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Environmental Noise Control Study

Proposed Residential Building
368 Chapel Street - Ottawa

Prepared For

368 Chapel Street Inc.

January 10, 2018

Report: PG4331-1

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Appendices

1.0 Introduction

Paterson Group (Paterson) was commissioned by 368 Chapel Street Inc. to conduct an environmental noise control study for the proposed residential building to be located at 368 Chapel Street, in the City of Ottawa.

The objective of the current study is to:

- ❏ Determine the primary noise sources impacting the site and compare the projected sound levels to guidelines set out by the Ministry of Environment and Climate Change (MOECC) and the City of Ottawa.

- ❏ Review the projected noise levels and offer recommendations regarding warning classes, construction materials or alternative sound barriers.

The following report has been prepared specifically and solely for the aforementioned project which is described herein. It contains our findings and includes acoustical recommendations pertaining to the design and construction of the subject development as they are understood at the time of writing this report.

This study has been conducted according to City of Ottawa document - Engineering Noise Control Guidelines (ENCG), dated January 2016, and the Ontario Ministry of the Environment Guideline NPC-300.

2.0 Background

It is understood that the proposed development will consist of a three (3) storey residential building consisting of several units with balconies and terraces. No outdoor living areas were identified on the site plans.

3.0 Methodology and Noise Assessment Criteria

The City of Ottawa outlines three (3) sources of environmental noise that must be analyzed separately:

- ❏ Surface Transportation Noise
- ❏ Stationary Noise
  - ❏ new noise-sensitive development applications (noise receptors) in proximity to existing or approved stationary sources of noise, and
  - ❏ new stationary sources of noise (noise generating) in proximity to existing or approved noise-sensitive developments
- ❏ Aircraft noise

Surface Transportation Noise

The City of Ottawa's Official Plan, in addition to the ENCG dictate that the influence area must contain any of following conditions to classify as a surface transportation noise source for a subject site:

- ❏ Within 100 m of the right-of-way of an existing or proposed arterial, collector or major collector road; a light rail transit corridor; bus rapid transit, or transit priority corridor
- ❏ Within 250 m of the right-of-way for an existing or proposed highway or secondary rail line
- ❏ Within 300 m from the right of way of a proposed or existing rail corridor or a secondary main railway line
- ❏ Within 500 m of an existing 400 series provincial highway, freeway or principle main railway line.

The NPC-300 outlines the limitations of the stationary and environmental noise levels in relation to the location of the receptors. These can be found in the following tables:

Table 1 - Sound Level Limits for Outdoor Living Areas

Time Period	Required $L_{eq(16)}$ (dBA)
16-hour, 7:00-23:00	55

❏ Standards taken from Table 2.2a; Sound Level Limit for Outdoor Living Areas - Road and Rail

Table 2 - Sound Level Limits for Indoor Living Area			
Type of Space	**Time Period**	**Required L_{eq} (dBA)**	
		Road	**Rail**
Living/Dining, den areas of residences, hospitals, nursing homes, schools, daycare centres, etc	7:00-23:00	45	40
Theaters, place of worship, libraries, individual or semi-private offices, conference rooms, reading rooms	23:00-7:00	45	40
Sleeping quarters	7:00-23:00	45	40
	23:00-7:00	40	35
❑ Standards taken from Table 2.2b; Sound Level Limit for Indoor Living Areas - Road and Rail			

It is noted in ENCG, that the limits outlined in Table 2 are for the sound levels on the interior of the glass pane. The ENCG goes on to state that the limit for the exterior of the glass pane will be 55 dBA.

If the sound level limits are exceeded at the window panes for the indoor living areas, the following Warning Clauses may be referenced:

Table 3 - Warning Clauses for Sound Level Exceedances

Warning Clause	Description
Warning Clause Type A	"Purchasers/tenants are advised that sound levels due to increasing road traffic (rail traffic) (air traffic) may occasionally interfere with some activities of the dwelling occupants as the sound levels exceed the sound level limits of the Municipality and the Ministry of the Environment."
Warning Clause Type B	"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 (rail traffic) (air traffic) may on occasions interfere with some activities of the dwelling occupants as the sound levels exceed the sound level limits of the Municipality and the Ministry of the Environment."
Warning Clause Type C	"This dwelling unit 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."
Warning Clause Type D	"This dwelling unit has been supplied with a central air conditioning system which will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the sound level limits of the Municipality and the Ministry of the Environment."
❑ Clauses taken from section C8 Warning Clauses; Environmental Noise Guidelines - NPC-300	

Stationary Noise

Stationary noise sources include sources or facilities that are fixed or mobile and can cause a combination of sound and vibration levels emitted beyond the property line. These sources may include commercial air conditioner units, generators and fans. Facilities that may contribute to stationary noise may include car washes, snow disposal sites, transit stations and manufacturing facilities.

The impact of stationary noise sources are directly related to the location of the subject site within the urban environment. The proposed development can be classified as Class 2 by provincial guidelines and outlined in the ENGC, meaning “suburban areas of the City outside of the busy core where the urban hum is evident but within the urban boundary.”

Table 4 - Guidelines for Stationary Noise - Class 2		
Time of Day	**Outdoor Point of Reception**	**Pane of Window**
7:00-19:00	50	50
19:00-23:00	45	50
23:00-7:00	-	45
❑ Standards taken from Table 3.2a; Guidelines for Stationary Noise - Steady and Varying Sound		

Due to the location of the subject site, an analysis of stationary noise is not required.

Aircraft/Airport Noise

Aircraft noise is distinct, as it is typically low frequency for longer durations. The sound level may also differ between different types of aircraft. Due to the location of the subject site, an analysis of aircraft/airport noise is not required.

4.0 Analysis

The proposed development is bordered to the west by Chapel Street, and to the south, east and west by residential buildings.

Based on the City of Ottawa Official Plan, Schedule F, Chapel Street is classified as a 2 lane major collector (2-UMCU). The remainder of the roads within the 100 m radius include Russel Avenue, Osgoode Street and Blackburn Avenue. However, Schedule E does not classify these roads as either an arterial, collector or major collector road. Somerset Street East is located to the south of the subject site, but is outside of the 100 m radius of influence. All noise sources are presented on Paterson Drawing PG4331-2 - Site Plan, located in Appendix 1.

There are no stationary noise sources or aircraft noise within the influence area for this subject site.

The noise levels from road traffic are provided by the City of Ottawa, taking into consideration the right-of-way width and the implied roadway class. It is understood that these values represent the maximum allowable capacity of the proposed roadways. The parameters to be used for sound level predictions can be found below.

Table 5 - Traffic and Road Parameters

Road	Implied Roadway	AADT (Veh/day)	Posted Speed (km/h)	Day/Night Split %	Medium Truck %	Heavy Truck %
Chapel Street	2-UMCU	12000	60	92/8	7	5

❑ Data obtained from the City of Ottawa document ENCG

There were several reception points that were considered for a thorough analysis of the proposed residential development. No Outdoor Living Areas (OLA) were noted on the site plan. While exterior terraces and balconies were noted on the plans, they are all less than 4 m in depth, and therefore are not to be included in the analysis. The analysis is completed so that no effects of sound reflection off of the building facade is considered, as stipulated by the ENGC.

Additional reception points were selected at the bedroom windows at different elevations. For this analysis, a reception point was taken at the centre of the window pane, at the ground level and at the fourth floor. Reception points are noted on Paterson Drawing PG4331-3 - Receptor Locations, located in Appendix 1.

Two (2) levels of reception points were selected for this analysis. First floor was analyzed at a 1.5 m elevation and the third floor was analyzed at 8.19 m.

Table 9 - Summary of Reception Points and Geometry, located in Appendix 1, provides a summary of the points of reception and their geometry with respect to the noise sources.

The analysis was completed using STAMSON version 5.04, a computer program which uses the road and rail traffic noise prediction methods using ORNAMENT (Ontario Road Noise Analysis Method for Environment and Transportation) and STEAM (Sound from Trains Environment Analysis Method), publications from the Ontario Ministry of Environment and Energy.

The buildings located directly to the north and south of the proposed development was analyzed as a solid barrier in the STAMSON software. Due to the proximity of the building and the building components, this is an accurate modeling representation for this development.

One limitation of the STAMSON software is that the minimum distance between the reception point and the noise source is 15 m. The actual distance from the reception point and the noise source of REC 2-1 and REC 2-3 is actually 6 m, measured from the window pane to the edge of the right-of-way. Therefore, the data will need to be further analyzed in order to determine an accurate noise level resulting from the roadway noise.

5.0 Results

The primary descriptors are the 16-hour daytime and the 8-hour night time equivalent sound levels, $L_{eq(16)}$ and the $L_{eq(8)}$ for City roads.

The proposed traffic noise levels were analyzed at all reception points. The results of the STAMSON software can be located in Appendix 2, and the summary of the results can be noted in Table 6.

As it was noted in subsection 4.0, a limitation of the STAMSON software does not allow for the noise source to be closer than 15 m to the reception point. In this situation, Reception Point 1-1 and Reception Point 1-3 are located 6 m from the source. Therefore, the difference in the sound level between a noise source at 15 m and a noise source at 6 m can be calculated using the following formula:

$$L_2 = L_1 - \left[20 \log\left(\frac{r_2}{r_1} \right) \right]$$

Where: L_2 = Sound Level at reception point 2
L_1 = Sound Level at reception point 1
r_2 = distance from source to reception point 2
r_1 = distance from source to reception point 1

The final results from the analysis are presented in Table 6, below.

Table 6 - Proposed Noise Levels

Reception Point	Description	Outdoor Area $L_{EQ(16)}$ (dBA)	Daytime at Facade $L_{EQ(16)}$ (dBA)	Nighttime at Facade $L_{eq(8)}$ (dBA)
REC 1-1	Western elevation, 1st Floor	--	75.53	67.93
REC 1-3	Western elevation, 3rd Floor	--	75.89	68.29
REC 2-1	Northern Elevation, 1st Floor	--	63.25	55.65
REC 2-3	Northern Elevation, 3rd Floor	--	63.41	55.81
REC 3-1	Eastern Elevation, 1st Floor	--	59.58	51.98
REC 3-3	Eastern Elevation, 3rd Floor	--	59.94	52.34

6.0 Discussion and Recommendations

6.1 Outdoor Living Areas

There were no outdoor living areas identified on the proposed development.

6.2 Indoor Living Areas and Ventilation

The results of the STAMSON modelling indicates that the $L_{eq(16)}$ ranges between 75.89 dBA and 59.58 dBA.

These values exceed the threshold limit of 55 dBA, as specified by ENCG, and therefore warning clauses will be required to be stated on any property titles. The applicable warning clauses are summarized in Table 7.

Table 7 - Summary of Warning Clauses

Elevation	Applicable Warning Clause	Additional Considerations
All units	Warning Clause Type D	All units must be equipped with a central air conditioning system, reducing the need to open windows.

6.3 Noise Control Measures for Surface Transportation Noise

Indoor Living Area

Where the daytime sound level at the receptors located at the plane of the window exceeds 60 dBA, noise control measures should be implemented. The following table outlines the MOECC recommended options for sound mitigation and the respected responses.

Table 8 - Indoor Living Area Noise Mitigation Solutions	
MOECC Recommended Option	**Site Specific Response**
Distance setback with soft ground.	The proposed development configuration limits the actual maximum setback distance. An additional setback is not feasible.
Insertion of noise insensitive land uses between the source and sensitive receptor.	Not applicable to this development.
Orientation of buildings to provide sheltered zones or modified interior spaces (room and corridor arrangement) and amenity areas	The proposed buildings are situated in order to shield the rear of the building from the noise sources. There is a possibility that living areas and bedrooms will face the noise source.
Enhanced construction techniques and construction quality (e.g. brick veneers, multi-pane windows).	Construction techniques and building materials are to be analyzed to confirm sufficient soundproofing.
Earth berms (sound barriers).	Not required
Indoor isolation - air conditioning and ventilation, enhanced dampening materials (indoor isolation)	Not required

Proposed Construction Specifications

It is understood that typical window and wall details are proposed for the residential buildings. The effectiveness of the noise insulation can be expressed as the Acoustical Insulation Factor (AIF), calculated as follows:

$$AIF = L_{eq(16)(Exterior)} - L_{eq(16)(Interior)} + 10\log_{10}(N) + 2dBA$$

Where:

$L_{eq(16)(Exterior)}$ = Calculated value at the window pane
$L_{eq(16)(Interior)}$ = 45 dBA
N = number of components in the room

No floor plans or detailed design drawings were provided for this portion of the review. A conservative approach is to assume that there are 2 components per room. Therefore, the AIF would need to be at least 36 dBA.

A conversion from AIF to a Standard Transmission Class (STC) rating will require the knowledge of room dimensions in addition to the wall and window dimensions. However, a conservative approach would be to increase the AIF factor by 3. **Therefore, provided the building materials of either the windows and/or exterior walls have an STC rating of 39 or higher, this would be a sufficient noise attenuation device.**

Construction details were not known at the time of writing this report. Once the exterior wall cross sections and window schedules have been finalized, Paterson is to review the details to confirm an acceptable STC rating has been utilized.

7.0 Conclusion

The subject site is located at 368 Chapel Street. It is understood that the development will consist of single three-storey building. The associated analysis identified one noise source: Chapel Street.

Several reception points were selected for the analysis, consisting of glass pane reception points on both the first and third floors. No outdoor living areas were identified in the analysis.

The northern, western and eastern elevation of the proposed building exceeded the 55 dBA guideline specified by the ENCG. Therefore, a warning clause will be required for these units.

A review of the building materials will be required in order to ensure that the sound dampening will be sufficient to minimize the noise within the individual units. At the time of writing this report, the construction materials were not known. Paterson will require that the construction details be reviewed in order to ensure that proper soundproofing is provided. A STC rating of 39 or higher will be required for the wall and window construction.

8.0 Statement of Limitations

The recommendations made in this report are in accordance with our present understanding of the project. Our recommendations should be reviewed when the project drawings and specifications are complete.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than the 368 Chapel Street Ltd or their agent(s) is not authorized without review by this firm for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

Stephanie A. Boisvenue, P.Eng.

David J. Gilbert, P.Eng.

Report Distribution:

- ❑ 368 Chapel Street Ltd. (3 copies)
- ❑ Paterson Group (1 copy)

APPENDIX 1

TABLE 9 - SUMMARY OF RECEPTION POINTS AND GEOMETRY

DRAWING PG4331-2 - SITE PLAN

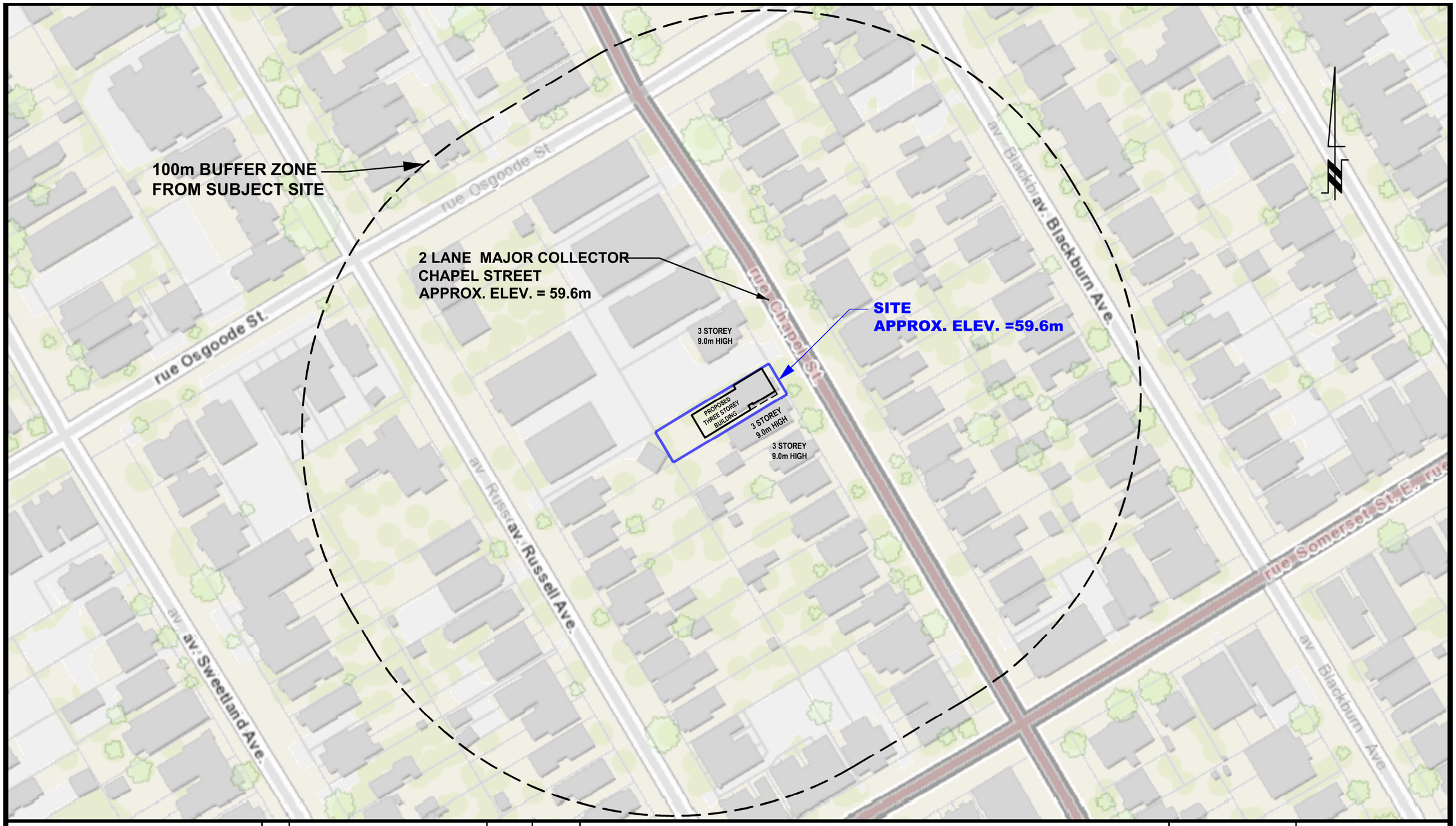
DRAWING PG4331-2A - SITE GEOMETRY (REC 1-1 AND REC 1-3)

DRAWING PG4331-2B - SITE GEOMETRY (REC 2-1 AND REC 2-3)

DRAWING PG4331-2C - SITE GEOMETRY (REC 3-1 AND REC 3-3)

DRAWING PG4331-3 - RECEPTOR LOCATIONS

Table 9 - Summary of Reception Points and Geometry 368 Chapel Street								
Point of Reception	Location	Leq Day (dBA)	Carling Avenue					
			Horizontal (m)	Vertical (m)	Total (m)	Local Angle (degree)	Barrier Height (m)	Distance (m)
REC 1-1	Western elevation, 1st	67.57	6	1.5	6.184658438	-90, 90	n/a	n/a
REC 1-3	Western Elevation, 3rd	67.93	6	8.19	10.15264005	-90, 90	n/a	n/a
REC 2-1	Northern Elevation, 1st Floor	63.25	15	1.5	15.07481343	-83, -52	9	9
						-52, 0	n/a	n/a
REC 2-3	Northern Elevation, 3rd Floor	63.41	15	8.19	17.09023405	-83, -52	9	9
						-52, 0	n/a	n/a
REC 3-1	Eastern Elevation, 1st Floor	59.58	15	1.5	15.07481343	0, 20	n/a	n/a
						20, 86	9	5
REC 3-3	Eastern Elevation, 3rd Floor	59.94	15	8.19	17.09023405	0, 20	n/a	n/a
						20, 86	9	5



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NO.	REVISIONS	DATE	INITIAL
0			

368 CHAPEL STREET INC.

NOISE ATTENUATION STUDY
PROPOSED BUILDING - 368 CHAPEL STREET

OTTAWA, ONTARIO

Title:

SITE PLAN

Scale: 1:1000	Date: 01/2018
Drawn by: RCG	Report No.: PG4331-1
Checked by: SB	Dwg. No.: PG4331-2
Approved by: DJG	Revision No.: 0

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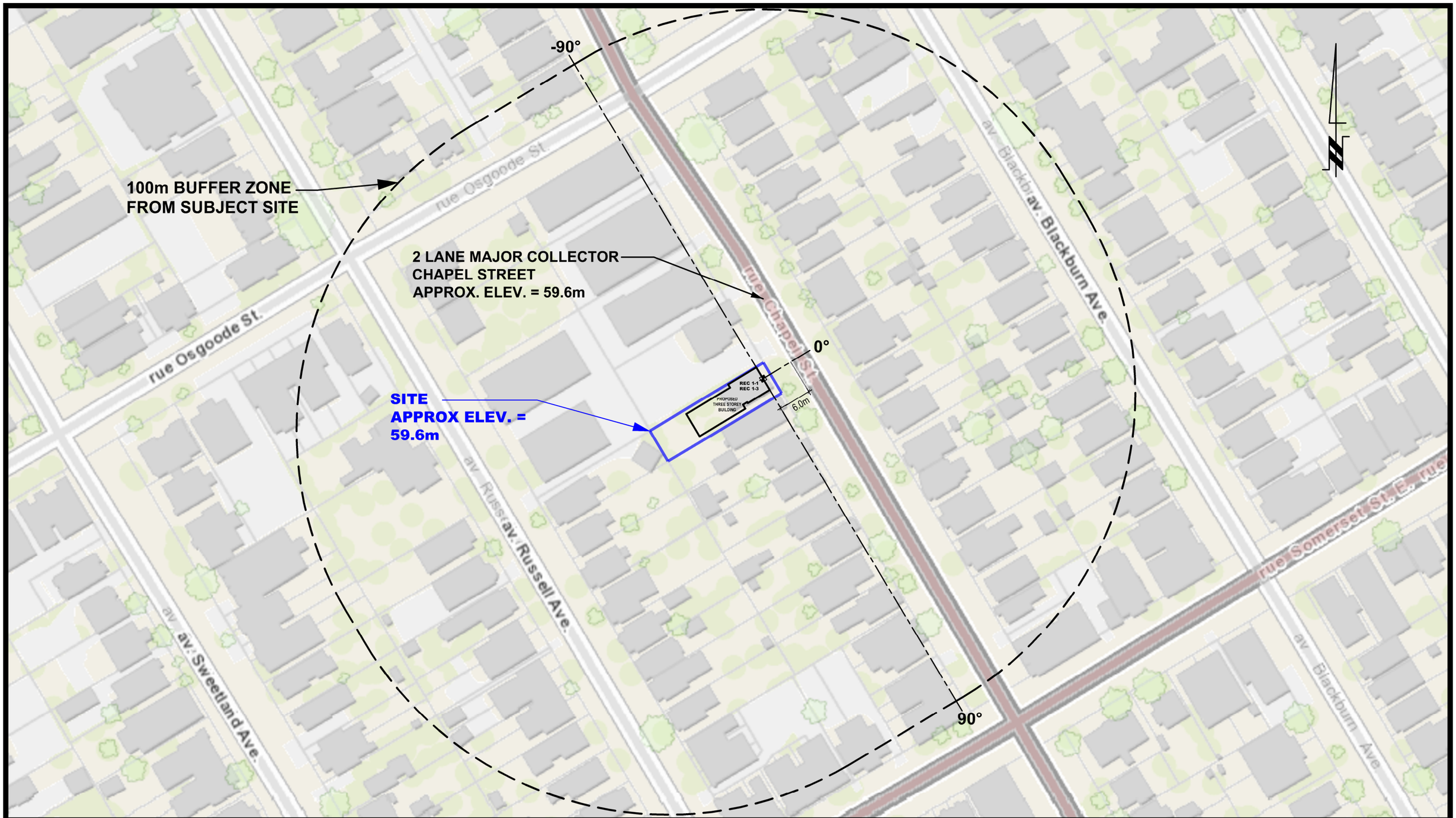

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0			

368 CHAPEL STREET INC.

NOISE ATTENUATION STUDY
PROPOSED BUILDING ADDITION - 368 CHAPEL STREET

OTTAWA, ONTARIO

Title:

SITE GEOMETRY - REC 1-1, REC 1-3

Scale: 1:1000	Date: 01/2018
Drawn by: RCG	Report No.: PG4331-1
Checked by: SB	Dwg. No.: PG4331-2A
Approved by: DJG	Revision No.: 0

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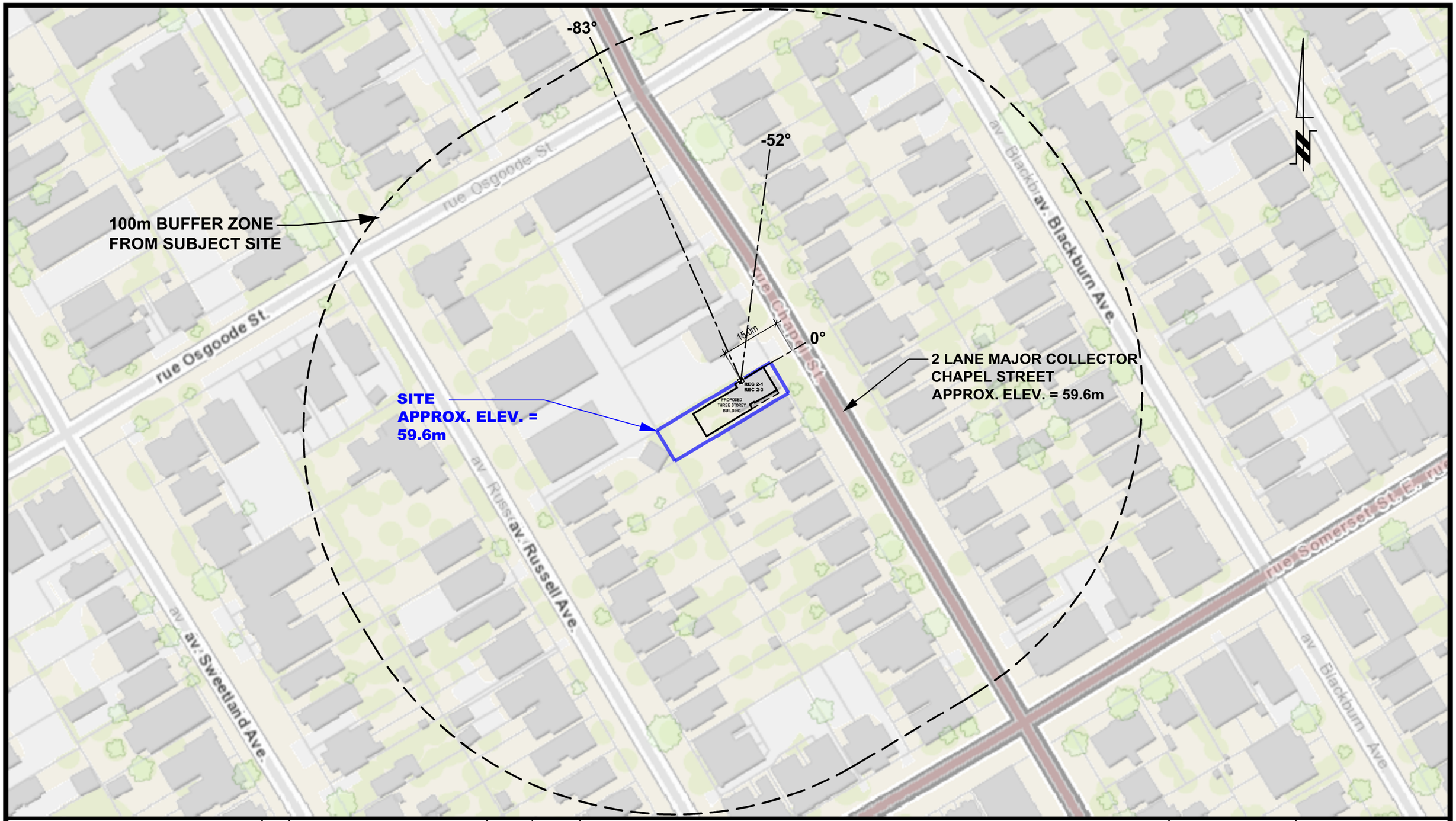

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368 CHAPEL STREET INC.

NOISE ATTENUATION STUDY
PROPOSED BUILDING ADDITION - 368 CHAPEL STREET

OTTAWA, ONTARIO

Title:

SITE GEOMETRY - REC 2-1, REC 2-3

Scale: 1:1000	Date: 01/2018
Drawn by: RCG	Report No.: PG4331-1
Checked by: SB	Dwg. No.: **PG4331-2B**
Approved by: DJG	Revision No.: 0

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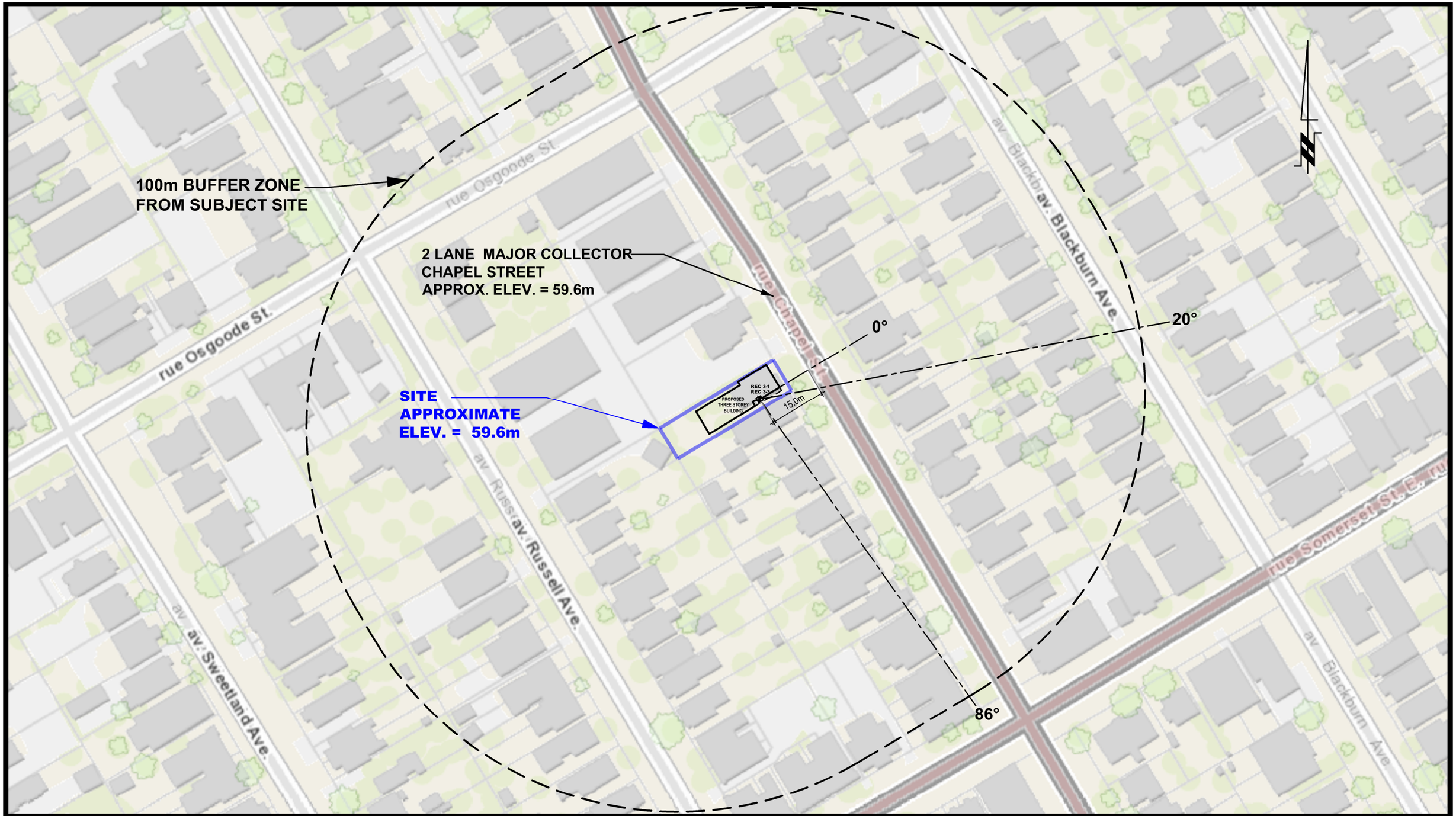

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368 CHAPEL STREET INC.

NOISE ATTENUATION STUDY
PROPOSED BUILDING ADDITION - 368 CHAPEL STREET

OTTAWA, ONTARIO

Title:

SITE GEOMETRY - REC 3-1, REC 3-3

Scale: 1:1000	Date: 01/2018
Drawn by: RCG	Report No.: PG4331-1
Checked by: SB	Dwg. No.: PG4331-2C
Approved by: DJG	Revision No.: 0

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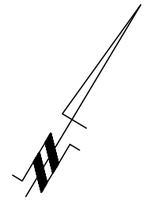
#364 CHAPEL STREET



REC 2-1
REC 2-3

WINDOW WELL

BAY WINDOW

BALCONY

PROPOSED THREE STOREY BUILDING

REC 1-1
REC 1-3

PORCH

LANDSCAPED

S T R E E T

C H A P E L

BAY WINDOW

REC 3-1
REC 3-3

RAMP UP

ASPHALTIC CONRETE DRIVEWAY

#370 CHAPEL STREET

LEGEND:

RECEPTOR LOCATION

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368 CHAPEL STREET INC.

PROPOSED BUILDING - NOISE ATTENUATION STUDY
368 CHAPEL STREET

OTTAWA, ONTARIO

Title:

RECEPTOR LOCATION PLAN

Scale: 1:100	Date: 01/2018
Drawn by: MPG	Report No.: PG4331-1
Checked by: SB	Dwg. No.: PG4331-3
Approved by: DJG	Revision No.: 0

APPENDIX 2

STAMSON RESULTS

STAMSON 5.0 NORMAL REPORT Date: 10-01-2018 10:42:53
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: rec11.te Time Period: Day/Night 16/8 hours
Description: Reception Point 1-1

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

Car traffic volume	9715/845	veh/TimePeriod *
Medium truck volume	773/67	veh/TimePeriod *
Heavy truck volume	552/48	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)	12000
Percentage of Annual Growth	0.00
Number of Years of Growth	0.00
Medium Truck % of Total Volume	7.00
Heavy Truck % of Total Volume	5.00
Day (16 hrs) % of Total Volume	92.00

Data for Segment # 1: Chapel (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	15.00 / 15.00	m
Receiver height	1.50 / 1.50	m
Topography	1	(Flat/gentle slope; no barrier)
Reference angle	0.00	

♀
Results segment # 1: Chapel (day)

Source height = 1.50 m

ROAD (0.00 + 67.57 + 0.00) = 67.57 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.66	69.03	0.00	0.00	-1.46	0.00	0.00	0.00	67.57

Segment Leq : 67.57 dBA

Total Leq All Segments: 67.57 dBA

♀
Results segment # 1: Chapel (night)

Source height = 1.50 m

ROAD (0.00 + 59.97 + 0.00) = 59.97 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.66	61.43	0.00	0.00	-1.46	0.00	0.00	0.00	59.97

Segment Leq : 59.97 dBA

Total Leq All Segments: 59.97 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 67.57
(NIGHT): 59.97

STAMSON 5.0 NORMAL REPORT Date: 10-01-2018 10:48:00
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: rec13.te Time Period: Day/Night 16/8 hours
Description: Reception Point 1-3

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

Car traffic volume	9715/845	veh/TimePeriod *
Medium truck volume	773/67	veh/TimePeriod *
Heavy truck volume	552/48	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)	12000
Percentage of Annual Growth	0.00
Number of Years of Growth	0.00
Medium Truck % of Total Volume	7.00
Heavy Truck % of Total Volume	5.00
Day (16 hrs) % of Total Volume	92.00

Data for Segment # 1: Chapel (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	15.00 / 15.00	m
Receiver height	8.19 / 8.19	m
Topography	1	(Flat/gentle slope; no barrier)
Reference angle	0.00	

♀
Results segment # 1: Chapel (day)

Source height = 1.50 m

ROAD (0.00 + 67.93 + 0.00) = 67.93 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.46	69.03	0.00	0.00	-1.10	0.00	0.00	0.00	67.93

Segment Leq : 67.93 dBA

Total Leq All Segments: 67.93 dBA

♀
Results segment # 1: Chapel (night)

Source height = 1.50 m

ROAD (0.00 + 60.33 + 0.00) = 60.33 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.46	61.43	0.00	0.00	-1.10	0.00	0.00	0.00	60.33

Segment Leq : 60.33 dBA

Total Leq All Segments: 60.33 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 67.93
(NIGHT): 60.33

STAMSON 5.0 NORMAL REPORT Date: 10-01-2018 10:48:45
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: rec21.te Time Period: Day/Night 16/8 hours
Description: Reception Point 2-1

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

Car traffic volume	:	9715/845	veh/TimePeriod *
Medium truck volume	:	773/67	veh/TimePeriod *
Heavy truck volume	:	552/48	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)	:	12000
Percentage of Annual Growth	:	0.00
Number of Years of Growth	:	0.00
Medium Truck % of Total Volume	:	7.00
Heavy Truck % of Total Volume	:	5.00
Day (16 hrs) % of Total Volume	:	92.00

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

Angle1 Angle2	:	-83.00 deg	-52.00 deg
Wood depth	:	0	(No woods.)
No of house rows	:	0 / 0	
Surface	:	1	(Absorptive ground surface)
Receiver source distance	:	15.00 / 15.00	m
Receiver height	:	1.50 / 1.50	m
Topography	:	2	(Flat/gentle slope; with barrier)
Barrier angle1	:	-83.00 deg	Angle2 : -52.00 deg
Barrier height	:	9.00 m	
Barrier receiver distance	:	9.00 / 9.00	m
Source elevation	:	0.00 m	
Receiver elevation	:	0.00 m	
Barrier elevation	:	0.00 m	
Reference angle	:	0.00	

♀
Road data, segment # 2: Chapel (day/night)

Car traffic volume	:	9715/845	veh/TimePeriod *
Medium truck volume	:	773/67	veh/TimePeriod *
Heavy truck volume	:	552/48	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)	:	12000
Percentage of Annual Growth	:	0.00
Number of Years of Growth	:	0.00
Medium Truck % of Total Volume	:	7.00
Heavy Truck % of Total Volume	:	5.00
Day (16 hrs) % of Total Volume	:	92.00

Data for Segment # 2: Chapel (day/night)

```
Angle1   Angle2           : -52.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  15.00 / 15.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

♀

Results segment # 1: Chapel (day)

```
Source height = 1.50 m

Barrier height for grazing incidence
-----------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 41.37 + 0.00) = 41.37 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -83    -52   0.12  69.03   0.00   0.00  -8.19   0.00   0.00 -19.47  41.37
-------------------------------------------------------------------------

Segment Leq : 41.37 dBA
```

♀

Results segment # 2: Chapel (day)

```
Source height = 1.50 m

ROAD (0.00 + 63.22 + 0.00) = 63.22 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -52      0   0.66  69.03   0.00   0.00  -5.81   0.00   0.00   0.00  63.22
-------------------------------------------------------------------------

Segment Leq : 63.22 dBA

Total Leq All Segments: 63.25 dBA
```

♀

Results segment # 1: Chapel (night)

```
Source height = 1.50 m

Barrier height for grazing incidence
-----------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 33.77 + 0.00) = 33.77 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -83    -52   0.12  61.43   0.00   0.00  -8.19   0.00   0.00 -19.47  33.77
```

Segment Leq : 33.77 dBA

♀
Results segment # 2: Chapel (night)

Source height = 1.50 m

ROAD (0.00 + 55.62 + 0.00) = 55.62 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-52	0	0.66	61.43	0.00	0.00	-5.81	0.00	0.00	0.00	55.62

Segment Leq : 55.62 dBA

Total Leq All Segments: 55.65 dBA

♀

TOTAL Leq FROM ALL SOURCES (DAY): 63.25
(NIGHT): 55.65

♀
♀

STAMSON 5.0 NORMAL REPORT Date: 10-01-2018 10:50:13
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: rec23.te Time Period: Day/Night 16/8 hours
Description: Reception Point 2-3

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

Car traffic volume	:	9715/845	veh/TimePeriod *
Medium truck volume	:	773/67	veh/TimePeriod *
Heavy truck volume	:	552/48	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)	:	12000
Percentage of Annual Growth	:	0.00
Number of Years of Growth	:	0.00
Medium Truck % of Total Volume	:	7.00
Heavy Truck % of Total Volume	:	5.00
Day (16 hrs) % of Total Volume	:	92.00

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

Angle1 Angle2	:	-83.00 deg	-52.00 deg
Wood depth	:	0	(No woods.)
No of house rows	:	0 / 0	
Surface	:	1	(Absorptive ground surface)
Receiver source distance	:	15.00 / 15.00	m
Receiver height	:	8.19 / 8.19	m
Topography	:	2	(Flat/gentle slope; with barrier)
Barrier angle1	:	-83.00 deg	Angle2 : -52.00 deg
Barrier height	:	9.00 m	
Barrier receiver distance	:	9.00 / 9.00	m
Source elevation	:	0.00 m	
Receiver elevation	:	0.00 m	
Barrier elevation	:	0.00 m	
Reference angle	:	0.00	

♀
Road data, segment # 2: Chapel (day/night)

Car traffic volume	:	9715/845	veh/TimePeriod *
Medium truck volume	:	773/67	veh/TimePeriod *
Heavy truck volume	:	552/48	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)	:	12000
Percentage of Annual Growth	:	0.00
Number of Years of Growth	:	0.00
Medium Truck % of Total Volume	:	7.00
Heavy Truck % of Total Volume	:	5.00
Day (16 hrs) % of Total Volume	:	92.00

Data for Segment # 2: Chapel (day/night)

```
Angle1   Angle2           : -52.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  15.00 / 15.00  m
Receiver height           :   8.19 / 8.19   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

♀

Results segment # 1: Chapel (day)

```
Source height = 1.50 m

Barrier height for grazing incidence
-----------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !        8.19 !        4.17 !         4.17

ROAD (0.00 + 45.30 + 0.00) = 45.30 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -83    -52   0.00  69.03   0.00   0.00  -7.64   0.00   0.00 -16.09  45.30
-------------------------------------------------------------------------------

Segment Leq : 45.30 dBA
```

♀

Results segment # 2: Chapel (day)

```
Source height = 1.50 m

ROAD (0.00 + 63.34 + 0.00) = 63.34 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -52      0   0.46  69.03   0.00   0.00  -5.68   0.00   0.00   0.00  63.34
-------------------------------------------------------------------------------

Segment Leq : 63.34 dBA

Total Leq All Segments: 63.41 dBA
```

♀

Results segment # 1: Chapel (night)

```
Source height = 1.50 m

Barrier height for grazing incidence
-----------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !        8.19 !        4.17 !         4.17

ROAD (0.00 + 37.70 + 0.00) = 37.70 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -83    -52   0.00  61.43   0.00   0.00  -7.64   0.00   0.00 -16.09  37.70
```

Segment Leq : 37.70 dBA

♀
Results segment # 2: Chapel (night)

Source height = 1.50 m

ROAD (0.00 + 55.74 + 0.00) = 55.74 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-52	0	0.46	61.43	0.00	0.00	-5.68	0.00	0.00	0.00	55.74

Segment Leq : 55.74 dBA

Total Leq All Segments: 55.81 dBA

♀

TOTAL Leq FROM ALL SOURCES (DAY): 63.41
(NIGHT): 55.81

♀
♀

STAMSON 5.0 NORMAL REPORT Date: 10-01-2018 10:52:20
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: rec31.te Time Period: Day/Night 16/8 hours
Description: Reception Point 3-1

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

Car traffic volume : 9715/845 veh/TimePeriod *
Medium truck volume : 773/67 veh/TimePeriod *
Heavy truck volume : 552/48 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): 12000
Percentage of Annual Growth : 0.00
Number of Years of Growth : 0.00
Medium Truck % of Total Volume : 7.00
Heavy Truck % of Total Volume : 5.00
Day (16 hrs) % of Total Volume : 92.00

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

Angle1 Angle2 : 0.00 deg 20.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 15.00 / 15.00 m
Receiver height : 1.50 / 1.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

♀
Road data, segment # 2: Chapel (day/night)

Car traffic volume : 9715/845 veh/TimePeriod *
Medium truck volume : 773/67 veh/TimePeriod *
Heavy truck volume : 552/48 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): 12000
Percentage of Annual Growth : 0.00
Number of Years of Growth : 0.00
Medium Truck % of Total Volume : 7.00
Heavy Truck % of Total Volume : 5.00
Day (16 hrs) % of Total Volume : 92.00

Data for Segment # 2: Chapel (day/night)

Angle1 Angle2 : 20.00 deg 86.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 15.00 / 15.00 m
Receiver height : 1.50 / 1.50 m

Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : 20.00 deg Angle2 : 86.00 deg
Barrier height : 9.00 m
Barrier receiver distance : 5.00 / 5.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00

♀
Results segment # 1: Chapel (day)

Source height = 1.50 m

ROAD (0.00 + 59.43 + 0.00) = 59.43 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	20	0.66	69.03	0.00	0.00	-9.60	0.00	0.00	0.00	59.43

Segment Leq : 59.43 dBA

♀
Results segment # 2: Chapel (day)

Source height = 1.50 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.50	1.50	1.50	1.50

ROAD (0.00 + 44.87 + 0.00) = 44.87 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
20	86	0.12	69.03	0.00	0.00	-4.72	0.00	0.00	-19.44	44.87

Segment Leq : 44.87 dBA

Total Leq All Segments: 59.58 dBA

♀
Results segment # 1: Chapel (night)

Source height = 1.50 m

ROAD (0.00 + 51.83 + 0.00) = 51.83 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	20	0.66	61.43	0.00	0.00	-9.60	0.00	0.00	0.00	51.83

Segment Leq : 51.83 dBA

♀
Results segment # 2: Chapel (night)

Source height = 1.50 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.50	1.50	1.50	1.50

ROAD (0.00 + 37.27 + 0.00) = 37.27 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
20	86	0.12	61.43	0.00	0.00	-4.72	0.00	0.00	-19.44	37.27

Segment Leq : 37.27 dBA

Total Leq All Segments: 51.98 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 59.58
(NIGHT): 51.98

STAMSON 5.0 NORMAL REPORT Date: 10-01-2018 10:53:19
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: rec33.te Time Period: Day/Night 16/8 hours
Description: Reception Point 3-3

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

Car traffic volume	: 9715/845	veh/TimePeriod *
Medium truck volume	: 773/67	veh/TimePeriod *
Heavy truck volume	: 552/48	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)	: 12000
Percentage of Annual Growth	: 0.00
Number of Years of Growth	: 0.00
Medium Truck % of Total Volume	: 7.00
Heavy Truck % of Total Volume	: 5.00
Day (16 hrs) % of Total Volume	: 92.00

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

Angle1 Angle2	: 0.00 deg	20.00 deg
Wood depth	: 0	(No woods.)
No of house rows	: 0 / 0	
Surface	: 1	(Absorptive ground surface)
Receiver source distance	: 15.00 / 15.00	m
Receiver height	: 8.19 / 8.19	m
Topography	: 1	(Flat/gentle slope; no barrier)
Reference angle	: 0.00	

♀
Road data, segment # 2: Chapel (day/night)

Car traffic volume	: 9715/845	veh/TimePeriod *
Medium truck volume	: 773/67	veh/TimePeriod *
Heavy truck volume	: 552/48	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)	: 12000
Percentage of Annual Growth	: 0.00
Number of Years of Growth	: 0.00
Medium Truck % of Total Volume	: 7.00
Heavy Truck % of Total Volume	: 5.00
Day (16 hrs) % of Total Volume	: 92.00

Data for Segment # 2: Chapel (day/night)

Angle1 Angle2	: 20.00 deg	86.00 deg
Wood depth	: 0	(No woods.)
No of house rows	: 0 / 0	
Surface	: 1	(Absorptive ground surface)
Receiver source distance	: 15.00 / 15.00	m
Receiver height	: 8.19 / 8.19	m

Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : 20.00 deg Angle2 : 86.00 deg
Barrier height : 9.00 m
Barrier receiver distance : 5.00 / 5.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00

♀
Results segment # 1: Chapel (day)

Source height = 1.50 m

ROAD (0.00 + 59.44 + 0.00) = 59.44 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	20	0.46	69.03	0.00	0.00	-9.58	0.00	0.00	0.00	59.44

Segment Leq : 59.44 dBA

♀
Results segment # 2: Chapel (day)

Source height = 1.50 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.50	8.19	5.96	5.96

ROAD (0.00 + 50.31 + 0.00) = 50.31 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
20	86	0.00	69.03	0.00	0.00	-4.36	0.00	0.00	-14.36	50.31

Segment Leq : 50.31 dBA

Total Leq All Segments: 59.94 dBA

♀
Results segment # 1: Chapel (night)

Source height = 1.50 m

ROAD (0.00 + 51.84 + 0.00) = 51.84 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	20	0.46	61.43	0.00	0.00	-9.58	0.00	0.00	0.00	51.84

Segment Leq : 51.84 dBA

♀
Results segment # 2: Chapel (night)

Source height = 1.50 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.50	8.19	5.96	5.96

ROAD (0.00 + 42.71 + 0.00) = 42.71 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
20	86	0.00	61.43	0.00	0.00	-4.36	0.00	0.00	-14.36	42.71

Segment Leq : 42.71 dBA

Total Leq All Segments: 52.34 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 59.94
(NIGHT): 52.34