Azymuth Acoustics UK

Professional Acoustic Services

Noise Verification Report
Ref: AA0449

External Plant for Mezz Bar and VIP Lounge
AO Arena Mezzanine Extension
Manchester

On behalf of

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1.0 Introduction

This report sets out the results of the external plant noise measurements that were undertaken by Azymuth Acoustics (henceforth Azymuth) on Monday 15th January 2024 at the AO Arena. The purpose of these measurements was to ensure that noise levels omitting from all new roof mounted plant associated with the Mezz Bar and VIP Lounge extension are of an acceptable level and shall not impact nearby receptors, both residential and commercial. The report shall also aim to address any noise related issues that were brought to light during the original Noise Impact Assessment (NIA) undertaken by Azymuth during the design stage of the project in October 2023.

An initial site visit was undertaken by Azymuth in December 2022 where baseline noise measurements were carried out on the existing plant roofs. Additional noise measurements at nearby receptors were undertaken in July/August 2023.

Recently measured noise levels of the fully operational plant have been inputted into a SoundPLAN noise model to accurately predict and visualise the impact of plant related noise on the local environment.

2.0 Design / Assessment Criteria

2.1 Manchester City Council Planning Conditions

Ref	Manchester City Council Planning and Noise Conditions
136189/FO/2023	
3 a)	Prior to first use of the development hereby approved, a scheme for the acoustic treatment of externally mounted plant, equipment and servicing shall be submitted for approval by the City Council, as local planning authority. The scheme shall be designed to achieve a rating of 5dB (L_{Aeq}) below the typical background (L_{A90}) level at the nearest noise sensitive location. The approved scheme shall be implemented in full before first use.
3 b)	Prior to the operation of the scheme, a verification report to confirm the work undertaken throughout the development conforms to the recommendations and requirements in the approved acoustic report shall be submitted in writing to the City Council, as local planning authority. Any instances of non-conformity with the recommendations in the report shall be detailed along with any measures required to ensure compliance with the agreed noise criteria.
136948/FO/2023	
3 a)	Externally mounted ancillary plant, equipment and servicing shall be selected and/or acoustically treated in accordance with the approved noise assessment (noise assessment or information AA0449.2RevA Noise Impact Assessment received by the City Council, as Local Planning Authority, on 11/10/2023; Correspondence Email Re: ACOUSTICS received by the City Council, as Local Planning Authority, on 02/11/2023) so as to achieve a rating level 5dB (L_{Aeq}) below the typical background (L_{A90}) level at the nearest noise sensitive location. The scheme shall be implemented in full before the use commences or as otherwise agreed in writing by the City Council as local planning authority.
3 b)	Prior to the first operation of the scheme a verification report shall be submitted to and approved in writing by the City Council as local planning authority to validate that the work undertaken throughout the development conforms to the recommendations and requirements in the approved acoustic report. The report shall also undertake post completion testing to confirm that the noise criteria have been met

Table 1 – MCC planning conditions associated with the development

3.0 Baseline Environmental Noise Survey

A baseline noise survey was carried out in July/August 2023 and submitted in the initial planning and noise report ref: AA0449.2RevA. The instrumentation used for the noise survey consisted of a SvanTek 971 type 1 precision sound level meter. The equipment was calibrated before and after the noise measurements. The sound level meter measured at A-weighted (fast response) noise levels as well as octave bands noise levels for all measurement records.

The environmental noise survey focussed on measurements close to the existing and proposed residential properties, these measurements were undertaken using the sound level meter at the position(s) shown in Figure 1:

- Position 1: Corner of Dutton Street
- Position 2: Breslyn / Mirabel Street

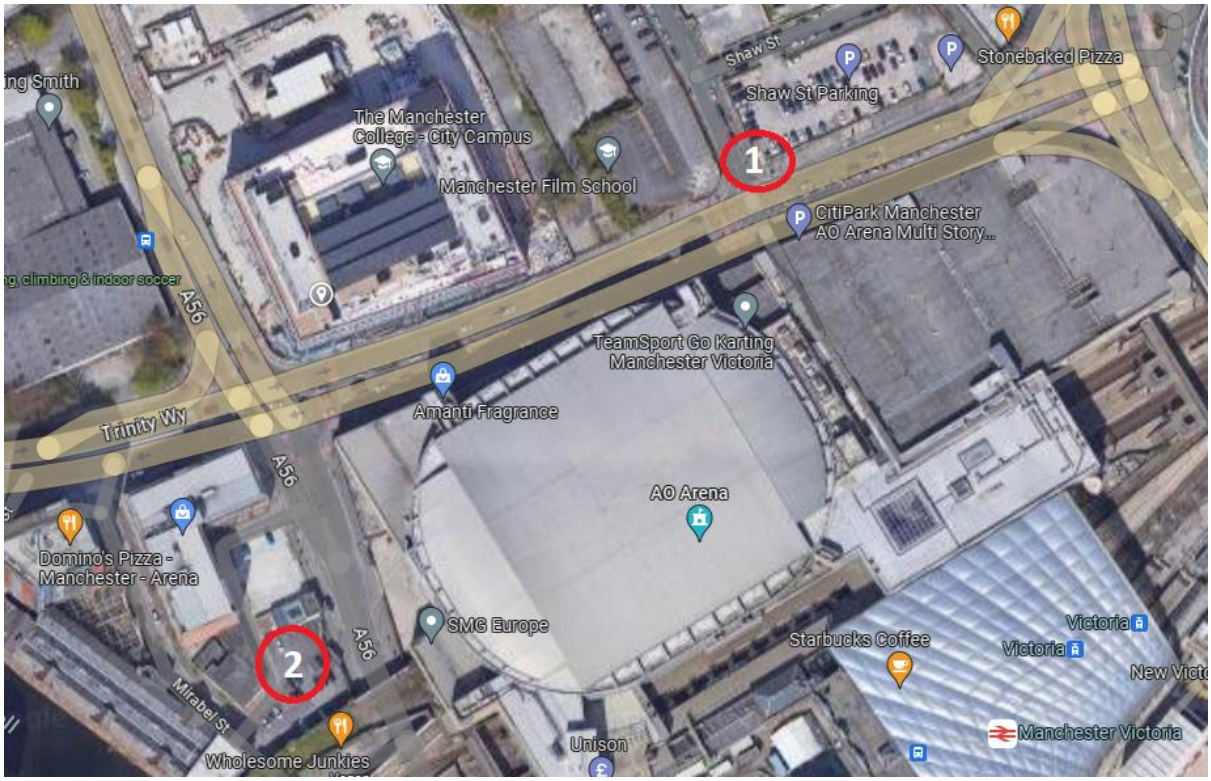


Figure 1 – Residential measurement locations

Location	Time	L_{AFmax}	L_{Aeq}	L_{A10}	L_{A50}	L_{A90}
1) Corner of Dutton Street	Day	83.7	70.3	73.2	67.1	62.5
1) Corner of Dutton Street	Night	75.0	59.0	68.7	62.6	54.9
2) Breslyn Street / Mirabel Street	Day	72.0	57.2	58.8	54.0	47.2
2) Breslyn Street / Mirabel Street	Night	66.2	52.8	59.1	53.2	47.6

Table 2 – Noise measurement data for residential measurements

4.0 Noise (Verification) Measurements

4.1 Noise Measurement Procedures

Near-field noise levels for all roof mounted plant on L4 and L5 were measured, additional noise measurements on L3 were also undertaken. Approximate measurement positions can be seen in Figures 2-4.

The instrumentation used for the noise survey consisted of a SvanTek 971 type 1 precision sound level meter. The equipment was calibrated before and after the noise measurements. The sound level meter measured at A-weighted (fast response) noise levels as well as octave bands noise levels for all measurement records.

A BS 4142 assessment has been undertaken using the results of the recent noise measurements and SoundPLAN noise modelling to predict the noise levels at the nearby receptors.

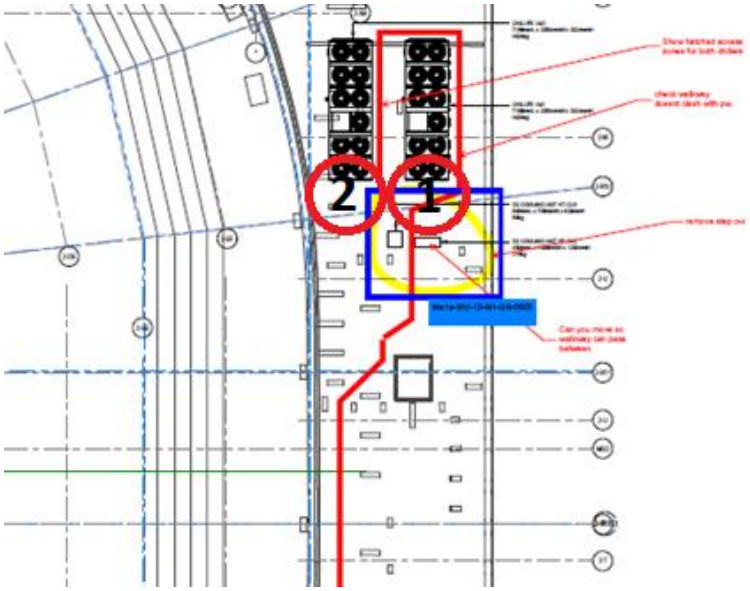


Figure 2 – Noise measurement positions, L5 roof

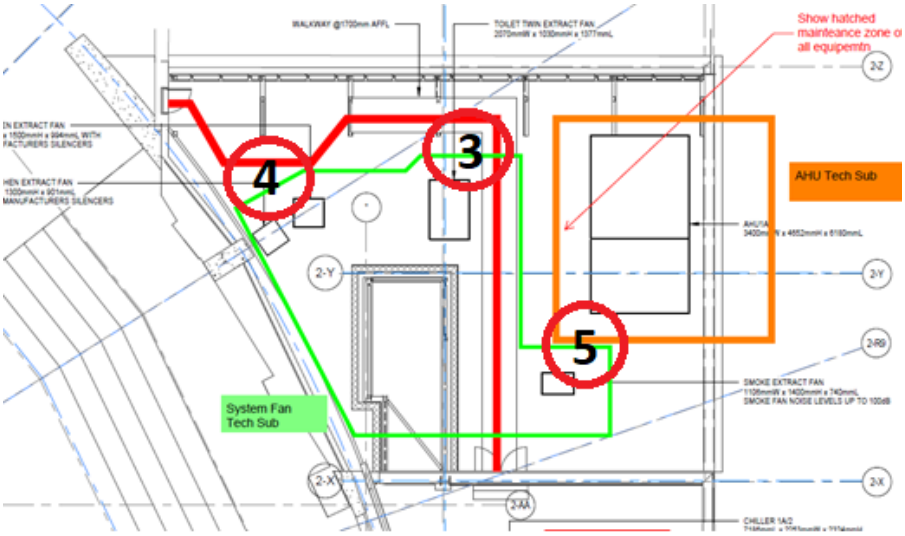


Figure 3 – Noise measurement positions, L4 roof

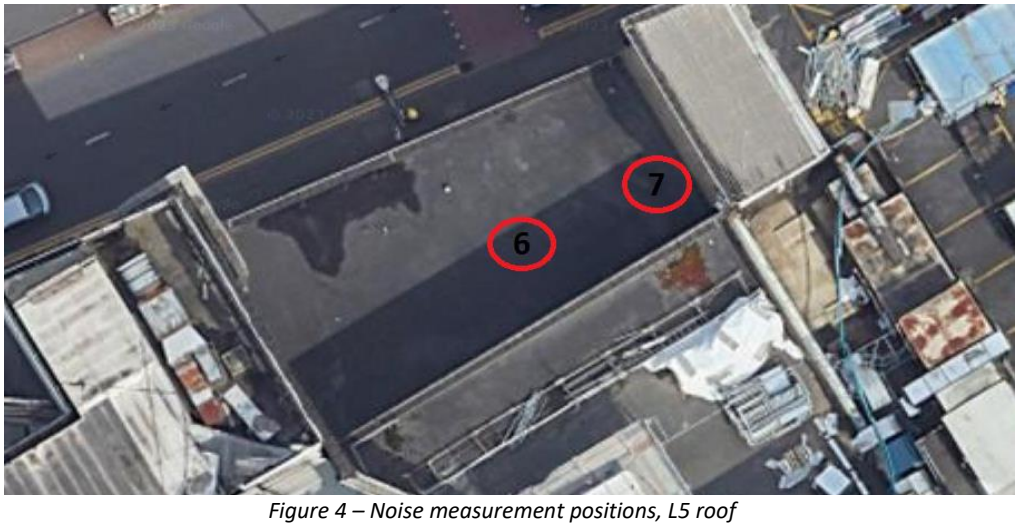


Figure 4 – Noise measurement positions, L5 roof

4.2 Results of Plant Noise Verification Measurements

The following table summarises the results of the noise measurements undertaken on the plant roof(s).

Measurement Position	Plant ON/OFF	Octave Band Centre Frequency (Hz)								dBA
		63	125	250	500	1k	2k	4k	8k	
1. L5 Roof	ON	72.6	67.4	67.1	71.4	63.9	59.5	58.4	49.7	70.8
2. L5 Roof	ON	71.2	67.0	70.6	77.3	67.8	60.7	60.1	51.0	75.6
3. L4 Roof	ON	74.5	70.6	73.0	71.7	65.3	62.4	64.8	63.2	73.3
4. L4 Roof	ON	79.3	72.5	71.0	70.6	65.0	58.9	64.6	61.9	72.3
5. L4 Roof	ON	80.7	72.4	74.0	69.2	67.6	67.4	61.9	55.1	73.7
6. L3 Roof	ON	73.7	68.0	69.3	62.5	60.4	55.6	50.0	40.3	66.0
6. L3 Roof	OFF	67.8	66.3	68.7	61.3	57.4	52.0	48.2	39.3	64.2
7. L3 Roof	ON	73.7	67.3	68.6	65.2	63.3	57.1	49.0	40.6	67.6
7. L3 Roof	OFF	71.5	65.6	67.8	64.3	61.7	53.4	45.8	37.4	66.1

Table 1 - Summary of measured plant noise levels

Noise measurements were undertaken with all plant operating as it would during a typical event. This allows Azymuth to compare measured values with the predicted outputs from the SoundPLAN noise model.

The sound from the associated plant is continuous and based on the octave band noise levels, as well as a subjective assessment of the character of the sound, it would best be described as non-tonal and non-intermittent in nature (i.e it is instead best described as a constant broadband type of sound).

4.3 Analysis of Roof Boundary Noise Levels

Azymuth have measured noise levels omitting from the L4 roof on the L3 roof. These measurement positions were identified as the noise verification positions in the previous iteration of the review of external plant report title 'AA0449.2RevA AO Arena Manchester Acoustic Review of Proposed External Plant Report 03102023'. In this report a noise limit of 68dB $L_{Aeq,5mins}$ on the L3 roof was set.

Azymuth have measured the noise levels (with a distance correction) at these positions to be 67.5dB $L_{Aeq,5mins}$ thus adhering to the aforementioned noise limit of 68dB $L_{Aeq,5mins}$ on the L3 roof.

The table below shows the measured octave band noise levels on the L3 roof.

Measurement Position	Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1k	2k	4k	8k	
L3 Roof	72.7	68.1	69.9	65.6	61.9	56.3	52.8	45.8	67.5

Table 3 – Octave band noise levels measured on L3 roof (measurement positions 6 and 7)

5.0 SoundPLAN Noise Model

A SoundPLAN noise model was developed for the initial planning stage NIA, this model has now been updated taking into account recent noise measurements as set out above.

The following Cross-section Noise Map (CSM) shows how the noise levels propagate from the new plant in terms of the change in noise levels that will be experienced across the neighbouring area (primarily across Trinity Way) when external plant changes ON/OFF state. It will be observed that the noise levels will change by 1dB or less at all adjacent receptor locations.

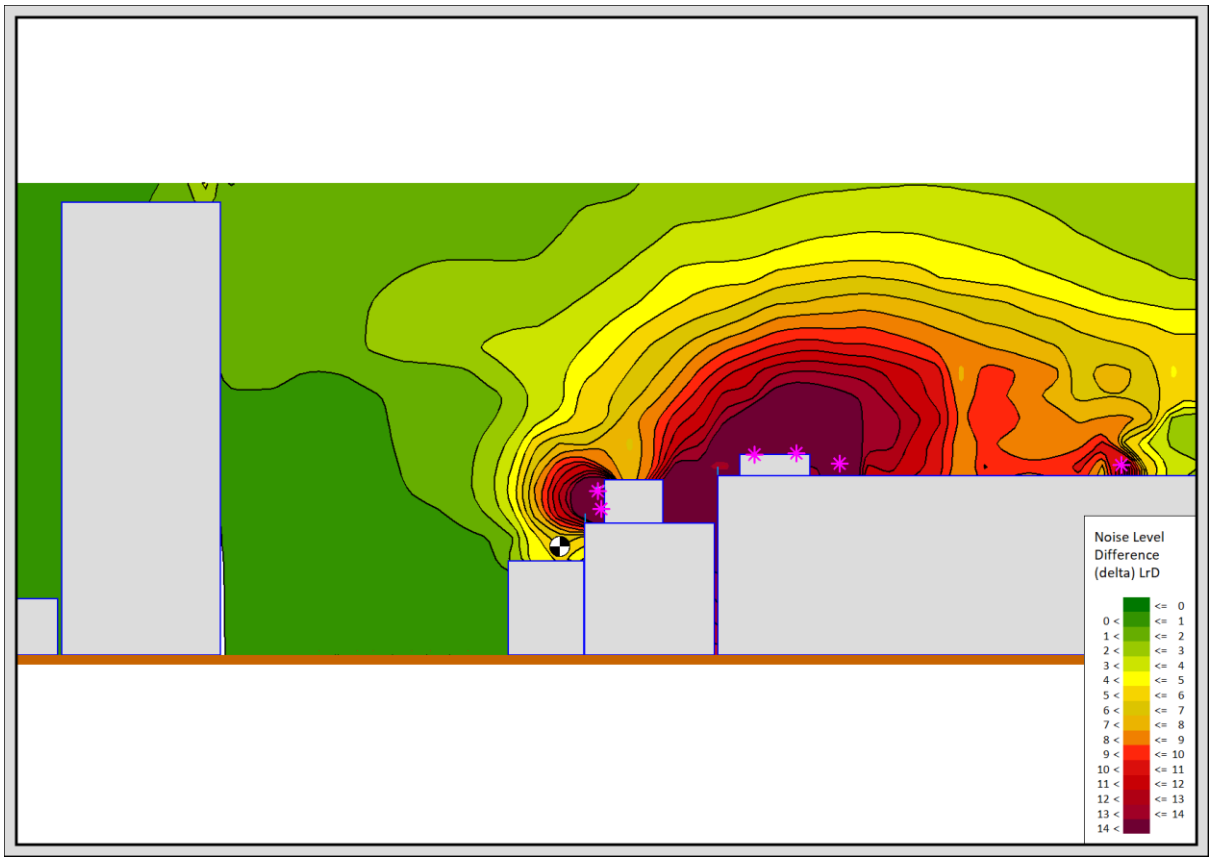


Figure 5 – Daytime noise level difference (ON/OFF) CSM

The Grid Noise Map (GNM) below shows the effect of plant noise on the surrounding environment in terms of the change in noise levels as above.

The GNM has been computed at a height of 15m to represent the approximate height of the fourth-floor window (receptor) adjacent to the roof plant.

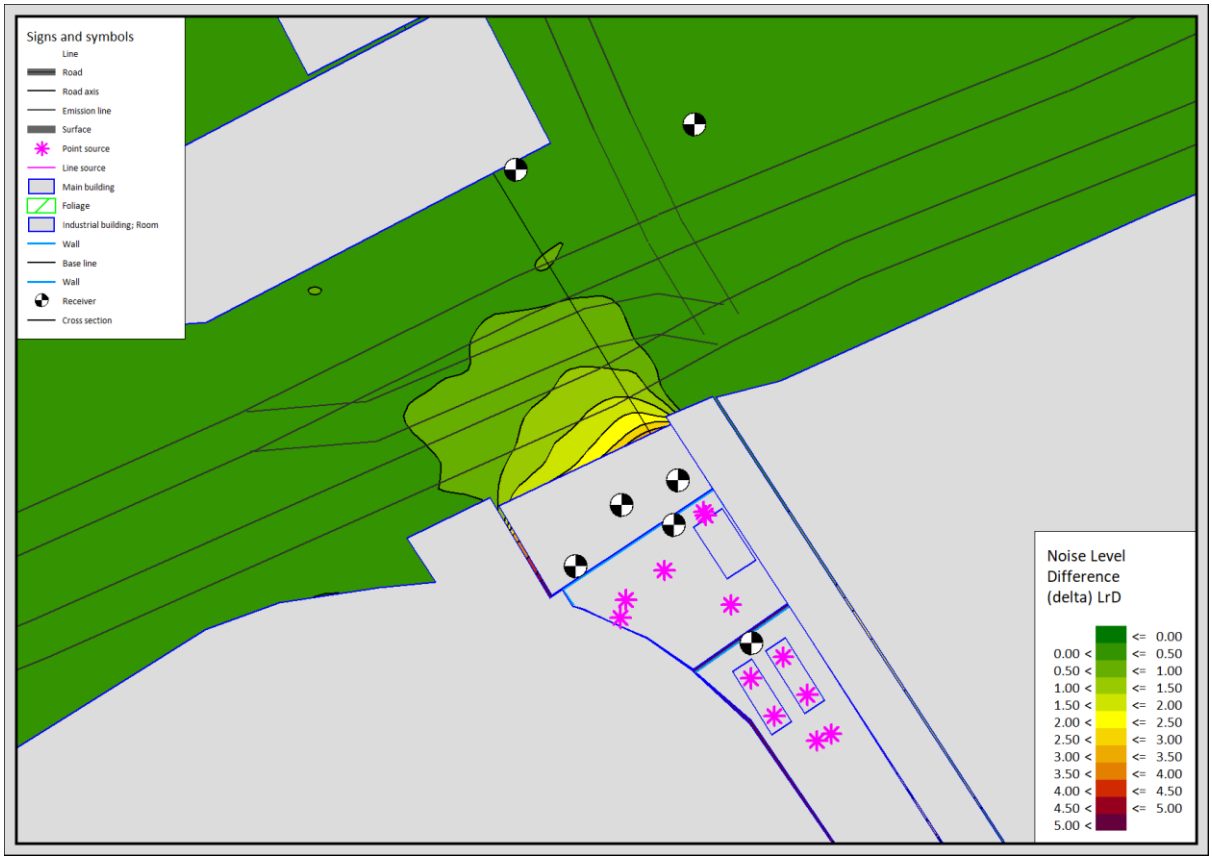


Figure 6 – Daytime noise level difference (ON/OFF) GNM (15m height)

6.0 Assessment of Noise Levels

The following table shows the BS 4142 noise assessment that has been undertaken using recently measured noise data for the nearby receptors. This assessment relies on the baseline noise data measured during the noise survey undertaken at the planning stage of the project.

The assessment is based on recently measured noise levels where plant is operating in the same capacity as it would during a typical event. The plant in this capacity is likely to only be operational for a few hours when there is an event on at the arena and therefore the impact across a full day is likely to be less due to the expected reduced noise levels when plant may not be in use.

Receptor Location	Distance from Source to Receiver (~m)	Time Period	Calculated Noise Level at Receptor (dBA)	Background Sound Level (dBA)	Penalty for Acoustic Character (dB)	Noise Rating Level (dBA)	Rating Level re. Background Sound Level
Residential Receptors							
Committed Development Dutton Street	30	Day	57.0	62.5	0 - 3*	57.0 - 60.0	-5.5 to -2.5
Beaumont Building	180	Day	36.0	47.2	0 - 3*	36.0 - 39.0	-11.2 to -8.2
Committed Development Mirabel St / Great Ducie St	180	Day	24.0	47.2	0 - 3*	24.0 - 27.0	-23.2 to -20.2
Commercial Receptors – BS 4142 not strictly applicable / NB tonal or intermittency penalty neeed not apply							
8-10 Dutton Street	110	Day	37.7	53	0 - 3*	37.7 - 40.7	-15.3 to -12.3
Manchester College Building (60 Great Ducie St)	72	Day	44.5	62.5	0 - 3*	44.5 – 47.5	-18 to -15
Peninsula Office (Victoria Place)	150	Day	37.2	62.5	0 - 3*	37.2 - 40.2	-25.3 to -22.3
*A penalty range of 0-3dB has been applied, this is due to the potential intermittency of plant changing ON/OFF state. It is unclear if this change in state shall be distincitve when compared to the residual acoustic environment. Azymuth have analysed their near-field measurements undertaken on the plant roof and do not deem any of the plant to have distinctive tonal qualities based on the data.							

Table 4 – BS 4142 noise assessment - Daytime

7.0 Summary / Conclusions

Azymuth Acoustics have carried out a noise verification survey in relation to the rooftop mounted external plant which shall serve the new Mezz Bar and VIP Lounge at the AO Arena. The results of the verification survey and the updated noise model confirm that the noise levels associated with plant noise are below the background sound levels at each of the nearby noise-sensitive receptors.

The extrapolated rating levels at the nearest residential receptors as a result of daytime plant noise are:

- Between 57-60dBA at the committed development on Dutton Street (more than 2.5dB below the background sound level)
- Between 36-39dBA at the Beaumont Building (more than ~8dB below the background sound level)
- Between 24-27dBA at the committed development on Mirabel / Great Ducie Street (more than ~20dB below the background sound level)

As such the noise associated with the development would be deemed to have no significant adverse impact on the surrounding environment as per BS 4142. Hence the findings are consistent with or better than the targets set out in 'AA0449.2RevA AO Arena Manchester Acoustic Review of Proposed External Plant Report 03102023' and as such demonstrate broad compliance with the planning consent.

The noise propagation from the plant also indicates that the noise levels at the nearest noise sensitive receptors will experience a change in noise levels of less than 1dB at any time of day or night during the operation of the plant.

Appendix A – Glossary of Acoustic Terms

Decibel (dB)
This is the unit used to measure sound. The human ear has an approximately logarithmic response to acoustic pressure over a very large dynamic range (typically 20 micro Pascal to 100 Pascal).

dB (A)
This is a measure of the overall noise level of sound across the audible spectrum with a frequency weighting (i.e. A-weighting) to compensate for the sensitivity of the human ear to sound of different frequencies. The A-weighting curve is implemented in sound level meters using an electronic filter that approximately corresponds to the frequency response of the ear.

Octave Band Noise Level
The human ear is sensitive to sound over a range of frequencies between approximately 20Hz to 20kHz. The ear is also generally more sensitive to medium and high frequencies than to low frequencies. In order to define the frequency content of a noise, the spectrum can be divided into frequency bands. The most commonly used frequency bands are octave bands, in which the mid-frequency of each band is twice that of the band below it.

L_{Aeq}
This is the equivalent steady sound level in dB (A) containing the same acoustic energy as the actual fluctuating sound level over a given time period.

Reverberation Time (RT or sometimes T_{30} or T_{60})
This is the time taken for the reverberant sound energy in an enclosure to decay one millionth of its equilibrium value, i.e. by 60dB, after the source has been switched off, is known as the reverberation time. The reverberation time is frequency dependent and it is customary to measure its value in octave or one-third octave bands. Reverberation occurs when sound waves are repeatedly reflected from each surface of the room.

Sound Reduction Index (SRI)
Difference measured between the amount of energy flowing towards the wall in the source room and the total amount of energy entering the receiving room (usual range 100 - 3150Hz for one third octave band values). The SRI varies with frequency and is measured in a laboratory in either octave or one-third octave bands.

SRI = L1 - L2 + 10 log (S/A), where:

L1 = Noise level in the source room
L2 = Noise levels in the receiving room
S = Surface area of test specimen
A = Equivalent acoustic absorption area in the receiving room

Weighted Sound Reduction Index (R_w)
This is a weighted single figure descriptor of the sound insulation performance of a partition measured under laboratory conditions. The procedure used to quantify the R_w is to compare the sound reduction index (SRI) in each of the one-third octave bands from 100Hz to 3150Hz against a set of standard reference curves.