B.Eat Street

NOISE ASSESSMENT

B.EAT STREET, MANCHESTER

1 December 2015

AEC REPORT: P3243/R1/DB

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DOCUMENT STATUS

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1.0 INTRODUCTION

1.1 Acoustic & Engineering Consultants Limited (AEC) has been appointed by B.Eat Street to undertake a noise assessment of the proposed development site of B.Eat Street at Deansgate Mews, Manchester, to accompany a planning application for the scheme.

1.2 The scheme is to develop an indoor and outdoor eating and dining area with associated bars and food outlets.

1.3 The measurement procedure and assessment criteria were discussed and agreed with Richard Knightley, an Environmental Health Officer (EHO) at Manchester City Council (MCC), to consider the potential impact on the existing nearby commercial properties, cinema and residential properties.

1.4 This report presents the general ambient and background noise levels measured on site, the calculated insulation between the development units and existing premises below, and undertakes an assessment based on methodology discussed with MCC.

1.5 Acoustic terminology used in this report is presented in brief in Appendix A.

2.0 BACKGROUND AND SITE DESCRIPTION

2.1 The development is proposed on the second floor of a number of existing buildings at Deansgate Mews, on Deansgate, with additional external seating areas outside, on the open walkway between the row of buildings and the Great Northern Warehouse. Proposed site location is shown in Figure 1, below.

2.2 The development is proposed to contain 6 micro-diners and 3 bars over units D - H and L - O, as well as the accompanying external area, as shown in Figure 2.

2.3 An additional mezzanine deck is also planned above the outside area to the north of the proposed site (in front of unit D), as identified in Figure 2.

2.4 The site is over 2 floors of currently unused units above street level retail units (currently operating as a hairdressers, estate agents and bathroom showroom) which are considered unlikely to remain open beyond 1900h. Evuna wine bar is located to the south of the site, although it is currently understood that only a food unit or quiet bar is proposed above this existing bar.

2.5 The proposed external seating area would be mainly located towards the northern part of the development as indicated by the groups of tables and chairs on Figure 2. This area is currently a relatively quiet walkway accessed from Deansgate and Great Bridgewater Street via Steps and the Great Northern development via first floor exit doors.

2.6 To the east of the proposed development is an AMC Cinema, situated approximately 5m from the proposed site boundary.

2.7 South of the site is Beetham Tower, the nearest residential building, located approximately 115m from the proposed site boundary.

2.8 The proposed operational times will be 7 days a week, through the day until the early hours of the morning.

3.0 NOISE MEASUREMENTS

3.1 External noise measurements were undertaken by AEC for night time noise levels on Wednesday 25 November 2015 between 1900h and 2000h and evening noise levels were measured on Thursday 26 November between approximately 0200h and 0300h.

3.2 Measurements were taken of background (L_{A90}) average (L_{Aeq}) and maximum (L_{max}) over 5 to 15 minute periods, at two locations identified on Figure 1. Full details of the noise surveys are presented in Appendix B with measured noise data presented in Table B1, with a brief description provided below.

3.3 Based on the measured data, the background noise levels in the vicinity of the site during the night time are around 46dBL_{A90} with ambient noise levels of around 50dBL_{Aeq}. It was noted that these noise levels were mainly due to road traffic. During the evening hours, the background noise levels affecting the site were around 55dBL_{A90}.

4.0 BASIS OF ASSESSMENT

4.1 With regard to Entertainment Venues, MCC's guidance states the following:

'Noise from entertainment venues, for example noise from recorded music, live bands, or karaoke, can be particularly annoying for local residents and businesses if it is not adequately contained within the venue.

When considering the potential impact of a proposal for an entertainment venue consultants should consider the overall noise level (L_{Aeq}) and the 63 Hz and 125 Hz octave band noise levels (L_{eq}). Music noise in the 63 Hz and 125 Hz octave bands, which is often described as "bass noise", is particularly difficult to contain and the impulsive character of this low frequency music noise is particularly disturbing for local residents exposed to it.

A planning application for an entertainment venue should demonstrate that music noise from the proposal will not be audible inside residential properties nearby assuming that the residential properties in question have their windows open. The target noise criteria here should be 10dB (L_{Aeq}) below the existing L_{A90} in each octave band.

Applicants and consultants should note that although a particular business model may require a "chilled out" or "acoustic" venue Planning Approval for an entertainment venue will remain in place as long as the development exists. Subsequent owners or tenants may wish to provide much louder entertainment in the future. For this reason applicants and consultants should predict the noise impact of a proposed entertainment venue using noise levels that are representative of those found in "typical" venues of the kind being applied for. Consultants should provide their rational for using particular noise levels and reference the source of the noise levels used during their predictions.'

The above methodology will be considered in the assessment of the music noise break-out to both residential and commercial developments residential.

4.2 Discussions with Richard Knightley of MCC revealed limited concern regarding the impact on nearby residential properties due to the distance of the proposed development from the nearest residential property. Richard's main concern was with the possible impact on the cinema across the open walkway from the proposed development.

4.3 From AEC's previous work with cinema designs, a restriction of NR25 L_{max} from external sources to within a screening auditoria, would seem a typical and reasonable internal value to restrict levels impacting the AMC cinema complex to.

4.4 Based on guidance in BS 8233:2014 – *"Guidance on sound insulation and noise reduction for buildings"*, a suggested internal limit for a cellular office is NR40L_{eq}. However, in addition, based

on the British Council for Offices, a maximum permissible level of 50dBL_{Amax} is also suggested for open plan offices. Factoring in the character of the external noise sources in this situation i.e. voices and music, it would seem applicable to apply an additional -5dB correction to compensate (as is suggested within BS8233), to restrict noise levels within the nearest offices from the site to an NR35 L_{eq} and NR45 L_{max}.

4.5 MCC requires that noise levels from entertainment venues including music are controlled so that the L_{eq} noise level in each octave band centre frequency is limited to no greater than 10dB below the lowest measured background.

4.6 Given the premise of the proposed development involving a lively external seating area, it may not be feasible to meet this criteria. Alternative consideration could be given to control noise from the external seating to a limit of NR25 L_{Amax} and NR20 L_{eq} for bedrooms of nearest residential properties at Beetham Tower, as a more applicable criteria.

4.7 For the nearest residential property, Beetham Tower, noise from music and the external seating area should be restricted to a max of NR25 L_{max} and an NR20 L_{eq}.

4.8 With regard to noise from mechanical services, the document indicates that plant noise levels affecting the nearest noise sensitive location must be controlled to no greater than 5dB below the lowest measured background noise levels at the nearest noise sensitive location to the plant, at the quietest time that the plant could be operational.

4.9 In addition to the above, the noise from the plant must not contain any characteristics (e.g. tonal or clicks). If the noise character of the plant cannot be controlled, the noise limit for the plant at the nearest noise sensitive property must be at least 10dB below the lowest measured background level.

5.0 ASSESSMENT OF PROPOSED DEVELOPMENT

5.1 The noise levels generated from different noise sources and potential operations associated with the development have been assessed individually as presented below.

External Seating (Clientele Noise)

5.2 The proposed design reduces seating areas the further south it progresses with the bulk of seating provision located to the north of the site, this would help to control noise impacting on sensitive properties to the south of the proposed development, including Beetham Tower.

5.3 It is understood that the current proposals are to use the external seating throughout the entire opening period. The noise will need to be controlled to nearby commercial properties during the daytime and during the late evening / night-time. With regard to the nearest residential properties at Beetham Tower, some 120m from the site and the adjacent cinema complex, noise will need to be controlled at all times.

5.4 Previous noise level measurements undertaken by AEC at a busy external bar and eating area containing around 200 people were made at a distance of around 8m, resulting in levels of 65dBL_{Aeq} during the day and 65-69dBL_{Aeq} at night, with levels up to 83dBL_{Amax} for a very loud voice or laughter. The proposed site is a smaller sized area, and as such, it is anticipated that external noise levels would be in the order 65dBL_{Aeq} in the day and 69dBL_{Aeq} at night, with maximum noise levels of no greater than 80dBL_{Amax}, at 8m.

5.5 Further to the above, generally accepted sound power level for the human voice has a range from 70-90dBL_{WA}, with a level of 83dBL_{WA} for a loud voice, which is considered to be appropriate for the external seating area. These values support the levels measured previously by AEC as a means for use in calculation.

5.6 The nearest noise sensitive windows to the external seating area are for the neighbouring 'Love Exclusive' photography studio to the south of the proposed development, the nearest windows will be approximately 40m south of the main external seating area.

5.7 Due to the location of the studio's windows, combined with the reflections from the Great Northern building, it is anticipated that the resulting external noise levels would be around 55dBL_{Aeq} at the windows of the photography studio.

5.8 It is understood that the photography studio operates Thursday to Sunday, 0900 to 1630h and all the windows are sealed closed. As such, the calculated internal noise level from the external seating area would be around NR25 L_{eq} (30dBL_{Aeq}). This level is well below the proposed required noise level of NR35 L_{eq} for offices, and, as such should be deemed acceptable.

5.9 Maximum noise levels due to laughter or loud voices could, on occasion be up to around 68dBL_{Amax} outside the property. This would result in internal noise levels of around 37dBL_{Amax} which is significantly below the proposed internal noise limit of 50dBL_{Amax}.

5.10 These calculated internal noise levels in the photography studio are unlikely to be deemed intrusive.

5.11 The predicted noise levels at the side of the AMC building are around 83dBL_{Amax}. From this façade to the inside of the cinema are double glazed windows, a corridor (approximately 2.5m wide) and an internal separating wall between the corridor and auditoria. Assuming the windows are standard double glazing (4mm glass / 12mm thermal cavity / 4mm glass) and the internal wall is of a twin steel stud construction (with 100mm air gap and 75mm of 33kg/m^3 rockwool with two layers of 12.5mm plasterboard either side i.e. standard for this type of development), this would result in expected noise levels inside the auditoria far below the required NR25 L_{max} from the external seating area. A copy of the spreadsheet calculation in relation to this element is presented in Appendix C.

5.12 AEC undertook the original design of Beetham Tower and with reference to the project data, it is known that the external glazing to habitable rooms overlooking the site have a glazing specification of 10/12/6 double glazing. Assuming a distance of 120m between the main external seating area and the nearest façade of the tower and the 'worst case' night-time crowd noise levels of 69dBL_{Aeq} @ 8m, the calculated night-time noise levels from external seating at the proposed development would result in an external noise level of around 45dB$L_{Aeq,}$ which is some 5dB below the lowest measured background level of 49dBL_{A90} between 0200 and 0300h and some 15dB below the lowest measured L_{Aeq} noise levels.

5.13 Although this does not completely comply with MCC's requirements for 10dB below the lowest measured noise levels, it should be noted that the calculated noise break-in noise levels would be up to 15dBL_{Aeq}, and 24dBL_{Amax} (NR15 L_{max}) which should be considered acceptable for distant crowd noise.

External Music

5.14 The planning proposal also has the inclusion of background music to the external seating areas. To allow for this, MCC have requested the inclusion of calculation for limitations to this noise level to enable music noise levels to meet the previously mentioned criteria.

5.15 The closest noise sensitive properties to the proposed site is the adjacent photography studio to the south of the proposed site. To control music break-in noise levels to the photography unit to no greater than NR45 L_{max}, based on standard sealed glazing, external music noise levels external to the studio windows should be limited to 75dBL_{Amax}. Assuming speakers were located at the site boundary, this would result in a limit of 80dBL_{max} in each octave band centre frequency between 63Hz and 4kHz at a distance of 1m from the speakers, which would be equivalent to relatively loud background music. With speakers located further from the studio, a higher noise level at 1m from the speakers would be acceptable.

5.16 This limitation is likely to only be required up until about 1700h as this will likely be the latest the adjacent photography studio would operate until.

5.17 As indicated above, residential properties at Beetham Tower are the closest to the proposed development. MCC request a target noise criteria level where dBL_{eq} noise levels in each octave band centre frequency should be 10dB below the existing background. Given that is external music to be controlled, it would be difficult to achieve this limit and still comply with MCC's requirements. A limit of approximately $85dBL_{Amax}$ at 1m from a speaker at the edge of the boundary would apply, which may limit the operation of the site. As such it is suggested that consideration is given to limiting music noise to no greater than NR25 L_{max} within the residential properties.

5.18 In order to meet the suggested internal noise level criteria of maximum levels of below NR25 L_{max}, a maximum allowable noise level of around $97dBL_{Amax}$ would need to be applied at 1m from the speakers, assuming that around 6 speakers were located at the southern boundary of the site.

5.19 To achieve this, music levels just outside the proposed boundary would need to be limited to around $88dBL_{max}$ in each octave band, as illustrated in Table 1 below.

Table 1: Required Noise Level Limits for External Music at Boundary

Overall, dBL_{Amax}	Noise Level, dBL_{max} @ Octave Band Centre Frequency, Hz						
	63	125	250	500	1K	2K	4K
95	88	88	88	88	88	88	88

5.20 The above limits would relatively loud music noise levels of $87dBL_{Aeq}$ and certainly above background music noise levels. This limit can be re-assessed when the number and location of speakers are known.

5.21 As indicated above, based on AEC's involvement in the design of numerous cinema buildings, it is likely that the nose level limit for the AMC cinema from all external noise sources is NR25 L_{max}. Based on the constructions the required limitation of the external music to allow for this criteria to be met (maintaining the construction assumption stated above), a maximum level at the proposed boundary of $102dBL_{Amax}$ would be needed. Since this level is above the requirement to control noise to Beetham Tower, noise level limits within the cinema.

Bar Noise Break-out

5.22 It is understood that, throughout the daytime and night time, music is wanted to be played. MCC has requested that an assessment level of 95dBL$_{Aeq}$ be used to calculate breakout from the bar/restaurant. However, this level of music would certainly not apply to the daytime when only background music would be played and, as such, consideration is only given to breakout noise to the residential.

Table 2: Typical Noise Levels in a Busy Bar with Background Music

Details	Overall, dBL$_{Aeq}$	Noise Level, dBL$_{eq}$ @ Octave Band Centre Frequency, Hz						
		63	125	250	500	1K	2K	4K
Noise level in busy bar with background music	95	80	80	79	85	88	89	89

5.23 The noise levels breaking out from the bar via the existing double glazed windows and roof have been calculated taking into account the sound insulation performance of the external envelope, distance to Beetham Tower and angle of view and are presented in Table 3, below, compared to the lowest measured background during the night time. As an example, a copy of the glazing break-out calculation sheet is included in Appendix C.

Table 3: Calculated Music Noise and Bar Noise Levels at the Windows of Beetham Tower compared the Lowest Measured Night time Background Noise Levels

Details	Overall	Noise Level, dBL$_{eq}$ @ Octave Band Centre Frequency, Hz						
		63	125	250	500	1K	2K	4K
Noise Breaking out from Bar, dBL$_{eq}$	36	40	41	39	35	28	17	13
Background Noise Level, dBL$_{90}$	49	53	48	50	45	44	39	36

5.24 Based on the above, MCC's requirement in relation to music noise would generally be achieved. However, it should be noted that any music system will be system will need to be controlled at low frequency.

5.25 In addition to the above, it should be noted that, even with windows open, background music noise levels from inside the bar during the daytime would also comply with MCC's requirements that average music noise levels (dBL$_{Aeq}$) should be at least 10dB below the lowest measured background noise levels in each octave band centre frequency.

5.26 For the night-time periods, the commercial properties adjacent to the property will be closed and not of concern, however, the cinema will remain open. Break-out noise to the cinema would be significantly below the maximum external level allowable to control internal noise levels to no greater than NR25 L$_{max}$ and, as such this would be acceptable

5.27 The proposed design does not intend to operate the bar with loud nightclub level music, only potentially loud bar level music and based on this music break-out from the bars should be adequately controlled, particularly when considering the large distance to Beetham Tower and the existing night time background levels along Deansgate.

Noise to Adjacent Uses

5.28 With reference to the noise data in Table 2 above, the expected levels within the bar/restaurant areas would be lower during the daytime, however, consideration has been given to a noise level of 95dBL$_{Aeq}$ in the bar during the day to demonstrate that this noise source should not impact on the units below.

5.29 It is noted that all units will have toilets and ancillary spaces on the lower floors hence buffering the restaurant and kitchen areas from the ground floor uses. The anticipated sound insulation performance of the two floors between the proposed development and the commercial properties below is presented in Table 4, below, together with the calculated noise level in the adjacent units and the suggested noise level limit.

Table 4: Maximum Noise Levels in a Busy Bar with Background Music Playing

Details	Overall	Noise Level or sound insulation performance, dB @ Octave Band Centre Frequency, Hz						
		63	125	250	500	1K	2K	4K
Sound insulation performance*	65dBR_w	35	45	55	65	73	66	72
Anticipated noise level	33dBL_{Aeq}	25	24	25	25	25	29	31
Suggested limit	NR40	67	57	49	44	40	37	35

5.30 As can be seen from Table 4 above, even the noise levels breaking into commercial properties beneath the planned development from the bar during the daytime will be below the suggested noise level limit.

5.31 In addition, as the properties are located on a main road, the background noise in the ground floor spaces will not be low and combined with the fact there are only plans to have background music during the day, it is likely that noise from the units on the top floor will be completely inaudible at all times.

Mechanical Services Plant

5.32 As any residential properties are a significant distance from the development and the background noise levels at this location only reach as low as around 51dBL_{A90}, even noisy mechanical services plant would not be audible at the residential property. As such it is suggested that mechanical services plant is designed to no greater than around 40dBL_{Aeq} at 15m from the development in order that the background noise levels of around in the area of the site are not significantly increased during the early hours of the morning.

6.0 MITIGATION MEASURES

6.1 As identified in the assessment of the noise associated with the proposed development presented in Section 5 above, provided that music noise levels within the bars and the external seating area is limited, noise should not have an adverse impact on the nearby noise sensitive properties. However there are a number of points that can be considered in order to limit potential noise impact and these are discussed below.

6.2 However, greater control of the noise levels from the external music can be achieved through the use of multiple, small, directional speakers. Even greater control can be achieved via the placement of the speakers, the ideal would be to position them around the perimeter boundary, facing down into the site and ideally surrounded by a cantilevered barrier constructed from plywood or equivalent material, focussing the sound into the proposed site and restricting noise levels from exiting the proposed development.

6.3 Acoustic screening in the form of 22mm thick plywood hoarding could be considered towards the south of the mezzanine and south of the ground floor main seating area.

6.4 Should there be a requirement for louder noise within the bar, consideration would need to be given to underlining the existing roof with plasterboard.

7.0 CLONCLUSION

7.1 Acoustic and Engineering Consultants Limited has undertaken evening and night time background and general ambient level measurements around the proposed development site of B.Eat Street, a collection of bars and restaurants with additional external seating area, outside the Great Northern Warehouse on Deansgate, Manchester.

7.2 Based on these measurements, it has been identified that the lowest background noise levels in this area up to 0300h would be around 49dBL_{A90}

7.3 Based on previously measured data for external seating areas, an assessment has been undertaken which demonstrates that using the external seating area should achieve acceptable noise levels at all times even during the worst case weekend night-time periods, when the area would be very busy.

7.4 Based on the existing constructions, calculations have been undertaken to demonstrate that during the night-time, based on typical noise levels in a busy town centre bar with loud music, the noise break-in to the nearby residential tower would comply with MCC's requirement's

7.5 Taking into account the existing constructions, an assessment has been undertaken of the noise transfer to the adjacent units, which demonstrates that for daytime use of the bar and restaurant, playing background music noise only, noise in the ground floor units should be inaudible.

7.6 A limit has been set for any atmospheric plant noise emissions in order that plant will be at least 5dB below the existing background noise levels in the vicinity of the site.

7.7 Potential additional mitigation measures have been identified in section 6 which could be considered to further control noise.

7.8 Based on the above, it would appear that noise should not be considered a determining factor when considering any planning application for the site, and any conditions set would not need to be onerous.

FIGURE 1 – Existing Site Layout Showing Monitoring Locations

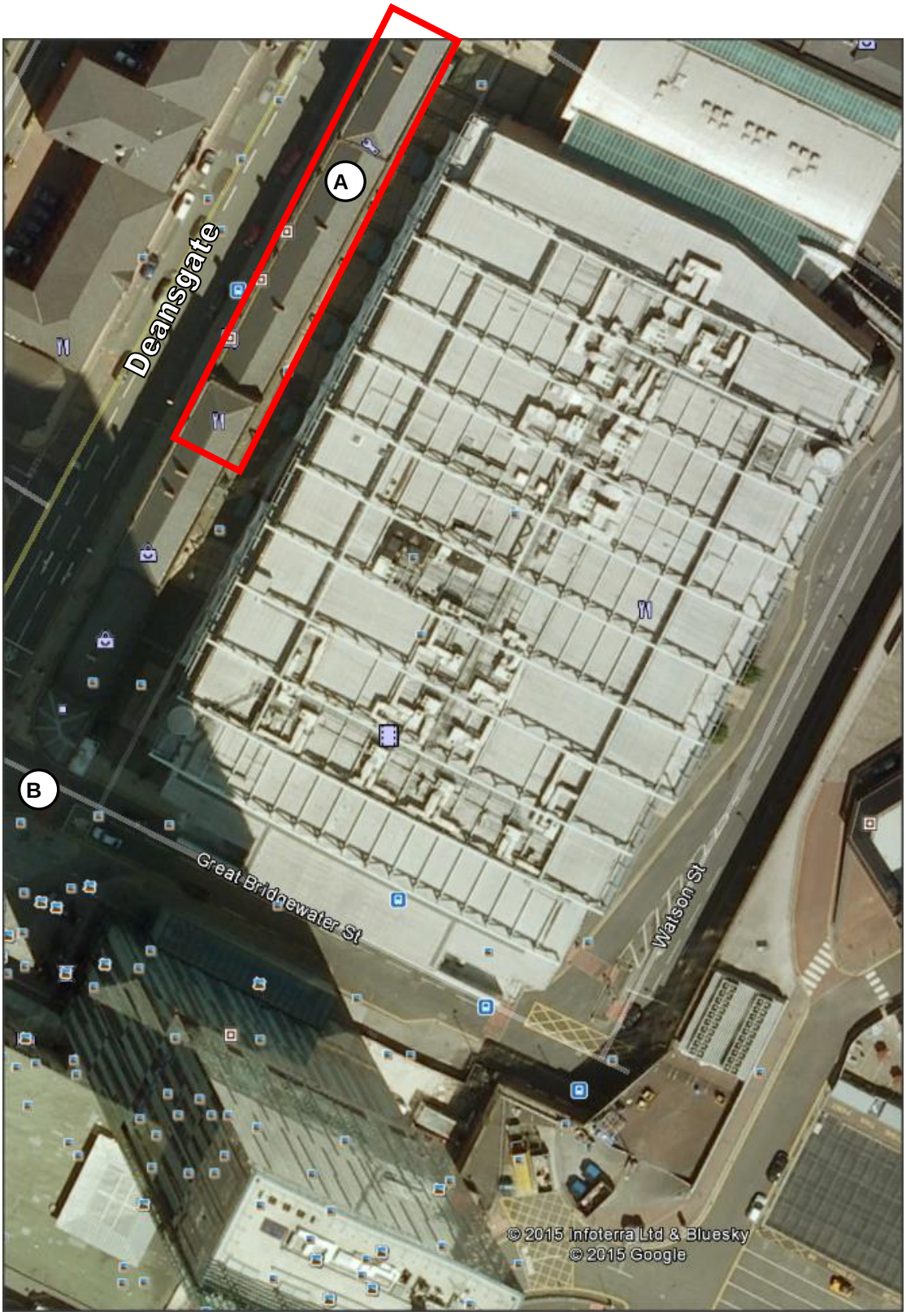
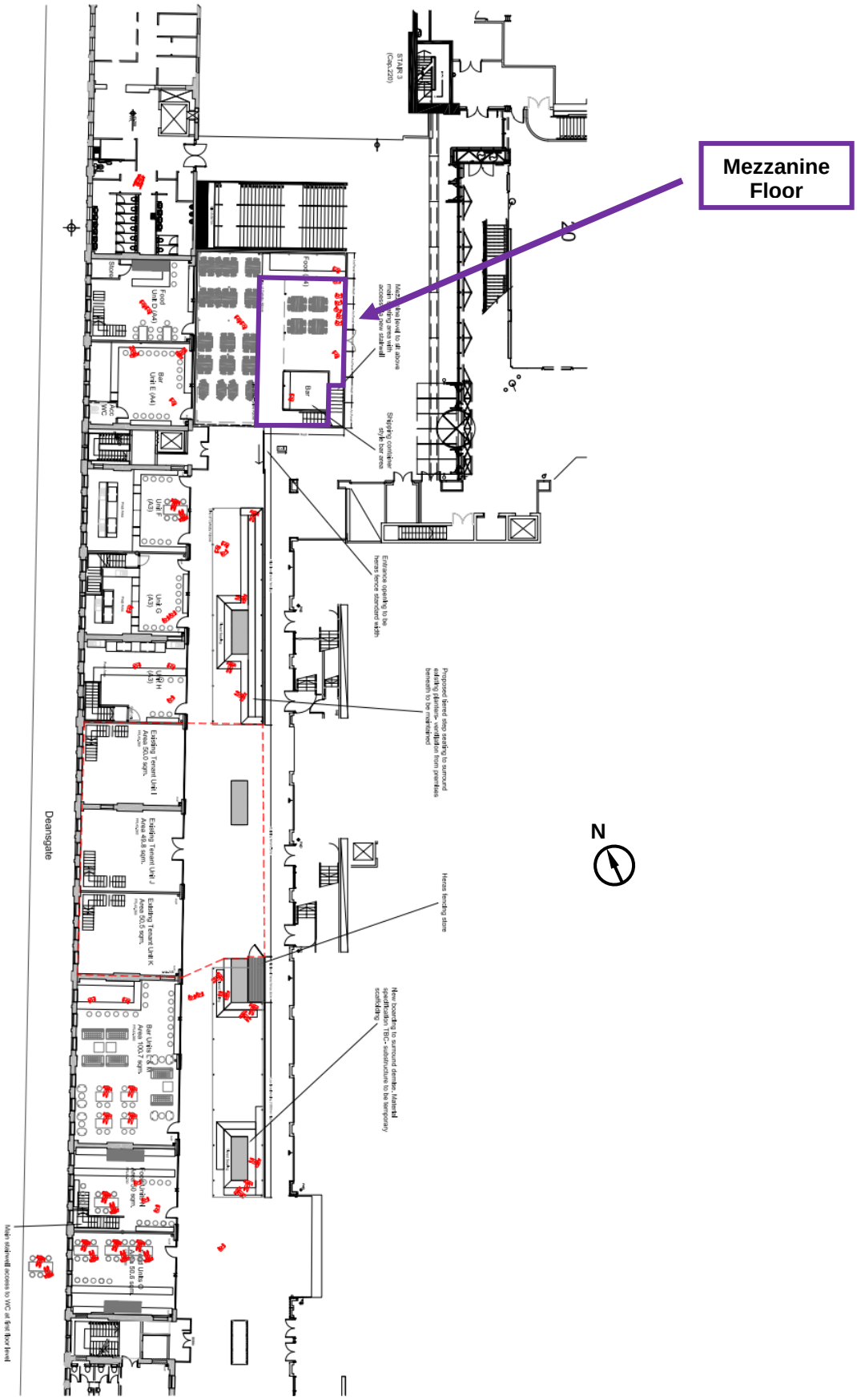


FIGURE 2 – Proposed Site Layout



APPENDIX A – Measurement Procedure

Date & Time of Survey:	Wednesday 25 November 2015, approximately 1900h to 2230h. Thursday 26 November 2015, approximately 0200h to 0300h.
Personnel Present:	Andy Burke (AEC).
Equipment Used:	B&K 2250 Real Time Analyser (AEC Kit 3)
Weather Conditions:	Overcast, dry, 8°C, 3m/s northwesterly wind.
Measurement Procedure:	Noise levels were measured at 2 locations around the development site, identified as A and B on Figure 1 and described below. A. On Deansgate Mews, close to the proposed mezzanine seating area. B. On Great Bridgewater Street, opposite Beetham Tower, approximately 5m from edge of carriageway. Both locations were selected to measure general ambient, background and maximum noise levels, which were measured in terms of L_{Aeq}, L_{A90}, and L_{Amax}, levels over 5-15 minute periods. All the measurements were taken in free-field at a height of 1.5m above ground. The sound level analyser, which conforms to BS EN 61672-12003 *'Electro acoustics – sound level meters - Part1Specifications'* for Class 1 Type Z meters, was in calibration and check calibrated before and after the measurement periods using a Brüel & Kjær type 4231 (94dB) calibrator. There was no significant drift of calibration. Calibration certificates are available on request.
Measured Data:	Full results are given in Table A1.

Table A1 – Measured Noise Levels

Position	Period	Measured Noise Level, dB			Notes
		L_{Aeq}	L_{A90}	L_{Amax}	
Evening					
A	1901-1907	58.6	54.4	68.9	Plant from Great Northern, Traffic on car park ramps to north, pedestrian activity, distant road traffic.
	1946-1948	57.4	55.1	63.7	As above
B	1908-1928	68.8	59.8	84.9	Traffic on Great Bridgewater Street and Deansgate
	1955-2005	72.8	58.7	93.8	As above, max due to car horn
Night-Time					
A	0223-0228	51.4	45.7	62.6	Plant from Great Northern, Traffic on car park ramps to north, occasional pedestrian activity, distant road traffic.
	0239-0244	50.5	46.0	60.4	As above
	0253-0258	49.8	45.6	55.8	As above
B	0230-0235	61.9	51.6	74.5	Traffic on Great Bridgewater Street and Deansgate
	0251-0256	63.3	51.1	77.8	As above
	0300-0306	60.6	49.0	73.6	As above

APPENDIX A – Calculation Examples

Calculation 1: Noise Break-out from Bar

AEC Ltd						**Date:**	16-Nov-15			
Contract No:	P3243									
Client:							Consultant:	DB		
Project:	B.Eat									
		NOISE BREAK OUT TO OUTSIDE								
Source	B.Eat									
Noise Level	95	dBA								
	Corrections to obtain Lp at element ?									
	(eg distance/directivity)									
Building & Element	Glazing									
Area (S)	30	m^2	Width(a)=	10	m	Height(b)=	3	m		
Position Directivity (Q)	4	(=4 for a wall, 2 for a roof)								
Additional Directivity										
Receiver	Boundary									
Distance (R) from element	5	m								
Propagation Corrections										
Barrier	0									
Façade	0									
Calculation										
Frequency, Hz		**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**dBA**
Internal Level,	dB	80	80	79	85	88	89	89	80	95
Internal Corrections ,	dB	0	0	0	0	0	0	0	0	
Corrected Internal Level,Lin,	dB	80	80	79	85	88	89	89	80	95
SRI of Element,	dB	19	24	20	25	35	38	35	40	4mm
Additional Directivity,	dB	0								
Propagation Corrections										
Barrier,	dB									
Façade,	dB									
Level (1) at Receiver	dB	51	46	49	50	43	41	44	30	51

Calculation 2: Noise Break-in to Cinema

Contract No:	P3243								**Date:**	11-Nov-15			
Client:									**Consultant:**	DB			
Project:	B.Eat												

NOISE BREAK IN FROM OUTSIDE VIA WINDOW

Noise Source:	B.Eat												
			Frequency,Hz	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**dBA**
Noise Level at	3	m distance(far field)	Lp,dB	90	90	90	90	95	95	95	95	101.6
Source:	Point											
Corrections												
Façade (0 or -3)	0	dB		0	0	0	0	0	0	0	0	
Distance to source	5	m	dB	-4	-4	-4	-4	-4	-4	-4	-4	
Barrier			Attenuation,dB									
Other			dB									

Building & Element	Window										
Area	200.0	m^2	Width=	25	m		Height=	8	m		
Angle of incidence	45	degrees (0 is normal)									
							Percentage Glazing =	100%			
Receiving Room	Cinema										
Volume	2000	m^3	Width=	25	m	Height=	8	m	Depth=	10	m
Reverberation Time	0.5	seconds									

Calculation

		Frequency,Hz	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**dBA**
External Lp			90	90	90	90	95	95	95	95	**102**
Corrections			-4	-4	-4	-4	-4	-4	-4	-4	
External free-field Lp			86	86	86	86	91	91	91	91	**98**
10log(S)			23	23	23	23	23	23	23	23	
10log(A), A=T/0.16V			-28	-28	-28	-28	-28	-28	-28	-28	
10log(4)			6	6	6	6	6	6	6	6	
10log(cos(angle))			-1.5	-1.5	-1.5	-1.5	-1.5	-1.5	-1.5	-1.5	
	Type										**Rw**
Element SRI	**AMC Wall**		**41**	**46**	**56**	**66**	**75**	**76**	**78**	**83**	**68**
Internal Lp			**44**	**39**	**29**	**19**	**15**	**14**	**12**	**7**	**27**
Internal Criterion: NR			55	44	35	29	25	22	20	18	
(enter at 1kHz)											
Difference			-11	-5	-6	-10	-10	-8	-8	-11	

Calculation 3: Break-out from Bar to Residential

AEC Ltd						**Date:**	16-Nov-15				
Contract No:	P3243										
Client:							Consultant:	DB			
Project:	B.Eat										
		NOISE BREAK OUT TO OUTSIDE									
Source	B.Eat										
Noise Level	95	dBA									
	Corrections to obtain Lp at element ?										
	(eg distance/directivity)										
Building & Element	Glazing										
Area (S)	30	m^2	Width(a)=	10	m	Height(b)=	3	m			
Position Directivity (Q)	4	(=4 for a wall, 2 for a roof)									
Additional Directivity											
Receiver	Boundary										
Distance (R) from element	120	m									
Propagation Corrections											
Barrier	0										
Façade	0										
Calculation											
Frequency, Hz		**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**dBA**	
Internal Level,	dB	92	93	87	91	91	88	85	72	95	
Internal Corrections ,	dB	0	0	0	0	0	0	0	0		
Corrected Internal Level,Lin,	dB	92	93	87	91	91	88	85	72	95	
SRI of Element,	dB	19	24	20	25	35	38	35	40	4mm	
Additional Directivity,	dB	0									
Propagation Corrections											
Barrier,	dB										
Façade,	dB										
Level (1) at Receiver	dB	35	31	29	28	18	12	12	-6	27	
Level (2) at Receiver	dB	33	29	27	26	16	10	10	-8	25	