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Trinity Islands, Manchester

Environmental Noise & Vibration Study

November 2021

Report Reference: PR0661-REP01-MPF

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PROJECT TITLE TRINITY ISLANDS, MANCHESTER

REPORT TITLE ENVIRONMENTAL NOISE & VIBRATION STUDY

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REPORT REFERENCE PR0657-REP05-MPF

DATE 23 NOVEMBER 2021

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DOCUMENT HISTORY

FIRST ISSUE 23 NOVEMBER 2021

CONTENTS

1.0	SUMMARY	3
2.0	INTRODUCTION	4
3.0	DESCRIPTION OF SITE	5
4.0	DESCRIPTION OF PROPOSED DEVELOPMENT	7
5.0	RELEVANT GUIDANCE DOCUMENTS	8
6.0	ENVIRONMENTAL NOISE SURVEY	14
7.0	NOISE INGRESS	19
8.0	EXTERNAL NOISE LEVELS DUE TO BUILDING SERVICES	25
9.0	NOISE EGRESS FROM COMMERCIAL UNITS	27
10.0	TRAIN VIBRATION	30
Table 1: Intrusive noise criteria		10
Table 2: Summary of measured environmental noise levels		16
Table 3: Minimum Recommended Sound Reduction Index of facade		20
Table 4: Environmental noise limits for non-emergency building services plant		25
Table 5: Environmental noise limits for emergency building services plant		26
Table 6: Maximum allowable external music noise levels due to proposed commercial units		28
Table 7: Maximum recommended noise levels in apartments due to music replay in amenity areas		29
Table 8: Vibration Dose Value ranges which might result in various probabilities of adverse comment within residential buildings		30
Figure 1: Site location plan		6
Figure 2: Site layout plan		7
Figure 3: Nearest noise sensitive residential premises to Plots C and D		12
Figure 4: Noise survey measurement locations		15
Figure 5: 3D model of development proposals & predicted incident noise levels		17
Figure 6: Summary external daytime noise levels incident on each façade (dB LAeq)		18
Figure 7: Acoustic specification location plan, Level 03 to Level 15 - Living Rooms & Bedrooms		21
Figure 8: Acoustic specification location plan, Level 16 to Level 30 - Living Rooms & Bedrooms		22
Figure 9: Acoustic specification location plan, Level 31 to roof - Living Rooms & Bedrooms		23
Figure 10: Vibration survey measurement location		31
Figure 11: Position 1 noise measurements, Thursday 26 August 2021 to Friday 27 August 2021 - maximum (L _{Amax}), average (L _{Aeq}) and background (L _{A90}) noise levels		34



Figure 12: Position 4 noise measurements, Thursday 26 August 2021 to Friday 27 August 2021 - maximum (L _{Amax}), average (L _{Aeq}) and background (L _{A90}) noise levels	35
Figure 13: Position 5 noise measurements, Thursday 26 August 2021 to Friday 27 August 2021 - maximum (L _{Amax}), average (L _{Aeq}) and background (L _{A90}) noise levels	36

1.0 SUMMARY

Fisher Acoustics Ltd has been commissioned by Renaker Build to conduct an environmental noise study relating to a proposed residential development at Trinity Islands, Trinity Way, Manchester.

An assessment of environmental noise around the proposed site has 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 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. The study is presented under separate cover.

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.

As assessment of groundborne vibration due to train movements on the rail viaduct that lies on the eastern perimeter of the site indicates that no mitigation measures are required to maintain residential amenity in relation to structureborne noise and vibration.

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 Trinity Island, Trinity Way, Manchester. The proposals provide for a new residential development of four towers ranging from thirty-eight to fifty-seven storeys. The development will provide approximately one thousand nine hundred and fifty residential units with commercial units at ground floor, internal residential amenity uses, private car parking within a multi-storey basement and cycle parking facilities.

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.

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 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
- Measurement of groundborne vibration levels due to train movements in order to assess 'feelable' vibration and to calculate structureborne noise levels in apartments

3.0 DESCRIPTION OF SITE

General Site Description

The site lies to the on the western periphery of Manchester's central business district and is comprised of two plots, Plot C and Plot D which are divided by Trinity Way (A6042).

The westernmost plot is named Plot D and is bounded to the north and west by the River Irwell, to the east by Trinity Way and to the south by Regent Road. Plot C is bounded to the north by the River Irwell, to the east by the Castlefield Railway viaduct, to the west by Trinity Way and to the south by Water Street.

The existing buildings around the site include residential buildings, a hotel and commercial buildings.

The site currently comprises two surface car parks, one of which is currently not in use.

Regent Road and Trinity Way are principal roads that are heavily trafficked. Water Street is an access road into the city centre which is relatively lightly trafficked.

The viaduct to the east of the proposed site carries main line railway traffic to the north and west of Manchester, including passenger and freight traffic. The Ordsall Chord rail bridge lies further to the east of the site.

Figure 1 shows the Trinity Island site in the context of the surrounding roads and buildings.

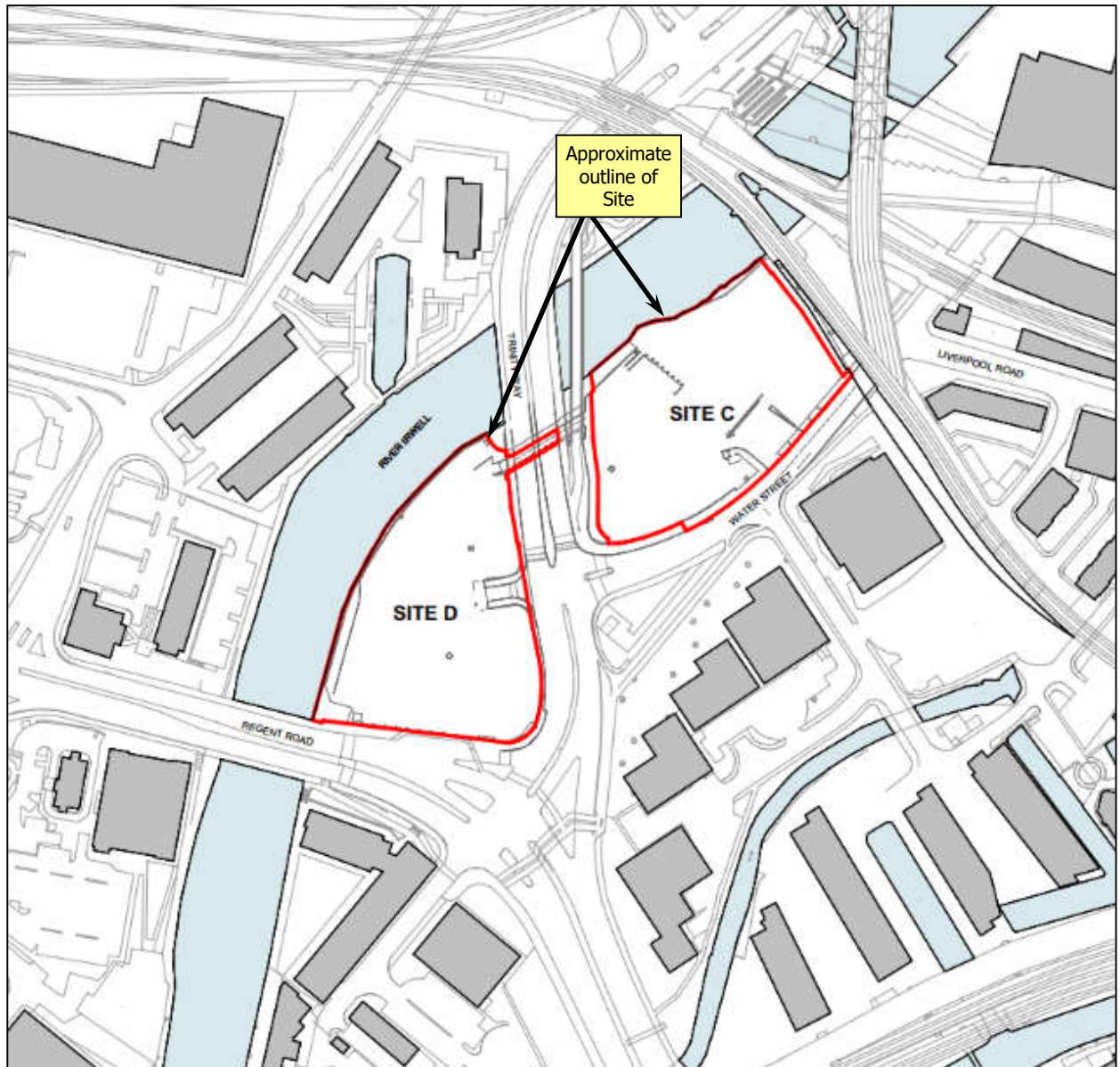


Figure 1: Site location plan

4.0 DESCRIPTION OF PROPOSED DEVELOPMENT

The development proposals are for the erection of four storey residential towers comprising a total of 1950 apartments (Use Class C3) and internal residential amenity uses, private car parking within a multi-storey basement and cycle parking facilities, together with commercial units, public realm, highway and associated works.

The residential amenity spaces are to be located on the ground to third floors of each tower and are proposed to include lounges, shared workspaces and a gym. The four towers are named Plots C1, C2, D1 and D2.

Figure 2 shows the site boundary for the proposed residential development and the proposed footprint of the residential building.

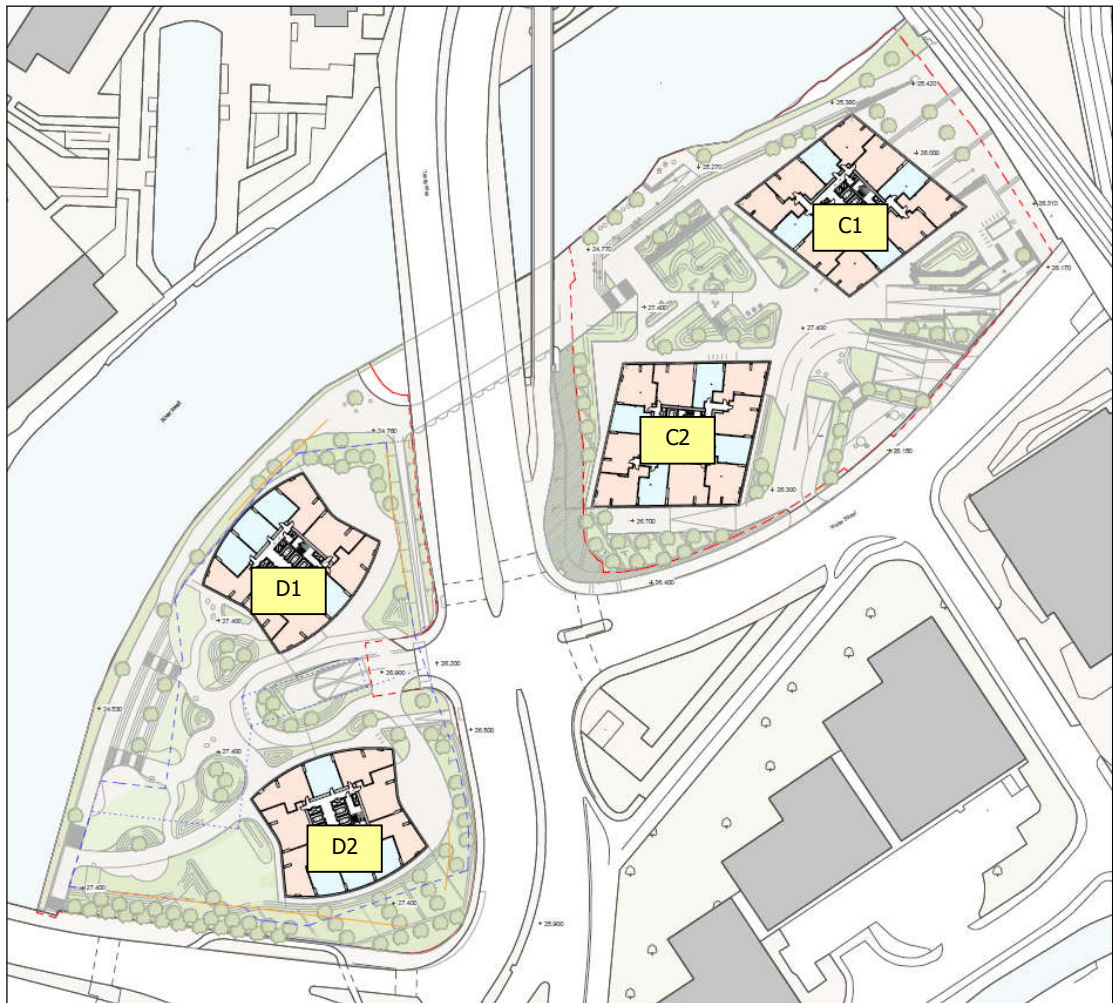


Figure 2: Site layout plan

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 impacts 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 December 2015 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, 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 45dB LAmax (fifteen excesses over 45dB LAmax 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. The requested assessment is provided under separate cover.

Building Services Noise

With regard to external noise due to building services plant, Section 3.6.1.5.1 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 3 identifies the nearest noise sensitive premises to the proposed development site.

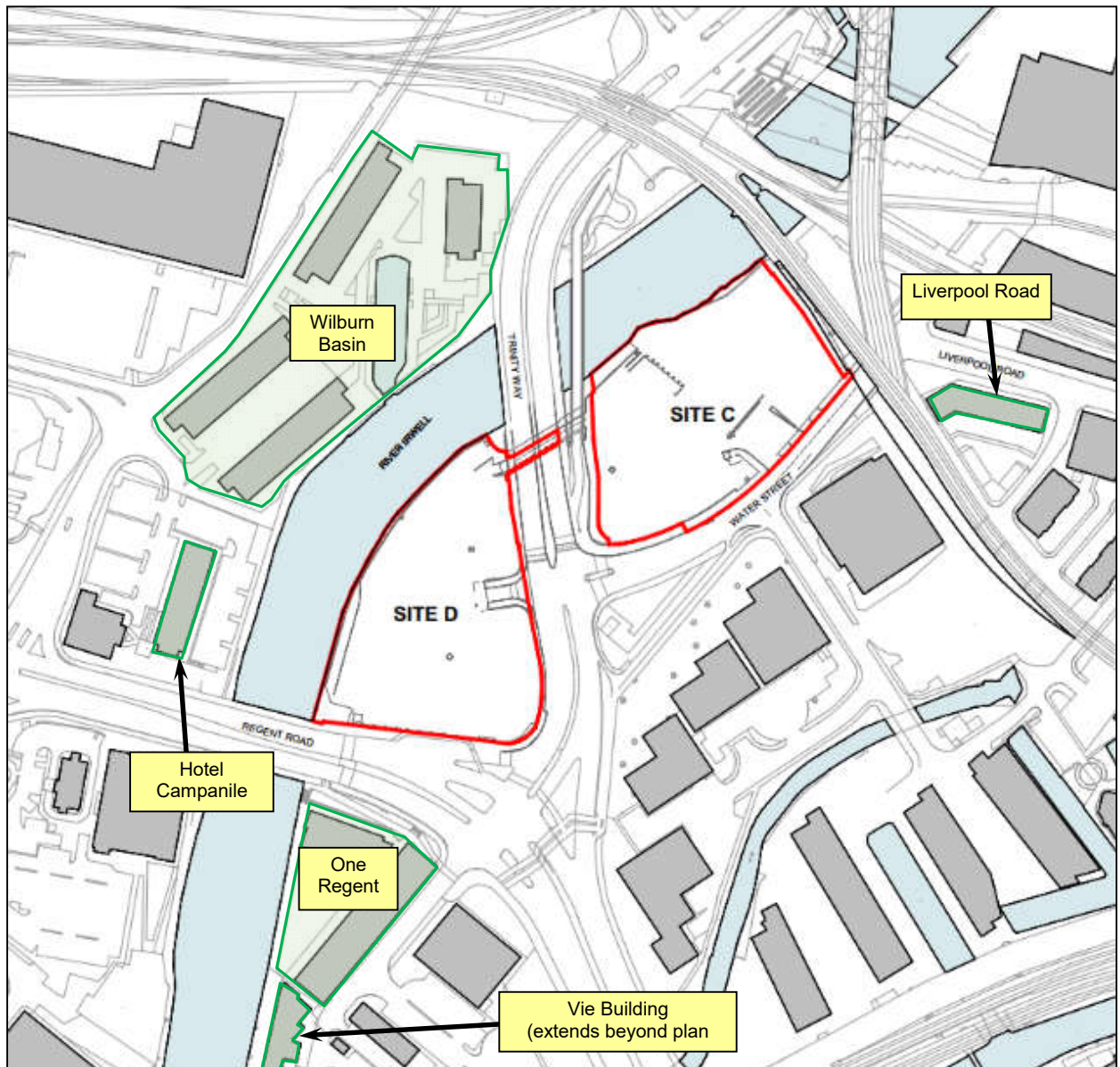


Figure 3: Nearest noise sensitive residential premises to Plots C and D

Noise from Commercial Operations

Noise egress from the proposed commercial units at the 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' 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 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) should be controlled to 10dB below the background noise level (LA90) without the entertainment noise present, in each octave band at the nearest noise sensitive location'.

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 11am to 3pm on Wednesday 25 August 2021 and from 4pm Thursday 26 August 2021 to 9:30am of Friday 27 August 2021.

The measurement locations used for the surveys are identified on Figure 4 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: At location of closest façade of Proposed Development to the railway line on Castlefield Viaduct, 15.2m from the viaduct, at a microphone height of 15 metres above site ground level
- Location 2: At location of closest façade of Proposed Development to Water Street, at 22 metres from the kerb, at a microphone height of 1.5 metres above site ground level
- Location 3: At location of closest façade of Proposed Development to Water Street, at 10.5 metres from the kerb, at a microphone height of 1.5 metres above site ground level
- Location 4: At location of closest façade of Proposed Development to Trinity Way (A6042), at 16 metres from the kerb, at a microphone height of 6 metres above site ground level
- Location 5: At a location 6.5 metres from the kerb of Regent Road (A57(M)), at a microphone height of 7 metres above site ground level.
- Location 6: At 6 metres from the kerb of the Trinity Way (A6042), at a microphone height of 12 metres above site ground level.
- Location 7: At 13 metres from the kerb of the Trinity Way (A6042), at a microphone height of 7 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.

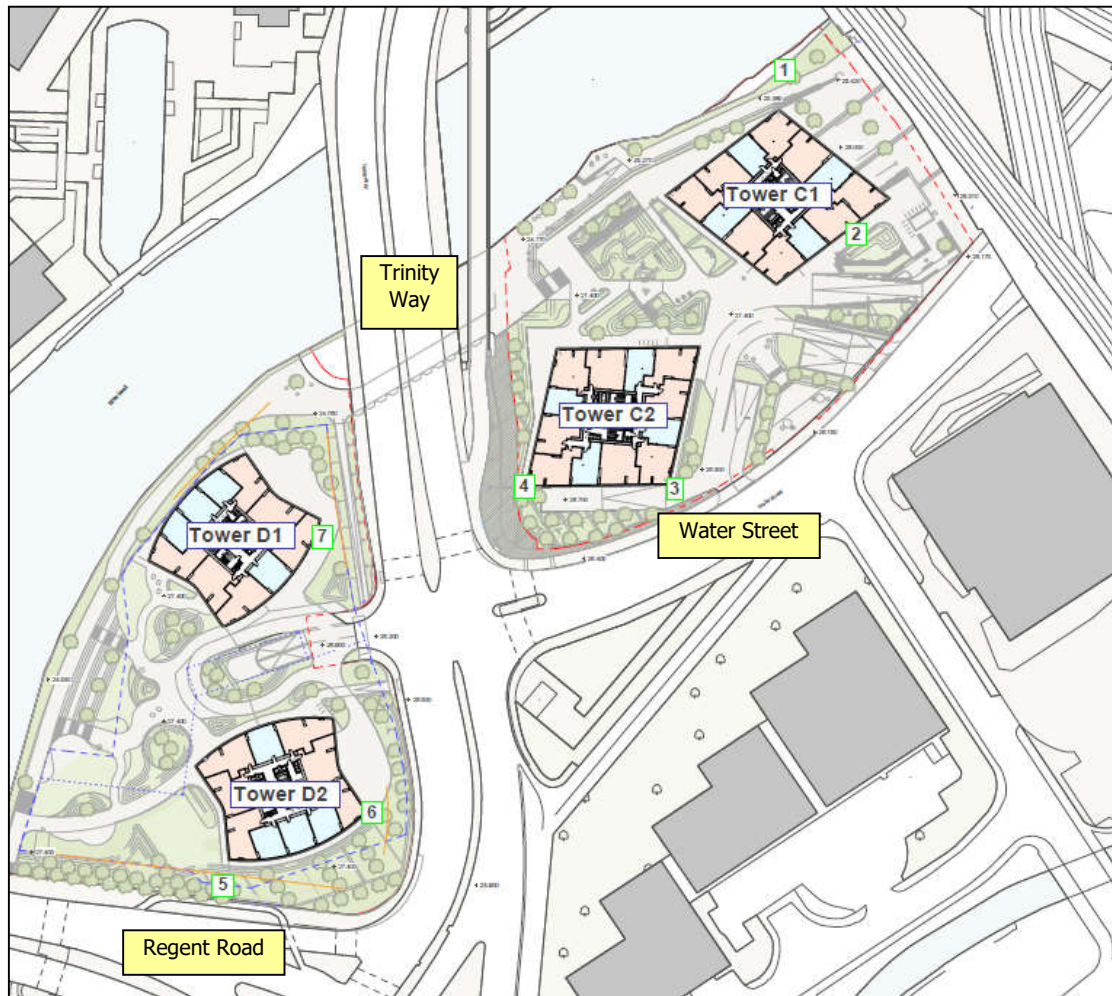


Figure 4: Noise survey measurement locations

The long-term noise environment around the Application Site is currently determined by the following principal external noise sources:

- Road traffic on Regent Road (A57 (M)), Trinity Way (A6042) and Water Street
- Rail traffic noise from Castlefield Viaduct and Ordsall Chord

Typical maximum noise levels at the site were generated by road vehicles on Regent Road (A57(M)) and Trinity Way (A6042). Maximum noise levels to the east of the site were governed by train movements on the adjacent viaducts.

The noise levels measured during the noise surveys are summarised in Table 2.

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 – Wednesday (East Elevation, C1)	66	62 to 85	56 to 65	-	-	-
1 – Thursday (East Elevation, C1)	66	60 to 93	50 to 62	63	51 to 95	39 to 60
1 – Friday (East Elevation, C1)	67	62 to 97	53 to 61	-	-	-
2 – Wednesday (S. East Elevation, C1)	61	58 to 90	50 to 55	-	-	-
3 – Wednesday (South Elevation, C2)	58	65 to 86	51 to 53	-	-	-
4 – Wednesday (West Elevation, C2)	68	73 to 95	58 to 61	-	-	-
4 – Thursday (West Elevation, C2)	66	64 to 94	51 to 63	62	52 to 86	39 to 62
4 – Friday (West Elevation, C2)	67	64 to 88	56 to 65	-	-	-
5 – Wednesday (South Elevation, D2)	71	77 to 86	63 to 67	-	-	-
5 – Thursday (South Elevation, D2)	71	71 to 74	59 to 71	69	65 to 100	46 to 71
5 – Friday (South Elevation, D2)	72	71 to 87	62 to 72	-	-	-
6 – Wednesday (East Elevation, D2)	68	74 to 79	64 to 65	-	-	-
7 – Wednesday (East Elevation, D1)	68	73 to 94	61 to 62	-	-	-

Table 2: Summary of measured environmental noise levels

The statistical noise levels ('LAmax' and 'LA90') given in Table 2 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 5 shows the modelled free-field noise levels incident upon the facades, viewed from the south east.

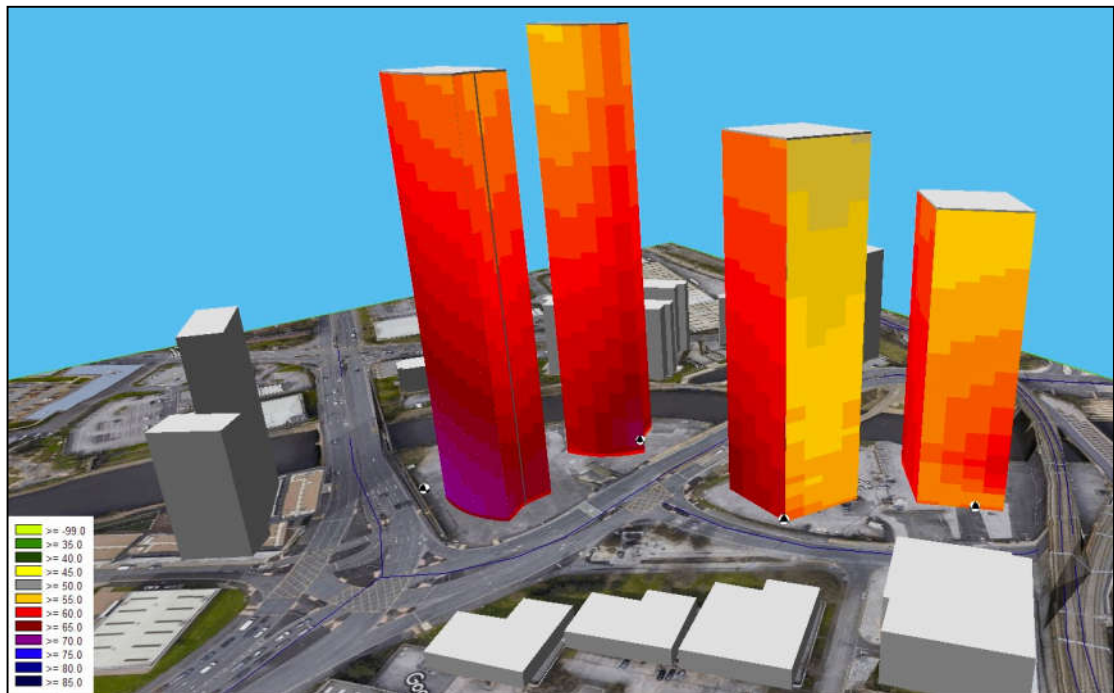


Figure 5: 3D model of development proposals & predicted incident noise levels

Figure 6 shows the calculated external daytime average (L_{Aeq}) noise levels incident upon the various façades of the proposed buildings. The incident noise levels are those at an elevation of 15 metres above ground floor to ensure a clear line of sight to the adjacent rail viaducts and elevated sections of road.



Figure 6: Summary external daytime 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 determined.

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 through via opening purge vents. The calculations assume that the purge vents are closed. As identified above, an assessment of the noise impact of opening purge vents has been carried out in response to the guidance given in the 'Acoustics, Ventilation and Overheating, Residential Design Guide', (AVO). The assessment is provided under separate cover.

Design recommendations

Calculations of noise ingress have been carried out to determine the minimum required 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 7 to 9 identify the locations of the various recommended specifications. The curtain wall a performance requirements are detailed below.

Table 3 identifies the minimum recommended weighted sound reduction index of the curtain wall specifications referred to below and in Figures 7 to 19. The recommended performance values in Table 3 relate to the composite performance of the full curtain wall assembly including glazing, drylined non-vision panels, the curtain wall frame and purge vents.

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

Specification	Rw
TYPE A	45 dB
TYPE B	42 dB
TYPE C	40 dB

Table 3: Minimum Recommended Sound Reduction Index of facade

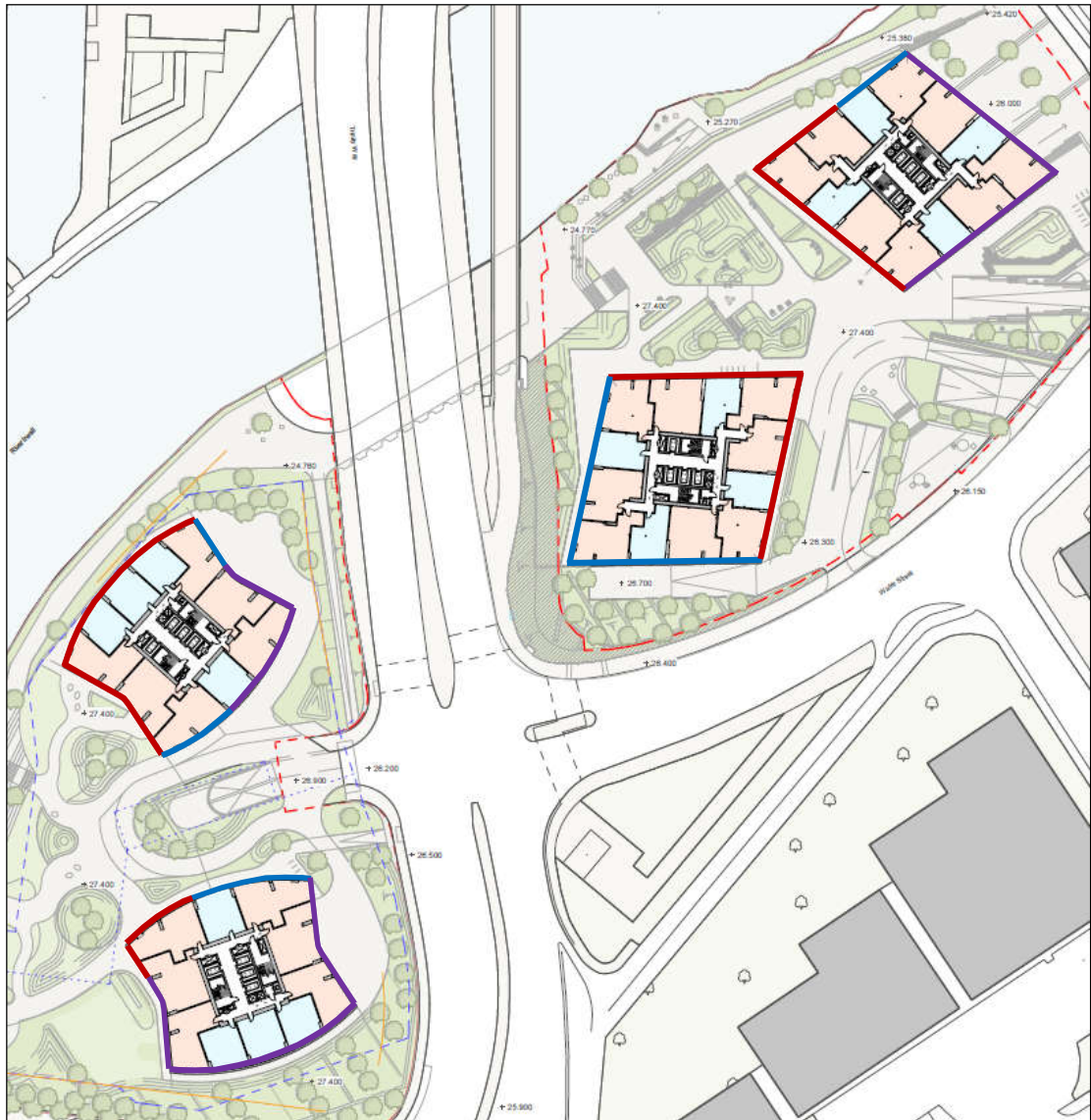


Figure 7: Acoustic specification location plan, Level 03 to Level 15 - Living Rooms & Bedrooms

KEY

- Acoustic Spec C (Rw 45)
- Acoustic Spec D (Rw 42)
- Acoustic Spec E (Rw 40)

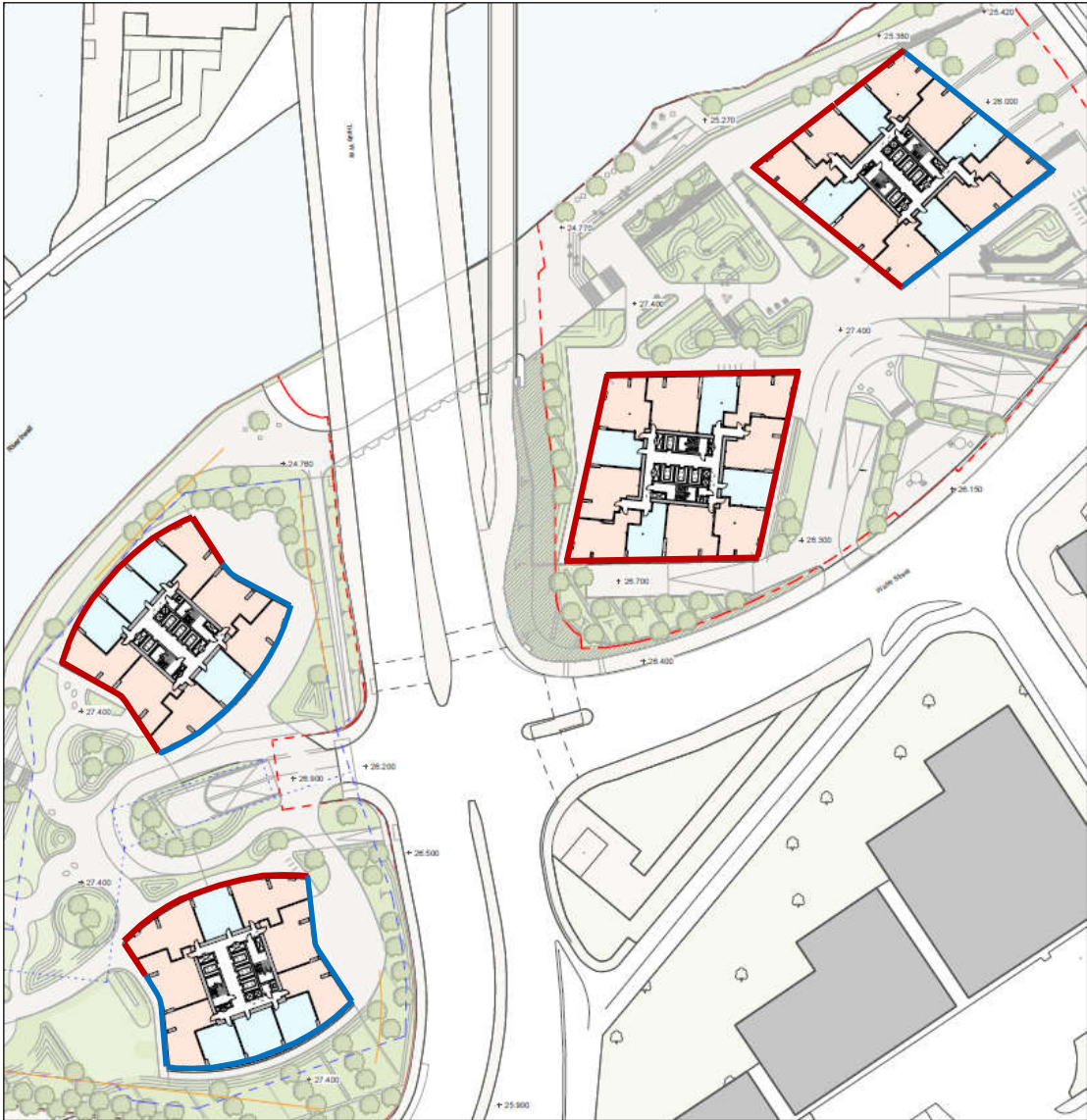


Figure 8: Acoustic specification location plan, Level 16 to Level 30 - Living Rooms & Bedrooms

KEY

- Acoustic Spec C (Rw 45)
- Acoustic Spec D (Rw 42)
- Acoustic Spec E (Rw 40)

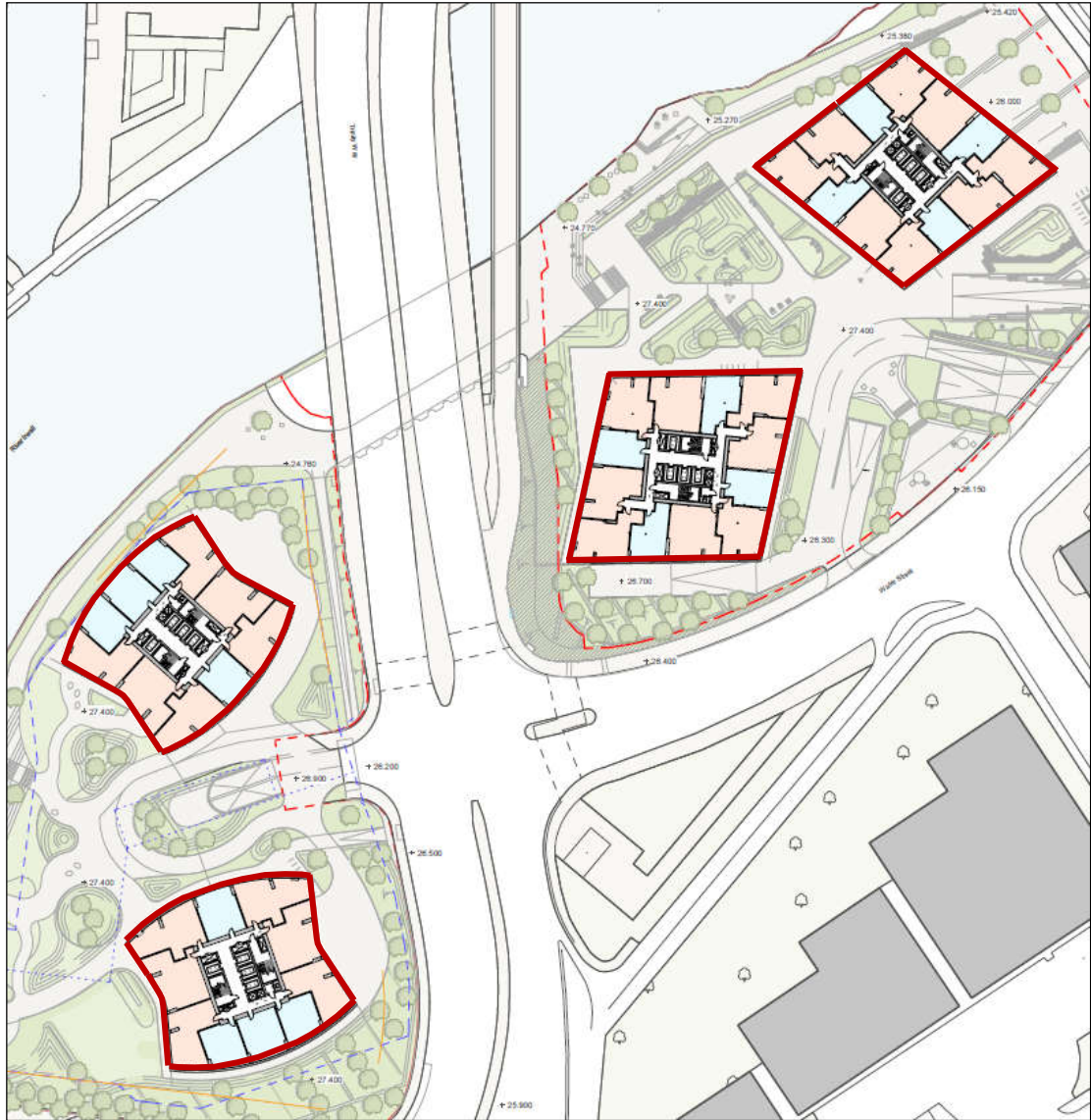


Figure 9: Acoustic specification location plan, Level 31 to roof - Living Rooms & Bedrooms

KEY

-  Acoustic Spec C (Rw 45)
 Acoustic Spec D (Rw 42)
 Acoustic Spec E (Rw 40)

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 recommended internal noise.

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

Given the recommended sound insulation performances given above for the façade and roof, compliance with the recommendations of the World Health Organisation in relation to maximum (LA_{max}) internal noise events 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 noise level at the nearest residential receptors to the development, due to all simultaneously-operating non-emergency building services plant and equipment.

Location	Rating noise level (dB LAeq)	
	Daytime (07:00 hrs to 23:00 hrs)	Night time (23:00 hrs to 07:00 hrs)
Tower C1	45	40
Tower C2	46	40
Tower D1	55	40
Tower D2	55	49
Wilburn Basin	45	40
Hotel Campanile	47	40
One Regent	55	49
Liverpool Road	45	40
Vie Building	45	38

Table 4: 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 (perhaps 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 LAeq) 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)
Tower C1	70
Tower C2	66
Tower D1	71
Tower D2	76
Wilburn Basin	71
Hotel Campanile	72
One Regent	79
Liverpool Road	66
Vie Building	69

Table 5: 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 at the ground floor of Plots C1 and C2 and the amenity spaces within Plots C1, C2, D1 and D2 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 10dB 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
Tower C1 (0700 to 2300)	45	35	33	31	34	27	20
Tower C1 (2300 to 0700)	45	35	31	30	32	25	20
Tower C2 (0700 to 2300)	59	53	52	51	52	46	35
Tower C2 (2300 to 0700)	45	35	33	31	32	26	20
Tower D1 (0700 to 2300)	54	50	48	46	48	42	31
Tower D1 (2300 to 0700)	45	35	33	31	32	26	20
Tower D2 (0700 to 2300)	58	52	50	48	50	44	37
Tower D2 (2300 to 0700)	45	39	39	39	42	36	23
Hotel Campanile (07:00 to 23:00)	50	45	43	40	42	37	26
Hotel Campanile (23:00 to 07:00)	44	39	39	36	37	31	20
Wilburn Basin (07:00 to 23:00)	50	45	43	40	42	37	26
Wilburn Basin (23:00 to 07:00)	44	39	39	36	37	31	20
One Regent (07:00 to 23:00)	58	52	50	48	50	44	37
One Regent (23:00 to 07:00)	45	39	39	39	42	36	23
Liverpool Road (07:00 to 23:00)	45	35	33	31	34	27	20
Liverpool Road (23:00 to 07:00)	45	35	31	30	32	25	20
Vie Building (07:00 to 23:00)	49	41	37	34	36	31	19
Vie Building (23:00 to 07:00)	44	37	32	27	29	24	13

Table 6: 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 do not exceed the values given in Table 7.

Location	Sound Pressure Level (dB) @ Octave Band Centre Frequency (Hz)						
	63	125	250	500	1k	2k	4k
Apartments	40	30	23	20	17	15	12

Table 7: Maximum recommended noise levels in apartments due to music replay in amenity areas

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.

10.0 TRAIN VIBRATION

'Feelable' Vibration

BS6472-1: 2008 'Guide to evaluation of human exposure to vibration in buildings - part 1: Vibration sources other than blasting' provides guidance on typically acceptable limits for vibration within residential and office buildings during the day and night. This document provides guidance on typically acceptable limits for perceived 'feelable' vibration, such that annoyance is likely to be avoided.

Table 8 gives the applicable criteria from BS6472-1: 2008. The applicable assessment criterion is the 'Vibration Dose Value' (VDV). Values of VDV within certain ranges indicate the likelihood or otherwise of adverse comment from occupants of the building due to feelable vibration.

	Low Probability of Adverse Comment $\text{ms}^{-1.75}$	Adverse Comment Possible $\text{ms}^{-1.75}$	Adverse Comment Probable $\text{ms}^{-1.75}$
Daytime (07:00 - 23:00)	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Night Time (23:00 - 07:00)	0.1 to 0.2	0.2 to 0.4	0.4 to 0.6

Table 8: Vibration Dose Value ranges which might result in various probabilities of adverse comment within residential buildings

Measurements of vibration have been carried out in order to determine the potential for vibration generated by train movements to cause adverse comment within the buildings of the proposed Development.

Measurements of groundborne vibration were carried out at one external location, 'V1', shown on Figure 10.

The measurements have been conducted in accordance with the guidance given in 'Measurement and Assessment of Groundborne Noise and Vibration' published by The Association of Noise Consultants.

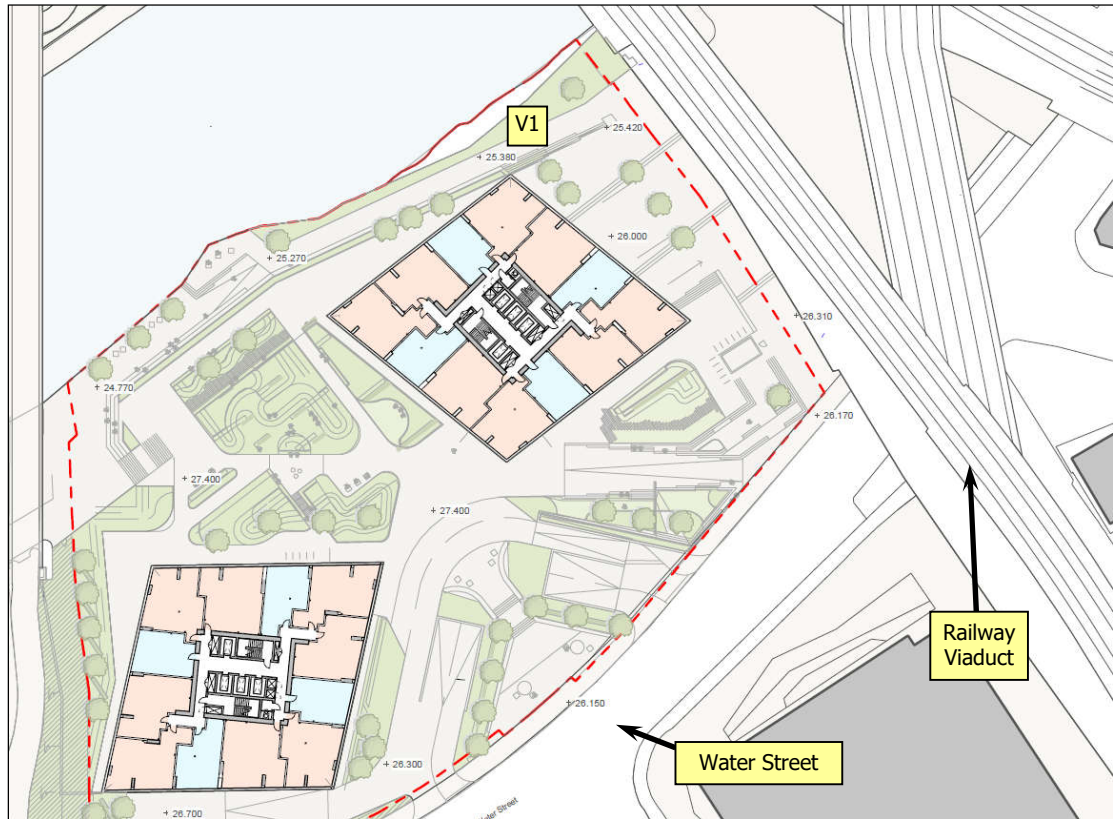


Figure 10: Vibration survey measurement location

Analysis of the measured vibration levels indicates that Vibration Dose Values at the base of Tower C1 is $0.11 \text{ ms}^{-1.75}$ during the day and $0.14 \text{ ms}^{-1.75}$ during the night. With reference to BS8472: 2008, these results indicate a 'low probability of adverse comment' due to feelable vibration in the proposed closest apartments to the rail viaducts.

The result indicates that no measures to mitigate levels of structureborne vibration should be required to maintain residential amenity.

Structureborne noise due to train movements

Groundborne vibration can generate audible structureborne noise within a building, which could cause adverse impact. The results of the groundborne vibration measurements have therefore been used to calculate the potential levels of structureborne noise within the closest proposed building to the rail viaducts.

The results of the calculations indicate that a daytime noise level no greater than 28 dB LAeq,16hrs and a night time noise level no greater than 26dB LAeq,1hr are expected in the apartments at the lower levels of Tower C1.

In addition, the predicted maximum structureborne noise level within bedrooms during the passage of a train between 11pm and 7am is 44dB LAmax. The majority of trains are expected to generate a maximum noise level no greater than 40 dB LAmax.

In practice, the structureborne noise levels are expected to be lower than those identified above by up to 4dB, as the calculations do not take into account the potential attenuation of structureborne vibration with height up the building.

Therefore the calculated structureborne noise levels comply with the recommendations for 'average' noise levels given in BS8233: 2014. In addition, the potential maximum night time noise levels due to structureborne noise comply with the recommendations of the World Health Organisation.

The above assessment indicates that no mitigation measures would be required to achieve levels of structureborne noise that comply with published guidance.

APPENDIX A: NOISE SURVEY DETAILS AND SUMMARY RESULTS

LOCATION

Trinity Islands, Trinity Way, Manchester

DATES AND TIMES

11am to 3pm on Wednesday 25 August 2021

4pm Thursday 26 August 2021 to 9:30am Friday 27 August 2021

WEATHER DURING SURVEYS

Wednesday 25 August 2021 (Day time)	1/8 cloud cover, 2 m/s wind, no rain, 19°C
Thursday 26 August 2021 (Day time)	Sky clear, 4 m/s wind, no rain, 18°C
Thursday 26 August 2021 (Night time)	2/8 cloud cover, 2 m/s wind, no rain, 10°C
Friday 27 August 2021 (Day time)	1/8 cloud cover, <1 m/s wind, no rain, 17°C

PERSONNEL PRESENT DURING SURVEY

Matt Fisher – Fisher Acoustics

Lee Copley – 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 checked 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 11 to 13 and Tables A1 to A12 identify the free-field noise levels measured at various locations on the Site. Measurement locations are shown in Figure 4 and described below.

- Location 1: At location of closest façade of proposed Development to the railway line on Castlefield Viaduct, 15.2m from the viaduct, at a microphone height of 15 metres above site ground level
- Location 2: At location of closest façade of proposed Development to Water Street, at 22 metres from the kerb, at a microphone height of 1.5 metres above site ground level

- Location 3: At location of closest façade of proposed Development to Water Street, at 10.5 metres from the kerb, at a microphone height of 1.5 metres above site ground level
- Location 3: At location of closest façade of proposed Development to Trinity Way (A6042), at 16 metres from the kerb, at a microphone height of 6 metres above site ground level
- Location 5: At a location 6.5 metres from the kerb of Regent Road (A57(M)), at a microphone height of 7 metres above site ground level.
- Location 6: At 6 metres from the kerb of the Trinity Way (A6042), at a microphone height of 12 metres above site ground level.
- Location 7: At 13 metres from the kerb of the Trinity Way (A6042), at a microphone height of 7 metres above site ground level.

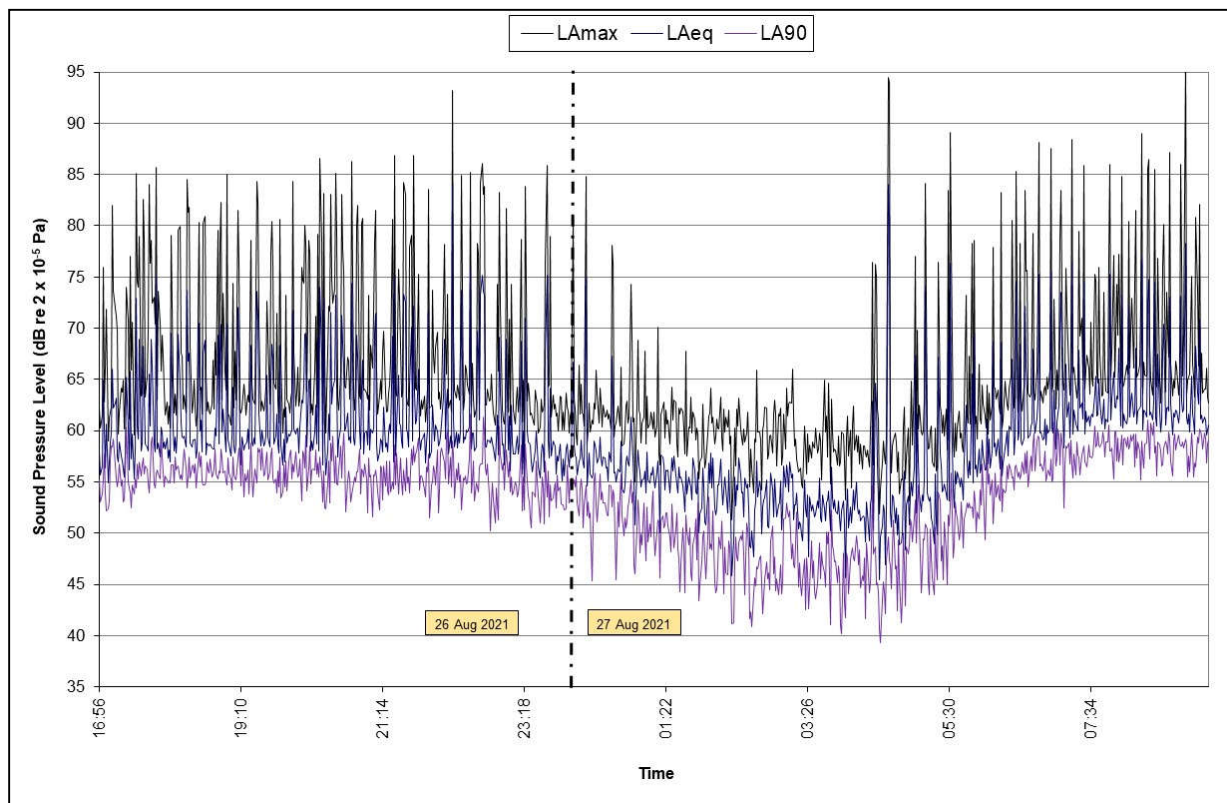


Figure 11: Position 1 noise measurements, Thursday 26 August 2021 to Friday 27 August 2021 - maximum (LAmax), average (LAeq) and background (LA90) noise levels

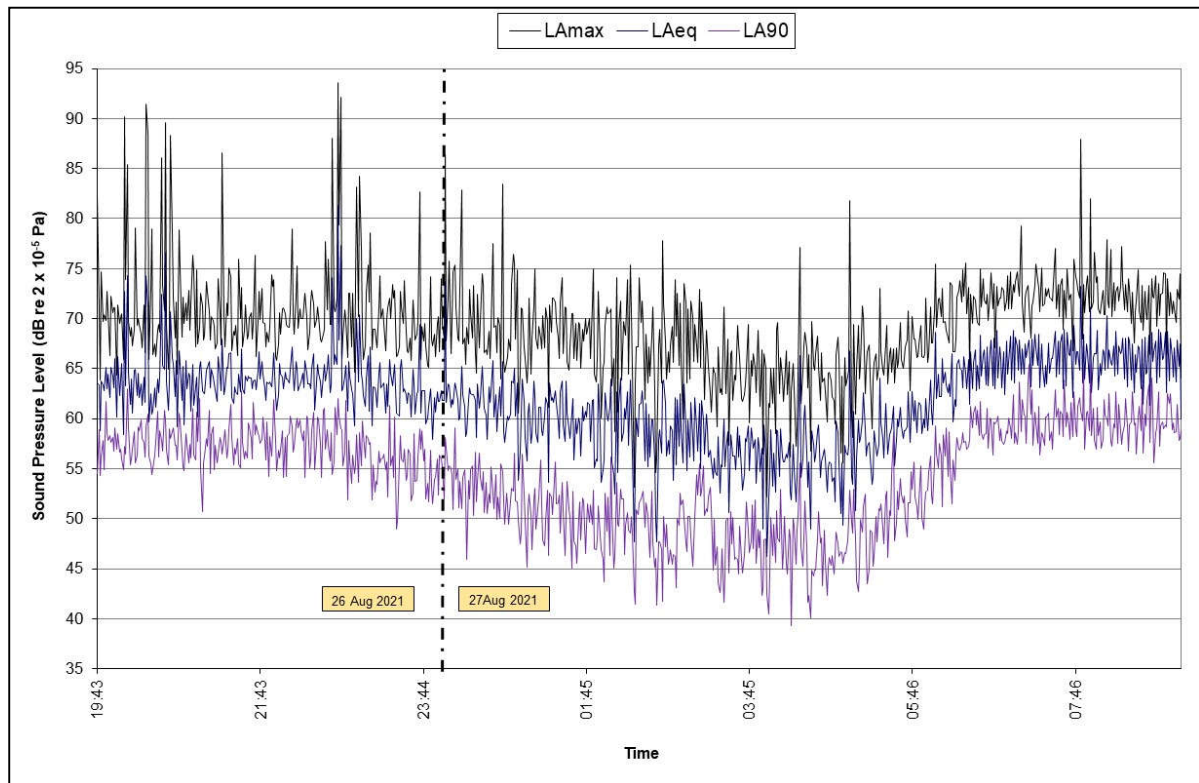


Figure 12: Position 4 noise measurements, Thursday 26 August 2021 to Friday 27 August 2021 - maximum (LAmix), average (LAeq) and background (LA90) noise levels

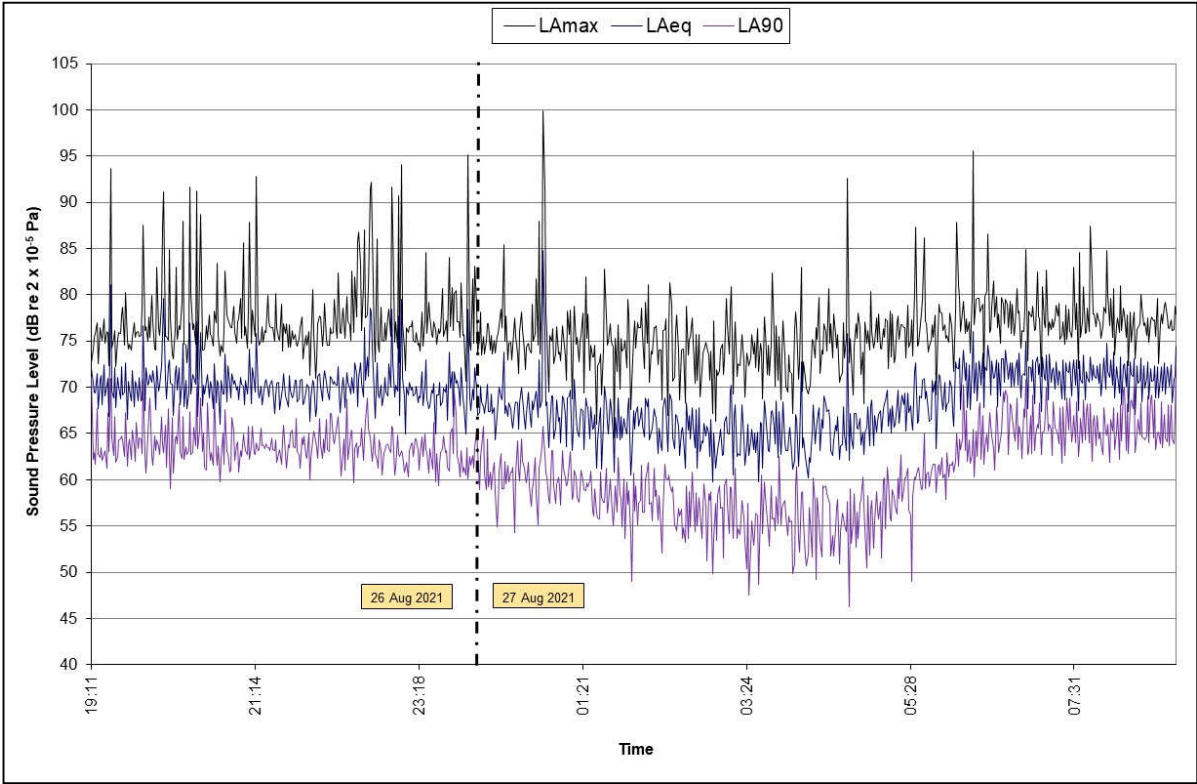


Figure 13: Position 5 noise measurements, Thursday 26 August 2021 to Friday 27 August 2021 - maximum (LAmx), average (LAeq) and background (LA90) noise levels

Measurement Position	Start Time	Measured Noise Levels, dB			Noise sources
		L _{Aeq}	L _{Amax}	L _{A90}	
2	11:15	56.7	67.6	49.7	Road traffic
2	11:20	57.3	69.7	49.5	"
2	11:25	58.7	68.8	49.9	"
2	11:30	55.7	58.3	54.9	"
2	11:36	57.1	67.9	49.9	"
2	11:41	57.9	68.5	50.6	"
2	11:46	57.8	69.4	50.9	"
2	14:17	58.6	74.1	50.6	"
2	14:22	59.0	74.6	51.7	"
2	14:27	57.5	69.2	49.9	"
2	14:32	69.9	89.8	52.0	"
2	14:38	59.3	68.8	51.8	"
2	14:43	56.2	67.0	50.0	"

Table A1: Summary Statistical Noise Levels, Position 2 – Daytime, 25th August 2021

Measurement Position	Start Time	Noise Level, dB L _{Aeq}	Sound Pressure Level (dB) @ Octave Band Centre Frequency (Hz)						
			63	125	250	500	1k	2k	4k
2	11:15	56.7	66.3	60.9	57.8	53.0	53.1	46.6	38.0
2	11:20	57.3	67.4	60.4	58.6	54.0	52.8	47.2	42.8
2	11:25	58.7	66.0	59.9	58.6	55.0	54.6	50.4	44.5
2	11:30	55.7	63.9	57.1	53.9	52.3	52.8	45.7	35.1
2	11:36	57.1	66.6	60.6	57.5	54.3	53.3	47.0	39.4
2	11:41	57.9	70.7	61.1	58.1	54.2	54.2	48.0	40.1
2	11:46	57.8	70.8	59.0	56.1	52.8	53.6	49.3	45.7
2	14:17	58.6	66.6	62.5	59.7	55.0	54.7	48.0	41.8
2	14:22	59.0	68.3	62.4	59.4	56.0	54.7	49.0	44.1
2	14:27	57.5	66.5	60.8	58.0	54.7	53.2	47.7	41.7
2	14:32	69.9	65.3	59.4	57.1	57.3	67.0	64.8	54.8
2	14:38	59.3	70.0	63.8	60.2	56.3	55.4	48.7	41.0
2	14:43	56.2	66.7	58.3	56.1	52.1	52.5	46.3	40.2

Table A2: Measured Octave Band L_{eq} Noise Levels, Position 2 – Daytime, 25th August 2021

Measurement Position	Start Time	Measured Noise Levels, dB			Noise sources
		L _{Aeq}	L _{Amax}	L _{A90}	
3	11:52	57.0	67.7	50.9	Road traffic
3	11:57	57.3	67.0	52.1	"
3	12:02	56.7	66.3	51.4	"
3	12:07	58.1	73.0	52.1	"
3	12:12	63.3	86.2	53.4	"
3	12:18	57.1	70.5	51.3	"
3	13:46	57.3	68.8	52.6	"
3	13:51	56.4	64.8	52.1	"
3	13:56	59.5	72.5	52.8	"
3	14:01	57.6	68.1	51.6	"
3	14:06	56.2	67.0	51.2	"
3	14:11	57.3	72.0	51.0	"

Table A3: Summary Statistical Noise Levels, Position 3 – Daytime, 25th August 2021

Measurement Position	Start Time	Noise Level, dB L _{Aeq}	Sound Pressure Level (dB) @ Octave Band Centre Frequency (Hz)						
			63	125	250	500	1k	2k	4k
3	11:52	57.0	66.7	56.6	53.7	53.4	53.8	48.2	40.5
3	11:57	57.3	67.7	58.6	54.5	53.3	53.9	48.9	42.3
3	12:02	56.7	67.2	57.1	53.3	52.6	53.4	48.4	41.0
3	12:07	58.1	68.0	61.3	60.0	54.9	53.5	48.4	41.1
3	12:12	63.3	68.1	60.4	55.2	55.5	59.8	57.5	50.4
3	12:18	57.1	67.6	58.1	54.4	53.5	53.6	48.3	41.5
3	13:46	57.3	68.8	58.6	54.7	53.4	53.8	48.9	42.0
3	13:51	56.4	70.2	57.9	53.6	52.4	53.0	47.7	40.3
3	13:56	59.5	66.6	59.9	57.0	56.0	55.6	51.1	45.4
3	14:01	57.6	67.9	61.3	56.0	53.9	53.9	48.7	41.7
3	14:06	56.2	66.6	60.2	54.2	52.8	52.7	47.0	39.1
3	14:11	57.3	68.1	63.6	58.3	52.7	53.2	47.8	40.0

Table A4: Measured Octave Band L_{eq} Noise Levels, Position 3 – Daytime, 25th August 2021

Measurement Position	Start Time	Measured Noise Levels, dB			Noise sources
		L _{Aeq}	L _{Amax}	L _{A90}	
4	12:42	66.3	80.7	59.6	Road traffic
4	12:47	66.3	75.3	61.2	"
4	12:52	66.2	73.5	60.0	"
4	12:57	66.0	84.0	59.0	"
4	13:02	67.2	79.3	60.7	"
4	13:07	65.6	76.3	58.4	"
4	13:12	67.1	82.6	59.5	"
4	13:17	66.1	73.0	59.2	"
4	13:22	65.8	74.2	58.2	"
4	13:27	73.3	94.5	59.3	"
4	13:32	65.2	74.2	58.5	"
4	13:37	65.6	75.3	59.4	"

Table A5: Summary Statistical Noise Levels, Position 4 – Daytime, 25th August 2021

Measurement Position	Start Time	Noise Level, dB L _{Aeq}	Sound Pressure Level (dB) @ Octave Band Centre Frequency (Hz)						
			63	125	250	500	1k	2k	4k
4	12:42	66.3	69.6	64.2	65.5	61.8	63.2	57.5	48.6
4	12:47	66.3	69.9	63.6	63.4	62.0	63.1	58.2	50.5
4	12:52	66.2	68.3	63.9	62.8	61.6	63.3	58.1	50.0
4	12:57	66.0	68.9	64.6	62.1	61.1	63.1	58.1	51.1
4	13:02	67.2	69.4	64.6	64.7	62.7	63.9	59.1	53.4
4	13:07	65.6	69.5	66.1	61.9	61.4	63.0	56.9	48.1
4	13:12	67.1	69.7	64.8	64.4	61.8	64.3	59.1	50.3
4	13:17	66.1	69.0	63.4	63.0	61.9	63.3	57.8	49.6
4	13:22	65.8	69.0	63.7	62.8	61.1	63.0	57.7	48.6
4	13:27	73.3	67.9	62.5	62.3	61.5	68.9	69.6	54.7
4	13:32	65.2	67.8	61.6	61.8	60.6	62.6	56.8	48.3
4	13:37	65.6	69.6	63.0	63.0	61.3	62.7	57.1	49.4

Table A6: Measured Octave Band L_{eq} Noise Levels, Position 4 – Daytime, 25th August 2021

Measurement Position	Start Time	Measured Noise Levels, dB			Noise sources
		L _{Aeq}	L _{Amax}	L _{A90}	
5	12:08	71.2	80.3	65.9	Road traffic
5	12:13	71.4	85.6	66.7	"
5	12:19	70.3	77.4	63.0	"
5	13:40	70.4	80.7	63.8	"
5	13:45	71.2	84.5	63.4	"
5	13:50	70.0	78.7	63.1	"
5	13:55	70.0	78.3	63.2	"
5	14:00	70.3	84.6	63.5	"
5	14:05	70.2	78.1	63.6	"

Table A7: Summary Statistical Noise Levels, Position 5 – Daytime, 25th August 2021

Measurement Position	Start Time	Noise Level, dB L _{Aeq}	Sound Pressure Level (dB) @ Octave Band Centre Frequency (Hz)						
			63	125	250	500	1k	2k	4k
5	12:08	71.2	77.1	69.9	68.7	67.1	68.1	62.7	54.8
5	12:13	71.4	77.5	68.8	67.1	66.8	68.5	63.2	55.7
5	12:19	70.3	76.8	68.1	66.6	66.0	67.7	61.6	52.9
5	13:40	70.4	73.6	67.6	66.9	66.3	67.6	61.9	54.1
5	13:45	71.2	74.3	68.9	68.2	65.9	68.0	63.8	56.6
5	13:50	70.0	75.2	69.2	67.2	65.5	67.1	61.5	53.7
5	13:55	70.0	74.6	68.3	67.1	65.5	67.1	61.7	54.2
5	14:00	70.3	74.3	68.5	66.6	65.6	67.4	62.2	54.6
5	14:05	70.2	75.6	69.9	66.5	65.7	67.4	61.8	54.3
5	12:08	71.2	77.1	69.9	68.7	67.1	68.1	62.7	54.8
5	12:13	71.4	77.5	68.8	67.1	66.8	68.5	63.2	55.7
5	12:19	70.3	76.8	68.1	66.6	66.0	67.7	61.6	52.9
5	13:40	70.4	73.6	67.6	66.9	66.3	67.6	61.9	54.1

Table A8: Measured Octave Band L_{eq} Noise Levels, Position 5 – Daytime, 25th August 2021

Measurement Position	Start Time	Measured Noise Levels, dB			Noise sources
		L _{Aeq}	L _{Amax}	L _{A90}	
6	12:26	68.5	78.6	64.9	Road traffic
6	12:31	68.4	75.0	63.5	"
6	12:36	68.6	79.2	64.7	"
6	12:41	68.7	78.0	64.9	"
6	12:46	68.7	76.8	64.2	"
6	12:51	68.4	74.6	64.4	"
6	14:11	68.1	73.5	64.0	"
6	14:16	68.1	75.2	63.6	"
6	14:22	68.4	76.7	64.9	"

Table A9: Summary Statistical Noise Levels, Position 6 – Daytime, 25th August 2021

Measurement Position	Start Time	Noise Level, dB L _{Aeq}	Sound Pressure Level (dB) @ Octave Band Centre Frequency (Hz)						
			63	125	250	500	1k	2k	4k
6	12:26	68.5	70.8	65.1	64.9	64.2	65.7	60.1	51.6
6	12:31	68.4	70.1	64.9	65.2	63.5	65.7	60.2	51.2
6	12:36	68.6	70.4	67.5	68.9	64.0	65.4	59.7	50.7
6	12:41	68.7	71.1	66.3	66.8	64.1	65.9	60.0	51.4
6	12:46	68.7	70.6	64.9	64.9	64.3	65.9	60.2	51.7
6	12:51	68.4	70.2	66.7	65.3	63.6	65.7	60.1	51.4
6	14:11	68.1	71.2	68.0	66.3	63.2	65.3	59.4	50.3
6	14:16	68.1	70.1	65.0	64.9	63.5	65.5	59.6	51.2
6	14:22	68.4	72.2	66.2	65.8	63.9	65.7	59.7	50.9

Table A10: Measured Octave Band L_{eq} Noise Levels, Position 6 – Daytime, 25th August 2021

Measurement Position	Start Time	Measured Noise Levels, dB			Noise sources
		L _{Aeq}	L _{Amax}	L _{A90}	
7	12:57	66.5	78.8	61.1	Road traffic
7	13:02	67.4	75.8	61.8	"
7	13:07	66.4	76.4	61.1	"
7	13:12	67.8	80.4	61.9	"
7	13:17	67.2	75.4	61.0	"
7	13:22	72.9	94.1	60.8	"
7	13:27	67.1	75.0	61.5	"
7	13:32	66.4	74.2	60.6	"
7	14:27	66.7	72.9	61.6	"
7	14:32	68.3	84.2	61.1	"
7	14:38	67.3	73.1	62.3	"
7	14:44	65.6	78.3	61.0	"

Table A11: Summary Statistical Noise Levels, Position 7 – Daytime, 25th August 2021

Measurement Position	Start Time	Noise Level, dB L _{Aeq}	Sound Pressure Level (dB) @ Octave Band Centre Frequency (Hz)						
			63	125	250	500	1k	2k	4k
7	12:57	66.5	68.1	66.5	63.2	61.5	63.9	58.2	48.9
7	13:02	67.4	69.0	66.2	65.4	63.2	64.4	58.9	50.5
7	13:07	66.4	68.6	66.7	62.5	61.7	63.9	57.8	48.3
7	13:12	67.8	69.9	66.3	67.0	63.5	65.0	58.9	49.5
7	13:17	67.2	68.7	65.0	64.1	63.4	64.3	58.6	49.7
7	13:22	72.9	68.8	64.5	63.5	62.2	68.3	69.2	54.2
7	13:27	67.1	66.9	63.5	63.1	62.4	64.5	59.2	49.7
7	13:32	66.4	67.2	63.9	63.1	61.6	63.9	57.8	48.3
7	14:27	66.7	67.5	64.5	63.5	62.1	64.1	57.9	48.6
7	14:32	68.3	68.6	66.8	67.8	62.8	65.2	60.8	52.4
7	14:38	67.3	68.1	64.9	63.9	62.8	64.8	58.7	49.3
7	14:44	65.6	67.3	63.2	62.1	60.5	63.3	56.8	47.8

Table A12: Measured Octave Band L_{eq} Noise Levels, Position 7 – Daytime, 25th August 2021