

Cornbrook, Manchester

Noise & Vibration Impact Assessment Report

Client:

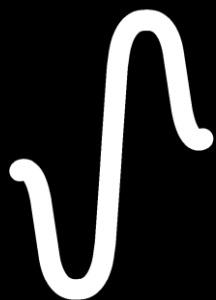
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14 Wood Street, Bolton
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**JAMESON
ACOUSTICS**

Consultants in acoustics,
noise and vibration

Document Control

Revision	Date	Author	Description
0	06-12-2023	AJ	-
1	11-12-2023	AJ	To reflect updated plans
2	17-01-2024	AJ	Updated site description and Grd-L05 floor plans

This report has been prepared with all reasonable skill, care and diligence for the sole benefit, use and information of the aforementioned Client in accordance with the purposes and terms agreed between ourselves and the Client. The liability of Jameson Acoustics Limited in respect of the information contained within this report will not extend to any third party.

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Date	17-01-2024

Executive Summary

Planning permission is sought for the erection of a 24-storey mixed use building incorporating 224 residential apartments (Use Class C3), 87 apart-hotel studios (Use Class C1), amenity space, flexible commercial space (Use Class E), and café (Use Class E(b)), together with infrastructure, landscaping, and other associated works.

The site is subject to noise from road traffic, primarily on Bridgewater Way (A56), as well as noise and vibration from train passbys on the elevated railway/tram lines to the north-west.

Jameson Acoustics Limited has been commissioned to undertake a noise and vibration impact assessment to supplement the planning application.

The assessment finds that acceptable internal noise levels within new dwellings can be achieved through the appropriate specification of façade elements and appropriate ventilation and overheating mitigation solutions that removes or restricts reliance on openable windows. Preliminary guidance on suitable specifications and solutions for framed external window/door systems has been provided. Acoustically-enhanced double glazed windows will be required for all façades, with the most onerous specifications for windows close to Bridgewater Way.

For the roof terraces (outdoor living spaces), our calculations demonstrate that acceptable noise levels are expected to be achieved in line with BS 8233.

Plant noise emission limits have been proposed so that future plant installations do not adversely impact on the locality.

Noise impacts from the operation of the ground floor commercial units and first floor amenity spaces have been considered and suitable noise criteria have been proposed, along with preliminary guidance on provisional solutions to mitigate the risk of adverse noise impacts. For the amenity spaces, provisions exist to enhance internal building fabric constructions as required to mitigate noise and vibration impact risks to adjoining dwellings. However, the exact usage of these amenity spaces is yet to be decided and it may therefore be prudent for the Local Authority to secure appropriate solutions are provided through a suitably worded condition of planning.

Vibration (and associated re-radiated noise) levels from train/tram passbys has been assessed. The findings indicate that estimated VDV vibration levels and structure-borne noise levels are expected to achieve good practice design guide limits.

Contents

1.0 Introduction 4

2.0 Objectives..... 4

3.0 Site Description 5

4.0 Planning Policy, Legislation & Assessment Guides 9

5.0 Baseline Noise Survey 11

6.0 Incident Road Traffic Noise Levels 17

7.0 Achieving Internal Noise Levels 19

8.0 Outdoor Living Space 23

9.0 Development-Generating Noise Impacts..... 25

10.0 Train-Induced Vibration Assessment 27

11.0 Conclusions 32

Appendix A – Acoustic & Vibration Terminology..... 34

Appendix B – Planning Policy & Assessment Guides 36

Appendix C – Noise Survey Time History Graphs..... 43

Appendix D – Vibration Survey Graphs..... 47

1.0 Introduction

Planning permission is sought for the erection of a 24-storey mixed use building incorporating 224 residential apartments (Use Class C3), 87 apart-hotel studios (Use Class C1), amenity space, flexible commercial space (Use Class E), and café (Use Class E(b)), together with infrastructure, landscaping, and other associated works.

The site is subject to noise from road traffic, primarily on Bridgewater Way (A56), as well as noise and vibration from train passbys on the elevated railway/tram lines to the north-west.

Jameson Acoustics Limited has been commissioned to undertake a noise and vibration impact assessment to supplement the planning application. The assessment seeks to demonstrate that [A] noise impacts can be sufficiently mitigated to achieve acceptable acoustic conditions within residential and commercial accommodation, [B] noise generated from the operation of the development (plant and commercial/amenity operation) can be mitigated to prevent adverse noise impacts on the locality and structurally-connected dwellings, and [C] vibration and associated re-radiated noise levels from train/tram passbys will not exceed good practice guideline limits.

For a description of the acoustic terminology used herein, please see Appendix A.

2.0 Objectives

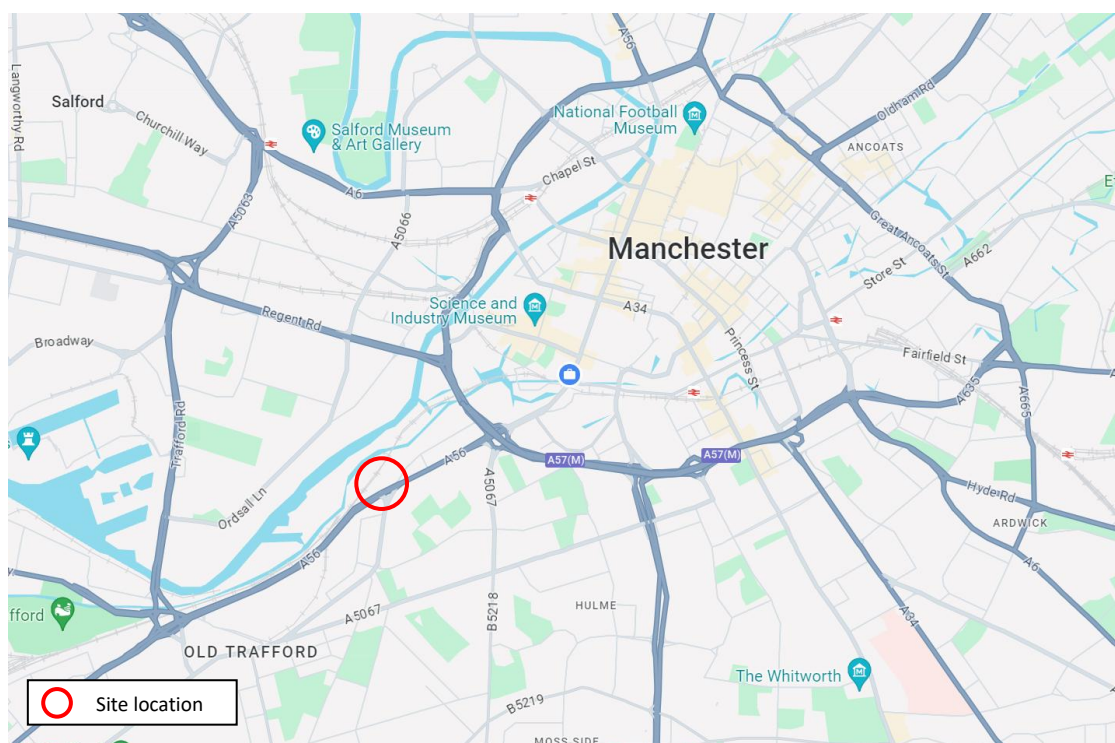
- To review the latest national and local planning policies/requirements and relevant design standards and good practice guides that will inform the noise impact assessments.
- To carry out a minimum 5-day noise survey at the site (encompassing a weekend), capturing daytime and night-time noise levels at selected positions in accordance with BS 7445.
- Based on the survey data, to undertake a noise assessment for the suitability of the site for residential use in accordance with the Noise Policy Statement for England (NPSE), National Planning Policy Framework (NPPF), statutory legislation, Planning Practice Guidance (ProPG), British Standard BS8233:2014 and Local Authority guidance/requirements.
- To subsequently provide guidance on noise mitigation and façade sound insulation solutions to achieve acceptable acoustic conditions within the completed scheme.
- To set noise emission limits for the development in line with BS 4142 with the aim of minimising the risk of the operation of new plant causing a noise nuisance to neighbours.
- To advise on sound insulation provisions to adequately control commercial/amenity noise transfer externally and to adjoining residential spaces.

- To survey train/tram vibration levels on-site and analyse the estimate resultant VDV vibration levels and re-radiated noise levels within the building against good practice guideline limits.

3.0 Site Description

3.1 Location

The site is located on land off Bridgewater Way (A56) in Cornbrook, Manchester and falls under the jurisdiction of Manchester City Council. See Location Plan below.



Location Plan (© maps.google.co.uk)

3.2 Description

The site is bounded by Bridgewater Way (A56) to the south-east, Cornbrook Road to the south-west, Dinton Street to the north-west and an adjacent multi-storey apartment building called 'Vox' to the north-east.

Beyond Dinton Street runs elevated railway/tram lines. There are 4nr primary lines; the furthest two are for trams serving Cornbrook Station, situated in close proximity to the site. All trams enter and exit the station at slow speed. The nearest two lines are for national rail passenger and freight trains.

Train/tram passbys influence the noise climate on-site, including freight train passbys through the night, however, road traffic is the dominant noise source. Bridgewater Way is a busy dual

carriageway into the city centre. Cornbrook Road and Dinton Street are relatively minor access roads, although both provide access for industrial vehicles serving a metal recycling centre beyond the railway lines to the north-west.

The area has become predominantly residential over the last few years, with the introduction of large-scale apartment buildings to the east and south. A site beyond 'Vox' Apartments to the north-east, currently cleared brown-field plot, has planning approval for another large scale residential development.

See site plan below.



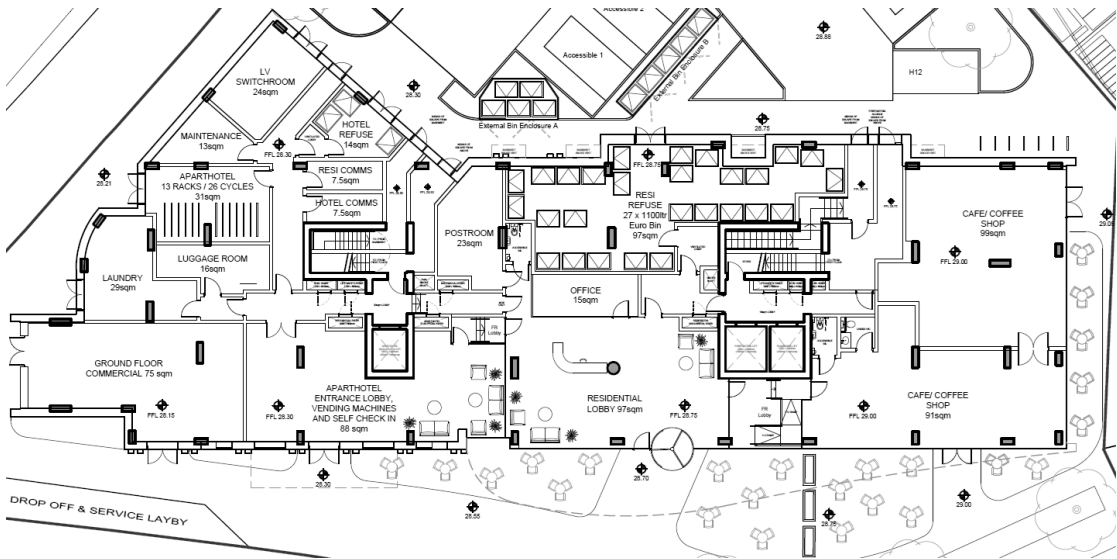
Site Plan (© maps.google.co.uk)

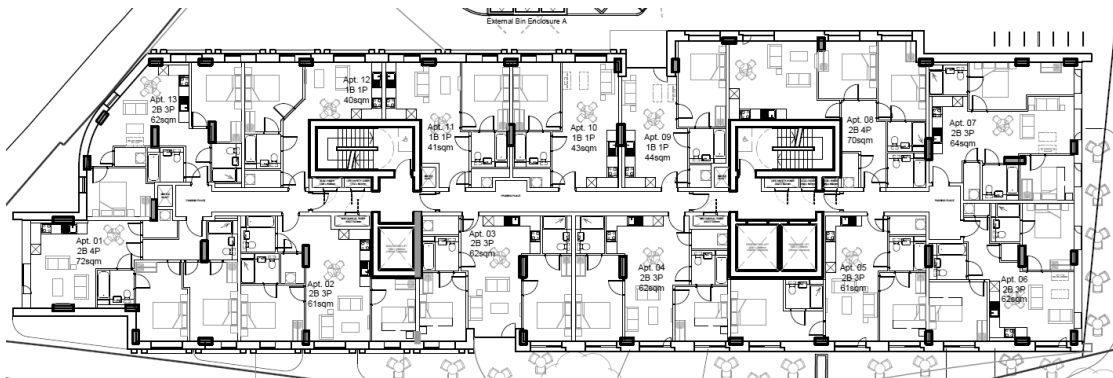
The proposal is for a single 24-storey development comprising 219nr residential units plus 5nr penthouses, 87nr apart-hotel studios, residential amenities, meetings rooms and commercial spaces (e.g. coffee shops). The ground floor comprises residential/hotel entrances, the 2nr commercial units and general servicing/back of house spaces. At Level 01 amenity and meeting space will occupy approximately half of the first floor space, with the remainder allocated for apart-hotel studios.

The apart-hotel will occupy Levels 01 to 05, typically with 25nr rooms for residential purpose per floor plate (12nr at Level 01). Private apartments occupy Levels 06 to 23.

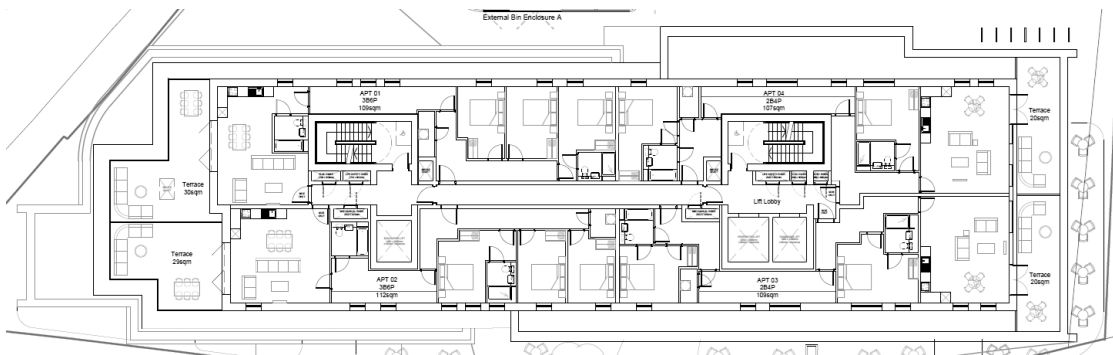
Penthouse apartments on Levels 22 and 23 will benefit from private terraces (outdoor living spaces).

See below the proposed ground floor plan, first floor plan, L02-05 floor plan, L06-19 floor plan and L22 & L23 floor plans. Levels 20-21 are also apartments with a slightly different floor layout (excluded for brevity).

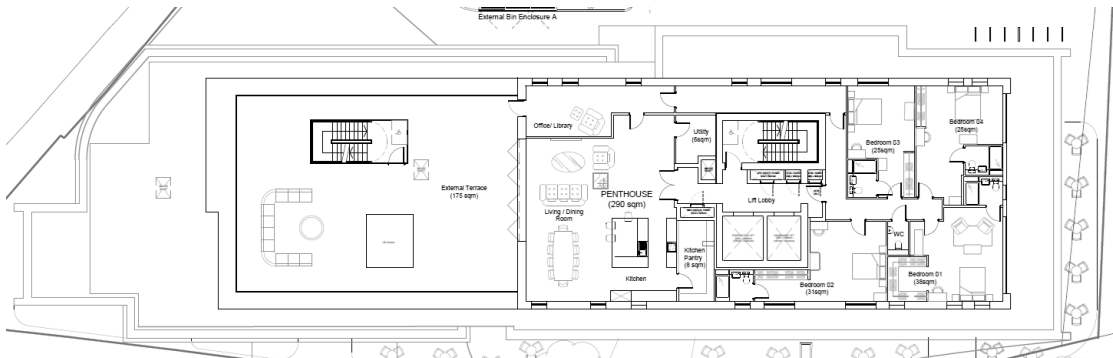




Proposed Levels 06-19 (Apartments)



Proposed Levels 22 (Penthouses with Private Terraces)



Proposed Levels 23 (Penthouse with Private Terrace)

4.0 Planning Policy, Legislation & Assessment Guides

4.1 National Planning Policy

National planning policies are set out in the following:

- Noise Policy Statement for England [NPSE], 2010;
- National Planning Policy Framework [NPPF], 2021;
- National Planning Practice Guidance – Noise [PPGN], 2019.

These documents provide a qualitative approach to noise assessments. See Appendix B for a detailed description of each.

4.2 Local Planning Requirements

4.2.1 Local Authority Development Plan

Manchester City Council's [MCC] Core Strategy was adopted on the 11 July 2012 and is the key document in the Manchester Local Plan. It sets out the long-term strategic policies for Manchester's future development and will form the framework that planning applications will be assessed against.

The Core Strategy requests that all new developments follow the 'Development Principles' and accord with the design guidance set out in the Supplementary Planning Documents. In accordance with Policy DM1, this includes the effects on amenity due to noise generated by a new development and, conversely for noise sensitive uses (e.g. residential), the effects of environmental noise onto the new development.

MCC's Supplementary Planning Document relating to noise is their 'Planning & Noise, Technical Guidance' published in October 2022 by their Environmental Protection Team. This document provides guidance to applicants and consultants concerning the assessment and prediction of environmental noise associated with a particular development. The key elements relevant to this development are summarised below.

4.2.2 Specific Guidance on Noise

In relation to noise affecting newly proposed residential properties, the council has adopted the following noise limits for sites affected only by environmental noise (e.g. road traffic):

- **Bedrooms (night time – 23.00 – 07.00) 30 dB L_{Aeq} (individual noise events should not normally exceed 45 dB $L_{Amax,F}$ by more than 10 times)**
- **Living Rooms (daytime – 07.00 – 23.00) 35 dB L_{Aeq}**
- **Gardens and terraces (daytime) 55 dB L_{Aeq}**

In relation to commercial noise, MCC's guidance advises that *"BS 4142 should be used to assess the likely impact of noise from industrial and commercial sources at noise sensitive premises"*.

The Council consider that new developments should contribute and enhance the area in which they are located and where possible, i.e. prevent 'noise creep', contribute to the improvement of people's health and quality of life as per the NPSE. With this in mind, the design objective should be:

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

For fixed plant, the Council advises a BS 4142 assessment that demonstrates that:

'Externally mounted ancillary plant, equipment and servicing shall be selected and/or acoustically treated in accordance with a scheme designed so as to achieve a rating level of 5dB (L_{Aeq}) below the typical background (L_{A90}) level at the nearest noise sensitive location'.

4.3 Legislation (Building Regulations)

The development will need to be built in such a way that it conforms to the Building Regulations 2010. In relation to noise and acoustics, the key documents to consider are:

- Approved Document E: 2003 Edition (incorporating amendments to 2015) – Resistance to the Passage of Sound [ADE];
- Approved Document F: 2021 Edition – Ventilation [ADF];
- Approved Document O: 2021 Edition – Overheating [ADO].

ADE relates to the design of the building's internal building fabric and primarily considers the control sound transfer between adjacent spaces. In planning terms, this development will contain party floors separating residential accommodation from the community/meeting spaces or residential amenity spaces. These vertical adjacencies will need to be designed in such a way that they achieve, as a minimum, the below ADE on-site sound insulation performance.

Description	Required Performance
Minimum airborne sound level difference <i>Party Floors separating dwellings or rooms for residential purpose from other parts of the building</i>	45 dB $D_{nT,w} + C_{tr}$

ADF includes a section on controlling noise from ventilation systems. It states that *"account should be taken of outside noise when considering whether openable windows are appropriate for purge ventilation"* and that noise from mechanical ventilation systems operating under normal conditions (not boost rates) should not exceed 30 dB L_{Aeq,T} for noise sensitive rooms (e.g. bedrooms) and 45 dB L_{Aeq,T} in less sensitive rooms.

ADO took effect on 15 June 2022 and does not apply to work subject to a building notice, full plans application or initial notice submitted before that date, provided the building work is started before 15 June 2023. It requires noise to be considered as part of the development's overheating strategy in locations where external noise may be an issue. It states that the overheating strategy should take account of the likelihood that windows will be closed during sleeping hours if noise within bedrooms exceeds the following limits.

- 40 dB $L_{Aeq,T}$, averaged over 8 hours (between 11pm and 7am).
- 55 dB L_{AFmax} , more than 10 times a night (between 11pm and 7am).

4.4 Assessment Guides

For planning and noise, the following industry standards and assessment guides shall be considered.

- ProPG: Planning & Noise, 2017;
- BS 8233: 2014 '*Guidance on sound insulation and noise reduction for buildings*';
- World Health Organisation [WHO] Environmental Noise Guidelines, 2018;
- Acoustics, Ventilation & Overheating [AVO] Residential Design Guide, 2020;
- BS 4142: 2014 '*Methods for Rating and Assessing Industrial and Commercial Sound*';
- BS 6472: 2008 '*Guide to Evaluation of Human Exposure to Vibration in Buildings*'.

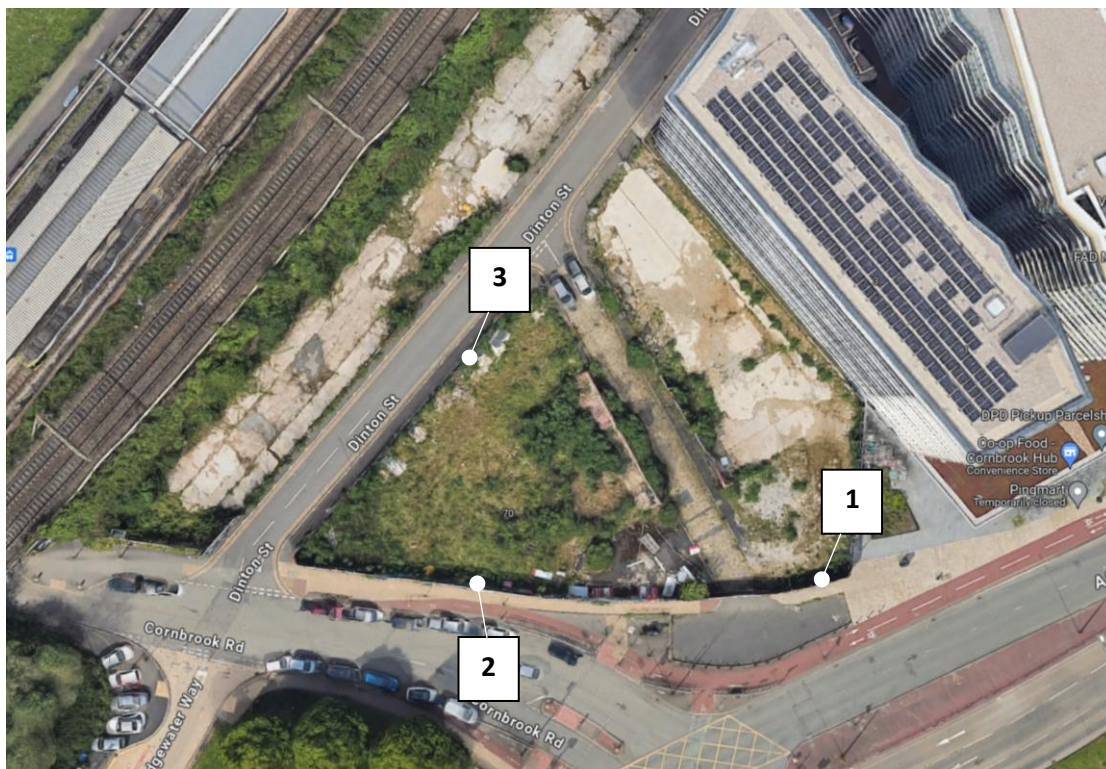
See Appendix B for a detailed description of each.

5.0 Baseline Noise Survey

5.1 Procedure

Automated noise level measurements were taken from 14:00 hours on Wednesday 1 November 2023 to 10:00 hours on Tuesday 7 November 2023 at 3nr on-site positions as described below. The positions were selected to establish the typical prevailing daytime and night-time ambient, maximum and background noise levels at the perimeters of the development site.

Position	Type	Description
1	Automated	To the east edge of the site, approx. 10 m from the roadside edge of Bridgewater Way. Microphone approx. 3 m above ground, protruding above site hoardings with full sight of Bridgewater Way.
2	Automated	To the south-west edge of the site, approx. 4 m from the roadside edge of Cornbrook Road. Microphone approx. 3 m above ground, protruding ~0.7 m above top of site hoardings with full sight of Cornbrook Road.
3	Automated	To the north-west edge of the site, approx. 2 m from the roadside edge of Dinton Street. Microphone approx. 3 m above ground, protruding ~0.7 m above top of site hoardings with full sight of Dinton Street and railway.



Site Plan showing measurement positions (© maps.google.co.uk)

The microphones were fitted with windshields and mounted in almost free-field conditions (corrections for reflections off site hoardings to be determined through noise mapping analysis).

The equipment was programme to continuously log all relevant A-weighted broadband (dBA) and linear spectral noise level indices, including L_{eq} , L_{90} , L_{10} and L_{max} , over 5-minute, 15-minute and 1-hour intervals.

All measurements were taken in general accordance with BS 7445-1: 2003 '*Description and Measurement of Environmental Noise*'.

5.2 Instrumentation

The instrumentation used for the survey is summarised below. The sound level meters were hand-calibrated at the beginning and end of the survey periods. No significant deviations in calibration level were noted.

Description	Equipment	Serial Nr	Lab Calibration Expiry	Lab Calibration Certificate Nr
Class 1 sound level meter	Svantek 971A (with Type 7152 microphone)	124663 (82835)	11 Aug 2024	12 Aug 2022
Class 1 sound level meter	Svantek 971A (with Type 7152 microphone)	131635 (85533)	1 Nov 2024	2 Nov 2022
Class 1 sound level meter	Svantek 971A (with Type 7152 microphone)	131642 (85571)	9 Nov 2024	10 Nov 2022
Class 1 sound calibrator	Cirrus CR:515	57570	8 Nov 2023	182770

5.3 Weather Conditions

Due to the nature of the survey, i.e. unmanned, it is not possible to describe the noise climate throughout the duration of the survey period. However, on install and collection, weather conditions were considered suitable for obtaining representative readings. The sky was clear with patchy cloud cover, road surfaces were predominantly dry and wind speeds were low (below 5 m/s). Based on internet weather reports for the full duration of the survey, conditions generally remain suitable for representative readings, albeit with occasional periods of light rain and scattered showers. Notably, there were prolonged periods of rainfall during the night-time periods of Friday 3 and Saturday 4 November 2023.

5.4 Observed Noise Climate

Due to the nature of the survey, i.e. unmanned, it is not possible to describe the noise climate throughout the duration of the survey period. However, on install and collection the noise climate was noted to be dominated by road traffic on Bridgewater Way. To the north-west of the site, tram passbys contributed to the noise climate. These were noted to occur every few minutes.

During our time on-site we noted 2nr passenger train passbys in a 2 hour period. The passbys were at a moderate speed and were influential to noise readings but not significant so.

We also noted a freight train passby during survey installation. This comprised tens of loaded carriages hauled by a diesel engine. The train passed at very slow speed, making the passby last for around 5-minutes. It was noted to elevate noise readings, but again not significantly so.

Other notable noise sources included occasional haulage vehicles passing along Cornbrook Road to the metal recycling centre. The recycling centre itself was visibly operational, with metal compressing machinery operational. However, the associated noise was barely audible on-site.

NB: The survey was scheduled to capture noise levels associated with football fans travelling to Old Trafford Football Ground. There was a Manchester United home fixture on the evening of Wednesday 1 November 2023.

5.5 Results & Analysis

The results of the automated survey have been plotted on Time History Graphs 22101-1-G1 to G3 enclosed in Appendix C. The graph presents the 15-minute A-weighted (dBA) L_{90} , L_{eq} and L_{max} levels at each position throughout the duration of the survey.

A summary of the results, as used to inform subsequent assessments against current guidelines, is presented in the following tables. NB: These values are uncorrected.

L_{Aeq} Ambient Noise Levels

The logarithmically-averaged 16-hour daytime and 8-hour night-time L_{Aeq} ambient noise levels

Position 1 Period Commencement (Day/Night of...) 2023	Ambient Noise Level (dB)	
	Daytime $L_{Aeq,16hr}$ (07:00-23:00)	Night-time $L_{Aeq,8hr}$ (23:00-07:00)
Wednesday 1 November	71 ¹	67
Thursday 2 November	71	68
Friday 3 November	71	68
Saturday 4 November	71	68
Sunday 5 November	71	67
Monday 6 November	71	67
Week Average	71	67

¹ incomplete 16-hr period

Position 2 Period Commencement (Day/Night of...) 2023	Ambient Noise Level (dB)	
	Daytime $L_{Aeq,16hr}$ (07:00-23:00)	Night-time $L_{Aeq,8hr}$ (23:00-07:00)
Wednesday 1 November	64 ¹	60
Thursday 2 November	64	60
Friday 3 November	64	60
Saturday 4 November	63	60
Sunday 5 November	64	59
Monday 6 November	64	60
Week Average	64	60

¹ incomplete 16-hr period

Position 3 Period Commencement (Day/Night of...) 2023	Ambient Noise Level (dB)	
	Daytime $L_{Aeq,16hr}$ (07:00-23:00)	Night-time $L_{Aeq,8hr}$ (23:00-07:00)
Wednesday 1 November	61 ¹	56
Thursday 2 November	61	57
Friday 3 November	62	57
Saturday 4 November	60	55
Sunday 5 November	63	56
Monday 6 November	62	57
Week Average	62	56

¹ incomplete 16-hr period

L_{Afmax} Maximum Noise Levels at Night

The 10-15th highest 5-minute L_{Afmax} maximum noise level night ‘event’

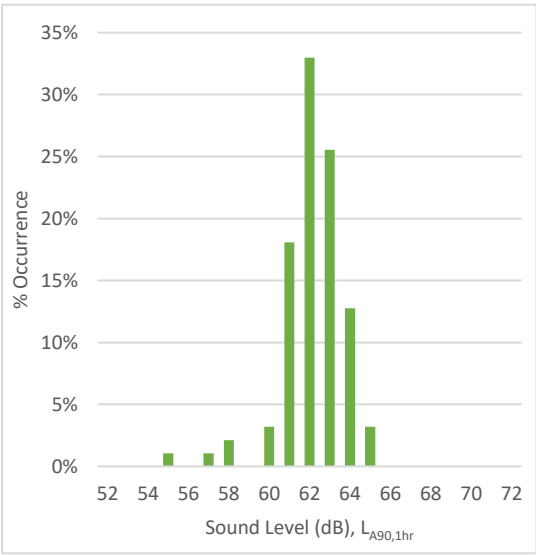
Position	Maximum Noise Level (dB) At Night-time L _{Amax,5min} (23:00-07:00)
1	80
2	74
3	72

L_{A90} Background Noise Levels

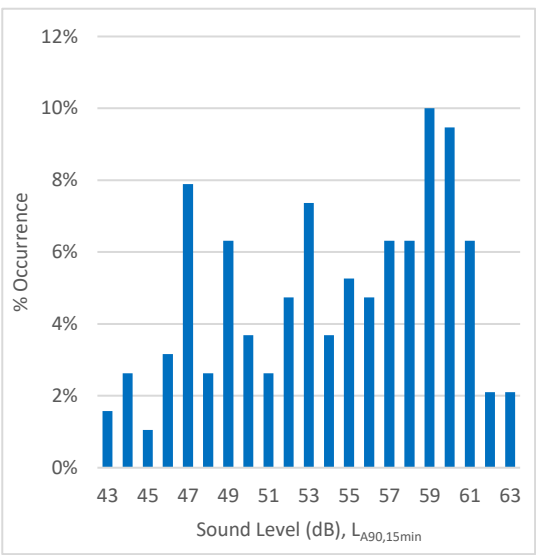
The representative background determined through statistical analysis to BS 4142

Position	Background Noise Level (dB)	
	Daytime L _{A90,1hr} (07:00-23:00)	Night-time L _{A90,15min} (23:00-07:00)
1	62	47
2	56	45
3	53	44

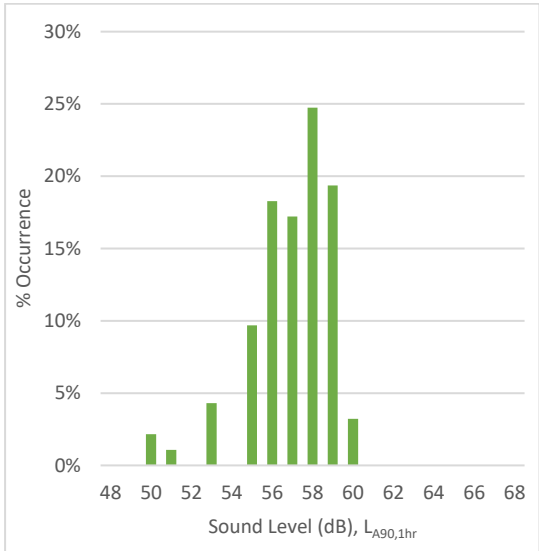
See below graphs showing the % distribution of background noise levels at each position throughout the duration of the survey.



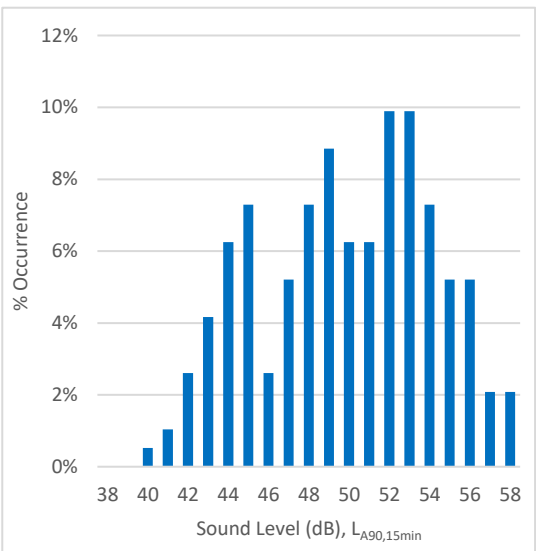
Position 1 – Daytime



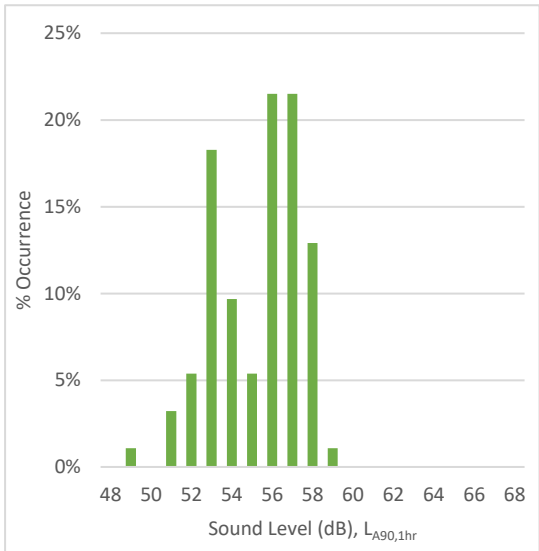
Position 1 – Night-time



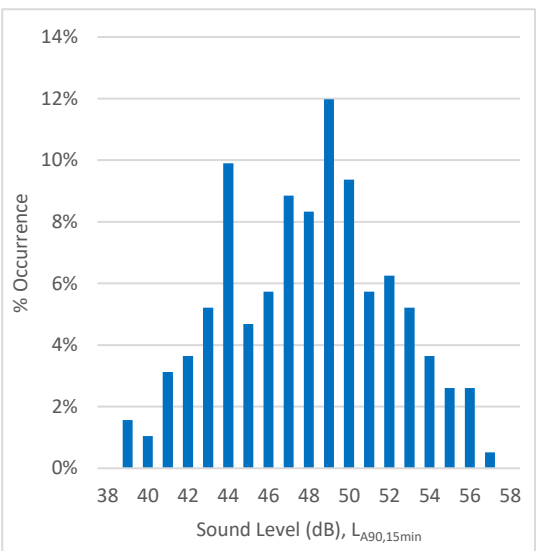
Position 2 – Daytime



Position 2 – Night-time



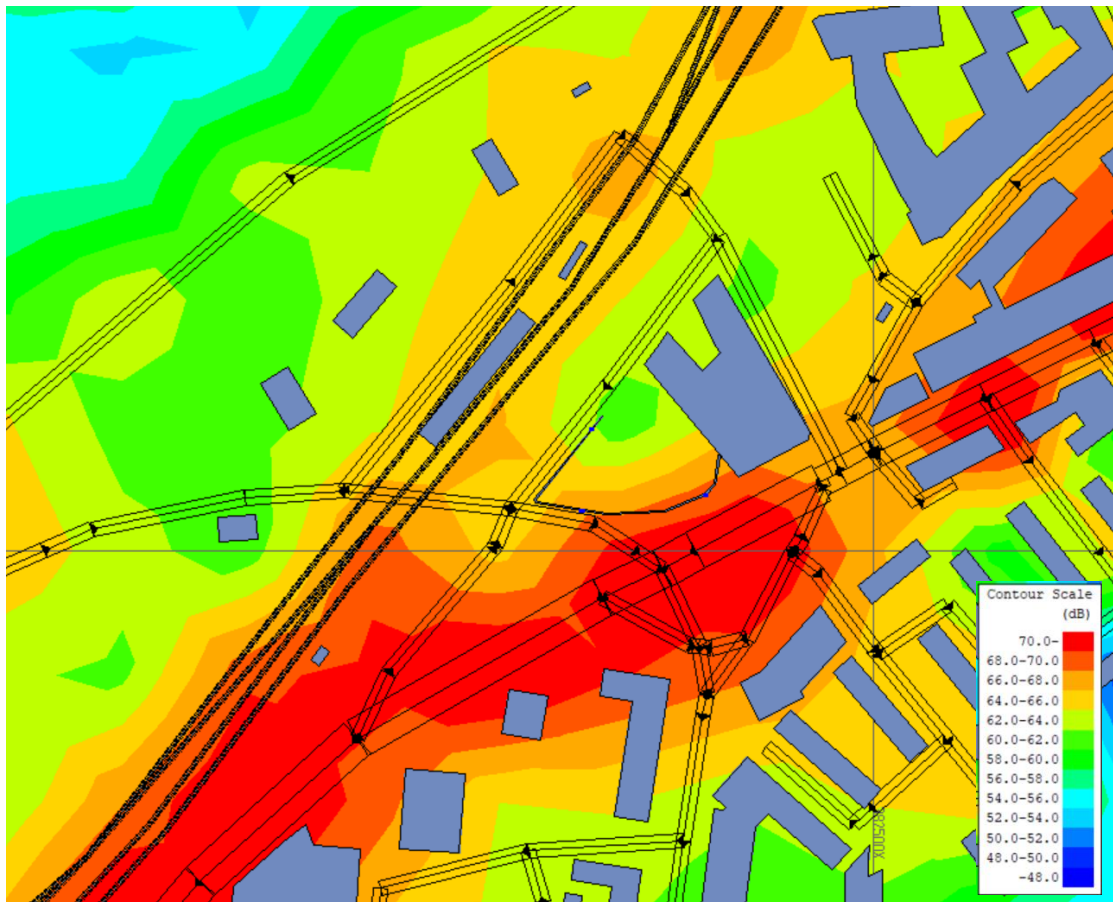
Position 3 – Daytime



Position 3 – Night-time

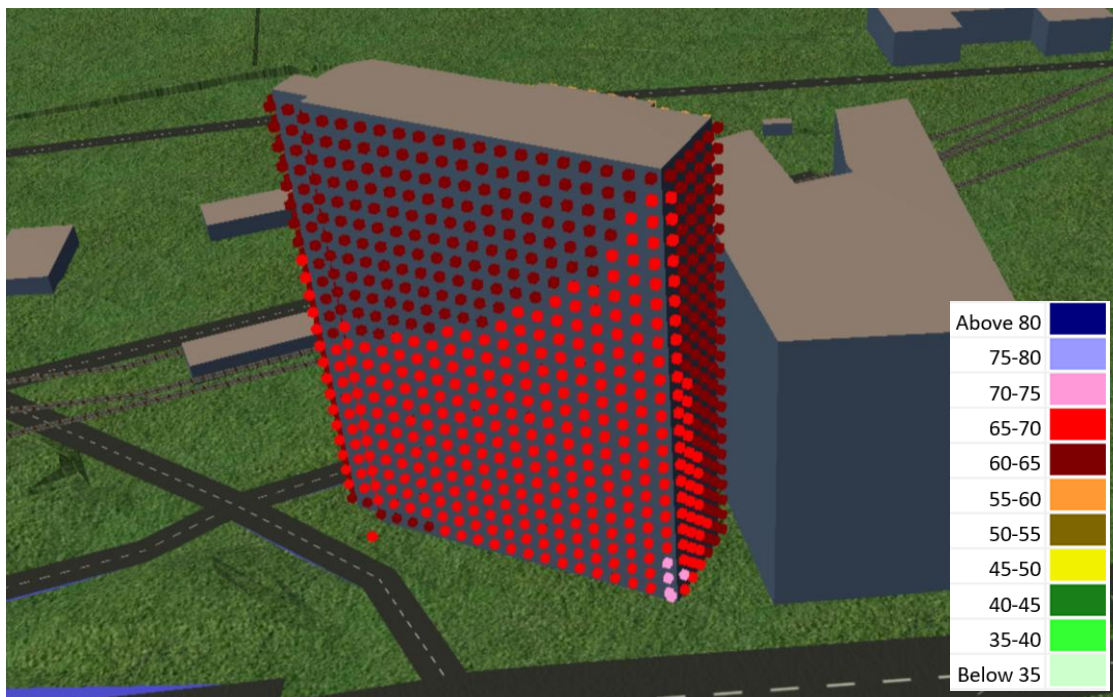
6.0 Incident Road Traffic Noise Levels

Incident road traffic noise levels onto each building façade have been analysed using 3D noise modelling software. The noise model has been calibrated using receivers set to match the 3nr precise measurement positions. The following plan illustrates the spread of daytime $L_{Aeq,16hr}$ noise levels across the existing site. Night-time noise levels have been excluded for brevity, although noise levels typically follow a similar spread with an overall level drop of circa 4-6 dB.

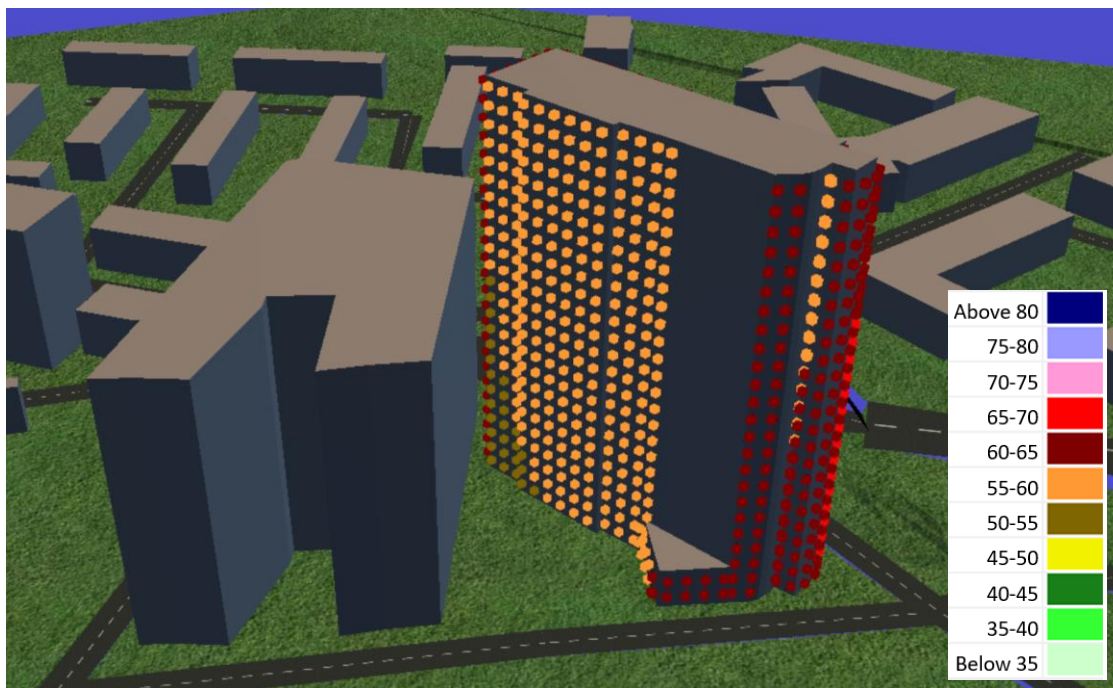


Noise Map of Existing Site – Daytime $L_{Aeq,16hr}$ traffic noise levels (4 m above ground level)

The following Figures illustrate the incident daytime $L_{Aeq,16hr}$ traffic noise levels across the proposed facades of the development. Again, night-time noise levels have been excluded for brevity.



Looking North-West



Looking South-East

The survey results suggest incident L_{Amax} noise levels are unlikely to influence the façade acoustic performance requirements on the road-facing elevations of the development. For the rail-facing elevation, incident L_{Amax} noise levels at night at calculated to be, at worst, 74 dB L_{Amax} for the worst-affected apartments.

7.0 Achieving Internal Noise Levels

7.1 Criteria

We would propose the following internal noise levels to be achieved (where feasible) within new dwellings during normal ventilation conditions.

Room	Desirable Internal Noise Level	
	Daytime (07:00-23:00)	Night-time (23:00-07:00)
Living Room	35 dB $L_{Aeq,16hr}$	-
Bedroom	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$ 45 dB* L_{Amax}

* Noise events (5-min) - not exceeded more than 10-15 times per night

Within the community/meeting spaces and residential amenity spaces, we would propose external noise intrusion is controlled to achieved an internal noise level of 40 dB $L_{Aeq,1hr}$.

7.2 Building Envelope Acoustic Design

7.2.1 External Walls & Roofs

The façade design proposes a mixture of curtain walling and brick/clad external walls with insulated SFS and plasterboard linings with punched-in double glazed windows. For the latter, such a construction would be expected to provide a sound reduction performance far in excess of 45 dB $R'_w + C_{tr}$ with 150 mm deep SFS, fully insulated, with 2 layers of plasterboard internally. This performance would far surpass what will be required on this site to control noise ingress.

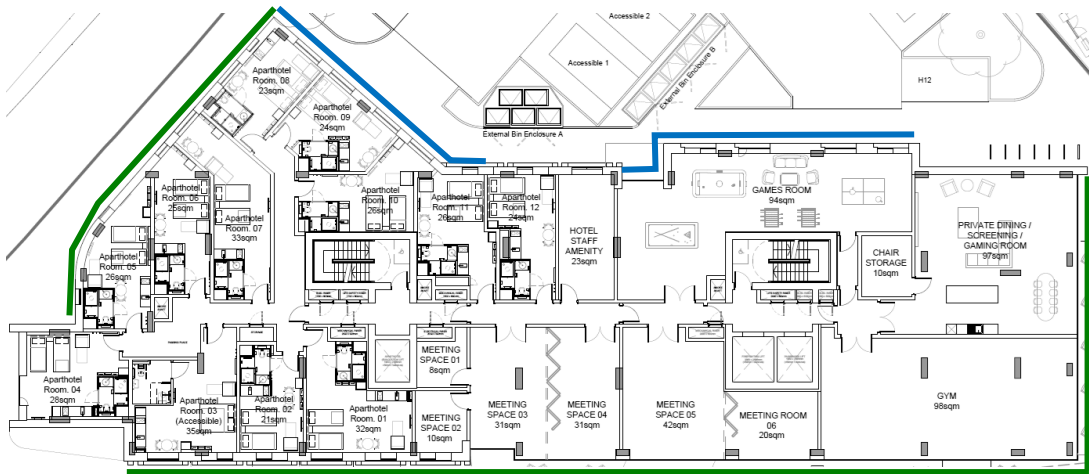
The roof elements will be a solid concrete slab of circa 200-225 mm depth which will provide a sound reduction performance far in excess of what will be required on this scheme (again, greater than 45 dB $R'_w + C_{tr}$).

7.2.2 Curtain Walling & Framed External Windows/Door Systems

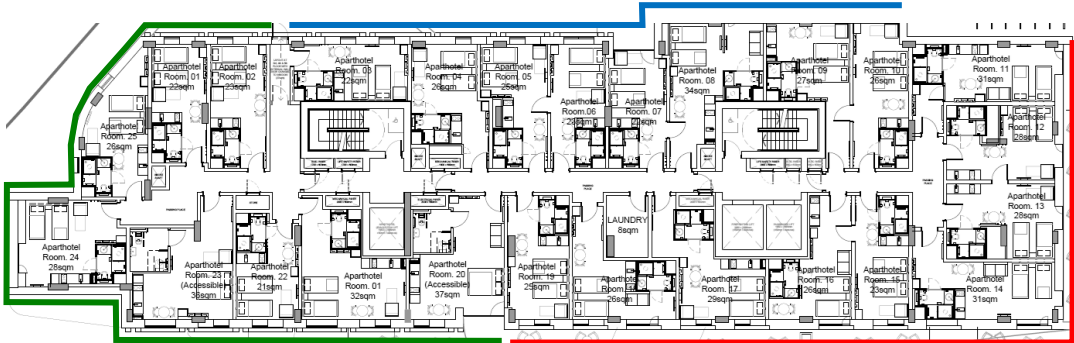
Preliminary sound insulation calculations have been carried out in order to specify the minimum sound insulation performance of the framed windows/doors and curtain walling elements. Our calculations follow BS 8233 procedures and consider the apartment room dimensions and window sizes taken from the latest architectural drawings.

Our calculations suggest provisions should be made for the following specifications for the complete framed window/door systems. Example configurations are provided for guidance only.

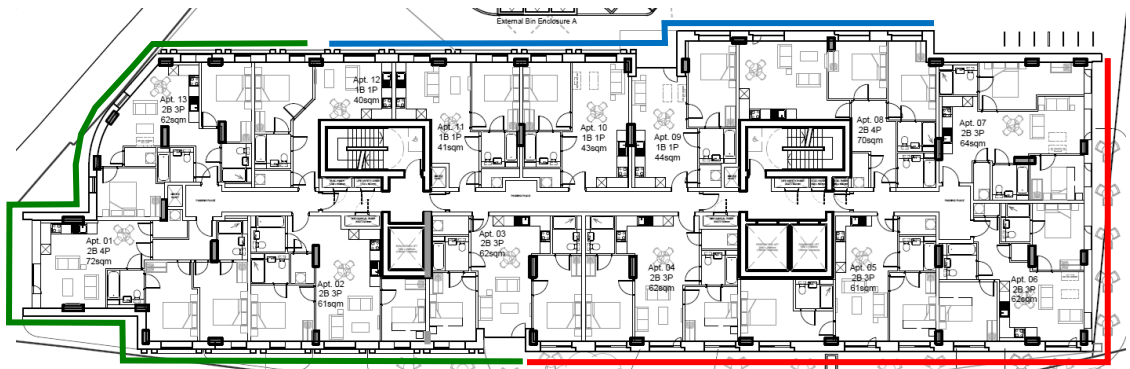
Façade Zone (ref. Figures below table)	Min. Required Sound Reduction $R_w + C_{tr}$ (dB)	Example Configuration
RED	38	10.4 / 16 / 6.4 mm (aco. lam.)
GREEN	34	8.4 / 16 / 6.4 mm (lam.)
BLUE	30	8 / 16 / 6 mm



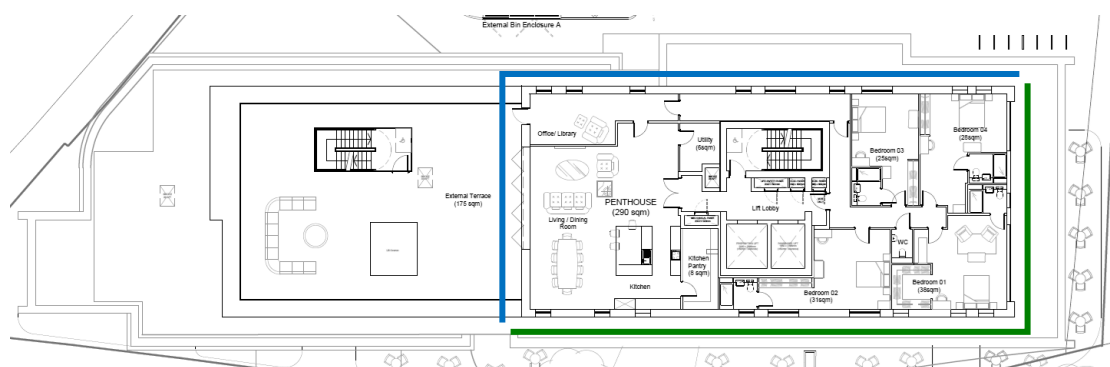
First Floor Plan



Levels 02-05 (Apart-Hotel)



Levels 06-22 (Apartments)



Levels 23 (Penthouse with Private Terrace)

7.2.3 Ventilation

For ventilation (and to assist with overheating), appropriately-sized MVHR heat recovery systems will be provided to each apartment. These will remove the need for trickle ventilators and/or reliance on openable windows to provide normal background ventilation (in line with Approved Document F).

Note: Noise from mechanical ventilation systems should be designed to NR 25 in bedrooms at night and NR 30 in both bedrooms and living rooms during the day.

7.3 Overheating & Noise

Often the overheating strategy for residential buildings places some reliance on openable windows in the summer months. For sites where incident noise levels are high, noise should be taken into account when considering whether openable windows are appropriate for providing this extra purge ventilation to control overheating.

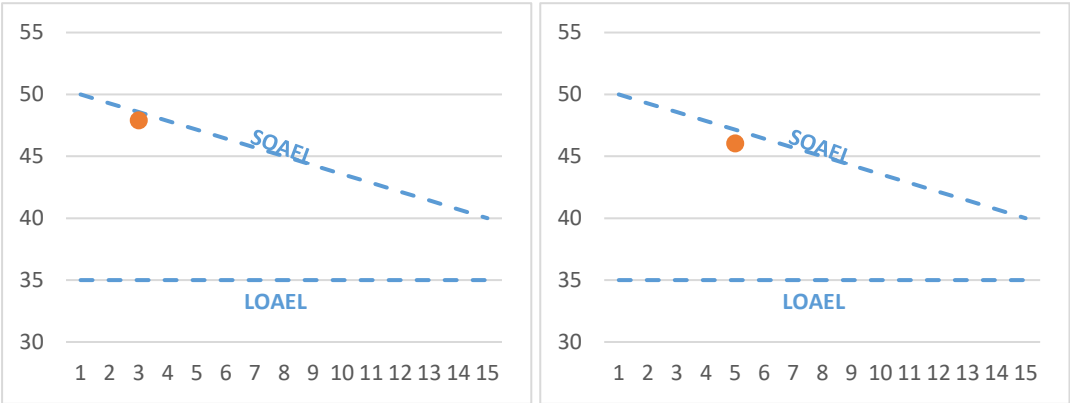
In accordance with the Acoustics, Ventilation and Overheating Guide (AVO), the associated risk of noise levels been deemed unacceptably high with windows open would be when incident external noise levels exceed 65 dB $L_{Aeq,16hr}$ (day) and 55 dB $L_{Aeq,8hr}$ (night). In addition, Building Regulations' Part O advises that the overheating strategy should assume windows will be closed throughout the night where incident façade noise levels exceed circa 49 dB $L_{Aeq,8hr}$ and 64 dB L_{Amax} .

Based on the Part O requirements, the overheating strategy shall assume windows will be closed throughout the night (23:00-07:00 hr) for all residential units.

For AVO (daytime), the following table sets out the maximum number of hours windows can be opened during daytime hours before internal noise levels would exceed the Significant Observed Adverse Effect Level (SOAEL). Please refer to façade zones in Figures in Section 7.2.2.

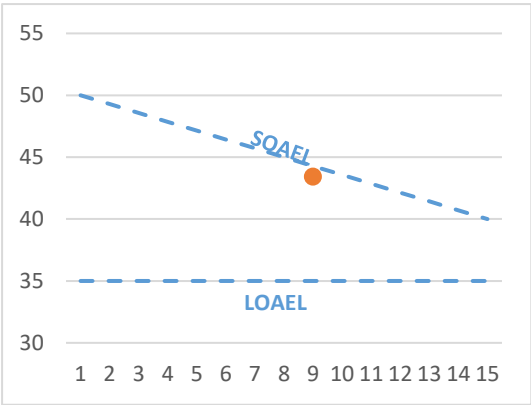
Façade Zone (ref. Figure in Section 7.2.2)	Maximum number of hours windows can be open during the day (07:00-23:00)
RED	3 hours
GREEN	5 hours
BLUE	9 hours

Provided the above limits are achieved, internal noise levels would fall below the AVO threshold in all zones, as illustrated on the below Figures. The x-axis scale is duration for which ‘overheating condition’ occurs (in hours), the y-axis is the internal ambient noise level (in dB, $L_{Aeq,16hr}$).



Red Zone – AVO Assessment

Green Zone – AVO Assessment



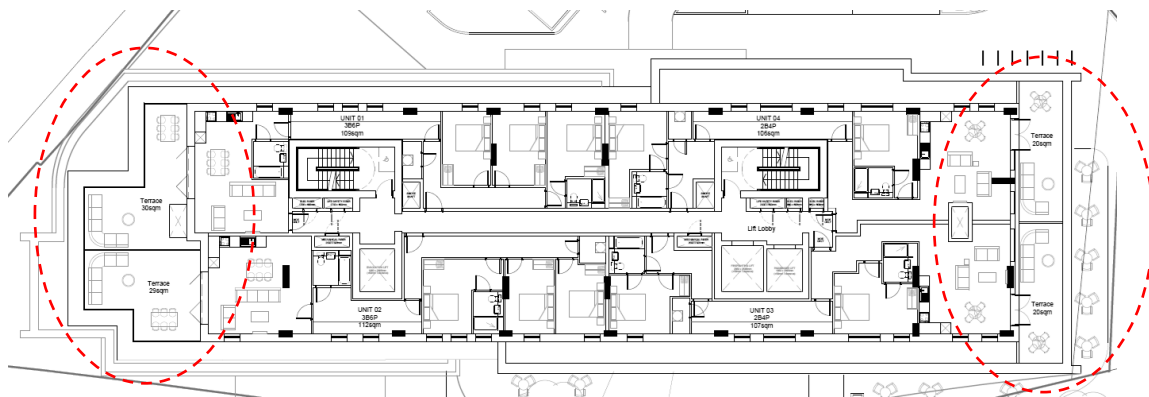
Blue Zone - AVO Assessment

Based on our experience working on similar schemes with restricted reliance on openable windows for acoustics, TM59 internal temperature targets can be achieved with a combination of suitably specified solar-rated glazing, appropriately sized windows, black-out blinds, and the specification of suitably sized mechanical ventilation systems to ‘trim’ the hours of reliance on openable windows.

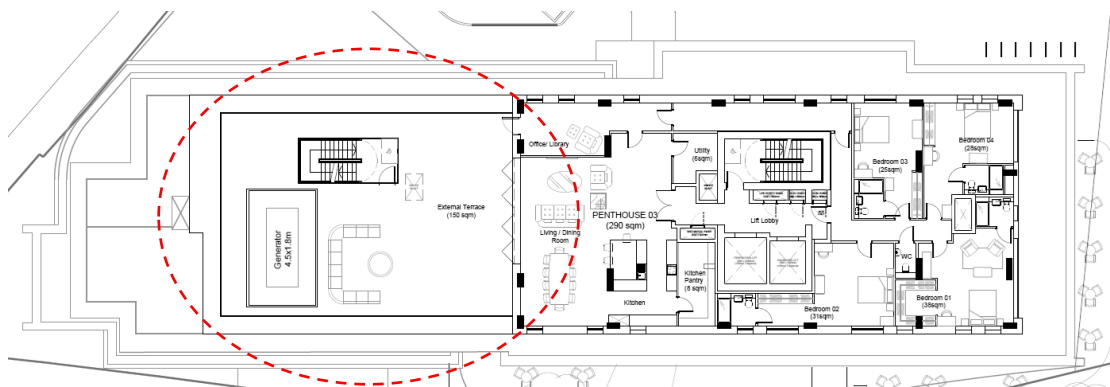
Air conditioning can be considered for quality developments. However, the introduction of mechanical solutions should be considered carefully; not only with regard to cost and maintenance, but sustainability and the environment, which are factors that carry more importance for any new development under MCC’s jurisdiction.

8.0 Outdoor Living Space

The development proposals roof terraces for penthouse apartments at Level 22 & 23, as shown below.



Proposed Levels 22 (Penthouses with Private Terraces)



Proposed Levels 23 (Penthouse with Private Terrace)

For outdoor living spaces, BS 8233 states:

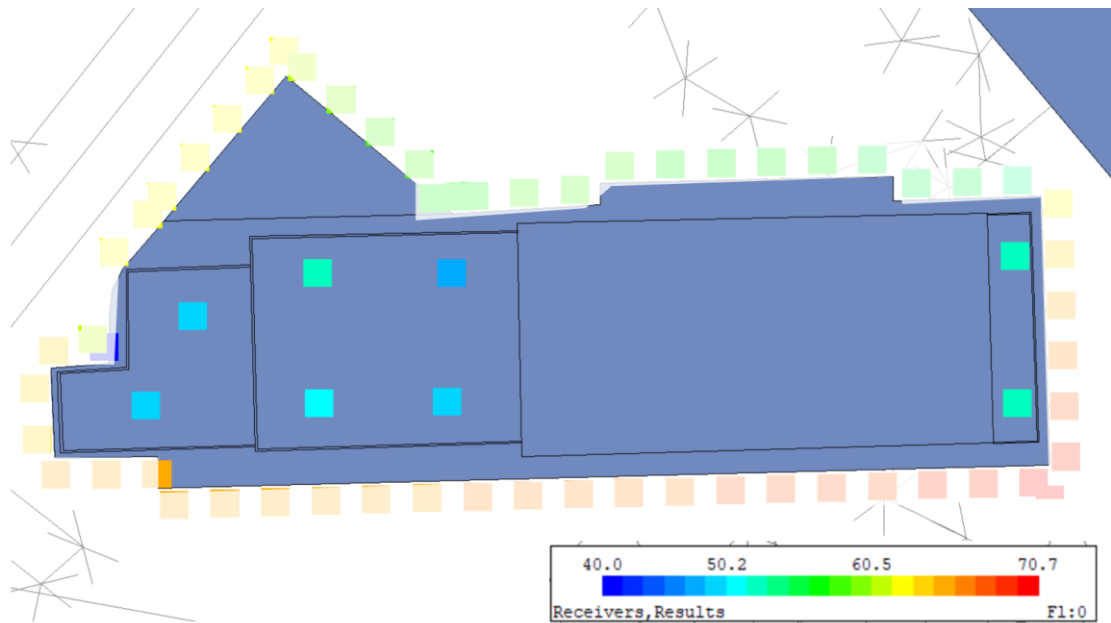
"For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable and a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces but should not be prohibited."

The development proposals allow for fully glazed balustrades around roof terraces, which are set back from the roof edge parapet, as illustrated below. Our calculations assume this balustrade would be circa 1.5 metres in height.



Section of 3D visual showing roof terrace glass balustrades (c/o LRW)

The calculated $L_{Aeq,16hr}$ daytime noise levels on each roof terrace are summarised on the following plan. These levels are calculated at a height of 1.7 m above roof level (approx. standing ear level).



Noise model showing noise levels on roof terraces (scale: dB, $L_{Aeq,16hr}$)

The results illustrate noise levels are expected to achieve the BS 8233 upper limit of ≤ 55 dB $L_{Aeq,16hr}$ on all terraces.

9.0 Development-Generating Noise Impacts

9.1 Plant Noise Emission Limits

Based on the results of the noise survey and the requirements of the Local Authority, we propose the following plant noise emission limits to be achieved incident at the nearest noise sensitive windows with all plant operating simultaneously. These limits are 5 dB below the prevailing 'representative' background noise levels.

Receptor Location	Plant Noise Rating Limit, $L_{A,T,r}$ ref. BS 4142 (dB)	
	Daytime (07:00-23:00)	Night-time (23:00-07:00)
Noise sensitive receptors to north & west	48	39
Noise sensitive receptors to south & east	51	40

Noise shall be assessed in accordance with BS 4142:2014 with corrections applied for any plant emitting noise of a tonal or irregular quality.

The above limits shall be subject to the final approval of the Local Authority.

9.2 Amenity / Commercial Unit Operations

The development will contain residential amenity spaces, as well as commercial units at ground floor. These spaces may have the potential to generate notable activity noise levels depending on the intended usage. This noise may have the potential to cause adverse impacts to external noise sensitive receptors (noise breakout through facades) and/or to the structurally-connected new dwellings within the building (transfer through floors/structure).

The exact uses / opening times etc. for these spaces are not known and thus, at this stage, exact operational noise levels have not been established and detailed noise control measures cannot be advised. The following sections provide preliminary design guidance.

It may be prudent for the local authority to consider a suitably worded condition so further information can be provided as the building design progresses.

9.2.1 Commercial Units

We would suggest the commercial unit is designed a shell that (a) satisfies minimum Building Regulations sound insulation standards to residential amenity spaces above as per Section 4.3, and (b) provides a conventional double-glazed curtain walling frontage that will control operational noise egress for the vast majority of prospective restaurant/café tenants. Item (a) is not strictly necessary but would represent a sensible performance standard for the demise adjacency.

Appropriate operational noise limits would need to be assigned depending on the proposed building structure. Should prospective tenants wish to exceed these limits, they would be responsible for

acoustic-enhancements to prevent adverse noise impacts. This would be secured through an appropriately worded clause in the AfL and the planning authority may also wish to secure this via an appropriate worded planning condition.

As an example, if a traditional restaurant was proposed (Class E), standard façade constructions and Building Regulations compliant floor constructions are likely to result in appropriate noise levels to accommodate anticipated operational noise. If, however, a modern bustling restaurant with music was proposed, additional acoustic treatment could be required but the AfL would ensure the tenant would provide this in their fit-out works (e.g. a plasterboard ceiling to control noise to above).

9.2.2 Amenity Spaces

The precise usage of the amenity spaces would need to be established, so that anticipated operational noise levels can be determined and appropriate noise mitigation solutions assigned. In lieu of known usage, we would propose the following design criteria:

- All separating constructions to neighbouring dwellings to achieve Building Regulations ADE minimum standards;
- Anticipated activity noise levels in amenity spaces not to ($L_{Aeq,5min}$) should be controlled to 5dB below the typical background noise level (L_{A90}) in each octave band in neighbouring habitable rooms. NB: If background noise levels closely match MEP services noise limits of NR30 (daytime) and NR25 (night-time), activity noise limits of NR25 (daytime) and NR20 (night-time) may be suitable.
- For 'entertainment' amenity spaces (e.g. cinema), noise levels in the 63Hz and 125Hz octave centre frequency bands (L_{eq}) should be controlled so as not to exceed (in habitable rooms) absolute noise limits of 47dB and 41dB ($L_{eq,5min}$), respectively.
- For gyms, airborne and structure-borne noise should be controlled in line with ProPG Gym Acoustics design guide (2023), with a suitable G-curve assigned to mitigate risks of structural-impacts caused by the dropping of weights, use of treadmills, etc..

For standard 'low noise' amenity spaces (e.g. residence lounge, study areas), conventional constructions achieving the minimum Building Regulations ADE requirements may be sufficient. Where noise levels and/or foot traffic may be elevated, provisions for additional acoustic treatment may be required for the floors, e.g. higher rated resilient floor coverings for heavier impact (footfall) noise control, and/or the ceilings, e.g. additional mass plasterboard ceilings with mineral wool insulation.

For 'high noise' generating amenities (e.g. gym, screening room), provisions should be made for significant additional treatment. These spaces have been positioned to avoid direct horizontal adjacencies with apartments. Provisions should be made for enhanced acoustic ceilings (double layer plasterboard, mineral wool, and possibly acoustic hangers) to protect apartments above. For gyms, provisions should be made for specialist acoustic floating floor treatments to mitigate the risk of

structure-borne noise and vibration transfer if free-weights (or similar ‘heavy floor impact’ activities) are proposed. Note that, depending on the use of the gym, size of weights, and ProPG G-curve assigned, it may be necessary to consider a heavy weight concrete floating floor system with additional rubber gym matting of an appropriate thickness.

The exact uses of the amenity spaces are yet to be decided, but the above seeks to demonstrate that provisions exist to mitigate all noise and vibration risks to an acceptable standard. It may be prudent for the Local Authority to secure this with a suitably worded condition of planning.

10.0 Train-Induced Vibration Assessment

10.1 Vibration Sources

10.1.1 Vibration Sources

The majority of the vibration energy from trains/trams is due to a combination of physical mechanisms such as wheel rail head interaction, wheel and rolling stock out-of-balance forces and suspension system resonances. All of this energy is transmitted via the track support system into the underlying ground or elevated platform structure. Any irregularities in the wheel/rail interface (eg wheel flat spots, railhead corrugation, rail joints, points etc.) can significantly increase the energy transmitted.

The main proportion of vibration energy transmitted by a train passby is found in the frequency range of 8 Hz to 250 Hz. It is usual to see some minor-to-moderate peaks in the frequency spectra at 10 to 20 Hz, due to the vehicle suspension system, although the majority of energy is contained at higher frequencies, typically between 50-400 Hz, where the rail-wheel mechanism becomes dominant.

10.1.2 Scheduled Passbys

The following table presents the estimated total number of train and tram movements past the development site based on Network Rail Working Timetables (Section CE04 passenger trains, Section CZ05 for Freight & Department Services) and the TfGM Metrolink website for daytime (07:00-23:00 hr) and night-time (23:00-07:00 hr) periods. The TfGM scheduling is based on a tram pass by every 12 minutes on each line between 06:00-00:00 hr daily (excl. Sunday) and every 24 minutes on each line between 00:00-01:00 hr on Friday / Saturday nights.

Transport	Daytime (07:00 – 23:00)	Night-Time (23:00 – 07:00)
Passenger trains	114	9
Freight trains	49	27
Metrolink (trams)	1120	112

NB: The Vibration Dose Value parameter is driven by the magnitude of the individual train passbys and is relatively insensitive to the number of train events.

10.2 Vibration Survey

10.2.1 Procedure

Vibration surveys were undertaken on the following date with the purpose of establishing the magnitude and frequency distribution of groundborne vibration levels from train and tram movements at 2nr measurement positions. The duration of measurements at each position was sufficient to capture 2nr freight train passbys, 3nr passenger train passbys and numerous tram passbys.

- Wednesday 1 November 2023, 13:00-15:00 hrs.

The key measurement positions (those used in our assessment) are described below.

Position	Description
1	Sensor mounted onto a solid concrete platform at the approximate distance of the closest part of the building to the railway lines.
2	Sensor mounted onto a solid concrete platform approximately 15 metres into the site.



Site plan showing vibration measurement positions (© maps.google.co.uk)

10.2.2 Instrumentation

The following instrumentation was used for the survey and subsequent analysis:

- Svantek SV106 – 6nr channel vibration meter, serial nr 69130,
- 2nr Svantek SV84 tri-axial accelerometers (X-, Y-, Z-axis),
- 2nr Svantek SV207 mounting bases,
- Svan PC++ data analysis software.

The equipment was hand calibrated before and after the survey which shown no unfavourable deviations. The equipment was factory calibrated on 18 January 2023.

The vibration was connected to the tri-axial accelerometers via extension cables. The equipment was set to log one-third octave band (1 Hz – 800 Hz) linear RMS vibration acceleration levels (m/s^2) in 1-second intervals.

The vibration measurements were undertaken with the accelerometers attached to the heavy mounting bases and sat onto the ground/surface with adjustable spiked feet to obtain true X-, Y-, Z-axis levels.

10.2.3 Results

Typical measured RMS acceleration vibration levels in the dominant Z-axis for a range of selected train/tram passbys at each measurement position are presented on Vibration Graphs 22101-1-VG1 to VG2 enclosed in Appendix D.

10.3 Design Criteria

10.3.1 Vibration Levels

British Standard BS 6472: 2008 *“Guide to Evaluation of Human Exposure to Vibration in Buildings”* advises that intermittent vibration events should not be judged based on perception alone but using the corresponding vibration dose value over a long period.

The table below details the Vibration Dose Values ($\text{m/s}^{1.75}$) above which various degrees of adverse comment may be expected in Residential Buildings.

Time Period	Low Probability of adverse comment	Adverse comment possible	Adverse comment probable
Daytime (07:00– 23:00)	0.2 to 0.4	0.4 to 0.8	0.8-1.6
Night-time (23:00-07:00)	0.1 to 0.2	0.2 to 0.4	0.4-0.8

10.3.2 Structure-borne Noise Levels

There is currently no UK or International Standard which proposes acceptable levels of structure-borne noise (SBN) from railways, but the main US and UK guidance documents on this subject are summarized below.

In general, structure-borne (or re-radiated) noise is of greatest concern when it is the dominant noise, and also when the source cannot be seen, as in the case of trains in a tunnel or overground trains running on the opposite side of the building. Criteria for re-radiated noise are therefore generally intended to apply to sources that are not seen.

Whilst there is no widely accepted method of evaluation of groundborne noise, there is some consensus that for levels at and above 50dBA $L_{Amax,slow}$ during daytime, there is likely to be significant adverse reaction.

The American Public Transit Association (APTA) document provides guidelines for recommended maximum SBN levels which take account of the building type, the proposed usage of property, whether residential, commercial or other, and also takes account of the prevailing ambient noise levels. Suggested levels are in the range of 30 to 35 dB L_{Amax} for low to medium density residential, to 40 to 45 dB L_{Amax} for high density residential and commercial properties, though the time weighting is not reported, i.e. 'fast' or 'slow'.

This and other experience in general identifies that there starts to be some impact on people in properties when the level exceeds 35 dB L_{Amax} . Consequently, in the UK, design aims for railways have been set at 40 dB $L_{Amax,slow}$ within residential (e.g. rail schemes such as Channel Tunnel Rail Link, Docklands Light Railway, Bank Line Extension, Woolwich Line Extension, Jubilee Line Extension, and Thameslink 2000).

Based on the above, for the purposes of this assessment 35 to 40 dB $L_{Amax,slow}$ is the recommended criterion in the proposed residential buildings (as summarised below), with the aim of achieving the lower levels in these ranges where practicable.

Location	Suggested $L_{Amax,slow}$ Noise Limit for Tram-Induced SBN (dB)	
	Ideal (where practically achievable)	Maximum
Within Apartments	35	40

10.4 Building Response

10.4.1 Assessment Methods

The building development superstructure will modify the surveyed vibration levels, superstructures often amplifying foundation vibration levels. Our analysis considers the following:

- Empirically researched floor amplification factors as given within “*A Prediction for Rail Transportation Ground-borne Noise and Vibration*” James Turner Nelson and High Saurenman Transportation Research Record 1143.
- Empirically researched floor amplification factors as given within “*Handbook for Urban Noise and Vibration Control*” Saurenman, Nelson, Wilson US Department of Commerce National Technical Information Services – February 1982.
- The typical maximum recorded vibration levels for different tram passbys shall be used at the various positions, with consideration for average floor plate response by Ungar & Bender 1983.

10.4.2 Foundations & Building Structure

The proposed building structure will, in brief, comprise:-

- Piled foundations.
- In-situ concrete frame building with residential accommodation from Level 1.
- Assumed 200 mm+ PT concrete slabs with anticipated natural frequencies ranging from 4-15 Hz.
- ‘Medium’ building amplification factor (heavyweight concrete frame).

10.5 Estimated VDV Vibration Levels

Based on the typical maximum recorded vibration levels we have estimated the VDV levels within the proposed development at the worst affected noise sensitive residential floors. Predictions are made using the measurement data in the vertical Z-axis (worst-case in all cases), the estimated train/tram movement frequency detailed above. The results are summarised below.

Location	Period	Estimated e.VDV (m/s ^{1.75})	Proposed Limit (m/s ^{1.75})	Compliance?
Worst-case dwellings at Level 2 (based on Position 1 measurements)	Daytime (16hr)	<0.05	0.20	✓
	Night-time (8hr)	<0.05	0.10	✓

The estimated VDV vibration levels fall below the threshold at which there would be a ‘low probability of adverse comment’ in accordance with BS 6472 and should therefore be considered acceptable.

10.6 Structure-borne Noise Levels

Based on the typical maximum recorded vibration levels we have estimated structure-borne noise levels within the proposed development at each residential floor.

Predictions are made using the measurement data and medium amplification factors based on the proposed building structure. The following table presents the estimated noise levels within the lower (worst-case) residential apartment closest to the railway lines. NB: Noise levels will decay slightly with height up the building, and a reasonable average estimate is ca. -1dB per floor.

Location	Source	Estimated SBN Level, $L_{Amax,slow}$ (dB)	Proposed SBN Limit, $L_{Amax,slow}$ (dB)	Compliance?
Worst-case Dwellings (based on Position 1)	Freight trains	33-35	35-40	✓
	Passenger trains	31-35	35-40	✓
	Trams	20-24	35-40	✓

The calculations indicate structure-borne noise levels are expected to achieve the proposed noise limits for all train/tram sources. No specific mitigation measures should be required to deal with train/tram induced structure-borne (re-radiated) noise.

11.0 Conclusions

Planning permission is sought for the erection of a 24-storey mixed use building incorporating 224 residential apartments (Use Class C3), 87 apart-hotel studios (Use Class C1), amenity space, flexible commercial space (Use Class E), and café (Use Class E(b)), together with infrastructure, landscaping, and other associated works.

The site is subject to noise from road traffic, primarily on Bridgewater Way (A56), as well as noise and vibration from train passbys on the elevated railway/tram lines to the north-west.

Jameson Acoustics Limited has been commissioned to undertake a noise and vibration impact assessment to supplement the planning application.

The assessment finds that acceptable internal noise levels within new dwellings can be achieved through the appropriate specification of façade elements and appropriate ventilation and overheating mitigation solutions that removes or restricts reliance on openable windows. Preliminary guidance on suitable specifications and solutions for framed external window/door systems has been provided. Acoustically-enhanced double glazed windows will be required for all façades, with the most onerous specifications for windows close to Bridgewater Way.

For the roof terraces (outdoor living spaces), our calculations demonstrate that acceptable noise levels are expected to be achieved in line with BS 8233.

Plant noise emission limits have been proposed so that future plant installations do not adversely impact on the locality.

Noise impacts from the operation of the ground floor commercial units and first floor amenity spaces have been considered and suitable noise criteria have been proposed, along with preliminary guidance on provisional solutions to mitigate the risk of adverse noise impacts. For the amenity spaces, provisions exist to enhance internal building fabric constructions as required to mitigate noise and vibration impact risks to adjoining dwellings. However, the exact usage of these amenity spaces

is yet to be decided and it may therefore be prudent for the Local Authority to secure appropriate solutions are provided through a suitably worded condition of planning.

Vibration (and associated re-radiated noise) levels from train/tram passbys has been assessed. The findings indicate that estimated VDV vibration levels and structure-borne noise levels are expected to achieve good practice design guide limits.

Appendix A – Acoustic & Vibration Terminology

dB	Decibel - Used as a measurement of sound level. Decibels are not an absolute unit of measurement but an expression of ratio between two quantities expressed in logarithmic form.
dB(A)	The human ear is more susceptible to mid-frequency noise than the high and low frequencies. The 'A'-weighting scale approximates this response and allows sound levels to be expressed as an overall single figure value in dBA. The _A subscript is applied to an acoustical parameter to indicate the stated noise level is A-weighted (e.g. $L_{Aeq,T}$ in dB). Noise levels in dBA do not have a linear relationship to each other; for similar noises, a change in noise level of 10dBA represents a doubling or halving of subjective loudness. A change of 3dBA is only just perceptible.
$L_{Aeq,T}$	$L_{Aeq,T}$ is the equivalent continuous sound pressure level. It is an average of the total sound energy measured over a specified time measurement period, T .
$L_{10,T}$	L_{10} is the noise level exceeded for 10% of the measurement period T (i.e. the quietest 10% of the measurement) and has, for many years, been used in the assessment of road traffic noise.
$L_{90,T}$	L_{90} is the noise level exceeded for 90% of the measurement period T (i.e. the quietest 10% of the measurement) and is often used to describe the 'background' noise level.
L_{max}	L_{max} is the maximum sound pressure level recorded over the measurement period, T . L_{max} is often used in assessing scheduled environmental noise 'events' (such as train passbys), particularly at night where such events may cause sleep disturbance.
R_w	The weighted sound reduction index, R_w , is a single figure description of sound reduction as defined in BS EN ISO 717-1. It is single-number quantity which characterizes the airborne sound insulating properties of a material or building element over a range of frequencies. The R_w is calculated from sound insulation measurements taken in an acoustic laboratory. Sound insulation ratings derived from site measurements are invariably lower than the laboratory figures and are referred to as the apparent weighted sound reduction index, R'_w .
$D_{n,e,w}$	The weighted element-normalised level difference, $D_{n,e,w}$, is a single figure description of the sound insulation performance of small building elements, such as a trickle ventilator.
C_{tr}	C_{tr} is correction term applied against the sound insulation single-number values (e.g. R_w) to provide a weighting against low frequency performance. The reference values used within the C_{tr} calculation are based on urban traffic noise.

The vibratory motion of a surface can be described by either:

- (a) displacement (m),
- (b) velocity (m/s), or
- (c) acceleration (m/s^2).

Furthermore, the vibration magnitude can be quantified in several ways:

peak to peak: This value gives the total excursion of the oscillation about the zero datum. The unit is often used where the vibratory displacement of a component is critical for maximum stress or mechanical clearance calculations.

peak: This value gives the maximum excursion of the oscillation above or below the zero datum. This value is useful for indicating the level of short duration shocks.

RMS : This value gives the root mean square of the time history over a specific time interval (time constant). This value is useful for indicating the energy content of the vibration.

dB: Decibel quantities are often encountered. A reference level of 10^{-6} m/s^2 RMS is typically used for acceleration.

Vibration Dose Value (V.D.V) ($\text{m/s}^{1.75}$):

This value assesses both the magnitude of vibration and its duration. Where possible the vibration dose value should be determined over the full exposure to vibration. It is often estimated from the frequency weighted r.m.s value of the acceleration and its duration and is then referred to as e.V.D.V.

Appendix B – Planning Policy & Assessment Guides

Planning Policy

- **Noise Policy Statement for England (NPSE)**

The Noise Policy Statement for England (NPSE) launched in March 2010 states the long-term vision of Government noise policy is to “*promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development*”.

The long-term vision is supported by the following aims; 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;
- Where possible, contribute to the improvement of health and quality of life.

The intention is that the NPSE should apply to all types of noise apart from noise in the workplace (occupational noise).

The NPSE introduces a three-tier concept for the assessment of noise impacts onto a receptor:

- **NOEL – No Observed Effect Level:** The level below which no effect can be detected and below which there is no detectable effect on health and quality of life due to noise.
- **LOAEL – Lowest Observable Adverse Effect Level:** The level above which adverse effects on health and quality of life can be detected.
- **SOAEL – Significant Observed Adverse Effect Level:** The level above which significant adverse effects on health and quality of life occur.

There are no numeric thresholds relating to each of the above. The NPSE acknowledges that the severity of noise impacts vary depending upon the type of noise, the type of receptor, the duration (on-time) of the noise, the characteristics of the noise, the time of day, the day of the week, etc.. As a result, the definition of what constitutes an SOAEL is somewhat flexible.

- **National Planning Policy Framework (NPPF)**

The National Planning Policy Framework (NPPF) was first published in 2012 and sets out the government’s planning policies for England and how these are expected to be applied.

The latest revision of the NPPF (July 2021) states that planning system should **contribute to, and enhance**, the natural and local environment by (amongst others) “*preventing both new and existing development*”

*from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, water or **noise pollution** or land stability.”*

The express inclusion of noise in the NPPF means that it is a material planning consideration for local planning decisions.

Paragraph 123 of the NPPF document states that planning policies and decisions should aim to:

“A. Avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;

B. Mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions;

C. Recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established; and

D. Identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.”

NPPF advises that decisions relating to planning applications should ensure “...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.”

To achieve this, new developments 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” and should also “identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.”

The NPPF recognises 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.”

- **Planning Practice Guidance on Noise (PPG)**

The National Planning Practice Guidance (PPG) is a web-based resource, launched by the Department for Communities and Local Government (DCLG) in March 2014 to support the NPPF and make it more accessible. It advises on how planning can manage potential noise impacts in new development. The guidance is regularly reviewed and updated and noise is listed as a specific category. The guidance is for ad hoc developments, as major infrastructure is covered by overarching National Policy Statements.

PPG provides the following tabulated summary of the effects of noise exposure (in terms of health and quality of life) associated with noise generating and sensitive developments.

Response	Examples of Outcomes	Increasing Effect Level	Action
No Observed Effect Level			
Not present	No effect	No Observed Effect	No specific measures required
Present and not intrusive	Noise can be heard, but does not cause any change in behaviour, attitude or other physiological response. Can slightly affect the acoustic character of the area but not such that there is a change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Present and intrusive	Noise can be heard and causes small changes in behaviour, attitude or other physiological response, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a small actual or perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Present and disruptive	The noise causes a material change in behaviour, attitude or other physiological response, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Present and very disruptive	Extensive and regular changes in behaviour, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory.	Unacceptable Adverse Effect	Prevent

Assessment Guides

- ProPG: Planning & Noise**

ProPG: Planning & Noise 'Professional Practice Guidance on Planning & Noise' was issued in May 2017 with the primary goal of assisting the delivery of sustainable residential development by promoting good health and well-being through the effective management of noise. It seeks to do that through encouraging a good acoustic design process in and around proposed new residential development having regard to national policy on planning and noise.

It is applicable to noise from existing transport sources (noting that good professional practice should have regard to any reasonably foreseeable changes in existing and/or new sources of noise). The recommended approach is also considered suitable where some industrial or commercial noise contributes to the acoustic environment provided that is “not dominant”.

ProPG advocates a systematic, proportionate, risk based, 2-stage, approach. The approach encourages early consideration of noise issues, facilitates straightforward accelerated decision making for lower risk sites, and assists proper consideration of noise issues where the acoustic environment is challenging.

The two sequential stages of the overall approach are:

Stage 1 – an initial noise risk assessment of the proposed development site; and

Stage 2 – a 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”; and
- Element 4 – consideration of “Other Relevant Issues”.

The ProPG considers suitable guidance on internal noise levels found in BS 8233 (see below) with the addition of an $L_{Amax,f}$ requirement for bedrooms at night, as below.

“Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$, depending on the character and number of events per night. Sporadic noise events could require separate values. In most circumstances in noise-sensitive rooms at night (e.g. bedrooms) good acoustic design can be used so that individual noise events do not normally exceed 45 dB $L_{Amax,F}$ more than 10 times a night. However, where it is not reasonably practicable to achieve this guideline then the judgement of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number, distribution, predictability and regularity of noise events.”

- **BS 8233: 2014**

British Standard 8233: 2014 ‘Sound insulation and noise reduction for buildings’ presents the following desirable internal ambient noise levels for dwellings based on steady external noise sources (e.g. road traffic).

Activity	Location	Desirable Internal Ambient Noise Level	
		07:00 – 23:00	23:00 – 07:00
Resting	Living Rooms	35 dB $L_{Aeq,16hour}$	-
Dining	Dining Room/Area	40 dB $L_{Aeq,16hour}$	-
Sleeping (Daytime Resting)	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$

BS 8233 states that where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved.

For outdoor living spaces, BS 8233 states:

“For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable and a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces but should not be prohibited.

Other locations, such as balconies, roof gardens and terraces, are also important in residential buildings where normal external amenity space might be limited or not available, i.e. in flats, apartment blocks, etc. In these locations, specification of noise limits is not necessarily appropriate. Small balconies may be included for uses such as drying washing or growing pot plants, and noise limits should not be necessary for these uses. However, the general guidance on noise in amenity space is still appropriate for larger balconies, roof gardens and terraces, which might be intended to be used for relaxation. In high-noise areas, consideration should be given to protecting these areas by screening or building design to achieve the lowest practicable levels. Achieving levels of 55 dB $L_{Aeq,T}$ or less might not be possible at the outer edge of these areas, but should be achievable in some areas of the space.”

For amenity and meeting spaces, a design range of 35-45 dB L_{Aeq} can be interpreted.

- **World Health Organisation (WHO)**

The current WHO Environmental Noise Guidelines 2018 for the European Region supersede the 1999 Guidelines for Community Noise, although it does suggest that the 1999 values for indoor noise levels remain valid, as presented below.

Noise Source	CNG guideline indoors all sources	ENG guideline outdoors noise from specific source only
Road traffic	35 dB $L_{Aeq, 16h}$	53 dB L_{den}
	30 dB $L_{Aeq, 8h}$	45 dB L_{night}
Railway	35 dB $L_{Aeq, 16h}$	54 dB L_{den}
	30 dB $L_{Aeq, 8h}$	44 dB L_{night}
Aircraft	35 dB $L_{Aeq, 16h}$	45 dB L_{den}
	30 dB $L_{Aeq, 8h}$	40 dB L_{night}

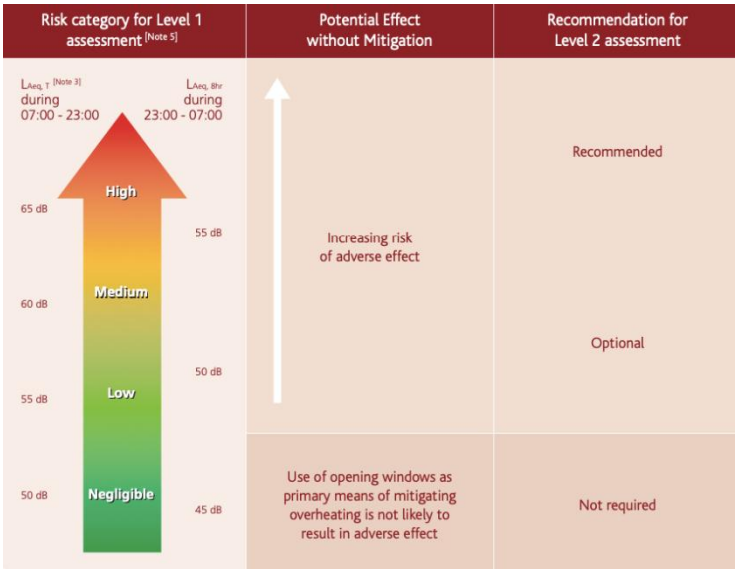
With regard to night-time noise “events”, WHO states “In many situations, average noise levels like the L_{den} or L_{night} indicators may not be the best to explain a particular noise effect. Single-event noise indicators – such as the maximum sound pressure level (L_{Amax}) and its frequency distribution – are warranted in specific situations, such as in the context of night-time railway or aircraft noise events that can clearly elicit awakenings and other physiological reactions that are mostly determined by $L_{A,max}$. Nevertheless, the assessment of the relationship between different types of single-event noise indicators and long-term

health outcomes at the population level remains tentative. The guidelines therefore make no recommendations for single-event noise indicators.”

• **Acoustics, Ventilation & Overheating Residential Design Guide**

The Acoustics, Ventilation and Overheating Residential Design Guide (Version 1.1) was issued in January 2020 by the Association of Noise Consultants (ANC) and the Institute of Acoustics (IOA). This document provides guidance on the interdependence between acoustics, ventilation and overheating.

The AVO guide recommends a two-level approach to assess the potential impact of noise ingress through windows that have been opened to mitigate overheating and also noise from any mechanical services used to provide comfort cooling. The level 1 assessment relates to incident environmental noise levels across a proposed site, it is used to define “risk categories” for each building façade based on these levels. These categories are set out below:



At planning stage the level of information required to undertake a level 2 assessment in-line with the AVO guide is often not available and a level 1 assessment, which establishes the risk categories of each proposed façade, would be most suitable.

• **BS 4142:2014**

British Standard BS 4142 looks at the assessment of noise of a commercial / industrial nature. It describes methods for rating and assessing outdoor sound of an industrial and/or commercial nature “on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident”. In relation to this development, this includes sound from fixed installations, comprising M&E plant and equipment.

The assessment method is based on the difference between the measured ‘background sound level’ without the influence of any industrial noise source, and the ‘rating level’ of the industrial source, at the

receiver location. A difference of around +10 dB or more is likely to be an indication of a significant adverse impact. A difference of around +5 dB is of marginal significance, and where the rating level does not exceed the background, this is an indication of the specific sound source having a low impact.

- **BS 6472:2014**

British Standard BS 6472: 2008 *“Guide to Evaluation of Human Exposure to Vibration in Buildings”* advises that intermittent vibration events should not be judged based on perception alone but using the corresponding vibration dose value over a long period.

BS 6472:2008 advises that “the VDV defines a relationship that yields a consistent assessment of continuous, intermittent, occasional and impulsive vibration and correlates well with subjective response” and also “the VDV is much more strongly influenced by vibration magnitude than by duration. A doubling or halving of the vibration magnitude is equivalent to an increase or decrease of exposure duration by a factor of sixteen.”

The perception threshold for continuous whole-body vibration varies widely among individuals. Approximately half a typical population, when standing or seated, can perceive a vertical weighted peak acceleration of 0.015 m/s^2 . A quarter of the population would perceive a vibration of 0.010 m/s^2 peak, but the least sensitive quarter would only be able to detect a vibration of 0.020 m/s^2 peak or more.

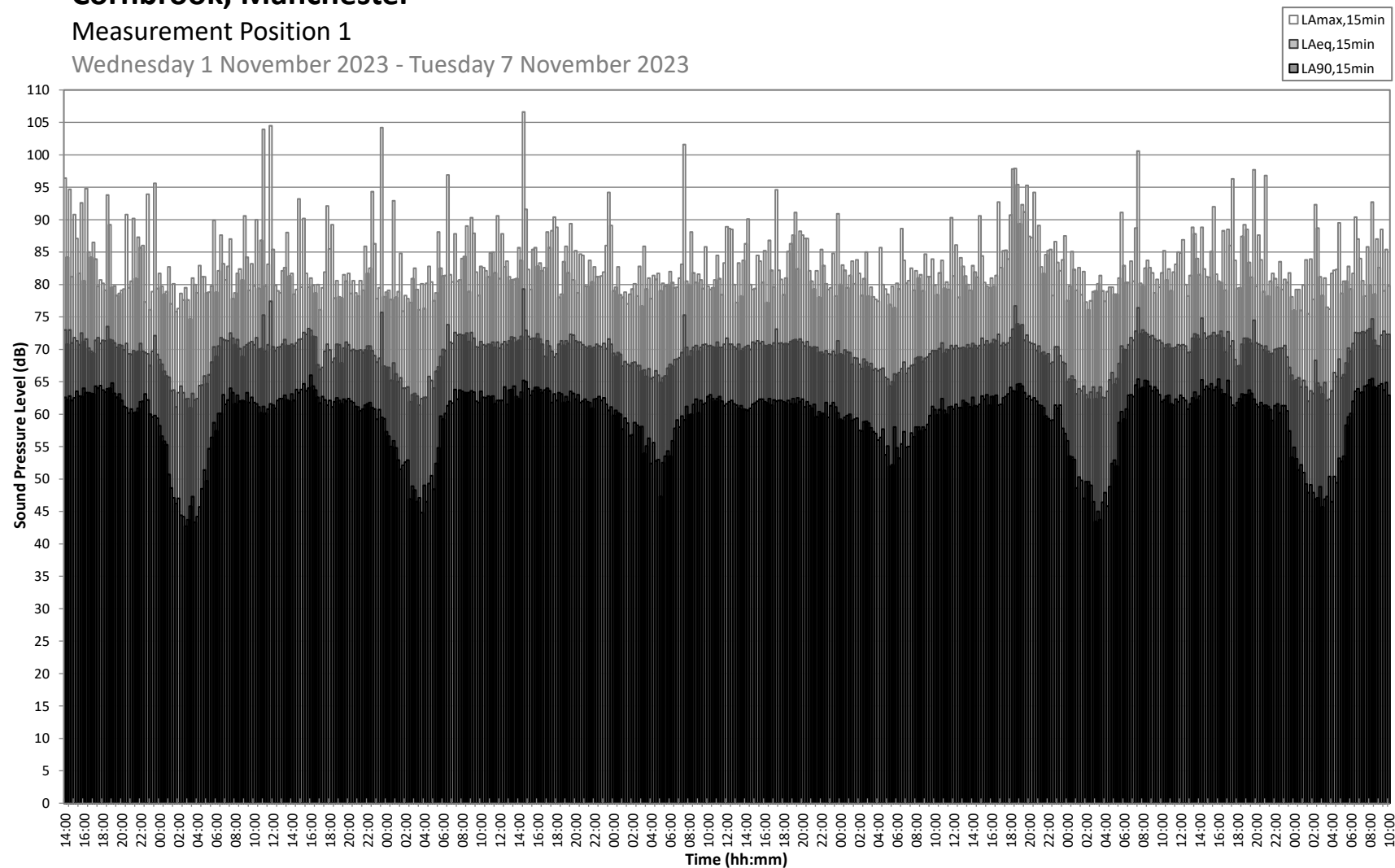
Appendix C – Noise Survey Time History Graphs

Cornbrook, Manchester

Measurement Position 1

Wednesday 1 November 2023 - Tuesday 7 November 2023

22101-1-G1

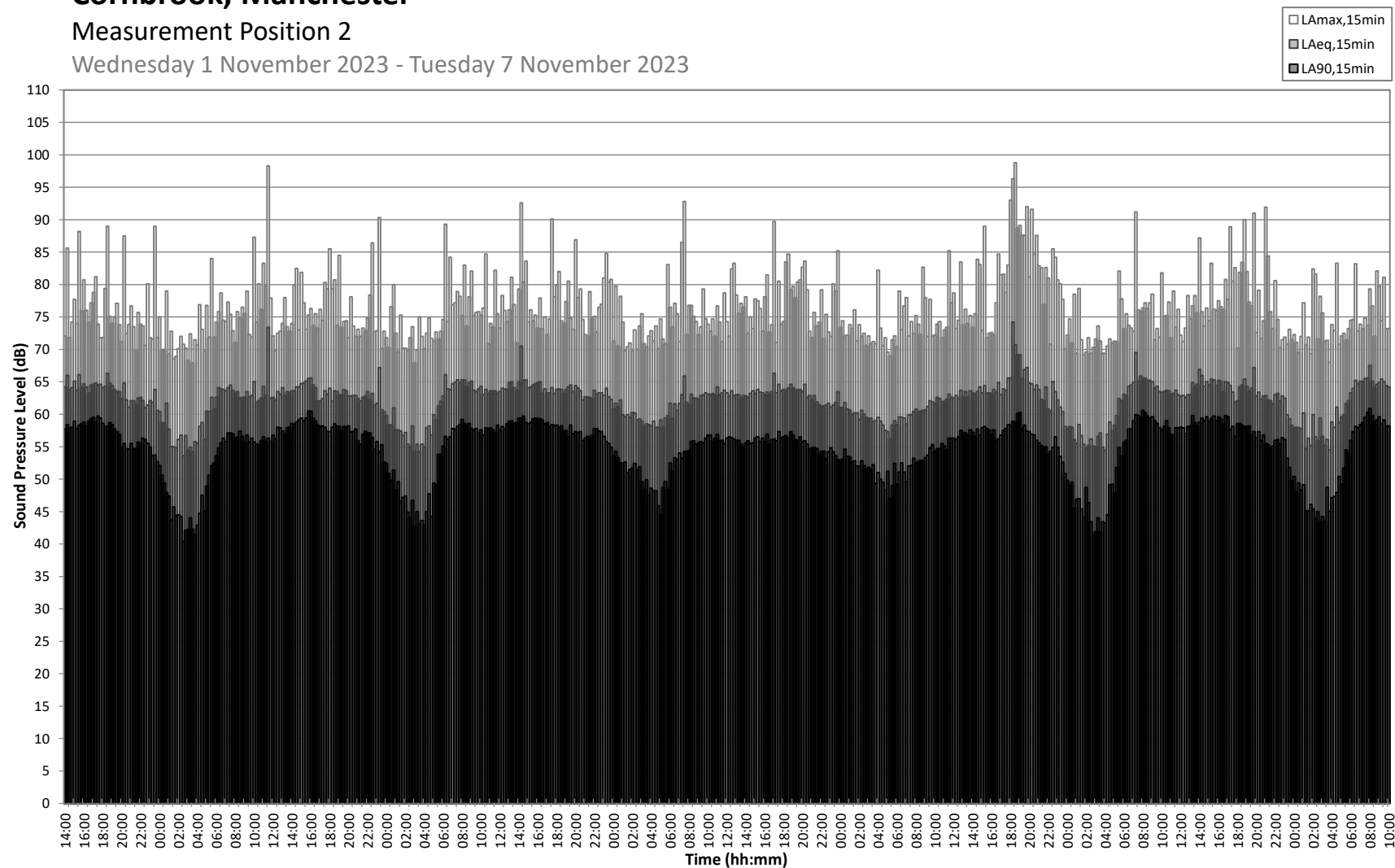


Cornbrook, Manchester

Measurement Position 2

Wednesday 1 November 2023 - Tuesday 7 November 2023

22101-1-G2

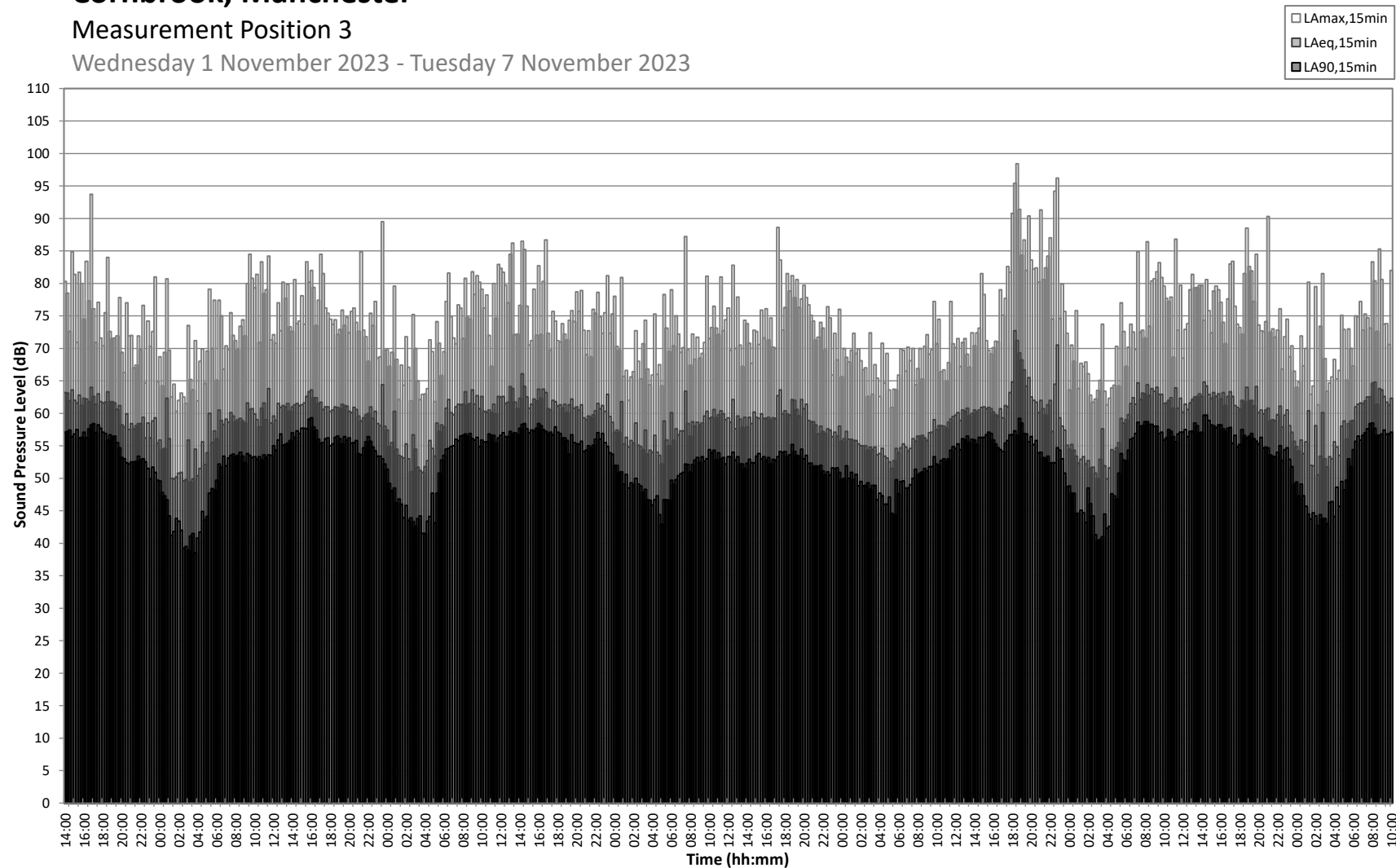


Cornbrook, Manchester

Measurement Position 3

Wednesday 1 November 2023 - Tuesday 7 November 2023

22101-1-G3



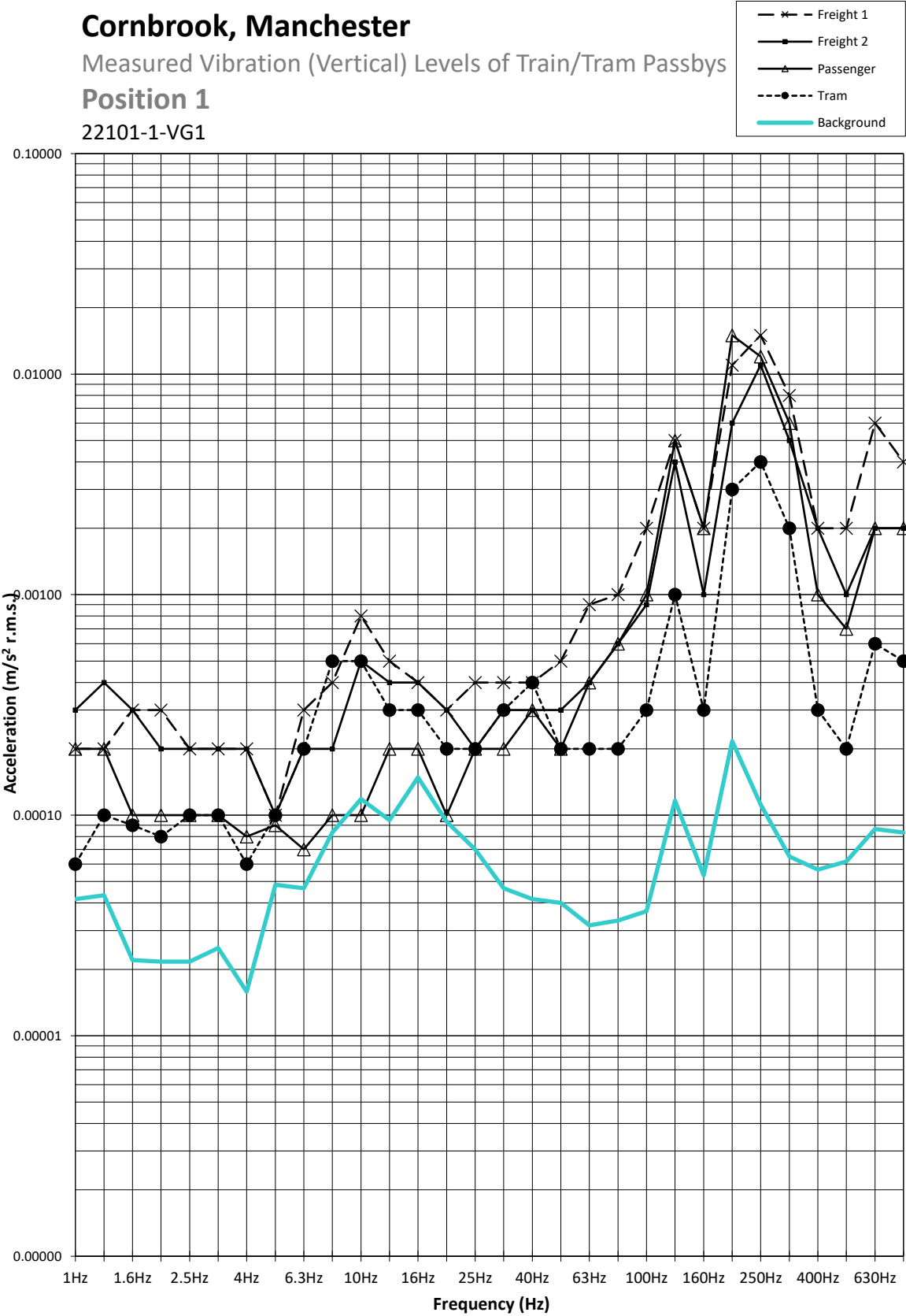
Appendix D – Vibration Survey Graphs

Cornbrook, Manchester

Measured Vibration (Vertical) Levels of Train/Tram Passbys

Position 1

22101-1-VG1



Cornbrook, Manchester

Measured Vibration (Vertical) Levels of Train/Tram Passbys

Position 2

22101-1-VG2

