Philip Dunbavin Acoustics Ltd
3 Bridgewater Court
Barsbank Lane
Lymm
WA13 0ER

ACOUSTIC CONSULTANTS

INTERNAL SOUND INSULATION DESIGN - COMMERCIAL

GREAT DUCIE STREET, MANCHESTER

REPORT REFERENCE NO. J003897-5827-DH-01

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Tel: 01925 759380 **Email: enquiries@pdaltd.com**

Registered Number 2302847 England
Registered Office: 3 Bridgewater Court, Barsbank Lane, Lymm WA13 0ER

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One Heritage 7th Floor 80 Mosley Street Manchester M2 3FX	PDA Ltd 3 Bridgewater Court Barsbank Lane Lymm Cheshire WA13 0ER

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01	19/10/2022	David Hible BA(Hons) AMIOA	Initial	Issued
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	Name	Position
Prepared By	David Hible BA(Hons) AMIOA	Graduate Consultant
Checked By	Edmund Evenden BSc (Hons) MIOA	Director

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This report has been prepared based upon a scope of works and associated resources agreed between the client and Philip Dunbavin Acoustics Ltd (PDA). This report has been prepared with all reasonable skill, care and diligence and has been based upon the interpretation of data collected. This has been accepted in good faith as being accurate and valid at the time of the collection. This report has been based solely on the specific design assumptions and criteria stated herein.

CONTENTS

1.0 SUMMARY 4
2.0 SITE DESCRIPTION 5
3.0 NOISE ASSESSMENT CRITERIA 6
3.1 Manchester City Council – Planning Conditions 6
3.2 BS8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings 6
3.3 WHO Guidelines for Community Noise 6
4.0 SURVEY DETAILS AND RESULTS 7
4.1 Environmental Noise and Vibration Survey 7
4.2 Measurement Results 7
4.2.1 Environmental Noise 7
5.0 NOISE SOURCES – COMMERCIAL UNITS 7
6.0 NOISE PROPAGTION AND IMPACT ASSESSMENT 9
6.1 Commercial Noise – Façade Break-Out 9
6.1.1 L90 Assessment 10
6.1.2 Proposed Residential Properties 11
6.2 Commercial Noise - Floor Transfer 12
7.0 CONCLUSIONS 13

APPENDIX A – SURVEY DATA

APPENDIX B – NOTES FOR QUALITY CONTROL

APPENDIX C - DEFINITION OF ACOUSTIC TERMS

1.0 SUMMARY

PDA Ltd was commissioned by One Heritage to carry out an internal sound insulation design assessment in regards to noise generated by commercial units of the proposed development at Great Ducie Street, Manchester. The assessment has covered noise break-out from the façade of the commercial units to the closest existing residential receivers and the proposed receivers to the floors above. The separating floor between commercial units and proposed receivers has also been assessed for noise transfer.

Calculations have been carried out in comparison to planning condition 19a as set out by Manchester City Council which focuses on the impact of entertainment noise, in particular to low frequency. The assessment suggests that the proposed use of the commercial units is likely to achieve the low frequency noise criteria at adjacent residential receivers while also being ≥10 dB below the measured typical background sound level in each octave band at the nearest existing receivers.

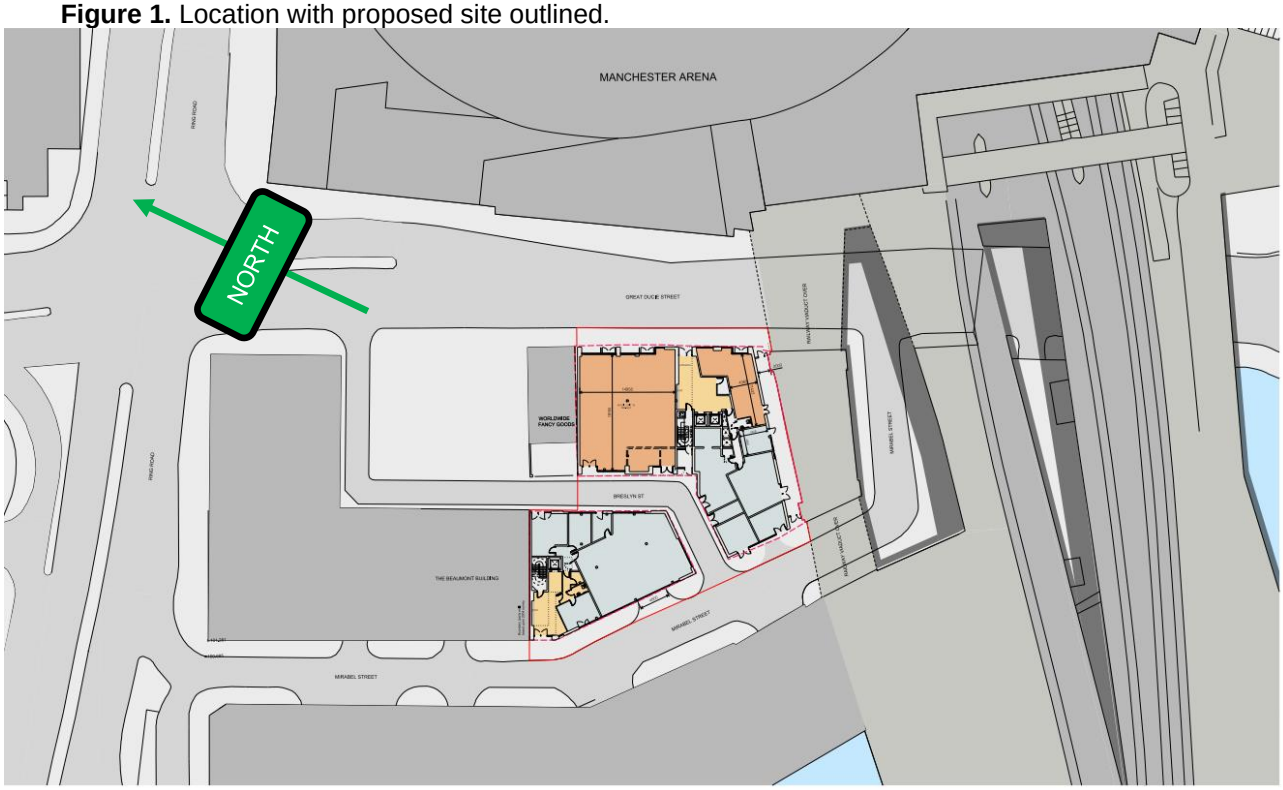
2.0 SITE DESCRIPTION

The proposed development consists of two 9 to 13 storey blocks comprising 129 no. residential apartments and 3 no. commercial units with a shared rooftop amenity space located upon the Great Ducie Street elevation block. The proposal for the ground floor commercial units incorporates A1/ A2 (retail/offices) as well as A3 (restuarant/café) uses.

The development site is immediately bordered by Great Ducie Street to the east with the AO Arena approximately 35m from the eastern boundary. Immediately to the west of site is Mirabel Street and Breslyn Street which runs between the two proposed blocks. To the south of site are four separate trainlines which feed into Manchester Victoria station which are on a raised viaduct.

A site plan showing the location of the site and surrounding local area is shown in Figure 1 below.

Figure 1. Location with proposed site outlined.



3.0 NOISE ASSESSMENT CRITERIA

3.1 Manchester City Council – Planning Conditions

The proposed development has planning conditions set out by Manchester City Council ref: '*122280_F0_2019-Decision_Notice-2059515'* which in particular contains reference to noise break-out from the development. The details of which are given within Condition 19a below:

'19) a) The premises shall be acoustically insulated and treated to limit the break out of noise in accordance with a noise study of the premises and a scheme of acoustic treatment that has been submitted to and approved in writing by the City Council as local planning authority before the development commences. The scheme shall be implemented in full before the use commences.

Where entertainment noise is proposed the LAeq (entertainment noise) shall be controlled to 10dB below the LA90 (without entertainment noise) in each octave band at the facade of the nearest noise sensitive location, and internal noise levels at structurally adjoined residential properties in the 63HZ and 125Hz octave frequency bands shall be controlled so as not to exceed (in habitable rooms) 47dB and 41dB, respectively.

Where any Class A3 use is proposed, before development commences on this use, the premises shall be acoustically insulated and treated to limit the break out of noise in accordance with a noise study of the premises and a scheme of acoustic treatment that has been submitted to and approved in writing by the City Council as Local Planning Authority. The scheme proposed shall normally include measures such as acoustic lobbies at access and egress points of the premises, acoustic treatment of the building structure, sound limiters linked to sound amplification equipment and specified maximum internal noise levels. Any scheme approved in discharge of this condition shall be implemented in full before the use commences.'

3.2 BS8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings

Dwelling houses, flats and rooms in residential use

British Standard 8233:2014, *Guidance on Sound Insulation and noise reduction for buildings*, gives guidance on internal noise levels within dwellings, flats and rooms in residential use when unoccupied. The following criteria are for Living and Dining Rooms for daytime use and Bedrooms for night time.

Table 1. BS8233 recommended indoor ambient noise levels

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35 dB $L_{Aeq,16hour}$	–
Dining	Dining room/area	40 dB $L_{Aeq,16hour}$	–
Sleeping (daytime resting)	Bedrooms	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$

It should however be stressed that the above criterion relates to from sources without a specific character. BS8233 further states the following: *'Noise has a specific character if it contains features such as a distinguishable, discrete and continuous one, is irregular enough to attract attention, or has strong low-frequency content, in which case lower noise limits might be appropriate.'*

3.3 WHO Guidelines for Community Noise

In 1999, the WHO (World Health Organisation) published Guidelines for Community Noise, stating the following internal noise levels are applicable within dwellings.

Table 2. WHO Guidelines for Community Noise criteria

Specific Environment	Critical Health Effect(s)	L_{Aeq} dB	Time Base (hours)*
Dwelling, indoors	Speech intelligibility & moderate annoyance, daytime & evening	35	16
Inside bedrooms	Sleep disturbance, night time	30	8

* Typically taken to be daytime/evening - 07:00 – 23:00 hours and night time 23:00 – 07:00 hours.

4.0 SURVEY DETAILS AND RESULTS

4.1 Environmental Noise and Vibration Survey

A noise level survey was undertaken at the site on Tuesday 5th July and Wednesday 6th July 2022. In addition a second noise level survey was carried out on Wednesday 13th July 2022. The periods measured were deemed to be representative of day and night-time hours. The details of which can be found in our environmental noise survey report ref: *'J003897-5694-DH-01 Environmental Noise Assessment – Great Ducie Street, Manchester'* dated 26th July 2022.

4.2 Measurement Results

4.2.1 Environmental Noise

Measurement positions on site are shown within Appendix A, Figure 1 of this report. A summary of the results is given below:

Table 3. Summary of environmental noise measurements – Measurement Position 1

Position	Time Period (hh:mm)	Duration (hh:mm)	$L_{Aeq,T}$ (dB)	Typical Night-time $L_{Amax,5mins}$ (dB)[1]
1	Day 5/7/2022 21:20 – 23:00 13/7/2022 07:00 – 11:00	05:40	66.1*	N/A
	Night 5/7/2022 23:00 – 01:00 Night 13/7/2022 06:05 – 07:00	02:55	63.4*	78.7

Notes:

1 Typical L_{Amax} noise levels are those which have been calculated as the upper tenth percentile of $L_{Amax's}$

* Periods removed where a street drummer was playing which is consider to not be typical of the environmental noise at site. This is shown within Appendix A Figure 5.

Table 4. Typical Background Sound Level – L_{A90}

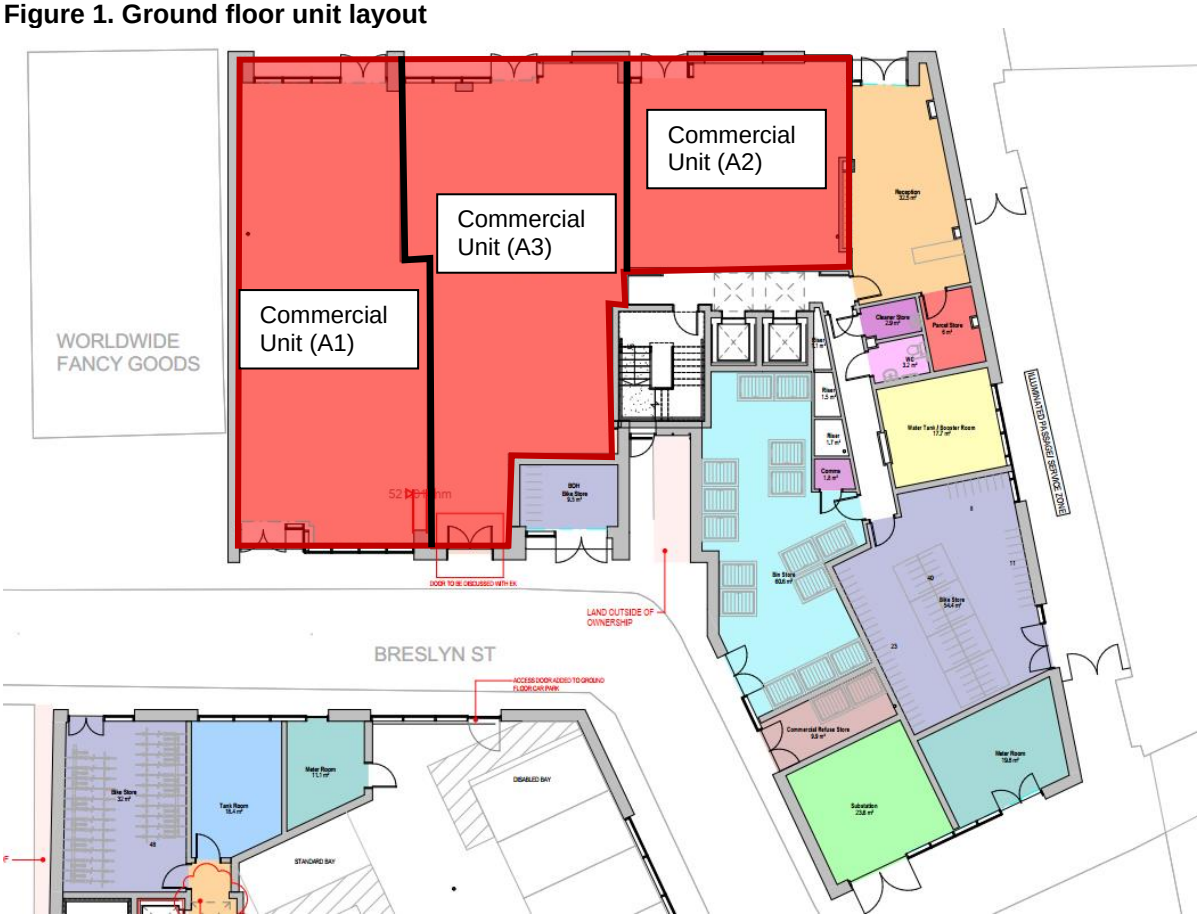
Octave Band Noise Level Data (dB[A]) L_{A90}								Noise Level (dB[A])
63	125	250	500	1k	2k	4k	8k	
32	39	51	50	53	50	40	27	57

NOTE: The figures above have been calculated by taking the average in each octave band from 23:15 – 01:00 which is in the absence of entertainment noise from the AO Arena.

5.0 NOISE SOURCES – COMMERCIAL UNITS

Within the proposed development it is understood there are three different commercial units to the ground floor which will incorporate A1/ A2 (retail/offices) as well as A3 (entertainment) uses. A layout of the ground floor spaces is shown in Figure 1 below taken from DAY Architecture drawing ref: '*1345-22-DAY-XX-00-DR-A-20-0000'*. The commercial spaces are highlighted in red below:

Figure 1. Ground floor unit layout



We would consider the noise generation provided by uses A1 (retail) and A2 (office) to be relatively low and therefore the noise break out would be negligible compared to the existing environmental noise. It is important to note that 'Commercial Unit (A1)' has a mainly glazed façade which faces onto Breslyn street. As this location is in close proximity to the proposed residential block across the street along with the adjacent existing residential receiver, we would highlight that this unit is *not* suitable for high noise level generation such as entertainment noise.

Where the use may be retail, we would expect that typical noise levels with low background music would result in noise-break out which does not give rise to the internal ambient criteria set out within Section 3.2. In addition, we would highlight that the expected noise break-out level of a retail unit would be below that measured for the environmental noise survey and therefore be in compliance with the internal ambient noise criteria as discussed within Section 3.

In order to assess the noise break out of Commercial Unit (A3) we have used noise levels from PDA's database measured within a 'lively' café/bar which are deemed representative of the intended use. The noise levels and associated break-out can be seen in the tables below.

For the glazing element of the Eastern façade we have been informed that the intended product will be 'SOLEAL FY 65' which typically contains a glazing build-up of 6mm-16mm-10mm.

Table 5. Proposed A3 Commercial Use – Sound Insulation Performance of Area Source – East Façade (facing Ducie Street)

Cladding Element	Proportion of Area m²	Sound Reduction Index Octave Band Centre Frequencies (Hz) dB								
		63	125	250	500	1k	2k	4k	8k	
SOLEAL FY 65 (6-16-10)	24	21	26	27	34	40	38	46	46	
Brickslip Wall Build-up	7	33	42	46	50	51	57	66	66	
										A-Weighted Sound Pressure Level (dB)
Internal Noise Level (Lively Bar/Café)		90	88	79	79	76	68	68	68	**81**
Composite SRI		-22	-27	-28	-35	-41	-39	-47	-47	-
Direct to Free Field Correction		-6	-6	-6	-6	-6	-6	-6	-6	-
Brick/Glazing Area Correction		15	15	15	15	15	15	15	15	-
Resultant Radiating Area Source (per m²)		77	70	60	53	44	38	30	30	**58**

Within the Western façade the build up is understood to be a brick-slip system containing a fire escape door which we have assumed as a steel acoustic doorset with perimeter and threshold seals. The performance values of which are detailed in the table below.

Table 6. Proposed A3 Commercial Use – Sound Insulation Performance of Area Source – East Façade (facing Breslyn Street)

Cladding Element	Proportion of Area m²	Sound Reduction Index Octave Band Centre Frequencies (Hz) dB								
		63	125	250	500	1k	2k	4k	8k	
Brickslip Wall Build-up	9	33	42	46	50	51	57	66	66	
Fire Escape Door	3	29	34	37	38	38	41	42	42	
										A-Weighted Sound Pressure Level (dB)
Internal Noise Level (Lively Bar/Café)		90	88	79	79	76	68	68	68	**81**
Composite SRI		-31	-38	-41	-43	-43	-46	-47	-47	-
Direct to Free Field Correction		-6	-6	-6	-6	-6	-6	-6	-6	-
Brick/Glazing Area Correction		11	11	11	11	11	11	11	11	-
Resultant Radiating Area Source (per m²)		63	55	43	41	38	27	25	25	**45**

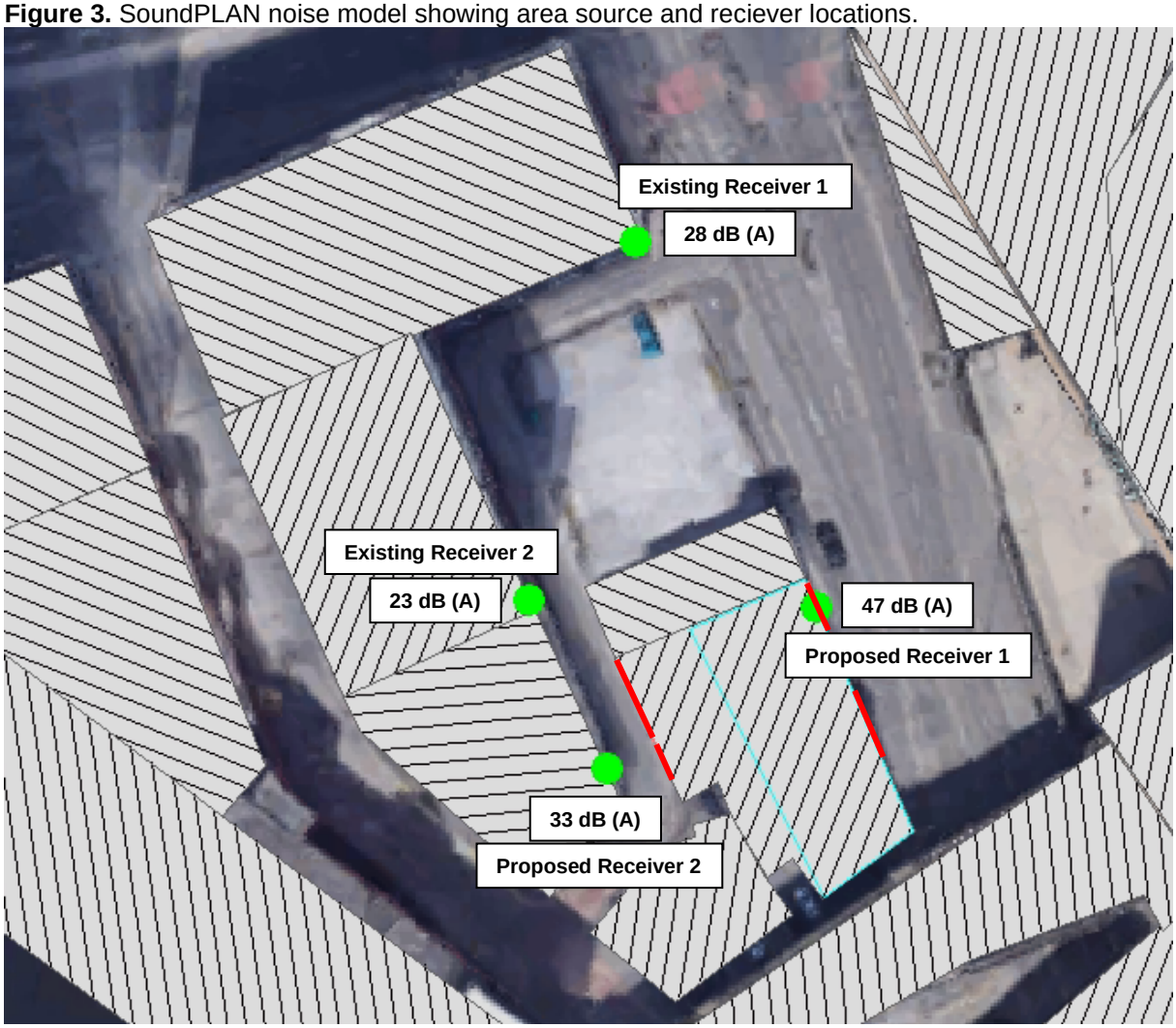
6.0 NOISE PROPAGTION AND IMPACT ASSESSMENT

6.1 Commercial Noise – Façade Break-Out

Using the predicted break-out noise level data above, a 3-dimensional computer noise model has been constructed using SoundPLAN noise modelling software to determine the noise level impact upon the proposed development and closest existing residential receivers. All calculations have followed the methodology contained within ISO 9613-2:1996 *Attenuation of sound during propagation outdoors - Part 2: General method of calculation*. The topographical data for the site and surrounding area is taken from Google Maps Terrain height data.

The model has been calibrated to the calculated area sources associated with the ground floor commercial units. A ground absorption coefficient of 0 has been used to take into account the predominantly hard surfaces of roads, hard standing, etc. From this, the proposed layout of the new buildings has been added. Noise level incident upon the proposed building are calculated at 5m above ground level and 2.8m for each additional floor for the 9-13 storey accommodation. The calculated noise levels at each receiver are shown in the SoundPLAN model below. Area sources are shown by the red lines on the Figure.

Figure 3. SoundPLAN noise model showing area source and reciever locations.



6.1.1 L90 Assessment

As discussed within Section 3.1, part of the planning condition provided by Manchester City Council states that any associated entertainment noise should comply with the limits of being controlled to 10dB below the L_{A90} (without entertainment noise) in each octave band at the façade of the nearest noise sensitive location. The predicted levels due to entertainment noise break-out have been compared with the derived L_{A90} octave spectrum, as given in Table 4 of Section 4.2.1, are displayed in the table below.

Table 7. Assessment against L_{A90} – Nearest Existing Residencies

Assessment Location		Octave Band Noise Level Data (dB[A])								Noise Level (dB[A])
		63	125	250	500	1k	2k	4k	8k	

Existing Receiver 1	Measured L90	32	39	51	50	53	50	40	27	**57**
	Predicted Level of Entertainment Noise	17	26	19	17	13	7	-5	-10	**28**
	Level Difference to Background	**-15**	**-13**	**-32**	**-33**	**-40**	**-43**	**-45**	**-37**	-
Existing Receiver 2	Measured L90	32	39	51	50	53	50	40	27	**57**
	Predicted Level of Entertainment Noise	14	17	13	17	17	7	4	2	**23**
	Level Difference to Background	**-18**	**-22**	**-38**	**-33**	**-36**	**-43**	**-36**	**-25**	-

As can be seen from the Table above, the predicted entertainment noise level due to noise break out from the façades of the proposed commercial units are ≥10dB below the existing L_{A90} in each octave band. This is therefore likely to comply with the planning condition set out by Manchester City Council.

6.1.2 Proposed Residential Properties

As discussed within Section 3.1, the planning condition requires that adjacent habitable rooms to a space which will generate entertainment noise should have internal levels controlled so that 63Hz and 125Hz octave frequency bands are not exceeded by 47dB and 41dB, respectively.

An assessment has been carried out to assess the noise break-out of the proposed commercial units and the predicted level expected at the façade and internally to the residential rooms directly above. A summary of which can be seen in the table below. The noise break-in calculation follows the same method and sound insulation properties as that stated in our earlier report ref '*J003897-5694-DH-01 Environmental Noise Assessment – Great Ducie Street, Manchester*' dated 26th July 2022.

Table 8. Internal Ambient Noise Assessment – Eastern Facade (facing Ducie Street)

Assessment Location		Octave Band Noise Level Data (dB)								Noise Level (dB[A])
		63	125	250	500	1k	2k	4k	8k	
Bedroom (Floor 1 – East Façade)	Predicted level at Façade	66	59	49	42	33	27	19	21	**47**
	Predicted Internal Ambient Noise Level	**39**	**33**	17	2	0	0	0	0	**19**
Kitchen/Diner (Floor 1 – East Façade)	Predicted level at Façade	66	59	49	42	33	27	19	21	**47**
	Predicted Internal Ambient Noise Level	**38**	**30**	14	0	0	0	0	0	**16**

Table 9. Internal Ambient Noise Assessment – Eastern Facade (facing Breslyn Street)

Assessment Location		Octave Band Noise Level Data (dB)								Noise Level (dB[A])
		63	125	250	500	1k	2k	4k	8k	
Bedroom (Floor 1 – West Façade)	Predicted level at Façade	52	43	31	29	26	15	14	16	**33**
	Predicted Internal Ambient Noise Level	**35**	**25**	13	2	-10	-20	-30	-28	**13**

Kitchen/Diner (Floor 1 – West Façade)	Predicted level at Façade	52	43	31	29	26	15	14	16	**33**
	Predicted Internal Ambient Noise Level	**29**	**22**	14	4	-11	-28	-24	-22	**10**

As can be seen from the tables above, the internal ambient noise levels predict that at 63Hz and 125Hz the level will be below 47dB and 41dB respectively and should therefore be likely to comply with the planning condition criteria. We would also note that this complies with the internal ambient noise criteria set out within *BS8233:2014* and *WHO*, discussed in Section 3.

6.2 Commercial Noise - Floor Transfer

In order to assess the transfer of noise generated within the proposed commercial spaces through the floor to the residential spaces above, we have modelled the floor based upon an understood construction:

- *225mm concrete slab, 250mm cavity with 100mm fibreglass insulation and 2 no. Gyproc SoundBloc 12.5mm.*

The assessment has been carried out using the highest expected noise generation which is from entertainment noise. Similarly to Section 6.1.2, the assessment has been carried out against the planning condition to have internal levels controlled so that 63Hz and 125Hz octave frequency bands are not exceeded by 47dB and 41dB, respectively.

The concrete slab floor has been modelled in Bastian, internal sound insulation prediction software, which provides a sound insulation performance of 64dB $D_{n,T,w} + C_{tr}$. The assessment has been carried out against the dimensions of the smallest residential bedroom on the floor above as a 'worst-case' scenario. The details of which are presented below.

Table 9. Internal Ambient Noise Assessment

Assessment Location		Octave Band Noise Level Data (dB)								Noise Level (dB[A])
		63	125	250	500	1k	2k	4k	8k	
Bedroom (Floor 1 – East Façade)	Internal Noise Level (Lively Bar/Café)	90	88	79	79	76	68	68	68	**81**
	Sound Reduction Index of Concrete Slab	56	58	58	65	73	77	91	91	**-**
	Predicted Internal Ambient Noise Level	**34**	**30**	21	14	3	0	0	0	**18**

The assessment shows that the predicted internal ambient noise level as a result of the entertainment noise from the commercial use on the ground floor is within the criteria set out by Manchester City Council. In addition, we would also highlight that this complies with the internal ambient noise criteria set out within *BS8233:2014* and *WHO*, discussed in Section 3.

Points to note

Within our calculations we have assumed that entrance and exit doors to each commercial unit will be closed. We would suggest that the use of a lobbied door system should be implemented in order to prevent sound break-out through an open area. All doors should be well sealed with no gaps around the perimeter.

At the time of the preparation of this report flanking details are not known however these calculations assume that flanking sound transfer is well controlled. It is recommended that once these details are known that their construction are checked to ensure that the floor performance will not be compromised.

When assessing entertainment use, we have assumed a typical noise level and spectra for a lively café/bar at 81 dB(A). It should be ensured that noise levels are not in exceedance of this by use of a limiter on the PA system. Where higher noise levels are desired an assessment may be carried out to consider the use of low frequency filters on the PA system to avoid exceedances of the planning condition criteria.

7.0 CONCLUSIONS

PDA Ltd was commissioned by One Heritage to carry out an internal sound insulation design assessment in regards to noise generated by commercial units of the proposed development at Great Ducie Street, Manchester. The assessment has covered noise break-out from the façade of the commercial units to the closest existing residential receivers and the proposed receivers to the floors above. The separating floor between commercial units and proposed receivers has also been assessed for noise transfer.

Calculations have been carried out in comparison to planning condition 19a as set out by Manchester City Council which focuses on the impact of entertainment noise, in particular to low frequency. The assessment suggests that the proposed use of the commercial units is likely to achieve the low frequency noise criteria at adjacent residential receivers while also being ≥10 dB below the measured typical background sound level in each octave band at the nearest existing receivers.

APPENDIX A – NOISE SURVEY

Figure 1. Noise and vibration survey locations.

The measurement positions are detailed as follows:

- *Measurement Position 1 – microphone located on a mast approximately 4m above ground level at the eastern boundary. This was deemed to have no reflective surfaces affecting the noise level measurements.*
- *Measurement Position 2 – vibration transducer located on ground level at southern boundary. This was deemed to be level and on hard ground.*
- *Measurement Position 3 – microphone located on a tripod approximately 1.5m above ground level and approximately 16m from the most southernly rail line. This was deemed to have no reflective surfaces affecting the noise level measurements.*

APPENDIX B – NOTES FOR QUALITY CONTROL

1. Blockwork

All blockwork is to be mortared to an almost fair faced standard both horizontally and vertically. Only perfect blocks may be used with no pitting or cracks. The blockwork must seal effectively to the underside of the soffit.

Where blockwork walls form a cavity wall, care should be taken to avoid rubble and snots from bridging the cavity. This is especially important where one or more of the leaves is floating.

2. Plasterboard

All plasterboard joints are to be butted tight. The rule of thumb is that the joint should be tight enough over its entire length to prevent a normal business card from being inserted. Multiple layers should be fitted with staggered joints.

Base details and deflection heads are to be as per the British Gypsum White Book unless otherwise stated, and copious amounts of mastic to be used when fitting to the walls, floor and ceiling respectively.

3. Mineral Fibre

Mineral fibre slabs are to be butted tightly together and to boundary structures, to form a homogeneous layer.

4. Windows

All window frames are to be a good tight fit into the building structure with any gaps to be filled both internally and externally with a non-setting mastic in addition to the usual weather proofing seal to the exterior. Any gaps between the frame and building that are greater than 5 mm are to packed with a dense mineral fibre prior to mastic sealing.

5. Electrical Sockets

Electrical sockets must not be fitted back to back and removed areas of blockwork and plasterboard should be kept to an absolute minimum.

6. Water Pipes

All water pipes (and any other pipework) are to be resiliently mounted to avoid “water hammer”. This is particularly important for plasterboard walls.

7. Penetrations

Penetrations are to be dealt with as described in this report. Details for specific services penetrations may be supplied upon request.

8. Approved Samples and Inspections

Samples of each individual acoustic element should be provided for inspection at the beginning of its installation. Once approved, the Clerk of Works must ensure that the same level of quality continues throughout construction.

APPENDIX C – DEFINITION OF ACOUSTIC TERMS

The decibel

This is the basic unit of noise, denoted dB.

A Weighting

This is a weighting process which simulates the human ear's different sensitivity at different frequencies. A weighting can be shown two typical ways, 50 dB(A) L_{eq} or 50 dB $L_{Aeq.}$ Both mean the same thing. (See below for a definition of L_{eq}). The dB(A) level can be regarded as the overall level perceived by human beings.

L_{eq} and $L_{eq(s)}$

This is the equivalent continuous noise level which contains the same acoustic energy as the actual time-varying sound. In other words it is a kind of average noise level. It is denoted dB L_{eq} or, for A-weighted figures dB(A) L_{eq} or dB L_{Aeq}. It can also be expressed in terms of frequency analysis (see later). $L_{eq(s)}$ is the sample L_{eq} level.

L_n

This is the level exceeded for n% of the time. It is denoted dB L_n or, for A-weighted figures dB(A) L_n or dB $L_{An.}$ It can be expressed in terms of frequency analysis (see later). L_{90} is the level exceeded for 90% of the time and is a measure of the lowest level typically reached. L_{10} is the level exceeded for 10% of the time and is the highest level typically reached. L_{50} is the level exceeded for 50% of the time and, mathematically, it is the median.

L_{max}

This is the maximum level reached during a measurement period. The "time constant", or the ability of the equipment to respond to impulses is usually expressed along with it, e.g. "Fast", "Slow", etc. It is denoted dB L_{max} or, for A-weighted figures dB(A) $L_{max,}$ dB $L_{Amax,}$ etc. It can also be expressed in terms of frequency analysis.

Frequency Analysis

Whereas dB(A) gives a very useful overall figure, it has its limitations in that it cannot be used to model or predict the effect of noise control and mitigation as this nearly always has radically different performance at different frequencies.

Frequency analysis expresses an overall noise level at each frequency or band of frequencies in the audible range. Octave band analysis divides the audible range into 10 bands from 31.5 Hz to 16 kHz and the noise level in each band can be expressed in any form e.g. L_{eq}, L_{90}, L_{max} etc. One third octave band analysis uses 30 bands.

Narrow band analysis takes the process to resolutions of less than 1 Hz. This is useful for identifying the existence of tones (whines, hums, etc.) and in pin-pointing the sources.