEGIES INC.

No.	Revision/Issue	Date

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Title	Project No.	Date
Georgian Court Masterplan	116-0448	July 20, 2017
Project Name	**Scale**	**Figure**
Georgian Court Redevelopment	N.T.S.	2

APPENDIX A

ROAD TRAFFIC DATA

Plains Rd E @ King Rd

Annual Average Daily Traffic Diagram

Total Factor = Monthly Factor(0.94) x Daily Factor(0.93) x 24 Hour Factor(1.85) = 1.617270

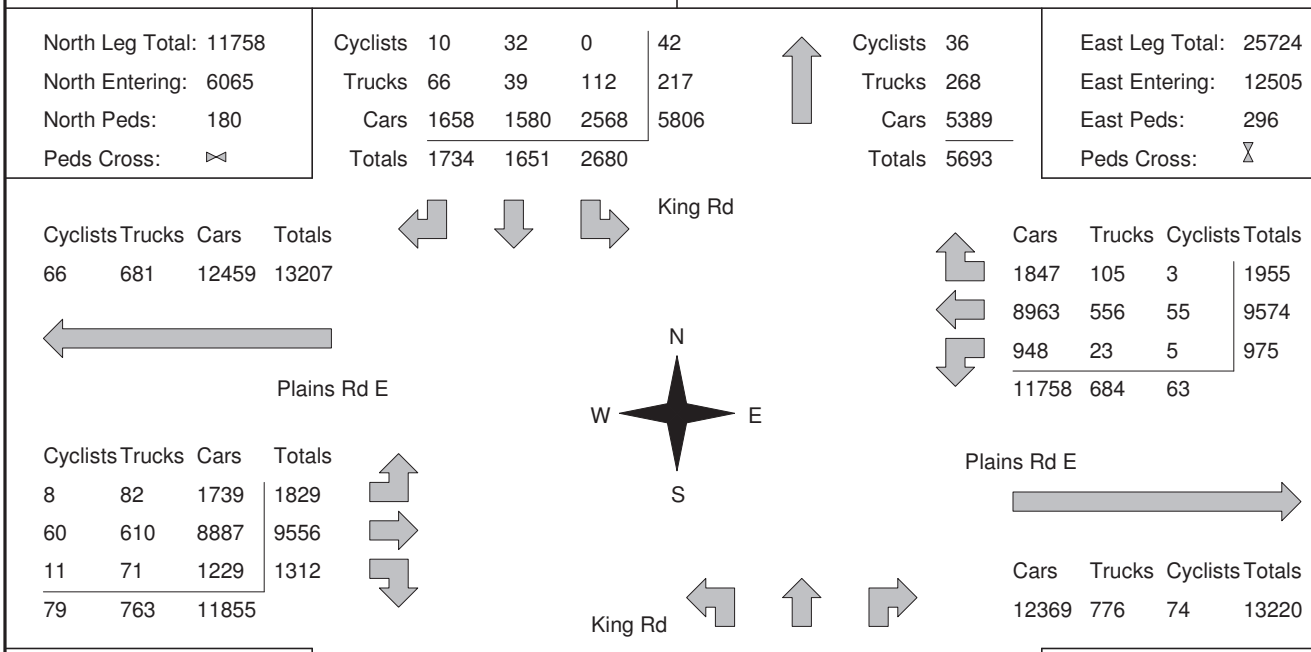
Municipality: Burlington
Site #: 0000201155
Intersection: Plains Rd E & King Rd
TFR File #: 2
Count date: 2-Jun-2015

Weather conditions:
Sunny/Dry

Person(s) who counted:
Rick

**** Signalized Intersection ****

Major Road: Plains Rd E runs W/E



Comments

Seema Nagaraj

From: Semple, Paul (MTO) <Paul.Semple@ontario.ca>
Sent: Thursday, June 01, 2017 2:20 PM
To: Seema Nagaraj
Cc: Tai, Arthur (MTO)
Subject: RE: Road traffic data request (VCL File: 116-0448)

Good afternoon Seema,

In response to your request please find below the information available from this office for the QEW south of Plains Rd E / Fairview St.:

Current AADT = 153,000
Ultimate AADT (Estimated) = 218,000
Current Number of Through Lanes = 6
Ultimate Number of Through Lanes = 8
Posted Speed = 100 km/hr
% Trucks (Estimated) = 13%

Please note that the above information is estimated based upon our current knowledge of the area, which may be subject to change in the future. Other information related to ROW, gradient, day/night split and heavy/medium truck split will be available from Central Region Traffic Office.

If you require further information, please don't hesitate to contact me.

Thanks,

Paul Semple
Planner, Systems Analysis & Forecasting Office
Ministry of Transportation
Policy & Planning Division
416-585-6308

From: Seema Nagaraj [mailto:seema@valcoustics.com]
Sent: June-01-17 10:05 AM
To: Semple, Paul (MTO)
Subject: Road traffic data request (VCL File: 116-0448)

Hi Paul,

We are currently preparing an environmental noise study for a proposed development near Plains Road East and King Road in Burlington (see attached image for specific location). Could you please provide ultimate traffic data for the QEW, south of Plains Road East?

Specifically, we are looking for:

- Ultimate AADT

- Current AADT
- Number of Lanes
- Posted Speed
- Truck Percentage (Medium/Heavy)
- Grade
- Day and Night Split

Thank you,

Seema Nagaraj, Ph.D., P.Eng.
Acoustical Engineer

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solutions@valcoustics.com

Seema Nagaraj

From: Kyrylo C. Rewa <rewa@bagroup.com>
Sent: Wednesday, June 28, 2017 11:45 AM
To: Seema Nagaraj
Cc: Corey Bialek (cbialek@urbanstrategies.com); John Emeljanow; Mark D. Jamieson
Subject: RE: Georgian Court Estates update

Hi Seema,

The counts were conducted in January 2017.

A growth rate of 2% over a 12 year horizon period was applied to the through movements at the key intersection of Plains Road / King Road and carried throughout the network.

Thanks,
Kyrylo

From: Seema Nagaraj [mailto:seema@valcoustics.com]
Sent: June-28-17 7:35 AM
To: Kyrylo C. Rewa
Cc: Corey Bialek (cbialek@urbanstrategies.com); John Emeljanow; Mark D. Jamieson
Subject: RE: Georgian Court Estates update

Hi Kyrylo,

Thank you for sending the data. A couple of quick questions – What year will these counts apply to, and what was the growth rate applied to the roads?

Thank you,

Seema Nagaraj, Ph.D., P.Eng.
Acoustical Engineer

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From: Kyrylo C. Rewa [mailto:rewa@bagroup.com]
Sent: Thursday, June 22, 2017 7:06 PM
To: Seema Nagaraj <seema@valcoustics.com>
Cc: Corey Bialek (cbialek@urbanstrategies.com) <cbialek@urbanstrategies.com>; John Emeljanow

<john@valcoustics.com>; Mark D. Jamieson <Jamieson@bagroup.com>
Subject: RE: Georgian Court Estates update

Hi Seema,

Please see below for responses as requested regarding future estimated traffic volumes near the Georgian Court site.

Estimated AADT volumes (sum of a.m. + p.m. peak hour link volumes x 5) and existing heavy vehicle percentages by approach:

King Road / Plains Road

- Along Plains Road east of King Road:**-/+ 22,300 veh.**
- 6% (1%) – a.m. (p.m.)

- Along Plains Road west of King Road: **-/+ 21,2785 veh.**
- 2% (1%) – a.m. (p.m.)

- Along King Road north of Plains Road: **-/+ 10,875 veh.**
- 5% (1%) – a.m. (p.m.)

- Along King Road south of Plains Road: **-/+ 8,900 veh.**
- 3% (2%) – a.m. (p.m.)

King Road / Surrey Lane

- Along Surrey Lane east of King Road:**-/+ 3,050 veh.**
- 1% (1%) – a.m. (p.m.)

King Road / Surrey Lane

- Along Surrey Lane east of King Road:**-/+ 1,050 veh.**
- 0% (0%) – a.m. (p.m.)

King Road / North Shore Boulevard

- Along North Shore Boulevard east of King Road:**-/+ 11,950 veh.**
- 2% (1%) – a.m. (p.m.)

Please let me know if you have any questions or require any further information.

Many thanks,
Kyrylo

APPENDIX B

ENVIRONMENTAL NOISE GUIDELINES

APPENDIX B

ENVIRONMENTAL NOISE GUIDELINES

MINISTRY OF THE ENVIRONMENT AND CLIMATE CHANGE (MOE)

Reference: MOE Publication NPC-300, August 2013: "Environmental Noise Guideline, Stationary and Transportation Source - Approval and Planning".

SPACE	SOURCE	TIME PERIOD	CRITERION
Living/dining, den areas of residences, hospitals, nursing homes, schools, daycare centres, etc.	Road	07:00 to 23:00	45 dBA
	Rail	07:00 to 23:00	40 dBA
	Aircraft	24-hour period	NEF/NEP 5
Living/dining, den areas of residences, hospitals, nursing homes, etc. (except schools or daycare centres)	Road	23:00 to 07:00	45 dBA
	Rail	23:00 to 07:00	40 dBA
	Aircraft	24-hour period	NEF/NEP 5
Sleeping quarters	Road	07:00 to 23:00	45 dBA
	Rail	07:00 to 23:00	40 dBA
	Aircraft	24-hour period	NEF/NEP 0
Sleeping quarters	Road	23:00 to 07:00	40 dBA
	Rail	23:00 to 07:00	35 dBA
	Aircraft	24-hour period	NEF/NEP 0
Outdoor Living Areas	Road and Rail	07:00 to 23:00	55 dBA
Outdoor Point of Reception	Aircraft	24-hour period	NEF/NEP 30#
	Stationary Source		
	Class 1 Area	07:00 to 19:00(1)	50* dBA
		19:00 to 23:00(1)	50* dBA
	Class 2 Area	07:00 to 19:00(2)	50* dBA
		19:00 to 23:00(2)	45* dBA
	Class 3 Area	07:00 to 19:00(3)	45* dBA
		19:00 to 23:00(3)	40* dBA
	Class 4 Area	07:00 to 19:00(4)	55* dBA
		19:00 to 23:00(4)	55* dBA

...../cont'd

SPACE	SOURCE	TIME PERIOD	CRITERION
Plane of a Window of Noise Sensitive Spaces	Stationary Source		
	Class 1 Area	07:00 to 19:00(1)	50* dBA
		19:00 to 23:00(1)	50* dBA
		23:00 to 07:00(1)	45* dBA
	Class 2 Area	07:00 to 19:00(2)	50* dBA
		19:00 to 23:00(2)	50* dBA
		23:00 to 07:00(2)	45* dBA
	Class 3 Area	07:00 to 19:00(3)	45* dBA
		19:00 to 23:00(3)	45* dBA
		23:00 to 07:00(3)	40* dBA
	Class 4 Area	07:00 to 19:00(4)	60* dBA
		19:00 to 23:00(4)	60* dBA
		23:00 to 07:00(4)	55* dBA

\# may not apply to in-fill or re-development.
* or the minimum hourly background sound level $L_{eq}(1)$, due to road traffic, if higher.
(1) Class 1 Area : Urban
(2) Class 2 Area : Urban during day; rural-like evening and night
(3) Class 3 Area : Rural
(4) Class 4 Area: Subject to land use planning authority's approval

Reference: MOE Publication ISBN 0-7729-2804-5, 1987: "Environmental Noise Assessment in Land-Use Planning".

EXCESS ABOVE RECOMMENDED SOUND LEVEL LIMITS (dBA)	CHANGE IN SUBJECTIVE LOUDNESS ABOVE	MAGNITUDE OF THE NOISE PROBLEM	NOISE CONTROL MEASURES (OR ACTION TO BE TAKEN)
No excess (<55 dBA)	—	No expected noise problem	None
1 to 5 inclusive (56 to 60 dBA)	Noticeably louder	Slight noise impact	If no physical measures are taken, then prospective purchasers or tenants should be made aware by suitable warning clauses.
6 to 10 inclusive (61 - 65 dBA)	Almost twice as loud	Definite noise impact	Recommended.
11 to 15 inclusive (66 - 70 dBA)	Almost three times as loud	Serious noise impact	Strongly Recommended.
16 and over (>70 dBA)	Almost four times as loud	Very serious noise impact	Strongly Recommended (may be mandatory).

APPENDIX C

SAMPLE STAMSON CALCULATION

```
STAMSON 5.04        NORMAL REPORT        Date: 20-07-2017 11:41:03
MINISTRY OF THE ENVIRONMENT AND CLIMATE CHANGE / NOISE ASSESSMENT

Filename: i_ef.te              Time Period: Day/Night 16/8 hours
Description: Location I - East Facade

Road data, segment # 1: QEW NB (day/night)
-----------------------------------------
Car traffic volume  : 63223/31607 veh/TimePeriod  *
Medium truck volume :  2362/1181  veh/TimePeriod  *
Heavy truck volume  :  7085/3542  veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT): 109000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   3.25
    Heavy Truck  % of Total Volume     :   9.75
    Day (16 hrs) % of Total Volume     :  66.67

Data for Segment # 1: QEW NB (day/night)
----------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 465.00 / 465.00 m
Receiver height           :  22.50 / 22.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Road data, segment # 2: QEW SB (day/night)
-----------------------------------------
Car traffic volume  : 63223/31607 veh/TimePeriod  *
Medium truck volume :  2362/1181  veh/TimePeriod  *
Heavy truck volume  :  7085/3542  veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT): 109000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   3.25
    Heavy Truck  % of Total Volume     :   9.75
    Day (16 hrs) % of Total Volume     :  66.67

Data for Segment # 2: QEW SB (day/night)
----------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 431.00 / 431.00 m
Receiver height           :  22.50 / 22.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Results segment # 1: QEW NB (day)
---------------------------------

Source height = 1.77 m

ROAD (0.00 + 67.41 + 0.00) = 67.41 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.02  82.72   0.00 -15.24  -0.06   0.00   0.00   0.00  67.41
-------------------------------------------------------------------------------

Segment Leq : 67.41 dBA

Results segment # 2: QEW SB (day)
---------------------------------

Source height = 1.77 m

ROAD (0.00 + 67.75 + 0.00) = 67.75 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.02  82.72   0.00 -14.90  -0.06   0.00   0.00   0.00  67.75
-------------------------------------------------------------------------------

Segment Leq : 67.75 dBA

Total Leq All Segments: 70.59 dBA

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

Source height = 1.77 m

ROAD (0.00 + 67.41 + 0.00) = 67.41 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.02  82.72   0.00 -15.24  -0.06   0.00   0.00   0.00  67.41
-------------------------------------------------------------------------------

Segment Leq : 67.41 dBA

Results segment # 2: QEW SB (night)
-----------------------------------

Source height = 1.77 m

ROAD (0.00 + 67.75 + 0.00) = 67.75 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.02  82.72   0.00 -14.90  -0.06   0.00   0.00   0.00  67.75
-------------------------------------------------------------------------------

Segment Leq : 67.75 dBA

Total Leq All Segments: 70.59 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 70.59
                           (NIGHT): 70.59
```

```
STAMSON 5.04        NORMAL REPORT        Date: 20-07-2017 11:44:12
MINISTRY OF THE ENVIRONMENT AND CLIMATE CHANGE / NOISE ASSESSMENT

Filename: b_wf.te              Time Period: Day/Night 16/8 hours
Description: Location B - West Facade


Road data, segment # 1: King (day/night)
----------------------------------------
Car traffic volume  :  9594/1066  veh/TimePeriod  *
Medium truck volume :   219/24    veh/TimePeriod  *
Heavy truck volume  :   149/17    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):   8728
    Percentage of Annual Growth        :   2.00
    Number of Years of Growth          :  12.00
    Medium Truck % of Total Volume     :   2.20
    Heavy Truck  % of Total Volume     :   1.50
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 1: King (day/night)
--------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 158.00 / 158.00 m
Receiver height           :  46.50 / 46.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Road data, segment # 2: Plains (day/night)
------------------------------------------
Car traffic volume  : 27912/3101  veh/TimePeriod  *
Medium truck volume :  1005/112   veh/TimePeriod  *
Heavy truck volume  :   650/72    veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  25904
    Percentage of Annual Growth        :   2.00
    Number of Years of Growth          :  12.00
    Medium Truck % of Total Volume     :   3.40
    Heavy Truck  % of Total Volume     :   2.20
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 2: Plains (day/night)
----------------------------------------
Angle1   Angle2           : -90.00 deg   -15.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 332.00 / 332.00 m
Receiver height           :  43.50 / 43.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Road data, segment # 3: Surrey (day/night)
------------------------------------------
Car traffic volume  :  2718/302   veh/TimePeriod  *
Medium truck volume :    16/2     veh/TimePeriod  *
Heavy truck volume  :    11/1     veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):   3050
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   0.60
    Heavy Truck  % of Total Volume     :   0.40
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 3: Surrey (day/night)
----------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  30.00 / 30.00  m
Receiver height           :  43.50 / 43.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

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

Source height = 1.11 m

ROAD (0.00 + 53.28 + 0.00) = 53.28 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  63.51   0.00 -10.23   0.00   0.00   0.00   0.00  53.28
-------------------------------------------------------------------------------

Segment Leq : 53.28 dBA

Results segment # 2: Plains (day)
---------------------------------

Source height = 1.22 m

ROAD (0.00 + 53.69 + 0.00) = 53.69 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90    -15   0.00  70.94   0.00 -13.45  -3.80   0.00   0.00   0.00  53.69
-------------------------------------------------------------------------------

Segment Leq : 53.69 dBA
```

```
Results segment # 3: Surrey (day)
---------------------------------

Source height = 0.80 m

ROAD (0.00 + 52.66 + 0.00) = 52.66 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  55.67   0.00  -3.01   0.00   0.00   0.00   0.00  52.66
-------------------------------------------------------------------------------

Segment Leq : 52.66 dBA

Total Leq All Segments: 58.00 dBA

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

Source height = 1.11 m

ROAD (0.00 + 46.79 + 0.00) = 46.79 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 -10.23   0.00   0.00   0.00   0.00  46.79
-------------------------------------------------------------------------------

Segment Leq : 46.79 dBA

Results segment # 2: Plains (night)
-----------------------------------

Source height = 1.22 m

ROAD (0.00 + 47.15 + 0.00) = 47.15 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90    -15   0.00  64.41   0.00 -13.45  -3.80   0.00   0.00   0.00  47.15
-------------------------------------------------------------------------------

Segment Leq : 47.15 dBA

Results segment # 3: Surrey (night)
-----------------------------------

Source height = 0.76 m

ROAD (0.00 + 46.01 + 0.00) = 46.01 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  49.03   0.00  -3.01   0.00   0.00   0.00   0.00  46.01
-------------------------------------------------------------------------------

Segment Leq : 46.01 dBA

Total Leq All Segments: 51.45 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 58.00
                           (NIGHT): 51.45
```