2019-01-14

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Merkburn Holdings – 56 Steacie Drive
Traffic Noise Impact and Mechanical Noise Control to the Exterior of the Building

Dear Peter,

This report assesses the environmental noise impact from the mechanical equipment located at the new proposed office building at 56 Steacie Drive in Ottawa, Ontario to other noise sensitive areas 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. In addition, the noise impact on the exterior envelope of the building from a nearby rail line has been calculated in order to determine whether the current exterior assemblies for walls and windows are acceptable.

This report is based on:

- Architectural Drawings received November 07, 2018
- Mechanical Rooftop Mechanical Sound Data and layout received November 20, 2018

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 proposed development at 56 Steacie Drive. It has been determined that noise mitigation measures are required for the RTUs located on the roof of the proposed building. It has also been determined that no changes are required to either the exterior wall or window assemblies proposed in the architectural drawings.

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 by Merkburn Holdings to complete a noise study, including both traffic noise impact on the building and stationary noise impact from the building itself for the new office building development to be located at 56 Steacie Drive, Ottawa, Ontario. It has two floors and is approximately 9 m tall with a stairwell extending a further 3.75 m. It is located in a primarily commercial area and is surrounded other small office buildings to the east, west and north and by by two and three storey residences to the south. The worst case stationary equipment noise impact from the new office building will be to the west at a similarly sized office building, however we have also analyzed other nearby noise sensitive locations.

The traffic noise impact onto the new development is from a nearby rail line, approximately 100 m to the north. This rail line is operated by CN and is not in use very frequently. After many attempts to contact CN and gather data for this rail line and receiving no contact from CN, we have made the necessary assumptions for the speed and frequency of trains along this rail line. This is explained in further detail below.

1.1 Scaled Area Location Plan

Figure 1.1 and 1.2 below shows the location of the new development at 56 Steacie Drive, including the surrounding area and site plan. Figure 1.1 also shows the CN rail line to the north. Adjacent noise sensitive buildings are commercial office buildings and residential houses.

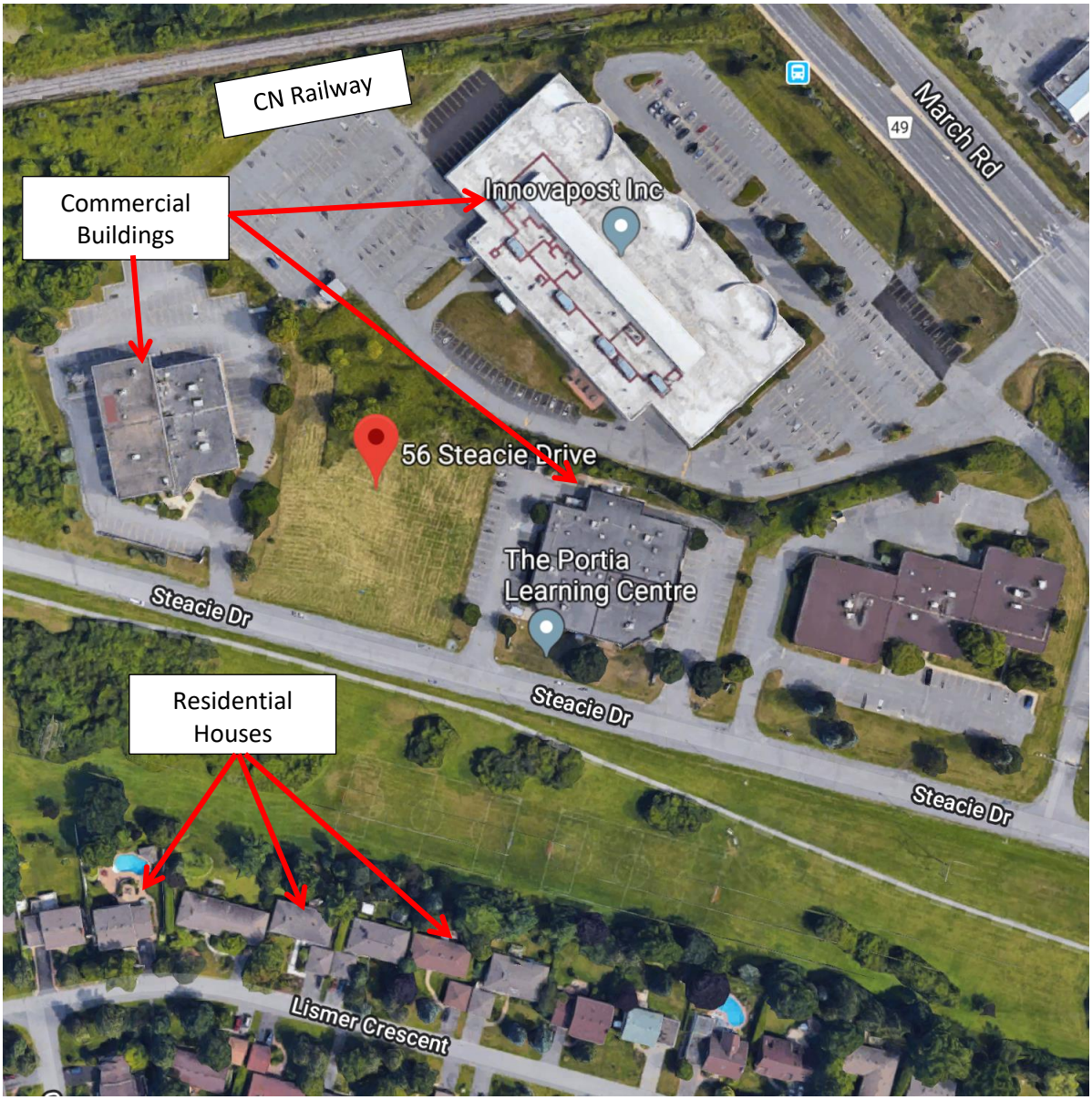


Figure 1.1 – Location of new office building at 56 Steacie Drive and surrounding area.

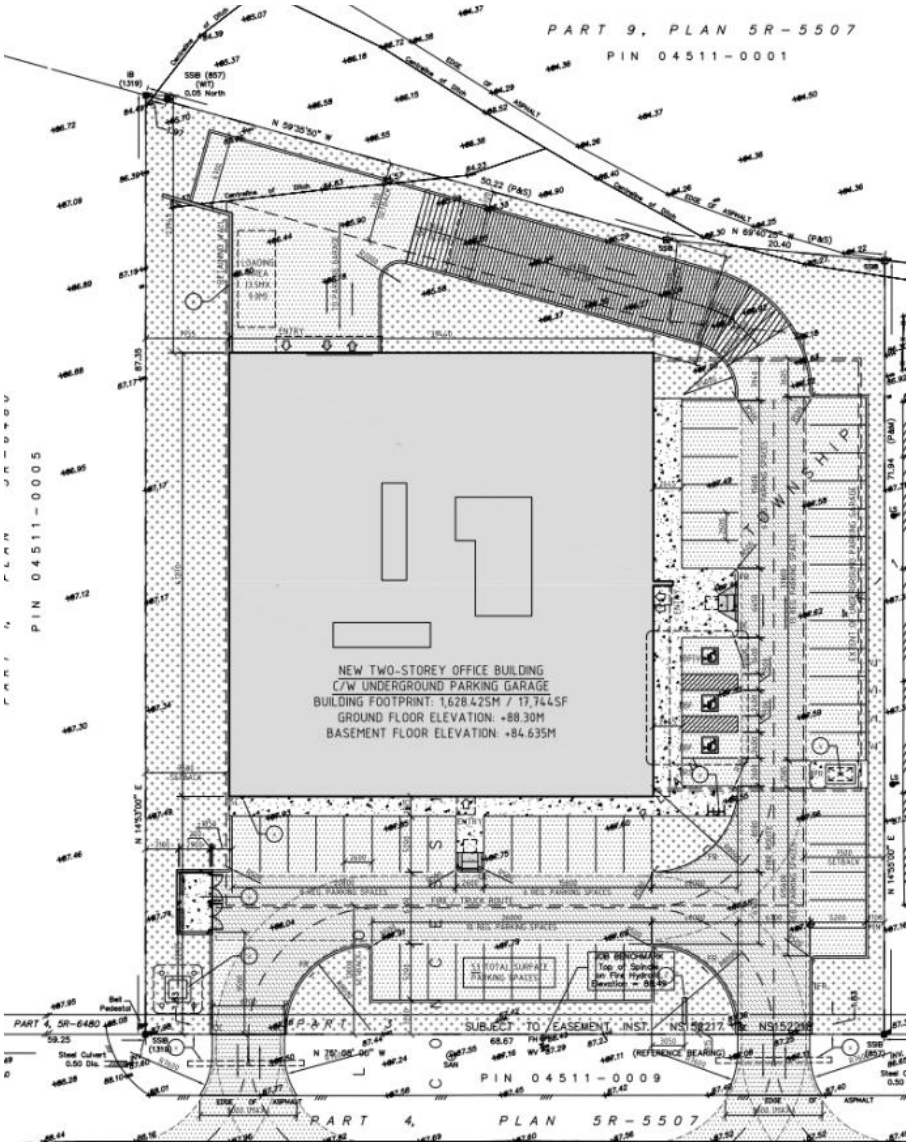


Figure 1.2 – Site plan of 56 Steacie Drive.

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 40 ton rooftop air-handling units, one serving each floor. These units are assumed to operate 24 hours a day, 7 days a week.

Figure 1.3 below shows a hand sketch of the location of the units, as they have been moved from their original locations in order to accommodate the stairwell and mechanical shafts.

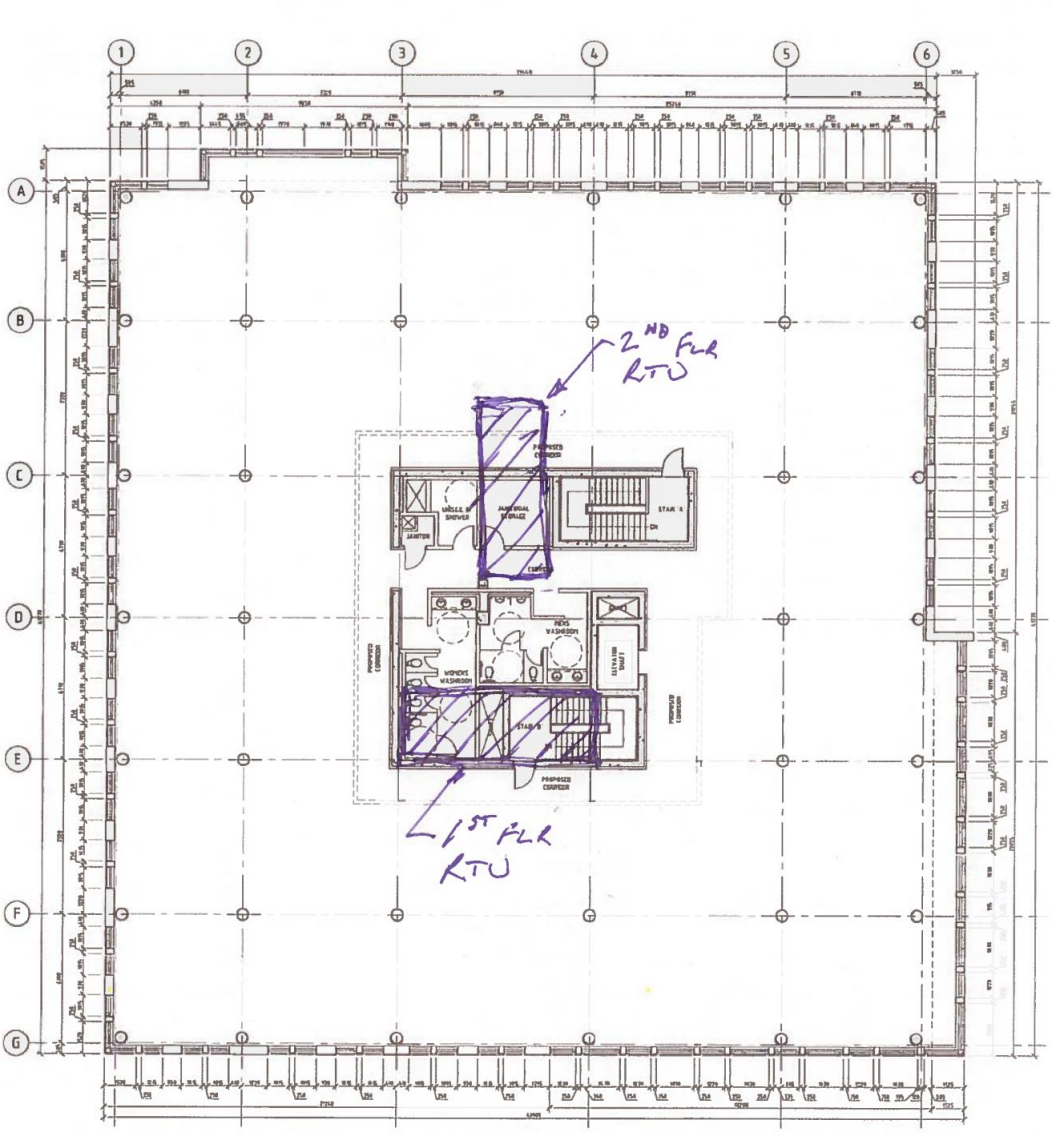


Figure 1.3 – Sketch showing locations of RTUs on rooftop.

1.3 City of Ottawa Noise Bylaw and Ministry of Environment NPC-300

The City of Ottawa Noise Bylaw and ENCG have the same limit for daytime 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 NPC-300 Noise Control Guidelines. The City of Ottawa ENCG requires a 45 dBA SPL at night 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 at night. As the nearest buildings to the new development are commercial office buildings, we have not analyzed these buildings at night, as they will not be occupied during the evening and nighttime hours (11:00pm-7am). We have analyzed the residences to the south during evening hours. 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.

2.0 Noise Sources & Points of Reception

The following sections describe the noise sources and points of reception included in this report. Locations of equipment are given in section 1.2.

2.1 Significant Noise Sources

This report evaluates the following significant types of noise sources. Tables 2.1a summarises the types of equipment and sound data used in our evaluation, while table 2.1b presents the sound power level per octave band for all equipment being considered. For this building, the only equipment under consideration is two rooftop air-handling units. The outdoor noise sound power data has been used to undertake this analysis, as this provides an analysis of the overall noise of the unit. The cut sheets and sound power data was provided by the mechanical engineer.

Significant Sources	Manufacturer	Model	Quantity	Sound Power Level Used (dBA)
RTU-1, RTU-2	Trane	SAHL	2	93 dBA (Outdoor Noise)

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**
RTU-1, RTU-2 Outdoor Noise	98	96	93	91	87	84	81	77	93

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

Cutsheets for equipment evaluated are provided in the Appendix.

2.2 Points of Reception

Points of reception (POR) have been selected based on the locations of nearby residences and planned future developments. The surrounding residential area is mostly low-lying two or three storey houses or townhomes. All three POR's were residential buildings chosen based on proximity to the mechanical equipment of 56 Steacie Drive. These points of reception are illustrated in Figure 2.2.

Figure 2.2 – Illustration of Points of Receptions for 56 Steacie Drive Stationary Noise

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 office 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 operations.

4.1 Acoustic Assessment Summary –Daytime Operations

Figure 4.1 shows the shows the noise grid prediction at 4.5 m and the sound pressure levels predicted at all the PORs with all equipment operating. The City of Ottawa Noise Bylaw and ENCG daytime limit of 50 dBA must be met.

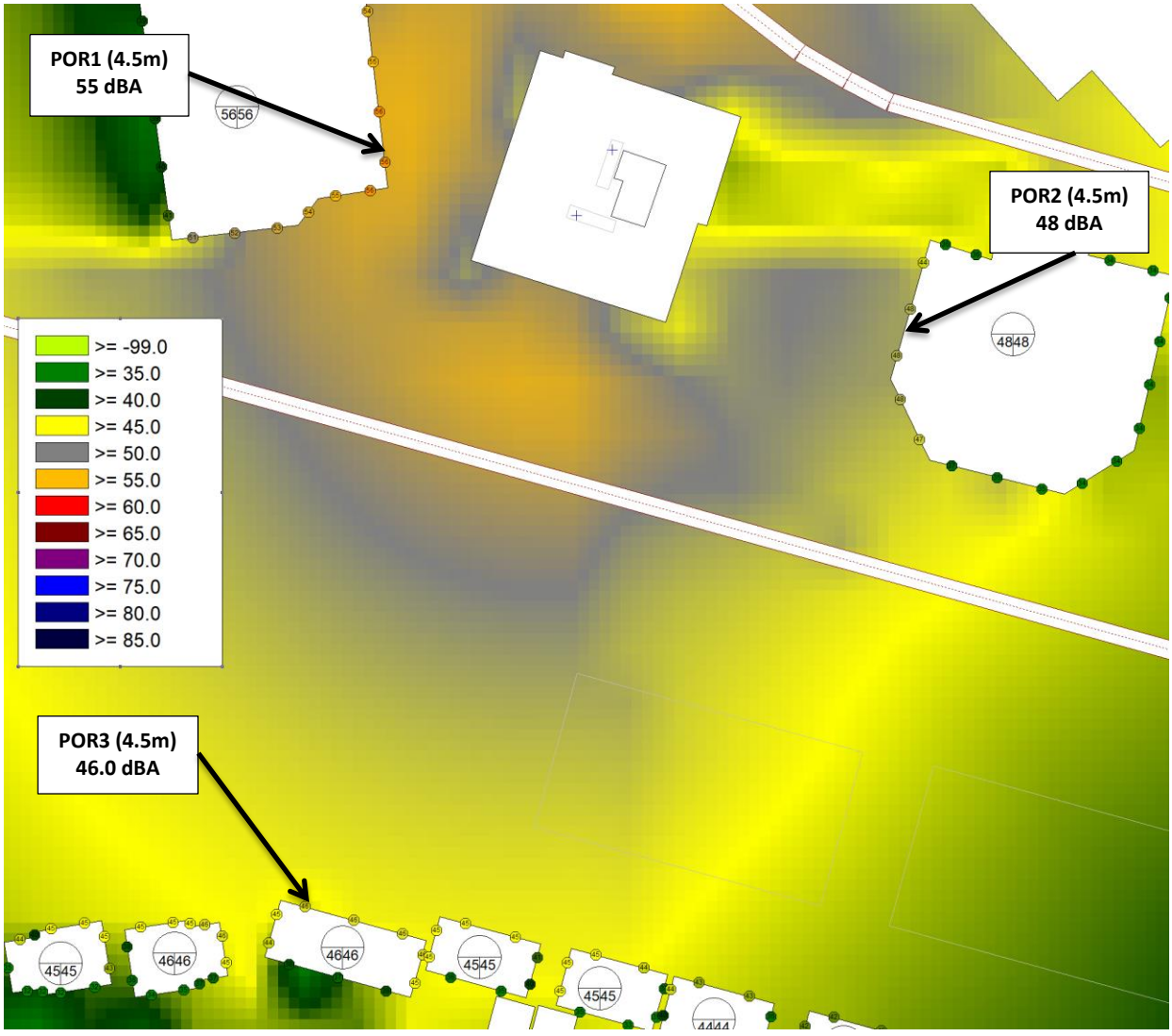


Figure 4.1 – Noise maps at 4.5m with current equipment selections daytime and nighttime conditions.

The numbers shown within the circle on each building in Figure 4.1 represent the highest sound pressure level at the exterior façade of the building. This allows us to easily see where noise from the mechanical equipment affects the nearby buildings the most. Figure 4.1 shows that POR2 and POR3 are under the 50 dBA daytime limit at 48.0 dBA and 46.0 dBA respectively, but POR1 is above the limit at 55 dBA. Therefore measures must be taken to mitigate the sound in order to lower the sound pressure at POR1 during the day. For the residences (POR3), the SPL is calculated to be 46.0 dBA, which is above the 45 dBA ENCG nighttime limit. Therefore, mitigation measures will be required due to these levels as well.

4.2 Acoustic Assessment Summary – Problematic Equipment

For POR1, Figure 4.1 shows the sound pressure level to be 56.0 dBA at approximately the height of the second storey of the building, which is higher than the 50 dBA daytime limit. Both RTUs contribute a similar amount to the overall noise levels at POR1 and therefore noise from each RTU must be mitigated. We have provided mitigation solutions for the RTUs below.

5.0 Noise Mitigation Measures and Assessment

In order to meet the city of Ottawa ENCG daytime limit of 50 dBA at POR1 and the nighttime limit of 45.0 dBA at POR3, noise control measures will need to be implemented for the RTUs.

Option 1 – RTU Selection

The architect and mechanical engineer have determined that selecting quieter RTUs is the most likely solution. In order to reduce the SPL at POR1 to below 50 dBA, the sound power levels of each RTU must be reduced by 2 dBA each. The resulting maximum sound power levels would be as shown in Table 5.1. These maximum sound power levels would apply to the outdoor/radiated noise.

Maximum SWL	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	dBA
RTUs	96	94	91	89	85	82	79	75	91

Table 5.1 – Maximum outdoor/radiated sound power levels for quieter RTUs at 56 Steacie Drive.

Selecting the sound power level spectrum in Tables 5.1 above or lower is satisfactory for meeting the 50 dBA daytime limit at POR1 and the 45 dBA nighttime limit at POR3. Choosing RTUs with no tones is also important and will prevent possible future complaints from neighbouring buildings and residences. Tones are often very noticeable and annoying and typically cause the sound levels from the mechanical equipment to seem louder than they actually are. It is ideal that the difference between adjacent octave bands be no more than 5 dB.

Option 2 – Acoustic Barrier around the RTUs

Another option, if for some reason quieter RTUs are not possible, is to install an acoustic barrier around the RTUs. In order to achieve the required noise mitigation to meet ENCG noise limits, the acoustic barrier must have a minimum height of 2 m and have a minimum surface density of 20 kg/m^2. The

barrier must not have any gaps and must extend to the roof floor. This barrier must extend to as shown in Figure 5.1 below or can be separated so that three sides of each RTU are enclosed with two barriers instead of one large one.

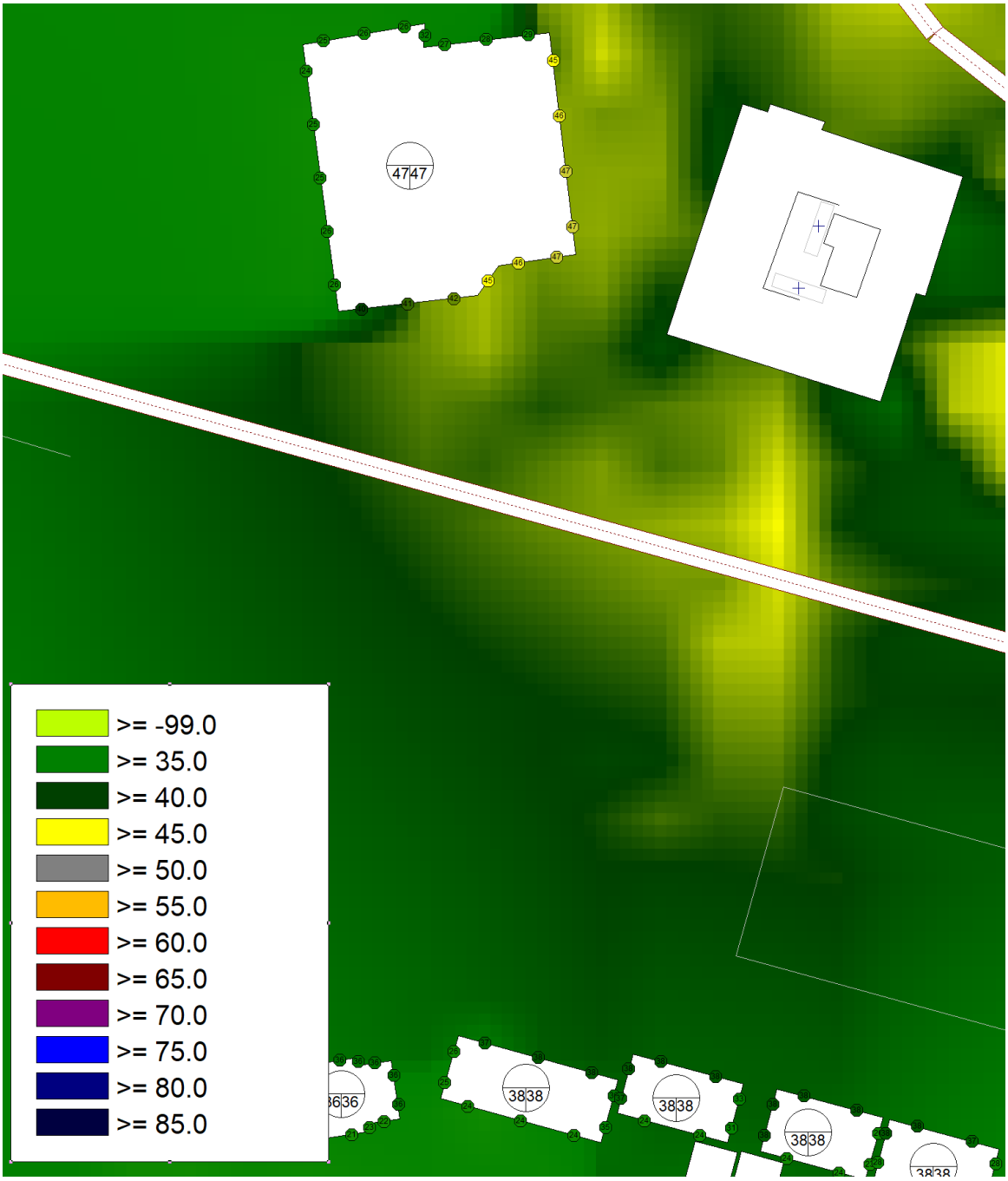


Figure 5.1 – Location of 2 m high acoustic barrier around RTUs at 56 Steacie Drive.

6.0 Traffic Noise Study

The following sections will outline the traffic noise impact on the new office building to be located at 56 Steacie Drive. The site description in Section 1.1 above shows the only source of traffic noise within range of the development, the CN rail line to the north of the site.

7.0 NOISE IMPACT PROCEDURE

7.1 Procedure Used to Assess Noise Impacts

This assessment uses the City of Ottawa - Environmental Noise Control Guidelines (ENCG), dated January 2016, to assess and mitigate noise from roads, transit ways, railways and aircraft. The maximum road noise levels for indoor areas that apply to this building are taken from Table 2.2c of the ENCG and summarized in Table 7.1 below.

Time	Indoor Leq Levels (dBA) Class 1, 2 & 3 Areas
	Rail Noise Level Limit (dBA)
07:00 – 23:00	**45** for General offices, reception areas, retail stores, etc.
07:00 – 23:00	**40** Individual or semi-private offices, conference rooms, etc

Table 7.1 – Criteria for Indoor Area Road and Rail Noise Levels

It should be noted that nighttime levels are not considered as this is a commercial building in which there will be no occupants overnight. The limits for indoor sound levels are also 5 dB more stringent for rail noise due to the characteristics of rail noise.

The ENCG states that noise control studies are to be prepared when the indoor area is within the following setback distances from the road, highway and railway noise sources:

- 100m from an arterial road or a major collector, light rail corridor or bus rapid transitway
- 250m from an existing or proposed highway
- 300m from a proposed or existing rail corridor or secondary main railway line
- 500m from a 400-series provincial highway or principle main railway line

This noise control study is required as the building is less than 300 m from the CN rail line to the north.

7.2 Noise Attenuation Requirements

This section outlines the required noise control measures and warning clauses and when to apply them, as stipulated by the ENCG for placement within purchase agreements.

If sound levels are predicted to be less than the specified criteria, no attenuation measures are required on the part of the proponent. If the predicted noise exceeds the criteria, the City of Ottawa recommends several attenuation measures.

These attenuation measures may include any or all of the following:

- construction of a noise barrier wall and/or berm;
- installation of a forced air ventilation system with provision for central air;
- installation of central air;
- acoustically selected building façade components

Where excessive noise levels may adversely affect the property or its use, the ENCG requires notices in the form of a Warning Clause to be placed on title in order to alert the buyer or renter of a possible environmental noise condition or a limitation on his/her property rights. The notices on title must be included in the Development Agreement(s) and in the Agreement(s) or Offer(s) of Purchase and Sale.

The City of Ottawa requires a Warning Clause whenever noise could meet or exceed 55 dBA 16 hour Leq at the Outdoor Living Area or Plane of Window of any living or sleeping area prior to any noise mitigation.

Table 7.2 provides the types of warning clauses and example text to be adapted into warning clauses. These warning clauses should be taken as *example only* and are taken from Appendix A of the ENCG which also states:
"*A warning clause is not considered a form of noise mitigation. It is not acceptable therefore to use warning clauses in place of physical noise control measures to identify an excess over the MOE or City noise limits*."

TYPE	Example Text	Notes
Generic	Purchasers/tenants are advised that sound levels due to increasing road/rail/Light Rail/transit way traffic may occasionally interfere with some outdoor activities as the sound levels may exceed the sound level limits of the City and the Ministry of the Environment. To help address the need for sound attenuation this development has been designed so as to provide an indoor environment that is within provincial guidelines. Measures for sound attenuation include: • multi-pane glass; • brick veneer; • concrete panels;	The generic warning clause outlines that MOE sound levels may be exceeded but the indoor environment is within guidelines. Mitigation measures are described including urban design features. Mention is also made of landscaping to screen the development visually from the source of noise.
Extensive mitigation of indoor and outdoor amenity area	"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/rail/Light Rail/transitway traffic may, on occasion, interfere with some activities of the dwelling occupants as the sound levels exceed	The warning clause makes reference to MOE sound levels being exceeded from time to time and that there are sound attenuation

	the sound level limits of the City and the Ministry of the Environment. To help address the need for sound attenuation this development may include: • multi-pane glass; • brick veneer; • construction of a solid fence in backyard area To ensure that provincial sound level limits are not exceeded it is important to maintain these sound attenuation features. This dwelling unit has also been designed with the provision for adding central air conditioning at the occupant's discretion. Installation of central air conditioning will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the sound level limits of the City and the Ministry of the Environment.	features and landscaping within the development that should be maintained.
No outdoor amenity area	Purchasers/tenants are advised that sound levels due to increasing road/rail/Light Rail/transitway traffic will interfere with outdoor activities as the sound levels exceed the sound level limits of the City and the Ministry of the Environment. To help address the need for sound attenuation this development may includes • multi-pane glass; • brick veneer; • construction of a solid fence in backyard area To ensure that provincial sound level limits are not exceeded it is important to maintain these sound attenuation features. This dwelling unit has been supplied with a central air conditioning system and other measures 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 City and the Ministry of the Environment.	This warning clause notes that only an indoor environment is being provided for.

Table 7.2 – Warning Clause Types and Example Text from the City of Ottawa (from ENCG Table A1)

7.3 Building Component Assessment (AIF Analysis)

According to the ENCG, when noise levels could exceed 55 dBA at the Plane of Window (POW) of an office area (day) the exterior cladding system of the building envelope must be acoustically designed to ensure the indoor noise criteria is achieved. The City of Ottawa recognizes the Acoustic Insulation Factor (AIF[1]) method as an appropriate analysis technique.

To comply with the City of Ottawa policies, the building envelope will require a minimum AIF rating to provide the indoor noise level required for living, dining and bedrooms of residential dwellings as described below.

The City of Ottawa's ENCG outlines the following maximum indoor Leq limits:

- maximum daytime indoor L_{eq} for general office space or reception areas should be 50 dBA
- maximum daytime indoor L_{eq} for individual or semi-private offices should be 45 dBA

For the overall exterior wall of any room, the required AIF for road and rail transportation noise is:

Required AIF = Outside L_{eq} - Indoor L_{eq} (Req) + 2dB (1)

When the exterior is comprised of components, then the AIF required of each component is determined by the following equation[1]:

Required AIF = Outside L_{eq} - Indoor L_{eq} (Req) + 10 $\log_{10}$ (Number of Components) + 2dB (2)

The required AIF is based on the Outside L_{eq}, Indoor L_{eq} required and the total number of exterior façade components. The AIF method allows for the number of components to be reduced if any component significantly exceeds the required AIF[1]:

"If the AIF of any component exceeds the required AIF by 10 or more, the calculation should be repeated for the other components with the 'total number of components' reduced by one. This reduction in the number of components lowers the required AIF for the others."

[1] J.D. Quirt, Building Research Note: Acoustic Insulation Factor: A Rating for the Insulation of Buildings against Outdoor Noise, National Rearch Council [Revised June 1980]

8.0 Traffic Noise Study Data and Procedure

The following section describes our analysis of the rail noise impact on the proposed Steacie Drive office building.

8.1 Rail Traffic Information

For this study, the only surface transportation noise source considered is rail traffic from the CN rail line to the north of the development. This building is farther than 100 m from any other urban collector and arterial road, therefore no other surface noise sources are considered.

Table 4.1 below summarizes the railway's parameters which were used in this analysis. These parameters have been taken from a similar traffic noise impact study, as we have made multiple attempts to get data for this section of track, including the frequency of trains and speed of the trains along this section but have not received a response. The parameters below in Table 8.1 are from a section of the same rail line further east and have been given by a CN representative in the past. This is anticipated to be very similar to the current conditions at the rail section to the north of 56 Steacie Drive. Due to the nearby rail crossing at March Road, we have also included whistle noise in our calculations.

Railway	Train Class	Speed	Current Train Counts	Year of Count	Projected 2032 Volume
CN Freight Line	Diesel	60 km/h	2 Day/ 2 Night	2013	2 Day/ 2 Night

Table 8.1 – Summary of Major Railway Noise Source

Assumptions that are required in order to complete the calculations are:

- All trains operating in this area are diesel trains
- Freight trains are modeled with one locomotive and an average of four cars per train
- The nearby crossing at March Road will require the incorporation of whistle noise into the calculations.
- Rail lines are not welded.
- Operating speed is approximately 60 km/h.

8.2 Procedure Used for Railway Noise Analysis

In order to calculate the rail noise impact at the proposed development, we utilized the Ministry of Environment's STAMSON modeling software version 5.04. This program allows us to input variables of a railway such as traffic volume, types of vehicles, speed, barrier locations and topography to determine the noise impact at a point of reception.

8.3 Points of Reception

To determine the worst case noise impact on the façade of the building, we have chosen one location at the north side of the building. There are currently no interior partitions planned, and while this entire floor could be open office, it could also be divided into office space with closed offices and meeting rooms. Therefore, we have chosen a location in the North West corner of the ground floor

office space with a typical office floor area in order to account for a worst case scenario. This space is depicted in Figure 8.1. This area includes two façades of the building which are composed of both glazing and an exterior wall assembly. This location will be the worst case in terms of noise as it is located closest to the rail line, approximately 108m away.

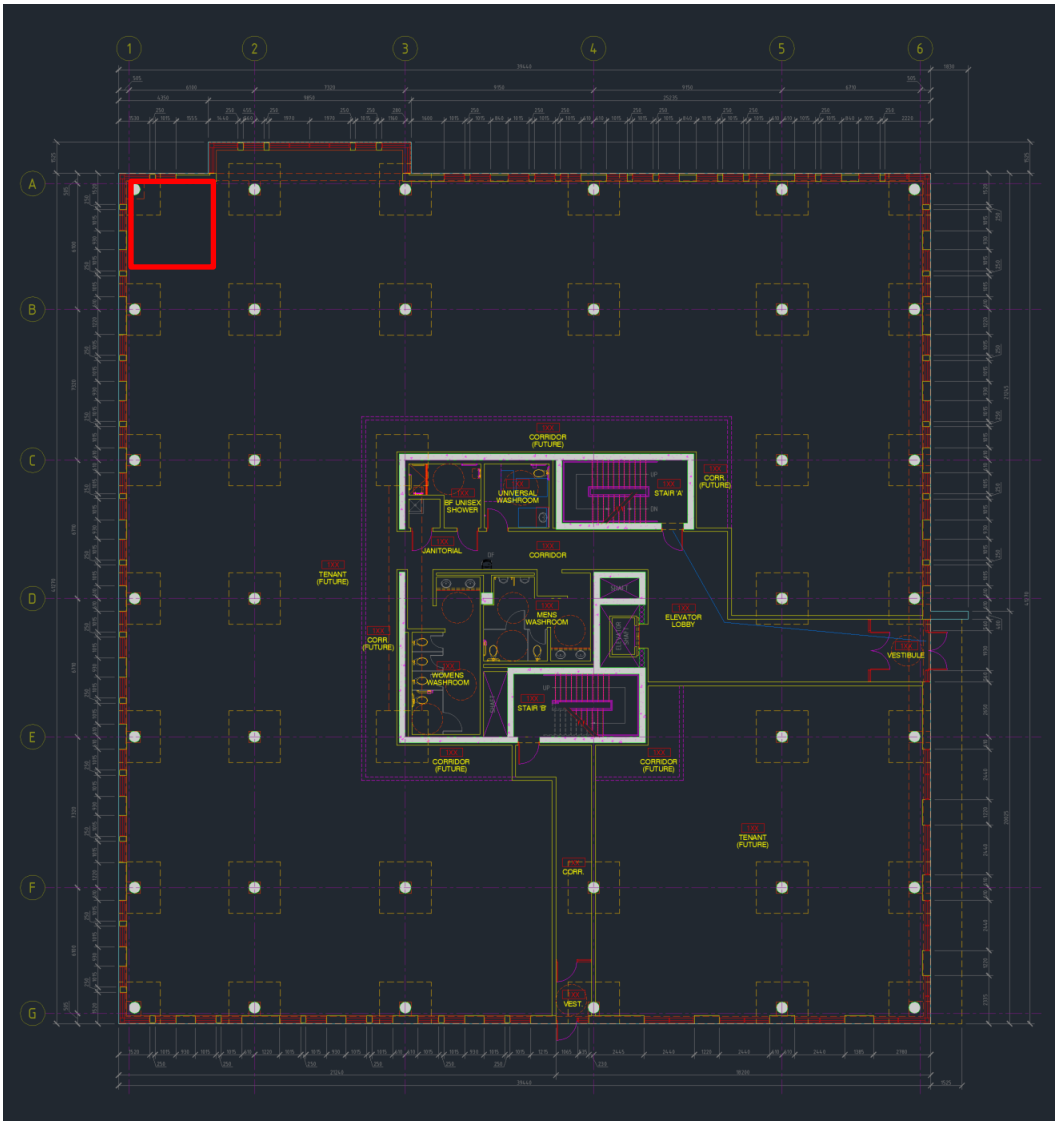


Figure 8.1 – Floor Plan of the ground floor showing the Plane of Window Point of Reception POR1.

8.4 Parameters Used for Analysis

The parameters used in STAMSON to assess the noise impact at POR1 are indicated in Table 8.2 below. These are used in conjunction with the parameters for train traffic volume given in Table 8.1.

Parameter	Values Used
Railway:	**CN Rail**
POR1	
Time Period	16h/8h
Topography	Flat/gradual slope; no barrier
Rows of Houses	0
Intermediate Surface	Reflective
Receiver Height (m)	1.5
Elevation Change (m)	0
Source Receiver Distance (m)	108

Table 8.2 – Parameters used in the STAMSON model

We have assessed daytime levels for POR 1 as this is a commercial building in which no one is expected to spend the night.

8.5 Surface Transportation Noise Levels

Table 8.3 summarizes the predicted sound pressure levels at the point of reception from the results of the STAMSON noise software calculation (Appendix A).

Noise Source	POR 1 (dBA)
	Day
CN Railway	54.9

Table 8.3 – Predicted Rail Noise at the Points of Reception**.**

8.6 Roadway Noise Summary and Analysis

We have calculated the predicted noise level caused by traffic using STAMSON and have shown that a 16 h L_{eq} at POR 1, located at the North West corner on the ground floor of the building, is 54.9 dBA as a worst case scenario. As these levels are below 55 dBA, an evaluation of exterior building components is not required and building components chosen for the exterior assembly and glazing are acceptable. As noted this analysis takes into account noise from the locomotive, wheels and whistle of the train. The sound level at the plane of window is relatively low due to the low frequency of trains, low speed and distance from the track.

9.0 Conclusion

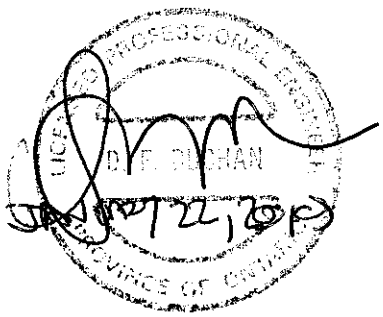
We have reviewed the sound pressure levels in our 3D acoustical model of the proposed commercial office building at 56 Steacie Drive and have found that given the current mechanical configuration and equipment selections, the noise levels exceed the City of Ottawa Environmental Noise Control Guidelines limit of 45 dBA at night at nearby residential properties and the City of Ottawa Noise Bylaw during the day at nearby commercial properties. We have proposed sound power levels for RTU reselection which the architect and mechanical engineer intend to follow later in the design process. Provided these sound power levels are put in place, the model shows that the ENCG nighttime limit of 45 dBA and daytime limit of 50 dBA as well as the City of Ottawa Noise Bylaw limit of 50 dBA is met at PORs located at the closest residential and commercial locations around the new development. We have also proposed a solution with an acoustic barrier if for some reason the sound power levels cannot be met.

The traffic noise from the rail line to the north of the proposed development was also analyzed. It was found that the combined noise from the locomotive, the wheels and the whistle of the train were less than 55 dBA at the nearest plane of window point of the development. Therefore, no additional analysis of the exterior assemblies was required and the current assemblies were acceptable. This was due to the low number of trains passing by, the relatively low speed of the train and proximity to the new development. 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:



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

APPENDIX

STAMSON Calculations

Equipment Sound Data

STAMSON 5.0 NORMAL REPORT Date: 17-01-2019 17:29:12
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: 56STEAC.te Time Period: Day/Night 16/8 hours
Description:

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

Train Type	Trains (Left)	Trains (Right)	Speed (km/h)	# loc /Train	# Cars /Train	Eng type	Cont weld
1.	1.0/1.0	1.0/1.0	60.0	1.0	4.0	Diesel	No

Data for Segment # 1: CN RAIL (day/night)

Angle1 Angle2 : -90.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 108.00 / 108.00 m
Receiver height : 1.50 / 1.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Whistle Angle : 60 deg Track 1
Reference angle : 0.00

Results segment # 1: CN RAIL (day)

LOCOMOTIVE (0.00 + 45.00 + 0.00) = 45.00 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	53.58	-8.57	0.00	0.00	0.00	0.00	45.00

WHEEL (0.00 + 37.20 + 0.00) = 37.20 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	45.78	-8.57	0.00	0.00	0.00	0.00	37.20

LEFT WHISTLE (0.00 + 53.66 + 0.00) = 53.66 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-63	60	0.00	63.88	-8.57	-1.65	0.00	0.00	0.00	53.66

RIGHT WHISTLE (0.00 + 45.67 + 0.00) = 45.67 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
60	80	0.00	63.88	-8.57	-9.64	0.00	0.00	0.00	45.67

Segment Leq : 54.86 dBA

Total Leq All Segments: 54.86 dBA

Results segment # 1: CN RAIL (night)

LOCOMOTIVE (0.00 + 48.01 + 0.00) = 48.01 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	56.59	-8.57	0.00	0.00	0.00	0.00	48.01

WHEEL (0.00 + 40.21 + 0.00) = 40.21 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	48.79	-8.57	0.00	0.00	0.00	0.00	40.21

LEFT WHISTLE (0.00 + 56.67 + 0.00) = 56.67 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-63	60	0.00	66.89	-8.57	-1.65	0.00	0.00	0.00	56.67

RIGHT WHISTLE (0.00 + 48.68 + 0.00) = 48.68 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
60	80	0.00	66.89	-8.57	-9.64	0.00	0.00	0.00	48.68

Segment Leq : 57.87 dBA

Total Leq All Segments: 57.87 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 54.86

Acoustics

	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
Supply Duct	95 dB	92 dB	91 dB	87 dB	87 dB	84 dB	79 dB	73 dB
Return Duct	95 dB	88 dB	103 dB	86 dB	82 dB	80 dB	76 dB	68 dB
Outdoor Noise	98 dB	96 dB	93 dB	91 dB	87 dB	84 dB	81 dB	77 dB

TRANE

Dimensional Data

Figure 26. Cooling only unit dimensions - SAHL — 20 to 75 tons air-cooled

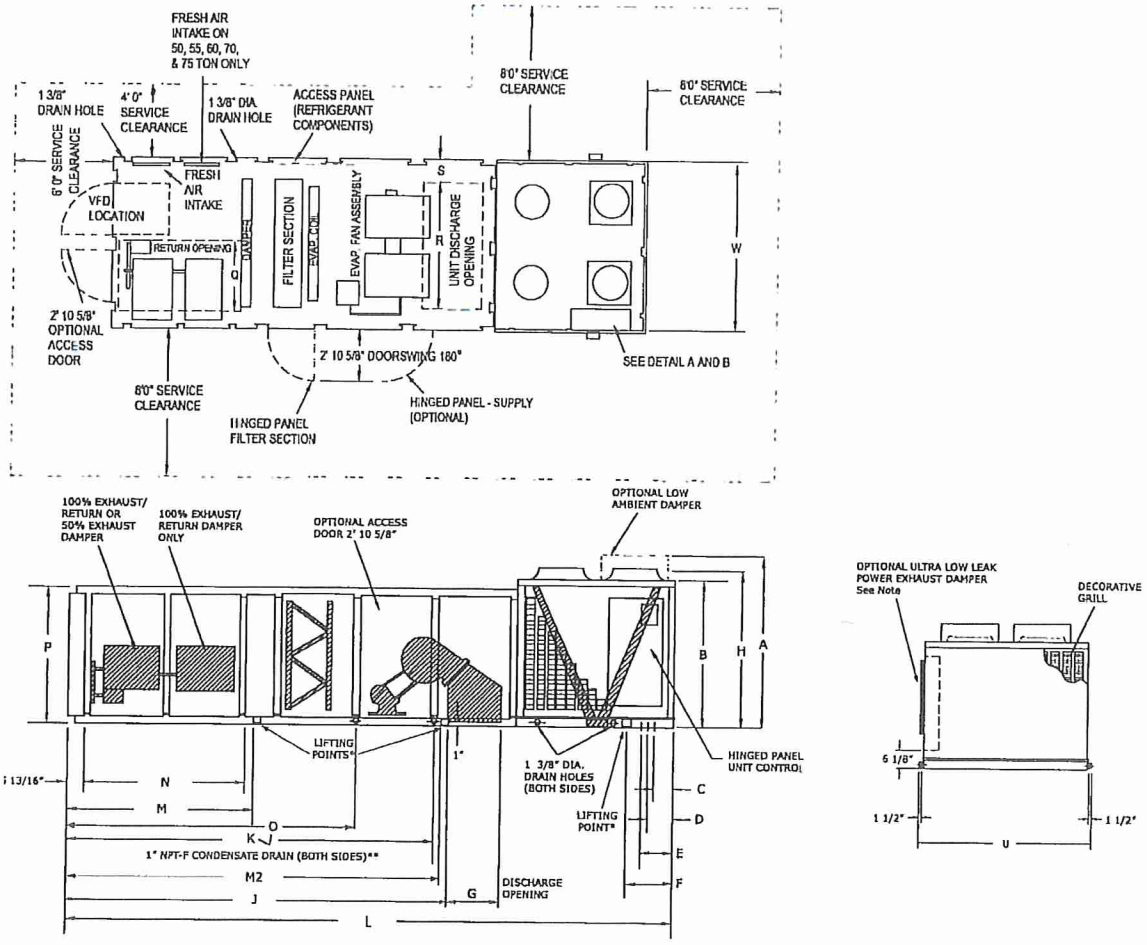


Table 77. Cooling only unit dimensions (ft. in.) - SAHL

Nom. Tons	H	L	W	A	B	C	D	E	F	G	J
20, 25	7-3 1/4	21-9 3/4	7-6 1/2	7-10 5/8	6-9	0-9 1/2	1-3 5/8	1-7 9/16	1-3 1/2	2-2 1/2	14-0 1/4
30	7-3 1/4	21-9 3/4	7-6 1/2	7-10 5/8	6-9	0-9 1/2	1-3 5/8	1-7 9/16	1-3 1/2	2-2 1/2	14-0 1/4
40	7-3 1/4	29-8	7-6 1/2	7-10 5/8	6-9	0-9 7/8	1-5 7/8	1-10 1/8	2-5	2-5	16-7 13/16
50, 55	7-3 1/4	29-8	7-6 1/2	7-10 5/8	6-9	0-9 1/2	1-5 7/8	1-10 1/8	2-5	2-5	16-7 13/16
60	7-3 1/4	29-8	9-8	7-10 5/8	6-9	0-9 7/8	1-5 7/8	1-10 1/8	2-5	2-5	16-7 13/16
70, 75	7-3 1/4	29-8	9-8	7-10 5/8	6-9	0-9 7/8	1-5 7/8	1-10 1/8	2-5	2-5	16-7 13/16

Nom. Tons	K	M	M2	N w/exhaust fan	N w/return fan	O	P	Q w/exhaust fan	Q w/return fan	R	S	U
20, 25	12-6	7-0	N/A	6-6 15/16	3	10-7	3-9 5/16	3-4 3/8	2 - 9 15/16	5-7	0-11 3/4	7-9 1/2
30	12-6	7-0	N/A	6-6 15/16	3	10-7	4-9 5/16	3-4 3/8	2 - 9 15/16	5-7	0-11 3/4	7-9 1/2
40	15-4 15/16	8-0	16-2 5/16	7-8 3/16	3 - 4	12-1	5-9 5/16	3-4 3/8	3 - 1 1/2"	5-7	0-11 3/4	7-9 1/2
50, 55	15-4 15/16	8-0	16-2 5/16	7-8 3/16	3 - 4	12-1	6-9 3/8	3-4 3/8	3 - 1 1/2"	5-7	0-11 3/4	7-9 1/2
60	15-4 15/16	8-0	16-2 5/16	7-8 3/16	4 - 5	12-1	5-9 5/16	4-5 3/8	4 - 2 1/2"	6-10 7/8	1-4 9/16	9-11
70, 75	15-4 15/16	8-0	16-2 5/16	7-8 3/16	4 - 5	12-1	5-9 5/16	4-5 3/8	4 - 2 1/2"	6-10 7/8	1-4 9/16	9-11

Note: Optional ultra low leak power exhaust extends beyond lifting lug and increases overall "U" dimension by 0.65".