2021-10-06

Thomas Blais, A.Sc.T.
Senior Geographic Information Systems Technologist
J.L. Richards & Associates Limited
700 - 1565 Carling Avenue, Ottawa, ON K1Z 8R1
Tel: 343-804-5347
tblais@jlrichards.ca

J.L. Richards& Associates – 535 Chapel Street Apartment Building
Stationary Noise Impact Study

Dear Thomas,

This report assesses the stationary noise impact from the mechanical equipment located on the roof of the new 3rd floor addition to the apartment building at 535 Chapel Street in Ottawa, Ontario to noise sensitive buildings in the surrounding area. The noise impact from mechanical equipment must not exceed the City of Ottawa Noise Bylaw limit of 50 dBA during the day and the City of Ottawa Environmental Noise Control Guidelines (ENCG) limit of 45 dBA at night. The ENCG references the Ontario Ministry of Environment NPC-300 Guidelines.

This report is based on:

- Pre-Application Consultation drawings received September 21, 2021
- Mechanical equipment and sound data received September 21, 2021

From the above information, we have constructed a 3D model to predict sound pressure levels at the locations of nearby residences resulting from the mechanical equipment at the site at 535 Chapel St., which is near several residential buildings that are approximately the same height. It has been determined that provided that the barrier conditions described in Section 5.1 are met, both daytime and nighttime limits for the City of Ottawa Environmental Noise Control Guidelines will be met and the current layout and equipment selections will be acceptable in regards to noise impact to the surrounding environment and noise sensitive points of reception.

Should you have any questions regarding this report, please do not hesitate to contact us.

Sincerely,

Patrick Richard, M.Sc.E.
Acoustic Consultant

Contents

1.0 Introduction & Site Description

State of the Art Acoustik Inc. has been commissioned to complete a noise impact study on the surrounding area from outdoor mechanical equipment located at 535 Chapel St. in Ottawa, Ontario. The building is an existing two storey building, to which a third storey is being added and two rooftop units will be added onto the roof. The building is approximately 10.3m and is located in a mixed use area however the nearest noise sensitive buildings are low-rise residential buildings, including single homes, apartment buildings and a small strip mall. We have analyzed several nearby noise sensitive points of reception where noise from the new rooftop units may potentially affect these buildings.

There are two significant mechanical noise sources that will affect the surrounding area which have been identified as rooftop units (RTUs).

1.1 Scaled Area Location Plan

Figure 1.1 and 1.2 below show the location of the existing building at 535 Chapel St., including the site plan and surrounding area, respectively. As can be seen in Figure 1.2, adjacent noise sensitive buildings are mainly residential houses and buildings in each direction of the proposed development. The proposed addition to the two storey existing building will be within the same footprint of the existing building. See Figure 1.3 for the 3D view of the proposed addition.

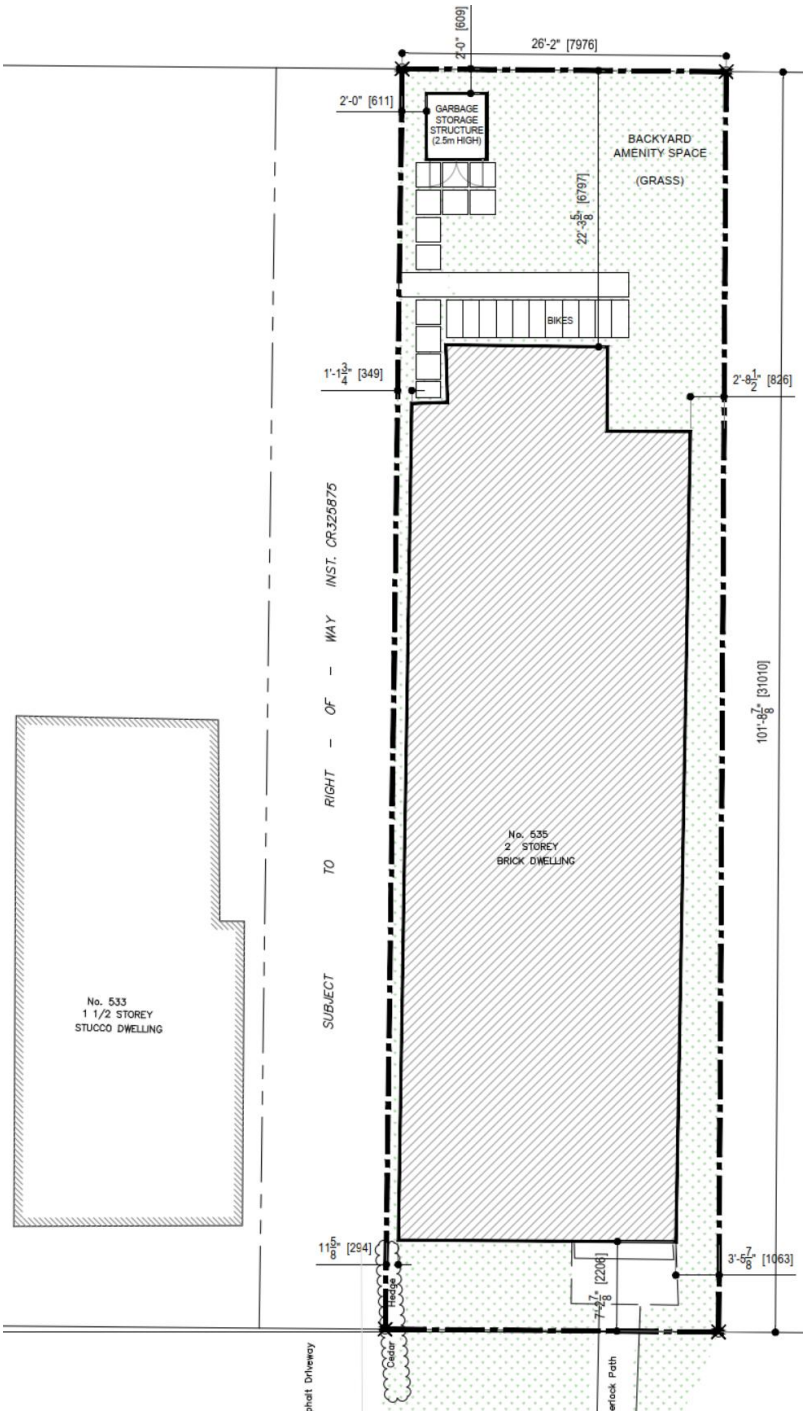

Figure 1.1 – Site plan of 535 Chapel St.

Figure 1.2 – Location of apartment building at 535 Chapel St. and surrounding area.

Figure 1.3 – 3D view showing addition of the 3rd floor at 535 Chapel St.

1.2 Equipment Site Plan & Operation Hours

The noise sources which are being considered for this assessment of the mechanical noise to nearby residences include two rooftop units, which are to be located outside on the roof above the new 3rd floor addition. Although it may not be the case, this equipment is assumed to operate 24 hours a day, 7 days a week and the worst case scenario of both rooftop units in operation at once must be accounted for.

It has been indicated by J.L. Richards & Associates that the rooftop units will be approximately centrally located on the roof and our model has taken this into account.

1.3 City of Ottawa Noise Bylaw and MOECP NPC-300

The City of Ottawa Noise Bylaw and ENCG have the same limit for daytime (7:00am-19:00pm) permissible Sound Pressure Level (SPL) at a noise sensitive location in a Class 1 area of 50 dBA. The Bylaw is to be used in conjunction with the City of Ottawa Environmental Noise Control Guidelines (ENCG), which are based on the Ministry of Environment, Conservation and Parks NPC-300 Noise Control Guidelines. The City of Ottawa ENCG requires a 45 dBA SPL during the evening (19:00-23:00pm) and at night (23:00pm-7:00am) or ambient noise, whichever is higher. Therefore, when analyzing equipment for environmental noise studies, all non-emergency equipment in operation during the day and at night must meet the ENCG limit of 50 dBA during the day and 45 dBA during the evening and at night. As it is likely that the equipment will be in operation during the day and at night, we must account for the worst case scenario and assume that **45 dBA** at the nearest noise sensitive plane of window (POW) points of reception must be met. In addition, outdoor points of reception, such as outdoor living areas (OLAs) must meet the 50 dBA limit during the day. There is no emergency equipment for this development (i.e. generator) and therefore is not included in this analysis.

For our analysis, the points of receptions are chosen based on the principle of "predictable worst case scenario" for noise impact. This will allow us to calculate the largest noise impact and mitigate it accordingly. These are discussed in more detail in Section 2.2 below.

2.0 Noise Sources & Points of Reception

The following sections describe the noise sources and points of reception included in this report.

2.1 Significant Noise Sources

Table 2.1a below summarizes the types of equipment and sound data used in our evaluation, while table 2.1b presents the sound power level per octave band for the equipment being considered. For this building, the equipment under consideration is two rooftop units (5 tons). The sound power levels for the rooftop units are based on manufacturer data (Lennox), for which we have acquired sound power data for the model being used for this building. The height of each condensing unit source was set at 0.9m for the RTUs, as per the data sheet provided and the noise is emitted mainly from the top of the unit where the fan is located.

Significant Sources	Manufacturer	Model	Quantity	Sound Power Level Used (dBA)
Rooftop Unit	Lennox	KGA060S	2	82

Table 2.1a – Summary of Equipment and Sound Levels in this Analysis

	Octave Band Sound Power Levels (dB)								
Noise Source	**63 Hz**	**125 Hz**	**250 Hz**	**500 Hz**	**1 KHz**	**2 KHz**	**4 KHz**	**8 KHz**	**dBA**
Lennox KGA060S	64	67	72	77	76	73	68	61	82

Table 2.1b – Octave Band Sound Power Levels of Noise Sources.

Cutsheets for RTUs are provided in the Appendix. There are no other significant sources of noise that were considered in this analysis. The locations of each RTU noise source on the roof is as shown in Figure 2.1 below.

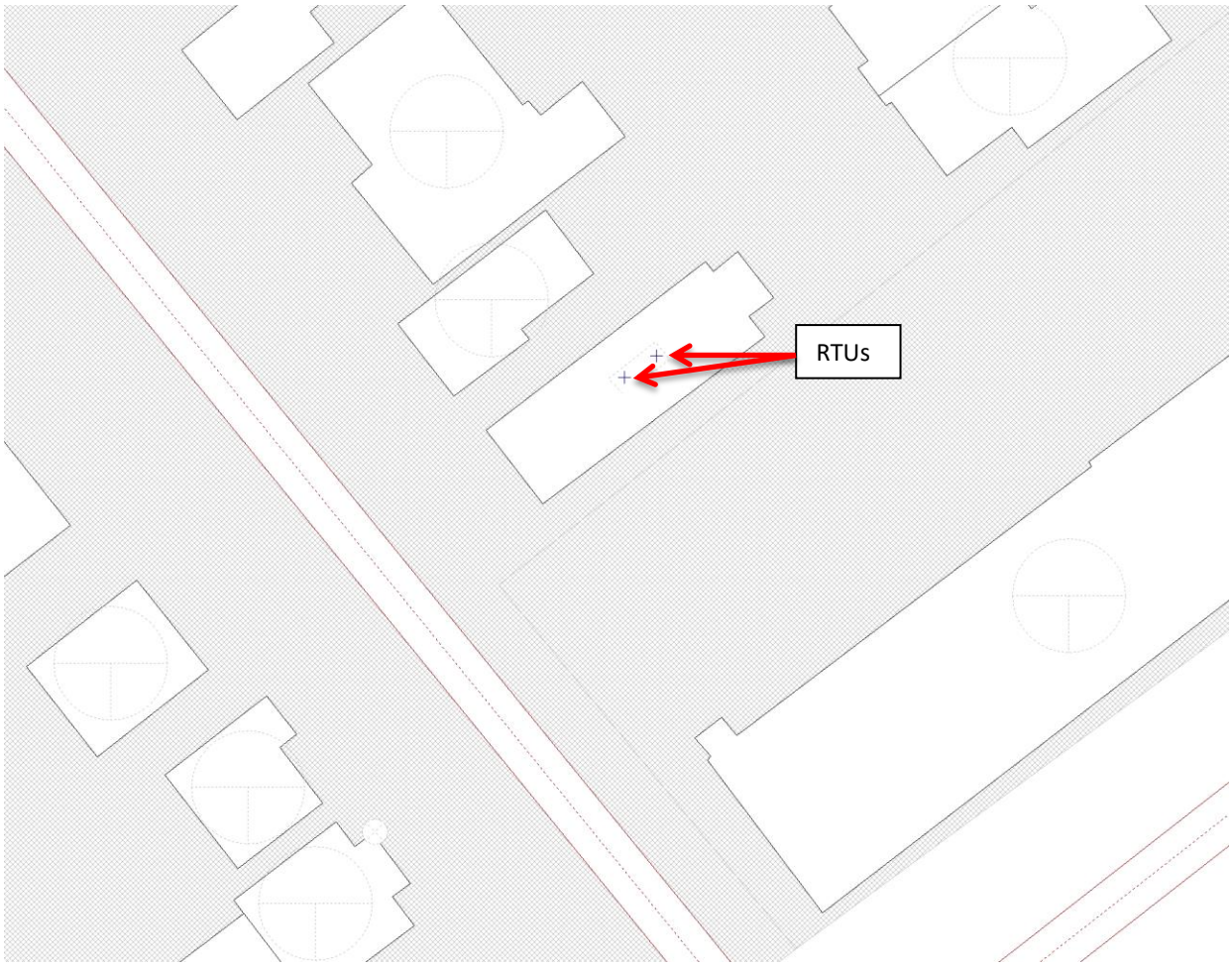

Figure 2.1 – Noise source location for 535 Chapel St.

2.2 Points of Reception

Points of reception (POR) have been selected based on the locations of nearby residences and residential buildings as well as an additional POR at the rear of the strip mall to the south east of the building. The surrounding residential area is mostly low-lying two or three storey houses and apartments. The PORs were chosen based on proximity to 535 Chapel St.; if sound level limits are met at these locations, then noise sensitive buildings further away will also meet sound level limits. These points of reception are illustrated in Figure 2.2.

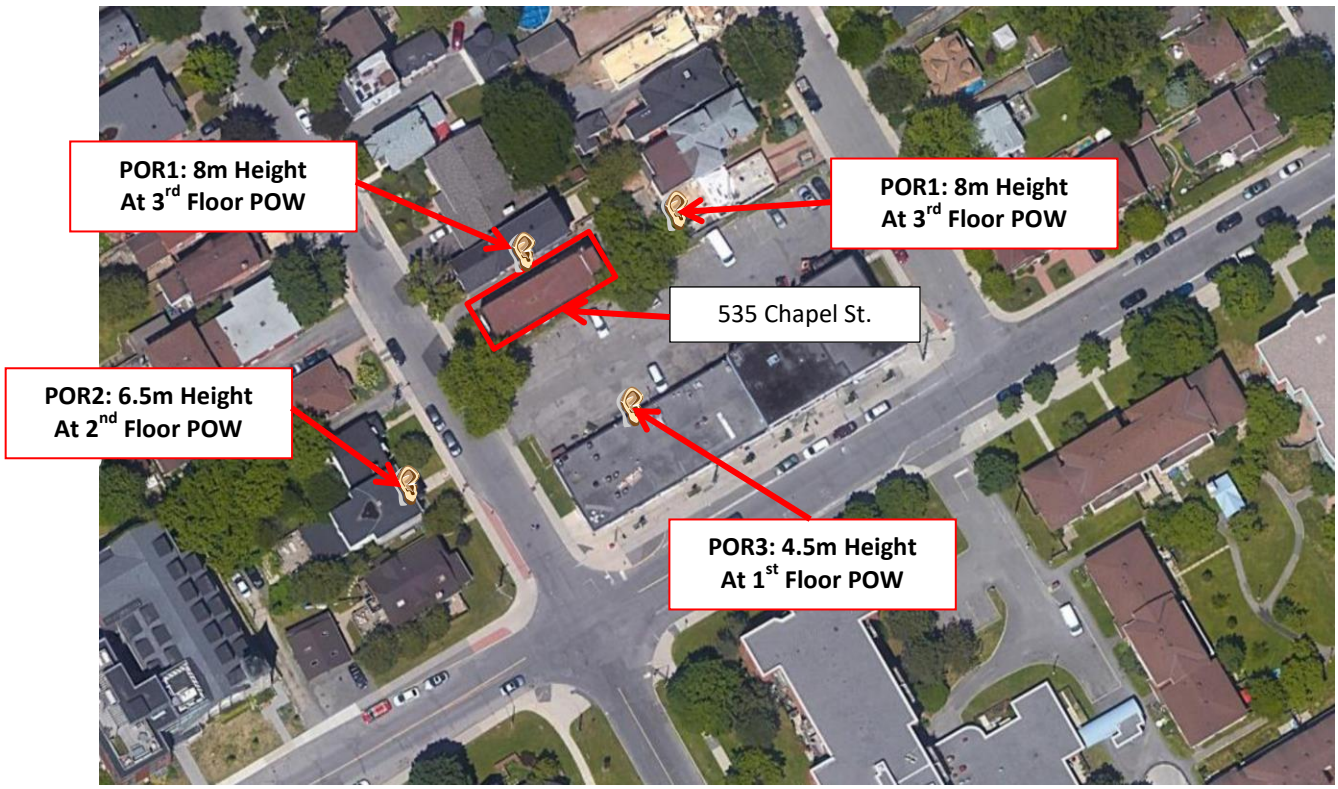

Figure 2.2 – Illustration of Points of Receptions for 535 Chapel St. Noise Study

POR1, POR2 and POR4 are all located at the nearest residences to the northwest, southwest and northeast sides of 535 Chapel St. and will be the closest noise sensitive points to the actual equipment of the roof. POR3 is located at the rear of the commercial strip mall to the southeast. All POR heights have been chosen so that they are the most noise sensitive and the location where noise from rooftop equipment at 535 Chapel St. will have the most impact. For POR1, the third storey plane of window height of 8m is chosen; for POR2 the plane of window height of 6.5m is chosen; for POR3, the first storey height of 5m is chosen; and for POR4, the third storey height of 8m was chosen. Heights were chosen based on approximate total heights of the surrounding buildings.

3.0 Methodology Used in Noise Impact Calculation

The following sections describe the methodology and software used to model the sound pressure levels at the points of reception due to the noise sources while taking into account parameters such as source levels, distance, topography, barriers and building geometry.

3.1 Procedure Used to Assess Noise Impact at Each Point of Reception

This environmental noise analysis was done using an environmental noise modeling software called CadnaA which references ISO 9613. CadnaA predicts environmental noise through calculations based on a 3D model which uses geometrical, landscape and topography data, combined with details of the proposed construction and the noise source power levels.

We created a 3D rendering of the neighbourhood around the new storage building development and placed the noise sources in the model at the appropriate locations and then and applied the sound power levels described in this report. The colours on the ground and building represent the sound pressure level in that area. Sound power levels per octave band were entered into the CadnaA at the source's location and the resulting sound pressure levels were calculated at the points of reception.

3.2 Other Parameters/Assumptions Used in Calculations

The following chart describes the parameters used in the CadnaA model:

Parameter	Value/Condition
Ground Absorption	Default value of 0
Building Reflections	On
Temperature (°C)	10
Relative Humidity (%)	70

Table 3.1 – Parameters used in CadnaA modeling

4.0 Acoustic Assessment Summary

This section summarizes the CadnaA noise mapping results. Section 4.1 below illustrates the steady state sound pressure levels generated by all the noise sources with the currently selected equipment described above for daytime and nighttime operations.

4.1 Acoustic Assessment Summary –Daytime/Evening/Nighttime Operations

Figure 4.1 shows the shows the noise grid prediction at 11 m, the total approximate height of the building, and the sound pressure levels predicted the PORs with both RTUs operating. The numbered labels on each of the surrounding buildings show the highest value of sound pressure level (SPL) from the entire perimeter of the building. The City of Ottawa ENCG nighttime limit of 45 dBA is the most stringent limit that must be met, as we are analyzing the worst case scenario of both RTUs in operation at night. Note that at POR3, we are accounting for daytime noise levels only (50 dBA limit) as these are commercial spaces. Results at each POR have been also been included in Table 4.1.

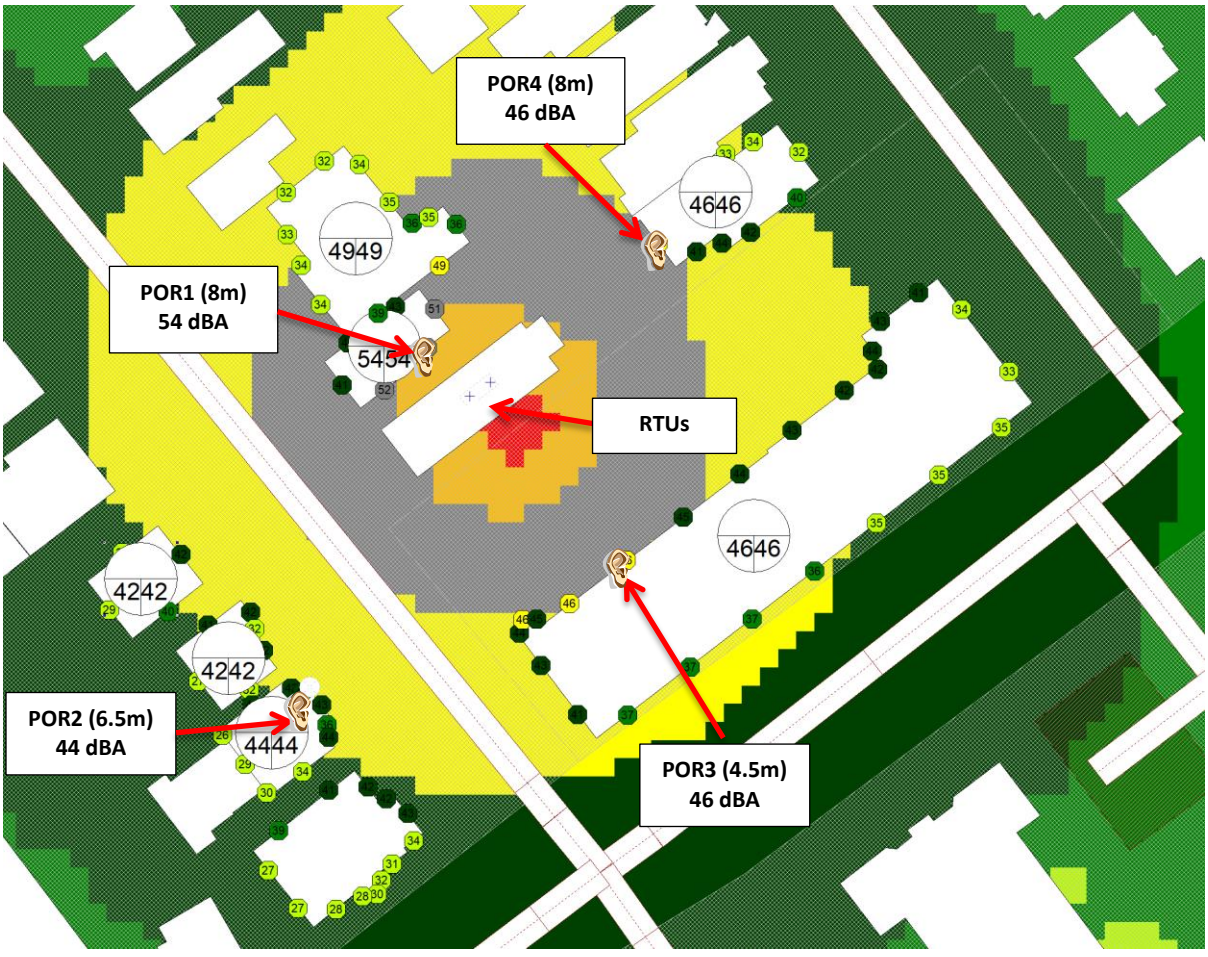

Figure 4.1 – Noise map at 11m and POR levels with current equipment selections for daytime and nighttime conditions.

Point of Reception	Daytime/Nighttime Limit (dBA)	Calculated Sound Pressure Levels At POR (dBA)
POR1	45	54
POR2	45	44
POR3	50	46
POR4	45	46

Table 4.1 – Summary of calculated sound pressure levels at each POR indicated in Section 2.2.

As noted in Table 4.1, sound pressure levels at POR1 and POR4 are above City of Ottawa and MOECP nighttime limit (45 dBA), which is the most stringent limit that must be met between the MOECP, City of Ottawa Environmental Noise Control Guidelines and City of Ottawa Bylaw. Sound pressure levels at POR2 and POR3 are met with the current design and equipment selection. Therefore, mitigation measures will be required.

5.0 Mitigation Recommendations

Below we have provided the necessary mitigation measures so that sound level limits at neighbouring properties to 535 Chapel St. are met.

5.1 Mitigation Summary –Daytime/Evening/Nighttime Operations

The most effective method for mitigating noise from the RTUs on the roof of 535 Chapel St. is to install a barrier around the RTUs. It is recommended that a full enclosure is used, so that sound cannot travel around an edge of the barrier and still have a significant effect on the noise sensitive PORs. Figure 5.1 shows the same grid at a height of 4.5m with a 2m high barrier around the RTUs and Table 5.1 gives the sound levels at each POR.

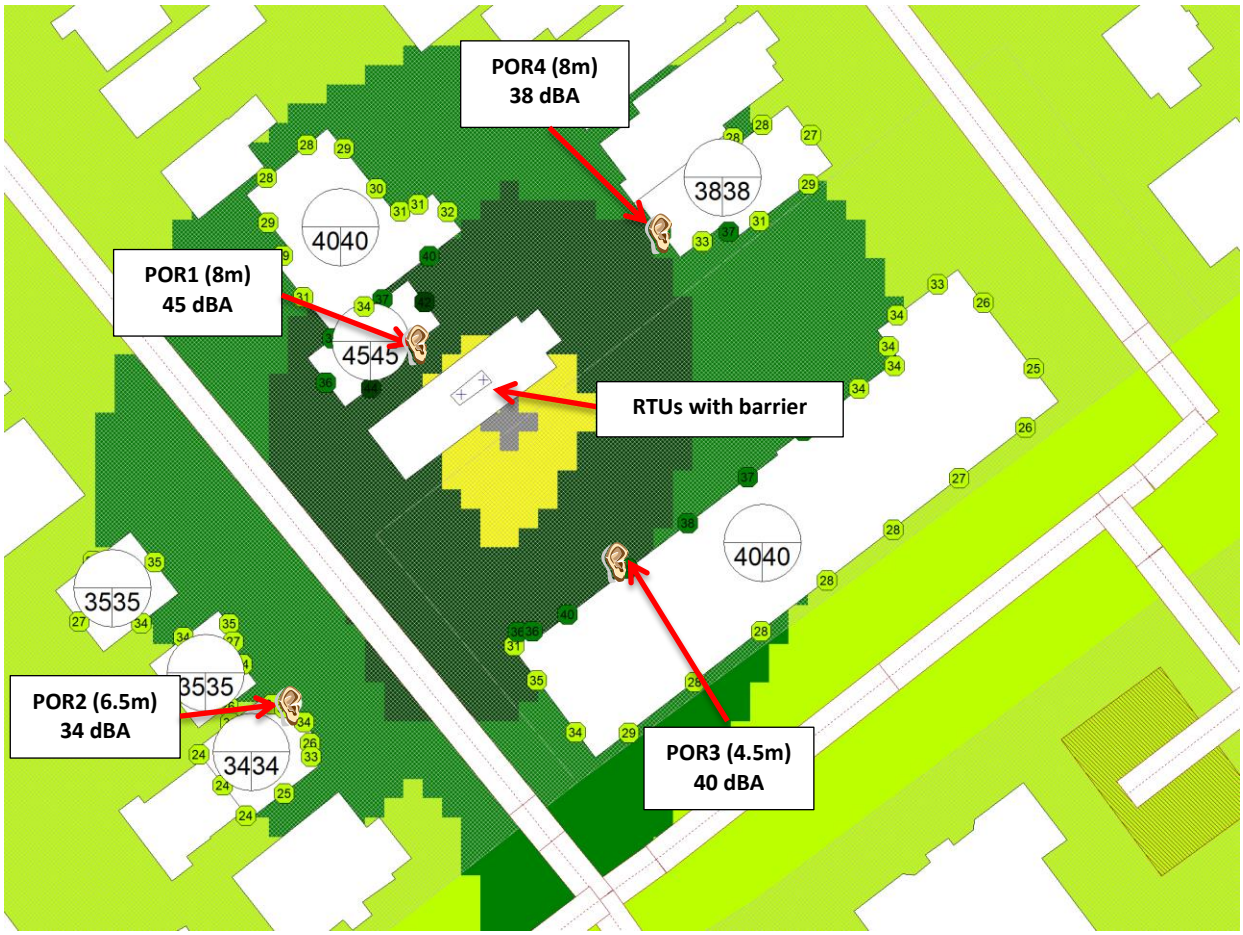

Figure 4.2 – Noise map at 11m and POR levels with current equipment selections for daytime and nighttime conditions with 2m barrier around RTUs.

In comparison to Table 4.1, we can see that sound levels at each POR have decreased or remained the same at all points and are now below the required sound level limits.

Point of Reception	Daytime/Nighttime Limit (dBA)	Calculated Sound Pressure Levels At POR (dBA)
POR 1	45	45
POR 2	45	34
POR 3	50	40
POR 4	45	38

Table 4.2 – Summary of calculated sound pressure levels at each POR indicated in Section 2.2 with 2m barrier surrounding RTUs.

As noted above, it is recommended that the barrier surrounding the RTUs be at least 2m in height and is to be solid barriers with no gaps, except for a gap less than 150mm at the bottom for drainage if required. This means that the barrier or screen surrounding the RTUs cannot be acoustically

transparent and must block a significant amount of the noise, for which we recommend a barrier material or assembly with a surface density of at least 20 kg/m^2. Surface density is calculated as:

Barrier Material Density (kg/m^3) x Thickness of Barrier (m) = Surface Density (kg/m^2)

6.0 Conclusion

We have reviewed the sound pressure levels in our 3D acoustical model of the new proposed 3rd floor addition to the apartment building located at 535 Chapel St. and have found that given the current mechanical configuration and equipment selections, the noise levels exceeds the 45 dBA nighttime limit at POR1 and POR4 at neighbouring properties. In order to reduce sound pressure levels, a barrier surrounding the rooftop units are to be a minimum of 2m. Conditions for barriers surrounding the RTUs in Section 5.1 must also be met. With the mitigation measures described in Section 5.2, sound pressure level limits at each POR will be met.

Should you have any comments or questions regarding this report, please do not hesitate to communicate with us.

Sincerely,

Patrick Richard, M.Sc.E.
Acoustic Consultant

Approved by:

Don Buchan, P.Eng.
Principal
Buchan Lawton Parent Ltd.

APPENDIX
Equipment Sound Data

SPECIFICATIONS - BELT DRIVE BLOWER — 3 - 7.5 TON

General Data	**Nominal Tonnage**	**3 Ton**	**4 Ton**	**5 Ton**	**6 Ton**	**7.5 Ton**
	Model No.	**KGA036S4B**	**KGA048S4B**	**KGA060S4B**	**KGA072S4B**	**KGA090S4B**
	Efficiency Type	**Standard**	**Standard**	**Standard**	**Standard**	**Standard**
	Blower Type	Single Speed Belt Drive	Single Speed Belt Drive	Single Speed Belt Drive	Single Speed Belt Drive	Single Speed Belt Drive
Cooling Performance	Gross Cooling Capacity - Btuh	37,500	50,000	61,800	72,500	92,000
	Net Cooling Capacity - Btuh	[1] 36,000	[1] 48,000	[1] 59,000	[2] 69,000	[2] 90,000
	AHRI Rated Air Flow - cfm	1200	1600	1800	2450	2430
	[3] Sound Rating Number (SRN) (dBA)	75	75	82	79	79
	Total Unit Power - kW	3.4	4.4	5.3	6.1	8.2
	SEER (Btuh/Watt)	[1] 13.0	[1] 13.0	[1] 13.0	- - -	- - -
	IEER (Btuh/Watt)	- - -	- - -	- - -	[2] 12.3	[2] 11.2
	EER (Btuh/Watt)	[1] 10.7	[1] 11.0	[1] 11.2	[2] 11.2	[2] 11.0
Refrigerant	Type	R-410A	R-410A	R-410A	R-410A	R-410A
	Charge Furnished	7 lbs. 12 oz.	8 lbs. 12 oz.	12 lbs. 8 oz.	7 lbs. 1 oz.	8 lbs. 8 oz.
Gas Heating Options - See page 15		**Standard (1 or 2 Stage) or Medium (1 or 2 Stage)**	**Standard (1 or 2 Stage), Medium (1 or 2 Stage) or High (1 or 2 Stage)**			**Medium (1 or 2 Stage) or High (1 or 2 Stage)**
Compressor Type (one per unit)		Scroll	Scroll	Scroll	Scroll	Scroll
Outdoor Coil	Net face area - sq. ft.	15.6	15.6	15.6	17.8	24.2
	Tube diameter - in.	3/8	3/8	3/8	- - -	- - -
	Number of rows	1	1.5	2	1	1
	Fins / inch	20	20	20	23	23
Outdoor Coil Fan	Motor - (No.) HP	(1) 1/4	(1) 1/4	(1) 1/3	(1) 1/3	(1) 1/2
	Motor rpm	825	825	1075	1075	1075
	Total Motor Input - watts	250	250	370	370	520
	Diameter - (No.) in. / No. of blades	(1) 24 - 3	(1) 24 - 3	(1) 24 - 3	(1) 24 - 3	(1) 24 - 4
	Total air volume - cfm	3700	3500	4300	4700	5300
Indoor Coil	Net face area - sq. ft.	7.8	7.8	7.8	9.7	9.7
	Tube diameter - in.	3/8	3/8	3/8	3/8	3/8
	Number of rows	3	3	4	4	4
	Fins per inch	14	14	14	14	14
	Drain Connection (no.) and size - in.	(1) 1 NPT	(1) 1 NPT	(1) 1 NPT	(1) 1 NPT	(1) 1 NPT
	Expansion device type	Refrigerant Metering Orifice (RFC)				
[4] **Indoor Blower & Drive Selection**	Nominal Motor HP	1 hp, 2 hp	1 hp, 2 hp	1 hp, 2 hp	1 hp, 2 hp	1 hp
	Maximum Usable Motor HP	1.15 hp, 2.3 hp	1.15 hp, 2.3 hp	1.15 hp, 2.3 hp	1.15 hp, 2.3 hp	1.15 hp
	Available Drive Kits	A01 673 - 1010 rpm A05 897 - 1346 rpm	A02 745 - 1117 rpm A06 1071 - 1429 rpm	A03 833 - 1250 rpm A07 1212 - 1548 rpm	A04 968 - 1340 rpm A08 1193 - 1591 rpm	AA01 522 - 784 rpm
	Nominal Motor HP	- - -	- - -	- - -	- - -	2 hp
	Maximum Usable Motor HP	- - -	- - -	- - -	- - -	2.3 hp
	Available Drive Kits	- - -	- - -	- - -	- - -	AA02 632 - 875 rpm AA03 798 - 1105 rpm
		- - -	- - -	- - -	- - -	3 hp
		- - -	- - -	- - -	- - -	3.45 hp
		- - -	- - -	- - -	- - -	AA04 921 - 1228 rpm
	Wheel nominal diameter x width - in.	(1) 10 x 10	(1) 10 x 10	(1) 10 x 10	(1) 10 x 10	(1) 15 x 9
Filters	Type	Disposable			Disposable	
	Number and size - in.	(4) 16 x 20 x 2			(4) 20 x 20 x 2	
Electrical Characteristics - 60 Hz		208/230V, 460V & 575V 3 phase	208/230V, 460V & 575V 3 phase	208/230V, 460V & 575V 3 phase	208/230V, 460V & 575V 3 phase	208/230V, 460V & 575V 3 phase

NOTE - Net capacity includes evaporator blower motor heat deduction. Gross capacity does not include evaporator blower motor heat deduction.

[1, 2] AHRI Certified to AHRI Standard [1] 210/240 or [2] 340/360: 95°F outdoor air temperature and 80°F db/67°F wb entering evaporator air; minimum external duct static pressure.

[3] Sound Rating Number (SRN) rated in accordance with test conditions included in ARI Standard 270-95.

[4] Using total air volume and system static pressure requirements determine from blower performance tables rpm and motor hp required. Maximum usable hp of motors furnished are shown. In Canada, nominal motor hp is also maximum usable motor hp output. If motors of comparable hp are used, be sure to keep within the service factor limitations outlined on the motor nameplate.

EXPANDED SOUND DATA

Current Commercial Product Only

PRODUCT SPECIFICATIONS

June 2017
Supersedes May 2017

ENERGENCE® / LANDMARK® / RAIDER® 2 TO 7.5 TONS

	[2] Test Conditions	External Static Pressure in. w.c.	CFM	Octave Linear Band Sound Power Levels dBA, re 10^{-12} Watts, Center Frequency - HZ								[1] Sound Rating Number (dB)
				[3] 63	125	250	500	1000	2000	4000	8000	
Outdoor Sound Level	**ENERGENCE**											
	LCH/LGH036S,048S,036H,048H	- - -	- - -	52	63	66	70	71	68	62	53	75
	LCH/LGH060S,060H,072H,074H	- - -	- - -	64	67	72	77	76	73	68	61	82
	LCH/LGH036U	- - -	- - -	57	60	65	69	68	63	58	51	73
	LCH/LGH048U	- - -	- - -	58	64	67	73	71	66	59	52	76
	LCH/LGH060U	- - -	- - -	52	66	69	74	74	68	62	55	78
	LCH/LGH074U	- - -	- - -	63	67	72	76	76	70	64	58	80
	LANDMARK											
	KCA/KGA/KHA036S,048S	- - -	- - -	52	63	66	70	71	68	62	53	75
	KCA/KGA/KHA060S	- - -	- - -	64	67	72	77	76	73	68	61	82
	KCA/KGA072S,090S	- - -	- - -	62	66	71	74	73	70	65	57	79
	KHA072S	- - -	- - -	64	67	75	78	78	75	68	59	83
	KCB/KGB024S,030S,036S,048S	- - -	- - -	50	61	65	70	67	64	58	49	74
	KCB/KGB060S,074S,072H,074H	- - -	- - -	67	66	71	74	73	70	65	57	79
	KHB024S,030S,036S	- - -	- - -	54	62	67	72	69	66	61	56	75
	KHB048S	- - -	- - -	52	61	67	70	70	68	63	56	75
	KHB060S	- - -	- - -	67	69	72	75	74	70	65	55	80
	KHB074S	- - -	- - -	66	67	75	78	78	75	68	59	83
	KHB/KDB024H	- - -	- - -	57	62	67	70	70	64	57	51	74
	KHB/KDB036H	- - -	- - -	57	62	66	71	69	64	57	51	75
	KHB/KDB048H	- - -	- - -	62	67	68	73	72	68	63	53	77
	KHB/KDB060H	- - -	- - -	58	66	68	70	72	69	63	56	77
	RAIDER											
	ZCA/ZGA036S ZCB/ZGB036S	- - -	- - -	65	66	70	73	72	70	67	60	78
	ZCA/ZGA048S ZCB/ZGB048S	- - -	- - -	62	68	71	75	74	71	68	63	80
	ZCA/ZGA060S	- - -	- - -	65	73	74	78	77	73	69	63	83
	ZCB/ZGB060S	- - -	- - -	56	64	68	72	73	69	67	63	78
	ZCA/ZGA072S ZCB/ZGB074S	- - -	- - -	61	73	76	80	78	73	68	66	84
	ZHA036S, 048S ZHB036S	- - -	- - -	64	66	70	75	73	71	67	60	79
	ZHA060S	- - -	- - -	68	71	74	80	76	73	69	64	83
	ZHB048S	- - -	- - -	54	62	69	73	72	69	65	57	78
	ZHB060S	- - -	- - -	62	70	72	78	75	72	70	66	82
	ZHB072S	- - -	- - -	57	70	77	81	80	76	73	69	86
KCB/KGB/KHB024S,030S with 1/4 hp Direct Drive Blower KHB/KDB024H with 1/3hp Direct Drive Blower												
Supply Air Only		0.25	800	41	47	45	47	46	44	39	33	- - -
		0.50	1150	42	51	54	55	54	54	52	44	- - -
Return Air Only		0.25	800	42	43	38	40	38	37	32	30	- - -
		0.50	1150	43	46	45	46	44	45	40	34	- - -

Note − The octave sound power data does not include tonal corrections.

[1] Sound Rating Number according to AHRI Standard 270-2008.

[2] Indoor tested according to AHRI Standard 260-2001.

[3] 63HZ band is not certified and is usually lower than reported.