60 Charles Street, Manchester

External Building Services Noise

SIX-M&R-SXA002-002-TRP-0005-02

CLIENT: McAleer and Rushe Ltd

DATE: 10.02.2021

sixense

NOTICE

DOCUMENT HISTORY

REVISION	DATE	PURPOSE	ORIGINATOR	REVIEWED	APPROVED
00	26.08.20	First issue for comment	R. Ramadorai	R. Fenton	G. Wickens
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EXECUTIVE SUMMARY

As part of the ongoing acoustic design for Maldron Hotel, Charles Street, Manchester, Sixense has been appointed by McAleer & Rushe to undertake an assessment of the proposed MEP services to ensure that the requirements of the *planning condition 12* for external noise emissions are met.

Details for MEP have been provided by Caldwell Consulting including drawings, schedules and equipment selections.

Based on the information provided, an assessment of noise emissions from the proposed external plant has been undertaken and mitigation measures, where required, have been proposed in order to meet the requirements of the planning condition.

1 INTRODUCTION

1.1. PURPOSE OF THIS REPORT

As part of the ongoing acoustic design for Maldron Hotel, 60 Charles Street, Manchester Sixense has been appointed by McAleer & Rushe to undertake an assessment of the proposed MEP services to ensure that the Manchester City Council[1] requirements for external noise emissions are achieved.

Details for MEP have been provided by Caldwell Consulting including drawings, schedules and equipment selections. It is noted that this report specifically deals with only the external noise levels from MEP plant. All assessments pertaining to internal emissions are dealt with in a separate report.

This noise assessment considers the following aspects:

- Manchester City Council Plant emission requirements (Condition 12).
- Proposed MEP services in terms of equipment selections, general arrangements etc.
- Calculation of resultant noise levels at nearest sensitive occupancies from proposed MEP services specific to ventilation and AC units.
- An assessment of noise levels using the criteria in relevant standards (BS4142), to predict whether noise impacts are likely and recommend mitigation measures as practicable.

This report contains references of a technical nature. Appendix 1 provides a glossary of technical terms.

1.2. AUTHOR CREDENTIALS

The author of this report holds a Master's degree in Audio Acoustics and has over 3 years relevant experience working on acoustic related projects.

The reviewer of this report holds a post graduate diploma in Acoustics and Noise Control and has over 10 years of acoustic related experience.

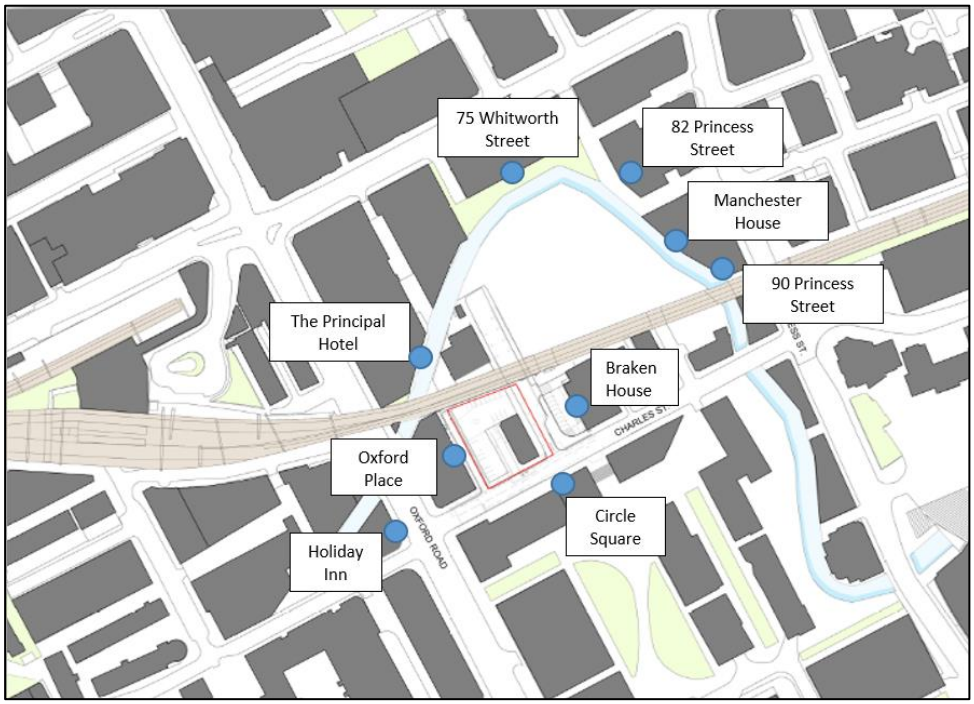
Both author and reviewer are corporate members of the Institute of Acoustics (MIOA).

1.3. SITE LOCATION

Figure 1.1 shows the aerial view of the local area, with the site boundary marked in red. Also indicated on the figure are the existing and proposed nearest noise sensitive receptors.

[1] Planning Application No. 122644/FO/2019

Figure 1.1: Site Location



2 LEGISLATION, POLICY AND STANDARDS

2.1. PLANNING CONDITION 12

As part of the planning consent for the project, the Local planning authority have imposed the following noise related condition on the development:

Figure 2.1: Planning Condition 12 Relating to External Noise Emissions

> 12) Prior to occupation of the development a scheme for the acoustic insulation of any plant or externally mounted ancillary equipment to ensure that it achieves a background noise level of 5dB below the existing background (La90) in each octave band at the nearest noise sensitive location shall be submitted to and approved in writing by the City Council as local planning authority in order to secure a reduction in the level of noise emanating from the equipment. The approved scheme shall be implemented prior to occupancy and shall remain operational thereafter.
>
> Reason - To safeguard the amenities of the occupiers of nearby residential accommodation, pursuant to policies SP1 and DM1 of the Core Strategy and saved UDP Policy DC26

The above condition is based on the principals set out in BS4142 which relates to the assessment of noise from fixed plant and machinery.

2.2. BS4142:2014: "METHODS FOR RATING AND ASSESSING INDUSTRIAL AND COMMERCIAL SOUND"

BS4142 provides a rating and assessment methodology for assessing the potential adverse impact of industrial and commercial noise sources on neighbouring dwellings.

The BS4142 assessment procedure initially compares the '**Rating Level**' of the source with the '**Background Noise Level**' when the source is not present.

Corrections can be applied to the '**Rating Level**' if the noise has certain audible characteristics. Corrections, which are listed in **Table 2.1,** are given based on a subjective assessment of noise source characteristics.

Table 2.1: BS4142:2014 Character Correction for Rating Level Calculation

Feature / Perception	Tonality	Impulsivity	Intermittency	Other Acoustic Characteristics
Just Perceptible	+2dB	+3dB	When the specific sound has identifiable On/Off conditions that are readily distinctive. +3dB	+3dB
Clearly Perceptible	+4dB	+6dB		
Highly Perceptible	+6dB	+9dB		

For assessment purposes, the background noise level needs to be determined without the noise source under investigation operating.

The time of operation must also be taken into account. During the day (normally taken to be 07.00 to 23.00 hours) a one-hour measurement period is considered appropriate. During the night (normally taken to be 23.00 – 07.00 hours) a 15-minute time period is normally used.

The following guidance is then based on the outcome of this initial assessment:

- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
- A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.
- The standard states that: *"Where the rating level **does not exceed** the background sound level, this is an indication of the specific sound source **having a low impact**,"*
- The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

A note accompanying the above guidance states:

> *"Adverse impacts include, but are not limited to, annoyance and sleep disturbance. Not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact."*

The initial estimate of the impact should then be modified to account for its context. Such considerations include:

- The absolute level of the sound - the magnitude of the overall impact might be greater for an acoustic environment where the residual sound level is high than for an acoustic environment where the residual sound level is low. Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night.
- Where residual sound levels are very high, the residual sound might itself result in adverse impacts or significant adverse impacts, and the margin by which the rating level exceeds the background might simply be an indication of the extent to which the specific sound source is likely to make those impacts worse.
- The character and level of the residual sound compared to the character and level of the specific sound.
- The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions.

3 SITE DETAILS

3.1. SITE SURVEY

As part of the original noise survey on site, extensive attended and unattended measurements of noise were undertaken. Full details of the survey and measurement positions are set out in the original report[2]. The following figure identifies the location of the various attended and unattended positions.

Figure 3.1: Noise Measurement Locations

3.2. NOISE BASELINE

In order to understand the prevailing existing noise environment at the Site, unattended noise monitoring was undertaken between Thursday 30th August 2018 and Monday 3rd September 2018 using a Larson Davis Model 831 Class 1 sound level meter (s/n 3400). The location LT1 is considered to be representative of noise levels at the nearest noise sensitive receptors.

A summary of the baseline noise data, rounded to the nearest decibel (dB), is presented in **Table 3.1**.

[2] SIX-MH-SS002S-RPT-002-03 - Noise and Vibration Impact Assessment 100719

Table 3.1: Baseline Noise Levels

Parameter	Free-Field Sound Levels (Ref 2 X 10^{-5} Pa)
$L_{Aeq,16hr}$ Day	68 dB
$L_{Aeq,8hr}$ Night	62 dB
Typical $L_{AF90,16hr}$ Day	59 dB
Typical $L_{AF90,8hr}$ Night	52 dB

The $L_{A90,T}$ background sound level is the sound level exceeded for 90% of the time in the absence of any sound from the specific source of interest.

The "typical" background sound levels as described in BS 4142:2014 have been established for the purposes of this noise assessment, from the $L_{A90,15min}$ measurement data at the unattended monitoring location. In practice, there is no single level for a background sound level as this is a fluctuating parameter, although the Standard recommends that a representative value for the period should be used, noting that this is not usually the lowest value of $L_{A90,15min}$.

The free field background sound levels measured at LT1 during the daytime (07:00 to 23:00) ranged between 52 and 66 dB $L_{A90,\ 15min}$. The daytime background sound level adopted for the purpose of this assessment is 59dB $L_{A90,\ 15min}$.

The free field background sound levels measured at LT1 during the night-time (23:00 to 07:00) ranged between 47 and 56 dB $L_{A90,\ 15min}$. The night-time background sound level adopted for the purpose of this assessment is 52 dB $L_{A90,\ 15min}$.

The adopted background sound levels for the daytime and night time periods are considered representative for all noise sensitive receptors pertinent to this assessment.

4 NOISE IMPACT ASSESSMENT

4.1. ASSESSMENT APPROACH

A noise impact assessment using BS4142 has been carried out to assess noise from fixed plant or machinery used on site. The operational noise assessment covers all items of plant and machinery within the Site considered to generate noise which may be audible at the site boundary. The plant is expected to operate during both the daytime and night-time period, however, to ensure a worse case assessment, only the night time period has been considered.

The assessment has been conducted in three phases:

- Collation of source data: relevant plant noise data has been obtained either via manufacturer's technical data (Sound Power Level);
- Modelling of noise emissions from the Site the night-time period, using specialist software; and
- Analysis of predicted noise levels to assess potential impacts at adjacent sensitive receptors.

4.2. NOISE SOURCES

Principal noise sources under consideration for this assessment are the ventilation and heating/cooling plant that are either located externally or in the case of ventilation units, discharge to the atmosphere.

Details and layouts for the plant were provided by Caldwell Consulting. The following drawings identify the location of the various items of plant that formed part of the analysis:

- 3919 - M405 AC Installation - Level 16-Model.pdf
- 3919 - M503 LPHW & Gas Installation - Level 16-Model.pdf
- 3919 - M306 Ventilation - Level 16-Model
- 3919 - M301 Ventilation Mezz-T1
- 3919 - M302 Ventilation Level 1-T1

Sound power levels for the units were obtained from manufacturer's data sheets as submitted as part of the plant package provided by Caldwell Consulting. **Table 4.1** below, summarises the source noise levels used for this assessment. Manufacturer's quoted sound power levels for the above units are set out in **Table 4.2**.

Table 4.1: Noise Sources Ventilation Plant

Plant Reference	Type
AHU01	Air handling plant
AHU02	Air handling plant
AHU03	Air handling plant
AHU04	Air handling plant (supply only)
EF01	Kitchen Extract Fan

Table 4.2: Ventilation Plant Sound Power Levels Reported by Manufacturers

Unit Ref	System	Sound Power Level (dB) @ Octave Band Centre Frequency (Hz)							
		63	**125**	250	500	1000	2000	4000	8000
AHU01	Supply	70	80	77	76	75	72	68	64
	Extract	73	85	82	82	79	74	72	69
AHU02	Supply	73	81	81	79	78	75	71	66
	Extract	72	79	77	75	75	71	67	62
AHU03	Supply	71	76	80	77	77	7	69	65
	Extract	66	66	75	75	75	71	69	67
AHU04	Supply	79	83	92	89	86	80	80	80
EF01	Kitchen Canopy	92	92	86	82	80	79	75	70

In addition to the above ventilation plant, condensing units and heat pumps are also proposed to be located on the roof. There are in total 30 condensing units in 2 banks and 3 heat pumps currently proposed to be located on the roof. Manufacturer's quoted sound power levels for these units are presented in **Table 4.3**.

Table 4.3: Condenser Plant Sound Power Levels Reported by Manufacturers

Plant Type	Make Model	No.	Location	Sound Power Level, dB(A) 100% Heating	Sound Power Level, dB(A) 90% Cooling	Sound Power Level, dB(A) 75% Cooling
A/C Condenser	Mitsubishi PURY-P200YNW-A	27	Roof	78	71	67
A/C Condenser	Mitsubishi PURY-P700YSNW-A	1	Roof	86	79	76
A/C Condenser	Mitsubishi PURY-P450YSNW-A	1	Roof	83	76	72
A/C Condenser	Mitsubishi PURY-P250YNW-A	1	Roof	80	74	70
Condenser	Daikin Altherma M EDLQ016CW1	3	Roof	66		

The condenser data does not include octave band information and as such, assessments have been based on overall figures. It is noted that given the distances to the nearest sensitive receptors, no acoustic features such as tonality or intermittency will be discernible. Therefore, the resultant assessment with overall noise levels will be equivalent to an assessment that includes octave band analysis.

The condensors will be used for cooling purposes only and for the purposes of the assessment, the sound power levels at 90% efficiency have been used. This is considered worst case, as it usual for the units to operate on a lower power output during the night-time period.

4.3. NOISE MODEL

In order to aid the assessment of operational noise, a 3D noise model has been developed using CadnaA specialist noise modelling software. The noise model excludes the ventilation plant since these units have silencers (discussed in Section 5) that will result in noise emissions from these units to be 10 dB below the condensers and heat pumps at the nearest noise sensitive receptors. Therefore, the assessment focusses on condensers and heat pumps as they are deemed the dominant noise source. The noise model calculation includes the results in all the noise sensitive receptors as previously identified in Figure 1.1

4.4. RESULTS AND BS4142 ASSESSMENT

The BS4142 assessment, for the relevant worst affected receptors, is presented in **Table 4.4** below.

Table 4.4: BS4142 Assessment (Night-time Levels)

Receptor	Predicted Noise Level From Plant ($L_{Aeq,T}$)	Existing Background Noise Level ($L_{A90,T}$)	Level Difference
Oxford Place	30	52	-22
Braken House	30	52	-22
Circle Square	46	52	-6
Holiday Inn	31	52	-21
75 Whitworth Street	30	52	-22
82 Princess Street	30	52	-22
Manchester House	29	52	-23
90 Princess Street	29	52	-23
The Principal Hotel	31	52	-21

As demonstrated above, the predicted Rating Noise Level is below the Background Noise Level by a minimum of 6dB at all locations during the night time period and therefore no noise impacts are predicted. The noise emissions from the plant associated with the development are therefore deemed to meet the planning requirements set out in Condition 12.

5 PROPOSED MITIGATION

5.1. AIR HANDING UNITS

The AHUs located on the roof and on the Mezzanine and Level 1 of the development discharge to the atmosphere. All AHUs have been shown to incorporate acoustic silencers at their terminations.

Based on this, the following insertion loss figures in **Table 5.1** are recommended for each of the AHUs to the atmospheric side. These insertion losses are based on an overall noise emission level that is 10 dB below the emissions of the condensing units to ensure that noise from the AHUs do not contribute to the overall noise emissions of the site.

Insertion losses listed here are taken from the Vibro Acoustic attenuator catalogue and the face velocities set out below are based on the attenuator data sheets to minimize regenerated noise. An indication of lengths has also been provided however, this is in line with the Vibro Acoustic catalogue and it is likely that other manufacturers may have different lengths for a similar set of insertion losses.

In any case, final attenuator selections would need to be made by the services engineer to ensure the system is appropriately designed for overall performance.

Table 5.1: AHU Silencer Insertion Loss Atmospheric Side

Unit Ref	System	Length (mm)	Face Velocity (m/s)	Dynamic Insertion Loss (dB) @ Octave Band Centre Frequency (Hz)							
				63	**125**	250	500	1000	2000	4000	8000
AHU01	Supply	1524	6.4	4	9	18	29	30	23	15	11
	Extract	1524	6.4	5	12	21	29	29	21	15	11
AHU02	Supply	1524	6.4	6	11	21	35	37	32	22	17
	Extract	1524	6.4	4	10	23	37	39	30	19	12
AHU03	Supply	1524	6.4	6	11	21	35	37	32	22	17
	Extract	1524	6.4	4	10	23	37	39	30	19	12
AHU04	Supply	1524	6.4	6	11	21	35	37	32	22	17

5.2. KITCHEN EXTRACT FAN

Noise levels for the kitchen extract fan have been provided. The kitchen extract fan is located on the roof, serving the kitchen located on the ground floor. Notwithstanding this, the following insertion losses in **Table 5.2** are recommended for the fan.

Table 5.2: Insertion Loss Recommended for Kitchen Extract Fan Atmospheric Side

Unit Ref	System	Length (mm)	Face Velocity (m/s)	Dynamic Insertion Loss (dB) @ Octave Band Centre Frequency (Hz)							
				63	125	250	500	1000	2000	4000	8000
EF01	Kitchen Extract	1524	6.4	5	9	18	32	37	34	24	18

Again, the above table provides the insertion losses required for the extract fan. Any final attenuators selected for the system will likely need to be melinex lined to ensure the attenuator is still effective under the greasy operating conditions in the kitchen. This will also mean that the overall pressure drop and the likely insertion loss for the silencer may be lower for a given length and free area. As a result, a longer or more restrictive silencer may be required. This should be taken into account by the MEP engineers.

5.3. CONDENSING UNITS AND HEAT PUMPS

Assessments and modelling results indicate that the proposed condensing units and heat pumps do not require any additional mitigation. They are noted to comply with the planning condition 12 criteria as proposed and are not expected to cause any noticeable noise impact at the nearest noise sensitive receptors.

6 CONCLUSIONS

As part of the ongoing acoustic design for Maldron Hotel, Charles Street, Manchester, Sixense has been appointed by McAleer & Rushe to undertake an assessment of the proposed MEP services to ensure that the requirements of the planning condition 12 for external noise emissions are met.

Details for MEP have been provided by Caldwell Consulting including drawings, schedules and equipment selections. It is noted that this report specifically deals only with the external noise levels from MEP plant. All assessments pertaining to internal emissions are dealt with in a separate report.

This noise assessment considers the following aspects:

- Manchester City Council Plant emission requirements (condition 12)
- Proposed MEP services in terms of equipment selections, general arrangements etc.
- Calculation of resultant noise levels at nearest sensitive occupancies from proposed MEP services specific to ventilation and AC units.
- An assessment of noise levels using the criteria in relevant standards (BS4142), to predict whether noise impacts are likely and recommend mitigation measures as practicable.

Based on the above, assessments of noise emissions of the proposed development have been undertaken and mitigation measures, where required, have been proposed. The resulting calculated levels indicate that the plant emission limits as set by condition 12 are met at all noise sensitive receptors.

A1 GLOSSARY OF TERMS

UNIT / TERM	DEFINITION
Decibel (dB)	Used as a measurement of sound pressure level. It is the logarithmic ratio of the noise being assessed to a standard reference level.
A-weighting - dB(A)	The human ear is more susceptible to mid-frequency noise than the high and low frequencies. To take account of this when measuring noise the 'A' weighting scale is used so that the measured noise corresponds roughly to the overall level of noise that is discerned by the average human. It is also possible to calculate the 'A' weighted noise level by applying certain corrections to an un-weighted spectrum. The measured or calculated 'A' weighted noise level is known as the dB(A) level. Because noise levels in dB(A) is a logaritmic scale, they do not have a linear relationship to each other. For similar noises, a change in noise level of 10dB(A) represents a doubling or halving of subjective loudness. A change of 3dB(A) is just perceptible.
L_{10} and L_{90}	If a non-steady noise is to be described it is necessary to know both its level and the degree of fluctuation. The Ln indices are used for this purpose, and the term refers to the level exceeded for n% of the time, hence L_{10} is the level exceeded for 10% of the time and as such can be regarded as the 'average maximum level'. Similarly, L_{90} is the average minimum level and is often used to describe the background noise. It is common practice to use the L_{10} index to describe traffic noise, as being a high average; it takes into account the increased annoyance that results from the non-steady nature of traffic noise.
L_{eq}	The concept of L_{eq} (equivalent continuous sound level) has up to recently been primarily used in assessing noise in industry but seems now to be finding use in defining many other types of noise, such as aircraft noise, environmental noise and construction noise. L_{eq} is defined as a notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the actual, fluctuating sound measured over that period (e.g. 1 hour). The use of digital technology in sound level meters now makes the measurement of L_{eq} very straightforward.
L_{max}	L_{max} is the maximum sound pressure level recorded over the period stated. Lmax is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the Leq noise level.
L_{Ar}	The 'Rating Level' (L_{Ar}) referred to as the specific noise level of the source under investigation (in terms of the L_{Aeq} noise index)