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Environmental Noise Control And Vibration Study

Proposed Multi-Storey Building
851 Richmond Road - Ottawa

Prepared For

Homestead Land Holdings

March 13, 2018

Report: PG4201-1R

Table of Contents Page

Appendices

1.0 Introduction

Paterson Group (Paterson) was commissioned by Homestead Land Holdings to conduct an environmental noise control and vibration study for the proposed multi-storey building to be located at 851 Richmond Road, in the City of Ottawa (refer to Figure 1 - Key Plan in Appendix 2 of this report).

The objective of the current study was 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 or alternative sound barriers.
- ❏ Review the potential of detrimental vibrations caused by the proposed light rail transit.

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 Engineering Noise Control Guidelines (ENCG), dated January 2016, and the Ontario Ministry of the Environment Guideline NPC-300. The document - Transit Noise and Vibration Impact Assessment, composed by the Department of Transportation of the United States of America, dated May 2006, was also followed for the vibrational analysis.

2.0 Background

It is understood that the proposed development will consist of an eleven (11) storey residential building with two (2) levels of underground parking. It is noted that there is no dedicated outdoor living area (OLA) for this proposed development. Private outdoor terraces are located on several floors, but due to the size limitations, are not designated an OLA and therefore will not be analyzed.

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 following conditions must be satisfied 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			

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

There are no outdoor living areas specified for this development. Therefore, a stationary noise analysis will not be 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 aircraft/airport noise is not required.

4.0 Methodology and Vibration Assessment Criteria

Due to the presence of the future Confederation Line, a ground vibration and ground-borne noise review was also performed for this development.

Effects of the Confederation Line on the Proposed Development

The human body can be affected by exposure to vibration, in particular ground-borne vibrations occurring at low frequencies. These can be caused by the surrounding vibration sources previously identified, which include such as wheels on a road or rail system. These ground-borne vibrations can cause the building to shake (ground-borne vibration) and/or rumbling sounds (ground-borne noise).

The methods of defining and measuring vibrations has its own challenges, based on the oscillatory motion identified as a vibration. Due to the nature of the oscillatory motion of the vibration, there is no net movement of the vibration element, and therefore motion descriptors are zero.

There are two (2) main methods of defining the magnitude of the overall vibration. The main one utilized in construction activities is the peak particle velocity (PPV). The PPV is defined as the maximum instantaneous positive or negative peak of the vibration signal and is often used when monitoring blasting vibrations and is ideal for evaluating the potential of building damage.

However, human responses require a different method of analysis as the human body required time to respond to vibration signals. The average vibration amplitude would be an applicable method of reporting the ground-borne vibrations that humans would respond to, however with the vibration being represented as a sine wave, the average vibration amplitude would be zero. Therefore, the root mean square (RMS) amplitude, typically calculated over a 1 second interval, is utilized for the analysis. The RMS value is always less than the PPV.

General factors that could affect the magnitude of the created vibrations include, but are not limited to, whether the light rail is above grade or below grade, speed, vehicle suspension, wheel and track condition, track support system, depth of system and soil conditions. It should be noted that vibrations that travel through the bedrock surface should be minimal, but can travel a further distance.

It is anticipated that both the construction of the Confederation Line in addition to the day to day operational frequency of the Confederation line will create vibrations that may be experienced within 851 Richmond Road. Vibrations caused by the Confederation Line could propagate through the bedrock surface, and extend to the building foundation at 851 Richmond Road, which in turn could extend the vibration through the remainder of the building.

The City of Ottawa has not defined limits as to the amount of vibration caused by the Confederation Line would be acceptable. In a document released to the Council on December 4, 2012, titled "Design, Build, Finance and Maintenance of Ottawa Light Rail Transit (OLRT) Project", submitted by Ms. Nancy Schepers, it states that:

> That assessment has established a noise and vibration standard that will protect all buildings including highly sensitive receptors like the CBC building on Queen Street and the National Arts Centre on Elgin Street.
>
> Noise levels in these sensitive receptors will be baselined and RTG will work with the institutions to meet performance specifications and coordinate construction activities to minimize impacts on their institution's operations.
>
> Following the assessment, RTG will develop specific noise and vibration mitigation measures as part of the project's final design and will maintain the light rail system to ensure that the mitigation measures remain effective in the future during normal operations.
>
> While some construction-related noise will be unavoidable as the Confederation Line is being built, RTG's construction methods and mitigation strategies will minimize disruption to the best extent possible.

Therefore, the Federal Transit Administration's Transit Noise and Vibration Impact Assessment Report: FTA-VA-90-1003-06 was utilized as the standard for vibration standards caused by light rail. Upon review of these documents, the following standards were obtained that are applicable to this analysis.

The criteria for the environmental impact from vibrations are based on the RMS vibration levels for repeated events. The proposed development would be classified as a Vibration Category 2 - Residential. This includes all locations where people would sleep. The following table outlines the limits for ground-borne vibrations.

Table 4 - Ground-Borne Vibration (GBV) for General Assessment			
Land Use Category	**GBV Impact Levels (VdB re 1 micro-inch/sec)**		
	Frequent Events	**Occasional Events**	**Infrequent Events**
Category 2	72 VdB	75 VdB	80 VdB

Notes:

- ❏ Frequent events is defined as more than 70 vibration events of the same source per day. Most rapid transit projects fall into this category.
- ❏ Occasional events is define as between 30 and 70 vibration events of the same source per day. Most commuter trunk lines have this many operations.
- ❏ Infrequent events is defined as fewer tan 30 vibration events of the same kind per day. This category includes most commuter rail branch lines.

The Confederation Line is classified as a light rail transit. According to the DOT - Transit Noise and Vibration Impact Assessment, the description of a light rail transit would be that “the ground-borne vibration characteristics of light rail systems are very similar to those of rapid transit systems. Because the speeds of light rail systems are usually lower, the typical vibration levels usually are lower.” This document also outlines screening radiuses, defined as where there is a potential for disturbing ground-borne vibrations, where additional studies should be completed. For a source of light rail transit within a category 2 classification, the screening distance for vibration assessment is 45 m (150'). The proposed development will be within this radius.

5.0 Analysis

5.1 Noise Attenuation Study

The proposed development is bordered to the southeast by Richmond Road and Byron Avenue. Residential and commercial development surround the proposed development on the remaining boundaries. Saunders Avenue is also located with the 100 m radius around the proposed development. However, Saunders Avenue is not identified as an arterial or collector road and therefore is not considered in this study.

It is understood that the Ottawa Light Rail Transit (OLRT) is proposing that the Confederation Line will be located either below Richmond Road or below Byron Avenue. It is understood that, at this time, the exact location and details of this proposed transit line is not known, and will not be finalized until 2018. For the issuance of this noise and vibration study, it is assumed that the Confederation Line will be located below Richmond Road (the closest possible proximity to the proposed development), at a depth of 10 m below the existing ground level.

Noise source locations are presented on Paterson Drawing PG4201-1 - Site Plan, located in Appendix 1.

There are no stationary noise or aircraft noise sources within the influence area.

The noise levels from road traffic are designated 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 %
Richmond Road	2-UAU	15000	50	92/8	7	5
Byron Avenue	2-UCU	8000	50	92/8	7	5

❑ Data obtained from the City of Ottawa document ENCG

The projected noise levels from the Confederation Line were provided by the City of Ottawa, taking into consideration the number of trips, the speed of the light rail and the type of engin. This information was provided to Paterson in an e-mail correspondence and is summarized below.

Table 6 - Light Rail Parameters

Light Rail Line	Engine Type	Maximum Speed (km/hr)	Number of Trips	Length of Train
Confederation Line	Electric	65	488	2

There were several reception points that were considered in our analysis of the proposed multi-storey building. Reception points were selected at the bedroom windows along the different building elevations that are exposed to the identified noise sources. For this analysis, a reception point was taken at the centre of the window pane, at several different floor levels. Reception points are noted on Paterson Drawing PG4201-2 - Receptor Locations, presented in Appendix 1.

Table 9 - Summary of Reception Points and Geometry, presented 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.

It is understood that the proposed Confederation Line will be located east of the proposed building, located approximately 10 m below ground level. A limitation of the STAMSON software is that a negative elevation can not be inputted. Alternatively, the change in elevation was input using the elevation of the Confederation Line as 0 m and the elevation of the ground floor of the proposed building as 10 m. Additionally, since the design of the Confederation Line includes the wall of the tunnel that will extend from the rail level to ground surface, this was modeled as a 10 m high “barrier”.

5.2 Vibration Assessment

At the time of the study, the design details of the Confederation Line is not known. Therefore, all analysis will need to be completed on a projected data basis (i.e. no direct monitoring of the existing conditions). The following assumptions were used for the completion of this study.

It is understood that the Confederation Line will be constructed at a minimum, of 15 m horizontally from the proposed building perimeter (measured from the proposed building to the centre of the rail line). The vertical distance is not applicable as both structures will be founded within the bedrock, at similar elevations. The following figure is a base curve for ground surface vibration levels, assuming the equipment is in good condition and speeds of 80 km/hr (50 mph) are not exceeded. Due to the nature of the Confederation Line, this table is applicable for the proposed development.

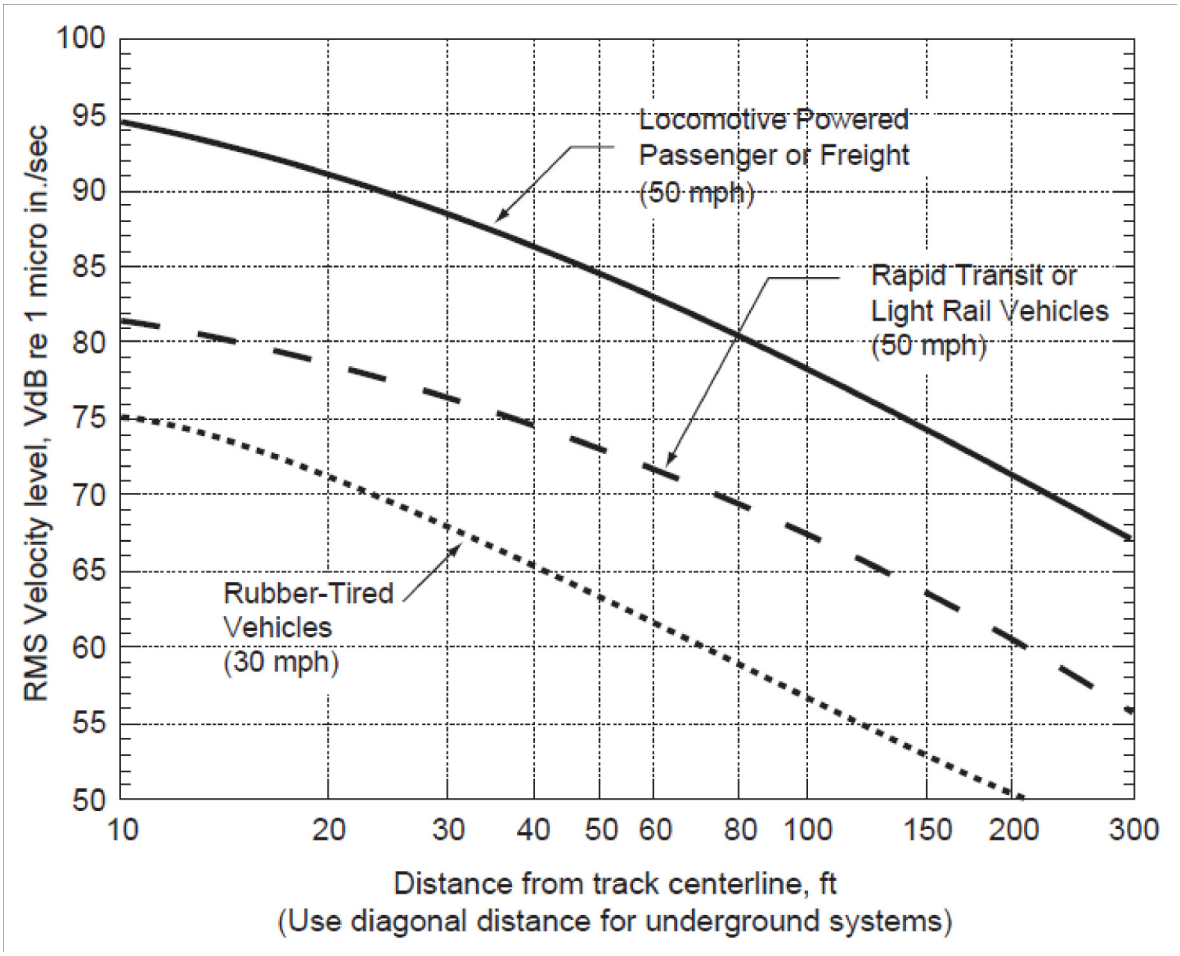

Figure 1 - Generalized Ground Surface Vibration Curve

6.0 Results

6.1 Noise Attenuation 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 7.

Table 7 - Proposed Noise Levels

Reception Point	Description	Daytime at Facade $L_{EQ(16)}$ (dBA)	Nighttime at Facade $L_{eq(8)}$ (dBA)
REC 1-1	Eastern Elevation, 1st floor	69.45	61.38
REC 1-5	Eastern Elevation, 5th floor	70.57	61.42
REC 1-11	Eastern Elevation, 11th floor	70.57	61.42
REC 2-1	Northern Elevation, 1st floor	63.59	55.96
REC 2-5	Northern Elevation, 5th floor	63.90	55.96
REC 2-11	Northern Elevation, 11th floor	65.13	56.01
REC 3-1	Southern Elevation, 1st floor	63.93	56.30
REC 3-5	Southern Elevation, 5th floor	64.24	56.31
REC 3-11	Southern Elevation, 11th floor	64.24	56.31

6.2 Vibration Assessment Results

Based on Figure 1, for a Category 2 structure, the Confederation would need to be constructed 18 m (measured from the centre of the track to the building perimeter) in order to keep the RMS velocity level below 72 VdB. As calculated, at the closest proximity to the proposed building, the Confederation Line will be 15 m. At 15 m, the RMS velocity will be 73 VdB.

7.0 Discussion and Recommendations - Noise Attenuation

As described in Tables 1 and 2, where the sound levels exceed the limits for the indoor receptors, noise control measures should be implemented.

The MOECC, lists the following options for sound mitigation:

- ❑ Distance set back with soft ground
- ❑ Insertion of noise insensitive land uses between the source and sensitive receptor
- ❑ Orientation of buildings to provide sheltered zones or modified interior spaces (room and corridor arrangement)
- ❑ Enhanced construction techniques and construction quality (e.g. brick veneers, multi-pane windows).
- ❑ Indoor isolation - air conditioning and ventilation, enhanced dampening materials (indoor isolation)

It should be noted that it is not possible to provide additional set-backs with soft ground from the identified noise sources and the orientation of the building has already been positioned to minimize the amount of noise. Therefore, the sound mitigation method that will be implemented for this proposed development will include a review of the construction techniques and construction materials.

7.1 Outdoor Living Areas

There were no outdoor living areas prescribed for the aforementioned development.

7.2 Indoor Living Areas and Ventilation

The results of the STAMSON modelling indicates that the $L_{eq(16)}$ ranges between 61.56 dBA and 70.75 dBA. These values exceed the limit of 45 dBA as specified in Table 2 and therefore warning clauses will be required to be stated on any property titles. The applicable warning clauses are summarized in Table 9 on the following page.

Table 8 - Summary of Warning Clauses			
Elevation	**Floor**	**Applicable Warning Clause**	**Additional Considerations**
East	All	Warning Clause Type D	All units must be equipped with a central air conditioning system, reducing the need to open windows. Additionally, building components including windows, walls and doors, where applicable, should be designed so that the indoor sound levels comply with the sound level limits in Table 2.
North	All	Warning Clause Type C	All units must be equipped with a central air conditioning system, reducing the need to open windows.
South	All	Warning Clause Type C	All units must be equipped with a central air conditioning system, reducing the need to open windows.

7.3 Noise Control Measures for Surface Transportation Noise

As described in Table 7, where the daytime sound level at the plane of the window exceeds 65 dBA, as noted on the eastern elevation, noise control measures should be implemented.

It should be noted that it is not possible to provide additional set-backs with soft ground from the identified noise sources and the orientation of the building has already been positions to minimize the amount of noise. Therefore, the sound mitigation method that will be implemented for this proposed development will include a review of the construction techniques and construction materials.

Proposed Construction Specifications

The MOECC states that, where the $L_{eq(24)}$ exceeds 60 dBA, the exterior walls next to the proposed rail line (the Confederation Line) are to be clad, as a minimum, of a brick veneer or masonry equivalent construction.

Otherwise, construction materials are not specified yet for the proposed building.

Sound Transmission Class (STC) is the single-number rating for describing sound transmission loss of a wall or partition. This is the most popular way of determining the construction materials that would be sufficient to reduce the rail and road noise. Based on the analysis of the environmental noise study, building materials with an STC value of 30 or higher is sufficient for this development.

8.0 Discussion and Recommendations - Vibration Assessment

Since specifics are not known for the proposed Confederation Line, the analysis was completed using known industry standards.

Based on the standard information provided on Figure 1, there is a slight exceedance of 1 VdB. An exceedance of 1 VdB should not be detrimental to the living environment at the proposed development and is considered acceptable. However, it should be noted that this measurement is based on theoretical values as the Confederation Line is not yet operational. There are several factors that could lower the proposed vibration:

- The true alignment of the Confederation Line. If the alignment of the Confederation Line is further than 18 m from the edge of the building, than the RMS value should be below the 72 VdB threshhold.
- Figure 1 is based on light rail transit travelling at speeds of 80 km/hr (50 mph). Upon discussion with the City of Ottawa, it is anticipated that the light transit will be traveling at speeds between 45-60 km/hr. This lowering of the speed will cause a reduction in the magnitude of the vibrations caused.
- The true founding conditions of both the proposed building and the Confederation Line. It has been studied that foundations on bedrock (both for the proposed building and the Confederation Line) will dampen the vibration effects, causing a lower overall RMS value at the proposed building. However, the true dampening will need to be measured in the field once the Confederation Line has been constructed.
- The City of Ottawa has stated that they will take several mitigation factors during construction in order to reduce the amount of vibrations caused by the Confederation Line. Once again, the true dampening will need to be measured in the field once the Confederation Line has been constructed.

Therefore, there will be no excessive vibrations on the proposed development as caused by the Confederation Line.

9.0 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 Homestead Land Holdings 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:

- ❑ Homestead Land Holdings (3 copies)
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APPENDIX 1

TABLE 9 - SUMMARY OF RECEPTION POINTS AND GEOMETRY

DRAWING PG4201-1 - SITE PLAN

DRAWING PG4201-1A - SITE GEOMETRY (REC 1-1, REC 1-5 AND REC 1-11)

DRAWING PG4201-1B - SITE GEOMETRY (REC 2-1, REC 2-5 AND REC 2-11)

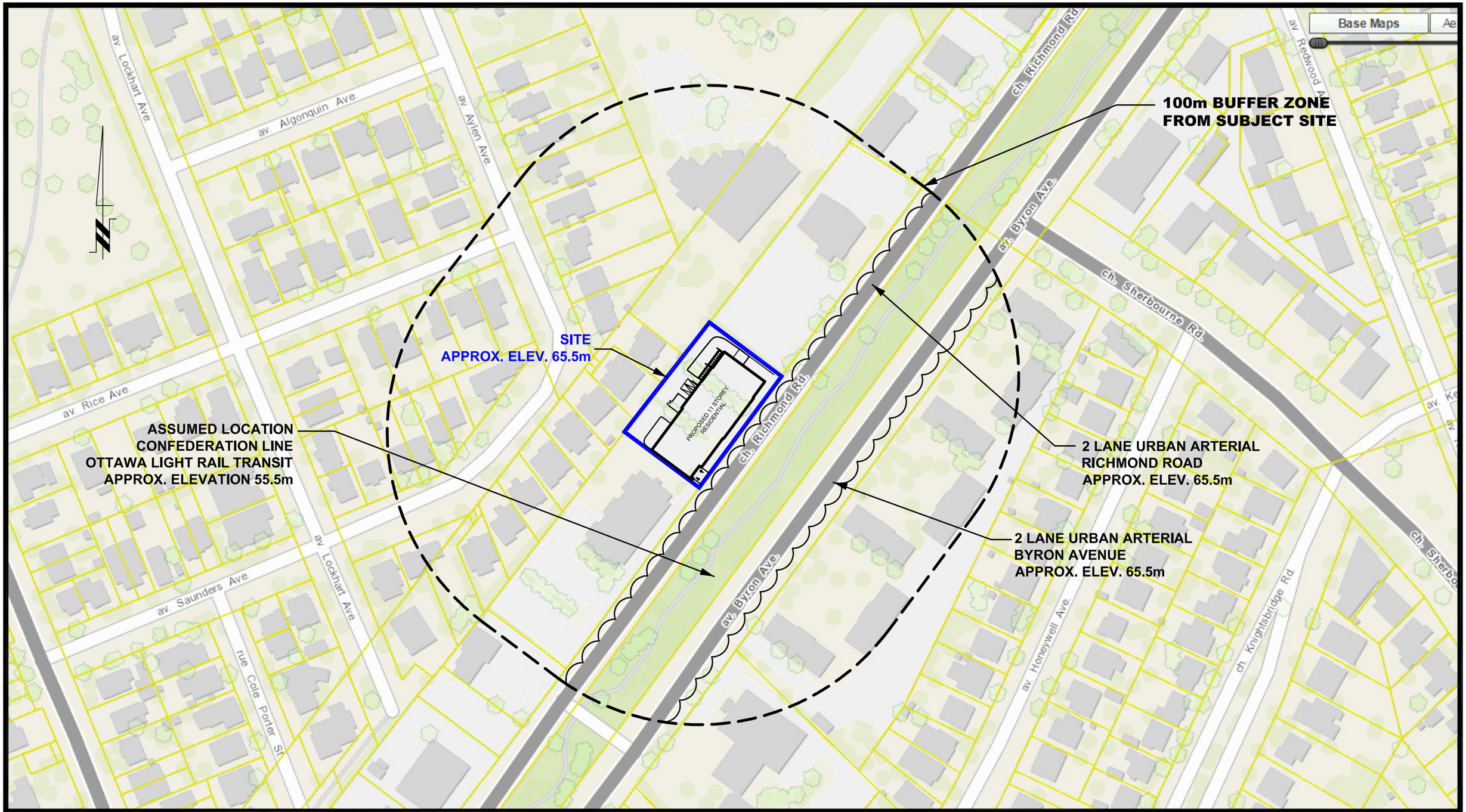
DRAWING PG4201-1C - SITE GEOMETRY (REC 3-1, REC 3-5 AND REC 3-11)

DRAWING PG4201-2 - RECEPTOR LOCATION PLAN

Table 9 - Summary of Reception Points and Geometry
851 Richmond Road

Point of Reception	Location	Leq Day (dBA)	Richmond Road						Byron Avenue					
			Horizontal (m)	Vertical (m)	Total (m)	Local Angle (degree)	Barrier Height (m)	Distance (m)	Horizontal (m)	Vertical (m)	Total (m)	Local Angle (degree)	Barrier Height (m)	Distance (m)
REC 1-1	Eastern Elevation, 1st floor	69.45	15	1.5	15.07481	-88, 88	n/a	n/a	47	1.5	47.02393	-74, 73	n/a	n/a
REC 1-5	Eastern Elevation, 5th floor	70.57	15	13.9	20.45018	-88, 88	n/a	n/a	47	13.9	49.012345	-74, 73	n/a	n/a
REC 1-11	Eastern Elevation, 11th floor	70.57	15	31.3	34.70864	-88, 88	n/a	n/a	47	31.3	56.468487	-74, 73	n/a	n/a
REC 2-1	Northern Elevation, 1st floor	63.59	25	1.5	25.04496	-82,0	n/a	n/a	60	1.5	60.018747	-65, 0	n/a	n/a
REC 2-5	Northern Elevation, 5th floor	63.9	25	13.9	28.60437	-82,0	n/a	n/a	60	13.9	61.589041	-65, 0	n/a	n/a
REC 2-11	Northern Elevation, 11th floor	65.13	25	31.3	40.05858	-82,0	n/a	n/a	60	31.3	67.673407	-65, 0	n/a	n/a
REC 3-1	Southern Elevation, 1st floor	63.93	25	1.5	25.04496	0, 88	n/a	n/a	60	1.5	60.018747	0, 73	n/a	n/a
REC 3-5	Southern Elevation, 5th floor	64.24	25	13.9	28.60437	0,88	n/a	n/a	60	13.9	61.589041	0, 73	n/a	n/a
REC 3-11	Southern Elevation, 11th floor	64.24	25	31.3	40.05858	0,88	n/a	n/a	60	31.3	67.673407	0, 73	n/a	n/a

Point of Reception	Location	Leq Day (dBA)	Proposed Confederation Line					
			Horizontal (m)	Vertical (m)	Total (m)	Local Angle (degree)	Barrier Height (m)	Distance (m)
REC 1-1	Eastern Elevation, 1st floor	69.45	15	11.5	18.90106	-88, 88	10	2
REC 1-5	Eastern Elevation, 5th floor	70.57	15	23.9	28.21719	-88, 88	10	2
REC 1-11	Eastern Elevation, 11th floor	70.57	15	41.3	43.93962	-88, 88	10	2
REC 2-1	Northern Elevation, 1st floor	63.59	25	11.5	27.51818	-82,0	10	2
REC 2-5	Northern Elevation, 5th floor	63.9	25	23.9	34.58627	-82,0	10	2
REC 2-11	Northern Elevation, 11th floor	65.13	25	41.3	48.27722	-82,0	10	2
REC 3-1	Southern Elevation, 1st floor	63.93	25	11.5	27.51818	0, 88	10	2
REC 3-5	Southern Elevation, 5th floor	64.24	25	23.9	34.58627	0,88	10	2
REC 3-11	Southern Elevation, 11th floor	64.24	25	41.3	48.27722	0,88	10	2



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HOMESTEAD LAND HOLDINGS

NOISE AND VIBRATION STUDY
851 RICHMOND ROAD

OTTAWA, ONTARIO

Title:

SITE PLAN

Scale: 1:1500	Date: 07/2017
Drawn by: MPG	Report No.: PG4201-1
Checked by: SB	Dwg. No.: PG4201-1
Approved by: DJG	Revision No.: 0

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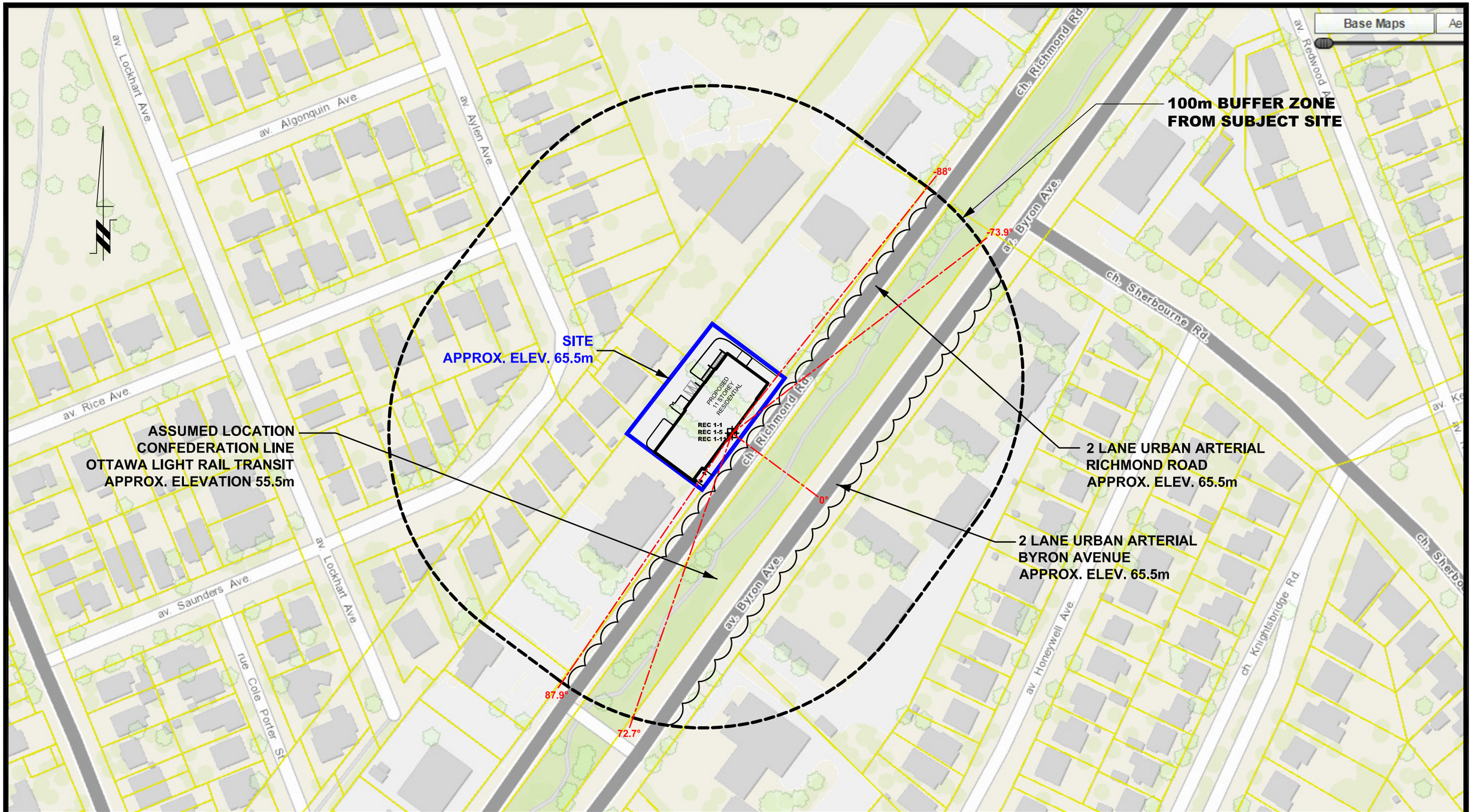

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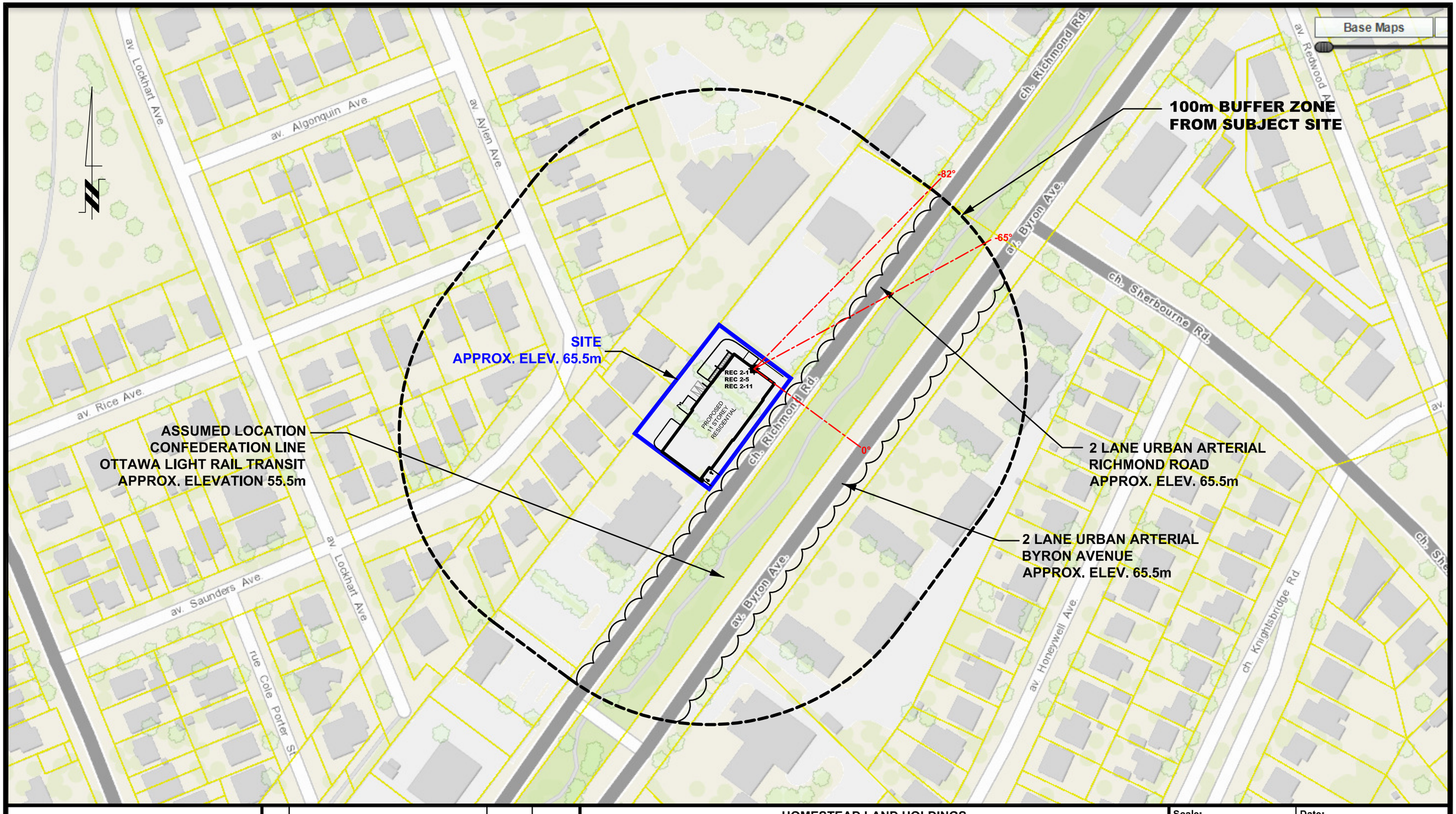

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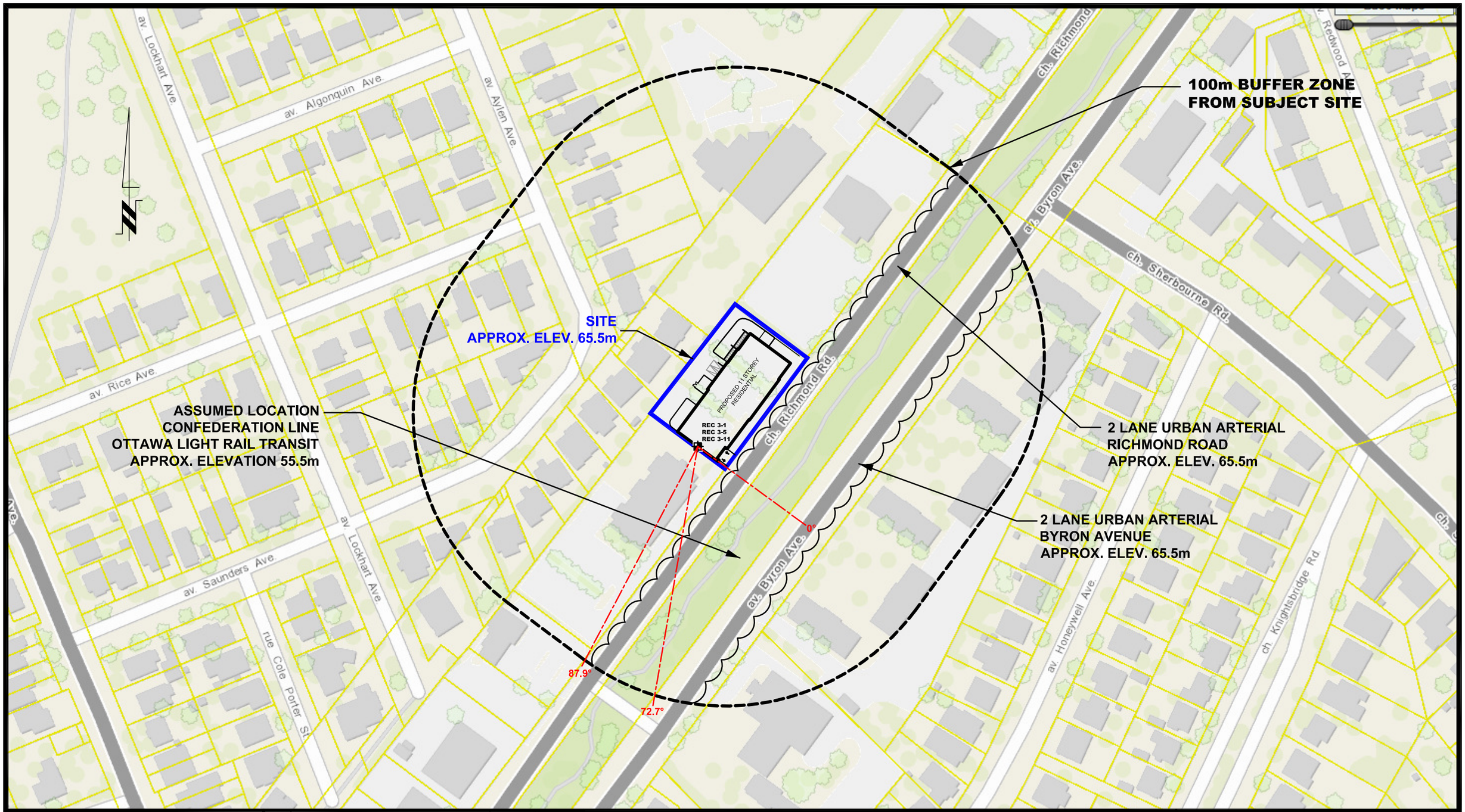

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NO.	REVISIONS	DATE	INITIAL
0			

HOMESTEAD LAND HOLDINGS

NOISE AND VIBRATION STUDY
851 RICHMOND ROAD

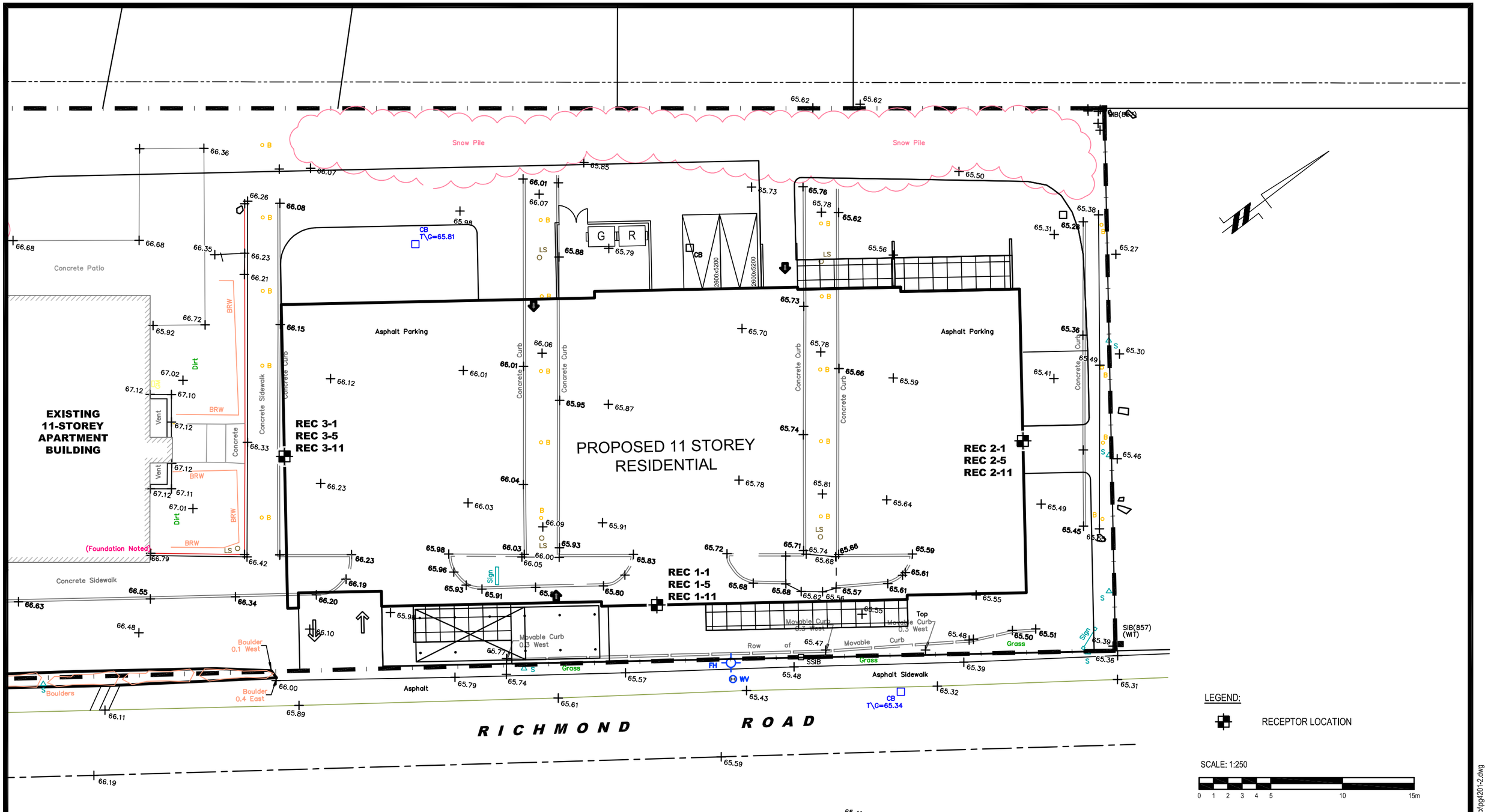
OTTAWA, ONTARIO

Title:

SITE GEOMETRY (REC 3-1, REC 3-5, REC 3-11)

Scale: 1:1500	Date: 07/2017
Drawn by: MPG	Report No.: PG4201-1
Checked by: SB	Dwg. No.: PG4201-1C
Approved by: DJG	Revision No.: 0

p:\autocad drawings\geotechnical\pg42xx\pg4201-1 noise attenuation.dwg



LEGEND:

RECEPTOR LOCATION

SCALE: 1:250

0 1 2 3 4 5 10 15m

patersongroup
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NO.	REVISIONS	DATE	INITIAL
0			

HOMESTEAD LAND HOLDINGS

NOISE AND VIBRATION STUDY
851 RICHMOND ROAD

OTTAWA, ONTARIO

Title:

RECEPTOR LOCATION PLAN

Scale: 1:250	Date: 07/2017
Drawn by: MPG	Report No.: PG4201-1
Checked by: SB	Dwg. No.: **PG4201-2**
Approved by: DJG	Revision No.: 0

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APPENDIX 2

STAMSON RESULTS

STAMSON 5.0 NORMAL REPORT Date: 08-02-2018 35:32:04
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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

Rail data, segment # 1: OLRT (day/night)

Train Type	Trains	Speed (km/h)	# loc /Train	# Cars /Train	Eng type	Cont weld
* 1. OLRT	422.0/1.0	65.0	1.0	1.0	Elec	Yes

* The identified number of trains have been adjusted for future growth using the following parameters:

Train type: No	Name	Unadj. Trains	Annual % Increase	Years of Growth
1.	OLRT	422.0/1.0	0.00	0.00

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

Angle1 Angle2	: -88.00 deg	88.00 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 / 1.50	m
Topography	: 4	(Elevated; with barrier)
No Whistle		
Barrier angle1	: -88.00 deg	Angle2 : 88.00 deg
Barrier height	: 10.00	m
Elevation	: 10.00	m
Barrier receiver distance	: 3.00 / 3.00	m
Source elevation	: 0.00	m
Receiver elevation	: 10.00	m
Barrier elevation	: 0.00	m
Reference angle	: 0.00	

♀
Results segment # 1: OLRT (day)

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
4.00	1.50	10.00	10.00
0.50	1.50	9.30	9.30

LOCOMOTIVE (0.00 + 57.48 + 0.00) = 57.48 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-88	88	0.00	62.58	0.00	-0.10	0.00	0.00	-5.00	57.48

WHEEL (0.00 + 55.86 + 0.00) = 55.86 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-88	88	0.00	62.59	0.00	-0.10	0.00	0.00	-6.63	55.86

Segment Leq : 59.76 dBA

Total Leq All Segments: 59.76 dBA

♀

Results segment # 1: OLRT (night)

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
4.00	1.50	10.00	10.00
0.50	1.50	9.30	9.30

LOCOMOTIVE (0.00 + 34.24 + 0.00) = 34.24 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-88	88	0.00	39.33	0.00	-0.10	0.00	0.00	-5.00	34.24

WHEEL (0.00 + 32.61 + 0.00) = 32.61 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-88	88	0.00	39.34	0.00	-0.10	0.00	0.00	-6.63	32.61

Segment Leq : 36.51 dBA

Total Leq All Segments: 36.51 dBA

♀

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

Car traffic volume : 12144/1056 veh/TimePeriod *
Medium truck volume : 966/84 veh/TimePeriod *
Heavy truck volume : 690/60 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): 15000
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: Richmond (day/night)

Angle1 Angle2 : -88.00 deg 88.00 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 / 1.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

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

Car traffic volume : 6477/563 veh/TimePeriod *
Medium truck volume : 515/45 veh/TimePeriod *
Heavy truck volume : 368/32 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): 8000
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: Byron (day/night)

Angle1 Angle2 : -74.00 deg 73.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 47.00 / 47.00 m
Receiver height : 1.50 / 1.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

♀
Results segment # 1: Richmond (day)

Source height = 1.50 m

ROAD (0.00 + 68.38 + 0.00) = 68.38 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-88	88	0.00	68.48	0.00	0.00	-0.10	0.00	0.00	0.00	68.38

Segment Leq : 68.38 dBA

♀
Results segment # 2: Byron (day)

Source height = 1.50 m

ROAD (0.00 + 59.91 + 0.00) = 59.91 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-74	73	0.00	65.75	0.00	-4.96	-0.88	0.00	0.00	0.00	59.91

Segment Leq : 59.91 dBA

Total Leq All Segments: 68.96 dBA

♀
Results segment # 1: Richmond (night)

Source height = 1.50 m

ROAD (0.00 + 60.79 + 0.00) = 60.79 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-88	88	0.00	60.88	0.00	0.00	-0.10	0.00	0.00	0.00	60.79

Segment Leq : 60.79 dBA

♀

Results segment # 2: Byron (night)

Source height = 1.50 m

ROAD (0.00 + 52.32 + 0.00) = 52.32 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-74	73	0.00	58.16	0.00	-4.96	-0.88	0.00	0.00	0.00	52.32

Segment Leq : 52.32 dBA

Total Leq All Segments: 61.37 dBA

♀

TOTAL Leq FROM ALL SOURCES (DAY): 69.45
(NIGHT): 61.38

♀
♀

STAMSON 5.0 NORMAL REPORT Date: 08-02-2018 35:33:25
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: rec15.te Time Period: Day/Night 16/8 hours
Description: Reception Point 1-5 - Revised

Rail data, segment # 1: OLRT (day/night)

Train Type	Trains	Speed (km/h)	# loc /Train	# Cars /Train	Eng type	Cont weld
* 1. OLRT	422.0/1.0	65.0	1.0	1.0	Elec	Yes

* The identified number of trains have been adjusted for future growth using the following parameters:

Train type: No	Name	Unadj. Trains	Annual % Increase	Years of Growth
1.	OLRT	422.0/1.0	0.00	0.00

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

Angle1 Angle2	: -88.00 deg	88.00 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	: 13.90 / 13.90	m
Topography	: 4	(Elevated; with barrier)
No Whistle		
Barrier angle1	: -88.00 deg	Angle2 : 88.00 deg
Barrier height	: 10.00	m
Elevation	: 10.00	m
Barrier receiver distance	: 3.00 / 3.00	m
Source elevation	: 0.00	m
Receiver elevation	: 10.00	m
Barrier elevation	: 0.00	m
Reference angle	: 0.00	

♀
Results segment # 1: OLRT (day)

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
4.00	13.90	19.92	19.92
0.50	13.90	19.22	19.22

LOCOMOTIVE (0.00 + 62.48 + 0.00) = 62.48 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-88	88	0.00	62.58	0.00	-0.10	0.00	0.00	0.00	62.48*
-88	88	0.00	62.58	0.00	-0.10	0.00	0.00	0.00	62.48

* Bright Zone !

WHEEL (0.00 + 62.49 + 0.00) = 62.49 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-88	88	0.00	62.59	0.00	-0.10	0.00	0.00	-0.00	62.49*
-88	88	0.00	62.59	0.00	-0.10	0.00	0.00	0.00	62.49

* Bright Zone !

Segment Leq : 65.50 dBA

Total Leq All Segments: 65.50 dBA

♀
Results segment # 1: OLRT (night)

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
4.00	13.90	19.92	19.92
0.50	13.90	19.22	19.22

LOCOMOTIVE (0.00 + 39.24 + 0.00) = 39.24 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-88	88	0.00	39.33	0.00	-0.10	0.00	0.00	0.00	39.24*
-88	88	0.00	39.33	0.00	-0.10	0.00	0.00	0.00	39.24

* Bright Zone !

WHEEL (0.00 + 39.25 + 0.00) = 39.25 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-88	88	0.00	39.34	0.00	-0.10	0.00	0.00	-0.00	39.25*
-88	88	0.00	39.34	0.00	-0.10	0.00	0.00	0.00	39.25

* Bright Zone !

Segment Leq : 42.26 dBA

Total Leq All Segments: 42.26 dBA

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

Car traffic volume : 12144/1056 veh/TimePeriod *
Medium truck volume : 966/84 veh/TimePeriod *
Heavy truck volume : 690/60 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): 15000
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: Richmond (day/night)
------------------------------------------
Angle1   Angle2           : -88.00 deg   88.00 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           :  13.90 / 13.90  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

♀
Road data, segment # 2: Byron (day/night)
-----------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    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):   8000
    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: Byron (day/night)
---------------------------------------
Angle1   Angle2           : -74.00 deg   73.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  47.00 / 47.00  m
Receiver height           :  13.90 / 13.90  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

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

Source height = 1.50 m

ROAD (0.00 + 68.38 + 0.00) = 68.38 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -88     88   0.00  68.48   0.00   0.00  -0.10   0.00   0.00   0.00  68.38
-------------------------------------------------------------------------------

Segment Leq : 68.38 dBA

♀
Results segment # 2: Byron (day)
--------------------------------

Source height = 1.50 m
```

ROAD (0.00 + 59.91 + 0.00) = 59.91 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-74	73	0.00	65.75	0.00	-4.96	-0.88	0.00	0.00	0.00	59.91

Segment Leq : 59.91 dBA

Total Leq All Segments: 68.96 dBA

♀

Results segment # 1: Richmond (night)

Source height = 1.50 m

ROAD (0.00 + 60.79 + 0.00) = 60.79 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-88	88	0.00	60.88	0.00	0.00	-0.10	0.00	0.00	0.00	60.79

Segment Leq : 60.79 dBA

♀

Results segment # 2: Byron (night)

Source height = 1.50 m

ROAD (0.00 + 52.32 + 0.00) = 52.32 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-74	73	0.00	58.16	0.00	-4.96	-0.88	0.00	0.00	0.00	52.32

Segment Leq : 52.32 dBA

Total Leq All Segments: 61.37 dBA

♀

TOTAL Leq FROM ALL SOURCES (DAY): 70.57
(NIGHT): 61.42

♀
♀

STAMSON 5.0 NORMAL REPORT Date: 08-02-2018 35:34:19
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: rec111.te Time Period: Day/Night 16/8 hours
Description: Reception Point 1-11 - Revised

Rail data, segment # 1: OLRT (day/night)

Train Type	Trains	Speed (km/h)	# loc /Train	# Cars /Train	Eng type	Cont weld
* 1. OLRT	422.0/1.0	65.0	1.0	1.0	Elec	Yes

* The identified number of trains have been adjusted for future growth using the following parameters:

Train type: No	Name	Unadj. Trains	Annual % Increase	Years of Growth
1.	OLRT	422.0/1.0	0.00	0.00

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

Angle1	Angle2	: -88.00 deg	88.00 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		: 31.30 / 31.30	m
Topography		: 4	(Elevated; with barrier)
No Whistle			
Barrier angle1		: -88.00 deg	Angle2 : 88.00 deg
Barrier height		: 10.00 m	
Elevation		: 10.00 m	
Barrier receiver distance		: 3.00 / 3.00	m
Source elevation		: 0.00 m	
Receiver elevation		: 10.00 m	
Barrier elevation		: 0.00 m	
Reference angle		: 0.00	

♀

Results segment # 1: OLRT (day)

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
4.00	31.30	33.84	33.84
0.50	31.30	33.14	33.14

LOCOMOTIVE (0.00 + 62.48 + 0.00) = 62.48 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-88	88	0.00	62.58	0.00	-0.10	0.00	0.00	0.00	62.48*
-88	88	0.00	62.58	0.00	-0.10	0.00	0.00	0.00	62.48

* Bright Zone !

WHEEL (0.00 + 62.49 + 0.00) = 62.49 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-88	88	0.00	62.59	0.00	-0.10	0.00	0.00	0.00	62.49*
-88	88	0.00	62.59	0.00	-0.10	0.00	0.00	0.00	62.49

 * Bright Zone !

Segment Leq : 65.50 dBA

Total Leq All Segments: 65.50 dBA

♀
Results segment # 1: OLRT (night)

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
4.00	31.30	33.84	33.84
0.50	31.30	33.14	33.14

LOCOMOTIVE (0.00 + 39.24 + 0.00) = 39.24 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-88	88	0.00	39.33	0.00	-0.10	0.00	0.00	0.00	39.24*
-88	88	0.00	39.33	0.00	-0.10	0.00	0.00	0.00	39.24

 * Bright Zone !

WHEEL (0.00 + 39.25 + 0.00) = 39.25 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-88	88	0.00	39.34	0.00	-0.10	0.00	0.00	0.00	39.25*
-88	88	0.00	39.34	0.00	-0.10	0.00	0.00	0.00	39.25

 * Bright Zone !

Segment Leq : 42.26 dBA

Total Leq All Segments: 42.26 dBA

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

Car traffic volume : 12144/1056 veh/TimePeriod *
Medium truck volume :   966/84   veh/TimePeriod *
Heavy truck volume :   690/60   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): 15000
    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: Richmond (day/night)
------------------------------------------
Angle1   Angle2           : -88.00 deg   88.00 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           :  31.30 / 31.30  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

♀
Road data, segment # 2: Byron (day/night)
-----------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    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):   8000
    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: Byron (day/night)
---------------------------------------
Angle1   Angle2           : -74.00 deg   73.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  47.00 / 47.00  m
Receiver height           :  31.30 / 31.30  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

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

Source height = 1.50 m

ROAD (0.00 + 68.38 + 0.00) = 68.38 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -88     88   0.00  68.48   0.00   0.00  -0.10   0.00   0.00   0.00  68.38
-------------------------------------------------------------------------------

Segment Leq : 68.38 dBA

♀
Results segment # 2: Byron (day)
--------------------------------

Source height = 1.50 m
```

ROAD (0.00 + 59.91 + 0.00) = 59.91 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-74	73	0.00	65.75	0.00	-4.96	-0.88	0.00	0.00	0.00	59.91

Segment Leq : 59.91 dBA

Total Leq All Segments: 68.96 dBA

♀

Results segment # 1: Richmond (night)

Source height = 1.50 m

ROAD (0.00 + 60.79 + 0.00) = 60.79 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-88	88	0.00	60.88	0.00	0.00	-0.10	0.00	0.00	0.00	60.79

Segment Leq : 60.79 dBA

♀

Results segment # 2: Byron (night)

Source height = 1.50 m

ROAD (0.00 + 52.32 + 0.00) = 52.32 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-74	73	0.00	58.16	0.00	-4.96	-0.88	0.00	0.00	0.00	52.32

Segment Leq : 52.32 dBA

Total Leq All Segments: 61.37 dBA

♀

TOTAL Leq FROM ALL SOURCES (DAY): 70.57
(NIGHT): 61.42

♀
♀

STAMSON 5.0 NORMAL REPORT Date: 08-02-2018 35:35:29
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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

Rail data, segment # 1: OLRT (day/night)

Train Type	Trains	Speed (km/h)	# loc /Train	# Cars /Train	Eng type	Cont weld
* 1. OLRT	422.0/1.0	65.0	1.0	1.0	Elec	Yes

* The identified number of trains have been adjusted for future growth using the following parameters:

Train type: No	Name	Unadj. Trains	Annual % Increase	Years of Growth
1.	OLRT	422.0/1.0	0.00	0.00

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

Angle1 Angle2	: -82.00 deg	0.00 deg
Wood depth	: 0	(No woods.)
No of house rows	: 0 / 0	
Surface	: 2	(Reflective ground surface)
Receiver source distance	: 25.00 / 25.00	m
Receiver height	: 1.50 / 1.50	m
Topography	: 4	(Elevated; with barrier)
No Whistle		
Barrier angle1	: -82.00 deg	Angle2 : 0.00 deg
Barrier height	: 10.00	m
Elevation	: 10.00	m
Barrier receiver distance	: 18.00 / 18.00	m
Source elevation	: 0.00	m
Receiver elevation	: 10.00	m
Barrier elevation	: 0.00	m
Reference angle	: 0.00	

♀
Results segment # 1: OLRT (day)

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
4.00	1.50	6.10	6.10
0.50	1.50	3.58	3.58

LOCOMOTIVE (0.00 + 41.19 + 0.00) = 41.19 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-82	0	0.00	62.58	-2.22	-3.41	0.00	0.00	-15.75	41.19

WHEEL (0.00 + 38.38 + 0.00) = 38.38 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-82	0	0.00	62.59	-2.22	-3.41	0.00	0.00	-18.58	38.38

Segment Leq : 43.02 dBA

Total Leq All Segments: 43.02 dBA

♀
Results segment # 1: OLRT (night)

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
4.00	1.50	6.10	6.10
0.50	1.50	3.58	3.58

LOCOMOTIVE (0.00 + 17.95 + 0.00) = 17.95 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-82	0	0.00	39.33	-2.22	-3.41	0.00	0.00	-15.75	17.95

WHEEL (0.00 + 15.13 + 0.00) = 15.13 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-82	0	0.00	39.34	-2.22	-3.41	0.00	0.00	-18.58	15.13

Segment Leq : 19.78 dBA

Total Leq All Segments: 19.78 dBA

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

```
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    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):  15000
    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: Richmond (day/night)

```
Angle1   Angle2           : -82.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  25.00 / 25.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

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

Car traffic volume : 6477/563 veh/TimePeriod *
Medium truck volume : 515/45 veh/TimePeriod *
Heavy truck volume : 368/32 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): 8000
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: Byron (day/night)

Angle1 Angle2 : -65.00 deg 0.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 60.00 / 60.00 m
Receiver height : 1.50 / 1.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

♀
Results segment # 1: Richmond (day)

Source height = 1.50 m

ROAD (0.00 + 62.85 + 0.00) = 62.85 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-82	0	0.00	68.48	0.00	-2.22	-3.41	0.00	0.00	0.00	62.85

Segment Leq : 62.85 dBA

♀
Results segment # 2: Byron (day)

Source height = 1.50 m

ROAD (0.00 + 55.31 + 0.00) = 55.31 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-65	0	0.00	65.75	0.00	-6.02	-4.42	0.00	0.00	0.00	55.31

Segment Leq : 55.31 dBA

Total Leq All Segments: 63.55 dBA

♀
Results segment # 1: Richmond (night)

Source height = 1.50 m

ROAD (0.00 + 55.25 + 0.00) = 55.25 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-82	0	0.00	60.88	0.00	-2.22	-3.41	0.00	0.00	0.00	55.25

Segment Leq : 55.25 dBA

Results segment # 2: Byron (night)

Source height = 1.50 m

ROAD (0.00 + 47.71 + 0.00) = 47.71 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-65	0	0.00	58.16	0.00	-6.02	-4.42	0.00	0.00	0.00	47.71

Segment Leq : 47.71 dBA

Total Leq All Segments: 55.95 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 63.59
(NIGHT): 55.96

STAMSON 5.0 NORMAL REPORT Date: 08-02-2018 35:36:30
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: rec25.te Time Period: Day/Night 16/8 hours
Description: Reception Point 2-5 - Revised

Rail data, segment # 1: OLRT (day/night)

Train Type	Trains	Speed (km/h)	# loc /Train	# Cars /Train	Eng type	Cont weld
* 1. OLRT	422.0/1.0	65.0	1.0	1.0	Elec	Yes

* The identified number of trains have been adjusted for future growth using the following parameters:

Train type: No	Name	Unadj. Trains	Annual % Increase	Years of Growth
1.	OLRT	422.0/1.0	0.00	0.00

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

Angle1 Angle2	-82.00 deg	0.00 deg
Wood depth	0	(No woods.)
No of house rows	0 / 0	
Surface	2	(Reflective ground surface)
Receiver source distance	25.00 / 25.00	m
Receiver height	13.90 / 13.90	m
Topography	4	(Elevated; with barrier)
No Whistle		
Barrier angle1	-82.00 deg	Angle2 : 0.00 deg
Barrier height	10.00	m
Elevation	10.00	m
Barrier receiver distance	18.00 / 18.00	m
Source elevation	0.00	m
Receiver elevation	10.00	m
Barrier elevation	0.00	m
Reference angle	0.00	

♀
Results segment # 1: OLRT (day)

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
4.00	13.90	9.57	9.57
0.50	13.90	7.05	7.05

LOCOMOTIVE (0.00 + 51.64 + 0.00) = 51.64 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-82	0	0.00	62.58	-2.22	-3.41	0.00	0.00	-5.30	51.64

WHEEL (0.00 + 46.35 + 0.00) = 46.35 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-82	0	0.00	62.59	-2.22	-3.41	0.00	0.00	-10.60	46.35

Segment Leq : 52.77 dBA

Total Leq All Segments: 52.77 dBA

♀
Results segment # 1: OLRT (night)

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
4.00	13.90	9.57	9.57
0.50	13.90	7.05	7.05

LOCOMOTIVE (0.00 + 28.40 + 0.00) = 28.40 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-82	0	0.00	39.33	-2.22	-3.41	0.00	0.00	-5.30	28.40

WHEEL (0.00 + 23.11 + 0.00) = 23.11 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-82	0	0.00	39.34	-2.22	-3.41	0.00	0.00	-10.60	23.11

Segment Leq : 29.53 dBA

Total Leq All Segments: 29.53 dBA

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

Car traffic volume	: 12144/1056	veh/TimePeriod *
Medium truck volume	: 966/84	veh/TimePeriod *
Heavy truck volume	: 690/60	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)	15000
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: Richmond (day/night)

Angle1 Angle2	: -82.00 deg	0.00 deg
Wood depth	: 0	(No woods.)
No of house rows	: 0 / 0	
Surface	: 2	(Reflective ground surface)
Receiver source distance	: 25.00 / 25.00	m
Receiver height	: 13.90 / 13.90	m
Topography	: 1	(Flat/gentle slope; no barrier)
Reference angle	: 0.00	

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

Car traffic volume : 6477/563 veh/TimePeriod *
Medium truck volume : 515/45 veh/TimePeriod *
Heavy truck volume : 368/32 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): 8000
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: Byron (day/night)

Angle1 Angle2 : -65.00 deg 0.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 60.00 / 60.00 m
Receiver height : 13.90 / 13.90 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

♀
Results segment # 1: Richmond (day)

Source height = 1.50 m

ROAD (0.00 + 62.85 + 0.00) = 62.85 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-82	0	0.00	68.48	0.00	-2.22	-3.41	0.00	0.00	0.00	62.85

Segment Leq : 62.85 dBA

♀
Results segment # 2: Byron (day)

Source height = 1.50 m

ROAD (0.00 + 55.31 + 0.00) = 55.31 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-65	0	0.00	65.75	0.00	-6.02	-4.42	0.00	0.00	0.00	55.31

Segment Leq : 55.31 dBA

Total Leq All Segments: 63.55 dBA

♀
Results segment # 1: Richmond (night)

Source height = 1.50 m

ROAD (0.00 + 55.25 + 0.00) = 55.25 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-82	0	0.00	60.88	0.00	-2.22	-3.41	0.00	0.00	0.00	55.25

Segment Leq : 55.25 dBA

Results segment # 2: Byron (night)

Source height = 1.50 m

ROAD (0.00 + 47.71 + 0.00) = 47.71 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-65	0	0.00	58.16	0.00	-6.02	-4.42	0.00	0.00	0.00	47.71

Segment Leq : 47.71 dBA

Total Leq All Segments: 55.95 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 63.90
(NIGHT): 55.96

STAMSON 5.0 NORMAL REPORT Date: 08-02-2018 35:37:50
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: rec211.te Time Period: Day/Night 16/8 hours
Description: Reception Point 2-11 - Revised

Rail data, segment # 1: OLRT (day/night)

Train Type	Trains	Speed (km/h)	# loc /Train	# Cars /Train	Eng type	Cont weld
* 1. OLRT	422.0/1.0	65.0	1.0	1.0	Elec	Yes

* The identified number of trains have been adjusted for future growth using the following parameters:

Train type: No	Name	Unadj. Trains	Annual % Increase	Years of Growth
1.	OLRT	422.0/1.0	0.00	0.00

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

Angle1 Angle2	: -82.00 deg	0.00 deg
Wood depth	: 0	(No woods.)
No of house rows	: 0 / 0	
Surface	: 2	(Reflective ground surface)
Receiver source distance	: 25.00 / 25.00	m
Receiver height	: 31.30 / 31.30	m
Topography	: 4	(Elevated; with barrier)
No Whistle		
Barrier angle1	: -82.00 deg	Angle2 : 0.00 deg
Barrier height	: 10.00	m
Elevation	: 10.00	m
Barrier receiver distance	: 18.00 / 18.00	m
Source elevation	: 0.00	m
Receiver elevation	: 10.00	m
Barrier elevation	: 0.00	m
Reference angle	: 0.00	

♀
Results segment # 1: OLRT (day)

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
4.00	31.30	14.44	14.44
0.50	31.30	11.92	11.92

LOCOMOTIVE (0.00 + 56.94 + 0.00) = 56.94 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-82	0	0.00	62.58	-2.22	-3.41	0.00	0.00	-0.00	56.94*
-82	0	0.00	62.58	-2.22	-3.41	0.00	0.00	0.00	56.94

* Bright Zone !

WHEEL (0.00 + 56.95 + 0.00) = 56.95 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-82	0	0.00	62.59	-2.22	-3.41	0.00	0.00	-2.22	54.73*
-82	0	0.00	62.59	-2.22	-3.41	0.00	0.00	0.00	56.95

* Bright Zone !

Segment Leq : 59.96 dBA

Total Leq All Segments: 59.96 dBA

♀
Results segment # 1: OLRT (night)

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
4.00	31.30	14.44	14.44
0.50	31.30	11.92	11.92

LOCOMOTIVE (0.00 + 33.70 + 0.00) = 33.70 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-82	0	0.00	39.33	-2.22	-3.41	0.00	0.00	-0.00	33.70*
-82	0	0.00	39.33	-2.22	-3.41	0.00	0.00	0.00	33.70

* Bright Zone !

WHEEL (0.00 + 33.71 + 0.00) = 33.71 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-82	0	0.00	39.34	-2.22	-3.41	0.00	0.00	-2.22	31.49*
-82	0	0.00	39.34	-2.22	-3.41	0.00	0.00	0.00	33.71

* Bright Zone !

Segment Leq : 36.72 dBA

Total Leq All Segments: 36.72 dBA

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

Car traffic volume : 12144/1056 veh/TimePeriod *
Medium truck volume : 966/84 veh/TimePeriod *
Heavy truck volume : 690/60 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): 15000
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: Richmond (day/night)
------------------------------------------
Angle1   Angle2           : -82.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  25.00 / 25.00  m
Receiver height           :  31.30 / 31.90  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

♀
Road data, segment # 2: Byron (day/night)
-----------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    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):   8000
    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: Byron (day/night)
---------------------------------------
Angle1   Angle2           : -65.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  60.00 / 60.00  m
Receiver height           :  31.30 / 31.30  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

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

Source height = 1.50 m

ROAD (0.00 + 62.85 + 0.00) = 62.85 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -82      0   0.00  68.48   0.00  -2.22  -3.41   0.00   0.00   0.00  62.85
-------------------------------------------------------------------------------

Segment Leq : 62.85 dBA

♀
Results segment # 2: Byron (day)
--------------------------------

Source height = 1.50 m
```

ROAD (0.00 + 55.31 + 0.00) = 55.31 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-65	0	0.00	65.75	0.00	-6.02	-4.42	0.00	0.00	0.00	55.31

Segment Leq : 55.31 dBA

Total Leq All Segments: 63.55 dBA

♀

Results segment # 1: Richmond (night)

Source height = 1.50 m

ROAD (0.00 + 55.25 + 0.00) = 55.25 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-82	0	0.00	60.88	0.00	-2.22	-3.41	0.00	0.00	0.00	55.25

Segment Leq : 55.25 dBA

♀

Results segment # 2: Byron (night)

Source height = 1.50 m

ROAD (0.00 + 47.71 + 0.00) = 47.71 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-65	0	0.00	58.16	0.00	-6.02	-4.42	0.00	0.00	0.00	47.71

Segment Leq : 47.71 dBA

Total Leq All Segments: 55.95 dBA

♀

TOTAL Leq FROM ALL SOURCES (DAY): 65.13
(NIGHT): 56.01

♀
♀

STAMSON 5.0 NORMAL REPORT Date: 08-02-2018 35:41:07
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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

Rail data, segment # 1: OLRT (day/night)

Train Type	Trains	Speed (km/h)	# loc /Train	# Cars /Train	Eng type	Cont weld
* 1. OLRT	422.0/1.0	65.0	1.0	1.0	Elec	Yes

* The identified number of trains have been adjusted for future growth using the following parameters:

Train type: No	Name	Unadj. Trains	Annual % Increase	Years of Growth
1.	OLRT	422.0/1.0	0.00	0.00

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

Angle1	Angle2	: 0.00 deg 88.00 deg
Wood depth		: 0 (No woods.)
No of house rows		: 0 / 0
Surface		: 2 (Reflective ground surface)
Receiver source distance		: 25.00 / 25.00 m
Receiver height		: 1.50 / 1.50 m
Topography		: 4 (Elevated; with barrier)
No Whistle		
Barrier angle1		: 0.00 deg Angle2 : 88.00 deg
Barrier height		: 10.00 m
Elevation		: 10.00 m
Barrier receiver distance		: 18.00 / 18.00 m
Source elevation		: 0.00 m
Receiver elevation		: 10.00 m
Barrier elevation		: 0.00 m
Reference angle		: 0.00

♀
Results segment # 1: OLRT (day)

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
4.00	1.50	6.10	6.10
0.50	1.50	3.58	3.58

LOCOMOTIVE (0.00 + 42.57 + 0.00) = 42.57 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	88	0.00	62.58	-2.22	-3.11	0.00	0.00	-14.68	42.57

WHEEL (0.00 + 39.89 + 0.00) = 39.89 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	88	0.00	62.59	-2.22	-3.11	0.00	0.00	-17.37	39.89

Segment Leq : 44.44 dBA

Total Leq All Segments: 44.44 dBA

♀

Results segment # 1: OLRT (night)

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
4.00	1.50	6.10	6.10
0.50	1.50	3.58	3.58

LOCOMOTIVE (0.00 + 19.33 + 0.00) = 19.33 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	88	0.00	39.33	-2.22	-3.11	0.00	0.00	-14.68	19.33

WHEEL (0.00 + 16.65 + 0.00) = 16.65 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	88	0.00	39.34	-2.22	-3.11	0.00	0.00	-17.37	16.65

Segment Leq : 21.20 dBA

Total Leq All Segments: 21.20 dBA

♀

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

Car traffic volume : 12144/1056 veh/TimePeriod *
Medium truck volume : 966/84 veh/TimePeriod *
Heavy truck volume : 690/60 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): 15000
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: Richmond (day/night)

Angle1 Angle2 : 0.00 deg 88.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 25.00 / 25.00 m
Receiver height : 1.50 / 1.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

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

Car traffic volume : 6477/563 veh/TimePeriod *
Medium truck volume : 515/45 veh/TimePeriod *
Heavy truck volume : 368/32 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): 8000
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: Byron (day/night)

Angle1 Angle2 : 0.00 deg 73.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 60.00 / 60.00 m
Receiver height : 1.50 / 1.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

♀
Results segment # 1: Richmond (day)

Source height = 1.50 m

ROAD (0.00 + 63.15 + 0.00) = 63.15 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	88	0.00	68.48	0.00	-2.22	-3.11	0.00	0.00	0.00	63.15

Segment Leq : 63.15 dBA

♀
Results segment # 2: Byron (day)

Source height = 1.50 m

ROAD (0.00 + 55.81 + 0.00) = 55.81 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	73	0.00	65.75	0.00	-6.02	-3.92	0.00	0.00	0.00	55.81

Segment Leq : 55.81 dBA

Total Leq All Segments: 63.89 dBA

♀
Results segment # 1: Richmond (night)

Source height = 1.50 m

ROAD (0.00 + 55.56 + 0.00) = 55.56 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	88	0.00	60.88	0.00	-2.22	-3.11	0.00	0.00	0.00	55.56

Segment Leq : 55.56 dBA

♀

Results segment # 2: Byron (night)

Source height = 1.50 m

ROAD (0.00 + 48.22 + 0.00) = 48.22 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	73	0.00	58.16	0.00	-6.02	-3.92	0.00	0.00	0.00	48.22

Segment Leq : 48.22 dBA

Total Leq All Segments: 56.30 dBA

♀

TOTAL Leq FROM ALL SOURCES (DAY): 63.93
(NIGHT): 56.30

♀
♀

STAMSON 5.0 NORMAL REPORT Date: 08-02-2018 35:42:13
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: rec35.te Time Period: Day/Night 16/8 hours
Description: Reception Point 3-5 - Revised

Rail data, segment # 1: OLRT (day/night)

Train Type	Trains	Speed (km/h)	# loc /Train	# Cars /Train	Eng type	Cont weld
* 1. OLRT	422.0/1.0	65.0	1.0	1.0	Elec	Yes

* The identified number of trains have been adjusted for future growth using the following parameters:

Train type: No	Name	Unadj. Trains	Annual % Increase	Years of Growth
1.	OLRT	422.0/1.0	0.00	0.00

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

Angle1	Angle2	: 0.00 deg 88.00 deg
Wood depth		: 0 (No woods.)
No of house rows		: 0 / 0
Surface		: 2 (Reflective ground surface)
Receiver source distance		: 25.00 / 25.00 m
Receiver height		: 13.90 / 13.90 m
Topography		: 4 (Elevated; with barrier)
No Whistle		
Barrier angle1		: 0.00 deg Angle2 : 88.00 deg
Barrier height		: 10.00 m
Elevation		: 10.00 m
Barrier receiver distance		: 18.00 / 18.00 m
Source elevation		: 0.00 m
Receiver elevation		: 10.00 m
Barrier elevation		: 0.00 m
Reference angle		: 0.00

♀
Results segment # 1: OLRT (day)

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
4.00	13.90	9.57	9.57
0.50	13.90	7.05	7.05

LOCOMOTIVE (0.00 + 51.97 + 0.00) = 51.97 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	88	0.00	62.58	-2.22	-3.11	0.00	0.00	-5.28	51.97

WHEEL (0.00 + 47.14 + 0.00) = 47.14 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	88	0.00	62.59	-2.22	-3.11	0.00	0.00	-10.12	47.14

Segment Leq : 53.20 dBA

Total Leq All Segments: 53.20 dBA

♀
Results segment # 1: OLRT (night)

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
4.00	13.90	9.57	9.57
0.50	13.90	7.05	7.05

LOCOMOTIVE (0.00 + 28.72 + 0.00) = 28.72 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	88	0.00	39.33	-2.22	-3.11	0.00	0.00	-5.28	28.72

WHEEL (0.00 + 23.90 + 0.00) = 23.90 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	88	0.00	39.34	-2.22	-3.11	0.00	0.00	-10.12	23.90

Segment Leq : 29.96 dBA

Total Leq All Segments: 29.96 dBA

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

Car traffic volume	: 12144/1056	veh/TimePeriod *
Medium truck volume	: 966/84	veh/TimePeriod *
Heavy truck volume	: 690/60	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)	15000
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: Richmond (day/night)

Angle1 Angle2	: 0.00 deg	88.00 deg
Wood depth	: 0	(No woods.)
No of house rows	: 0 / 0	
Surface	: 2	(Reflective ground surface)
Receiver source distance	: 25.00 / 25.00	m
Receiver height	: 13.90 / 13.90	m
Topography	: 1	(Flat/gentle slope; no barrier)
Reference angle	: 0.00	

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

Car traffic volume : 6477/563 veh/TimePeriod *
Medium truck volume : 515/45 veh/TimePeriod *
Heavy truck volume : 368/32 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): 8000
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: Byron (day/night)

Angle1 Angle2 : 0.00 deg 73.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 60.00 / 60.00 m
Receiver height : 13.90 / 13.90 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

♀
Results segment # 1: Richmond (day)

Source height = 1.50 m

ROAD (0.00 + 63.15 + 0.00) = 63.15 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	88	0.00	68.48	0.00	-2.22	-3.11	0.00	0.00	0.00	63.15

Segment Leq : 63.15 dBA

♀
Results segment # 2: Byron (day)

Source height = 1.50 m

ROAD (0.00 + 55.81 + 0.00) = 55.81 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	73	0.00	65.75	0.00	-6.02	-3.92	0.00	0.00	0.00	55.81

Segment Leq : 55.81 dBA

Total Leq All Segments: 63.89 dBA

♀
Results segment # 1: Richmond (night)

Source height = 1.50 m

ROAD (0.00 + 55.56 + 0.00) = 55.56 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	88	0.00	60.88	0.00	-2.22	-3.11	0.00	0.00	0.00	55.56

Segment Leq : 55.56 dBA

♀

Results segment # 2: Byron (night)

Source height = 1.50 m

ROAD (0.00 + 48.22 + 0.00) = 48.22 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	73	0.00	58.16	0.00	-6.02	-3.92	0.00	0.00	0.00	48.22

Segment Leq : 48.22 dBA

Total Leq All Segments: 56.30 dBA

♀

TOTAL Leq FROM ALL SOURCES (DAY): 64.24
(NIGHT): 56.31

♀
♀

STAMSON 5.0 NORMAL REPORT Date: 08-02-2018 35:45:22
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: rec311.te Time Period: Day/Night 16/8 hours
Description: Reception Point 3-11 - Revised

Rail data, segment # 1: OLRT (day/night)

Train Type	Trains	Speed (km/h)	# loc /Train	# Cars /Train	Eng type	Cont weld
* 1. OLRT	422.0/1.0	65.0	1.0	1.0	Elec	Yes

* The identified number of trains have been adjusted for future growth using the following parameters:

Train type: No	Name	Unadj. Trains	Annual % Increase	Years of Growth
1.	OLRT	422.0/1.0	0.00	0.00

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

Angle1 Angle2	: 0.00 deg	88.00 deg
Wood depth	: 0	(No woods.)
No of house rows	: 0 / 0	
Surface	: 2	(Reflective ground surface)
Receiver source distance	: 25.00 / 25.00	m
Receiver height	: 13.90 / 13.90	m
Topography	: 4	(Elevated; with barrier)
No Whistle		
Barrier angle1	: 0.00 deg	Angle2 : 88.00 deg
Barrier height	: 10.00	m
Elevation	: 10.00	m
Barrier receiver distance	: 18.00 / 18.00	m
Source elevation	: 0.00	m
Receiver elevation	: 10.00	m
Barrier elevation	: 0.00	m
Reference angle	: 0.00	

♀
Results segment # 1: OLRT (day)

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
4.00	13.90	9.57	9.57
0.50	13.90	7.05	7.05

LOCOMOTIVE (0.00 + 51.97 + 0.00) = 51.97 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	88	0.00	62.58	-2.22	-3.11	0.00	0.00	-5.28	51.97

WHEEL (0.00 + 47.14 + 0.00) = 47.14 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	88	0.00	62.59	-2.22	-3.11	0.00	0.00	-10.12	47.14

Segment Leq : 53.20 dBA

Total Leq All Segments: 53.20 dBA

♀

Results segment # 1: OLRT (night)

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
4.00	13.90	9.57	9.57
0.50	13.90	7.05	7.05

LOCOMOTIVE (0.00 + 28.72 + 0.00) = 28.72 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	88	0.00	39.33	-2.22	-3.11	0.00	0.00	-5.28	28.72

WHEEL (0.00 + 23.90 + 0.00) = 23.90 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	88	0.00	39.34	-2.22	-3.11	0.00	0.00	-10.12	23.90

Segment Leq : 29.96 dBA

Total Leq All Segments: 29.96 dBA

♀

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

Car traffic volume : 12144/1056 veh/TimePeriod *
Medium truck volume : 966/84 veh/TimePeriod *
Heavy truck volume : 690/60 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): 15000
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: Richmond (day/night)

Angle1 Angle2 : 0.00 deg 88.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 25.00 / 25.00 m
Receiver height : 31.30 / 31.30 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

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

Car traffic volume : 6477/563 veh/TimePeriod *
Medium truck volume : 515/45 veh/TimePeriod *
Heavy truck volume : 368/32 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): 8000
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: Byron (day/night)

Angle1 Angle2 : 0.00 deg 73.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 60.00 / 60.00 m
Receiver height : 31.30 / 31.30 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

♀
Results segment # 1: Richmond (day)

Source height = 1.50 m

ROAD (0.00 + 63.15 + 0.00) = 63.15 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	88	0.00	68.48	0.00	-2.22	-3.11	0.00	0.00	0.00	63.15

Segment Leq : 63.15 dBA

♀
Results segment # 2: Byron (day)

Source height = 1.50 m

ROAD (0.00 + 55.81 + 0.00) = 55.81 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	73	0.00	65.75	0.00	-6.02	-3.92	0.00	0.00	0.00	55.81

Segment Leq : 55.81 dBA

Total Leq All Segments: 63.89 dBA

♀
Results segment # 1: Richmond (night)

Source height = 1.50 m

ROAD (0.00 + 55.56 + 0.00) = 55.56 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	88	0.00	60.88	0.00	-2.22	-3.11	0.00	0.00	0.00	55.56

Segment Leq : 55.56 dBA

♀

Results segment # 2: Byron (night)

Source height = 1.50 m

ROAD (0.00 + 48.22 + 0.00) = 48.22 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	73	0.00	58.16	0.00	-6.02	-3.92	0.00	0.00	0.00	48.22

Segment Leq : 48.22 dBA

Total Leq All Segments: 56.30 dBA

♀

TOTAL Leq FROM ALL SOURCES (DAY): 64.24
(NIGHT): 56.31

♀
♀

APPENDIX 3

CORRESPONDENCE

Stephanie Boisvenue

From: Schmidt, Mike <Mike.Schmidt@ottawa.ca>
Sent: July-24-17 9:55 AM
To: Stephanie Boisvenue
Subject: RE: Proximity Study - 851 Richmond Road
Attachments: 2017_07_20__CIV-0123-CK-CW_profile__851_Richmond_Rd.dwg; 2017_07_20__TRK-0-CK-CW_Align__851_Richmond_Rd.dwg; TRK-2-CK-SHEETS.PDF; TUN-2-S-115to195.pdf; TUN-2-S-115to195 Section.pdf

Hi Stephanie,

Attached is the track horizontal alignment and vertical profile between New Orchard Station and Cleary Station. This shows where the centerline of tracks will physically be located within the Byron Linear Park. In addition, you can see the depth of the track relative to OG (original grade). Furthermore, you may go to GeoOttawa to see the entire Stage 2 LRT alignment by selecting Rail Implementation Office layer http://maps.ottawa.ca/geoottawa/. Attached are (CAD) Alignment files for confederation line limited to the area adjacent to the development. These are stripped down horizontal and vertical alignment but will provide info needed. Attached is also a cross-section showing the typical tunnel box within the Byron Park as well as the Tunnel Alignment.

In terms of the information requested information for the noise and vibration study the following information has been provided to me by our team:

These values are for 2024 (opening year of Confed West):

- On a typical weekday, 244 trips in each direction (488 total)
- Trains are two cars long (2 x 49m = 98 m) and are electric-powered (no locomotives)
- Speeds alongside this parcel range from 45-60 kph. (Speeds in the Cleary Station area are limited to 45kph, though it's difficult to say exactly what the passing speed will be.)

As previously mentioned the track alignment and station locations cannot be considered finalized until the contract is awarded and final design completed.

Regards,

Mike

Mike Schmidt
Planner II | Urbaniste II
O-Train Planning | Planification de l'O-Train
Transportation Services Department | Direction générale des transports
City of Ottawa | Ville d'Ottawa
613-580-2424 x 13431

From: Schmidt, Mike
Sent: Thursday, July 20, 2017 12:31 PM
To: Stephanie Boisvenue <SBoisvenue@Patersongroup.ca>
Subject: RE: Proximity Study - 851 Richmond Road