

SANDY BROWN

Consultants in Acoustics, Noise & Vibration

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Treehouse Hotel, Manchester

Planning noise report

London, Manchester, Edinburgh, Birmingham, Belfast

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Version	Date	Comments	Author	Reviewer
A	16 Apr 21	-	Jake Woolley	Bob Albon
B	21 Apr 21	Minor amendments	Jake Woolley	Bob Albon
C	6 Aug 21	Representative background noise levels amended to reflect increased external activity following the lifting of COVID restrictions. Patron noise assessment included for external rooftop terrace.	Julian Martinez	Bob Albon

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Summary

Sandy Brown has been appointed by AA Projects on behalf of Deansgate c/o Starwood to provide an assessment of noise in relation to the proposed redevelopment of an existing hotel on Blackfriars Street, Manchester

An environmental noise survey has been carried out at the site. The noise survey was carried out between Friday 19 March 2021 and Tuesday 23 March 2021.

Assessment of representative background noise levels has been carried out based on a statistical analysis of the background noise levels and also in accordance with the calculation method provided within Manchester City Council's (MCC) *Planning and Noise Technical Guidance* document dated December 2015. Given the reduced levels of activity as a result of COVID restrictions in place at the time of the survey it is considered that the levels described from the statistical analysis are a more appropriate basis for the determination of plant noise limits.

Based on the requirements of the MCC and on the results of the noise survey, all plant must be designed such that the cumulative noise level at 1 m from the worst affected windows of the nearby noise sensitive premises does not exceed L_{Aeq} 48 dB during the daytime and L_{Aeq} 42 dB during the night. A scheme of mitigation has been developed to ensure these limits are achieved with the proposed plant.

As assessment of the noise impact from patrons for the daytime use of the roof terrace has been undertaken. The predicted noise levels, based on the proposed seating arrangement, are below the adopted criterion.

An assessment of music playback during the daytime on the terrace has been undertaken and limiting noise levels determined to achieve the MCC entertainment noise criterion. The MCC criterion will ensure inaudibility outside the nearest noise sensitive receiver. The limiting noise levels for music on the terrace are consistent with the use of low level background music.

Music noise egress from the internal areas of the proposed Bar and restaurant areas on level 13 and 14 of the hotel has been assessed. Maximum allowable noise levels and minimum sound insulation performance standards have been determined for these spaces to achieve compliance with the MCC entertainment noise criteria.

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1 Introduction

Sandy Brown has been commissioned by AA Projects to provide acoustic advice in relation to the proposed redevelopment of an existing hotel on Blackfriars Street, Manchester.

As part of this, an environmental noise survey is required, the purpose of which is to establish the existing sound levels on and around the site.

The background noise levels measured during the survey are used as the basis for setting limits for noise emission from proposed building services plant, amplified sound, and patron noise from external amenity areas.

This report presents the survey method and results, limits for plant and activity noise and an assessment of the main external plant items proposed and activity noise for internal and external amenity areas. Minimum sound insulation performance requirements for the building envelope to these areas are recommended to control noise egress.

2 Site description

2.1 The site and its surrounding

The site location in relation to its surroundings is shown in Figure 1. The existing hotel building (outlined in red) is located on Blackfriars Street, Manchester.

There is an existing derelict office building (outlined in blue) adjoining the existing hotel building. This office building is located on the corner of Blackfriars Street and Deansgate.



Figure 1 Aerial view of site (courtesy of Google Earth Pro)

2.2 Adjacent premises

The nearest residential premises to the proposed development are:

- No. 1 Deansgate, approx. 45 m to the east (highlighted in green in Figure 1)
- The Edge, Clowes Street, approx. 90 m to the south west (highlighted in light blue).

The nearest hotels to the Proposed Development are:

- Travelodge Manchester Central, Blackfriars Street, approx. 55 m to the west (highlighted in pink)
- Premier Inn Manchester City Centre (Arena/Printworks), Victoria Bridge Street, approx. 65 m to the north (highlighted in purple)
- CitySuites Aparthotel, Chapel Street, approx. 135 m to the north (highlighted in red).

There are various commercial and retail premises surrounding the proposed development, highlighted in orange in Figure 1.

3 Assessment criteria

3.1 NPPF and NPSE

The National Planning Policy Framework, February 2019 (NPPF) sets out the UK government's planning policies for England. It supersedes previous guidance notes such as PPG24. No specific noise criteria are set out in the NPPF, or in the Noise Policy Statement for England (NPSE) to which it refers.

The NPPF states:

'Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

- *mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life.*
- *identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.'*

and

'Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed.'

The NPSE states that its aims are as follows:

‘Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

- *Avoid significant adverse impacts on health and quality of life*
- *Mitigate and minimise adverse impacts on health and quality of life and*
- *Where possible, contribute to the improvement of health and quality of life.’*

As such, neither document sets out specific acoustic criteria for new residential developments, but they require consideration of the effect of existing noise on the new development and the effect of noise from the development on the surroundings.

3.2 ProPG

ProPG *Planning & Noise (Professional Practice Guidance on Planning & Noise), New Residential Development, 2017* provides guidance to the management of noise within the planning system in England. It is restricted to consideration of new residential developments that will be exposed predominantly to airborne noise from transport sources.

The two stages of the approach are given below

- Stage 1 – Initial noise risk assessment of the proposed development site
- Stage 2 – Systematic consideration of four key elements
 - Element 1 – Demonstrating a “Good Acoustic Design Process”
 - Element 2 – Observing internal “Noise Level Guidelines”
 - Element 3 – Undertaking an “External Amenity Area Noise Assessment”
 - Element 4 – Consideration of “Other Relevant Issues”.

Following this approach, there are four possible recommendations, the choice of recommendation is as follows:

- Grant without conditions
- Grant with conditions
- Avoid
- Prevent.

Guidance provided in ProPG has been used to assess the proposed development site and recommend mitigation measures to reduce noise levels.

3.3 Noise egress

3.3.1 Standard guidance – plant and machinery

BS 4142:2014+A1:2019 *Methods for rating and assessing industrial and commercial sound* (BS 4142) provides a method for assessing noise from items such as building services plant against the existing background sound levels at the nearest noise sensitive premises.

BS 4142 suggests that if the noise level is 10 dB or more higher than the existing background sound level, it is likely to be an indication of a significant adverse impact. If the level is 5 dB above the existing background sound level, it is likely to be an indication of an adverse impact. If the level does not exceed the background level, it is an indication of having a low impact.

If the noise contains 'attention catching features' such as tones, bangs etc, a penalty, based on the type and impact of those features, is applied.

3.3.2 Standard guidance – patron noise

The Institute of Acoustics (IOA) *Draft Code of Practice for the control of noise from pubs and clubs* (1999) provides example noise limits for both night-time and daytime operation for noise from amplified and non-amplified music singing and speech. Extracts from the document are included below:

'5.2.3 Noise limits between 23:00 and 10:00

- The $L_{Aeq,5min}$ level measured 1 metre outside a window to a habitable room, with entertainment taking place shall show no increase when compared to the representative $L_{Aeq,5min}$ level measured from the same position, under the same conditions and during a comparable period with no entertainment taking place; and
- The $L_{eq,5min}$ level in the 63 Hz and 125 Hz octave bands measured 1 metre outside a window to a habitable room with entertainment taking place should show no increase in the 63 Hz and 125 Hz octave bands measured from the same position, under the same conditions and during a comparable period with no entertainment taking place.

3.3.4 Noise limits between 10:00 and 23:00

- a) For venues where live and/or non-live amplified music events take place more than twice in a week, the limits in Section 5.2.3 shall apply.
- b) For venues where more than 30 events take place per calendar year but these events do not occur more than twice per week, the following limits shall apply:
 - the $L_{Aeq,5min}$ level measured 1 metre outside a window to a habitable room, with entertainment taking place shall be no more than 3 dB higher than the representative $L_{Aeq,5min}$ level measured from the same position, under the same conditions and during a comparable period with no entertainment taking place; and

- *the $L_{eq,5min}$ in the 63 Hz and 125 Hz octave bands measured 1 metre outside a window to a habitable room, with entertainment taking place, shall be no more than 3 dB higher than the representative $L_{eq,5min}$ in the 63 Hz and 125 Hz octave bands measured from the same position, under the same conditions and during a comparable period with no entertainment taking place.'*

3.3.5 Local Authority criteria – plant noise egress

Manchester City Council (MCC) provides guidance in relation to plant noise emissions in *Planning and Noise Technical Guidance* document dated December 2015. This document states the following in relation to plant noise egress:

'The development should be designed so as to achieve a rating level of 5 dB (L_{Aeq}) below the typical background (L_{A90}) level at the nearest noise sensitive location.'

Corrections for tonal or attention catching characteristics would need to be applied to the rating level in accordance with BS4142: 2014.

3.3.6 Local Authority criteria - amplified music

MCC in their *Planning and Noise Technical Guidance* document dated December 2015 stipulates the following in relation to amplified music associated with a new development:

'Entertainment noise (L_{Aeq}) should be controlled to 10 dB below the background noise level (L_{A90}) without the entertainment noise present, in each octave band at the nearest noise sensitive location.'

4 Noise survey method

The survey included unattended and attended noise measurements.

The measurement positions used during the survey are indicated in Figure 2.

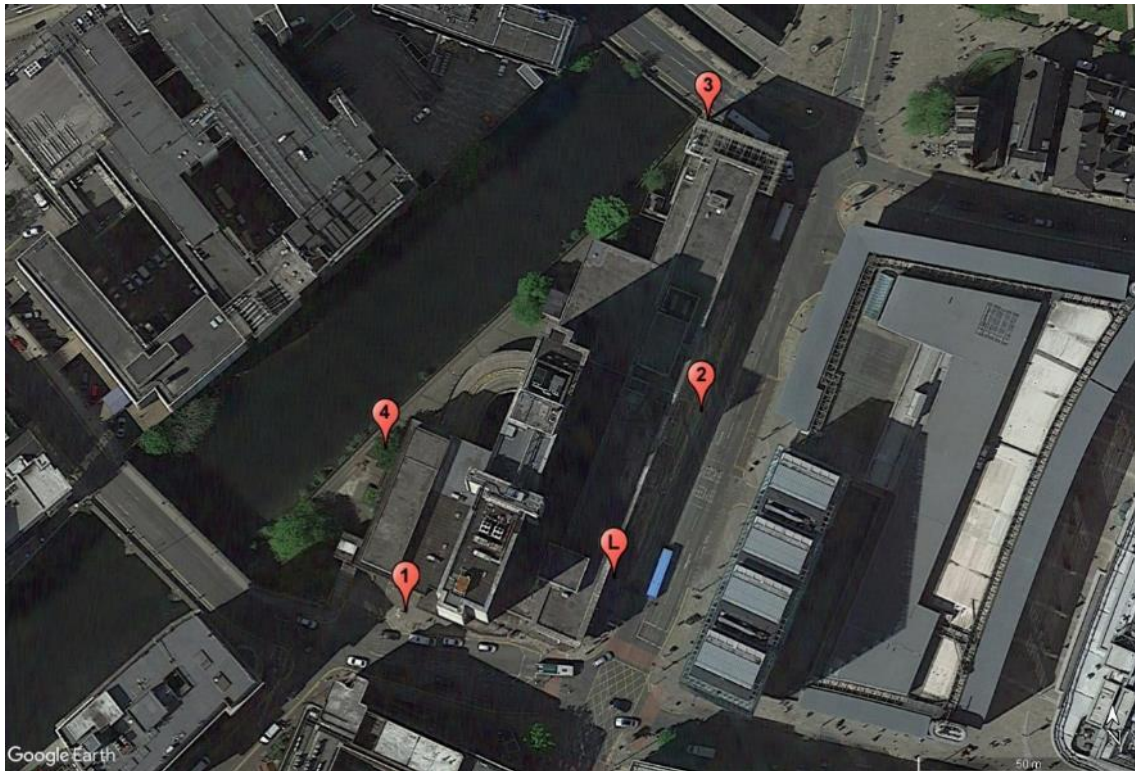


Figure 2 Noise survey measurement position mark-up (courtesy of Google Earth Pro)

4.1 Unattended measurements

Unattended noise monitoring was undertaken at the site over 5 days.

Details of the equipment used, and the noise indices measured, are provided in Appendix A.

The unattended measurements were taken over 15-minute periods between 12:00 on Friday 19 March 2021 and 10:00 on Tuesday 23 March 2021. The equipment was installed and collected by Thomas Dent.

The measurement position used during the survey is indicated in Figure 2, denoted by the letter 'L'.

The equipment was installed out of a Level 1 window of the existing derelict office building, overlooking Deansgate. The microphone was positioned approximately 1 m from the existing office building facade. The microphone was approximately 10 m above ground level.

A photograph showing the measurement location is provided in Figure 3.



Figure 3 Photograph showing unattended logger position

This location was chosen to be reasonably representative of noise levels at the site and outside the nearest noise sensitive premises.

The unattended measurements obtained are considered to be facade noise levels.

4.2 Attended measurements

Attended sample measurements were taken by Thomas Dent at 4 locations around the site. These are indicated in Figure 2 as positions '1' to '4'. The measurements were carried out on Friday 19 March 2021, over 15-minute periods.

At each position, the microphone was mounted on a tripod approximately 1.2 m above the ground level and at least 2 m from any other reflective surface. Details of the equipment used, and the noise indices measured, are provided in Appendix A.

Dominant noise sources occurring during the measurements were noted.

The attended measurements obtained are considered free-field noise levels.

4.3 Weather conditions

Weather conditions during the survey are described in Appendix A.

5 Noise survey results

5.1 Observations

The dominant noise sources observed at the site during the survey were road traffic along Deansgate, Blackfriars Street and Victoria Bridge Street.

Less significant noise sources included chatter from passing pedestrians, distant road traffic noise and noise from pedestrian crossings.

5.2 Noise measurement results

5.2.1 Unattended measurement results

A graph showing the results of the unattended measurements is provided in Appendix B.

Day and night-time ambient noise levels measured during the unattended survey are presented in Table 1. These are facade noise levels.

Table 1 Ambient noise levels measured during the unattended survey

Date	Daytime (07:00 – 23:00) $L_{Aeq,16h}$ (dB)	Night (23:00 – 07:00) $L_{Aeq,8h}$ (dB)
Friday 19 March 2021	64 ^[1]	57
Saturday 20 March 2021	64	58
Sunday 21 March 2021	63	57
Monday 22 March 2021	63	56
Tuesday 23 March 2021	64 ^[1]	-
Average	63	57

^[1] Measurement not made over full period due to monitoring start and end time (the measurement on Friday 19 March 2021 was over 11 hours, and on Tuesday 23 March 2021 over 3 hours); not included in the average.

Given that the measurements were undertaken during the Government's mobility and activity restrictions to halt the spread of COVID-19. Post-pandemic noise levels are expected to increase as traffic volumes and commercial activities return to pre-pandemic levels.

5.2.2 Background noise levels

In line with BS 4142:2014+A1:2019, for the purpose of analysis and establishing representative background sound levels, day and night-time typical levels have been quantified using statistical analysis from the continuous logging measurements. These are facade noise levels.

Daytime and night-time statistical analysis of representative values for the site are given in Figure 4 and Figure 5. From this analysis, representative background noise levels have been determined based on the mode of the measured levels. The daytime period is a unimodal distribution with a mode of $L_{A90,15min}$ 53 dB, whereas the night-time period is a bimodal distribution with modes of $L_{A90,15min}$ 43 dB and $L_{A90,15min}$ 47 dB. For the night-time period, the $L_{A90,15min}$ 47 dB is considered more likely to reflect pre-pandemic conditions of increased traffic and external activities and is therefore a more suitable representative background noise level.

Treehouse Hotel, Manchester
Statistical analysis of day time background sound level at 'L'
Friday 19 March 2021 to Tuesday 23 March 2021
Daytime period (07:00 to 23:00)

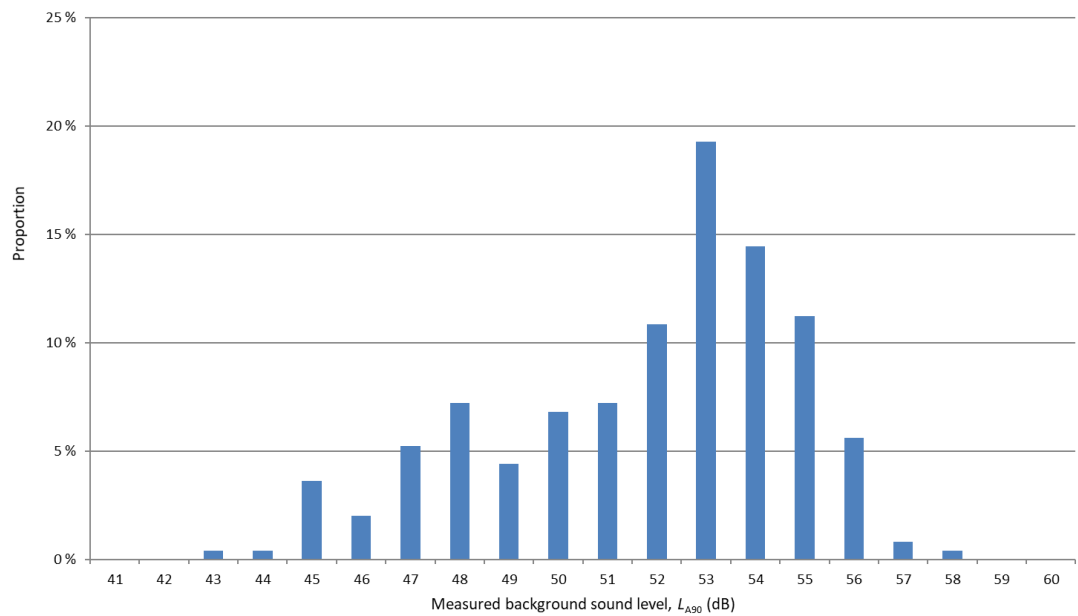


Figure 4 Statistical analysis of daytime background noise levels

Treehouse Hotel, Manchester

Statistical analysis of night time background sound level at 'L'

Friday 19 March 2021 to Tuesday 23 March 2021

Night-time period (23:00 - 07:00)

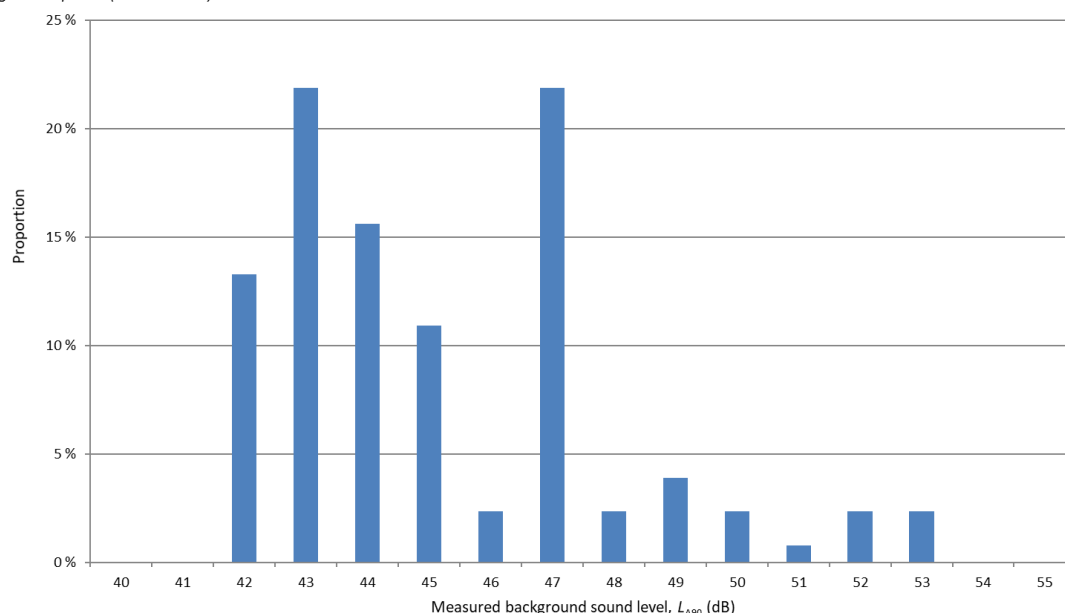


Figure 5 Statistical analysis of night-time background noise levels

Octave band representative background noise levels have been determined as the arithmetic average of the octave band spectrum levels for the day and night 15-minute periods with levels of $L_{A90,15min}$ 53 dB and $L_{A90,15min}$ 47 dB respectively. These are summarised in Table 3. These are facade noise levels.

Table 2 Octave band representative background noise levels (facade noise levels)

Time of day	Maximum sound pressure level at 1 m from noise sensitive premises, L_{eq} (dB)							
	Octave-band centre frequency (Hz)							dBA
	63	125	250	500	1k	2k	4k	
Daytime (07:00-23:00)	57	52	49	49	50	46	40	53
Night-time (23:00-07:00)	55	50	48	44	42	35	27	47

Assessment of representative background noise levels has also been carried out in accordance with the calculation method provided within Manchester City Council (MCC) *Planning and Noise Technical Guidance* document dated December 2015. Calculation via this method results in the following representative background noise levels:

- $L_{A90,15min}$ 44 dB during the daytime (corresponding to the 15-minute period between 22:45 and 23:00)
- $L_{A90,15min}$ 42 dB during the night-time (corresponding to the 15-minute period between 01:45 and 02:00).

Octave band representative background noise levels have been determined, based on analysis of the survey data corresponding to the time periods above. Octave band representative background noise levels are summarised in Table 3. These are facade noise levels.

Table 3 Octave band representative background noise levels (facade noise levels) based on Manchester City Council (MCC) *Planning and Noise Technical Guidance* document

Time of day	Maximum sound pressure level at 1 m from noise sensitive premises, L_{eq} (dB)							
	Octave-band centre frequency (Hz)							dBA
	63	125	250	500	1k	2k	4k	
Daytime (07:00-23:00)	51	45	45	41	39	34	26	44
Night-time (23:00-07:00)	49	44	44	39	37	32	24	42

5.2.3 Attended measurement results

Noise levels and key sources recorded during the attended measurements are summarised in Table 4. These are free-field noise measurements.

Table 4 Noise levels and key noise sources from attended measurements

Position	Start time	Sound pressure levels (dB)			Noise sources
		$L_{Aeq,15min}$	$L_{AFmax,15min}$	$L_{A90,15min}$	
1	12:00	65	94	57	Road traffic noise along Blackfriars Street. Occasional HGVs and buses. Occasional cars entering/leaving car park. Noise from pedestrian crossing. Max due to car horn
1	13:00	63	78	54	Road traffic noise along Blackfriars Street. Occasional HGVs and busses. Occasional cars entering/leaving car park. Noise from pedestrian crossing. Max due to passing bus
1	14:00	64	83	53	Road traffic noise along Blackfriars Street. Occasional HGVs and busses. Occasional cars entering/leaving car park. Noise from pedestrian crossing. Max due to passing bus
2	12:16	66	87	54	Road traffic noise along Deansgate. Occasional HGVs and buses. Distant road traffic noise. Chatter from passing pedestrians. Noise from pedestrian crossing. Max due to passing motorbike
2	13:16	66	84	54	Road traffic noise along Deansgate. Occasional HGVs and buses. Distant road traffic noise. Chatter from passing pedestrians. Noise from pedestrian crossing. Max due to passing bus
2	14:16	68	94	53	Road traffic noise along Deansgate. Occasional HGVs and buses. Distant road traffic noise. Chatter from passing pedestrians. Noise from pedestrian crossing. Max due to passing HGV

Position	Start time	Sound pressure levels (dB)			Noise sources
		$L_{Aeq,15min}$	$L_{AFmax,15min}$	$L_{A90,15min}$	
3	12:32	66	84	54	Road traffic noise along Victoria Bridge Street. Vehicles idling at traffic lights, then accelerating away from lights uphill. Occasional HGVs and buses. Noise from pedestrian crossing. Max due to passing bus
3	13:32	63	80	53	Road traffic noise along Victoria Bridge Street. Vehicles idling at traffic lights, then accelerating away from lights uphill. Occasional HGVs and buses. Noise from pedestrian crossing. Max due to passing bus
3	14:32	64	83	53	Road traffic noise along Victoria Bridge Street. Vehicles idling at traffic lights, then accelerating away from lights uphill. Occasional HGVs and buses. Noise from pedestrian crossing. Max due to car horn
4	15:00	55	67	53	Distant road traffic noise. Running water from pipe (other side of river). Occasional cars and pedestrians within car park
4	15:15	55	69	53	As above
4	15:30	55	66	53	As above

6 Assessment of typical noise climate

As a result of the current Covid-19 pandemic, measured noise levels are considered lower than usual. Road traffic levels were generally reduced due to current lockdown restrictions.

Furthermore, temporary pedestrianisation was in place during the survey along the section of Deansgate south of Blackfriars, with access for buses, taxis and cycles only. It is understood that these restrictions had been in place for approximately ten months at the time of the survey.

Although there were no traffic restrictions in place on the section of Deansgate alongside the site, it is considered likely traffic may travel via alternative routes to avoid the road closure. As such, it is expected that road traffic levels were lower than typical. This is difficult to quantify.

It is assumed that road traffic levels will eventually return to typical levels before the Covid-19 pandemic and traffic restrictions along Deansgate will be lifted. An assessment of expected typical noise climate has been carried out on this basis.

6.1.1 Background noise levels

The background noise levels measured during the survey are likely to be lower than typical given the reduced levels of activity resulting from the restrictions. It is therefore considered that the representative background noise levels determined from the statistical analysis are a more appropriate basis for the external plant noise limits than those derived in accordance with the standard MCC method.

Furthermore, these representative background noise levels determined from the statistical analysis of the data are comparable to background noise levels measured during pre-pandemic conditions as part of preceding planning applications from neighbouring sites.

Application 126328-FO-2020 for 39 Deansgate includes a noise survey assessment by BWB Consulting titled “39 Deansgate Manchester – Noise Impact Assessment MCA2017” where background noise levels were measured for a 48 hour period, from 23 October 2019 to 25 October 2019 at St Marys Gate, opposite the south facade of 1 Deansgate. The representative background noise levels for this site were $L_{A90,16h}$ 56 dB during the daytime (07:00 -23:00) and $L_{A90,8h}$ 50 dB during the night-time. The measured noise levels are free-field levels.

6.1.2 DEFRA Strategic noise mapping 2017

Government strategic noise mapping has been reviewed to assist in determining typical ambient noise levels due to the roads surrounding the proposed site. This data is published by the Department for Environment, Food and Rural Affairs, and was produced in 2017.

A screenshot of the DEFRA $L_{Aeq,16hr}$ strategic noise map is provided in Appendix C.

Based on the DEFRA noise map, typical road noise levels at the kerbside of the roads around the site are expected to be in the region of:

- Deansgate: $L_{Aeq,16hr}$ 70-75 dB
- Blackfriars Street: $L_{Aeq,16hr}$ 65-70 dB
- Victoria Bridge Street: $L_{Aeq,16hr}$ 65-70 dB.

This data will be used to supplement the unattended and attended noise survey measurements carried out to inform the design of the development with respect to environmental noise ingress through the building envelope.

6.1.3 Noise maxima as a result of passing vehicles

During the measurement survey, a range of vehicles passed along Deansgate, Blackfriars Street and Victoria Bridge Street, including cars, buses, HGVs and motorbikes.

Based on the observations made during the survey, the measurements obtained are considered to likely include a suitable sample of different vehicle types representative of typical conditions. As such, measured maxima due to passing vehicles is considered representative of the typical noise climate, though the frequency of events may be reduced.

7 Plant noise egress

7.1 Plant noise limits

Based on the above criteria, the measurement results, and the consideration of the typical noise climate in the absence of COVID restrictions, the cumulative noise level from the operation of all new plant should not exceed the limits set out in Table 5.

The limits apply at 1 m from the worst affected windows of the nearest noise sensitive premises and are presented as facade levels.

Table 5 Plant noise limits at 1 m from the nearest noise sensitive premises

Time of day	Maximum sound pressure level at 1 m from noise sensitive premises, $L_{Aeq,15min}$ (dB)
Daytime (07:00-23:00)	48
Night-time (23:00-07:00)	42

[1] The limits set out in Table 5 do not include any attention catching features. The penalty corrections for attention catching features may be significant and will need to be considered as the building services design progresses. This is discussed in Appendix C.

7.2 Assessment

7.2.1 Proposed building services plant

The proposed new items of building services plant include 12 Mitsubishi PURY-M500YNW-A1 condenser units. 10 of the units are proposed to be located within an internal plant area located at Level 1 whilst the remaining 2 units are proposed to be located at roof level within a screened enclosure.

Ventilation plant proposed to replace existing plant serving the GF kitchen are also proposed.

Manufacturers' noise data for the proposed condenser units is summarised in Table 6.

Spectral noise data has been provided in the form of sound pressure levels. For the purpose of the assessment, the spectral shape has been adjusted to achieve the worst-case broadband sound power levels stated for heating mode by the manufacturer.

Table 6 Proposed mechanical building services – manufacturers' octave band noise data (dB)

Item	Octave band centre frequency (Hz)								dBA
	63	125	250	500	1k	2k	4k	8k	
Mitsubishi PURY-M500YNW-A1									
Sound pressure levels at 1 m (dB) (heating)	66	64	66	63	57	57	53	49	65
Sound pressure levels at 1 m (dB) (low noise)	63	61	52	50	48	42	45	41	54
Broadband sound power level (dB) (heating)	-	-	-	-	-	-	-	-	84

7.2.2 Noise sensitive receptors

The nearest noise sensitive receptors are discussed in Section 2.2, and include residential premises and hotel developments.

All noise sensitive receptors identified have been considered as part of the assessment.

7.2.3 Calculations

Calculations have been undertaken to predict noise levels at the worst affected noise sensitive receptor resulting from the cumulative operation of all new proposed condenser units.

Distance attenuation has been based on the geometric spreading of sound power. Barrier attenuation has been accounted for where applicable, based on Maekawa's method.

It is understood that the condenser units will operate for limited periods during the daytime (approximately 07:00-09:00 and 18:00-23:00) and are not likely to operate during the night time period (23:00-07:00).

The results of the calculations indicate that mitigation measures are required to achieve the plant noise limits and are discussed below.

7.2.4 Recommended mitigation – Level 1 plant room

The Level 1 plant room is shown in Figure 6. Discharge connections associated with the condenser units in this location will need to be ducted to atmosphere via the facade highlighted in blue. They must not be ducted to the facade highlighted in red as a result of the close proximity of bedroom windows associated with the hotel. Furthermore, discharge grille will need to be provided with a 300 mm acoustic louvre.

Fresh air intake can be provided by either or both facade areas, however, a 300 mm louvre will need to be provided to the facade highlighted in blue and a 605 mm louvre will need to be provided to the facade highlighted in red.

External doors to the plant area should achieve a minimum performance of R_w 30 dB.

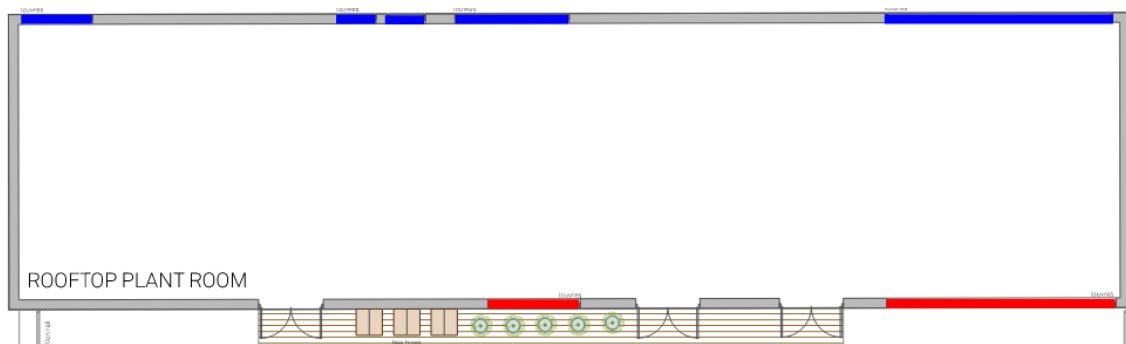


Figure 6 Level 1 plant area

Minimum insertion losses for the required louvres are presented in Table 7.

Table 7 Mitigation measures – required louvre insertion losses (dB)

	Octave-band centre frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
300 mm louvre								
Minimum insertion losses (dB)	6	7	10	12	18	18	14	10
605 mm louvre								
Minimum insertion losses (dB)	6	12	15	21	24	27	25	20

Suitable louvres are available for IAC (www.iacacoustics.global).

7.2.5 Recommended mitigation – rooftop plant area

A 2.85 m high barrier is required to the rooftop plant area. The screen should be formed of a solid screen with a minimum mass of 11 kg/m² and Class A sound absorbent lining on the inner (plant side) side face. If required for airflow it would be acceptable to form the lower section of the barrier from a 605 mm acoustic louvre capable of achieving the minimum insertion losses given in Table 7. The louvre should extend no more than 1 m above roof level.

7.2.6 Remaining plant items

Any remaining plant serving the building will be designed to a level compatible with achieving the overall plant noise limits.

There is allowance for other rooftop plant items to increase the noise levels at the worst affected noise sensitive receivers by up to 2 dB.

8 Activity noise egress

8.1 Amplified music noise limits

Based on the requirements of Manchester City Council and the results of the environmental noise survey, octave band operational noise egress criteria related to music playback are summarised in Table 8.

The limits apply at 1 m from the worst affected windows of the nearest noise sensitive premises and are presented as facade levels.

Table 8 Octave band amplified music limits at 1m from the nearest noise sensitive premises

Time of day	Maximum sound pressure level at 1 m from noise sensitive premises, L_{eq} (dB)							
	Octave-band centre frequency (Hz)							dBA
	63	125	250	500	1k	2k	4k	
Daytime (07:00-23:00)	47	42	39	39	40	36	30	43
Night-time (23:00-07:00)	45	40	38	34	32	25	17	37

8.2 Patron noise egress

Based on the guidance given in the IOA *Draft Code of Practice for the control of noise from pubs and clubs* (1999), during the daytime patron noise should not increase the ambient noise level in terms of the $L_{Aeq,5min}$ and the $L_{eq,5min}$ level at the 63 Hz and 125 Hz octave bands. This is equivalent to patron noise being equal to 10 dB below the existing ambient noise level as defined in these parameters.

On the basis of the above criteria and the lack of significant energy from speech in the 63 Hz and 125 Hz octave band, a facade limit of L_{Aeq} 52 dB has been adopted, corresponding to 10 dB below the average L_{Aeq} measured between 22:00 and 23:00, the latest hour the terrace is proposed to operate. Given the reduced activity around the site as a result of COVID restrictions, the limit is considered to be conservative.

8.3 Operational noise levels

An assessment of activity noise has been undertaken for the external terrace and the rooftop bar on level 14, and for the bar and restaurant on level 14. The external terrace is to be occupied no later than 23:00.

The assessment considers the nearest existing noise sensitive receptors; the 1 Deansgate residences to the east of the proposed hotel.

8.3.1 Patron noise – External roof terrace

A 3D acoustic model of the proposed development and the surrounding noise sensitive receptors has been simulated using CadnaA to assess the impact of patron noise from the rooftop terrace of the Treehouse hotel.

The 3D model is based on the proposed design for the level 14 terrace area of the Treehouse Hotel and considers geometrical characteristics such as building heights, massing, and separation distances to the proposed hotel of the nearest existing noise sensitive receptors.

The CadnaA acoustic model considers screening by building mass, reflections from building facades, geometrical divergence of noise sources to account for distance attenuation, and air absorption of sound as specified in ISO 9613-2.

An image of the 3D model is provided in Figure 7. The terrace area is highlighted in red. The nearest noise sensitive receptor to the east, 1 Deansgate, is highlighted in Blue.

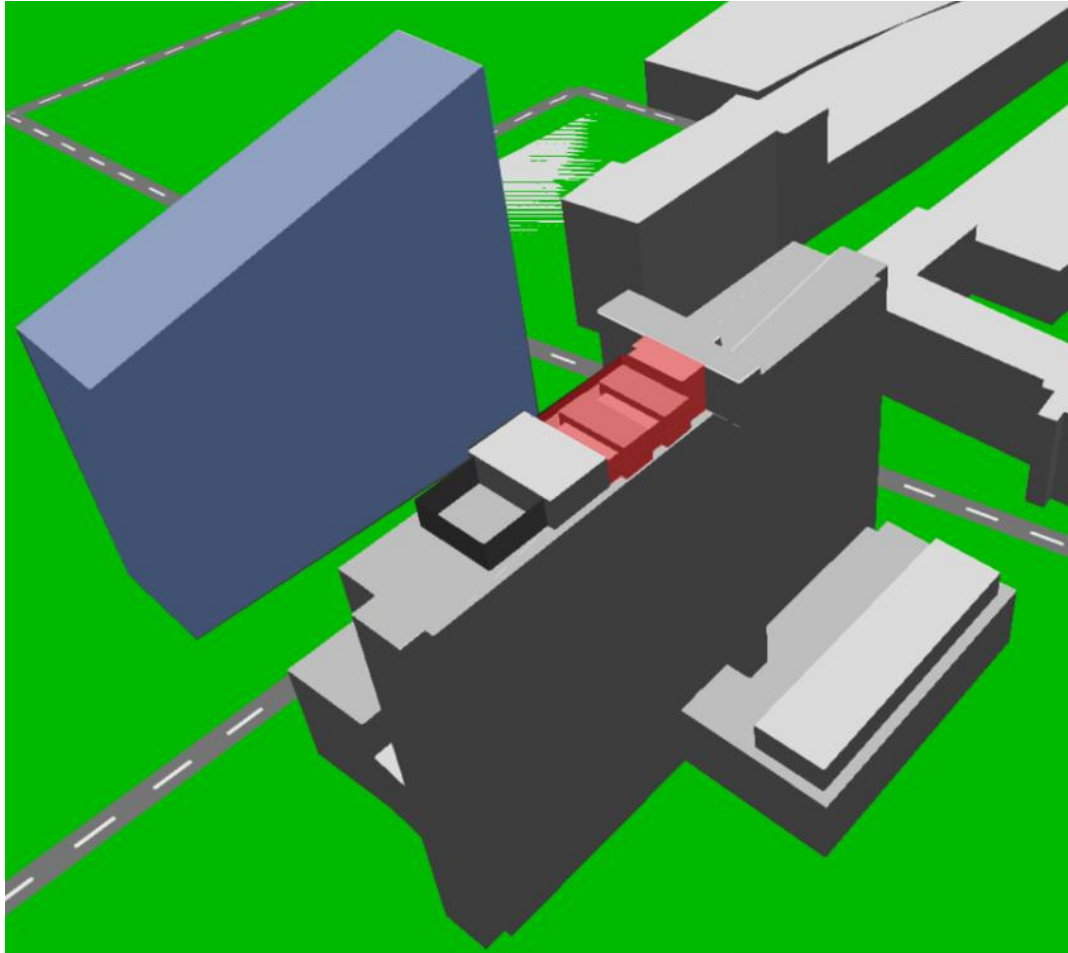


Figure 7 Image from 3D model

Based on the proposed terrace design drawings, as shown in Figure 9, seating is provided for 18 patrons. For the assessment, maximum occupation of the terrace seating has been assumed, with a worst-case of 50% of patrons talking simultaneously. Four patrons are assumed to speak using a normal voice level and five patrons are assumed to speak using a raised voice level. Normal and raised voice levels and their corresponding octave band spectra are provided in Table 9 and are based on male voices, which are typically 1-2 dB louder than female voices.

Table 9 Sound power levels for normal and raised voices

	Octave-band centre frequency (Hz)							dBA
	63	125	250	500	1k	2k	4k	
Normal voice, L_w (dB)	57	61	63	68	69	65	53	72
Raised voice, L_w (dB)	62	68	70	74	75	70	60	78

The patrons are modelled as omnidirectional point sources and are placed at a height of 1.8 from the finished floor level, to simulate the height of a standing person. The sources are in a direct line of sight to the existing east side noise sensitive receptors at 1 Deansgate.

Music playback has been assessed separately and is detailed in section 8.3.2.

The predicted noise levels at the nearest noise sensitive receptors are shown in Table 10 as facade levels.

Table 10 Predicted facade levels

Receptor	Sound pressure level at 1 m from facade, L_{Aeq} dB
1 Deansgate	35-48

Figure 8 shows the distribution of levels along the affected facades of 1 Deansgate.

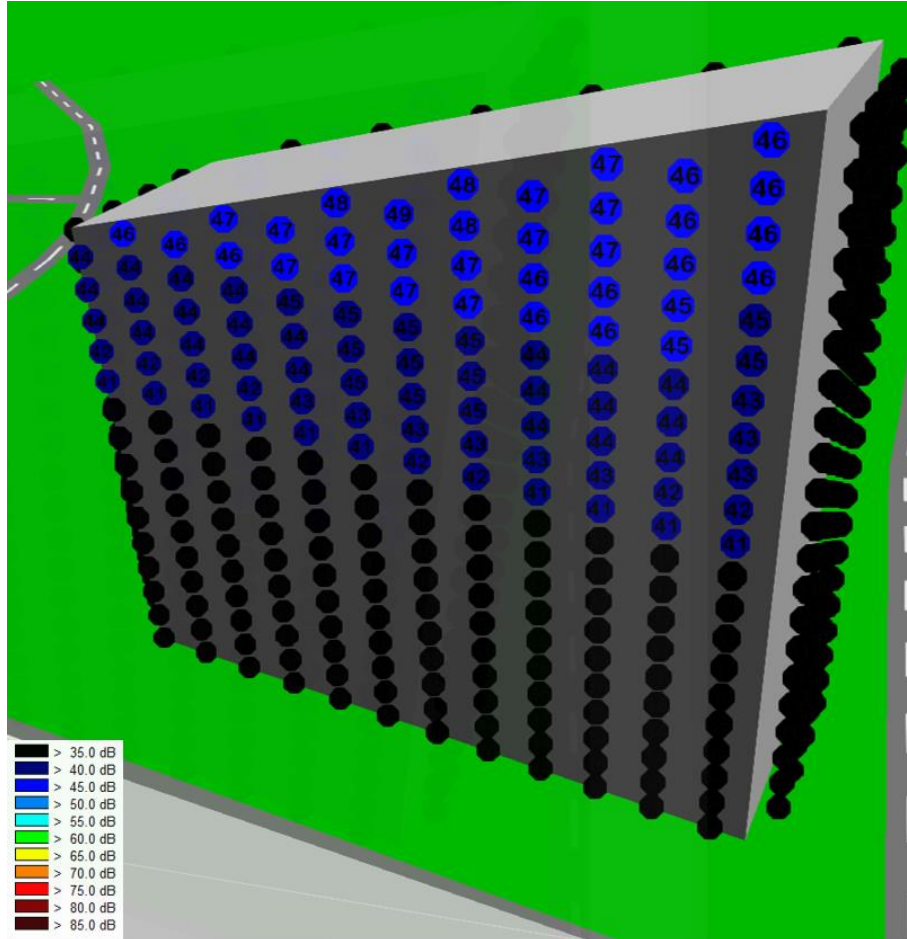


Figure 8 Distribution of Patron noise broadband levels at 1 Deansgate west facade.

Noise resulting from patron occupation at the terrace is equal to, or below, the criterion of L_{Aeq} 52 dB and is therefore not considered to have an adverse impact.

It is understood that a high-rise residential tower extending above the treehouse hotel terrace level is being considered to the northeast of the hotel as part of the wider masterplan for the site. The determined limits are compatible with achieving the proposed limits at any new noise sensitive receptor with a direct line of sight to the terrace that is a distance of 28 m or more from the hotel.

It is expected that any proposed residential units with a direct line of sight to the terrace would be located at distances greater than 28 metres from the terrace, and no adverse effects from patron noise would be expected.

8.3.2 Amplified music noise levels - External roof terrace (Level 14)

The 3D acoustic model described in the previous section has also been used to determine maximum noise limits from external music playback on the rooftop bar terrace at Level 14 that would comply with the MCC entertainment noise criteria for daytime use (until 23:00) as proposed.

For the assessment, music playback is simulated by considering a series of facade mounted speakers distributed across the east elevation of the external terrace facade as shown in Figure 9.

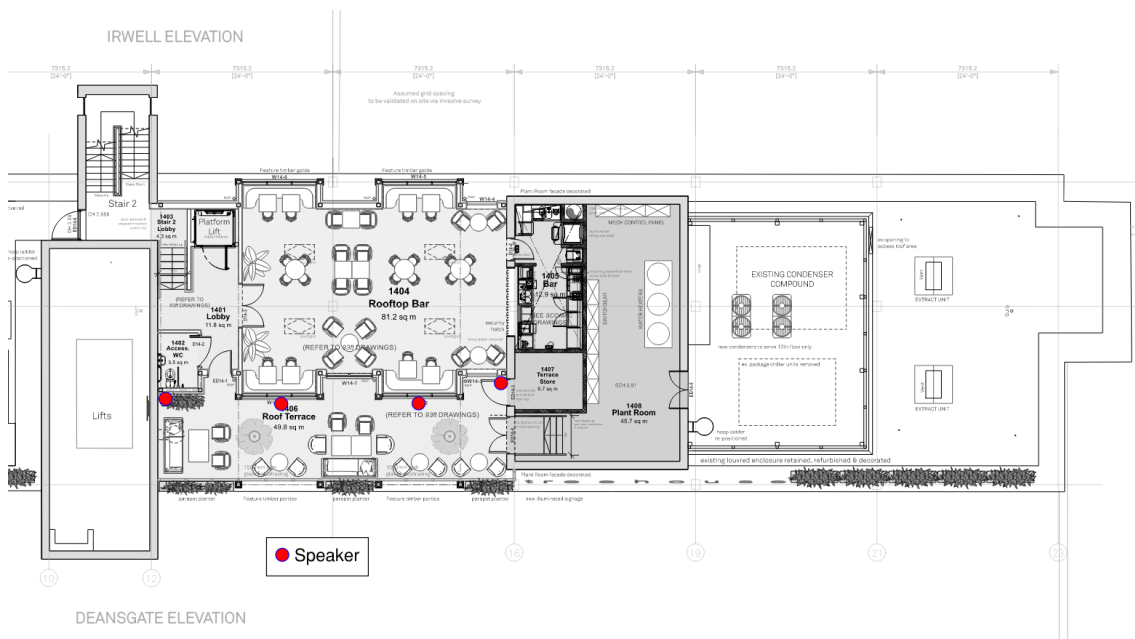


Figure 9 Rooftop Bar and terrace arrangement, including modelled speaker locations

The speakers are modelled as positioned at a height of 2.7 m above the proposed level 14 finished floor level (FFL). There is therefore a direct line of sight to the upper-level flats of the 1 Deansgate residences. The speakers are modelled as omnidirectional point sources.

The sound pressure level at the terrace is determined by setting a series of receptors located 2.5 m away from the speakers, approximately halfway to the width of the terrace, at a height of 1.7 m from the floor, to assume a standing person's height, and by setting a sound power level spectrum for the speakers which is typical of music playback.

The allowable levels of music on the terrace have been determined on this basis and are presented in Table 11. These are free field levels.

Table 11 Maximum permissible octave band music levels for the rooftop terrace (external)

Time of day	Octave-band centre frequency (Hz)							dBA
	63	125	250	500	1k	2k	4k	
Daytime (07:00-23:00)	67	62	59	60	60	57	53	64

The above limiting music levels are considered to be consistent with the playing of low level background music.

Provided these limits are not exceeded, the amplified sound egress limits will be met. An electronic compressor limiter should be employed in the music playback system to ensure compliance.

The broadband noise levels resulting from music playback at the nearest noise sensitive receptors are presented in Figure 10.

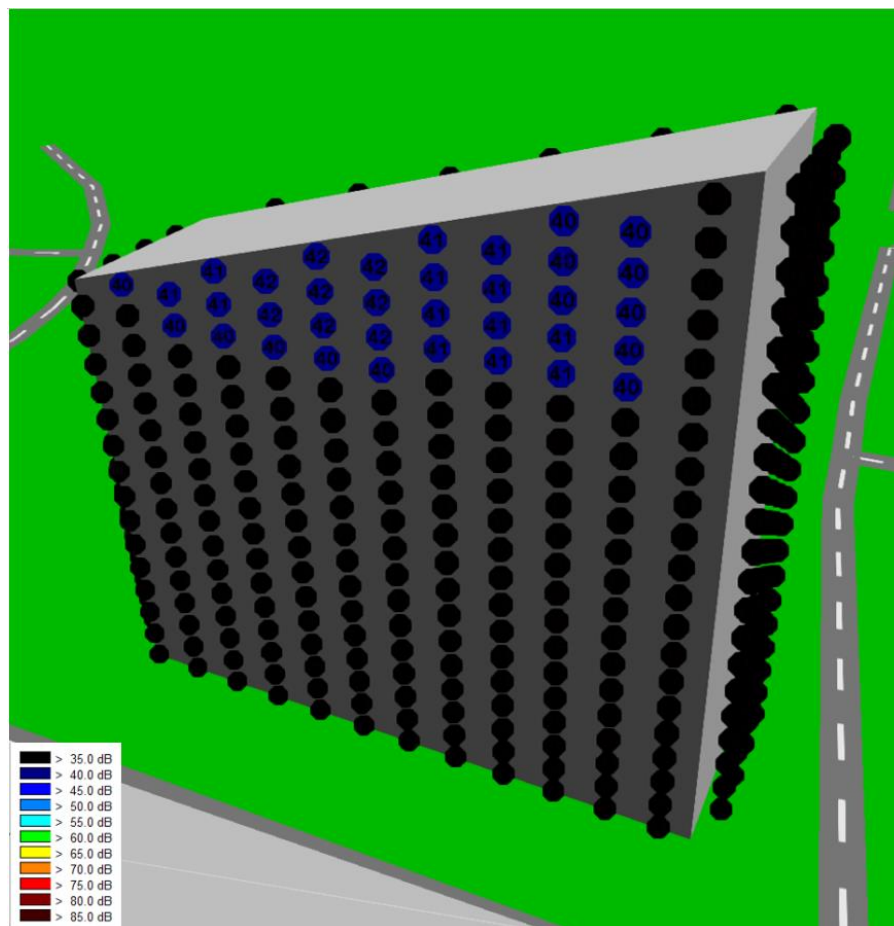


Figure 10 Broadband music noise levels at the west facade of 1 Deansgate

The determined limits are compatible with achieving the proposed limits at any new noise sensitive receptor with a direct line of sight to the terrace that is a distance of 40 m or more from the hotel.

It is expected that any proposed residential units with a direct line of sight to the terrace would be located at distances equal to or greater than 40 metres from the terrace, and no adverse effects from external music noise would be expected at these locations.

8.3.3 Internal activity noise levels – Rooftop bar (Level 14), Restaurant and Bar (Level 13)

The limiting noise levels for music within the rooftop bar on level 14, and the bar and restaurant on Level 13 have been determined based on the maximum permissible music noise levels determined in Table 8, the proposed design of the rooftop bar inclusive of the building envelope areas facing the nearest noise sensitive receptors, typical sound insulation performances for the building envelope constructions, and the distance between the proposed bar and the nearest noise sensitive receptor.

The noise level at the nearest noise sensitive receptors is estimated based on the methodology described in ISO 12354-4 *Building Acoustics – Estimation of acoustic performance of buildings from the performance of elements – Part 4: Transmission of indoor sound to the outside*. In this standard the total sound pressure level at a reception point that is chosen a distance from a building is determined by the following contributions:

- The sound radiated by the elements of the building envelope due to the sound pressure level inside.
- The sound radiated by individual sound sources, fixed in or onto the outside of the building
- The outdoor sound propagation

The sound radiation by the building envelope is represented by the radiation of one or more substitute point sources. Each point source represents the contribution of a segment of a plane radiator (walls, windows, doors, roof, etc) that constitutes the building envelope.

For a segment of structural elements of the building envelope, the sound power level (L_w) is determined by the following formula:

$$L_w = L_{p,in} + C_d - R' + 10 \log \frac{S}{S_0}$$

Where

$L_{p,in}$ is the sound pressure level at 1 or 2 m from the inside of the segment, in decibels.

C_d is the diffusivity term for the inside of the sound field at the segment in decibels. For a diffuse field and reflecting walls, the diffusivity term is $C_d = -6$ dB.

R' is the apparent sound reduction index for the segment in decibels

S is the area of the segment in square metres.

S_0 is the reference area in square metres; $S_0 = 1 \text{ m}^2$

After the sound power level (L_w) of the corresponding building envelope element is established, the sound pressure level (L_p) at the nearest noise sensitive receptor is calculated based on a sound power level to sound pressure level conversion for a point source, defined by the following formula:

$$L_p = L_w + 10 \log \frac{Q}{4\pi r^2}$$

Where

L_w is the sound power level of the building envelope element in decibels.

Q is the directivity factor of the idealised point source. For the assessment all sources are assumed to propagate hemispherically, with a Q value of 2.

r is the distance from the source to the receiver

For the assessment, sources and receivers are assumed to have a direct line of sight, and losses from screening are not considered to account for a worst-case scenario.

A 3 dB facade correction is then added to the resultant sound pressure level (L_p) values.

Based on the methodology described above, the required sound insulation performances for the building elements and corresponding internal noise levels have been determined ensuring that the cumulative sum of the facade radiated noise at the nearest noise sensitive receptors complies with the limits stated in Table 8.

Rooftop bar (Level 14)

Table 12 shows a description of the proposed building envelope elements for the Rooftop Bar, their areas of sound radiation (S) and the distance to the assessed noise sensitive receptors (r).

Table 12 Rooftop bar building envelope information

Element	Description	Area, $S \text{ (m}^2 \text{)}$	Distance, $r \text{ (m)}$
Glazed facade	Curtain walling with double glazed windows	24	54
Doors	Glazed doors	2.5	54
Roof	Insulated panel on Z purlins with underlining below purlin	156	58

Table 13 includes the minimum sound insulation performance requirements of the building envelope.

Table 13 Minimum sound insulation performance requirements of the building envelope

Element	Apparent sound reduction index, R' (dB)								
	Octave-band centre frequency (Hz)								
	63	125	250	500	1k	2k	4k	R'_w	
Glazed Facade	20	26	30	38	43	38	52	39	35
Doors	12	17	31	28	28	29	32	29	27
Roof	20	25	34	41	46	47	51	43	37

Examples of typical constructions capable of achieving these sound insulation performances are provided below:

- Glazed Facade: some examples of double-glazed windows capable of achieving the R'_w and $R'_w + C_{tr}$ performance requirements are:
 - 6 mm float glass / 16 mm argon filled cavity / 9.52 mm laminated glass
 - 8 mm float glass / 12 mm cavity / 8.4 mm laminated glass
 - 10 mm float glass / 12 mm cavity / 12 mm float glass

The R_{63Hz} performance requirement shall be demonstrable via laboratory test report.

- Doors: some examples of doors capable of achieving the sound insulation performance requirements are:
 - Solid door: 44 mm solid-core timber door closing onto a rebated frame with full perimeter compressible seals along the head, jambs and threshold. Threshold seal to close onto hard threshold strip. The door must be side hinged rather than pivoted. For double doors, meeting jambs must be rebated and fitted with seals. The door leaf would typically have a weight of at least 25 kg/m².
 - Glazed door: Fully framed glazed door with seals as for timber doors. The glass would need to be approximately 12 mm thick to provide sufficient weight. A frameless door will not be capable of achieving this level of performance.

To control noise egress, a set of lobbied doors are proposed to minimise leakage of noise when doors to the external terrace are opened. This is seen in Figure 9.

- Roof: The proposed roof is comprised of a 124 mm thick Kingspan KS 500 Kingzip Insulated standing seam roof, set on Z purlins with underlining below the purlins. The underlining requires a minimum surface mass of 26kg/m². An example of a construction compatible with this surface mass is a layer of 8 mm fibre cement board with a layer of 12.5 mm Soundbloc. The ceiling cavity should have a minimum depth of 250 mm and contain a 50 mm thick mineral wool infill.

Based on the envelope requirements listed above, maximum permissible internal activity noise levels for the rooftop bar are shown in Table 14.

Table 14 Rooftop bar octave band amplified music limiting noise levels (internal)

Time of day	Octave-band centre frequency (Hz)							dBA
	63	125	250	500	1k	2k	4k	
Daytime (07:00-23:00)	87	86	86	92	92	93	95	100
Night-time (23:00-07:00)	85	84	85	87	84	82	82	90

The above limiting noise levels are considered to be representative of foreground music.

Restaurant (Level 13)

Table 15 shows a description of the proposed building envelope elements for the Restaurant facades facing 1 Deansgate, along with their corresponding areas of sound radiation (S) and the distance to these noise sensitive receptors (r).

Table 15 Rooftop bar building envelope information

Element	Description	Area, S (m ²)	Distance, r (m)
Glazed facade	Curtain walling with double glazed windows	62	50

The facade also includes non-glazed solid portions, however these provide sufficient mass to control noise egress and have not been considered in the assessment.

The minimum sound insulation performance requirements of the restaurant glazing correspond to the same listed in Table 13, with the exception of the $R'_{63\text{Hz}}$ performance requirement, which should be omitted, as it is unlikely that high levels of low frequency music will be played within a restaurant environment.

Maximum permissible internal activity noise limits for the restaurant are shown in Table 16.

Table 16 Restaurant octave band amplified music limiting noise levels (internal)

Time of day	Octave-band centre frequency (Hz)							dBA
	63	125	250	500	1k	2k	4k	
Daytime (07:00-23:00)	82	84	83	87	87	91	93	97
Night-time (23:00-07:00)	80	82	82	82	79	80	80	86

The above limiting noise levels are considered to be representative of foreground music and are well above the typical levels for an occupied restaurant, which range from 75-80 dBA.

Music playback in the restaurant is expected to be played at background noise levels, therefore the above noise levels are highly unlikely to be encountered for a restaurant setting and are considered a worst-case scenario.

Bar (Level 13)

Table 17 shows a description of the proposed building envelope elements on the east facade of the Level 13 Bar, along with their corresponding areas of sound radiation (S) and the distance to these noise sensitive receptors (r).

Table 17 Level 13 bar building envelope information

Element	Description	Area, S (m ²)	Distance, r (m)
Glazed facade	Curtain walling with double glazed windows	43	50

The minimum sound insulation performance requirements of the restaurant glazing correspond to the same listed in Table 13. Maximum permissible internal activity noise limits for the level 13 bar are shown in Table 18

Table 18 Level 13 Bar octave band amplified music limiting noise levels (internal)

Time of day	Octave-band centre frequency (Hz)							dBA
	63	125	250	500	1k	2k	4k	
Daytime (07:00-23:00)	87	85	86	92	92	93	95	100
Night-time (23:00-07:00)	85	83	85	87	84	82	82	90

The above limiting noise levels are considered to be representative of foreground music.

9 Conclusion

An environmental noise survey has been carried out at the site.

From this, and consideration of the typical noise climate in the absence of COVID restrictions, representative noise levels have been determined.

All plant must be designed such that the cumulative noise level at 1 m from the worst affected windows of the nearby noise sensitive premises does not exceed L_{Aeq} 48 dB during the daytime and L_{Aeq} 42 dB during the night. A scheme of mitigation has been determined to ensure the plant noise limits are achieved.

Furthermore, an assessment of patron noise for the rooftop terrace has been undertaken and limiting noise levels for music have been set for internal and external areas of the proposed hotel on levels 13 and 14, to ensure that the limits for activity noise egress are achieved at the nearest noise sensitive premises.

Appendix A

Survey details

Equipment

The unattended and attended noise measurements were taken using a Rion NL-52 sound level meter and a Norsonic 118 sound level meter, respectively.

Calibration details for the equipment used during the survey are provided in Table A1.

Table A1 Equipment calibration data

Equipment description	Type/serial number	Manufacturer	Calibration expiry	Calibration certification number
<i>Unattended measurements</i>				
Sound level meter	NL-52/00932326	Rion	16 Mar 23	TCRT21/1182
Microphone	UC-59/05549	Rion	16 Mar 23	TCRT21/1182
Pre-amp	NH-25/32354	Rion	16 Mar 23	TCRT21/1182
Calibrator	NC-74/34125432	Rion	16 Mar 23	TCRT21/1181
<i>Attended measurements</i>				
Sound level meter	Nor118/31754	Norsonic	16 Feb 23	UCRT21/1226
Microphone	40AF/62396	Gras	16 Feb 23	UCRT21/1226
Pre-amp	1206/30873	Norsonic	16 Feb 23	UCRT21/1226
Calibrator	1251/31322	Norsonic	16 Feb 23	UCRT21/1224

Calibration of the meters used for the measurements is traceable to national standards. Calibration certificates for the sound level meters used in this survey are available upon request.

Calibration checks were carried out on the meters and their measurement chains at the beginning and end of the survey. No significant calibration deviation occurred.

Noise indices

Noise indices recorded included the following:

- $L_{Aeq,T}$ The A-weighted equivalent continuous sound pressure level over a period of time, T.
- $L_{AFmax,T}$ The A-weighted maximum sound pressure level that occurred during a given period, T, with a fast time weighting.
- $L_{ASmax,T}$ The A-weighted maximum sound pressure level that occurred during a given period, T, with a slow time weighting.
- $L_{A90,T}$ The A-weighted sound pressure level exceeded for 90% of the measurement period. Indicative of the background sound level.

Sound pressure level measurements are normally taken with an A-weighting (denoted by a subscript 'A', eg L_{A90}) to approximate the frequency response of the human ear.

A more detailed explanation of these quantities can be found in BS7445: Part 1: 2003 *Description and measurement of environmental noise, Part 1. Guide to quantities and procedures*.

Weather conditions

During the attended noise measurements, the weather was generally clear and dry and no rain occurred. Weather reports for the area indicated that wind speed was less than 6 m/s.

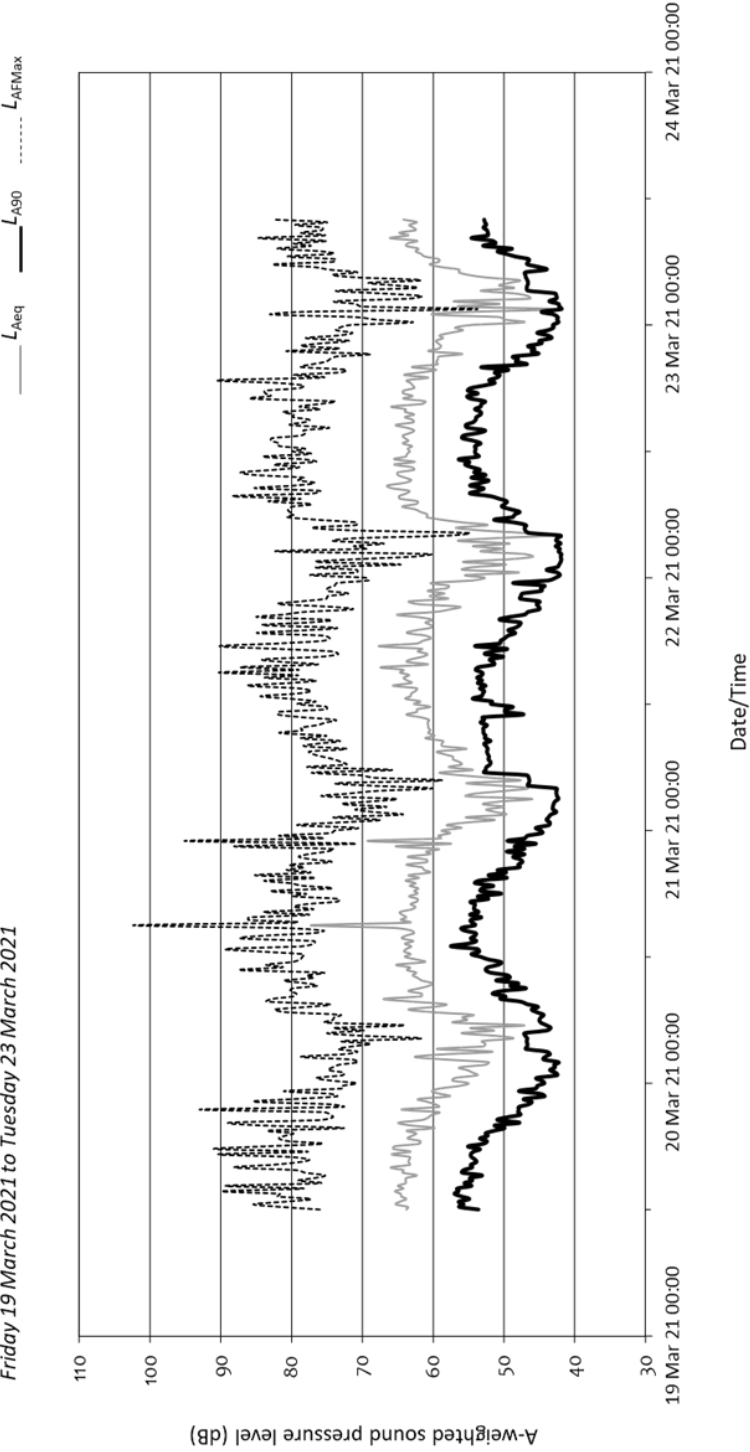
During the unattended noise measurements, weather reports for the area indicated that temperatures varied between 3°C at night and 11°C during the day, and the wind speed was less than 6 m/s.

These weather conditions are considered suitable for obtaining representative measurements.

Appendix B

Results of unattended measurements at Location 'L'

Treehouse Hotel, Manchester
Results of noise logging survey at 'L'
Friday 19 March 2021 to Tuesday 23 March 2021



Appendix C

DEFRA strategic noise map 2017 $L_{Aeq,16hr}$ screenshot



▼ Choose a location or tile



Layer List

Operational layers

- ☒ Environment Data WMS Service
 - ☒ Road_Noise_LAeq16h_England_Round_3
 - Noise Bands
 - 75+ dB(A)
 - 70.0-74.9 dB(A)
 - 65.0-69.9 dB(A)
 - 60.0-64.9 dB(A)
 - 55.0-59.9 dB(A)
 - 00.0-54.9 dB(A)

40m

These datasets have been made freely available by Defra and its agencies for your use. You can either

Appendix D

BS 4142 corrections for attention catching features

The following applies where plant noise is assessed in accordance with BS 4142:2014+A1:2019.

If the proposed plant noise contains attention catching features (such as tonal elements, whines, whistles, bangs etc), penalty corrections should be applied based on the type and impact of the features.

If appropriate, a subjective assessment of the plant features can be adopted. Where the plant noise contains tonal elements, the following corrections can be made depending on how perceptible the tone is at the noise receptor:

- 0 dB where the tone is not perceptible
- 2 dB where the tone is just perceptible
- 4 dB where the tone is clearly perceptible
- 6 dB where the tone is highly perceptible.

Where the plant noise is impulsive, the following corrections can be made depending on how perceptible the impulsivity is at the noise receptor:

- 0 dB where the impulse is not perceptible
- 3 dB where the impulse is just perceptible
- 6 dB where the impulse is clearly perceptible
- 9 dB where the impulse is highly perceptible.

For noise which is equally both impulsive and tonal, then both features can be accounted for by linearly summing the corrections for both characteristics.

If the plant has other distinctive characteristics, such as intermittency, then a 3 dB correction can be made.

If a subjective assessment of tonality is not appropriate, an objective assessment can be made by analysis of time-averaged, third-octave band sound pressure levels. A noise source is deemed to be tonal if the level in a third-octave band exceeds the level in adjacent third-octave bands by the level differences given below:

- 15 dB in the low frequency third-octave bands (25 Hz to 125 Hz)
- 8 dB in the mid frequency third-octave bands (160 Hz to 400 Hz)
- 5 dB in the high frequency third-octave bands (500 Hz to 10000 Hz).

If an objective assessment identifies the plant noise to be tonal then a 6 dB correction must be made.