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Crown Street Phase 3 and Plot D,
Manchester

Environmental Noise Study

April 2023

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1.0 SUMMARY

Fisher Acoustics Ltd has been commissioned by Renaker Build to conduct an environmental noise study relating to a proposed primarily residential development at Crown Street Phase 3 and Great Jackson Street Plot D, Manchester.

Surveys of environmental noise have determined the pre-existing environmental noise levels during the day and night at and around the site.

The recommended acoustic performance of the curtain wall elements of the proposed buildings to achieve the recommended internal noise levels within apartments has been determined.

A study of external noise in relation to the control of overheating within apartments has been carried out, with specific reference to the 'Acoustics, Ventilation and Overheating Residential Design Guide' (AVO), published by the Association of Noise Consultants and the Institute of Acoustics in January 2020.

Overall environmental noise limits have also been recommended for building services plant serving the development and in relation to noise egress from the proposed commercial units on the ground floor of the Development and from the proposed residential amenity areas.

2.0 INTRODUCTION

Fisher Acoustics Ltd has been commissioned by Renaker Build to conduct an environmental noise assessment relating to a full planning application for a proposed residential development at Crown Street Phase 3 and Great Jackson Street Plot D, Manchester. The proposals provide for five new residential buildings of between 47-storeys and 71-storeys and a 3-storey office building. The development will provide approximately two thousand three hundred and eighty eight residential units, approximately six hundred and ninety car parking spaces, approximately two thousand three hundred and eighty eight internal cycle parking spaces, approximately 4,465 square metres of private internal amenity space, approximately 1,929 square metres of commercial space and approximately 2638 square metres (GIA) of office space.

This report examines the pre-existing environmental noise conditions at the site and advises on the required sound insulation performance of façade elements to habitable rooms to achieve recommended internal noise criteria. Appropriate environmental noise limits for building services plant and activity noise egress from the development are also identified.

In addition, this report includes an assessment in line with 'Acoustics, Ventilation and Overheating, Residential Design Guide', (AVO) published by the Association of Noise Consultants and the Institute of Acoustics in January 2020.

The steps undertaken in compiling this study are as follows:

- Assessment of daytime and night time external noise survey data to determine the typical levels of noise at the site during daytime and night time periods
- Calculation of the required composite weighted sound reduction index of the curtain wall to habitable rooms to allow the achievement of appropriate internal noise levels due to external noise sources.
- Determination of suitable overall noise limits for building services plant to safeguard residential amenity
- Determination of suitable overall noise limits relating to potential noise egress from the residential amenity spaces and commercial space
- Assessment of potential internal noise levels in relation to the control of overheating

3.0 DESCRIPTION OF SITE

General Site Description

The overall Site is bounded by the A57(M) Mancunian Way to the south, a combination of existing low-rise services and parking to the north, Crown Street Phase 2 apartments to the west, Deansgate Square Towers and the cleared Plot F EIA Site to the east and Great Jackson Street running through the centre.

The Crown Street Phase 3 site is bounded by Silvercroft Street and Owen Street Car Park to the north, Melbourne Street and Plot F to the south, Owen Street and Deansgate Square to the east, and the under-construction Crown Street Phase 2 to the west. The Site currently comprises the Renaker Marketing Suite, the vacant Gaddum House building and former light industrial units.

Plot D is currently comprised of a temporary concrete batching plant for the manufacture and distribution of ready mixed concrete.

The Mancunian Way (A57(M)) and Chester Road are major roads that are heavily trafficked. Great Jackson Street, Melbourne Street and Owen Street are relatively lightly trafficked.

Figure 1 shows the overall Site in the context of the surrounding roads and buildings.

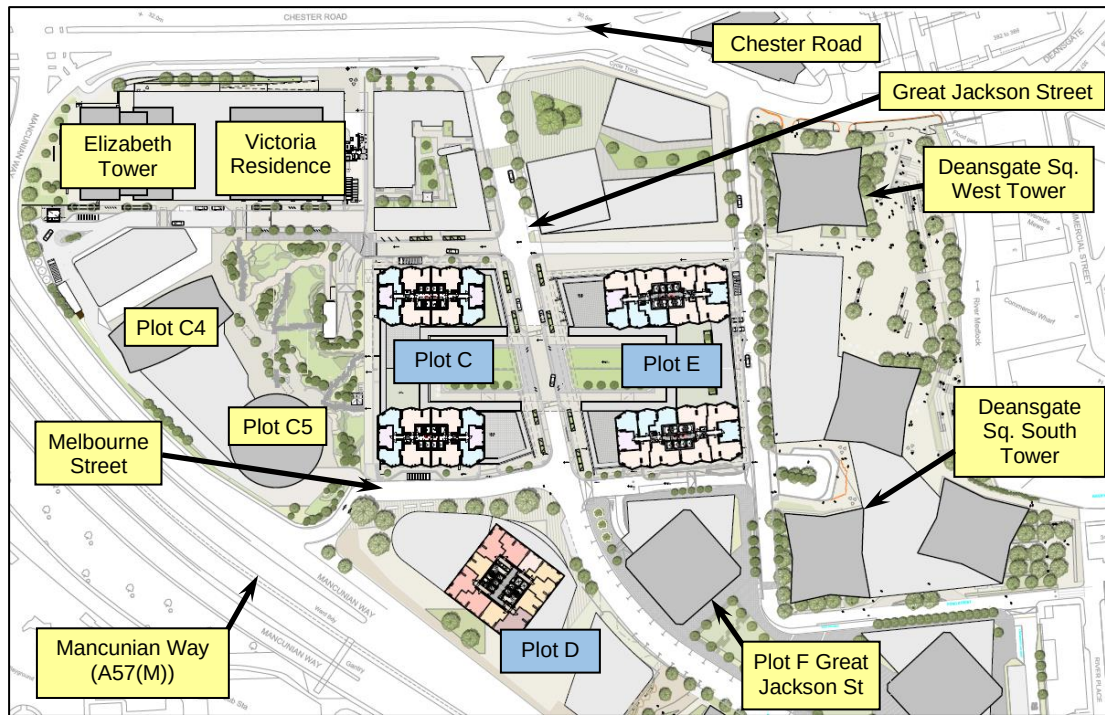


Figure 1: Site location plan – Crown Street Phase 3 (Plots C & E) and Great Jackson Street Plot D

4.0 DESCRIPTION OF PROPOSED DEVELOPMENT

The Proposed Development is comprised of three distinct plots of the Great Jackson Street Development Framework area, Plot C, Plot D and Plot E. The proposed residential buildings within the three plots are named C7, C8, D, E1 and E2.

The proposals for Plot D include the erection of a 71-storey residential tower comprising a total of 642 apartments (Use Class C3) and internal residential amenity uses, private car parking within a multi-storey basement and cycle parking facilities. Adjacent to the residential tower is a proposed 3-storey office building.

The residential amenity spaces within the Plot D tower are to be located on the ground floor and Level 1 and on Levels 67 to 70.

Figure 2 shows the site boundary for the Proposed Development at Plot D.

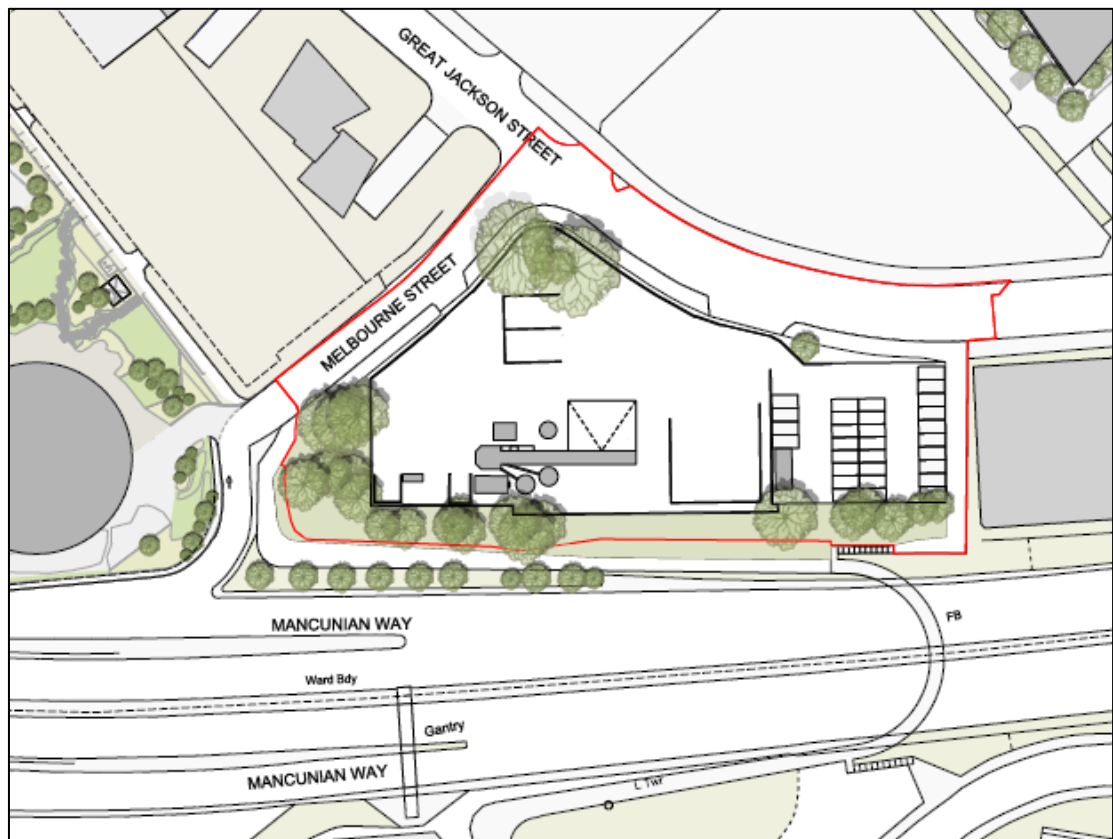


Figure 2: Site boundary plan – Plot D

The proposals for Plot C include the erection of two 51 storey residential towers comprising a total of 844 apartments (Use Class C3) and internal residential amenity uses, private car parking within a multi-storey basement and cycle parking facilities

The residential amenity spaces within each tower are to be located on the ground floor, Level 1 and Level 2.

The proposals for Plot E include the erection of two 47 storey residential towers comprising a total of 902 apartments (Use Class C3) and internal residential amenity uses, private car parking within a multi-storey basement and cycle parking facilities

The residential amenity spaces within each tower are to be located on the ground floor, Level 1 and Level 2.

Figure 3 shows the site boundaries for Plot C and E and the proposed ground floor footprint of the buildings.



Figure 3: Site layout plan – Plots C & E

5.0 RELEVANT GUIDANCE DOCUMENTS

NATIONAL PLANNING POLICY

The National Planning Policy Framework (NPPF), published in July 2021 by the Ministry of Housing, Communities and Local Government 'sets out the Government's planning policies for England and how these should be applied'.

Clause 174 of the National Planning Policy Framework states that 'Planning policies and decisions should contribute to enhance the natural and local environment by:

'preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability'.

Clause 185 of the National Planning Policy Framework 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:

- a) mitigate and reduce to a minimum potential adverse impact resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;
- b) 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
- c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation."

The National Planning Policy Framework document cross references the 'Explanatory Note to the Noise Policy Statement for England'. The 'Noise Policy Statement for England' (NPSE) was published by the Department for Environment Food and Rural Affairs in March 2010.

The NPSE does not give suggested external noise criteria for commercial Developments. In the absence of specific criteria, reference shall be made in this document to established guidance and principles, as established in British Standards and the local Planning policy.

National Planning Practice Guidance – Noise

‘Planning Practice Guidance – Noise’ is a web-based resource provided by the Ministry of Housing, Communities and Local Government (last revision date 22 July 2019) which gives guidance on Planning considerations in relation to noise.

The document identifies the subjective grading of noise and the recommended actions and different effect levels. Again, as ‘Planning Practice Guidance – Noise’ does not refer to objective criteria, reference shall be made in this document to established guidance and principles, as established in British Standards and the local Planning policy

LOCAL PLANNING POLICY

Manchester City Council’s Core Strategy was adopted on 11th July 2012 and is the key Development Plan Document in the Local Development Framework (LDF).

Section 13.6 ‘Development Management’ of the Core Strategy states that ‘all new developments should follow the ‘Development Principles’ and accord with the design guidance set out in the Supplementary Planning Documents.

Policy DM 1, ‘Development Management’ of the Core Strategy states that:

- All development should have regard to the following specific issues for which more detailed guidance may be given within a supplementary planning document: Effects on amenity, includingnoise, vibration.... This could also include proposals which would be sensitive to existing environmental conditions, such as noise.

‘Planning & Noise, Technical Guidance’, dated June 2022 has been issued by the Environmental Protection, Environmental Health and The Neighbourhoods Service sections of Manchester City Council. The document provides guidance to applicants and consultants concerning the assessment and prediction of environmental noise associated with a particular development. Reference is also made in the document to the relevant supporting information and guidance documents that Developers are expected to refer to when submitting a planning application.

Internal noise criteria

Internal noise levels within the proposed living accommodation must be appropriate for the intended use.

With regard to noise ingress to residential dwellings, section 3.5 'National & International Standards' of the 'Planning & Noise, Technical Guidance' advises that Manchester City Council has adopted the internal noise limits for residential properties identified in Table 1.

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35 dB LAeq,16h	-
Dining	Dining room / area	40 dB LAeq,16h	-
Sleeping (daytime resting)	Bedroom	35 dB LAeq,16h	30 dB LAeq,8h 45dB LAmix (ten excesses over 45dB LAmix allowed per night)

Table 1: Intrusive noise criteria

Manchester City Council has also advised that planning applications for residential applications must include an assessment in line with 'Acoustics, Ventilation and Overheating, Residential Design Guide', (AVO) published by the Association of Noise Consultants and the Institute of Acoustics in January 2020.

Building Services Noise

With regard to external noise due to building services plant, Section 3.7.1.5 of 'Planning & Noise, Technical Guidance' states:

- '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 (LAeq) below the typical background (LA90) level at the nearest noise sensitive location'

Figure 4 identifies the nearest noise sensitive premises to the proposed development site.

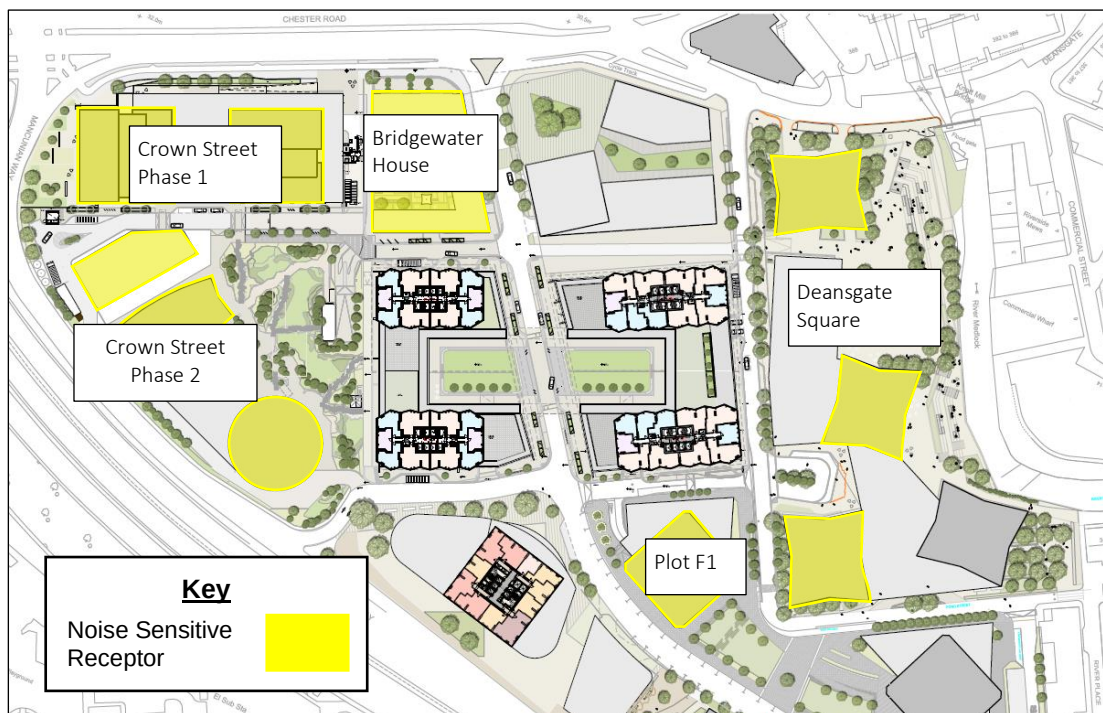


Figure 4: Nearest noise sensitive premises to Plots C, D and E

Noise from Commercial Operations

Noise egress from the proposed commercial units at the Proposed Development must be controlled to appropriate levels so as to avoid noise nuisance to existing sensitive receptors.

With regard to entertainment venues, 'Planning & Noise, Technical Guidance' issued by Manchester City Council as reference above states:

- 'When considering the potential impact of a proposal for an entertainment venue, consultants should consider the overall noise level (LAeq) and the 63 Hz and 125 Hz octave band noise levels (Leq). Music noise in the 63 Hz and 125 Hz octave bands, which is often described as "bass noise", is particularly difficult to contain and the impulsive character of this low frequency music noise is particularly disturbing for local residents exposed to it'.
-a criterion that would achieve a condition of 'inaudible' / 'virtually inaudible' which is applicable for new residential developments that are structurally connected to entertainment venues (or vice versa) would be:
 - 'Music noise levels in the 63Hz and 125Hz octave centre frequency bands (Leq) should be controlled so as not to exceed (in habitable rooms) 47dB and 41dB (Leq,5min), respectively'. This criterion may also be applicable for new residential developments that are structurally separate from an existing entertainment venue.
- 'A planning application for a new entertainment venue that is structurally detached from other building uses should demonstrate that music noise from the proposal will not be 'audible' in nearby residential properties, assuming that the residential properties in question have their windows open. The criterion here is:
 - Entertainment noise (LAeq,5 min) should be controlled to 5dB below the background noise level (LA90) without the entertainment noise present, in each octave band at the nearest noise sensitive location'.

BRITISH STANDARDS – INTERNAL NOISE IN DWELLINGS DUE TO EXTERNAL NOISE SOURCES

BS8233: 2014 'Guidance on sound insulation and noise reduction for buildings' provides appropriate criteria for acceptable levels of noise ingress within dwellings.

In particular, section 7.2.2 'Internal ambient noise levels in dwellings' of BS8233: 2014 states that 'In general, for steady external noise sources, it is desirable that the internal ambient noise level does not exceed the guideline values in Table 4'. Table 2 identifies the guideline values.

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35 dB LAeq,16h	-
Dining	Dining room / area	40 dB LAeq,16h	-
Sleeping (daytime resting)	Bedroom	35 dB LAeq,16h	30 dB LAeq,8h

Table 2: Intrusive noise criteria – BS8233:2014

Note 7 of section 7.2.2 states that: 'Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed up to 5 dB and reasonable internal conditions still achieved'.

With regard to maximum night time noise levels within bedrooms, BS8233: 2014 states '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 LAmax,f depending on the character and number of events per night. Sporadic noise events could require separate values'.

In the absence of a specific performance criterion within BS8233 for short-term noise maxima, reference can be made to guidance published by the WHO. In particular, the WHO publication 'Guidelines for Community Noise' (1999), from which the guidance given in BS8233: 2014 is itself derived, states that 'for a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dB LAmax more than ten to fifteen times per night'.

6.0 ENVIRONMENTAL NOISE SURVEY

In order to determine the prevailing ambient noise levels at and around the site, surveys of the existing noise environment have been carried out from 2:30 pm Friday 16 September 2022 to 3pm on Wednesday 21 September 2022 and from 11pm Thursday 29 September 2022 to 1am of Friday 30 September 2022.

The measurement locations used for the surveys are identified on

and are representative of the positions of the façades of the proposed Development and of the nearest existing residential properties. The measured noise levels can therefore be used to assess the expected internal noise levels within the proposed buildings and also to determine acceptable levels of noise at the existing sensitive properties around the site due to noise from the Development.

The measurement locations were as follows:

- Location 1: 9m from the kerb of Chester Road adjacent to the junction of Great Jackson Street and Chester Road, at a microphone height of 1.5 metres above site ground level
- Location 2: 3m from the west tower of Deansgate Square residences, at a microphone height of 1.5 metres above site ground level
- Location 3: 3m from the south tower of Deansgate Square residences, at a microphone height of 1.5 metres above site ground level
- Location 4: At location of closest façade of Proposed Development to Great Jackson Street, 1 metre in front of site hoarding), at a microphone height of 1.5 metres above site ground level
- Location 5: 5 metres from the kerb of Great Jackson Street at the proposed location of C8, at a microphone height of 1.5 metres above site ground level
- Location 6: On the roof of the Crown Street marketing suite on Great Jackson Street at a microphone height of 9 metres above site ground level
- Location 7: 16 metres from the closest carriageway of the A57(M) (Mancunian Way) at a microphone height of 13.5 metres above site ground level
- Location 8: On Melbourne Street adjacent to the site boundary of Plot D, at 32 metres from the kerb of Great Jackson Street, at a microphone height of 1.5 metres above site ground level

Full survey details are given in Appendix A. Appendix A also contains a summary of the results obtained from the surveys.

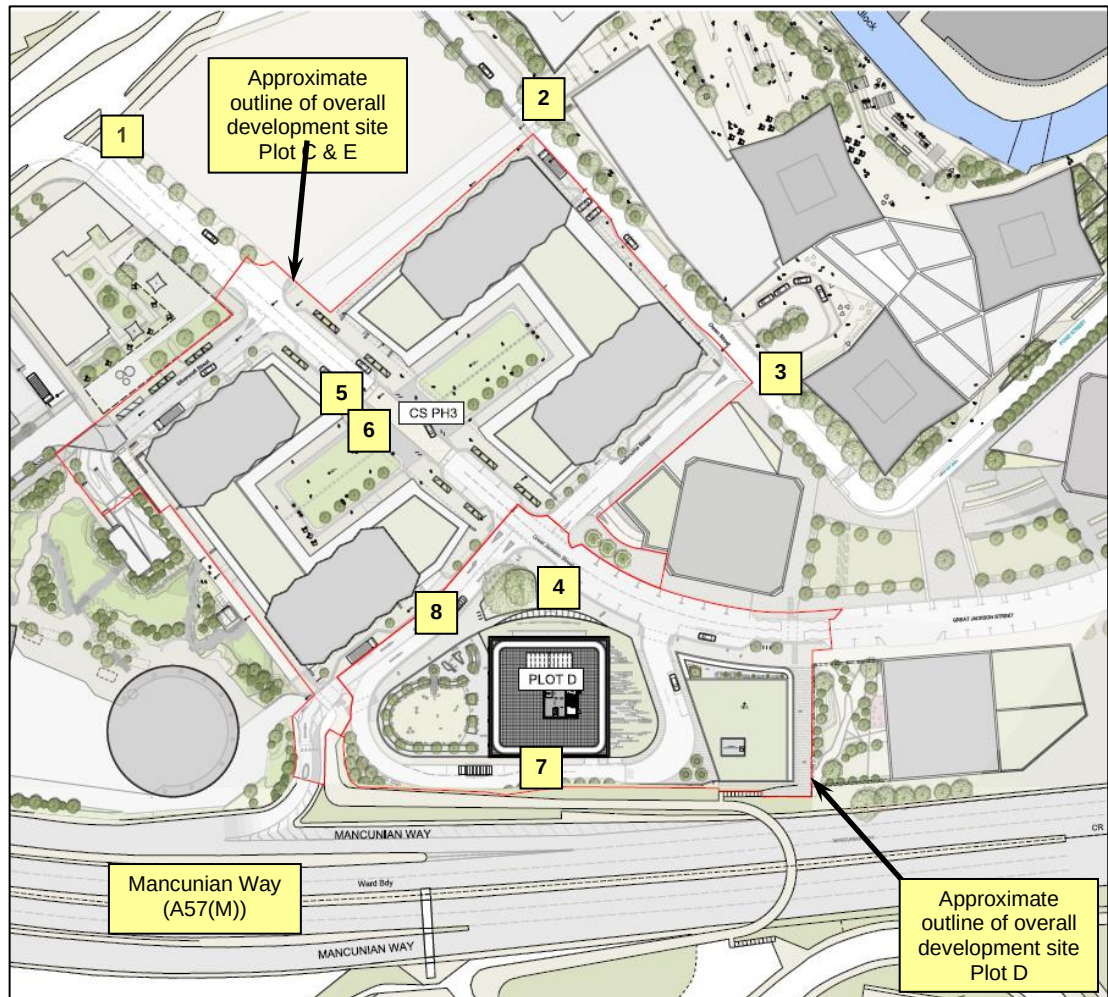


Figure 5: Noise survey measurement locations

The long-term noise environment at and around the Site is principally determined by road traffic on Mancunian Way (A57(M)) and Chester Road, with a contribution to noise levels from road traffic on Great Jackson Street.

Typical maximum noise levels at the site were generated by road vehicles on Mancunian Way (A57(M)) and Chester Road.

The noise levels measured during the noise surveys are summarised in Table 3.

Measurement Location	Measured Noise Level					
	Daytime (defined as 7 am to 11 pm)			Night time (defined as 11 pm to 7 am)		
	dB, LAeq	dB, LAmax	dB, LA90	dB, LAeq	dB, LAmax	dB, LA90
1 - Thursday 29 September 2022	71	79 to 85	60 to 67	69	59 to 84	48 to 65
2 - Thursday 29 September 2022	61	68 to 83	56 to 59	59	65 to 77	55 to 57
3 - Thursday 29 September 2022	61	61 to 83	58 to 60	60	70 to 78	56 to 59
4 – Friday 16 September 2022	64	73 to 80	57 to 60	-	-	-
4 – Thursday 29 September 2022	-	-	-	58	56 to 81	50 to 55
5 – Friday 16 September 2022	62	70 to 74	58 to 60	-	-	-
5 – Thursday 29 September 2022	-	-	-	60	61 to 76	53 to 57
6 – Friday 16 September 2022	62	66 to 84	58 to 62	60	61 to 80	54 to 60
6 – Saturday 17 September 2022	63	64 to 90	57 to 63	60	61 to 80	52 to 60
6 -Sunday 18 September 2022	62	61 to 94	54 to 61	59	60 to 77	51 to 60
6 -Monday 19 September 2022	61	63 to 91	55 to 60	58	59 to 77	47 to 62
6 -Tuesday 20 September 2022	65	65 to 94	57 to 66	59	60 to 78	48 to 63
6 -Wednesday 21 September 2022	66	68 to 88	61 to 69	-	-	-
7 (West Elevation, Plot D) - Friday 16 September 2022	76	76 to 93	67 to 77	74	74 to 90	56 to 75
7 – Saturday 17 September 2022	76	74 to 94	61 to 77	74	75 to 91	54 to 76
7 -Sunday 18 September 2022	76	76 to 98	55 to 77	73	73 to 98	49 to 75
7 -Monday 19 September 2022	76	75 to 99	60 to 76	73	68 to 92	46 to 77
7 -Tuesday 20 September 2022	77	76 to 99	64 to 78	73	72 to 97	47 to 77
7 -Wednesday 21 September 2022	77	77 to 100	71 to 78	-	-	-
8– Thursday 29 September 2022	-	-	-	61	62 to 67	56 to 61

Table 3: Summary of measured environmental noise levels

The statistical noise levels ('LAmax' and 'LA90') given in Table 3 show the range of noise levels measured over the sample periods. The quoted average (LAeq) noise levels are the average noise levels measured over the full measurement periods in question at each measurement position.

The results of the noise survey have been used to develop a 3D model of the site, from which the external noise levels across the facades of the proposed residential buildings have been determined.

Figure 6 shows the modelled free-field noise levels incident upon the facades, viewed from the north.

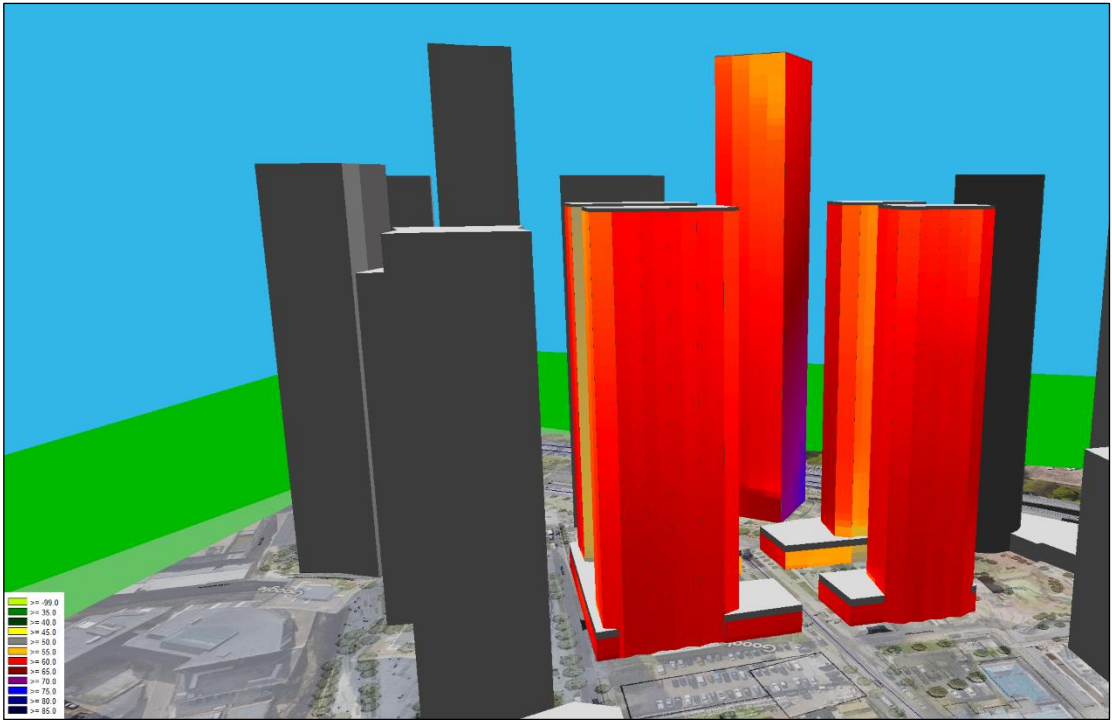


Figure 6: 3D model of development proposals & predicted incident noise levels – viewed from the north

Figure 7 shows the modelled free-field noise levels incident upon the facades, viewed from the south.

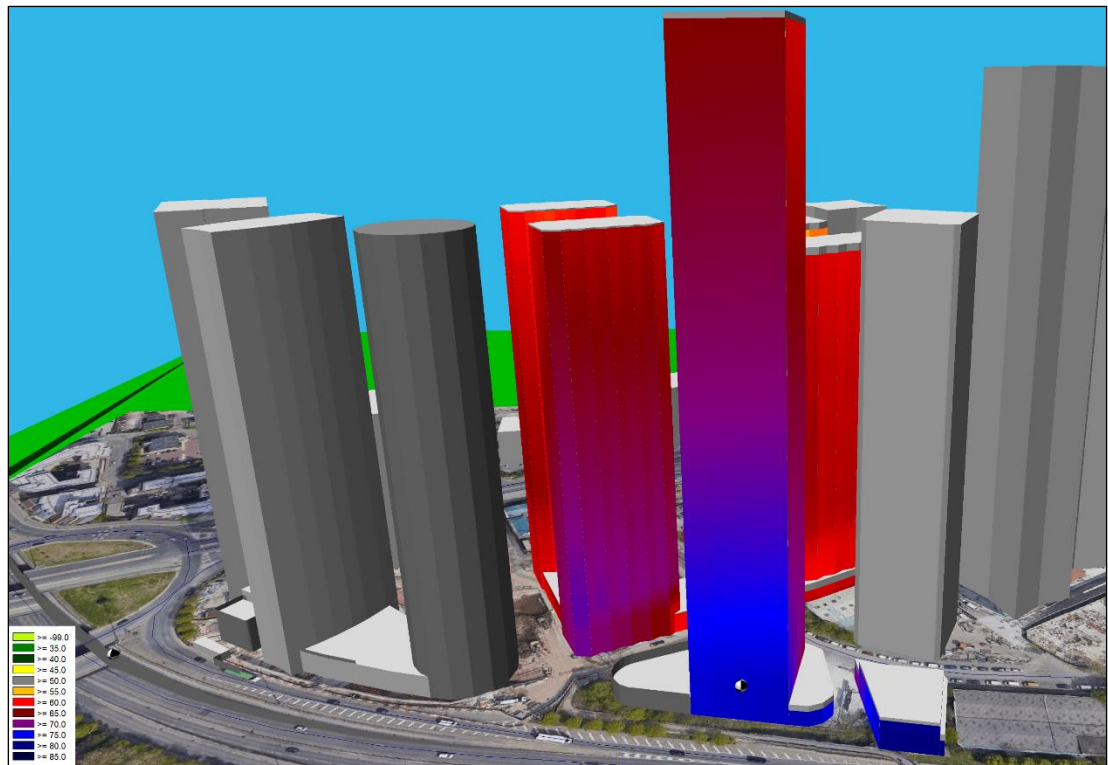


Figure 7: 3D model of development proposals & predicted incident noise levels – viewed from the south

Figure 8 shows the calculated typical external daytime average ($L_{Aeq,16h}$) noise levels incident upon the various façades of the lower floor levels of the proposed buildings.

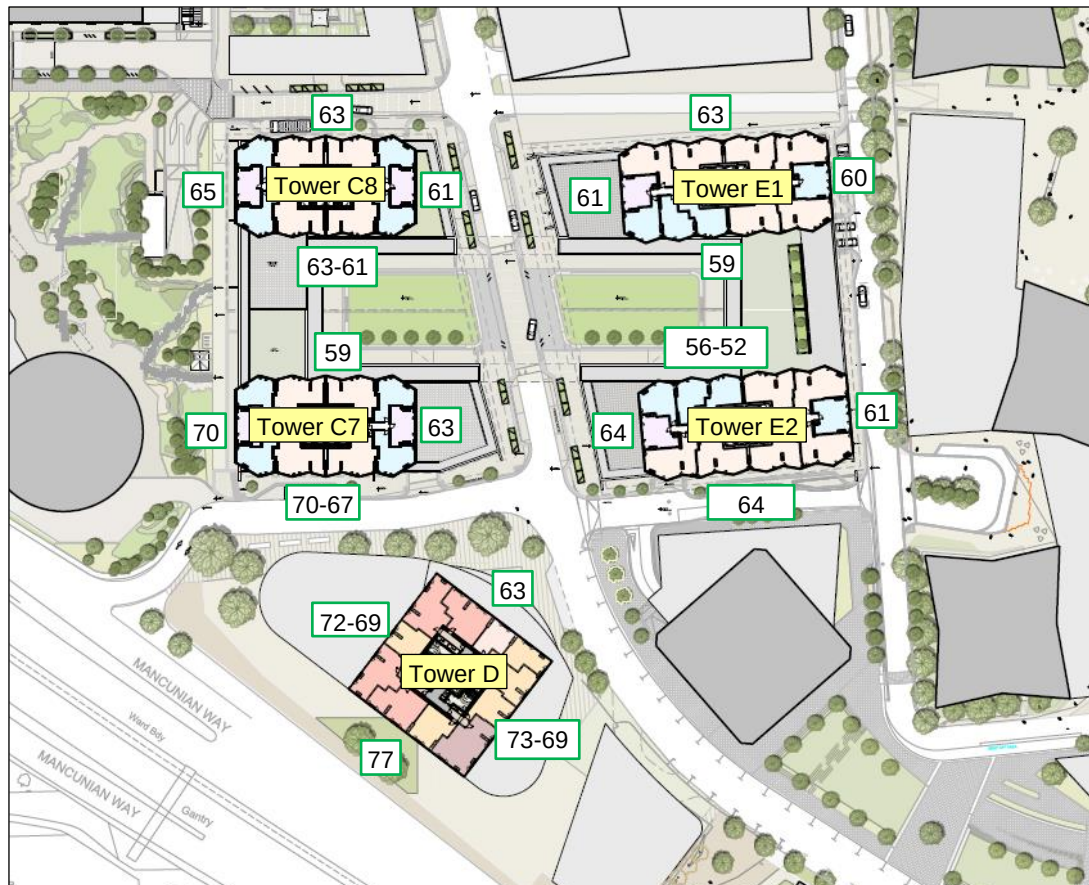


Figure 8: Summary external daytime noise levels incident on each façade (dB $L_{Aeq,16h}$)

Figure 9 shows the calculated typical external night time average ($L_{Aeq,8h}$) noise levels incident upon the various façades of the lower floor levels of the proposed buildings.

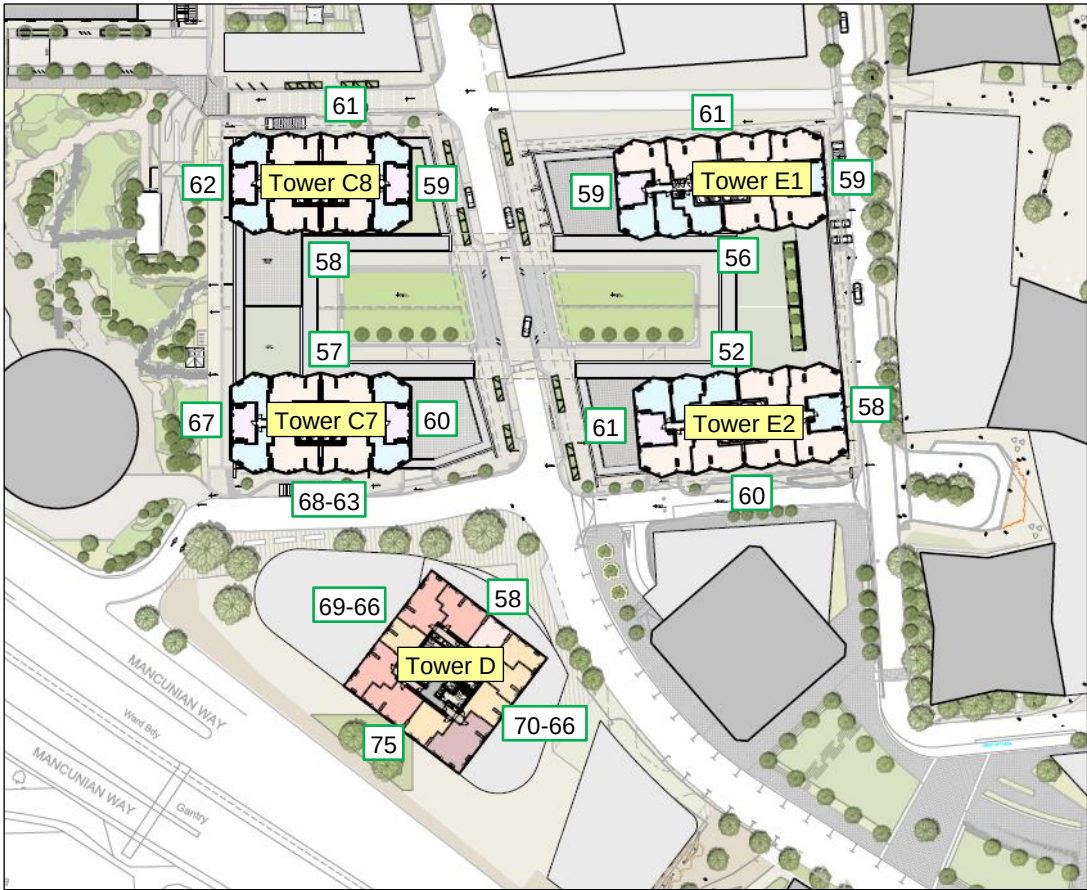


Figure 9: Summary external night time noise levels incident on each façade (dB LAeq)

7.0 NOISE INGRESS

By taking into account the measured levels of noise at the site, the areas of the façade to each room and the likely reverberation time of the apartment rooms, the required sound insulation performance of the curtain wall to achieve the target internal noise criteria can be calculated.

The apartments of the Proposed Development are to be provided with continuously running supply and extract ventilation in order to achieve the background ventilation requirements of Approved Document F of the Building Regulations. Therefore, no passive trickle ventilators are required within the façade of the proposed habitable rooms. Purge ventilation is to be achieved via opening purge vents. The calculations of noise ingress assume that the purge vents are closed.

Design recommendations

Calculations of noise ingress have been carried out to determine the minimum required composite weighted sound reduction index of the curtain wall to achieve the internal noise criteria detailed in Section 5 of this report. The calculations are based upon the room sizes and layouts identified on the drawings submitted for Planning purposes.

It has been determined that a range of acoustic specifications for the curtain wall will be required to achieve the recommended internal noise levels. Figures 10 to 19 identify the locations of the various recommended specifications. The curtain wall performance requirements are detailed below.

Table 4 identifies the minimum recommended weighted sound reduction index of the curtain wall specifications referred to below and in Figures 10 to 19. The recommended performance values in Table 4 relate to the composite performance of the full curtain wall assembly including glazing, drylined non-vision panels, the curtain wall frame and openable purge vents.

Specification	Rw
TYPE A	35 dB
TYPE B	39 dB
TYPE C	42 dB
TYPE D	45 dB
TYPE E	48 dB
TYPE F	50 dB

Table 4: Minimum Recommended Sound Reduction Index of facade

Preliminary investigations into the required sound insulation of the individual curtain wall elements to achieve an overall performance of 50dB Rw, indicate that it is not expected to be possible to achieve such a performance. This finding is based on the provision of high-performance triple glazing that incorporates acoustically laminated panes and frame sections with acoustic infills to minimise external noise intrusion, in addition to opening purge panels and solid curtain wall panels that achieve a maximum practicable acoustic performance. Hence, it is not expected to be possible to achieve the internal noise criteria in the apartments of Plot D below Level 15 on the south elevation of the building.

Appendix B therefore sets out a justification for seeking a relaxation in the internal noise criteria for the affected apartments.

During the detailed design phase, the acoustic performance requirements of the individual elements of the curtain will be determined and advised.

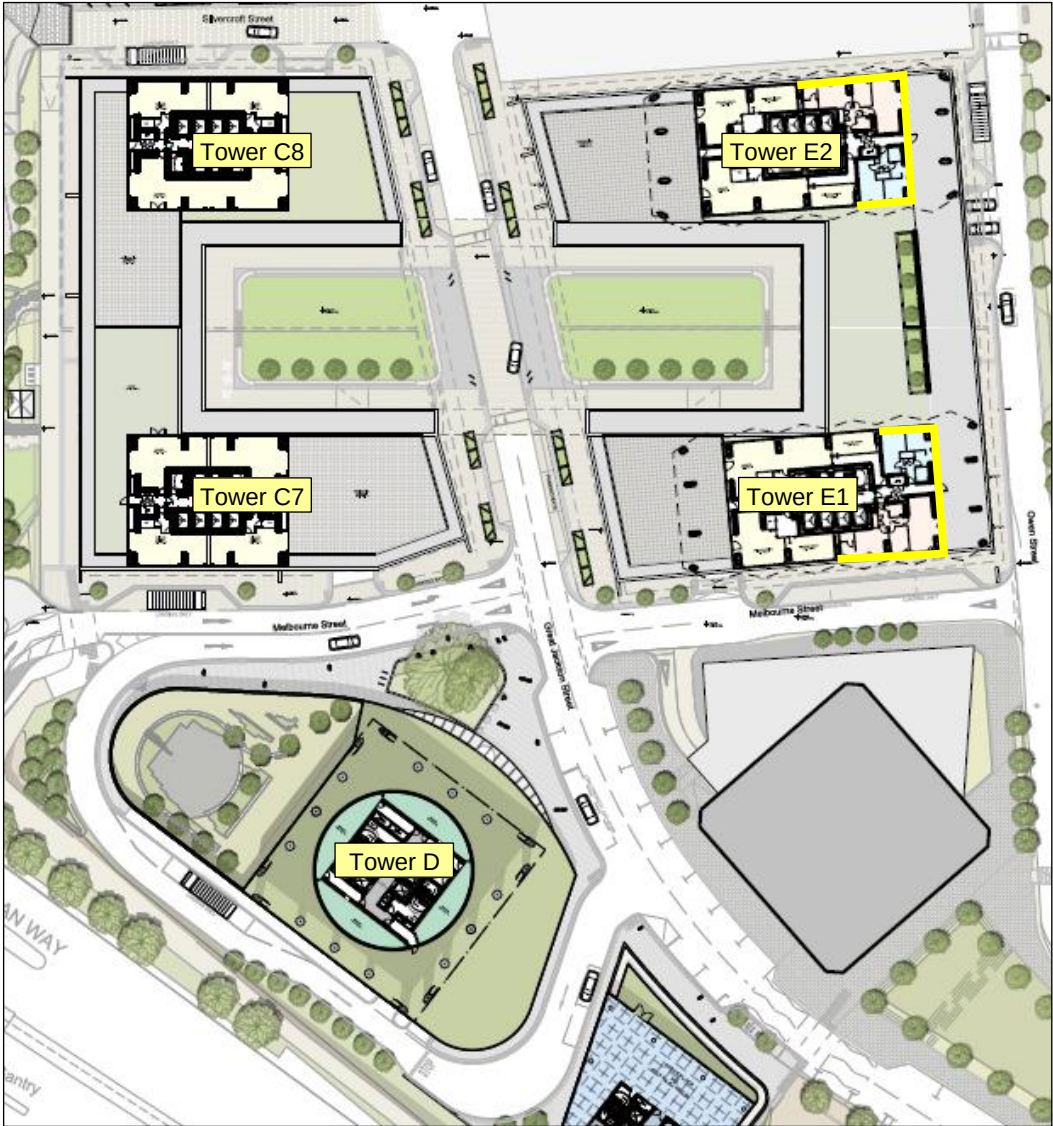


Figure 10: Acoustic specification location plan, Level 02 - Living Rooms & Bedrooms

KEY

	Acoustic Spec A (Rw 35 dB)		Acoustic Spec D (Rw 45 dB)
	Acoustic Spec B (Rw 39 dB)		Acoustic Spec E (Rw 48 dB)
	Acoustic Spec C (Rw 42 dB)		Acoustic Spec F (Rw 50 dB)

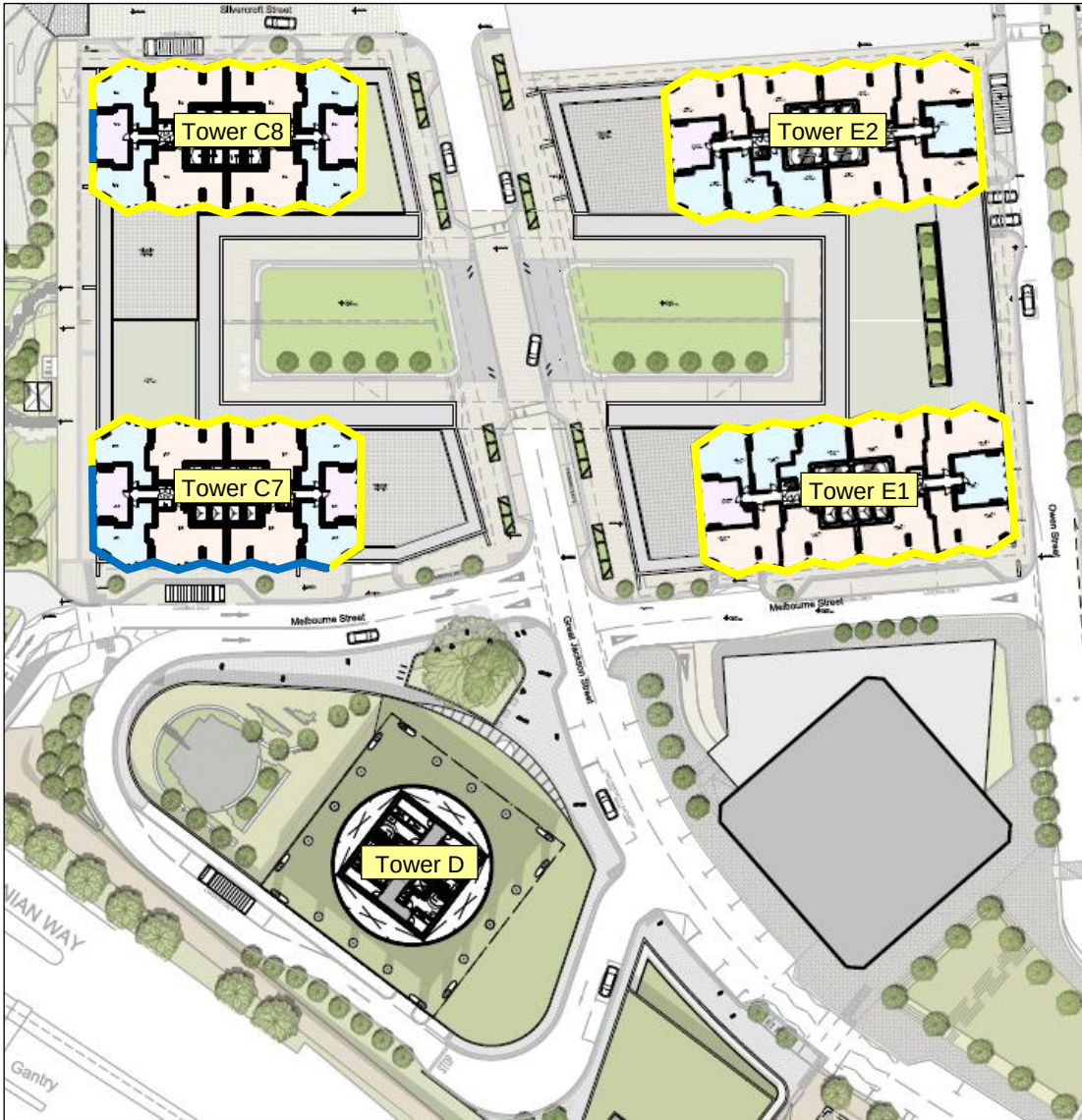


Figure 11: Acoustic specification location plan, Level 03 - Living Rooms & Bedrooms

KEY

Acoustic Spec A (Rw 35 dB)	Acoustic Spec D (Rw 45 dB)
Acoustic Spec B (Rw 39 dB)	Acoustic Spec E (Rw 48 dB)
Acoustic Spec C (Rw 42 dB)	Acoustic Spec F (Rw 50 dB)

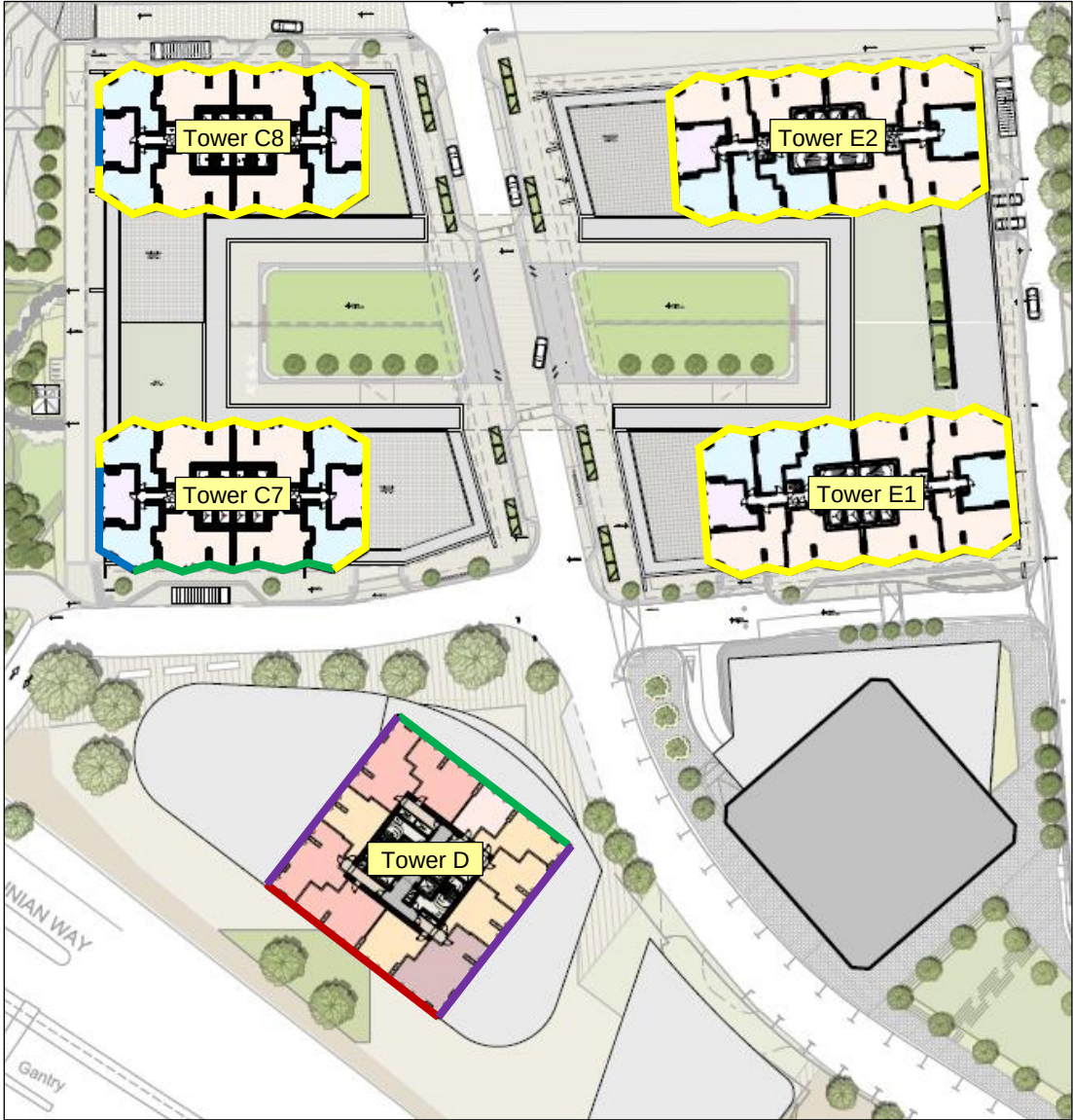


Figure 12: Acoustic specification location plan, Level 04 to Level 14 - Living Rooms & Bedrooms

KEY

	Acoustic Spec A (Rw 35 dB)		Acoustic Spec D (Rw 45 dB)
	Acoustic Spec B (Rw 39 dB)		Acoustic Spec E (Rw 48 dB)
	Acoustic Spec C (Rw 42 dB)		Acoustic Spec F (Rw 50 dB)

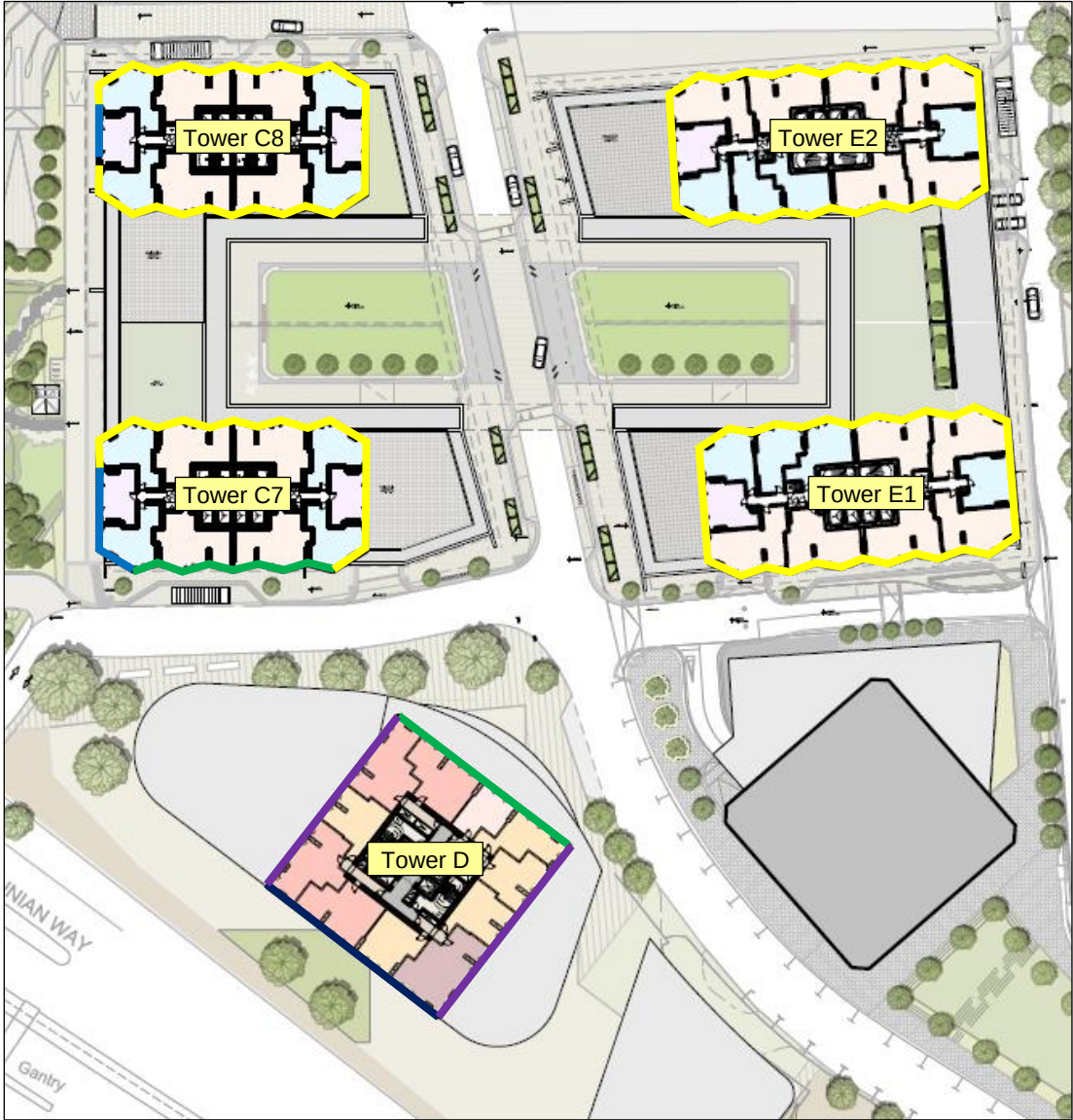


Figure 13: Acoustic specification location plan, Level 15 to Level 26 - Living Rooms & Bedrooms

KEY

	Acoustic Spec A (Rw 35 dB)		Acoustic Spec D (Rw 45 dB)
	Acoustic Spec B (Rw 39 dB)		Acoustic Spec E (Rw 48 dB)
	Acoustic Spec C (Rw 42 dB)		Acoustic Spec F (Rw 50 dB)

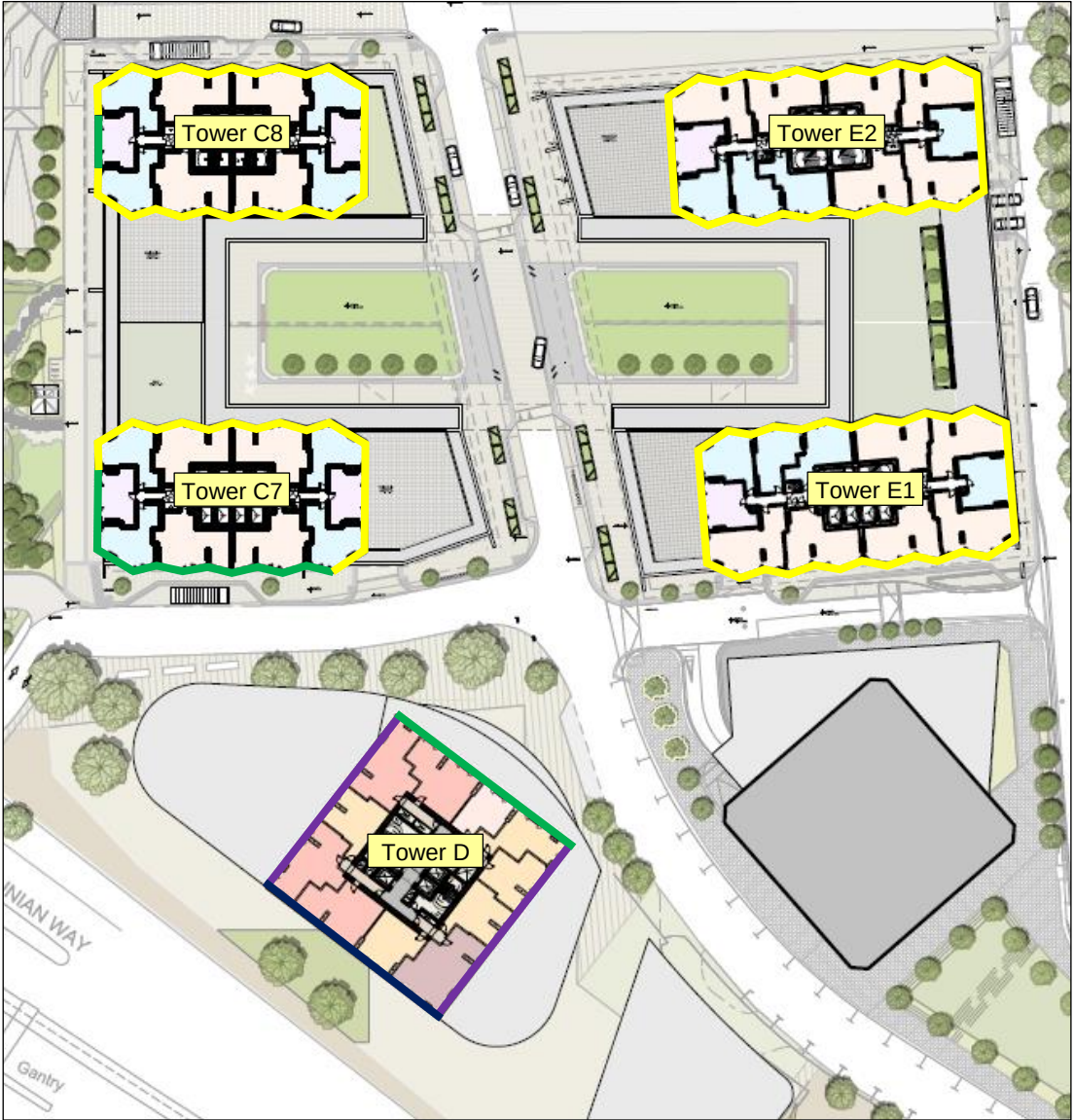


Figure 14: Acoustic specification location plan, Level 27 to Level 29 - Living Rooms & Bedrooms

KEY

	Acoustic Spec A (Rw 35 dB)		Acoustic Spec D (Rw 45 dB)
	Acoustic Spec B (Rw 39 dB)		Acoustic Spec E (Rw 48 dB)
	Acoustic Spec C (Rw 42 dB)		Acoustic Spec F (Rw 50 dB)

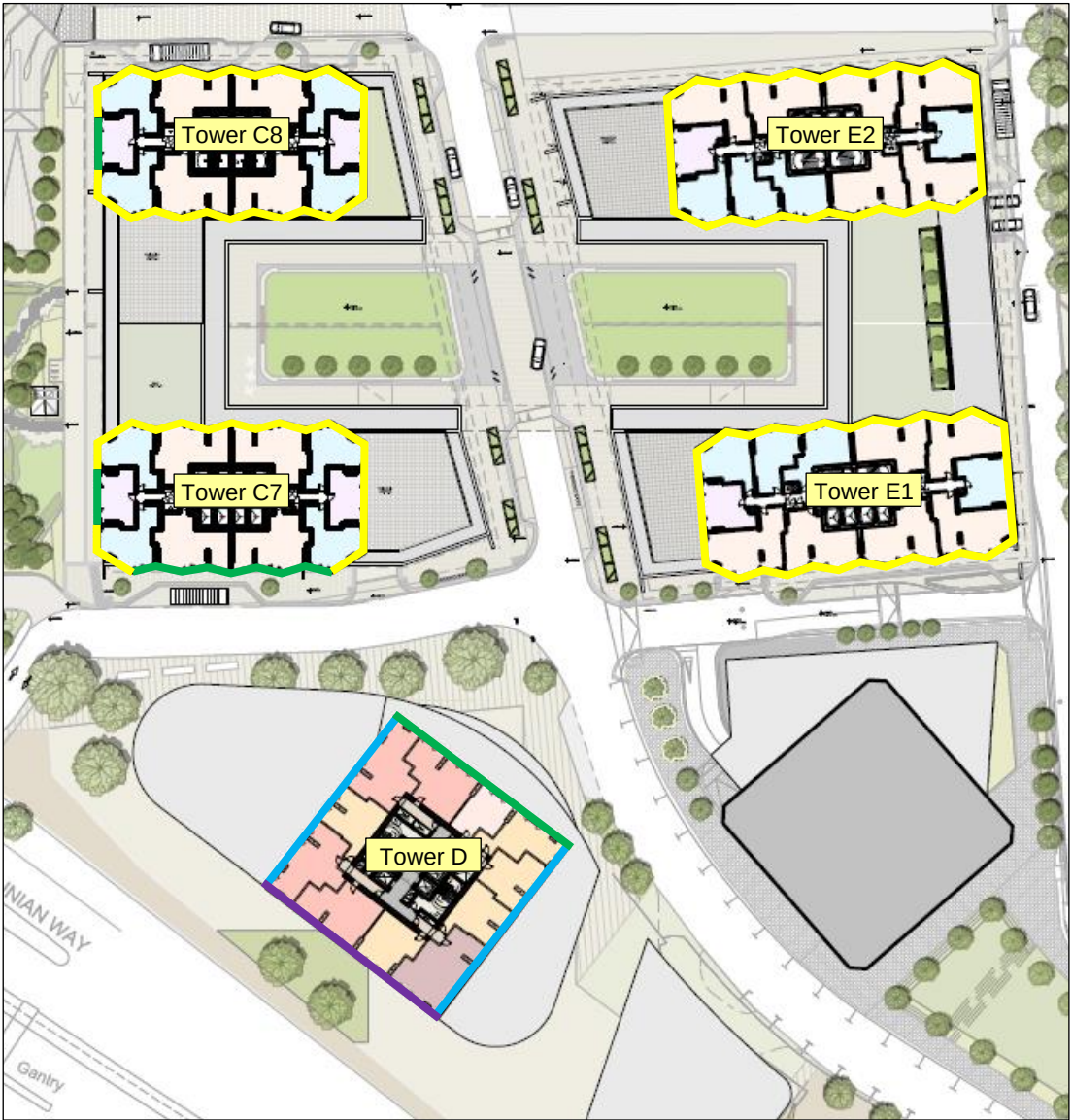


Figure 15: Acoustic specification location plan, Level 30 to Level 35 - Living Rooms & Bedrooms

KEY

	Acoustic Spec A (Rw 35 dB)		Acoustic Spec D (Rw 45 dB)
	Acoustic Spec B (Rw 39 dB)		Acoustic Spec E (Rw 48 dB)
	Acoustic Spec C (Rw 42 dB)		Acoustic Spec F (Rw 50 dB)

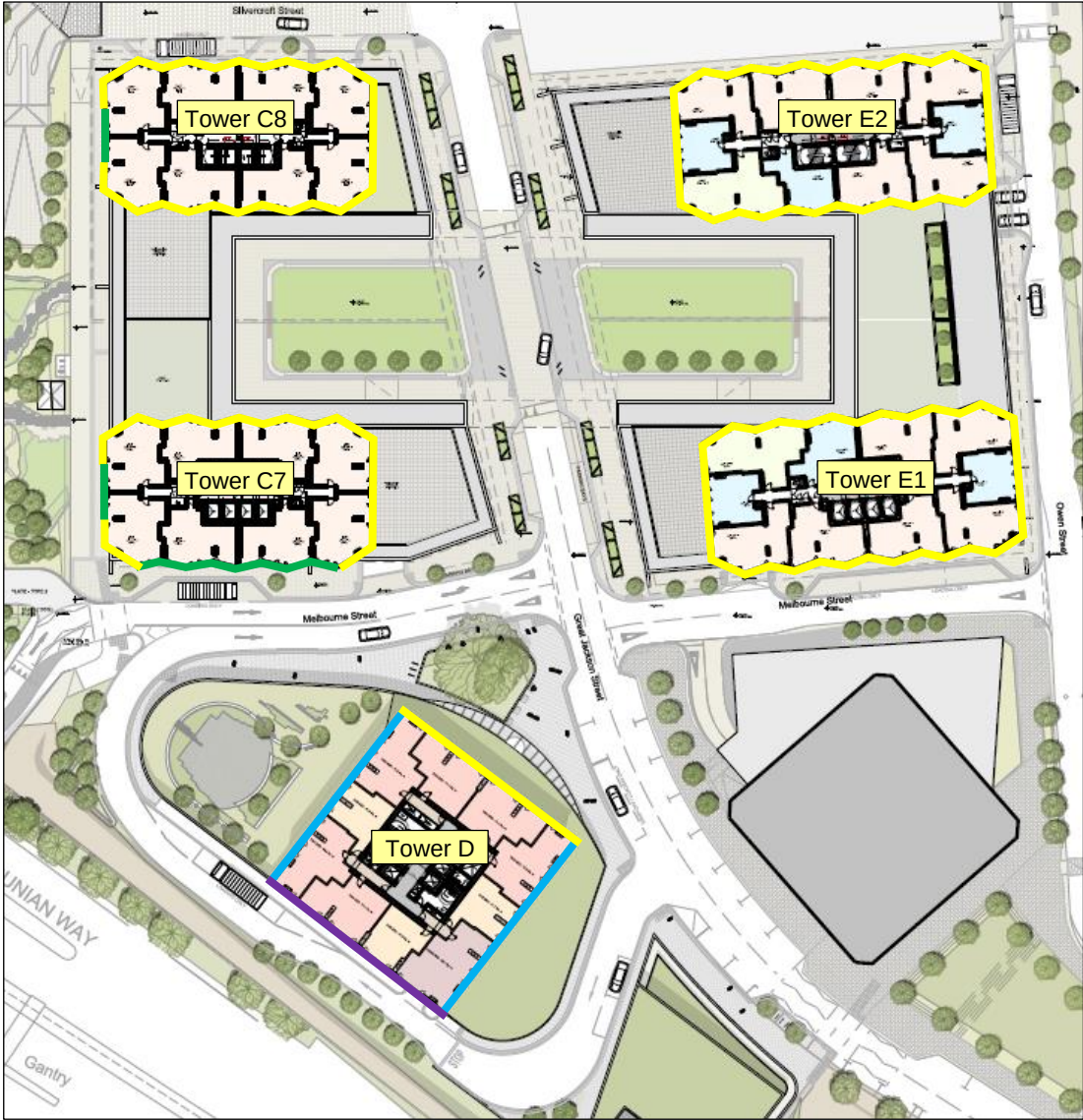


Figure 16: Acoustic specification location plan, Level 36 to Level 39 - Living Rooms & Bedrooms

KEY

Acoustic Spec A (Rw 35 dB)	Acoustic Spec D (Rw 45 dB)
Acoustic Spec B (Rw 39 dB)	Acoustic Spec E (Rw 48 dB)
Acoustic Spec C (Rw 42 dB)	Acoustic Spec F (Rw 50 dB)

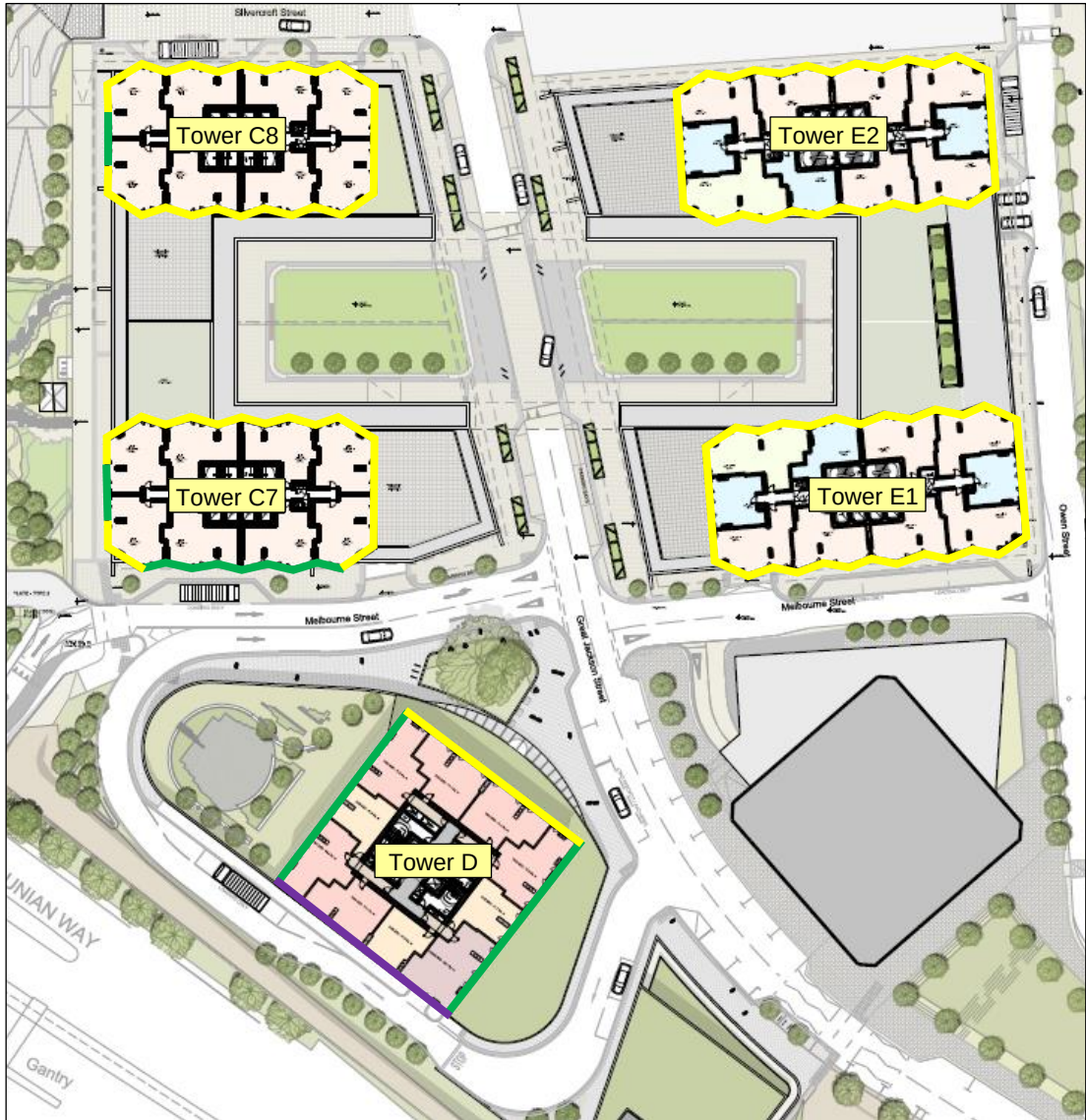


Figure 17: Acoustic specification location plan, Level 40 to Level 46 - Living Rooms & Bedrooms

KEY

— Acoustic Spec A (Rw 35 dB)	— Acoustic Spec D (Rw 45 dB)
— Acoustic Spec B (Rw 39 dB)	— Acoustic Spec E (Rw 48 dB)
— Acoustic Spec C (Rw 42 dB)	— Acoustic Spec F (Rw 50 dB)

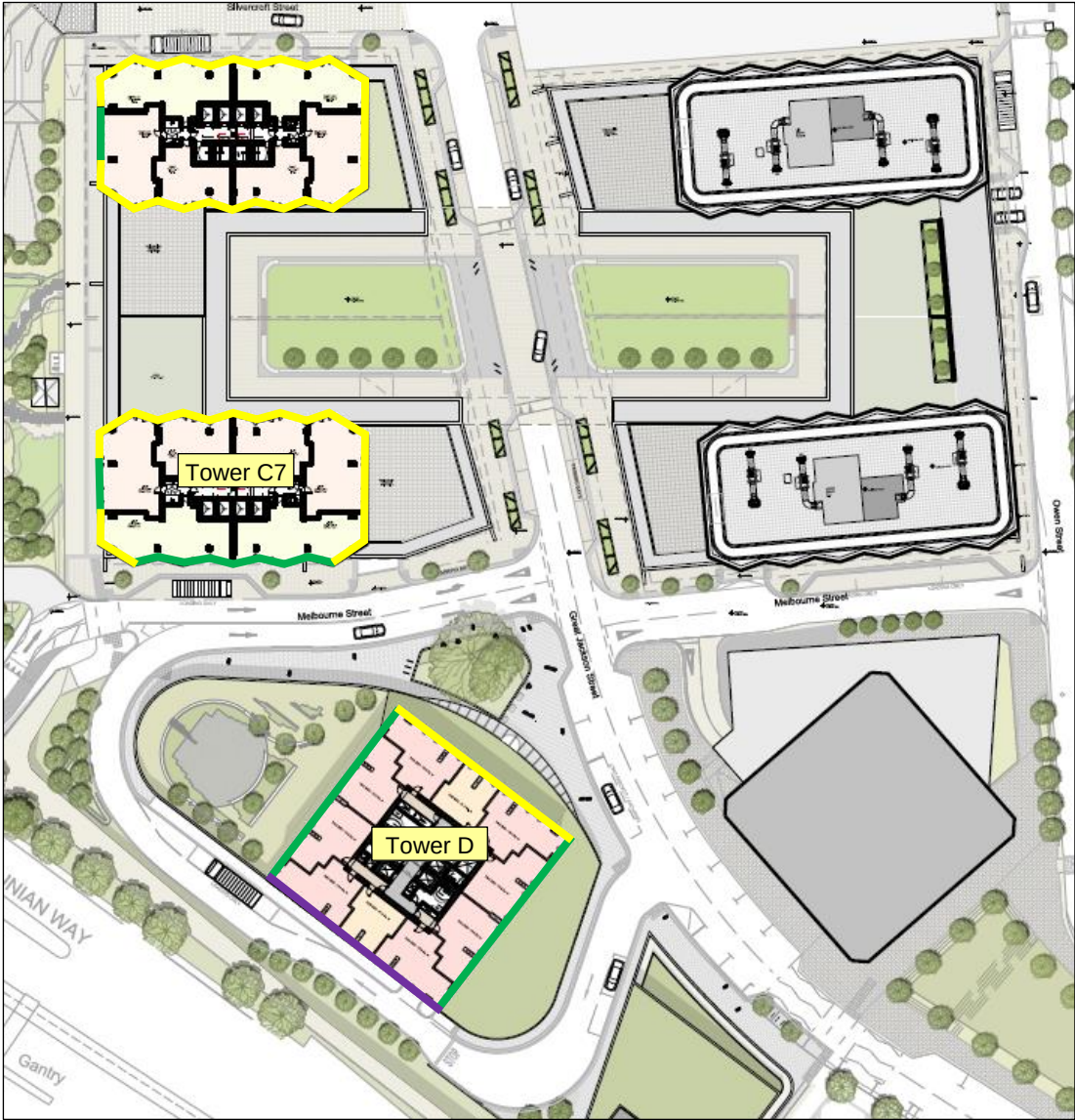


Figure 18: Acoustic specification location plan, Level 47 to Level 50 - Living Rooms & Bedrooms

KEY

	Acoustic Spec A (Rw 35 dB)		Acoustic Spec D (Rw 45 dB)
	Acoustic Spec B (Rw 39 dB)		Acoustic Spec E (Rw 48 dB)
	Acoustic Spec C (Rw 42 dB)		Acoustic Spec F (Rw 50 dB)

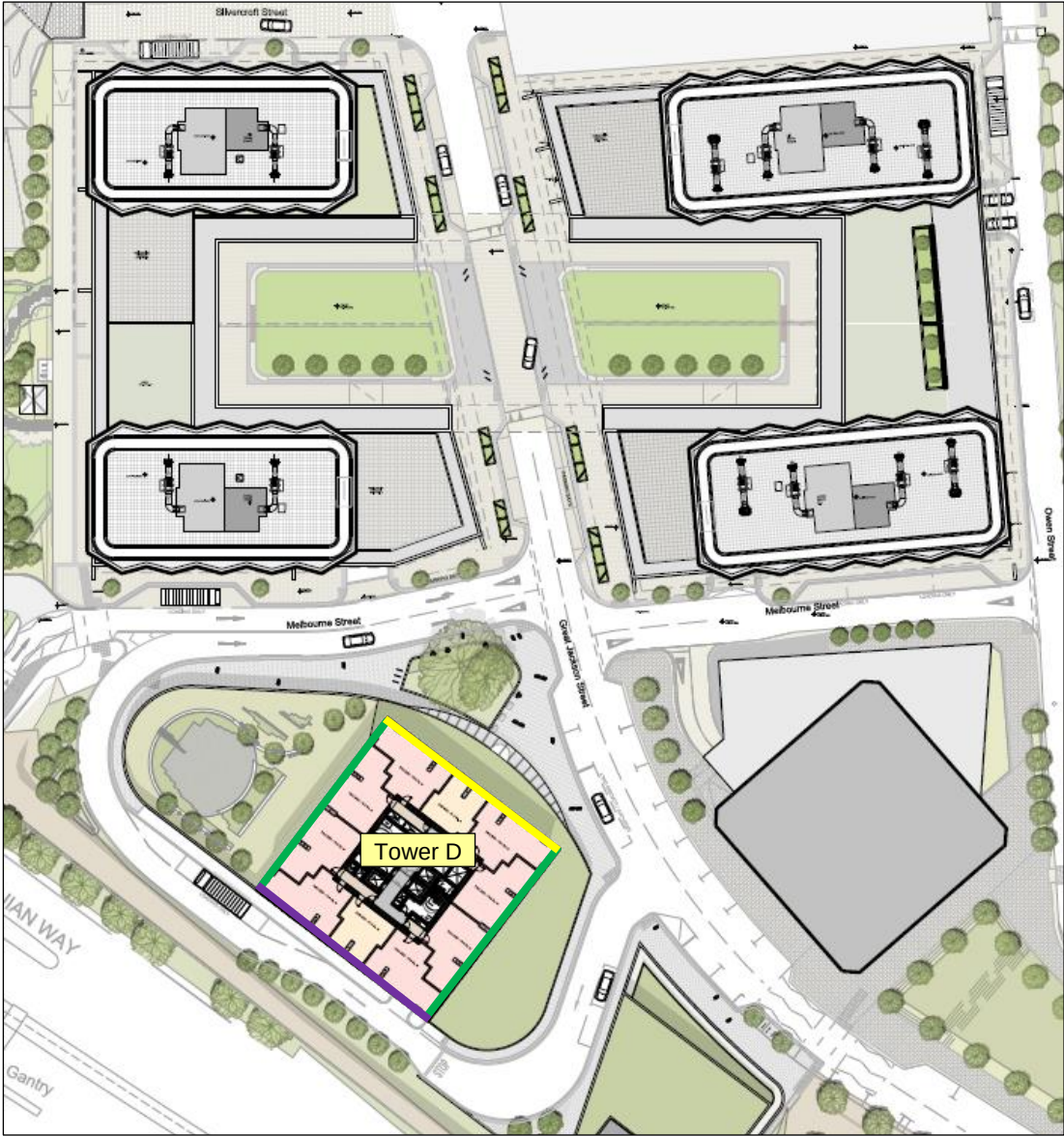


Figure 19: Acoustic specification location plan, Level 51 to Level 66 - Living Rooms & Bedrooms

KEY

	Acoustic Spec A (Rw 35 dB)		Acoustic Spec D (Rw 45 dB)
	Acoustic Spec B (Rw 39 dB)		Acoustic Spec E (Rw 48 dB)
	Acoustic Spec C (Rw 42 dB)		Acoustic Spec F (Rw 50 dB)

Roof

The principle acoustic elements of the proposed roof of each proposed building are a concrete slab and a ceiling that comprises a single layer of 12.5 mm wallboard fixed to a suspended metal frame. The expected minimum weighted sound reduction index of the roof construction is 60dB Rw. This performance is fully commensurate with the achievement of the target internal noise levels within the proposed apartments.

External noise ingress via MVHR ductwork

It is possible that in-line ductwork silencers would need to be introduced to some of the proposed apartment MVHR systems to reduce external noise ingress via the atmosphere terminations of the MVHR systems (i.e. the intake and exhaust of the MVHR fans) and to achieve the applicable internal noise criteria.

As the detailed design progresses, the acoustic requirements of any in-line ductwork silencers will be assessed.

Conclusion

Compliance with the recommended sound insulation performances of the façade and roof elements is expected to allow full compliance with the daytime and night time 'average' noise level criteria identified in Section 5 above.

However, the preferred internal noise criteria in the apartments of Plot D below Level 15 on the south elevation of the building are requested to follow Note 7 of section 7.2.2 of BS8233: 2014. Appendix B sets out a justification for the internal noise criteria for the affected apartments.

Given the recommended sound insulation performances given above for the façade and roof, compliance with the recommendations of Manchester City Council in relation to maximum (LAmax) night time noise levels in bedrooms is expected.

8.0 EXTERNAL NOISE LEVELS DUE TO BUILDING SERVICES

The measured background noise levels around the site can be used to establish the acceptable level of noise from plant serving the development. Final plant selections have not been made at this early design stage. In the absence of specific selection of plant items, overall plant noise limits can be provided.

With reference to the discussion in Section 5, the cumulative Rating level due to all simultaneously operating non-emergency plant must be at least 5dB lower than the typical pre-existing background noise level at the nearest residential receptors to the site.

Table 4 identifies the allowable combined free-field Rating level at the nearest residential receptors to the development, due to all simultaneously-operating non-emergency building services plant and equipment.

Location	Rating level (dB LAeq)	
	Daytime (07:00 hrs to 23:00 hrs)	Night time (23:00 hrs to 07:00 hrs)
Elizabeth Tower	52	47
Victoria Residence	52	47
Plot C4	52	47
Plot C5	52	47
Plot D	52	45
Plot C7	52	45
Plot C8	52	45
Plot E1	52	45
Plot E2	52	45
Plot F1	52	45
Deansgate Square, North Tower	52	51
Deansgate Square, West Tower	52	51
Deansgate Square, South Tower	52	51
Bridgewater House	52	45

Table 5: Environmental noise limits for non-emergency building services plant

Emergency plant

If any emergency plant is required at the Development, it is expected that such plant would only operate during emergencies and during periodical test runs (such as test runs of thirty minutes every two weeks).

On this basis, it is not considered appropriate to require emergency plant to comply with the noise limits for continuously operating non-emergency plant. It is therefore suggested that the noise level from any emergency plant is no more than 10dB(A) greater than the ambient noise level (measured as an LA90) at any residential receptor. It is therefore recommended that the noise level at any residential façade during operation of any emergency plant does not exceed the daytime noise levels given in Table 5.

Location	Daytime noise level (dB LAeq)
Elizabeth Tower	67
Victoria Residence	67
Plot C4	67
Plot C5	67
Plot D Tower, north elevation	67
Plot D Tower, south elevation	70
Plot C7	67
Plot C8	67
Plot E	67
Plot E2	67
Plot F1	67
Deansgate Square, North Tower	67
Deansgate Square, West Tower	67
Deansgate Square, South Tower	67
Bridgewater House	67

Table 6: Environmental noise limits for emergency building services plant

The above noise limits for non-emergency and emergency plant must be forwarded to the project's Mechanical Engineer to allow the selection of appropriate equipment and any associated noise control hardware. Building services equipment must also be provided with appropriate vibration isolation to minimise the risk of disturbance to the building occupants by structureborne noise.

9.0 NOISE EGRESS FROM AMENITY AREAS AND COMMERCIAL UNITS

In order to avoid potential noise nuisance to the existing and proposed noise-sensitive buildings around the site, activity noise egress from the proposed commercial units and amenity spaces within the proposed residential towers must be controlled. As the proposed spaces may potentially employ music replay, suitable limits relating to music noise egress from the proposed areas must be established.

As detailed in Section 5 above, Manchester City Council suggests that external music noise levels (measured as an L_{eq} noise level) external to a residential property due to an entertainment venue should be 5 dB lower than the prevailing background noise level in each octave band.

Octave band noise limits at the nearest noise sensitive receptors have been determined by reference to noise survey data at the nearby noise sensitive premises.

Table 6 identifies the recommended maximum allowable cumulative daytime and night time free-field noise levels at the closest residential façades due to music noise from the amenity spaces and commercial units within the proposed development to comply with the guidance of Manchester City Council.

Location/period	Sound Pressure Level (dB Leq) @ Octave Band Centre Frequency (Hz)						
	63	125	250	500	1k	2k	4k
Elizabeth Tower (07:00 to 23:00)	47	44	46	46	50	43	30
Elizabeth Tower (23:00 to 07:00)	47	40	42	42	45	38	26
Victoria Residence (07:00 to 23:00)	47	44	46	46	50	43	30
Victoria Residence (23:00 to 07:00)	47	40	42	42	45	38	26
Plot C4 (07:00 to 23:00)	47	44	46	46	50	43	30
Plot C4 (23:00 to 07:00)	47	40	42	42	45	38	26
Plot C5 (07:00 to 23:00)	47	44	46	46	50	43	30
Plot C5 (23:00 to 07:00)	47	40	42	42	45	38	26
Plot D (07:00 to 23:00)	58	52	50	48	49	43	34
Plot D (23:00 to 07:00)	47	40	40	40	45	36	22
Plot C7 (07:00 to 23:00)	47	44	46	46	50	43	30
Plot C7 (23:00 to 07:00)	47	40	42	42	43	36	23
Plot C8 (07:00 to 23:00)	47	44	46	46	50	43	30
Plot C8 (23:00 to 07:00)	47	40	42	42	43	36	23
Plot E1 (07:00 to 23:00)	47	44	46	46	50	43	30
Plot E1 (23:00 to 07:00)	47	40	42	42	43	36	23
Plot E2 (07:00 to 23:00)	47	44	46	46	50	43	30
Plot E2 (23:00 to 07:00)	47	40	42	42	43	36	23
Plot F1 (07:00 to 23:00)	58	52	50	48	49	43	34
Plot F1 (23:00 to 07:00)	47	40	40	40	45	36	22
Deansgate Square, North Tower (07:00 to 23:00)	49	46	48	48	52	44	31
Deansgate Square, North Tower (23:00 to 07:00)	49	46	48	48	46	39	29
Deansgate Square, West Tower (07:00 to 23:00)	49	46	48	48	52	44	31
Deansgate Square, West Tower (23:00 to 07:00)	49	46	48	48	46	39	29
Deansgate Square, South Tower (07:00 to 23:00)	49	46	48	48	52	44	31
Deansgate Square, South Tower (23:00 to 07:00)	49	46	48	48	46	39	29
Bridgewater House (07:00 to 23:00)	47	44	46	46	50	43	30
Bridgewater House (23:00 to 07:00)	47	40	42	42	43	36	23

Table 7: Maximum allowable external music noise levels due to proposed commercial units

INTERNAL NOISE TRANSFER- AMENITY AREAS TO APARTMENTS

There are residential apartments directly above the proposed amenity areas. There is therefore the possibility of internal noise transfer between the amenity areas and the apartments above via the party floor structures. In order to avoid potential noise nuisance, it is recommended that the internal noise levels within an apartment due solely to music replay in the amenity areas are targeted to the values given in Table 7.

Location	Sound Pressure Level (dB) @ Octave Band Centre Frequency (Hz)						
	63	125	250	500	1k	2k	4k
Apartments	43	33	23	20	17	15	12

Table 8: Recommended noise levels in apartments due to music replay in amenity areas

It will be noted that the recommended noise levels in apartments due to music noise transfer at 63 Hz and 125 Hz are lower than those recommended by Manchester City Council (47dB at 63Hz and 41dB at 125Hz). Therefore, targeting the recommended values in Table 7 will provide a substantial margin of comfort that the recommendations of Manchester City Council will be achieved. Whilst the final achieved values may differ from the values in Table 7, compliance with the noise limits published in Manchester City Council's guidance will be achieved.

During the detailed design stages, the sound insulation requirements of the party floor to comply with the above noise limits will be determined given the potential noise levels generated within the amenity spaces. Ultimately, if a practicable sound insulation of the party floor cannot be achieved then the activity noise levels within the amenity spaces, in particular the sound level of amplified music, will be controlled by the building management such that residential amenity is maintained.

10.0 ACOUSTICS, VENTILATION AND OVERHEATING

Manchester City Council has advised that the design of each building should refer to the guidance given in the 'Acoustics Ventilation and Overheating Residential Design Guide ('AVO') published by the Association of Noise Consultants and the Institute of Acoustics in January 2020.

The apartments within the proposed development are to be ventilated using continuous mechanical supply and extract with heat recovery and summer bypass (MVHR) units in order to comply with the 'whole dwelling' ventilation requirements of Approved Document F of the Building Regulations (ADF).

Therefore, no passive trickle ventilators are required within the façade of the proposed habitable rooms and opening windows are not required to achieve the background ventilation requirements of ADF. Therefore, under normal circumstances, the full acoustic benefit of the curtain wall to apartments will be available.

Purge ventilation, delivered by either openings (windows or doors) or mechanical extract ventilation, is required under ADF to rapidly dilute indoor air pollutants (e.g. paint fumes) and extract water vapour when necessary in habitable rooms. Purge ventilation of the apartments is to be provided by manually-operated inward-opening doors (purge panels) within the curtain wall.

The provisions for purge ventilation (e.g. openable purge panels) can also be used to improve thermal comfort. The AVO recommends that when using provisions for purge ventilation such as opening windows, an assessment is carried out of the potential effect of the subsequent internal noise levels within apartment rooms.

As stated in the Foreword of the document, the AVO

- 'provides an approach as to how the competing aspects of thermal and acoustic comfort can be managed'.

In the absence of mandatory requirements under the Building Regulations at the time that the AVO was written in relation to the overheating of dwellings, the AVO is

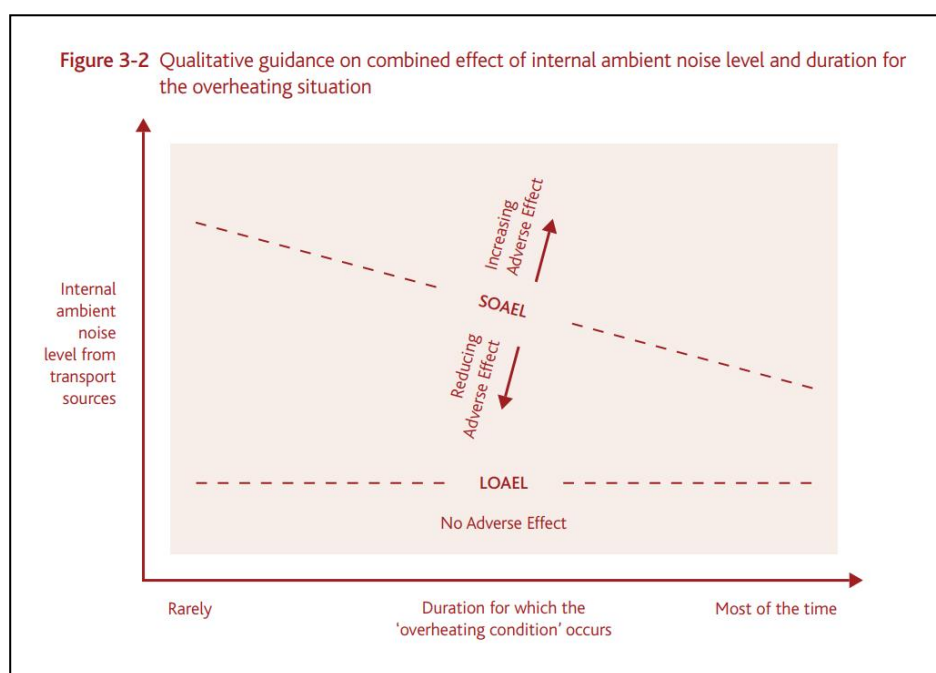
- 'intended to be used by acoustics practitioners as well as all those involved in the planning, development, design and commissioning of new dwellings. It recommends an approach to acoustic assessments for new residential development that takes due regard of the interdependence of provisions for acoustics, ventilation, and overheating'.

The AVO presents a method for assessing the risk of an adverse effect on occupants depending on 1) the potential internal noise level within apartments with windows open and 2) the duration of window opening.

With regard to the duration of window opening required to mitigate overheating, the AVO states:

- No quantitative guidance regarding the combined effect of level and duration for the overheating condition is included in the current version of this document. However, the situation is summarised qualitatively in Figure 3-2 and also addressed in the worked examples included in Appendix B.

Figure 3-2 from the AVO is reproduced below.



It will be noted that no absolute noise levels are indicated on the y-axis and no specific durations are identified on the x-axis of Figure 3.2.

With regard to the duration of the overheating condition (i.e. the time that windows or purge panels may be open), 'rarely' and 'most of the time', as referenced in Figure 3-2 of the AVO are not defined, although reference is made to 'Overheating in New Homes', published by the Good Homes Alliance in July 2019, which provides an early design stage tool in order to identify key factors contributing to overheating risk, and possible mitigation measures.

The tool 'is not meant to provide a detailed assessment, but instead to sit between existing high level guidance...and detailed calculation and modelling tools...'.

The AVO recognises that further development work is required to better understand how long people will tolerate higher noise levels in their homes in order to stay cool, with the ultimate aim of creating 'cost effective and sustainable buildings'.

Furthermore, the AVO advises that:

- In the case of the overheating condition, the effect of increased internal ambient noise from external noise sources will depend both on the absolute noise level and the amount of time for which the overheating condition occurs. A good design process should therefore, as a priority, seek to minimise heat gains thereby reducing the amount and duration of ventilation required to control overheating and the consequential effect from increased ingress of noise.

Importantly, the AVO acknowledges that

- Appropriate research work is urgently needed to better inform the guidance for the overheating condition.

and

- There are other benefits for occupants from opening windows, such as the connection with the outside, sense of fresh air, experience of draughts when overheating, and sense of control over one's environment' and states that 'consideration of these factors is also beyond the scope of the AVO Guide.

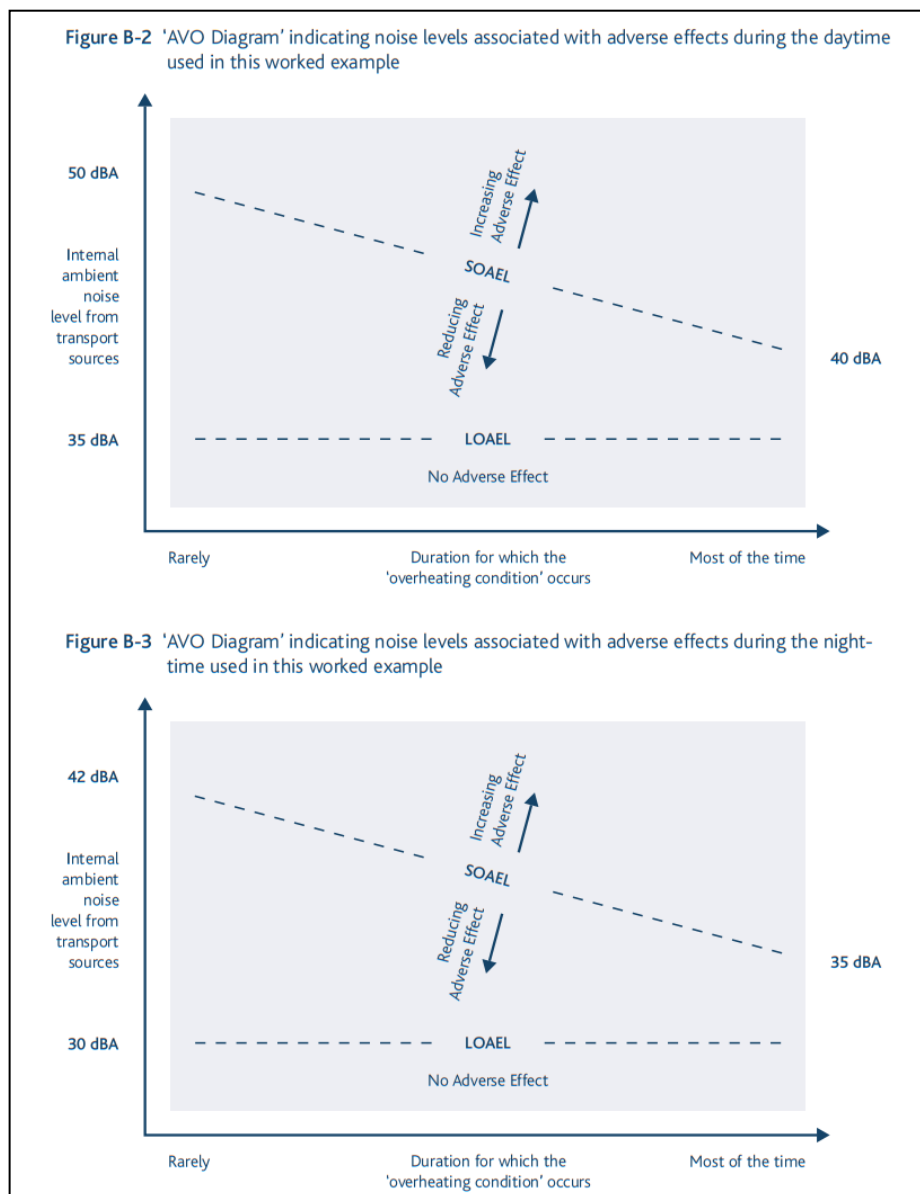
Worked examples are provided in Appendix B of the AVO. These examples give suggested absolute dB levels for the SOAEL (Significant Observed Adverse Effect Level) and LOAEL (Lowest Observed Adverse Effect Level) curves in Figure 3-2. The LOAEL is defined as the level above which adverse effects on health and quality of life can be detected. The SOAEL is defined as the level above which significant adverse effects on health and quality of life occur.

The AVO advises that:

- 'although for both LOAEL and SOAEL, the word 'level' is used, this does not mean that the impact can only be described as an individual noise level or exposure. It could also include factors such as the number of times the noise impact occurs, the duration of the impact, and the time of day the impact occurs. Thus, depending on the circumstance, the noise impact could be managed by reducing how often it occurs rather than just reducing the level of impact when it does occur.

The AVO advises that the NPSE (Noise Policy Statement for England) states it is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times.

Figures B-2 and B-3 from the AVO worked examples are reproduced below.



The AVO states that the suggested upper daytime noise limit of 50 dB LAeq,T is defined on the basis that it represents the upper end of the range for reliable speech communication. The upper night time noise limit of 42 dB LAeq,T is defined in the AVO with reference to the WHO Night Noise guidelines, which state that for external levels above 55dB LAeq,T, 'adverse health effects occur frequently and a sizeable proportion of the population is highly annoyed and sleep-disturbed'.

A noise level of 50dB LAeq,T is also the upper limit for indoor long-term ambient noise within open plan offices recommended in BS8233: 2014 'Guidance on sound insulation and noise reduction for buildings'.

The value of 'T', the averaging period used to determine the 'average' noise level 'LAeq,T', is not defined in the AVO. However, when discussing the further work required to better understand the issue of noise disturbance when windows are opened to control overheating, AVO states that further information is required, including

- how long will people tolerate higher noise levels in order to stay cool? One suggestion is to consider the overall average day (16h) and night (8h) time average noise levels. There is some logic to this as we all know that we can tolerate high noise levels for a short duration and moderately high levels for a little longer.

With regard to the absolute dB noise levels representing the LOAEL and the SOAEL in Figures B-2 and B-3, AVO states:

- The values presented....should not be regarded as fixed thresholds and reference can also be made to relevant dose-response relationships such as those described in a DEFRA 2014 study.the references are based on evidence drawn from *external* noise levels. There is currently very little robust evidence linking *internal* averaged noise levels with health outcomes and occupant behaviour.

Therefore, the noise levels identified in Figures B-2 and B-3 must be viewed with caution.

BUILDING REGULATIONS APPROVED DOCUMENT O – OVERHEATING (2021)

Requirement O1 'Overheating mitigation' of Approved Document O is as follows:

(1) Reasonable provision must be made in respect of a dwelling, institution or any other building containing one or more rooms for residential purposes, other than a room in a hotel ("residences") to —

- (a) limit unwanted solar gains in summer;
- (b) provide an adequate means to remove heat from the indoor environment.

(2) In meeting the obligations in paragraph (1)—

- (a) account must be taken of the safety of any occupant, and their reasonable enjoyment of the residence; and
- (b) mechanical cooling may only be used where insufficient heat is capable of being removed from the indoor environment without it.

Approved Document O further states:

- In the Secretary of State's view, requirement O1(2)(a) is met in a new residential building if the building's overheating mitigation strategy for use by occupants taking account of all of the following.
 - a. Noise at night – paragraphs 3.2 - 3.4.
 - b. Pollution – paragraphs 3.5
 - c. Security – paragraphs 3.6 - 3.7.
 - d. Protection from falling – paragraphs 3.8 - 3.10.
 - e. Protection from entrapment – paragraph 3.11

With regard to noise in dwellings, Section 3 of Approved Document O, 'Ensuring the overheating mitigation strategy is usable', states

3.2 In locations where external noise may be an issue (for example, where the local planning authority considered external noise to be an issue at the planning stage), the overheating mitigation strategy should take account of the likelihood that windows will be closed during sleeping hours (11pm to 7am).

3.3 Windows are likely to be closed during sleeping hours if noise within bedrooms exceeds the following limits.

- a. 40 dB LAeq, T, averaged over 8 hours (between 11pm and 7am).
- b. 55 dB LAFmax, more than 10 times a night (between 11pm and 7am)

3.4 Where in-situ noise measurements are used as evidence that these limits are not exceeded, measurements should be taken in accordance with the Association of Noise Consultants' *Measurement of Sound Levels in Buildings* with the overheating mitigation strategy in use.

NOTE: Guidance on reducing the passage of external noise into buildings can be found in the *National Model Design Code: Part 2 – Guidance Notes* (MHCLG, 2021) and the Association of Noise Consultants' *Acoustics, Ventilation and Overheating: Residential Design Guide* (2020).

It can be seen therefore that Approved Document O, whilst referring to the AVO design guide, only requires that internal noise levels within bedrooms at night achieve certain criteria when combating overheating within dwellings. No requirement for the achievement of daytime internal noise levels within dwellings in the overheating condition is presented in Approved Document O.

CIBSE TECHNICAL MEMORANDUM 59 'DESIGN METHODOLOGY FOR THE ASSESSMENT OF OVERHEATING RISK IN HOMES (TM59)'

CIBSE TM59 provides guidance on the assessment of overheating in dwellings. The document sets out a standardised methodology for predicting temperatures inside dwellings using dynamic thermal modelling and also provides overheating compliance criteria.

Dynamic thermal modelling has been carried out by Futureserv for a number of representative apartments within the proposed development. The detailed output from the modelling studies is provided under separate cover.

The input parameters for the TM59 model include the solar energy transmittance (G value) of the glazing and the MVHR ventilation rate.

In particular, the thermal design of the buildings includes the following measures to mitigate overheating:

Plot D

- 1) Low G value (0.35) of vision glazing to curtain wall to minimize solar heat gain to apartments
- 2) Solid purge vent panels to minimize solar heat gain to apartments
- 3) Blind shading coefficient of 0.28 to minimize solar heat gain to apartments
- 4) Continuously-running whole-house ventilation (MVHR) units with Summer Bypass within each apartment
- 5) Additional mechanical ventilation purge fans where required in living rooms (2 no. apartments per floor)
- 6) Passive ventilative cooling via opening purge vents

Plot C (C7, C8)

- 1) Low G value (0.35) of fixed vision glazing to curtain wall to minimize solar heat gain to apartments
- 2) Low G value (0.18) of glazed purge vent panels to curtain wall to minimize solar heat gain to apartments
- 3) Blind shading coefficient of 0.28 to minimize solar heat gain to apartments
- 4) Continuously-running whole-house ventilation (MVHR) units with Summer Bypass within each apartment
- 5) Additional mechanical ventilation purge fans where required in living rooms (2 no. apartments per floor)
- 6) Passive ventilative cooling via opening purge vents

Plot E (E1, E2)

- 1) Low G value (0.35) of fixed vision glazing to curtain wall to minimize solar heat gain to apartments
- 2) Solid purge vent panels to minimize solar heat gain to apartments
- 3) Blind shading coefficient of 0.28 to minimize solar heat gain to apartments
- 4) Continuously-running whole-house ventilation (MVHR) units with Summer Bypass within each apartment
- 5) Additional mechanical ventilation purge fans where required in living rooms (2 no. apartments per floor)
- 6) Passive ventilative cooling via opening purge vents

For the TM59 model, the opening purge panels to all bedrooms across the development are prevented from opening between 11pm and 8am. Thus if compliance with the bedroom temperature criterion of TM59 is achieved, then the bedroom purge vents can remain closed all night and the internal night time noise criteria of BS8233: 2014 and Manchester City Council guidance can be achieved.

It should be noted that the opening hours of the purge vent are based on the vent opening at an internal temperature of 22 Deg C. It could be considered that the TM59 model represents a worst case in terms of opening hours, as not all occupants may feel the need to open a purge vent at this temperature.

Furthermore, the TM59 modelling results identify the opening hours of the vent on the basis of the vent only closing when the internal temperature has dropped to 22 Deg C.

If the occupant of an apartment chose to close their vent before the internal temperature dropped back to 22 Deg C, it could be the case that the internal temperature would not then rise above the 'fail' temperature criterion of TM59.

Therefore the opening hours of the purge vents identified by the TM59 model are not necessarily the opening hours required to maintain thermal comfort for the occupants. It is expected to be possible to achieve thermal comfort with shorter purge vent opening hours than those determined by the TM59 modelling.

RESULTS OF TM59 MODELLING AND EXPECTED INTERNAL NOISE LEVELS

Night time

The dynamic thermal modelling has determined that the night time temperature criterion of TM59 is achieved without the need to open purge vents to the bedrooms and living rooms of all apartments within the proposed development between 11pm and 8am. Therefore, the internal noise criteria identified in BS8233: 2014 for bedrooms at night time can be achieved whilst avoiding overheating as defined by TM59.

Therefore, the temperature mitigation strategy for the development would be in compliance with Approved Document O and AVO in relation to noise.

Daytime

The TM59 model assumes that the purge vents to bedrooms can be opened as required between 8am and 11pm.

In addition, the TM59 model assumes that the purge vents to living rooms can only be opened as required between 8am and 7pm.

This restriction of purge vent opening times in living rooms is on the assumption that under normal circumstances, the impact of internal noise would be less significant during a normal working day than in the evening. This follows from the acknowledgement in the AVO that the SOAEL is likely to be different at different times of the day.

On this point, the 'Guidelines for Environmental Noise Impact Assessment' published by the Institute of Environmental Management & Assessment (IEMA) in 2014 states

- Time-of-day sensitivity is related to the activity being undertaken by the individual affected by the noise.

It also can be argued that within the 16-hour period, the evening period (19:00–23:00 hours) is relatively more sensitive than the remaining 12-hour period [07:00 – 19:00 hours]. This is also activity-related, since during the evening people are generally at home relaxing, and children will be going to bed during this time.

With reference to the above, it is suggested that the varying sensitivities to noise over the course of the day could be described as follows:

- Daytime noise levels (7am – 7pm): Low sensitivity for both living rooms and bedrooms, due to residents either being out of the home, or generally being more active around the home.
- Evening noise levels (7pm – 11pm): High sensitivity in living rooms, due to the majority of people using this space for relaxation / leisure time. Medium to low sensitivity in bedrooms, as the majority of people will not be asleep during this period.
- Night-time noise levels (11pm – 7am): High sensitivity in bedrooms and low sensitivity in living rooms, due to the majority of residents being asleep during these hours.

The thermal modelling has determined that to achieve compliance with the daytime temperature criterion of TM59, the purge vent doors would need to be open in all apartment rooms across the development for 1 hour per day between May and September. However, as discussed above, the opening hours of the purge vents identified by the TM59 model are not necessarily the opening hours required to maintain thermal comfort for the occupants. It is expected that it would be possible to achieve thermal comfort for some occupants with shorter opening hours.

NB The thermal modelling software only generates results in increments of 1 hour. In addition, all required purge vent opening periods time of 10 minutes to 60 minutes are registered in the output file as 1 hour. Therefore, it is possible that purge vents may only be required to open for 10 minutes per day to control overheating, but the model would register this as requiring the vent to be open for 1 hour.

The results of previous modelling studios indicates that the actual required opening hours of purge vents in May, June and October could be a fraction of the required opening hours of purge vents in July and August.

Given the calculated opening hours of the purge vents (i.e. 1 hour to all rooms, regardless of the time of year) and the daytime external noise levels around the buildings, Tables 8 to 12 identify the calculated internal noise levels within living rooms on a typical lower floor level on each elevation of Towers C7, C8, E1, E2 and D respectively.

Tower C7

Calculated internal noise level within living rooms, LAeq,16h noise levels (daytime)					
Location	May	June	July	August	September
North	36	36	36	36	36
East	40	40	40	40	40
South	47	47	47	47	47
West	47	47	47	47	47

Table 9: Calculated internal noise levels in Tower C7 living rooms given open hours of purge vents**Tower C8**

Calculated internal noise level within living rooms, LAeq,16h noise levels (daytime)					
Location	May	June	July	August	September
North	40	40	40	40	40
East	38	38	38	38	38
South	40	40	40	40	40
West	42	42	42	42	42

Table 10: Calculated internal noise levels in Tower C8 living rooms given open hours of purge vents**Tower E1**

Calculated internal noise level within living rooms, LAeq,16h noise levels (daytime)					
Location	May	June	July	August	September
North	40	40	40	40	40
East	37	37	37	37	37
South	36	36	36	36	36
West	38	38	38	38	38

Table 11: Calculated internal noise levels in Tower E1 living rooms given open hours of purge vents**Tower E2**

Calculated internal noise level within living rooms, LAeq,16h noise levels (daytime)					
Location	May	June	July	August	September
North	33	33	33	33	33
East	38	38	38	38	38
South	41	41	41	41	41
West	41	41	41	41	41

Table 12: Calculated internal noise levels in Tower E2 living rooms given open hours of purge vents

Tower D

Calculated internal noise level within living rooms, LAeq,16h noise levels (daytime)					
Location	May	June	July	August	September
North	40	40	40	40	40
East	50	50	50	50	50
South	54*	54*	54	54	54*
West	49	49	49	49	49

* see discussion below

Table 13: Calculated internal noise levels in Tower D living rooms given open hours of purge vents

It can be seen that in all living rooms on all elevations of each tower, with the exception of living rooms on the south elevation of Tower D, compliance with the suggested upper noise limit within AVO of 50dB LAeq,16h is expected to be achieved.

With regard to Tower D, there are three living rooms per floor on fifteen floors that may not achieve an internal noise level of 50dB LAeq,16h. However, the calculated noise levels are considered to be acceptable for the following reasons:

- The purge vents within living rooms are not required to be opened after 7pm. Thus, with reference to the 'Guidelines for Environmental Noise Impact Assessment' published by the Institute of Environmental Management & Assessment (IEMA) and in particular relation to the low relative sensitivity of occupants to noise before 7pm, a low impact due to the calculated internal noise levels within the affected apartments is expected.
- The calculated noise levels are only expected to occur for perhaps two months of the year (July and August), as the required purge vent opening hours during other months are expected to be significantly less than 1 hour. As discussed above, the limitations of the proprietary thermal modelling software do not allow opening periods of less than 1 hour to be determined.
- In the context of a total of 2388 residential units within the Proposed Development and the associated economic and social benefits of the development, the calculated potential internal noise levels to 45 apartments are considered to be acceptable.
- As noted above, the thermal model assumes that purge vents will be opened when internal temperatures reach 22 Deg C. However, it is expected that not all occupants will feel the need to open the purge vents at this temperature. Therefore, the calculated internal noise level in the living rooms in question may not prevail in practice.

APPENDIX A: NOISE SURVEY DETAILS AND SUMMARY RESULTS**LOCATION**

Plots D, C & E, Great Jackson Street, Manchester

DATES AND TIMES

2:30 pm Friday 16 September 2022 to 3pm on Wednesday 21 September 2022

11pm Thursday 26 September 2022 to 1am of Friday 30 September 2022

WEATHER DURING SURVEYS

Friday 16 September 2022 (Day time)	1/8 cloud, 5m/s breeze (N), no rain, 15°C
Friday 16 September 2022 (Night-time)	Sky Clear, 2m/s breeze (N), no rain, 6°C
Saturday 17 September 2022 (Day time)	1/8 cloud, 12m/s breeze (NW), no rain, 15°C
Saturday 17 September 2022 (Night-time)	5/8 cloud, 4m/s breeze (WNW), no rain, 13°C
Sunday 18 September 2022 (Day time)	7/8 cloud, 12m/s breeze (NNE), light rain, 16°C
Sunday 18 September 2022 (Night-time)	Sky Clear, 2m/s breeze (S), no rain, 15°C
Monday 19 September 2022 (Day time)	2/8, 5m/s breeze (NNE), no rain, 16°C
Monday 19 September 2022 (Night-time)	Sky Clear, 2m/s breeze (northerly), no rain, 15°C
Tuesday 20 September 2022 (Day time)	2/8 cloud, 2m/s wind (N), no rain 17°C
Tuesday 20 September 2022 (Day time)	1/8 cloud, 2m/s wind (N), no rain 13°C
Wednesday 21 September 2022 (Day time)	1/8 cloud, 4m/s wind (S), no rain 17°C
Thursday 29 September 2022 (Night-time)	2/8 cloud, 2 m/s wind (E), no rain, 9°C

PERSONNEL PRESENT DURING SURVEY

Matt Fisher – Fisher Acoustics

INSTRUMENTATION

Norsonic Type 118 IEC 60651 Type 1 Integrating-Averaging Sound Level Meter (serial no. 31498)
Norsonic Type 140 IEC 60651 Type 1 Integrating-Averaging Sound Level Meters (serial no. 1406387)
Norsonic Type 140 IEC 60651 Type 1 Integrating-Averaging Sound Level Meters (serial no. 1403193)
Norsonic Type 1251 IEC 60942-1997 Class 1 Sound Calibrators (x2) (serial nos. 31971, 27878)

MEASUREMENT METHODOLOGY

Before and after the noise survey the sound level meters were check calibrated to an accuracy of ± 0.3 dB using the Norsonic Type 1251 Calibrators - no drift in sensitivity was detected. The measurement microphones were installed at the locations identified in this report. All survey measurements were in 'free field' conditions.

Figures A1 and A2 and Tables A1 to A6 identify the free-field noise levels measured at various locations on the Site. Measurement locations are shown in Figure 5 and described below.

- Location 1: 9m from the kerb of Chester Road adjacent to the junction of Great Jackson Street and Chester Road, at a microphone height of 1.5 metres above site ground level
- Location 2: 3m from the north tower of Deansgate Square residences, at a microphone height of 1.5 metres above site ground level
- Location 3: 3m from the south tower of Deansgate Square residences, at a microphone height of 1.5 metres above site ground level
- Location 4: At location of closest façade of Proposed Development to Great Jackson Street, 1 metre in front of site hoarding), at a microphone height of 1.5 metres above site ground level
- Location 5: 5 metres from the kerb of Great Jackson Street at the proposed location of C8, at a microphone height of 1.5 metres above site ground level
- Location 6: On the roof of the Crown Street marketing suite on Great Jackson Street at a microphone height of 9 metres above site ground level
- Location 7: 16 metres from the closest carriageway of the A57(M) (Mancunian Way) at a microphone height of 13.5 metres above site ground level
- Location 8: On Melbourne Street adjacent to the site boundary of Plot D, at 32 metres from the kerb of Great Jackson Street, at a microphone height of 1.5 metres above site ground level

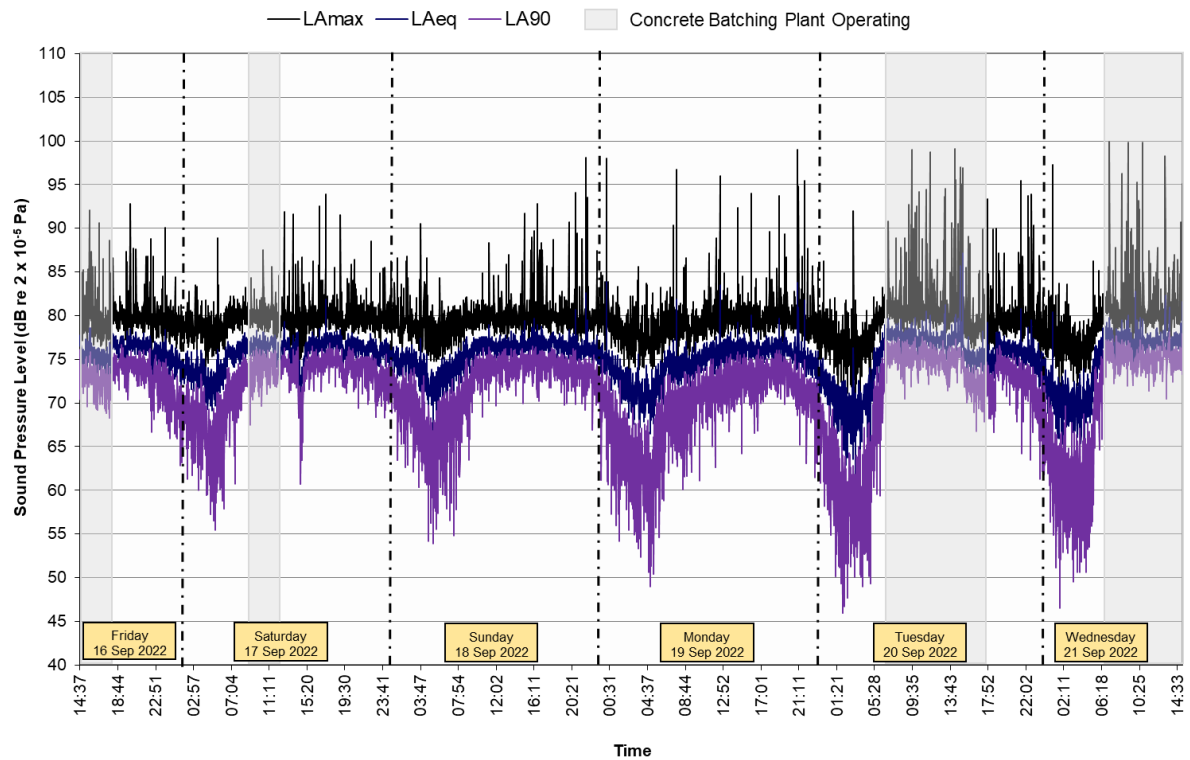


Figure A1: Position 7 noise measurements, Friday 16 September 2022 to Wednesday 21 September 2022 - maximum (LAmx), average (LAeq) and background (LA90) noise levels

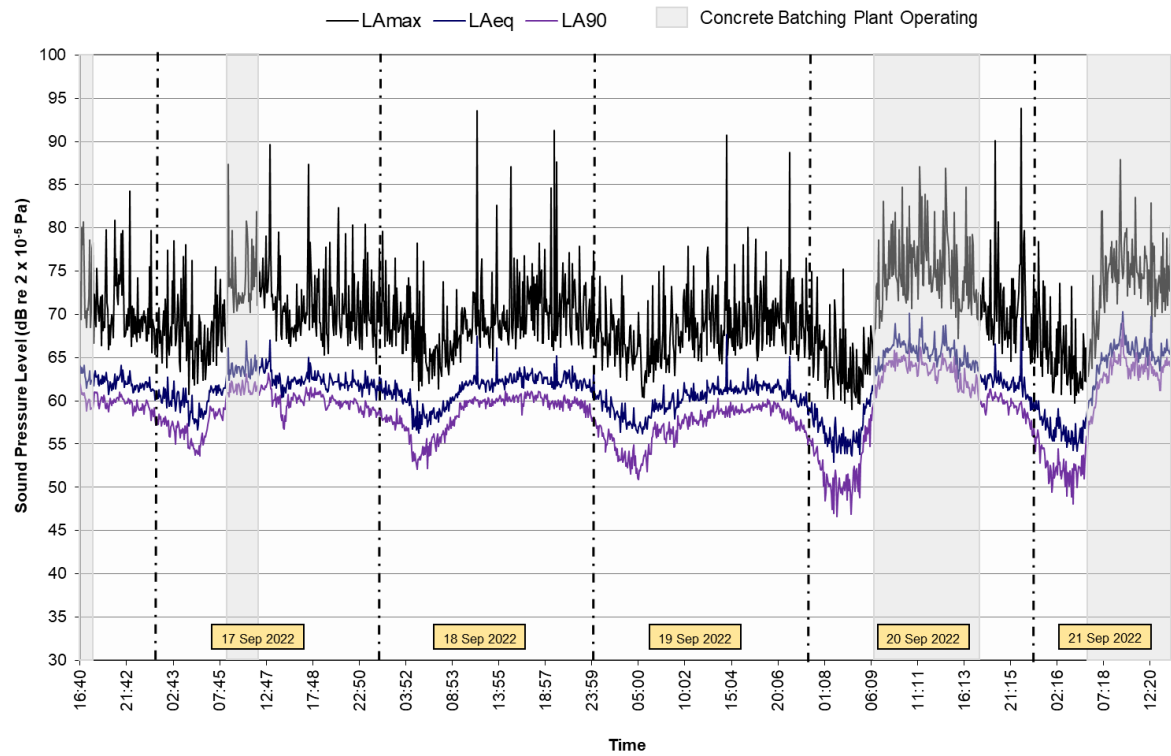


Figure A2: Position 6 noise measurements, Friday 16 September 2022 to Wednesday 21 September 2022 - maximum (LAmx), average (LAeq) and background (LA90) noise levels

Measurement Position	Start Time	Measured Noise Levels, dB			Noise sources
		L _{Aeq}	L _{Amax}	L _{A90}	
1	15:37	70.6	85.4	63.6	Road Traffic
1	15:42	70.7	81.6	61.6	"
1	15:47	70.8	79.1	60.1	"
1	16:25	71.6	80.2	66.1	"
1	16:30	71.3	78.6	64.4	"
1	16:35	71.0	82.5	63.2	"
1	17:09	71.4	80.7	64.2	Chester Rd busy, wind gusts ~68-69dB @63Hz
1	17:14	71.2	81.3	64.2	"
1	17:19	71.3	79.0	65.8	"
1	17:39	72.5	80.6	67.2	Chest Rd busy, but a bit windy
2	15:25	62.7	76.1	57.7	Traffic Noise
2	15:30	59.7	71.7	57.4	"
2	16:13	59.8	71.2	56.8	"
2	16:18	63.6	83.1	57.9	"
2	16:58	61.0	74.2	57.9	background governed by car park extract
2	17:04	58.5	68.0	56.4	"
2	17:33	59.2	69.7	57.2	"
3	15:10	60.9	69.7	58.5	Road Traffic
3	15:15	63.3	83.0	58.8	"
3	16:01	61.8	73.8	59.3	"
3	16:06	62.1	75.0	59.1	"
3	16:43	59.9	77.1	57.6	"
3	16:48	59.9	70.3	57.5	"
3	17:27	61.0	72.7	57.7	63Hz affected by breeze off towers
3	17:30	60.5	61.2	59.9	no wind, just car park extract noise
4	15:19	63.8	77.0	59.1	Road Traffic
4	15:24	61.8	72.7	56.9	"
4	15:45	63.4	73.5	59.6	Still breezy, some noise from Hanson batching plant mainly @2kHz&4kHz
4	15:51	65.7	79.7	59.3	"
5	15:34	60.6	74.0	58.4	63Hz affected by breeze (wind: 68dB @63Hz; no wind ~63dB @63Hz), some noise from C4/C5 site, minor traffic flows on Great Jackson St
5	15:37	62.3	70.4	59.6	"

Table A1: Summary Statistical Noise Levels, Daytime, 16th September 2022

Measurement Position	Start Time	Noise Level, dB LAeq	Sound Pressure Level (dB) @ Octave Band Centre Frequency (Hz)						
			63	125	250	500	1k	2k	4k
1	15:37	70.6	73.0	67.3	67.4	65.1	68.6	60.9	51.4
1	15:42	70.7	70.8	67.1	65.9	65.4	68.8	61.0	50.1
1	15:47	70.8	72.6	66.2	65.7	65.3	69.2	60.6	49.2
1	16:25	71.6	75.0	70.3	67.7	66.4	69.6	61.8	52.4
1	16:30	71.3	73.7	67.5	66.3	65.9	69.5	61.6	51.0
1	16:35	71.0	71.4	68.3	66.5	65.2	69.1	61.4	52.0
1	17:09	71.4	71.6	66.5	66.0	66.1	69.7	61.3	50.8
1	17:14	71.2	70.0	66.8	66.1	65.8	69.5	61.3	50.6
1	17:19	71.3	70.1	66.2	65.8	65.8	69.6	61.2	50.5
1	17:39	72.5	72.2	67.5	67.3	67.2	70.8	62.3	51.1
2	15:25	62.7	65.5	63.2	58.7	58.4	58.2	56.6	48.6
2	15:30	59.7	62.7	61.8	59.5	56.3	56.5	50.0	40.4
2	16:13	59.8	64.9	59.6	57.6	56.2	56.8	50.8	42.8
2	16:18	63.6	70.0	62.9	59.5	57.9	61.4	54.4	47.4
2	16:58	61.0	66.7	60.0	58.8	57.3	57.5	52.5	46.8
2	17:04	58.5	68.2	59.9	57.5	54.8	55.2	48.8	42.4
2	17:33	59.2	63.7	59.0	58.1	56.5	55.9	49.1	41.4
3	15:10	60.9	66.3	60.1	60.1	59.1	56.6	51.6	45.3
3	15:15	63.3	68.8	64.4	62.0	61.6	58.8	53.6	48.8
3	16:01	61.8	68.3	61.3	60.2	59.0	58.6	51.6	44.9
3	16:06	62.1	68.2	61.4	60.1	58.8	58.6	52.4	46.8
3	16:43	59.9	65.3	61.2	59.7	57.5	55.8	50.2	43.3
3	16:48	59.9	67.4	61.1	59.1	57.1	55.8	51.0	45.1
3	17:27	61.0	69.3	62.6	61.2	59.8	55.9	49.9	44.6
3	17:30	60.5	60.4	60.1	61.3	59.1	55.9	49.2	41.4
4	15:19	63.8	72.1	63.3	59.9	59.5	61.3	54.2	46.3
4	15:24	61.8	70.7	62.6	59.0	57.6	59.0	52.7	45.1
4	15:45	63.4	69.4	61.8	61.6	59.0	60.3	54.9	48.9
4	15:51	65.7	72.1	63.6	62.1	60.8	63.1	57.0	50.1
5	15:34	60.6	66.4	58.5	56.5	56.9	57.5	52.6	44.8
5	15:37	62.3	68.0	61.2	59.0	58.0	59.5	53.3	47.0

Table A2: Measured Octave Band L_{eq} Noise Levels, Daytime, 16th September 2022

Measurement Position	Start Time	Measured Noise Levels, dB			Noise sources
		L _{Aeq}	L _{Amax}	L _{A90}	
1	23:19	67.7	75.0	62.4	Road Traffic Noise from Chester Road
1	23:21	69.6	75.5	58.1	"
1	23:22	68.5	76.2	57.7	"
1	23:23	68.2	73.9	59.0	"
1	23:24	70.6	76.9	62.6	"
1	23:25	70.9	78.8	60.7	"
1	23:26	70.6	76.8	60.3	"
1	23:27	70.3	77.6	63.6	"
1	23:28	66.2	74.6	55.2	"
1	23:29	70.9	77.9	60.3	"
1	23:48	67.3	74.5	59.3	"
1	23:49	69.8	77.4	60.8	"
1	23:51	68.2	74.3	55.3	"
1	23:52	69.0	76.1	62.0	"
1	23:53	69.5	79.4	60.3	"
1	23:54	68.4	76.0	57.1	"
1	23:55	65.5	73.7	57.3	"
1	23:56	70.6	78.3	59.5	"
1	23:57	70.8	78.3	60.5	"
1	23:58	69.9	83.2	58.3	"
1	00:13	70.6	77.8	60.7	"
1	00:14	69.4	77.3	62.2	"
1	00:15	66.8	75.9	55.4	"
1	00:16	70.1	78.2	58.6	"
1	00:17	70.9	76.3	65.1	"
1	00:18	70.1	83.5	55.4	"
1	00:19	70.0	76.4	62.5	"
1	00:20	68.5	78.8	57.3	"
1	00:21	70.5	78.3	62.5	"
1	00:23	68.1	74.5	63.3	"
1	00:24	67.7	75.5	53.4	"
1	00:25	69.6	76.3	56.6	"
1	00:26	72.7	80.1	61.8	"
1	00:28	66.0	76.6	54.3	"
1	00:29	70.0	78.0	63.7	"
1	00:30	69.8	76.3	61.3	"
1	00:31	68.9	77.6	59.2	"
1	00:32	70.0	77.8	61.4	"
1	00:33	69.6	77.6	52.3	"
1	00:34	67.5	75.9	59.2	"
1	00:35	67.9	76.8	58.4	"
1	00:36	68.2	79.3	55.0	"
1	00:37	68.0	77.7	58.3	"
1	00:40	70.6	80.8	58.6	"
1	00:59	112.3	117.9	52.8	"
1	00:59	54.4	61.1	51.5	"
1	01:00	56.7	65.7	52.9	"

Measurement Position	Start Time	Measured Noise Levels, dB			Noise sources
		L _{Aeq}	L _{Amax}	L _{A90}	
1	01:02	56.2	63.2	52.0	"
1	01:04	53.7	62.6	50.2	"
1	01:06	53.0	63.5	49.5	"
1	01:07	52.3	58.5	47.9	"

Table A3: Summary Statistical Noise Levels, Night-time, 30th September 2022

Measurement Position	Start Time	Noise Level, dB LAeq	Sound Pressure Level (dB) @ Octave Band Centre Frequency (Hz)						
			63	125	250	500	1k	2k	4k
1	23:19	67.7	65.1	62.4	63.3	61.8	66.0	58.2	46.4
1	23:21	69.6	67.7	66.0	65.2	63.8	67.9	59.8	48.1
1	23:22	68.5	66.8	62.5	62.4	62.0	66.8	59.4	48.0
1	23:23	68.2	61.4	60.6	62.8	61.8	66.7	58.7	45.3
1	23:24	70.6	68.0	64.4	66.4	64.4	68.9	61.1	49.4
1	23:25	70.9	67.9	64.1	65.5	64.5	69.3	61.7	49.6
1	23:26	70.6	70.5	67.7	65.9	64.5	68.8	61.1	49.2
1	23:27	70.3	67.0	63.4	65.2	64.0	68.8	60.4	47.8
1	23:28	66.2	63.8	62.0	62.2	60.7	64.5	56.1	45.1
1	23:29	70.9	68.5	65.2	66.0	64.6	69.2	61.8	49.7
1	23:48	67.3	67.1	64.1	63.2	61.8	65.4	57.6	46.7
1	23:49	69.8	67.1	62.7	64.1	64.2	67.9	61.1	50.7
1	23:51	68.2	66.2	65.1	63.0	62.3	66.3	59.3	49.1
1	23:52	69.0	63.3	60.5	63.0	62.8	67.3	60.0	46.7
1	23:53	69.5	66.0	61.7	62.5	62.6	67.7	60.9	48.7
1	23:54	68.4	63.7	61.7	62.7	62.0	66.8	59.1	46.7
1	23:55	65.5	63.7	59.9	60.1	59.5	63.7	56.0	45.4
1	23:56	70.6	66.6	64.2	65.5	64.7	69.0	60.8	48.8
1	23:57	70.8	69.6	65.9	65.7	64.8	69.1	61.1	49.1
1	23:58	69.9	69.3	65.9	64.2	66.5	67.6	60.3	48.2
1	00:13	70.6	67.5	64.6	64.7	64.8	68.7	62.1	49.9
1	00:14	69.4	70.7	65.7	64.9	64.2	67.3	60.4	50.1
1	00:15	66.8	64.2	61.6	62.0	61.1	65.0	57.4	45.8
1	00:16	70.1	66.3	63.4	63.3	64.0	68.3	61.2	49.9
1	00:17	70.9	64.9	61.8	64.2	64.9	69.1	62.2	49.0
1	00:18	70.1	66.7	65.6	64.6	65.8	67.7	61.5	52.7
1	00:19	70.0	70.4	65.3	65.0	64.3	67.9	61.2	50.3
1	00:20	68.5	64.2	60.7	62.2	62.3	66.7	59.9	47.3
1	00:21	70.5	71.4	67.3	65.7	67.1	68.0	60.5	50.9
1	00:23	68.1	63.9	61.0	62.3	61.9	66.2	59.6	47.3
1	00:24	67.7	60.7	59.7	61.9	61.3	66.0	59.1	46.7
1	00:25	69.6	68.2	61.3	63.2	63.3	67.7	61.5	49.7
1	00:26	72.7	68.3	63.7	66.1	65.9	71.0	63.9	51.1
1	00:28	66.0	60.7	57.8	59.3	60.1	64.0	57.7	45.4
1	00:29	70.0	67.6	65.3	65.8	66.7	67.6	59.9	50.2
1	00:30	69.8	67.6	61.6	63.6	64.6	68.1	60.6	48.6
1	00:31	68.9	65.2	62.9	62.9	63.0	67.2	59.6	47.7
1	00:32	70.0	62.9	62.1	63.5	63.7	68.1	61.2	51.9
1	00:33	69.6	62.1	60.8	62.8	63.2	67.8	60.9	47.5
1	00:34	67.5	69.9	64.6	63.1	62.8	65.3	58.3	49.6
1	00:35	67.9	61.9	59.4	61.1	61.4	66.2	59.3	46.2
1	00:36	68.2	62.7	59.0	61.1	61.8	66.6	59.0	46.3
1	00:37	68.0	64.8	62.7	66.5	64.1	65.9	57.3	45.1
1	00:40	70.6	63.7	63.2	64.2	64.5	68.9	61.7	49.4
1	00:59	112.3	-	-	-	-	-	-	-

Measurement Position	Start Time	Noise Level, dB LAeq	Sound Pressure Level (dB) @ Octave Band Centre Frequency (Hz)						
			63	125	250	500	1k	2k	4k
1	00:59	54.4	-	-	-	-	-	-	-
1	01:00	56.7	-	-	-	-	-	-	-
1	01:02	56.2	-	-	-	-	-	-	-
1	01:04	53.7	-	-	-	-	-	-	-
1	01:06	53.0	-	-	-	-	-	-	-
1	01:07	52.3	-	-	-	-	-	-	-

Table A4: Measured Octave Band L_{eq} Noise Levels, Night-time, 30th September 2022

Measurement Position	Start Time	Measured Noise Levels, dB			Noise sources
		L _{Aeq}	L _{Amax}	L _{A90}	
2	23:12	59.1	73.3	56.8	Road Traffic
2	23:40	59.7	76.9	56.6	"
2	00:10	57.7	64.6	56.2	"
2	00:25	57.4	67.6	55.3	"
3	22:54	61.2	75.0	57.8	"
3	23:00	59.7	70.1	57.8	"
3	23:34	61.8	77.8	58.7	"
3	00:03	60.0	74.7	57.8	"
3	00:17	58.0	70.2	56.3	"
4	22:55	58.5	70.0	54.6	"
4	22:56	59.5	69.6	54.7	"
4	22:57	58.5	71.4	52.3	"
4	22:58	58.6	70.1	53.9	"
4	22:59	63.2	81.0	52.5	"
4	23:00	53.6	56.3	52.5	"
4	23:01	57.6	68.6	53.2	"
4	23:02	54.5	61.8	51.7	"
4	23:03	59.2	70.1	52.8	"
4	23:04	61.5	73.8	53.0	"
4	23:05	57.1	67.9	51.9	"
4	23:33	61.0	71.4	53.1	"
4	23:34	56.0	61.2	53.3	"
4	23:35	59.0	69.7	53.3	"
4	23:36	56.8	67.0	53.5	"
4	23:37	54.0	57.0	52.1	"
4	23:38	58.7	68.6	54.8	"
4	23:39	55.0	57.9	53.4	"
4	23:40	57.5	66.1	54.1	"
4	23:41	54.9	56.8	54.0	"
4	23:42	57.4	67.7	52.9	"
4	23:58	54.0	57.8	51.6	"
4	23:59	56.1	65.0	50.6	"
4	00:00	53.4	56.4	50.4	"
4	00:01	55.6	64.7	51.8	"
4	00:02	55.3	63.9	53.1	"
4	00:03	52.5	57.1	50.6	"
5	23:09	63.1	76.3	53.8	"
5	23:10	57.6	61.3	56.2	"
5	23:11	62.5	73.7	56.3	"
5	23:12	59.7	70.0	56.8	"
5	23:13	60.5	70.8	57.3	"
5	23:14	58.1	63.7	55.9	"
5	23:15	62.1	73.6	56.5	"
5	23:16	57.5	61.0	55.9	"
5	23:17	58.0	60.8	56.7	"
5	23:18	58.8	64.2	56.6	"
5	23:45	59.3	68.0	55.5	"

Measurement Position	Start Time	Measured Noise Levels, dB			Noise sources
		L _{Aeq}	L _{Amax}	L _{A90}	
5	23:46	60.9	76.4	55.1	"
5	23:47	59.3	68.6	56.0	"
5	23:48	61.7	72.6	56.4	"
5	23:49	56.6	61.6	53.4	"
5	23:50	59.4	67.0	55.7	"
5	23:51	56.2	61.8	54.2	"
5	23:52	57.2	62.0	54.5	"
5	23:53	62.1	70.5	56.0	"
5	23:54	56.6	61.7	53.6	"
5	23:55	59.0	67.8	55.6	"
5	00:06	63.1	73.9	56.9	"
5	00:07	61.2	69.8	56.9	"
5	00:08	57.7	66.5	53.5	"
5	00:09	63.7	74.5	56.1	"
5	00:10	61.4	72.8	53.7	"
5	00:11	58.1	66.3	55.7	"
8	23:20	60.8	66.2	56.3	"
8	23:21	61.6	65.5	60.3	"
8	23:22	61.2	66.5	59.3	"
8	23:23	61.2	65.5	59.0	"
8	23:24	61.0	65.7	59.5	"
8	23:25	62.0	64.0	60.5	"
8	23:26	60.9	63.0	59.1	"
8	23:27	60.9	66.4	58.6	"
8	23:28	60.3	62.5	59.1	"
8	23:30	60.2	62.4	59.1	"
8	23:31	60.5	63.8	59.5	"

Table A5: Summary Statistical Noise Levels, Night-time, 30th September 2022

Measurement Position	Start Time	Noise Level, dB LAeq	Sound Pressure Level (dB) @ Octave Band Centre Frequency (Hz)						
			63	125	250	500	1k	2k	4k
2	23:12	59.1	64.2	59.5	58.6	55.6	55.7	49.5	43.0
2	23:40	59.7	66.1	61.6	62.3	56.7	55.1	48.7	42.4
2	00:10	57.7	61.4	57.2	57.1	55.2	54.0	48.0	40.3
2	00:25	57.4	61.8	57.6	57.4	54.9	53.6	47.5	39.8
3	23:00	59.7	65.6	60.4	59.3	58.1	56.9	52.9	48.2
3	23:34	61.8	62.6	58.4	59.1	57.3	55.6	50.5	44.2
3	00:03	60.0	66.6	61.5	60.7	58.9	57.8	53.4	46.3
3	00:17	58.0	70.8	61.3	62.2	57.4	55.6	49.8	41.7
4	22:55	58.5	60.1	53.8	53.8	52.6	56.0	50.7	42.5
4	22:56	59.5	61.2	56.6	55.0	53.6	57.1	51.5	41.0
4	22:57	58.5	59.2	55.6	53.9	52.2	56.2	50.3	40.5
4	22:58	58.6	62.1	55.3	54.1	52.8	56.2	50.6	40.8
4	22:59	63.2	58.8	54.3	63.9	62.0	58.1	51.2	40.7
4	23:00	53.6	53.4	46.7	47.1	47.0	51.8	44.6	33.3
4	23:01	57.6	58.0	50.7	51.7	51.4	55.3	49.9	38.3
4	23:02	54.5	57.9	51.7	49.1	48.5	52.5	45.9	35.6
4	23:03	59.2	56.6	55.7	56.3	53.9	56.6	51.2	39.6
4	23:04	61.5	57.6	53.6	55.6	54.9	59.3	54.1	41.8
4	23:05	57.1	56.1	49.5	50.4	50.1	55.4	48.4	34.9
4	23:33	61.0	58.8	54.1	56.7	54.8	59.2	52.1	41.3
4	23:34	56.0	57.7	51.3	50.3	49.4	54.1	47.4	39.7
4	23:35	59.0	57.0	53.0	55.0	52.5	56.7	51.1	39.1
4	23:36	56.8	56.0	53.6	52.4	51.2	54.7	48.2	35.1
4	23:37	54.0	54.4	48.1	48.2	48.1	52.4	44.1	29.6
4	23:38	58.7	57.3	52.9	52.9	53.0	56.9	49.9	38.2
4	23:39	55.0	57.6	53.2	48.7	48.2	53.4	45.8	33.5
4	23:40	57.5	57.5	52.2	53.2	51.6	55.3	49.2	39.0
4	23:41	54.9	57.5	50.9	49.6	48.9	53.2	45.5	32.0
4	23:42	57.4	56.3	52.1	53.3	51.6	55.5	48.3	37.5
4	23:58	54.0	54.5	47.2	47.2	47.5	52.4	44.8	32.8
4	23:59	56.1	55.4	53.0	52.7	50.4	54.0	47.5	34.3
4	00:00	53.4	54.6	47.1	46.9	47.0	51.9	43.7	30.5
4	00:01	55.6	54.9	50.0	50.7	49.9	53.8	46.2	34.4
4	00:02	55.3	56.0	51.7	50.4	49.3	53.3	46.6	35.6
4	00:03	52.5	54.0	46.3	46.4	45.9	51.0	43.1	30.5
5	23:09	63.1	57.9	61.4	58.3	59.7	60.8	52.7	44.4
5	23:10	57.6	59.5	51.1	50.9	51.7	56.2	47.3	32.6
5	23:11	62.5	62.8	57.8	58.9	56.6	60.4	53.7	42.2
5	23:12	59.7	63.7	55.9	54.0	54.3	57.9	50.1	39.0
5	23:13	60.5	70.9	62.9	57.8	54.7	57.9	51.3	43.4
5	23:14	58.1	57.7	50.3	51.3	52.7	56.6	48.0	33.6
5	23:15	62.1	58.7	55.1	55.5	56.4	60.3	53.5	41.9
5	23:16	57.5	56.8	50.9	51.6	51.4	56.0	47.5	33.6
5	23:17	58.0	56.0	51.2	52.3	52.3	56.5	47.9	34.6
5	23:18	58.8	57.8	56.2	56.2	52.8	57.1	48.3	34.6

Measurement Position	Start Time	Noise Level, dB LAeq	Sound Pressure Level (dB) @ Octave Band Centre Frequency (Hz)						
			63	125	250	500	1k	2k	4k
5	23:45	59.3	60.0	53.4	54.1	55.3	57.2	49.6	40.4
5	23:46	60.9	58.5	54.3	54.1	55.6	58.8	52.7	41.6
5	23:47	59.3	62.0	58.7	54.5	54.0	57.1	50.5	42.1
5	23:48	61.7	61.1	55.6	56.2	55.3	59.7	53.5	42.2
5	23:49	56.6	56.3	49.7	49.9	51.1	55.1	46.6	34.5
5	23:50	59.4	59.6	55.5	55.0	54.1	57.5	50.2	39.6
5	23:51	56.2	57.5	50.4	49.1	50.2	54.6	46.8	35.7
5	23:52	57.2	55.7	50.3	50.6	51.5	55.6	47.7	34.8
5	23:53	62.1	63.9	57.9	57.4	57.0	59.9	53.7	42.4
5	23:54	56.6	55.7	50.2	50.3	50.9	55.1	46.6	32.5
5	23:55	59.0	58.6	55.4	54.4	53.4	57.1	49.6	37.9
5	00:06	63.1	62.1	59.8	59.6	57.9	60.8	54.7	43.4
5	00:07	61.2	63.2	60.0	58.8	56.2	59.0	51.8	41.9
5	00:08	57.7	59.3	53.1	53.1	51.7	55.7	48.5	38.1
5	00:09	63.7	62.6	64.2	63.0	59.0	60.8	54.4	44.7
5	00:10	61.4	66.4	60.1	58.2	56.7	58.4	52.8	47.2
5	00:11	58.1	68.1	57.7	55.8	53.6	55.7	47.9	38.1
8	23:20	60.8	60.0	54.4	55.3	54.4	58.8	52.5	39.7
8	23:21	61.6	60.3	55.1	54.6	54.7	59.8	53.3	41.0
8	23:22	61.2	61.9	54.1	54.7	54.5	59.4	52.7	40.0
8	23:23	61.2	63.5	55.2	55.2	54.0	59.1	53.7	43.5
8	23:24	61.0	63.7	55.7	56.1	54.5	59.1	52.5	40.1
8	23:25	62.0	67.4	56.8	58.1	55.9	59.9	53.3	40.7
8	23:26	60.9	60.2	53.3	53.7	53.7	59.1	52.6	39.6
8	23:27	60.9	60.6	54.6	54.8	55.6	58.9	52.2	40.4
8	23:28	60.3	62.1	53.0	53.5	54.7	58.3	51.7	39.3
8	23:30	60.2	61.0	53.3	53.9	54.4	58.3	51.8	39.0
8	23:31	60.5	59.3	53.2	54.1	54.9	58.5	51.9	39.8

Table A6: Measured Octave Band L_{eq} Noise Levels, Night-time, 30th September 2022

APPENDIX B: RELAXATION OF INTERNAL NOISE CRITERION

INTRODUCTION

The same relaxation of internal noise levels that was granted on Crown Street, Phase 1 and Phase 2 is requested, where due to elevated road traffic noise levels from the Mancunian Way, an increase in the daytime living room noise threshold was granted by Manchester City Council such that secondary glazing could be avoided whilst maintaining an appropriate acoustic standard within apartments in accordance with BS8233; 2014 'Guidance on sound insulation and noise reduction for buildings'.

This report sets out the justification for seeking a similar dispensation for Crown Street, Phase 3/Great Jackson Street Plot D.

1. MANCHESTER CITY COUNCIL PUBLISHED GUIDANCE

'Planning & Noise, Technical Guidance', dated June 2022 has been issued by the Environmental Protection, Environmental Health and The Neighbourhoods Service sections of Manchester City Council. The document provides guidance to applicants and consultants concerning the assessment and prediction of environmental noise associated with a particular development. Reference is also made in the document to the relevant supporting information and guidance documents that Developers are expected to refer to when submitting a planning application.

'Planning & Noise, Technical Guidance' refers to the following guidance documents:

- BS 8233 (2014) Guidance on sound insulation and noise reduction for buildings
- WHO (1999) Guidelines for Community Noise.

Section 3.6 'National & International Standards' of 'Planning & Noise, Technical Guidance', references both BS8233: 2014 and WHO 'Guidelines for Community Noise' 1999, but advises that 5dB relaxations of the internal noise criteria in these documents should not be assumed. The document states that 'Manchester City Council has adopted the following internal noise limits for residential properties':

- | | | |
|-----------------|----------------------------|---|
| ▪ Living Rooms: | Daytime (0700-2300 hrs) | 35dB LAeq |
| ▪ Bedrooms: | Night time (2300-0700 hrs) | 30dB LAeq, 45dB LMax |
| | | (ten excesses over 45dB LMax allowed per night) |

2. BRITISH STANDARDS GUIDANCE

BS8233: 2014 'Guidance on sound insulation and noise reduction for buildings' provides appropriate criteria for acceptable levels of noise ingress within dwellings.

In particular, section 7.2.2 'Internal ambient noise levels in dwellings' of BS8233: 2014 states that 'In general, for steady external noise sources, it is desirable that the internal ambient noise level does not exceed the guideline values in Table 4'. Table B1 identifies the guideline 'desirable' values.

BS8233: 2014 – Desirable Indoor ambient noise levels for dwellings			
Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35 dB LAeq, 16 hours	-
Dining	Dining room / area	40 dB LAeq, 16 hours	-
Sleeping (daytime resting)	Bedroom	35 dB LAeq, 16 hours	30 dB LAeq, 8 hours

Table B14: BS8233: 2014 intrusive noise criteria

Note 7 of section 7.2.2 of BS8233: 2014 states that: 'Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed up to 5 dB and reasonable internal conditions still achieved'.

Noise levels at the proposed Development are above the WHO (World Health Organisation) external noise guideline levels and therefore BS8233: 2014 would recommend that the maximum daytime intrusive noise level within the habitable rooms of the Development does not exceed 40 dB LAeq,(16 hours), with a corresponding night time intrusive noise limit within bedrooms of 35 dB LAeq,(8 hours) to achieve reasonable conditions. Additionally, the recommended daytime intrusive noise level within bedrooms of the development is 40 dB LAeq,(16 hours).

Table B2 identifies the guideline 'reasonable' values of BS8233: 2014.

BS8233: 2014 – Reasonable Indoor ambient noise levels for dwellings			
Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	40 dB LAeq, 16 hours	-
Sleeping (daytime resting)	Bedroom	40 dB LAeq, 16 hours	35 dB LAeq, 8 hours

Table B15: BS8233: 2014 intrusive noise criteria

3. THE CROWN STREET PHASE 3/GREAT JACKSON STREET PLOT D DEVELOPMENT SITE

Great Jackson Street Plot D development includes a residential tower located on a site directly to the north of the A57(M) 'Mancunian Way'. The southern facades of the development are immediately adjacent to the A57(M) and are thus exposed to relatively high levels of traffic noise. Figures 1 and 2 in the main body of this report show the location of the site.

Figure B1 below shows a typical residential floor layout.

4. EXTERNAL NOISE LEVELS

The prevailing noise levels at the proposed site have been measured by Fisher Acoustics at the southern perimeter of the site at a position representative of the closest proposed façade to the Mancunian Way (A57(M)). Continuous unattended noise measurements were taken over a five-day period between Friday 16 September 2022 and Wednesday 21 September 2022.

Figure 5 in the main body of this report identifies the location of the noise survey measurement position representative of Plot D (position 7). The measurement microphone was mounted at a height of 13.5 metres above street level to ensure line of sight to both carriageways of the A57(M).

The noise levels measured during the noise survey at position 7 are summarised in Table B3.

Measurement Location	Measured Noise Levels			
	Daytime (Defined as 7 am to 11 pm)		Night time (Defined as 11 pm to 7 am)	
	dB, LAeq, 16 hrs	dB, LAmax	dB, LAeq, 8 hrs	dB, LAmax
7	77	76 to 100	73	72 to 97

Table B16: Summary of measured environmental noise levels

The quoted average (L_{Aeq}) noise levels are the average noise levels measured over the full measurement periods in question at each measurement position. The quoted L_{Amax} noise levels show the range of noise levels measured over the sample periods.

5. EXTERNAL NOISE BREAK-IN TO APARTMENTS

Fisher Acoustics has used the measured external noise survey data to calculate the required sound insulation performance of façade elements to achieve the internal noise criteria within apartment rooms due to external noise. The calculations are based on the 'more rigorous' calculation method identified in Annex G.2.1 of BS8233:2014 'Guidance on sound insulation and noise reduction for buildings'.

The calculations take into account the measured levels of noise at the site, the areas of individual façade elements, (eg glazing, curtain wall framing and openable purge vent panels) and the expected reverberation time of the apartment rooms.

The proposed curtain wall to the apartments that are most exposed to road traffic noise includes triple glazing that incorporates acoustically laminated panes and frame sections with acoustic infills to minimise external noise intrusion.

The noise break-in calculations have determined that due to the high levels of traffic noise at the site, it is not expected to be possible in all apartments on the south elevation of the building to achieve the BS8233 'desirable' internal noise criteria and Manchester City Council requirements of 35 dB $L_{Aeq,16\text{ hrs}}$ within living rooms and 30 dB $L_{Aeq,8\text{ hrs}}$ within bedrooms during the night. In particular the calculated worst-case internal noise levels exceed the criteria by up to 2dB. In bedrooms on the lowest levels of the south elevation, an internal noise level of 31.5 dB $L_{Aeq,8\text{ hrs}}$ has been calculated for a Saturday night. During a weekday, the calculated night time noise level in these bedrooms is 30.5 dB $L_{Aeq,8\text{ hrs}}$.

However, compliance with the criterion of Manchester City Council relating to maximum noise events in bedrooms is expected to be achieved, with six calculated exceedances over 45dB LA_{max} over the course of a Saturday night (11pm to 7am) and no internal noise level greater than 50dB LA_{max}.

It has been determined that the achievement of a daytime internal noise level of 35 dB LA_{eq,16 hrs} and a night time internal noise level of 30 dB LA_{eq,8 hrs} would require the installation of secondary glazing to all vision areas of the curtain wall on the south elevation up to Level 15 of the building. Due to the influence of other elements of the curtain wall, the acoustic performance of which has been maximized as far as practicable, the expected reduction in internal noise levels achieved by the introduction of secondary glazing is only 2dB. A reduction in noise of 2dB is generally accepted to be not discernible 'in the field'. The loss of internal floor space and the added use of materials is not therefore considered to be appropriate in terms of residential amenity.

It is therefore recommended that a relaxation of the internal ambient noise criteria required by Manchester City Council for living rooms and bedrooms is sought, such that 'reasonable internal conditions' are achieved, in line with Note 7 to Table 4 of BS8233 (as described above). In particular, relaxations of the daytime internal noise criterion to 40dB LA_{eq,16 hrs} and the night time internal noise criterion to 35dB LA_{eq,8 hrs} are suggested.

6. BENEFITS OF A RELAXATION IN INTERNAL NOISE CRITERIA

The following potential benefits of a relaxation in the internal noise criteria have been identified.

- If secondary glazing units are required to achieve the internal noise criterion to living rooms, the visual appearance of the façade will be affected. The differing glass build-ups across the facades is expected to lead to a 'patchwork' glass colour and reflectivity. A relaxation of the internal noise criterion for living rooms could therefore reduce adverse impact on the building aesthetic.
- The height of the vision panels within apartments (2.85 m) is such that an additional horizontal frame section at a height of approximately 2.1 m would need to be introduced to any secondary glazing in order to allow units to be manoeuvred into the apartments (in the event that the secondary glazing units need to be replaced, e.g. due to breakage). This would have a significant adverse impact on the building aesthetic.
- Secondary glazing would reduce the internal floor space. The secondary glazing would occupy a zone of approximately 200 mm in front of the curtain wall. In living rooms at the corners of the building, the loss in floor area would be approximately 1 m².

