

**PROPOSED INNKEEPER'S COLLECTION HOTEL
1 YORK STREET, MANCHESTER**

NOISE IMPACT ASSESSMENT

On behalf of:

Mitchells & Butlers Leisure Retail Ltd

**PROPOSED INNKEEPER'S COLLECTION HOTEL
AT 1 YORK STREET, MANCHESTER**

NOISE IMPACT ASSESSMENT

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1.0 INTRODUCTION

- 1.1 Hepworth Acoustics Ltd was commissioned by Mitchells & Butlers Leisure Retail Ltd to carry out a noise impact assessment in connection with proposals for conversion of the former offices on the upper floors of 1 York Street to an Innkeeper's Collection hotel.
- 1.2 The ground floor of the building is occupied by an existing Brown's restaurant (also owned/operated by Mitchells & Butlers) and this is to be retained.
- 1.3 The noise impact assessment has included:
- Inspection of the building and surrounding area;
 - Measurement of ambient noise levels at appropriate locations over weekday and weekend periods;
 - Measurement of the airborne sound insulation between the proposed ground floor Brown's and proposed hotel guest room spaces above;
 - Assessment of potential impact of existing ambient noise on hotel guest rooms;
 - Recommendation of appropriate sound insulation measures.
- 1.4 The various noise units and indices referred to in this report are described in Appendix I. All noise levels mentioned in the text have been rounded to the nearest decibel, as fractions of decibels are imperceptible.

2.0 SITE DESCRIPTION & PROPOSALS

Site Description

- 2.1 The existing building is located on the corner of York Street and Spring Gardens in Manchester city centre. The building is bounded by York Street to the south, Spring Gardens to the west and Milk Street to the east. York Street is a single lane one way street, but is a fairly busy route through the city centre. Spring Gardens is a much less used minor road and Milk Street is a narrow alley with very little traffic. The area is predominantly commercial in nature with numerous shops, bars/restaurants and offices in the vicinity.
- 2.2 The building is of traditional substantial masonry construction with existing large single glazed windows. Along the York Street and Spring Gardens elevations, the building is four storey with a double height ground floor which is occupied by Brown's restaurant (also owned and operated by Mitchells & Butlers). The north-eastern corner of the building is a single double-height storey and is occupied by Brown's back of house including a fully enclosed servicing area with a lightweight roof over, this being overlooked by the rear elevation windows of the upper floors of the building.
- 2.3 The upper floors of the building were formerly used as offices. At the time of the noise survey and acoustic testing described in this report, the first and second floors of the building were occupied by residential 'guardians', with only the third floor unoccupied.
- 2.4 The site location is shown in Figure 1.

Proposals

- 2.5 The proposals are for the upper floors of the building to be converted to form a new Innkeeper's Collection hotel with a total of 49 guest bedrooms. The proposed floor layouts are shown in Figure 2. There will be two guest bedrooms at mezzanine level (above the side section and private dining area of the Browns restaurant), which will be referred to as first floor level, with the other guest bedrooms spread more or less evenly across the second, third and fourth floors.
- 2.6 We understand that the existing windows are to be retained and refurbished with secondary glazing installed in all guest bedrooms. Guest bedrooms will be mechanically ventilated via a ducted system with duct terminations away from the noisiest elevations such that there will be no significant external noise break-in via the ventilation system.

- 2.7 Hotel access will be via the stairwell at the eastern end of the York Street elevation, with the reception at current first floor (to be referred to as second floor level). The Brown's restaurant will provide breakfasts for guests of the new hotel.
- 2.8 There is to be no new external plant or equipment installed as part of the development. New mechanical equipment will be limited to air conditioning condenser units and these are to be installed within the fully enclosed servicing area to the rear; and guest bedroom ventilation equipment (i.e. fans) that will be installed within the building with duct terminations at roof level or on the rear elevation, with no significant associated noise anticipated.

3.0 ACOUSTIC DESIGN CRITERIA

Control of Noise Ingress to Hotel Guestrooms

- 3.1 Manchester City Council have clear guidance on appropriate acoustic design criteria for new residential developments, but they do not require any specific noise criteria for proposed new hotels – instead recognising that hotel operators often have their own brand standards and/or rely on appropriate acoustic conditions to provide a good guest experience.
- 3.2 We are not aware of Innkeeper's Collection hotels having any specific brand standards in terms of acoustics, so in the absence of any other guidance we have referred to the Manchester City Council planning guidance for dwellings which is based upon the guidance from British Standard 8233:2014 *Guidance on sound insulation and noise reduction for buildings* to adopt desirable target acoustic criteria. On this basis, we recommend that the following criteria are achieved wherever possible in order to provide guests with a good standard of noise control:

Daytime noise levels no higher than 35 dB $L_{Aeq,16hour}$

Night-time noise levels no higher than 30 dB $L_{Aeq,8hour}$

Night-time peaks of noise to be controlled to generally within 45 dB L_{AFmax} (this applies to the 15th highest L_{AFmax} during any one night)

- 3.3 In addition, for residential developments structurally connected to entertainment premises, Manchester City Council require noise transmission through separating floors/walls to be controlled to be 'inaudible'/'virtually inaudible' as follows:

'Music noise levels in the 63Hz and 125Hz octave centre frequency bands (L_{eq}) should be controlled so as not to exceed (in habitable rooms) 47dB and 41dB (L_{eq}), respectively'.

- 3.4 This would be a desirable target criterion for the control Brown's trading noise transmission to hotel guest rooms above

Control of Plant & Equipment Noise

- 3.5 It is noted that the proposals do not include any new external plant/equipment and there are no existing dwellings in the immediate vicinity in any case. As such, no acoustic design criteria are warranted in respect of plant/equipment.

4.0 NOISE SURVEYS AND MEASUREMENTS

Ambient/Background Noise Survey

- 4.1 Automated external noise measurements were carried out by installing automated data-logging sound analysers with microphones mounted onto poles protruding approximately 1m from the façade of the building through partially open existing third floor windows as shown in Figure 1 and described as follows:
- a) On the York Street elevation;
 - b) On the Spring Gardens elevation; and
 - c) On the rear elevation.
- 4.2 Existing third floor rooms were used as the third floor was the only floor not occupied by “guardians”.
- 4.3 The noise measurements were carried out from around 14:15 on Thursday 7 October 2021 until the morning of the following Monday 10 October 2021 and so covered both weekday and weekend periods.
- 4.4 The purpose of the noise survey was to establish the prevailing external ambient noise climate to determine the sound insulation performance requirements for guest bedroom glazing; and
- 4.5 Noise measurements were taken as a series of consecutive 5-minute periods. Weather conditions during the survey were dry, partially overcast, generally calm and mild (with daytime temperatures of around 15 – 18°C and night-time temperatures between around 6 – 10°C and so suitable for the noise survey. Details of the equipment used for the noise measurements are shown in Appendix II. Calibration checks were carried out both before and after the survey with no variance in levels noted. Frequency analysis was also carried out.
- 4.6 The full results of the noise survey are shown in Appendix II.

Existing External Ambient Noise Levels

- 4.7 Table 1 summarises the measured range of daytime and night-time noise levels at the site over the course of the noise survey excluding the very short Monday morning period.

Table 1: Summary of measured ambient noise levels (dB)

Location	Daytime (07:00-23:00)	Night-time (23:00 – 07:00)	
	L_{Aeq}	L_{Aeq}	15 th highest L_{Amax}
a) York Street elevation	61 - 62	58 – 63	74 – 80
b) Spring Gardens elevation	57 – 64*	54 – 58	67 – 74
c) Rear elevation	54 – 57	49 – 52	61 – 70

* The daytime noise level of 64 dB $L_{Aeq,07:00-23:00}$, which was measured on Friday 8 October was dictated by intermittent short periods of high noise levels during the morning and early afternoon period (as can be seen from the time trace in Appendix II). From review of the audio recordings, these elevated noise levels were found to be due to use of an angle grinder at the construction site immediately opposite on Spring Gardens and therefore not typical. On this basis, we have used the next highest daytime value of 58 dB $L_{Aeq,07:00-23:00}$ for design purposes.

- 4.8 Notwithstanding the extraneous noise noted above, the noise climate at the site is dictated by road traffic noise on York Street and other roads in the vicinity, with some low level, steady building services noise also apparent during lulls in road traffic.
- 4.9 As one would expect, noise levels were highest on York Street, with noise levels on the less busy Spring Gardens being around 4 – 7 dB lower and those on the rear elevation being 3- 5 dB lower still.
- 4.10 The following octave band L_{eq} noise levels have been adopted for design purposes in respect of existing external noise ingress to hotel guest rooms.

Table 2: Adopted daytime octave band external ambient noise levels in dB $L_{eq,07:00-23:00}$

Location	Octave Band Centre Frequency (Hz)							A
	63	125	250	500	1k	2k	4k	
a) York Street elevation	69	61	60	59	58	55	50	62
b) Spring Gardens elevation	63	60	55	55	53	50	43	58
c) Rear elevation	60	56	55	55	53	49	41	57

Table 3: Adopted night-time octave band external ambient noise levels in dB $L_{eq,23:00-07:00}$

Location	Octave Band Centre Frequency (Hz)							A
	63	125	250	500	1k	2k	4k	
a) York Street elevation	68	60	59	58	59	56	52	63
b) Spring Gardens elevation	61	60	53	53	53	50	46	58
c) Rear elevation	58	53	50	48	48	45	40	52

Table 4: Adopted night-time octave band external ambient noise levels in dB L_{Fmax}

Location	Octave Band Centre Frequency (Hz)							A
	63	125	250	500	1k	2k	4k	
a) York Street elevation	85	74	68	78	80	73	65	80
b) Spring Gardens elevation	76	78	69	70	71	70	59	74
c) Rear elevation	76	65	66	64	65	65	63	70

Sound Level Difference Testing

- 4.11 Indicative airborne sound insulation testing has been carried out between the Brown's restaurant and proposed hotel guest room spaces above.
- 4.12 The scope of the testing was restricted by conflicting availability of access to the Brown's restaurant (testing in Brown's could only be carried out prior to 09:00 when the restaurant opens for breakfast trading) and guardian-occupied rooms (access to occupied rooms was only available accompanied after 09:00). Testing between Brown's and upper floor spaces was therefore restricted to the only two suitable vacant spaces on the first floor that were vacant at the time of the testing.
- 4.13 The testing between Brown's and the two vacant first floor spaces was carried out by generating high levels of pink noise within the Brown's large main trading area using sound sources and loudspeakers. The source noise levels were measured in the ground trading area and the corresponding transmitted noise levels were measured in the first-floor spaces. Background noise levels (i.e. the prevailing noise levels in the absence of the transmitted noise) were also measured on the first floor. All rooms used in the testing featured painted plastered walls and ceiling, and thin contract carpet over concrete floor.
- 4.14 The testing was undertaken with B&K 2250 'Type 1' sound analyser (serial no. 3011706). The analyser was checked calibrated before and after the measurements with no variance noted.
- 4.15 The measured in-situ airborne sound insulation values were 50 – 51 dB $D_{nT,w} + C_{tr}$. These values are well above the minimum requirements of Part E of the Building Regulations. For the purposes of this assessment we have adopted the following sound level difference, these being the lower values of the two tests:

Table 5: Measured sound level differences (dB)

Description	Octave Band Centre Frequency (Hz)						
	63	125	250	500	1k	2k	4k
Between Brown’s and first floor spaces	21	32	42	47	54	58	67

5.0 CONTROL OF EXTERNAL NOISE INGRESS TO GUEST BEDROOMS

- 5.1 Using the adopted external noise levels as shown in Tables 2 – 4, we have carried out calculations of potential noise ingress to typical guest bedrooms on each elevation of the building. The calculations, which are shown in Appendix III, have been carried out in line with the rigorous method as set out in BS 8233:2014. Because night-time noise levels were typically found to be similar to or, at the very least, no more than 5 dB below the corresponding daytime values, the calculations have focussed on night-time periods as these will dictate the sound insulation requirements.
- 5.2 The calculations, a sample of which are shown in Appendix III, have indicated that secondary glazing formed of 6mm glass in a separate, substantial and well-sealed frame with a minimum cavity of 50mm between the existing window and new inner window will adequately control the break-in of external noise to all guest rooms.
- 5.3 Please note that we recommend that the existing windows are fully refurbished to ensure that the frames are well-fitted and fully sealed air-tight shut to ensure that the sound insulation properties are optimised prior to installation of the new secondary glazing.

6.0 CONTROL OF BROWN'S TRADING NOISE

- 6.1 As noted in Section 4, the measured airborne sound insulation performance values between the ground floor Brown's demise and the two first floor spaces were above the minimum requirements of Part E of the Building Regulations, but it is necessary to consider whether an improvement in the existing sound insulation performance is warranted in order to adequately control noise impact in line with Manchester City Council's requirements as set out in Section 3.
- 6.2 To determine whether the existing situation will comply with the Manchester City Council criteria, we carried out some short-term noise measurements within Brown's restaurant during a busy Friday evening trading period to establish typical worst-case trading noise levels. The Brown's trading style is for background music noise levels only, so noise levels are dictated by customers' voices.
- 6.3 The following early Friday evening noise levels were measured in the main Brown's trading area between 18:30 and 19:00 on Friday 7 February 2020:

Table 6: Adopted worst-case Brown's trading noise levels in dB L_{eq}

Location	Octave Band Centre Frequency (Hz)							A
	63	125	250	500	1k	2k	4k	
Busy early Friday evening trading period in restaurant with background music	63	72	72	77	76	71	65	79

- 6.4 Using the measured sound level difference values between the Brown's and the proposed guest room 107 above (the lowest sound insulation performance of the two tested rooms), and adopted Brown's trading noise levels, we have calculated the likely transmitted noise levels in hotel guest rooms above as follows:

Table 7: Calculation of likely resulting Brown's trading noise levels in guest rooms

Location	Octave Band Centre Frequency (Hz)							A
	63	125	250	500	1k	2k	4k	
Source trading noise level in L_{eq}	63	72	72	77	76	71	65	79
Measured sound level difference	21	32	42	47	54	58	67	
Calculated resulting L_{eq} in guest bedroom	42	40	30	30	22	13	-2	30

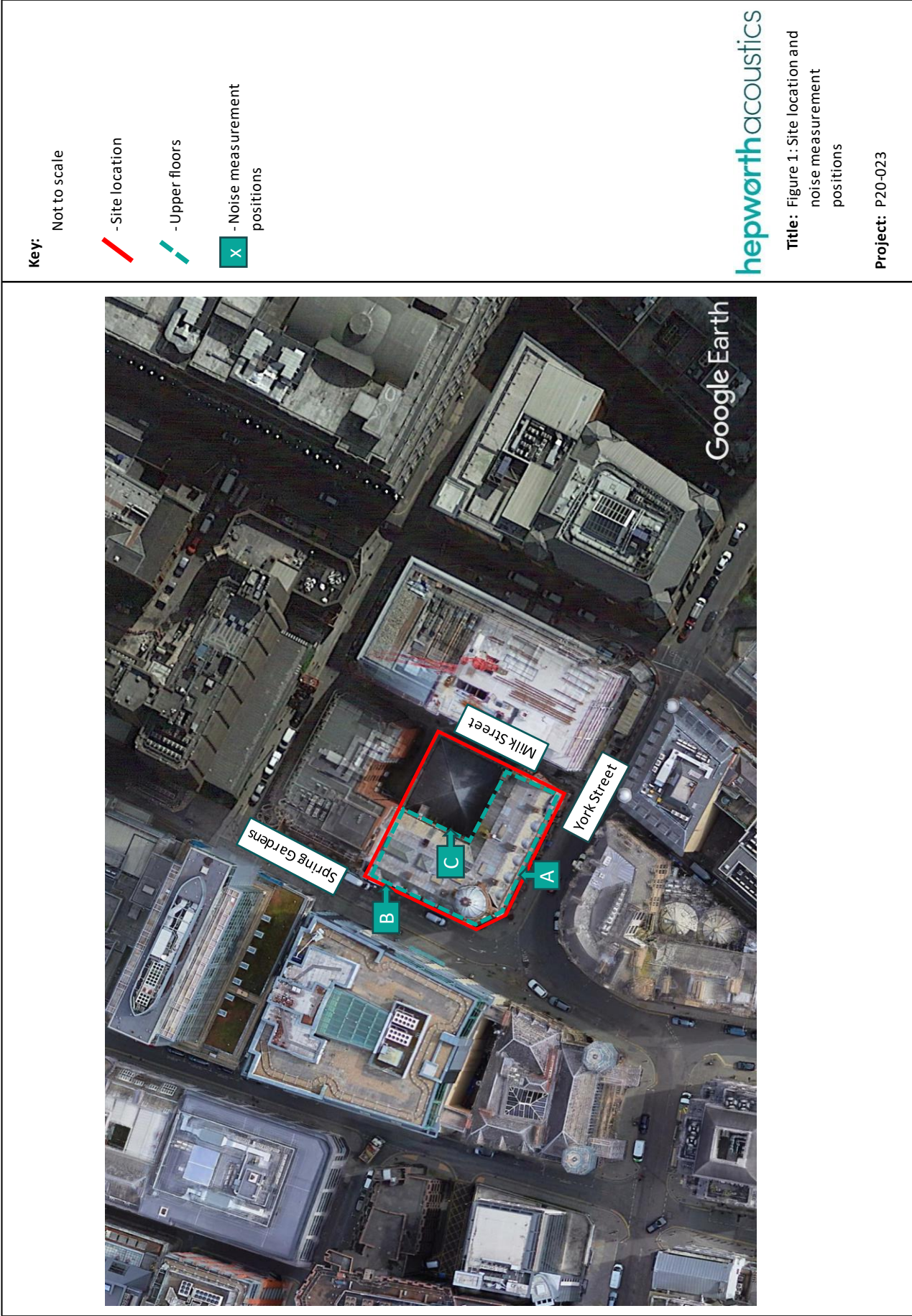
- 6.5 Table 7 shows that the calculated transmitted Brown's trading noise levels will be within the Manchester City Council criteria. The overall transmitted broadband noise level is however

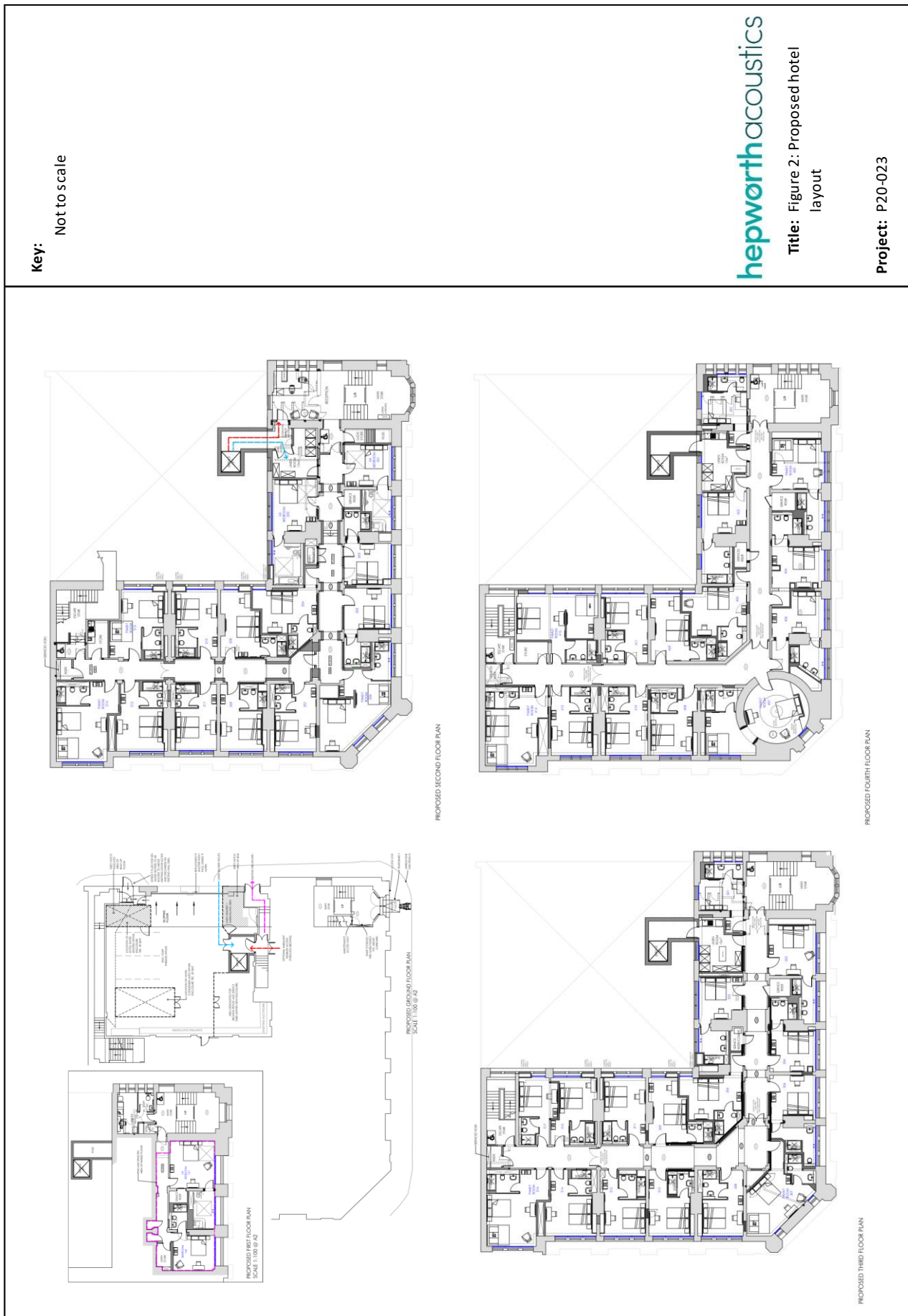
equivalent to 30 dB L_{Aeq} which is equal to the relevant Manchester City Council for external noise ingress for bedrooms at night and so is higher than would be desirable.

- 6.6 A substantially raised floor is however proposed for the first-floor hotel spaces and as such there is the opportunity to incorporate additional sound insulation. We recommend that the raised floor is mounted via proprietary acoustic resilient mounts (e.g. an acoustic cradle and batten system) and mineral wool should be placed between the battens. Subject to these improvements, the overall sound insulation of the floor will be improved significantly such that Brown's transmitted trading noise levels will be well within the relevant Manchester City Council criteria.

7.0 SUMMARY AND CONCLUSION

- 7.1 A noise assessment has been carried out in respect of proposals for the conversion of the former offices on the upper floors of 1 York Street in Manchester city centre to form a new Innkeeper's Collection hotel.
- 7.2 The proposals include formation of 49 hotel guest rooms across the upper floors of the building, with the existing Brown's restaurant (which is also owned and operated by Mitchells & Butlers) on the ground floor to be retained. No new external plant or equipment is proposed as part of the development.
- 7.3 The assessment has included indicative sound insulation testing between the ground floor Brown's restaurant and an ambient and background noise survey at the site covering weekday and weekend periods.
- 7.4 Whilst Manchester City Council have no formal acoustic criteria for hotel bedrooms, we have nevertheless used their residential development acoustic criteria as a basis for determining whether sound insulation enhancements are warranted.
- 7.5 Our calculations have indicated that the proposed secondary glazing will control the break-in of existing external noise to within the adopted noise criteria in guest bedrooms subject to a minimum specification which we have recommended.
- 7.6 We have also recommended some sound insulation measures for the proposed raised floor in guest bedrooms above the Brown's restaurant.





Appendix I: Noise Units & Indices

Sound and the decibel

A sound wave is a small fluctuation of atmospheric pressure. The human ear responds to these variations in pressure, producing the sensation of hearing. The ear can detect a very wide range of pressure variations. In order to cope with this wide range of pressure variations, a logarithmic scale is used to convert the values into manageable numbers. Although it might seem unusual to use a logarithmic scale to measure a physical phenomenon, it has been found that human hearing also responds to sound in an approximately logarithmic fashion. The dB (decibel) is the logarithmic unit used to describe sound (or noise) levels. The usual range of sound pressure levels is from 0 dB (threshold of hearing) to 120dB (threshold of pain).

Due to the logarithmic nature of decibels, when two noises of the same level are combined together, the total noise level is (under normal circumstances) 3 dB(A) higher than each of the individual noise levels e.g. 60 dB(A) plus 60 dB(A) = 63 dB(A). In terms of perceived 'loudness', a 3 dB(A) variation in noise level is a relatively small (but nevertheless just noticeable) change. An increase in noise level of 10 dB(A) generally corresponds to a doubling of perceived loudness. Likewise, a reduction in noise level of 10 dB(A) generally corresponds to a halving of perceived loudness.

The ear is not equally sensitive to sound at all frequencies. It is less sensitive to sound at low and very high frequencies, compared with the frequencies in between. Therefore, when measuring a sound made up of different frequencies, it is often useful to 'weight' each frequency appropriately, so that the measurement correlates better with what a person would actually hear. This is usually achieved by using an electronic filter called the 'A' weighting, which is built into sound level meters. Noise levels measured using the 'A' weighting are denoted dB(A) or dBA.

Frequency and Hertz (Hz)

As well as the loudness of a sound, the frequency content of a sound is also very important. Frequency is a measure of the rate of fluctuation of a sound wave. The unit used is cycles per second, or hertz (Hz). Sometimes large frequency values are written as kiloHertz (kHz), where 1 kHz = 1000 Hz.

Young people with normal hearing can hear frequencies in the range 20 Hz to 20 kHz. However, the upper frequency limit gradually reduces as a person gets older.

Glossary of Terms

When a noise level is constant and does not fluctuate, it can be described adequately by measuring the dB(A) level. However, when the noise level varies with time, the measured dB(A) level will vary as well. In this case it is therefore not possible to represent the noise climate with a simple dB(A) value. In order to describe noise where the level is continuously varying, a number of other indices can be used. The indices used in this report are described below.

D This is the Level Difference and is a field measurement of the airborne sound insulation between adjacent spaces. As well as being field measurement, this term and all other D terms below therefore include on-site conditions other than direction noise transmission through, for example, a wall (flanking transmission).

D_n This is the Normalized Level Difference and is a field measurement of the airborne sound insulation between adjacent spaces.

D_{nT} This is the Standardised Level Difference, which is equivalent to the measured D_n and corrected to a standardised reverberation time of 0.5s.

D_{nT,w} This the Weighted Standardised Level Difference, is a single figure value of D_{nT}, and is the field measurement of airborne sound transmission

D_{nT,w} + C_{tr} This is the Weighted Standardized Level Difference with Spectrum Adaption Term C_{tr}

L_{Aeq} This is the A-weighted 'equivalent continuous noise level' which is an average of the total sound energy measured over a specified time period. In other words, L_{Aeq} is the level of a continuous noise which has the same total (A-weighted) energy as the real fluctuating noise, measured over the same time period. It is increasingly being used as the preferred parameter for all forms of environmental noise.

L_{AFmax} This is the maximum A-weighted noise level that was recorded during the monitoring period with the sound level meter set to the 'fast' time-weighting.

L_{A90} This is the A-weighted noise level exceeded for 90% of the time period. L_{A90} is used as a measure of background noise.

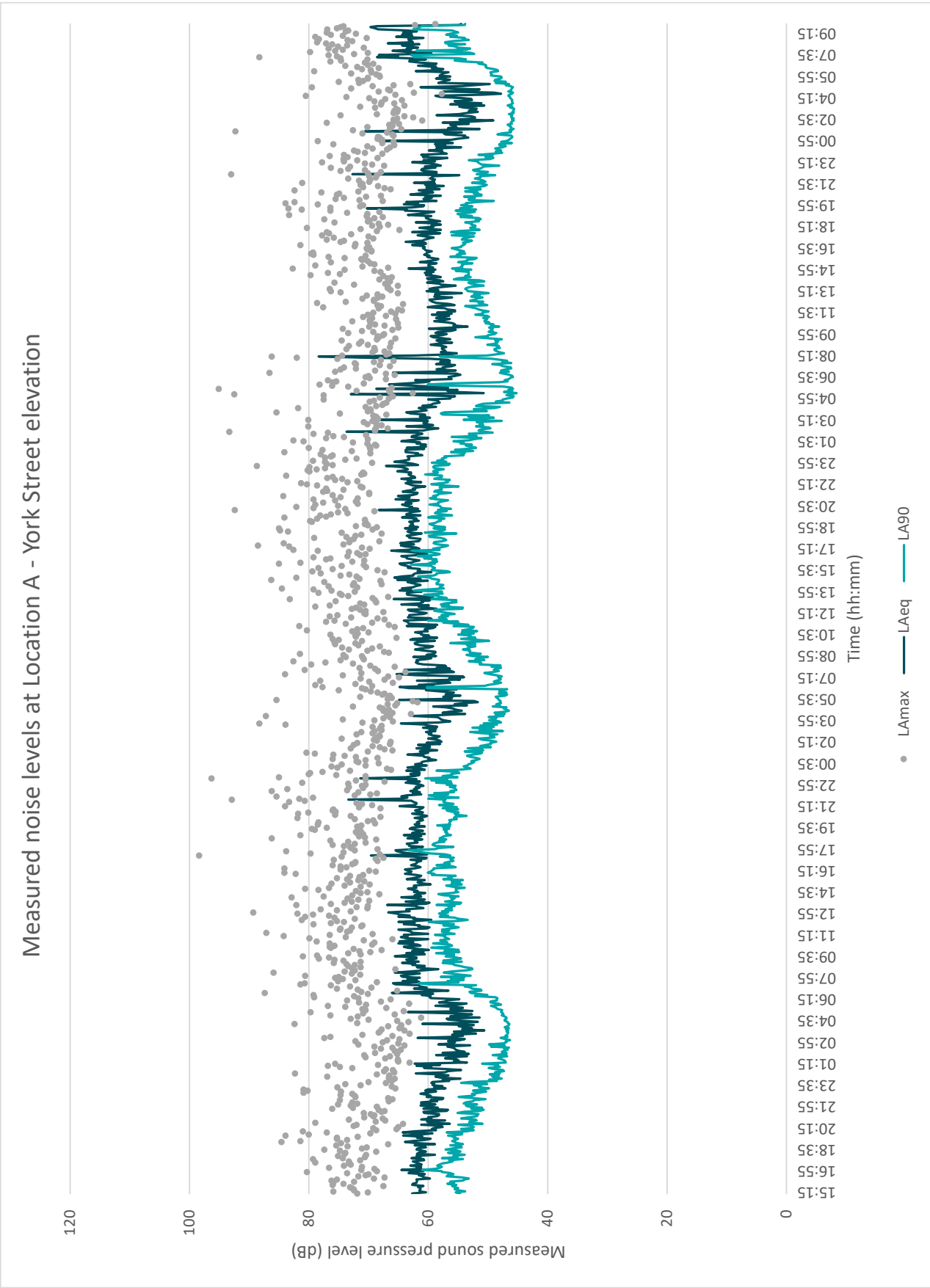
Appendix II: Noise Survey Results

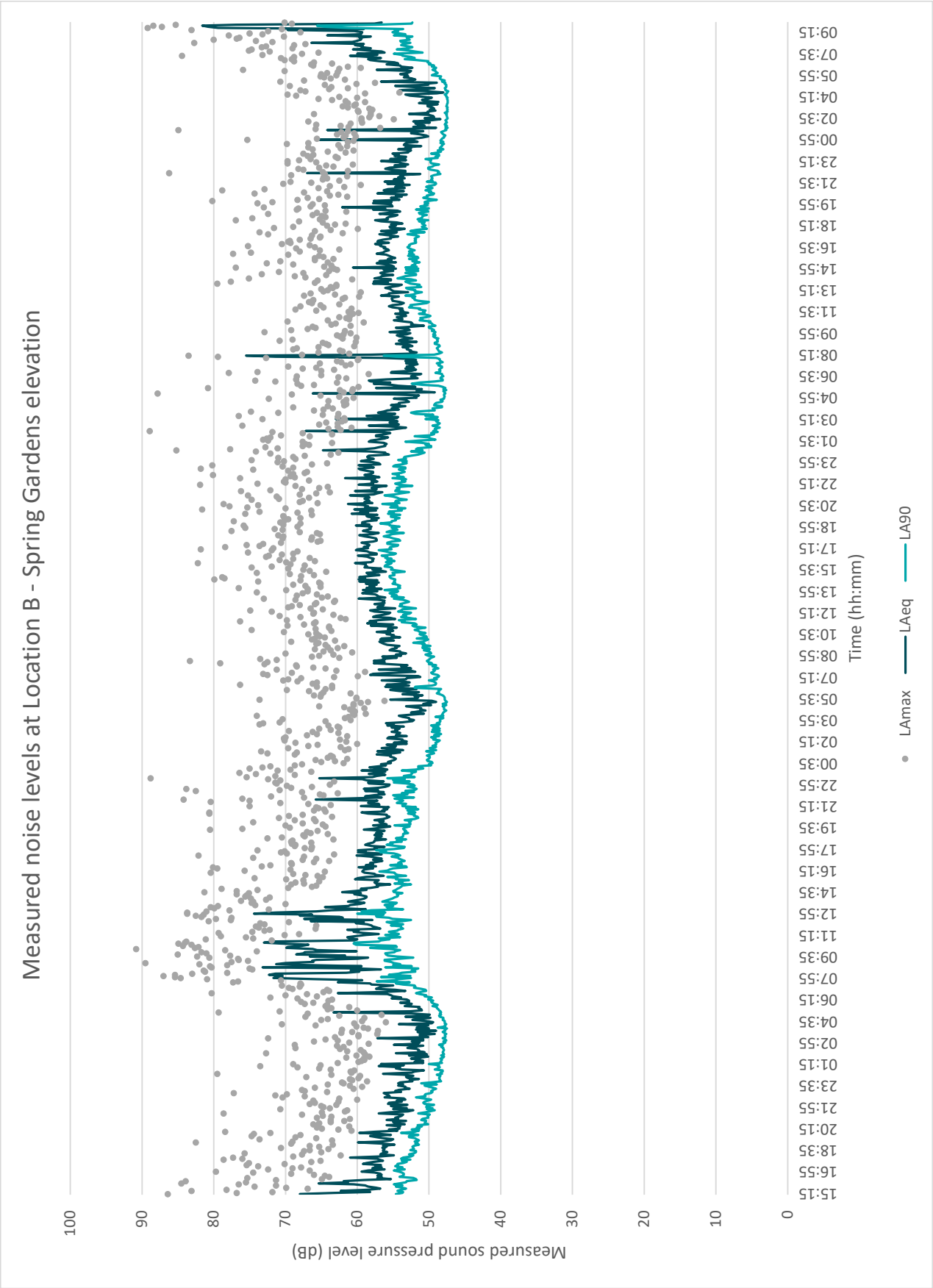
Date(s): Thursday 7 to Monday 11 October 2021

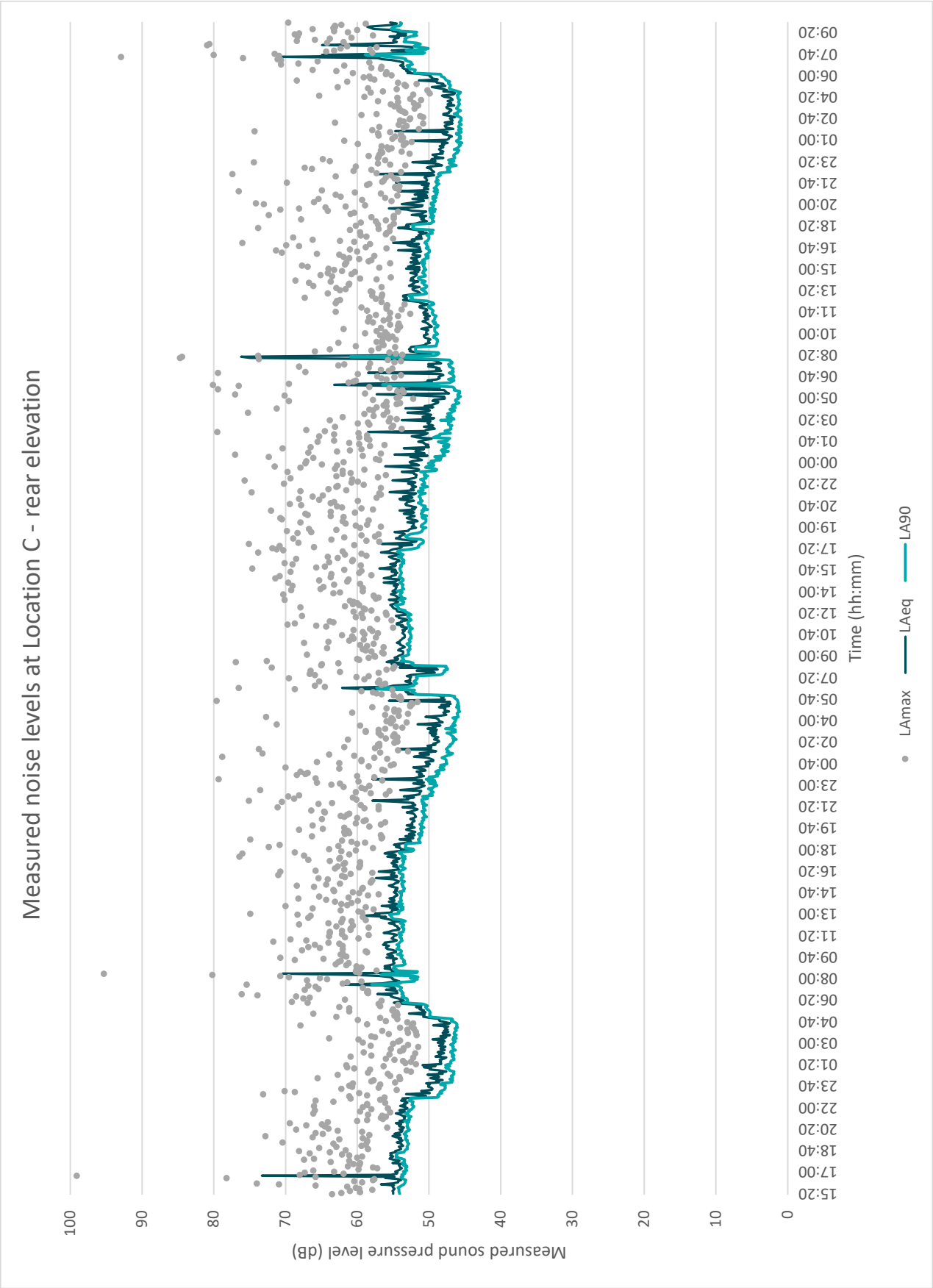
Equipment: 3 x Rion NL52 'Class 1' sound analysers (serial nos. 00620870, 01143558 and 00610178)
Tripods, poles, extension cables and environmental windshields
Calibrator

Weather: Dry, partially overcast, generally calm and mild (with daytime temperatures of around 15 – 18°C and night-time temperatures between around 6 – 10°C)

All levels in dB(A)







Appendix III: Calculations

BS 8233 Calculation of Noise Break-in

The expected precision of this calculation is 12 dB

Site	KC, York Street, Manchester
Period	Night
Room	Room 103 - York Street elevation

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Term	Term Description	Value
S	Facade area (incl. window) (m ²)	9.5
S _w	Area of the windows (m ²)	5.1
S _{ew}	Area of the external wall (m ²)	4.4
x	Room Dimension x (m)	3.5
y	Room Dimension y (m)	3.9
z	Room Dimension z (m)	2.7

RT	Receiving Room RT
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A	L _{max}	Outside Room
A	L _{eq}	Outside Room
	D _{se}	Insulation of the Acoustic Vents ignore Trickle Vent
	R _{wi}	SRI of the window Selectagaze secondary glazing - 4:50:6
	R _{we}	SRI of the external wall BS8233 Example - Brick and block external wall

F	= 10 log (b + c + d)
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G	= 10 x log (5*RT/0.161*V)
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L _{max}	Inside Room (A + F)
L _{eq}	Inside Room (A + F + G)

A-weighting

L _{Amax}	Inside Room
L _{Aeq}	Inside Room

Octave Band Centre Frequency				
125	250	500	1000	2000
0.5	0.4	0.4	0.4	0.4

74	68	78	80	73
60	59	58	59	56

130	130	130	130	130
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18	30	36	42	43
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40	44	45	51	56
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$$B = \frac{A_0}{S} 10^{-\frac{D_{se}}{10}}$$
$$C = \frac{S_{ew}}{S} 10^{-\frac{R_{ew}}{10}}$$
$$D = \frac{S_{ew}}{S} 10^{-\frac{R_{ew}}{10}}$$

-21	-33	-38	-44	-46
-----	-----	-----	-----	-----

-1	-2	-2	-2	-2
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53	36	40	36	28
39	24	17	12	9

-16	-9	-3	0	1
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37	27	37	36	29
23	15	14	12	10

BS 8233 RESULT	
L _{Amax}	42
L _{Aeq}	24

BS 8233 Calculation of Noise Break-in

The expected precision of this calculation is 12 dB

Site	KC, York Street, Manchester
Period	Night
Room	Room 111 - Spring Gardens elevation

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Term	Term Description	Value
S	Facade area (incl. window) (m ²)	9.5
S _w	Area of the windows (m ²)	5.1
S _{ew}	Area of the external wall (m ²)	4.4
x	Room Dimension x (m)	3.5
y	Room Dimension y (m)	3.5
z	Room Dimension z (m)	2.7

RT	Receiving Room RT
----	-------------------

A	L _{max}	Outside Room
A	L _{eq}	Outside Room
	D _{se}	Insulation of the Acoustic Vents ignore Trickle Vent
	R _{wi}	SRI of the window Selectagaze secondary glazing - 4:50:6
	R _{we}	SRI of the external wall BS8233 Example - Brick and block external wall

F	= 10 log (b + c + d)
---	----------------------

G	= 10 x log (5*RT/0.161*V)
---	---------------------------

L _{max}	Inside Room (A + F)
L _{eq}	Inside Room (A + F + G)

A-weighting

L _{Amax}	Inside Room
L _{Aeq}	Inside Room

Octave Band Centre Frequency				
125	250	500	1000	2000
0.5	0.4	0.4	0.4	0.4

78	69	70	71	70
60	53	53	54	50

130	130	130	130	130
-----	-----	-----	-----	-----

18	30	36	42	43
----	----	----	----	----

40	44	45	51	56
----	----	----	----	----

$$B = \frac{A_0}{S} 10^{-\frac{D_{se}}{10}}$$
$$C = \frac{S_{ew}}{S} 10^{-\frac{R_{ew}}{10}}$$
$$D = \frac{S_{ew}}{S} 10^{-\frac{R_{ew}}{10}}$$

-21	-33	-38	-44	-46
-----	-----	-----	-----	-----

0	-1	-2	-2	-2
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57	36	32	27	24
39	19	13	7	3

-16	-9	-3	0	1
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41	27	29	27	25
23	10	10	7	4

BS 8233 RESULT	
L _{Amax}	42
L _{Aeq}	23

BS 8233 Calculation of Noise Break-in

The expected precision of this calculation is ±2 dB

Site	KC, York Street, Manchester
Period	Night
Room	Room 110 - Rear elevation

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Term	Term Description	Value
S	Facade area (incl. window) (m ²)	9.5
S _w	Area of the windows (m ²)	5.1
S _{ext}	Area of the external wall (m ²)	4.4
x	Room Dimension x (m)	3.5
y	Room Dimension y (m)	3.2
z	Room Dimension z (m)	2.7

RT	Receiving Room RT
----	-------------------

A	L _{out}	Outside Room
A	L _{in}	Outside Room

D _{1,2}	Insulation of the Acoustic Vents	Ignore Trickle Vent
------------------	----------------------------------	---------------------

R _w	SRI of the window	Selectagaze secondary glazing - 4:50:6
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R _{ext}	SRI of the external wall	BS8233 Example - Brick and block external wall
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F	= 10 log (b + c + d)
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G	= 10 × log (S × RT / 0.161 × V)
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L _{in,rt}	Inside Room (A + F)
--------------------	---------------------

L _{in}	Inside Room (A + F + G)
-----------------	-------------------------

A-weighting

L _{A,rt}	Inside Room
-------------------	-------------

L _A	Inside Room
----------------	-------------

Octave Band Centre Frequency				
125	250	500	1000	2000
0.5	0.4	0.4	0.4	0.4

65	66	64	65	65
53	50	48	48	45

130	130	130	130	130
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18	30	36	42	43
----	----	----	----	----

40	44	45	51	56
----	----	----	----	----

-21	-33	-38	-44	-46
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0	-1	-2	-2	-1
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44	34	25	21	19
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32	16	8	2	-2
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-16	-9	-3	0	1
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28	25	22	21	20
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16	7	5	2	-1
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$$B = \frac{A_s}{S} 10^{\frac{-D_{1,2}}{10}}$$

$$C = \frac{S_{ext}}{S} 10^{\frac{-R_{ext}}{10}}$$

$$D = \frac{S_{ext}}{S} 10^{\frac{-R_{ext}}{10}}$$

BS 8233 RESULT

L _{A,rt}	31
L _A	17