CONFEDERATION LINE EXTENSION PROJECT

COMMUNITY NOISE IMPACT ASSESSMENT (DRAFT)

Revision 1

West Extension
Richmond Road to Connaught Park Area

City of Ottawa
January 19, 2022

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REVISION HISTORY

NOTE: Revisions are identified with a revision bar unless otherwise specified below. Any printed copies are uncontrolled and may not be current.

Rev	Date	Description	Summary of changes
0	Oct 29, 2021	First Draft	N/A
1	Jan 19, 2022	Second Draft	The inclusion of information related to the area south of Richmond Road to Connaught Park Area

DISCLAIMER

This document is composed of excerpts relevant to the between Richmond Road and the Connaught Park area from the following report:

EWC Designers (EJV). *Confederation Line Extension West Extension - Community Noise Impact Assessment (Rev 4)*. Report # EJV-S0GENW-ENV-RPT-0001, dated 6/02/21

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1.0 INTRODUCTION

This Noise Impact Assessment was prepared to demonstrate compliance with the Environmental Obligations for the development of the Confederation Line Extension (CLE) program.

This assessment analyses the operational noise impact of the West LRT Extension, which extends from Tunney's Pasture Station to Moodie LMSF and Algonquin Station to the Lincoln Fields merger.

Note that the operational vibration, the construction noise and the construction vibration are analyzed in separate reports.

As part of this undertaking, a Community Impact Study of the project is required to meet the requirements of the City of Ottawa's Environmental Noise Control Guidelines and the CLE Project Agreement (PA) - Schedule 17, United States Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Standards, as well as the Ministry of the Environment, Conservation and Parks (MECP) Guidelines.

This report documents the noise impact on the representative and sensitive receptors surrounding the project West alignment. Aerial images and zoning maps were analyzed. Field measurements were conducted to validate the acoustic model and to establish a project noise baseline.

Acoustic impact models of the project were developed to predict the noise impact of the project on the surrounding community.

2.0 REGULATIONS, STANDARDS, SPECIFICATIONS AND OTHER APPLICABLE DOCUMENTS

This section lists documents, applicable regulations, standards, and specifications for the noise impact assessment.

[1] City of Ottawa, Confederation Line Extension - Project Agreement – Schedule 17, 2019

[2] City of Ottawa, Environmental Noise Control Guidelines, January 2016

[3] City of Ottawa, Bylaw No. 2013-14

[4] Ontario Ministry of Environment, Conservation and Parks, Environmental Noise Guideline, Stationary and Transportation Sources – Approval and Planning (Publication NPC-300), August 2013

[5] United States Federal Transit Administration (FTA), Transit Noise and Vibration Impact Assessment Manual, September 2018

[6] United States Federal Highway Administration Traffic Noise Model (TMN), January 2006

[7] ISO 1996-2, Acoustics — Description, Measurement and Assessment of Environmental Noise — Part 2: Determination of Sound Pressure Levels, July 2017

[8] Ontario Provincial Standard Specification – Construction Specification for Noise Barrier Systems, (OPSS 760), November 2014.

[9] EWC, RFI – Rationale for employing US Traffic Model (TNM 2.5) over the Ontario Road Noise Analysis Method for Environment and Transportation (ORNAMENT), EJV-S0GENR-ENV-MEM-0001, October 2019

[10] EWC, Noise Emission Analysis of Tunnel Ventilation Fans, EJV-S2CGPW-ACO-MEM-1001

[11] EWC, Stations – Passenger Modelling Design Assumptions Report, EJV-SOGENR-COD-RPT-0001

[12] ST2, Noise and Vibration Assessment Ottawa Light Rail Transit (Stage 2), Revision 0, January 2017

[13] EWC, Lincoln Fields Station Acoustics Design Report, EJV-S1STLI-ACO-RPT-1001

3.0 CRITERIA

3.1 Operational Noise Impact Criteria

3.1.1 LRT and Road Activity

The operational noise impact criteria shall follow the City of Ottawa Environmental Noise Control Guidelines [2]. The guidelines define the representative receptor as an outdoor living area being 3.0 m from the centre of a dwelling unit, and 1.5m above ground level.

Table 3-1 below identifies the transportation noise emission criteria

Table 3-1: Summary of Criteria to Warrant Noise Mitigation Investigation (from City of Ottawa Environmental Noise Control Guidelines [2])

Future Sound Level, $L_{eq,16}$ (07:00 – 23:00)	Change Above Ambient [dB]	Impact Rating	Mitigation
Less than or equal to 55 dBA	N/A	N/A	None required
Greater than 55 dBA and less than or equal to 60 dBA	0-3	Not generally noticeable	
	3-5	Generally noticeable	
	5-10	Significant	Investigate noise control measures and mitigate to achieve retrofit criteria (min. attenuation of 6 dB)
	10+	Very Significant	
Greater than 60 dBA	0-3	Not generally noticeable	
	3-5	Generally noticeable	
	5-10	Significant	
	10+	Very Significant	

It should be noted that the objective for outdoor sound level is the higher of the Leq,16-hr 55 dBA or the Leq,16-hr ambient level that may prevail at the start of project construction (referred to as the established ambient) [2]. Therefore, if it is demonstrated that future noise levels will not exceed existing noise levels, provided levels do not exceed 60 dBA, investigation into noise controls is not required.

Where mitigation is deemed worth investigating, the final proposed noise barrier must achieve Administrative, Technical, and Economic feasibility for it to be implemented. The definition of each feasibility type is described in Table 3-2.

Table 3-2: Feasibility Constraints to be Achieved before Barrier Implementation

Feasibility Type	Definition
Administrative	▶ The barrier must be capable of being positioned on the right of way with a minimum 0.3m clearance to the property line[1] ▶ Noise barriers must be installed in a continuous line, though openings may be considered for access to fire hydrants.
Technical	▶ Barrier must be no less than 100m in length[2] ▶ Barrier must provide a loss of 6 dB when averaged over the first row of points of reception ▶ Barrier must be a minimum of 2.5m tall with a maximum of 3m for roads and 5m for freeways[3]
Economic	▶ Cost must be less than $100,000[4] per protected (>=6 dB noise reduction) dwelling employing an estimated cost of $550/m^2.

4.0 METHODOLOGY

4.1 Noise Modelling

It is noted in City of Ottawa Environmental Noise Control Guidelines Part 4 [2] that ORNAMENT (Ontario Road Noise Analysis Method for Environment and Transportation) and STEAM (Sound from Trains Environment Analysis Method) are the preferred prediction methods for determining the impact of noise from road and rail sources respectively. However, under City of Ottawa Environmental Noise Control Guidelines Part 4, section 3.5 [2], the City supports the preparation of noise contour mapping and encourages its submission where possible. Project Agreement – Schedule 17, section 8.5 (c) [1] permits an alternative and equivalent method of assessment.

As a result, noise modeling was completed using the CadnaA environmental noise prediction software by Datakustik. The model employed the US Federal Highway Association (US FHWA) Traffic Noise Model version 2.5 (TNM 2.5) to predict road traffic noise, the US Federal Transit Administration (US FTA) model to predict rail noise, and ISO 9613-2 to predict stationary source noise emissions. The CadnaA modeling software package employing the TNM, FTA, and ISO 9613-2 calculation methods allow for the production of noise contour mapping.

In order to satisfy the Ottawa Environmental Noise Control Guideline [2] requirement for ORNAMENT calculations, a memo containing justification for the use of TNM 2.5 as a replacement for ORNAMENT was completed [9].

[1] This is a requirement under the City of Ottawa Environmental Noise Control Guidelines Part 5, Section 3.3.2 Barrier Design [2]. It is directed to developers requiring to place barriers at a minimum distance of 0.3m from the City right of way. The same criterion was carried forward for defining administrative feasibility.
[2] This is a requirement under the City of Ottawa Environmental Noise Control Guidelines Part 3, Section 3.1[2].
[3] 2.5m - 3m is the preferred barrier height range outlined in the City of Ottawa Environmental Noise Control Guidelines Part 3, Section 4.1 Acoustic Barrier Design [2]. A 5m maximum is outlined in OPSS 760 Designer Action/Considerations [8]
[4] This $100,000 threshold is industry standard. Projects that used and documented this threshold in their analysis assessments include 407 Transitway - Kennedy to Brock Road and Highway 404 Extension - East Gwillimbury.

Inputs to the noise model shall follow the hierarchy:

- Latest design Inputs from the EJV Design Team
- Inputs outlined in the Project Agreement
- Inputs outlined in the Ottawa Environmental Noise Control Guideline [2]
- Other sources (City of Ottawa published traffic, Ontario standards, Federal Standards, best practice international standards)

The following general assumptions are made for all noise models:

- Study area
  - 250 m from the right of way of the LRT[5]
- Ground Characteristics
  - Include ground topography
  - Ground absorption of 0.5
- Shielding Effects
  - Existing Berms
  - Existing Housing
  - Existing Barriers
- Underground segments do not have a community airborne noise impact, and therefore, are not modelled

4.2 Operational Noise Impact

4.2.1 LRT, Bus Loops, and Road Activity

The following noise scenarios were modeled:

- Existing Road Traffic Model
- Future Build: Road and OLRT Rail Traffic Model (All Sources)
- Future Build: Road and OLRT Rail Traffic Model with proposed noise controls

The above scenarios were compared as summarized in Table 4-1 below.

[5] As noted in Ottawa Environmental Noise Control Guideline, Part 1, section 2.1 [2]

Table 4-1: Steps Taken for Noise Control Assessment

No	Description	Purpose	Design Action
1	Compare Existing Road Traffic Model against Baseline Measurements	Validate Acoustic Model is a reasonable approximation to measured levels	Compare the measured 16-hr L_{eq}[6] day, 8-hr L_{eq} night, and 24-hr L_{eq} to the equivalent modeled results. ▶ 0-3 dB difference – good ▶ 3-5 dB difference – fair ▶ > 5 dB difference – poor
2	Compare Future Build Road and OLRT Rail Traffic Model (All Sources) against Noise Criteria	Identify receptors that: ▶ Exceed 60 dBA	Investigate noise controls for these receptors
3.	Compare Future Build Road and OLRT Rail Traffic Model (All Sources) against Existing Road Traffic Model	Identify receptors where: ▶ Build levels are between 55 dBA and 60 dBA, and; ▶ Build levels exceed Existing pre-construction levels by at least 5 dB	Investigate noise controls for these receptors
4.	Compare Future Build Road and OLRT Rail Traffic Model against Future Build Road and OLRT Rail Traffic Model with barriers	Demonstrate barrier feasibility: ▶ Technical feasibility ▶ Administrative feasibility ▶ Economic feasibility	Size barriers to achieve compliance with project noise criteria

The following general assumptions are made:

- Road Traffic
  - Future Volumes are calculated using annual increase values from the Project Agreement
  - Speed is the design speed where available, otherwise it is the posted speed limit
  - Percentage Medium and Heavy Trucks as per Ottawa guidelines
  - Road surfaces as smooth asphalt
- LRT Traffic
  - Constant vehicle speed (no slowing at stations)
  - Noise emitted to train noise reverberation is included. This was calculated using a reverberant noise model (RAP ONE) using tunnel geometry. The resulting levels from the reverberant model were used as an input in the Cadna/A model at the tunnel portals.
- Bus Loops
  - Noise impacts due to station related noise, including bus loops, are assessed in their respective station acoustic reports.

[6] The minimum measured nighttime 1-hour Leq represents the quietest periods where the noise environment is dominated by steady noises (traffic) and is the most representative of the road noise model.

5.0 POINTS OF RECEPTION

Refer to **Appendix A** to identify locations of the representative noise receptors.

6.0 NOISE SOURCES

6.1 Road Traffic

A complete list of modeled road segments identifying the day-night volume splits, percentage, truck percentage, speed, and road conditions for each scenario is listed in **APPENDIX B.**

6.2 Rail Traffic

All above-ground rail was modelled. Model input details for each segment volume, day-night volume splits, and speed are listed in **APPENDIX B.** In accordance with the US FTA railway noise prediction guidelines, sections of track within 300 ft (91 m) of jointed track are modelled with a 5 dB penalty to account for noise generated by turnout and crossover. Further, a 4 dB penalty was applied to aerial portions of the guideway. Wheel squeal penalties were applied to curves with less than 1,000 ft in radius. Table 6-1 identified the locations where wheel squeal was applied. The Sound Exposure Level (SEL) of 136 dBA was selected as per the FTA. This SEL was adjusted to account for the total squeal event time over a 16-hour period, based on train speeds, curve lengths, and train volumes.

Please see **Appendix C** for graphics depicting chainage locations as identified in Table 6-1.

Table 6-1: Wheel Squeal Locations Summary

Chainage	
Start	**End**
62+658.74	62+834.38
42+656.83	42+828.15
93+446.15	93+727.52
83+448.7	83+741.04

Radiated train noise from tunnels was included as part of this assessment. Levels at the portals were predicted based on RAP-ONE reverberant calculations. These levels were then used as inputs in the CadnaA model.

A comparison between Alston train emissions and the FTA base LRV train emissions was undertaken. As per the Stage 2 Noise and Vibration Assessment dated January 2017 [12] (hereafter Stage 2 Report), Alstom provided LRV noise emission data indicating a maximum pass-by sound level of 80 dBA Lmax at 15 m and 70 km/h. Based on the FTA equation F-3, this is equivalent to a reference SEL of 83 dBA at 15 m and 80 km/h. The modelled train consists of the FTA 'AGT' with a reference SEL of 80 dBA at 15 m at 80 km/h. This SEL was bumped-up by 3 dB using the 'Train Classes and Penalty' feature in the Cadna/A rail object.

Conservatively, train speeds were modelled as 100 km/h throughout.

7.0 IMPACT ASSESSMENT

7.1 Background Measurements and Traffic Model Prediction Validation

Table 7-1 lists baseline measurements and the acoustic model results employing existing AADT traffic counts along the CLE east extension (Refer **Appendix D** for measured receptor). The 16-hr day, 8-hr night, minimum 1-hr night, and 24-hr Leq are compared. Typically, these metrics compare best between a 48-hr measurement and a background model based on AADT traffic counts. The following differences between measured and model results identifies the level measurement to model correlation:

- 3 dB or less = Good
- 3-5 dB = Fair
- >5 dB = Poor

The CadnaA model tended to underpredict the actual noise levels. In most cases, this is expected to be due to unquantifiable noise sources near the receptor that are significant but not modelled, or a result of traffic variation during the measurement period that was not consistent with the AADT used in the model.

In the case of the receptor location LINCN02, there are residential and shopping areas nearby that produce vehicle traffic noise which is not accounted for in the model as the traffic is not on primary roads.

In other cases where a poor correlation exists between the model and measured results, there is generally an unmodelled local road which may explain the model underprediction. These local roads were not modelled due to the unavailability of reliable traffic data. Such receptors are often a significant distance away from major noise sources such as Highway 417, increasing the relative significance of local noise sources.

Table 7-1: A Comparison between Field Measurements and Model Results

Monitored Location ID	Noise Level (L_{eq}, dBA)										
	Baseline Measurements				Modeled Results			Difference			
	Day (16 hr)	Night (8 hr)	Night (1 hr)	24-hr	Day (16 hr)	Night (8 hr and1 hr)	24-hr	Day (16 hr)	Night (8 hr)	Night (1 hr)	24-hr
CARLN01	51	50	43	51	48	41	46	-3	-9	-2	-5
IRISN01	54	47	44	53	49	41	47	-5	-6	-3	-6
IRISN02	56	54	50	56	57	50	55	1	-4	0	-1
LINCN01	64	55	45	62	54	46	52	-10	-9	1	-10
LINCN02	65	56	47	64	48	40	46	-17	-16	-7	-18
LINCN03	61	52	44	59	53	46	51	-8	-6	2	-8
QUEEN01	57	54	50	57	56	48	54	-1	-6	-2	-3

7.2 Predicted Future Road + Rail Noise Levels

Table 7-2 details the predicted Leq noise levels at each representative Outdoor Living Area (OLA) during the 16-hour daytime and 8-hour nighttime as required by the City's noise guideline. Existing [A] levels are based on current, pre-construction road conditions. The predicted Build (All Sources) [B] levels includes existing major roads, future operations of the Hwy 417 road modifications, and the new West LRT extension, as well as radiated train noise from tunnels.

Where daytime Build (All Sources) [B] levels exceed 60 dBA, barriers are investigated. Where daytime Build (All Sources) [B] levels are between 55 dBA and 60 dBA, barriers are investigated if the difference between the Build (All Sources) [B] and Existing [A] case is at least 5 dB.

Table 7-2: Future Sound Levels Evaluation

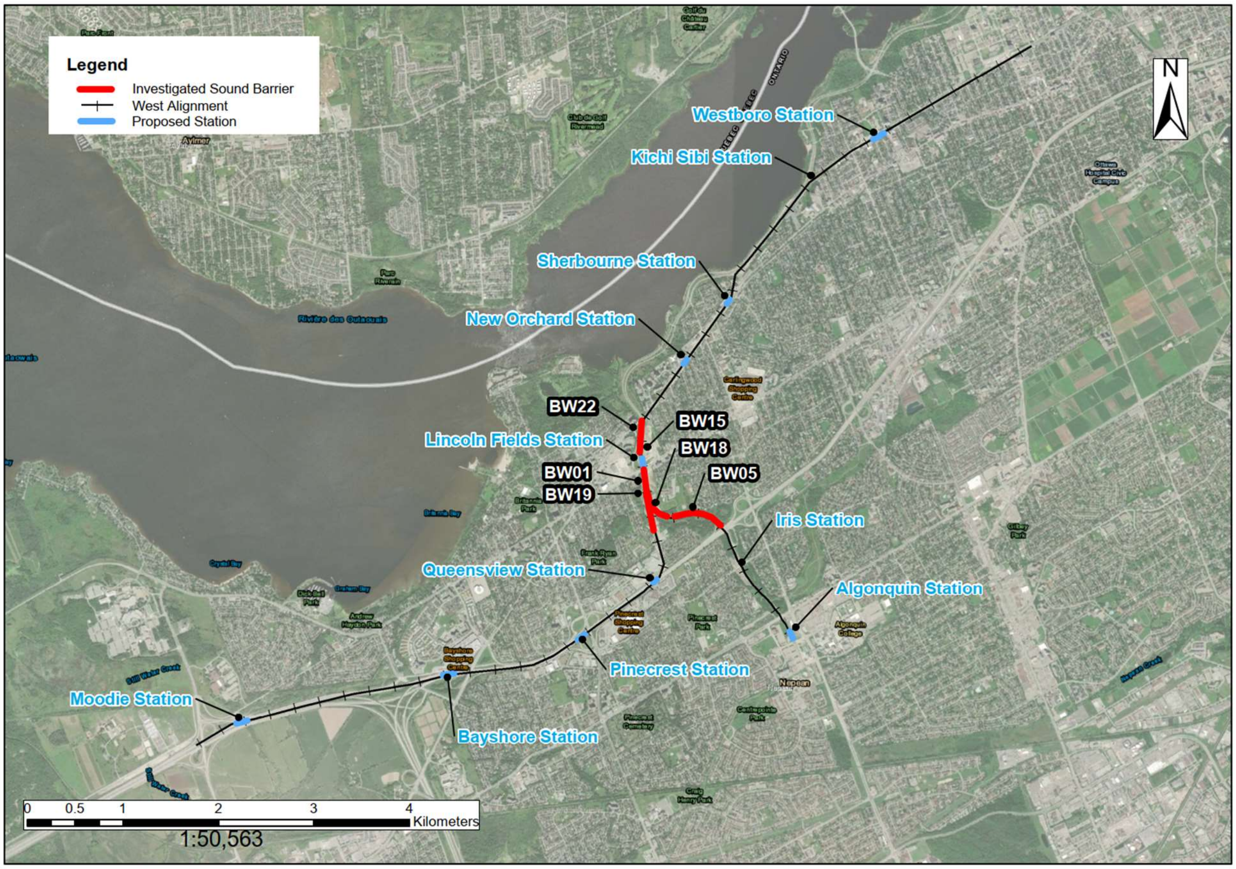
Representative Receptor ID	Existing [A]		Build (All Sources)						Future Leq (16hr) Evaluation		Barrier Investigation	Bar ID.
			Roadway		LRV		Overall [B]		> 60 dBA?	[B]-[A]		
	Day (dBA)	Night (dBA)	Day (dBA)	Night (dBA)	Day (dBA)	Night (dBA)	Day (dBA)	Night (dBA)				
W_RR_29	57	50	58	50	55	50	**60**	53	N	3		Not Modelled
W_RR_30	56	49	57	48	59	54	**61**	55	Y	5	✓	BW22
W_RR_31	54	47	55	46	57	52	**59**	53	N	5	✓	BW22
W_RR_32	54	47	54	45	56	51	**58**	52	N	4		BW22
W_RR_33	56	49	58	49	60	55	**62**	56	Y	6	✓	BW19
W_RR_34	51	43	53	47	59	53	**60**	54	N	9	✓	BW19
W_RR_35	52	44	55	44	61	54	**62**	54	Y	10	✓	BW19
W_RR_36	57	49	57	49	63	58	**64**	58	Y	7	✓	BW19
W_RR_37	53	46	55	50	61	56	**62**	57	Y	9	✓	BW15
W_RR_38	50	42	49	42	58	53	**58**	53	N	8	✓	BW15
W_RR_39	56	48	58	52	68	63	**68**	63	Y	12	✓	BW01
W_RR_40	53	45	60	48	66	60	**67**	60	Y	14	✓	BW01
W_RR_41	57	50	56	50	62	56	**63**	57	Y	6	✓	BW18
W_RR_42	56	49	57	50	59	52	**61**	54	Y	5	✓	BW18
W_RR_48	61	53	61	54	55	48	**62**	55	Y	1	✓	BW05
W_RR_54	52	45	49	47	55	49	**56**	51	N	4		Not Modelled

8.0 MITIGATION MEASURES

8.1 Barrier Investigation

As documented in Table 7-2, exceedances at receivers (beyond those explicitly required under the project agreement) were identified. Subsequently, mitigation for each of these receptors was reviewed using the City of Ottawa Environmental Noise Control Guidelines feasibility criteria (as summarized in Table 3-2).

Figure 8 1 identifies the noise barriers additional to Project Agreement requirements investigated in this study. Table 8-1 lists all investigated noise barriers and identifies barriers that achieve the City's feasibility criteria.



Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Figure 8-1: Investigated Acoustic Walls

Table 8-1: Feasibility of Investigated Acoustic Barriers

Barrier ID	Approx. Start	Approx. End	Modelled Length (m)	Modelled Height (m)	No. Rec. Protected	Avg. Reduction (dB)	Cost / Rec.	Feasibility (and reason for non-feasibility, if applicable)
BW01	63+650	63+800	183	4.5	5	6	$90k	**Feasible**
BW05	93+000	93+300	368	5	0	2	N/A	Not Feasible (Tech.)
BW15	64+100	64+400	295	3	10	9	$49k	**Feasible**
BW18	83+400	83+400	277	5	0	2	N/A	Not Feasible (Tech.)
BW19	43+100	43+700	663	5	0	3	N/A	Not Feasible (Tech.)
BW22	43+900	44+300	411	5	0	3	N/A	Not Feasible (Tech.)

As noted in Table 3-2 and the City of Ottawa Environmental Noise Control Guidelines, barriers achieving an average 6 dB of mitigation are deemed technically feasible.

As noted in Table 3-2, a noise barrier is deemed economically feasible if it costs $100,000 or less per protected receiver. This cost is calculated based on noise barrier surface area multiplied by a cost of $550 per m2, divided by the number of protected receivers.

Based on the assessment presented in Table 8 1, Barrier BW01 achieves the feasibility criteria.

Barrier BW15 achieves all three of the City's feasibility criteria. However, because the barrier would be positioned north of Lincoln Fields station alongside the guideway, extensive tree removals may be required on NCC lands. Furthermore, the barrier would conflict with an existing multi-use path.

9.0 CONCLUSIONS

9.1 Background Noise Validation

There is a good level of confidence that the model is capable of accurately predicting future noise levels arising from the upgraded road and new rail activities. Furthermore, the model results can be relied upon to verify the feasibility of the barriers proposed to mitigate noise levels for areas of interest within the surrounding community.

9.3 Operational noise – LRT and Road Activity

Exceedances at representative receivers were identified warranting the investigation of additional noise barriers from the Project Agreement requirements. Noise barriers covering these flagged representative receptors were evaluated in accordance with the City's feasibility criteria. Two barriers (BW01 and BW15) achieved the City's feasibility criteria.

These barriers are summarized below in Table 9-1. The barrier layouts are shown in Figure 9-1.

Table 9-1: Acoustic Barriers that meet Technical, Administrative, and Economic Feasibility

Barrier ID	Approx. Start	Approx. End	Modelled Length (m)	Height (m)	No. Rec. Protected	Avg Reduction (dB)	Cost / Rec
BW01	63+650	63+800	183	4.5	5	6	$90k
BW15	64+100	64+400	295	3	10	9	$49k

Figure 9-1: Acoustic Barriers that meet Technical, Administrative, and Economic Feasibility or must be constructed as per the project agreement

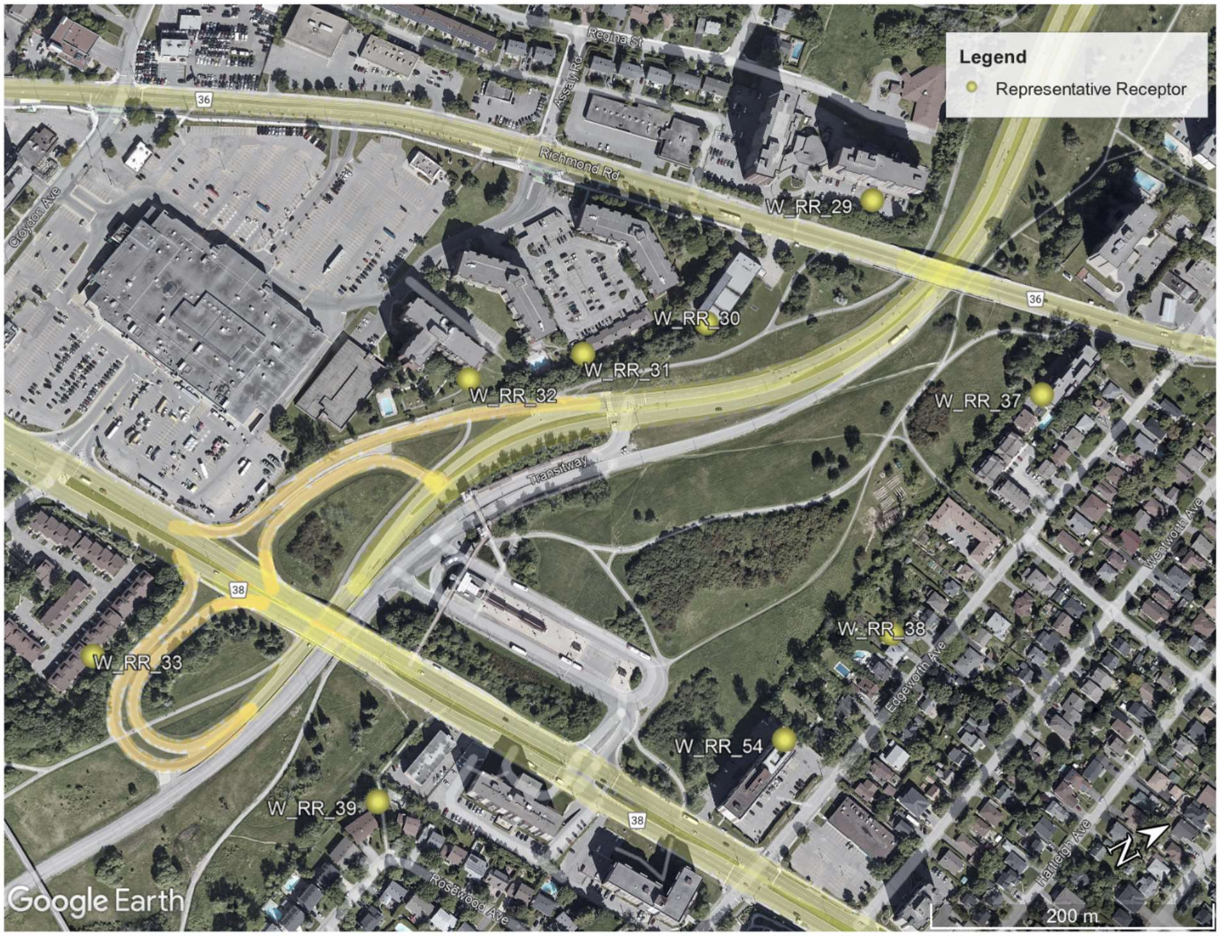
10.0 RECOMMENDATIONS

No recommendations were provided for noise mitigation in the Connaught Park area.

Further advice is required from the City of Ottawa, as follows:

- Direction (via Variation Enquiry) whether the City of Ottawa wishes to proceed with Barriers (BW01 and BW15).
- If the City does wish to proceed with BW15, further consultations with both the City and NCC are recommended to address impacts on the existing multi-use path and mandatory extensive tree removals.

APPENDIX A - LOCATIONS OF THE REPRESENTATIVE NOISE RECEPTORS




Legend
Representative Receptor
W_RR_33
W_RR_34
W_RR_35
W_RR_39
W_RR_40
Transitway
Rosewood Ave
Georgina Dr
Connaught Ave
Tavistock Rd
Norice Ave
38
Google Earth
200 m
N

Legend
Representative Receptor
W_RR_48
W_RR_40
W_RR_42
W_RR_41
W_RR_35
W_RR_36
Transitway
Queensway
Hopkins Rd
Hanlon Ave
Roman Ave
Connaught Ave
Google Earth
300 m

APPENDIX B - MODEL INPUTS

Table 10-1: Road Traffic Inputs

Road Name	Current Traffic Counts (Hourly)		Future Traffic Counts – With project (Hourly)		% of Heavy Vehicles		Speed Limit (km/h)
	Day	Night	Day	Night	Day	Night	
Queensway 416 to Richmond E	8257	1436	10327	1796	8.5	8.5	100
Queensway 416 to Richmond W	8257	1436	10327	1796	8.5	8.5	100

Table 10-2: Rail Inputs

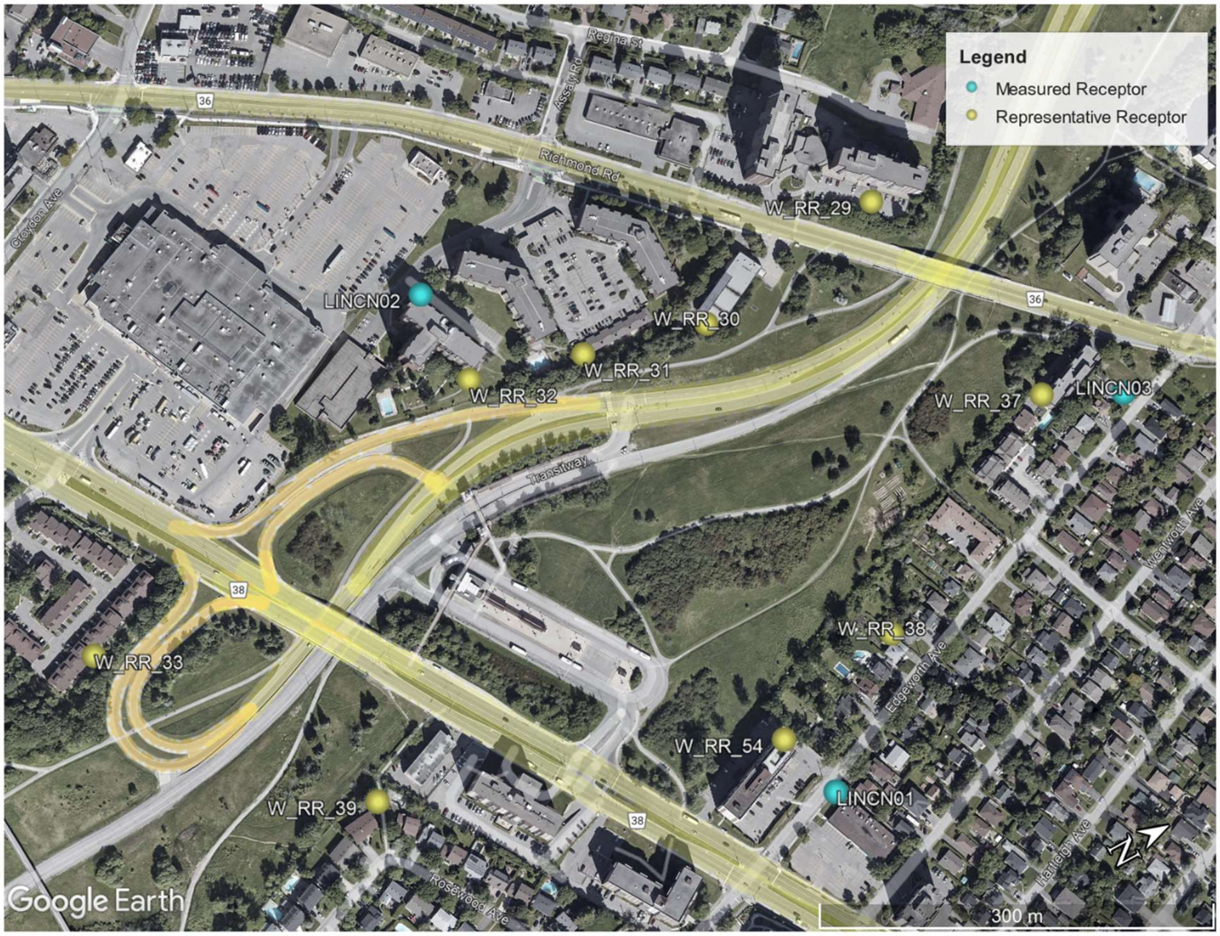
Rail Segment	Traffic Volume		Train Length (m)	Speed Limit (km/h)
	Day	Night		
All Lines	318	63	107	100

APPENDIX C - TRACK CURVE CHAINAGE

South of Woodroffe High School
Chainage 93+446.15 to 93+727.53, 83+448.7 to 83+741.04:

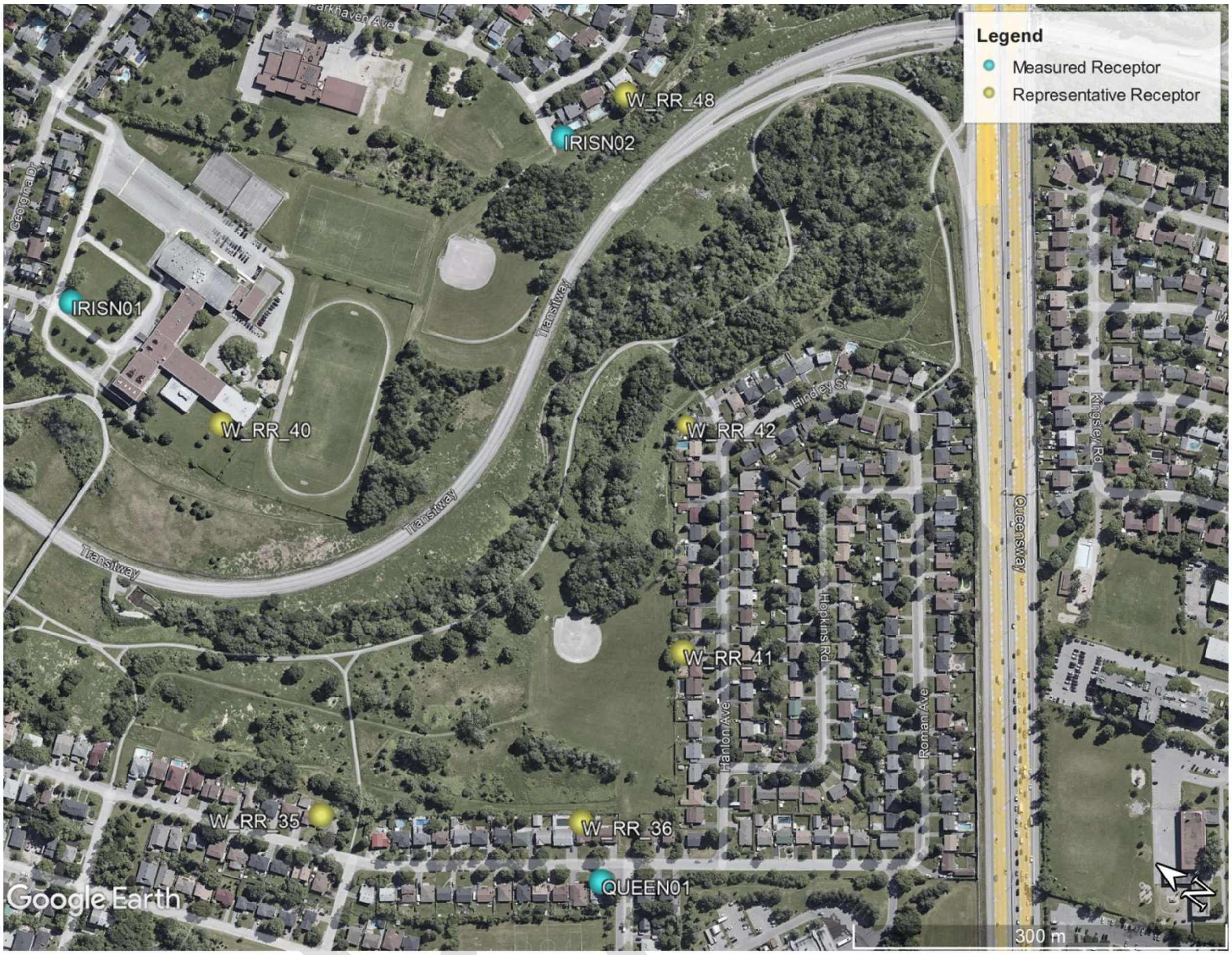
South of OC Transpo Yard
Chainage 62+658.74 to 62.834.38, 42+656.83 to 42+828.15:

APPENDIX D - MEASURED RECEPTORS



Legend
Measured Receptor
Representative Receptor
W_RR_33
W_RR_34
W_RR_39
W_RR_35
W_RR_40
IRISN01
Transitway
Rosewood Ave
Georgina Dr
38
Google Earth
200 m


Legend
Measured Receptor
Representative Receptor
W_RR_33
W_RR_34
CARLN01
Richmond Rd
Elmhurst St
Google Earth
200 m
N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Representative Receptor
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IRISN02
IRISN01
W_RR_40
W_RR_42
W_RR_41
W_RR_35
W_RR_36
QUEEN01
Transitway
Queensway
Hopkins Rd
Hanlon Ave
Roman Ave
Hindley St
Kingsley Rd
Google Earth
300 m