Residential Noise Assessment

Site Address: 140a Manchester Road, Huddersfield HD1 3JA

Client Name: Fibre Architects

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Revision	Reported By	Checked By
02	T. Sloan, PGDip, AMIOA	S. Chesney, MSc, MIOA

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Contact Details

NOVA Acoustics Ltd,
Suite 13, Crown House,
94 Armley Road,
Leeds,
LS12 2EJ

0113 322 7977

www.novaacoustics.co.uk

technical@novaacoustics.co.uk

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Contents

1. INTRODUCTION 4
   1.1 Standards, Legislation, Policy & Guidance 4
   1.2 Proposal Brief 5
2. ENVIRONMENTAL NOISE SURVEY 6
   2.1 Measurement Methodology 6
   2.2 Context & Subjective Impression 7
   2.3 Environmental Noise Survey Results 7
   2.4 The Agent of Change Principle 8
3. NOISE MODELLING 9
4. NOISE BREAK-IN ASSESSMENT AND SOUND INSULATION SCHEME 11
   4.1 Internal Noise Level Criteria 11
   4.2 Glazing and Background Ventilation Specification 12
   4.3 Room-in-Roof Construction 13
5. OPEN WINDOW NOISE BREAK-IN ASSESSMENT 14
   5.1 Internal Noise Levels with Open Windows Criteria 14
   5.1 Open Window Assessment 15
6. NOISE BREAKTHROUGH ASSESSMENT AND SOUND INSULATION SCHEME 16
   6.1 Noise Breakthrough Criteria 16
   6.2 Recommended Noise Breakthrough Assessment and Specification 16
7. EXTERNAL NOISE LEVEL ASSESSMENT 18
   7.1 External Noise Level Criteria 18
   7.2 External Noise Level Assessment 18
8. CONCLUSION AND ACTION PLAN 19

APPENDIX A – ACOUSTIC TERMINOLOGY 20

APPENDIX B – STANDARDS, LEGISLATION, POLICY, AND GUIDANCE 21
   B.1 – National Planning Policy Framework (2023) 21
   B.2 – Noise Policy Statement for England (2010) 21
   B.3 – BS8233:2014 'Guidance on Sound insulation and noise reduction for buildings' 23
   B.4 – Approved Document 0: Overheating (2021) 24
   B.5 – Acoustics Ventilation and Overheating – Residential Design Guide 2020 24

APPENDIX C – PROPOSED FLOOR PLANS 28

APPENDIX D – ENVIRONMENTAL SURVEY 29
   D.1 – Time History Noise Data 29
   D.2 – Surveying Equipment 30
   D.3 – Meteorological Conditions 30

APPENDIX E – NOISE BREAK-IN CALCULATIONS 31

APPENDIX F – NOISE MODELLING PARTICULARS 37

List of Figures

Figure 1 – Proposed Development 5
Figure 2 – Measurement Locations and Site Surroundings 6
Figure 3 – $L_{Aeq,16hr}$ Ambient Sound Map 9
Figure 4 – $L_{Aeq,8hr}$ Ambient Sound Map 9
Figure 5 – $L_{AFmax,1min}$ Sound Map 10
Figure 6 – Façade Map for Break-in Calculations 13
Figure 7 – AVO Guide Level 1 Risk Category 25
Figure 8 – AVO Guide Level 2 Internal Ambient Noise Levels 27
Figure 9 – Proposed Floor Plans 28
Figure 10 – MP1 Noise Survey Time History 29
Figure 11 – MP3 Noise Survey Time History 29
Figure 12 – Southern Façade Window Calculations 32
Figure 13 – Eastern Façade Window Calculations 33
Figure 14 – Western Façade Window Calculations 34
Figure 15 – Red Façade Window Calculations with Room-in-Roof Detail 35
Figure 16 – Yellow Façade Window Calculations with Room-in-Roof Detail 36

List of Tables

Table 1 – Measurement Methodology 6
Table 2 – Long Term Measurements Sound Level Results Summary 7
Table 3 – Short Term Measurements Sound Level Results Summary 7
Table 4 – Internal Acoustic Design Criteria 11
Table 5 – Glazing & Background Ventilation Specification 12
Table 6 – AVO Guide Open Window Criteria 14
Table 7 – Open Window Assessment 15
Table 8 – Noise Breakthrough Assessment 16
Table 9 – External Acoustic Design Criteria 18
Table 10 – BS8233 External Amenity Area Noise Level Assessment 18
Table 11 – BS8233:2014 Internal Ambient Noise Level Criteria 23
Table 12 – AVO Guide (2020) Level 1 Risk Assessment 26
Table 13 – Surveying Equipment 30
Table 14 – Weather Conditions 30

1. Introduction

NOVA Acoustics Ltd has been commissioned to prepare a noise assessment for a new build residential development ('the Proposed Development') at 140a Manchester Road, Huddersfield HD1 3JA ('the Site'). The site is subject to noise from the surrounding road network, trainline, nearby pub, takeaway food establishments and a Wickes outlet.

The application is preparing to submit a planning application to the Kirklees Council. This report has been prepared to accompany the planning application to be submitted to the Local Planning Authority ('LPA').

A noise survey has been undertaken to establish the prevailing sound levels at the proposed development. The findings have been subsequently used to assess the suitability of the site for residential use. Measures required to mitigate noise impacts for the proposed development have been assessed in accordance with the relevant performance standards, legislation, policy, and guidance.

This noise assessment is necessarily technical in nature; therefore, a glossary of terms is included in Appendix A to assist the reader.

1.1 Standards, Legislation, Policy & Guidance

The following performance standards, legislation, policy, and guidance have been considered to ensure good acoustic design in the assessment:

- National Planning Policy Framework (2023).
- Noise Policy Statement for England (2010).
- British Standard BS8233:2014 – 'Guidance on sound insulation and noise reduction for buildings'.
- ProPG: 'Planning and Noise 2017' (including supplementary documents 1 & 2).
- Approved Document O: Overheating (2021).
- Acoustics Ventilation Overheating: Residential Design Guide 2020' (AVO Guide).

Further information on the legislation can be found in Appendix B.

1.2 Proposal Brief

The proposal is for the erection of a new build 49-bed student accommodation block with drop-off parking at the front and amenity area to the rear. The figure below shows the proposed development.

Drawing Ref No.AL0010 from 'Fibre Architects'

Figure 1 – Proposed Development

2. Environmental Noise Survey

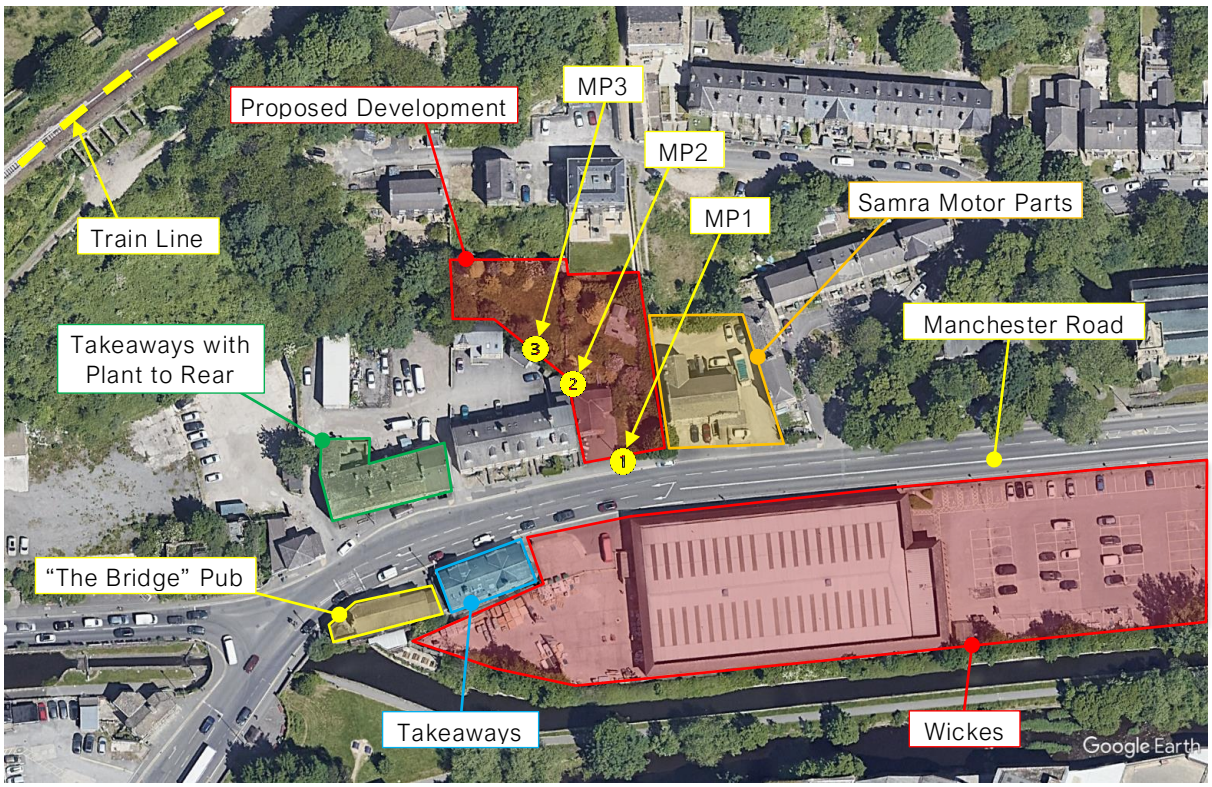
2.1 Measurement Methodology

The following table outlines the measurement dates and particulars.

Location	Survey Dates	Measurement Particulars
MP1	15/03/2024 – 18/03/2024	Equipment mounted on a lamppost 3.5m above the ground, overlooking Manchester Road.
MP2	15/03/24	Attended measurements with equipment tripod mounted 1.5m above the ground facing the lower level carpark to the rear of the takeaways, with line of sight to the railway bridge.
MP3	15/03/2024 – 16/03/2024	Equipment tripod mounted 1.5m above the ground facing the lower level carpark to the rear of the takeaways.

Table 1 – Measurement Methodology

The figure below outlines the site surroundings and measurement locations:



Imagery taken from Google Earth Pro ©2024

Figure 2 – Measurement Locations and Site Surroundings

2.2 Context & Subjective Impression

The proposed development site is located on land behind 140a Manchester Road, with an existing building set to be demolished to the front. The area surrounding the site is a mixture of residential dwellings to the north and commercial establishments on all other sides including a large industrial estate to the south. Situated 120m from the north-western boundary of the site is a rail line linking Huddersfield to Lockwood stations.

The acoustic environment is deemed to be moderate in level and the noise profile is dominated by heavy road traffic noise emissions on Manchester Road with very few lulls during the site visits. During setup, a train passing by was clearly audible producing clattering impulsive noise, less frequently LGV movement and loading/unloading noise could be heard from "Samra Motor Parts", and waste disposal/sorting noise from the takeaways near the proposed development.

There is plant present to the rear of the nearby takeaways, but it was not audible at the boundary during the site visits, and noise from Wickes included a white noise alarm from a forklift which was audible from the front of the site.

2.3 Environmental Noise Survey Results

The following section outlines the measured sound levels during the survey. The time history results can be found in Appendix D.

Location	Measurement Period ('T')	Octave Frequency Band (Hz, $L_{eq,T}$, dB)							$L_{Aeq,T}$ (dB)	'Typical' $L_{AFmax,1min}$ (dB)
		63	125	250	500	1k	2k	4k		
MP1	$L_{eq,16hr}$ (Day)	71	66	66	66	69	66	59	72	--
	$L_{eq,8hr}$ (Night)	65	60	61	62	64	61	55	67	85
	Highest $L_{eq,1hr}$ (Day)	74	69	69	68	70	68	64	74	--
	Highest $L_{eq,1hr}$ (Night)	69	66	67	67	69	65	58	72	--
MP3	$L_{eq,16hr}$ (Day)	59	52	50	48	50	46	43	54	--
	$L_{eq,8hr}$ (Night)	51	45	42	42	45	46	40	50	73
	Highest $L_{eq,1hr}$ (Day)	61	55	52	51	51	47	49	56	--
	Highest $L_{eq,1hr}$ (Night)	54	48	45	45	48	53	47	56	--

Table 2 – Long Term Measurements Sound Level Results Summary

Location	Measurement Period	Octave Frequency Band (Hz, $L_{eq,T}$, dB)							$L_{Aeq,T}$ (dB)	$L_{AFmax,T}$ (dB)
		63	125	250	500	1k	2k	4k		
MP2	11:53 to 12:45	62	57	52	50	52	48	43	55	66

Table 3 – Short Term Measurements Sound Level Results Summary

2.4 The Agent of Change Principle

In locations where a new residential development could place unreasonable restrictions on the operations of an established business, the 'agent of change' principle must be considered. This guidance puts the onus on the side of the developer to ensure that adverse impact will not take place.

Regarding this, the following is stated in paragraph 193 of the NPPF:

"Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed."

During the site visit, it was noted that noise from fixed mechanical plant associated with the nearby hot food takeaways was not audible over the road traffic noise. However, noise from activity within the rear service yard (i.e. emptying food waste into the bins) was clearly perceptible at the boundary but is anticipated to be infrequent. In addition, there are existing residential dwellings that are closer to the hot food takeaways than the site, indicating that some level of control at the takeaways would be necessary to avoid complaint.

There is also limited evidence in the long-term data that noise from either the takeaways or the pub is highly perceptible or would result in unacceptable impacts at the proposed development site, with the measurement time histories following a diurnal pattern (typically associated with transportation noise). Therefore, the noise break-in assessment is focused on noise from emanating from road traffic, with use of the rail line understood to be infrequent.

3. Noise Modelling

The environmental noise survey has allowed the sound levels at the proposed development to be modelled within SoundPlan 9.0. The modelling particulars are outlined in Appendix F. The sound maps showing the daytime $L_{Aeq,T}$, night-time $L_{Aeq,T}$ and night-time $L_{AFmax,1min}$ sound levels incident upon the proposed development can be seen in the figures below.

Figure 3 – $L_{Aeq,16hr}$ Ambient Sound Map

Figure 4 – $L_{Aeq,8hr}$ Ambient Sound Map

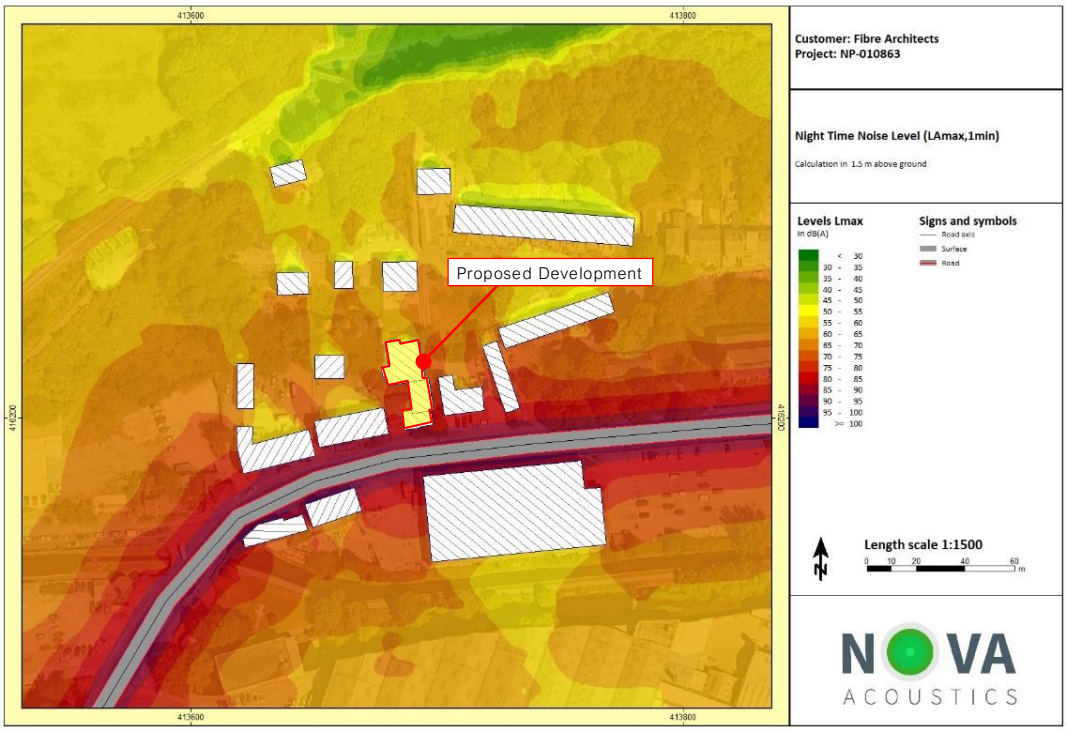


Figure 5 – $L_{AFmax,1min}$ Sound Map

Discussion: Owing to the road noise from Manchester Road being highly dominant throughout the site, the predicted noise levels incident on the proposed development will be used for the breakthrough assessment and calculations for rear the façades. These predicted levels are higher than the measured levels at MP3, ensuring a robust assessment and further corroborating that road traffic noise is dominant at the site.

4. Noise Break-in Assessment and Sound Insulation Scheme

4.1 Internal Noise Level Criteria

The noise profile of the area is predominantly "anonymous" steady state noise sources e.g., transport. The following table outlines the internal acoustic design criteria used in the following assessment.

Activity	Location	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)
Resting	Living Room	35dB $L_{Aeq,16hr}$	--
Dining	Dining Room/Area	40dB $L_{Aeq,16hr}$	--
Sleeping (Daytime resting)	Bedroom	35dB $L_{Aeq,16hr}$	30dB $L_{Aeq,8hr}$ 45dB L_{AFmax}*

**Note 1: The maximum criteria have been taken from the World Health Organisation (WHO) Guidelines for Community Noise.*

**Note 2: ProPG:2017 which is relevant to 'New Residential' states; "In most circumstances in noise sensitive rooms at night (e.g., bedrooms) good acoustic design can be used so that individual noise events do not normally exceed 45dB $L_{Amax,F}$ more than 10 times a night. However, where it is not reasonably practicable to achieve this guideline then the judgement of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number, distribution, predictability, and regularity of noise events".*

Note 3: BS8233:2014 states: "Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved".

Note 4: BS8233:2014 states: "The levels shown in Table 4 (criteria shown above) are based on the existing guidelines issued by the WHO and assume normal diurnal fluctuations in external noise. In cases where local conditions do not follow a typical diurnal pattern, for example on a road serving a port with high levels of traffic at certain times of the night, an appropriate alternative period, e.g., 1 hour, may be used, but the level should be selected to ensure consistency with the levels recommended in Table 4.

Note 5: BS8233:2014 states: "If relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level.

Table 4 – Internal Acoustic Design Criteria

The measured sound levels at the proposed development are assessed against the relevant criteria and a sound insulation scheme is provided to achieve a good internal acoustic environment.

4.2 Glazing and Background Ventilation Specification

The following section provides a glazing and background ventilation specification that achieves the relevant internal noise criteria. The calculations considering the following sound insulation scheme can be found in Appendix E. Refer to the façade map on Figure 6 for details on each façade location.

Sound Insulation Scheme – Red Façades Bedrooms									
Description	Octave Frequency Band (Hz, dB)							Overall (dB)	Overall (dB)
	63	125	250	500	1k	2k	4k		
6mm Glass / 16mm Argon Cavity / 6.8mm Optiphon Glass	21	21	28	37	48	48	54	39 (R_w)	33 (R_w + C_{tr})
Greenwood MA3051 (2 No. Trickle)	30	46	45	50	55	65	67	55 ($D_{ne,w}$)	52 ($D_{ne,w}$ + C_{tr})
Sound Insulation Scheme – Yellow Façades Bedrooms									
6mm Glass / 16mm Air Cavity / 4mm Glass	20	21	20	26	38	37	39	31 (R_w)	27 (R_w + C_{tr})
Greenwood MA3051 (2 No. Trickle)	30	46	45	50	55	65	67	55 ($D_{ne,w}$)	52 ($D_{ne,w}$ + C_{tr})
Sound Insulation Scheme – Green Façades Bedrooms									
6mm Glass / 16mm Air Cavity / 4mm Glass	20	21	20	26	38	37	39	31 (R_w)	27 (R_w + C_{tr})
Titon V75 + Standard Canopy (2 No. Trickle)	--	38	37	35	40	42	45	40 ($D_{ne,w}$)	38 ($D_{ne,w}$ + C_{tr})

Table 5 – Glazing & Background Ventilation Specification

Any other window or ventilation specification capable of providing this attenuation will be suitable provided the glazing suppliers can provide an acoustic test report in accordance with BS EN ISO 10140-2:2010 or an evidence-based calculation.

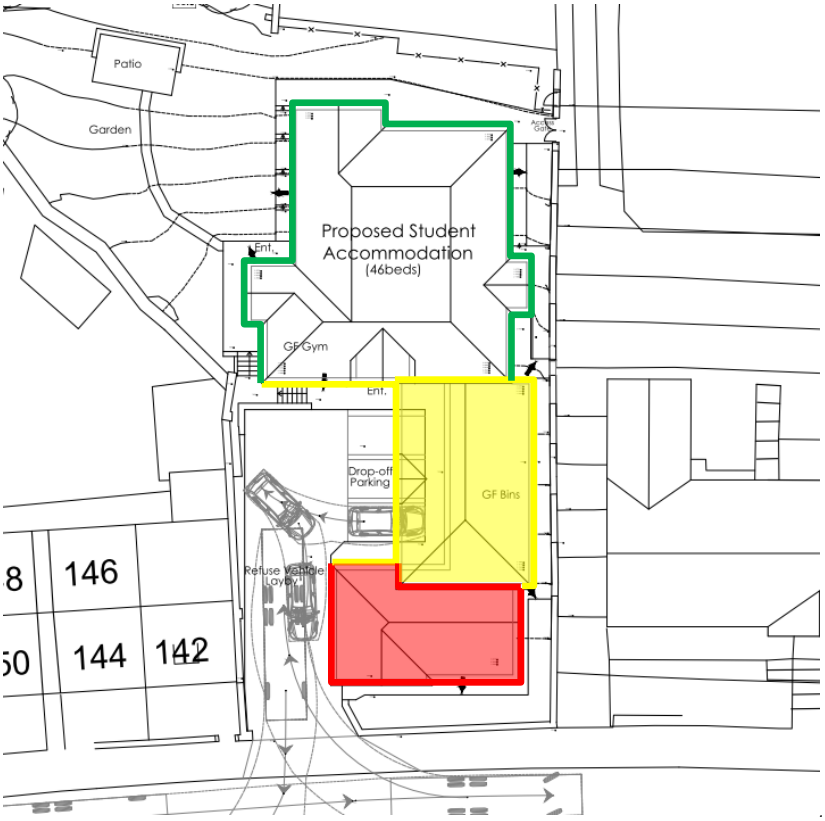


Figure 6 – Façade Map for Break-in Calculations

4.3 Room-in-Roof Construction

In this section, an indicative specification for the roof buildup over room in roof areas will be provided that achieves the relevant internal noise criteria. The calculations considering the following sound insulation scheme can be found in Appendix E. Refer to the façade map on Figure 6 for details on each area location.

Room in Roof – Red and Yellow Areas

- 8mm Roofing Slate
- 4mm Weather Membrane
- 200mm Joists with Resilient Bar, filled with 100mm RW45 Rockwool Insulation (tightly and evenly packed)
- 2 No. 15mm Gyproc SoundBloc Plasterboard (12.6kg/m^2 surface mass)

Due to the elevated noise levels, it is considered necessary to include a resilient bar system to the underside of the timber roofing joists to increase the sound insulation performance. Any other room in roof construction specification capable of providing a similar level of attenuation will be suitable.

5. Open Window Noise Break-In Assessment

5.1 Internal Noise Levels with Open Windows Criteria

The AVO Guide advises that if windows are open regularly to provide higher rates of ventilation to mitigate overheating, this will lead to elevated internal noise levels which could lead to undesirable living conditions. If windows are opened rarely the occupants may be able to tolerate elevated noise levels due to the inherent benefits of natural ventilation. This assessment will firstly assess whether the internal noise level criteria can be achieved with open windows. The AVO Guide provides criteria for both daytime and night-time periods which shown below.

Windows	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)	AVO Guide Table 3-3 Example Outcomes	AVO Guide Table 3 – 2 Recommendation for Level 2 Assessment
Rarely Open	50dB $L_{Aeq,16hour}$	42dB $L_{Aeq,8hour}$ Normally Exceeds 65dB $L_{AF,max}$	Noise causes a material change in behaviour e.g., having to keep windows closed most of the time	Recommended
Increasing Noise Level			Increasing likelihood of impact on reliable speech communication during the day or sleep disturbance at night	Optional
Often Open	40dB $L_{Aeq,16hour}$	35dB $L_{Aeq,8hour}$ Normally Exceeds 45dB $L_{AF,max}$	Noise can be heard, but does not cause any change in behaviour	Not Required

Table 6 – AVO Guide Open Window Criteria

To advise if openable windows can be used as the ventilation strategy (whilst maintaining reasonable internal noise levels), an open window assessment will be provided. The suitability of the internal noise levels will be based upon the internal noise criteria above and an open window providing 13 dB attenuation. If required, an alternative ventilation strategy compliant with Approved Document F will be proposed.

Given the dominance of road traffic noise, relying on an open window strategy to overcome overheating effects will not likely result in adverse impacts associated with noise from nearby businesses.

5.1 Open Window Assessment

This assessment will firstly consider whether the internal noise level criteria from Table 3 – 3 of the AVO Guide can be achieved with open windows.

AVO Open Window Assessment – Red Façades				
External Noise Levels	AVO Guide Windows Open Often	Exceedance	AVO Guide Windows Rarely Open	Exceedance
74 $L_{Aeq,16hr}$ (Day)	53	+21	63	+11
69 $L_{Aeq,8hr}$ (Night)	48	+21	55	+14
84 $L_{AF,max}$ (Night)	58	+26	78	+6
AVO Open Window Assessment – Yellow Façades				
65 $L_{Aeq,16hr}$ (Day)	53	+12	63	+2
60 $L_{Aeq,8hr}$ (Night)	48	+12	55	+5
78 $L_{AF,max}$ (Night)	58	+20	78	0
AVO Open Window Assessment – Green Façades				
63 $L_{Aeq,16hr}$ (Day)	53	+10	63	0
58 $L_{Aeq,8hr}$ (Night)	48	+10	55	+3
75 $L_{AF,max}$ (Night)	58	+17	78	-3
AVO Open Window Assessment – North Facing Green Façades				
45 $L_{Aeq,16hr}$ (Day)	53	-8	63	-18
40 $L_{Aeq,8hr}$ (Night)	48	-8	55	-15
61 $L_{AF,max}$ (Night)	58	+3	78	-17

Table 7 – Open Window Assessment

The external noise levels exceed the AVO Guides 'Rarely Open' criteria on all red, yellow and all but the north facing green façades which means that windows cannot be used for the primary means of ventilation and an alternate ventilation strategy is required in the residential areas that failed that is capable of a higher rate of ventilation. Due to the level of exceedance, it is unlikely that any passive ventilation strategy (such as attenuated louvres) would result in suitable internal levels. Therefore, it is recommended that provision of a mechanical extract ventilation system is considered to provide suitable levels of ventilation; windows should still remain openable at the occupant's choice and to provide purge ventilation, when required. This system may require design by a specialist to ensure conformance with Approved Document F and to ensure that adequate levels of ventilation are provided to overcome potential overheating effects.

For the north facing green façade residential areas, the external noise levels slightly exceed the AVO Guide's 'Windows Open Often' criteria. These areas are considered low risk in terms of noise impacts and am open window strategy is considered suitable.

6. Noise Breakthrough Assessment and Sound Insulation Scheme

6.1 Noise Breakthrough Criteria

It is understood that all partitions between residential uses will be designed to achieve the criteria outlined in Approved Document E (ADE). However, there are areas where residential uses structurally adjoin non-residential uses via separating floors and walls. It should be highlighted that all non-residential uses either service the development (i.e. the bin store and admin office) or provide additional facilities to be used by future residents such as the gym, cycle store and common room.

Guidance on sound insulation between adjoining domestic and non-domestic dwellings is discussed in Approved Document E (ADE) of the Building Regulations, section 0.8 of Part E states.

> *The performance standards set out in Tables 1a and 1b are appropriate for walls, floors and stairs that separate spaces used for normal domestic purposes. A higher standard of sound insulation may be required between spaces used for normal domestic purposes and communal or non-domestic purposes. In these situations, the appropriate level of sound insulation will depend on the noise generated in the communal or non-domestic space. Specialist advice may be needed to establish if a higher standard of sound insulation is required and, if so, to determine the appropriate level.*

Therefore, to minimise potential impacts, it is recommended that the sound insulation performance between residential and non-residential uses is considered dependent on the level of expected level of noise generated within the space.

6.2 Recommended Noise Breakthrough Assessment and Specification

The following table outlines the expected level of risk associated with the use of the structurally adjoining non-residential areas and provides a recommended sound insulation standard.

Partition Description	Level of Risk from Noise	Required Sound Insulation Standard (dB)
Partition Walls and Floors Small Office to Residential Areas	Medium	≥50 $D_{nT,w} + C_{tr}$
Partition Walls and Floors between Bin/Cycle Stores to Residential Areas	Medium	
Partition Floor between Gym and Common Room	High	≥60 $D_{nT,w}$
Partition Floor Common Room and Residential Areas	High	

Table 8 – Noise Breakthrough Assessment

An indicative specification that can achieve the required sound insulation standard is outlined below. The airborne sound reduction provided by the proposed system has been modelled in INSUL 9.0.

Floor Specification:

- 150mm Concrete Floor (min. density 2000kg/m^3)
- 150mm service void with 25mm mineral wool insulation
- 2no. layers of 15mm Gypsum Fireline (min. surface mass 11.7kg/m^2 per board)

Wall Specification:

- 2no. layers of 15mm Gypsum Soundbloc (min. surface mass 12.6kg/m^2 per board)
- Twin steel stud system with minimum cavity of 160mm between the plasterboard linings, partially filled with 50mm mineral wool insulation (min. density 45kg/m^3).
- 2no. layers of 15mm Gypsum Soundbloc (min. surface mass 12.6kg/m^2 per board)

It should be noted that this report provides an indicative specification that can achieve the required acoustic performance and considers that all flanking routes for sound have been appropriately suppressed. As with any construction project, the ability to meet the specification will rely upon the quality of the built structure. As such the works should be carried out to a high standard of workmanship to ensure that any sound insulation measures are not breached, for example by installing a rigid connection across an isolated connection. The development cannot achieve compliance until sound insulation testing is carried out by a UKAS accredited sound insulation testing company upon completion and assessed against the required sound insulation standard.

7. External Noise Level Assessment

7.1 External Noise Level Criteria

It is understood that there will be a garden and patio area to the rear of the development, which may be used for relaxation purposes. The following table outlines the external acoustic design criteria used in the following assessment.

Activity	Location	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)
Relaxation	External Amenity Spaces	50 - 55 dB $L_{Aeq,16hr}$	--

Table 9 – External Acoustic Design Criteria

7.2 External Noise Level Assessment

The following section analyses the external amenity area noise levels across the Proposed Development. The external amenity area sound levels at MP2 are summarised in the table below.

$L_{Aeq,16hr}$ Noise Level (dB)	BS8233:2014 Criteria (dB)	Exceedance (dB)
55	50 – 55 $L_{Aeq,16hr}$	0

Table 10 – BS8233 External Amenity Area Noise Level Assessment

As can be seen in Table 10, the predicted noise reduction at a point central of the amenity area does not exceed the BS8233 upper threshold.

It should be highlighted that due to the design of the development, the rear garden area is significantly screened from road traffic, which is the dominant source in the area. Therefore, it is anticipated that the additional of any localised screening (i.e. an acoustic fence along the perimeter of the garden) would provide limited acoustic gain and is not required.

8. Conclusion and Action Plan

The proposed development has been assessed against the acoustic design criteria and a sound insulation scheme has been provided to ensure the criteria has been achieved.

The following 'Action Plan' is outlined to ensure the design considerations and specifications from this report are duly implemented:

1. The proposed glazing and background ventilation system, or a suitable alternative, should be installed as shown in section 4.2.
2. Due to the high levels of road traffic noise incident on the development, some façades may require a mechanical ventilation or cooling system to overcome potential overheating effects. The level of ventilation provided by the system may depending on the level of risk from overheating at the site and should therefore be assessed by an overheating or ventilation specialist. Any assessment of the ventilation system should be undertaking assuming windows will need to remain closed to achieve suitable internal noise levels.
3. For areas where non-residential uses directly adjoin residential uses, it is recommended that the sound insulation performance achieves an uplift from that provided in ADE (as highlighted in Section 6.2). An indicative specification is also provided in Section 6.2.

The findings of this report will require written approval from the Local Authority prior to work commencing.

Appendix A – Acoustic Terminology

A-weighted sound pressure level, L_{pA}	Quantity of A-weighted sound pressure given by the following formula in decibels (dBA). $L_{pA} = 10 \log_{10} (pA/p_0)^2$. Where: pA is the A-weighted sound pressure in pascals (Pa) and $p0$ is the reference sound pressure (20 µPa)
Background Sound	Underlying level of sound over a period, T, which might in part be an indication of relative quietness at a given location
Equivalent continuous A-weighted sound pressure level, $L_{Aeq,T}$	Value of the A-weighted sound pressure level in decibels (dB) of a continuous, steady sound that, within a specified time interval, T, has the same mean-squared sound pressure as the sound under consideration that varies with time
Facade level	Sound pressure level 1 m in front of the facade
Free-field level	Sound pressure level away from reflecting surfaces
Indoor ambient noise	Noise in a given situation at a given time, usually composed of noise from many sources, inside and outside the building, but excluding noise from activities of the occupants
Noise Criteria	Numerical indices used to define design goals in a given space
Noise Rating (NR)	Graphical method for rating a noise by comparing the noise spectrum with a family of noise rating curves
Octave Band	Band of frequencies in which the upper limit of the band is twice the frequency of the lower limit
Percentile Level, $L_{AN,T}$	A-weighted sound pressure level obtained using time-weighting “F”, which is exceeded for N% of a specified time interval
Rating Level, $L_{Ar,Tr}$	Equivalent continuous A-weighted sound pressure level of the noise, plus any adjustment for the characteristic features of the noise
Reverberation time, T	Time that would be required for the sound pressure level to decrease by 60 dB after the sound source has stopped
Sound Pressure, p	root-mean-square value of the variation in air pressure, measured in pascals (Pa) above and below atmospheric pressure, caused by the sound
Sound Pressure Level, L_p	Quantity of sound pressure, in decibels (dB), given by the formula: $L_p = 10\log_{10}(p/p_0)^{2.}$ Wherehere: p is the root-mean-square sound pressure in pascals (Pa) and $p0$ is the reference sound pressure (20 µPa)
Weighted sound reduction index, R_w	Single-number quantity which characterizes the airborne sound insulating properties of a material or building element over a range of frequencies

Appendix B – Standards, Legislation, Policy, and Guidance

This report is to be primarily based on the following standards, legislation, policy, and guidance.

B.1 – National Planning Policy Framework (2023)

Government policy on noise is set out in the National Planning Policy Framework (NPPF), published in 2023. This replaced all earlier guidance on noise and places an emphasis on sustainability. In section 15, Conserving and enhancing the natural and local environment, paragraph 180, it states:

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. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans.

Paragraph 191 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.*

B.2 – Noise Policy Statement for England (2010)

Paragraph 191 of the NPPF also refers to advice on adverse effects of noise given in the Noise Policy Statement for England (NPSE). This document sets out a policy vision to:

Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development.

To achieve this vision the Statement identifies the following three aims:

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

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

In achieving these aims the document introduces significance criteria as follows:

SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur. It is stated that "significant adverse effects on health and quality of life should be avoided while also considering the guiding principles of sustainable development".

LOAEL – Lowest Observed Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected. It is stated that the second aim above lies somewhere between LOAEL and SOAEL and requires that: "all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also considering the guiding principles of sustainable development. This does not mean that such adverse effects cannot occur."

NOEL – No Observed Effect Level

This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise. This can be related to the third aim above, which seeks: "where possible, positively to improve health and quality of life through the pro-active management of noise while also considering the guiding principles of sustainable development, recognising that there will be opportunities for such measures to be taken and that they will deliver potential benefits to society. The protection of quiet places and quiet times as well as the enhancement of the acoustic environment will assist with delivering this aim."

This is further expanded using the updated "Noise Exposure Hierarchy Table" which includes an additional level of impact referred to as the 'No Observed Adverse Effect Level' ('NOAEL'). It is stated that at this level: *"noise can be heard, but does not cause any change in behaviour, attitude or other physiological response"*. In addition, noise at this level *"can slightly affect the acoustic character of the area but not such that there is a change in the quality of life".*

The NPSE recognises that it is not possible to have a single objective noise-based measure that is mandatory and applicable to all sources of noise in all situations and provides no guidance as to how these criteria should be interpreted. It is clear, however, that there is no requirement to achieve noise levels where there are no observable adverse impacts but that reasonable and practicable steps to reduce adverse noise impacts should be taken in the context of sustainable development and ensure a balance between noise sensitive and the need for noise generating developments.

Any scheme of noise mitigation outlined in this report will, therefore, aim to abide by the above principles of the NPPF and NPSE whilst recognizing the constraints of the site.

B.3 – BS8233:2014 'Guidance on Sound insulation and noise reduction for buildings'

BS8233 provides guidance on noise levels from sources without specific character in the built environment, based on the recommendations of the World Health Organization; specifically, 'WHO Guidelines on Community Noise, 1999'. The Guidelines on Community Noise (1999) document defines community noise to include noise from "industries" and "construction". The desirable criteria levels of steady state, "anonymous" noise in unoccupied spaces within dwellings, from sources such as road traffic, mechanical services and other continuously running plant, are tabulated below.

BS8233:2014 Internal Ambient Noise Level Criteria			
Activity	Location	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)
Resting	Living Room	35 dB $L_{Aeq,16hour}$	--
Dining	Dining Room/Area	40 dB $L_{Aeq,16hour}$	--
Sleeping (Daytime resting)	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$ 45 dB L_{AFmax}*

Table 11 – BS8233:2014 Internal Ambient Noise Level Criteria

**ProPG:2017 states that's good acoustic design can be used so that individual noise events do not normally exceed 45 dB L_{AFmax} more than 10 time a night within noise sensitive rooms such as bedrooms. However, where it is not reasonably practicable to achieve the guideline then the judgment of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number distribution, predictability, and regularity of noise events.*

It is noted, however, that where development is considered necessary or desirable, despite external noise level above WHO guidelines, the above target levels may be relaxed by up to 5 dB.

General recommendations for mitigation to enable these targets to be achieved are provided, including the use of bunds and barriers to reduce external noise and space planning and sound insulation for the control of internal noise levels.

For this assessment, the above criteria are considered to be the 'LOAEL' as defined in the NPSE in Appendix B.

B.4 – Approved Document 0: Overheating (2021)

Approved Document O states the following in relation to noise:

1. 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).
2. Windows are likely to be closed during sleeping hours if noise within bedrooms exceeds the following limits.
    a. 40dB $L_{Aeq,T}$, averaged over 8 hours (between 11pm and 7am).
    b. 55dB L_{AFmax}, more than 10 times a night (between 11pm and 7am).
3. 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).B.6 - Acoustics Ventilation and Overheating – Residential Design Guide 2020

B.5 – Acoustics Ventilation and Overheating – Residential Design Guide 2020

It is suggested that the desirable internal noise criteria within BS8233:2014 should be achieved considering adequate ventilation as defined by Building Regulations 'Approved Document F' ('ADF') whole dwelling ventilation. However, for a whole dwelling ventilation system such as MVHR it is considered reasonable to allow higher levels of internal ambient noise from transport sources when higher rates of ventilation are required in relation to the overheating condition.

The 'Institute of Acoustics' ('IOA') and the 'Association of Noise Consultant's ('ANC') have published 'The AVO Guide: 2020' document 2020. It provides guidance for those acousticians involved in the design of buildings to prevent noise ingress to and achieve reasonable internal levels. This provides valuable guidance on ventilation and overheating in support of the "Good Acoustic Design" principle advocated by ProPG. Along with guidance showing an acoustic assessment during the overheating condition, the AVO Guide (2020) provides a framework that has a two-level assessment procedure to estimate the potential impact on occupants:

Level 1 Risk Assessment

AVO 'Level 1' risk assessment criteria guide based on external free field ambient noise levels for dwellings relying on purge ventilation (e.g., opening windows) to prevent summertime overheating. AVO Guide Table 3-2 detailed in the figure below. To assess the possibility of overheating it is reasonable to relax the BS 8233:2014 internal ambient noise levels from opening a window by 5 decibels (5 dB). Also, it is assumed that a partially open window will provide a sound reduction of 13 dB. Therefore, to achieve internal noise levels in line with BS 8233:2014 the façade external noise levels should fall inside the levels shown in Table 3-2.

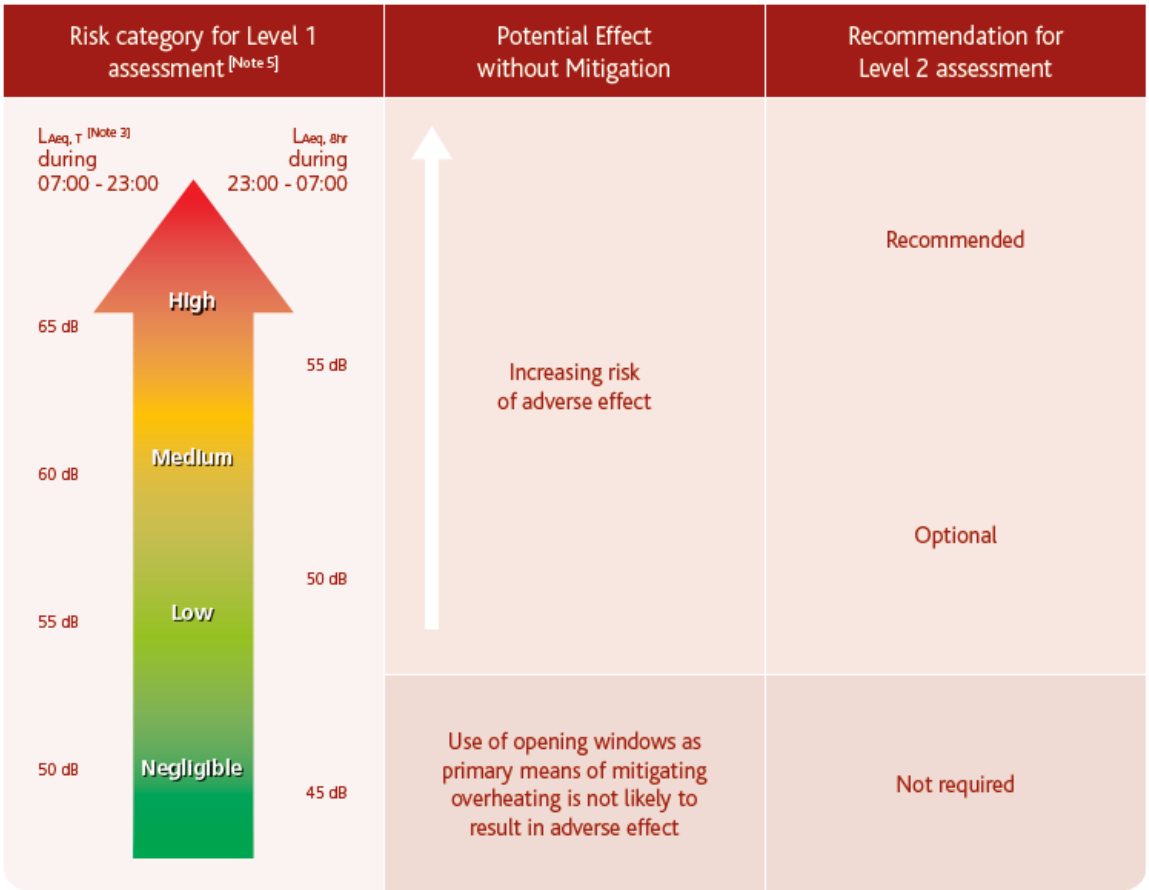


Table 3-2 of AVO Guide (2020)

Figure 7 – AVO Guide Level 1 Risk Category

The AVO Guide (2020) seeks to determine the level of risk associated with overheating in a new residential development based on the existing noise climate. The AVO risk categories are detailed in the table below with clearer categorisation.

Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)	Risk Category	Mitigation
≥63 dB $L_{Aeq,16hour}$	≥55 dB $L_{Aeq,8hour}$	High Risk	Level 2 assessment recommended. Windows which are unopenable on grounds of noise will inevitably create issues for the overheating strategy.
57 – 62 dB $L_{Aeq,16hour}$	52 – 54 dB $L_{Aeq,8hour}$	Medium Risk	Level 2 assessment optional to give more confidence regarding the suitability of internal noise conditions.
54 – 56 dB $L_{Aeq,16hour}$	49 – 51 dB $L_{Aeq,8hour}$	Low Risk	
≤53 dB $L_{Aeq,16hour}$	≤48 dB $L_{Aeq,8hour}$	Negligible Risk	None required – openable windows suitable for ventilation

Table 12 – AVO Guide (2020) Level 1 Risk Assessment

Level 2 Risk Assessment:

A 'Level 2' assessment of noise is recommended where a dwelling using purge ventilation (e.g., open windows) reaches Level 1 'High Risk' or 'Medium Risk'. The Level 2 assessment guidance comments that where internal ambient noise levels are >50 dB $L_{Aeq,16hr}$ (day) or >42 dB $L_{Aeq,8hr}$ (night) then the outcome might be that the noise causes a material change in behaviour, e.g., having to keep windows closed for the majority of the time, or there is the potential for sleep disturbance.

To conduct a Level 2 assessment, the following minimum information is required:

- Statement of the overheating criteria being applied.
- Description of the provisions for meeting the stated overheating criteria. This should include, where relevant, the area of façade opening.
- Details of the likely internal ambient noise levels whilst using provisions for mitigating overheating, and the method used to predict these.
- Estimation of how frequently and for what duration such provisions are required to mitigate overheating.
- Consideration of the effect of individual noise events.
- Assessment of the adverse effect on occupants.

The figure below outlines the AVO Guide (2020) guidance for a Level 2 assessment of noise from transport sources relating to the Overheating Condition.

Internal ambient noise level [Note 2]			Examples of Outcomes [Note 5]	
$L_{Aeq,T}$ [Note 3] during 07:00 – 23:00 [Note 6]	$L_{Aeq,8h}$ during 23:00 – 07:00	Individual noise events during 23:00 – 07:00 [Note 4]		
> 50 dB	> 42 dB	Normally exceeds 65 dB $L_{AF,max}$	Noise causes a material change in behaviour e.g. having to keep windows closed most of the time	Avoiding certain activities during periods of intrusion. Having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.
			Increasing likelihood of impact on reliable speech communication during the day or sleep disturbance at night	At higher noise levels, more significant behavioural change is expected and may only be considered suitable if occurring for limited periods. As noise levels increase, small behaviour changes are expected e.g. turning up the volume on the television; speaking a little more loudly; having to close windows for certain activities, for example ones which require a high level of concentration. Potential for some reported sleep disturbance. Affects the acoustic environment inside the dwelling such that there is a perceived change in quality of life. At lower noise levels, limited behavioural change is expected unless conditions are prevalent for most of the time. [Note 8]
≤ 35 dB	≤ 30 dB	Do not normally exceed $L_{AF,max}$ 45 dB more than 10 times a night	Noise can be heard, but does not cause any change in behaviour	Noise can be heard, but does not cause any change in behaviour, attitude, or other physiological response[Note 9]. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.

Note 1 The noise levels suggested in Tables 3-2 and 3-3 assume a steady road traffic noise source but may be adapted for other types of transport.

Table 3-3 of AVO Guide (2020)

Figure 8 – AVO Guide Level 2 Internal Ambient Noise Levels

Appendix C – Proposed Floor Plans

Figure 9 – Proposed Floor Plans

Appendix D – Environmental Survey

D.1 – Time History Noise Data

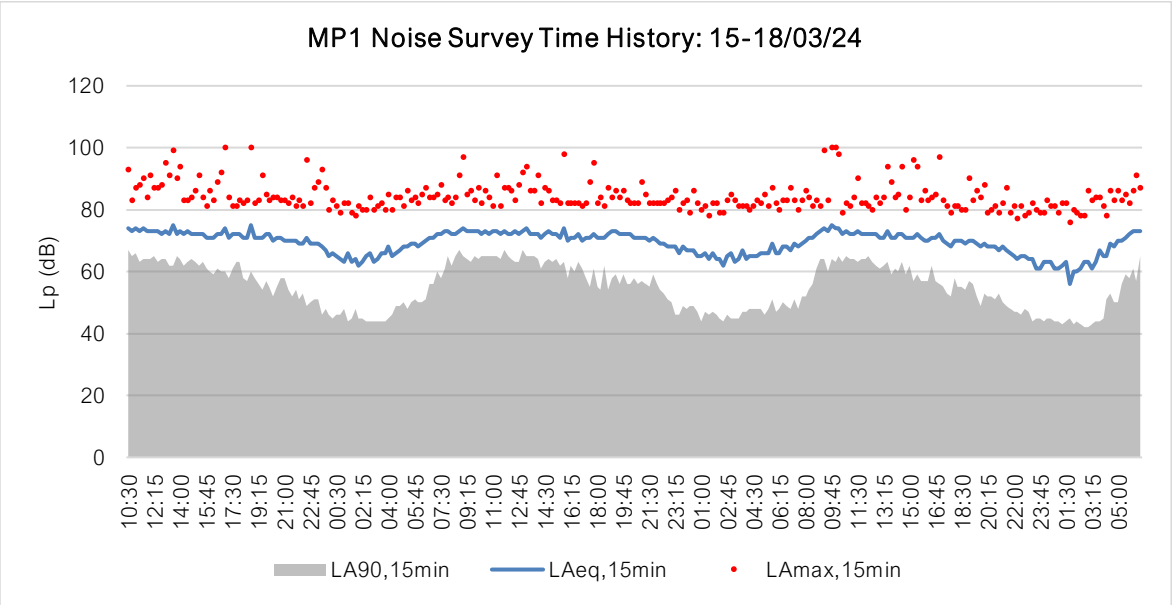


Figure 10 – MP1 Noise Survey Time History

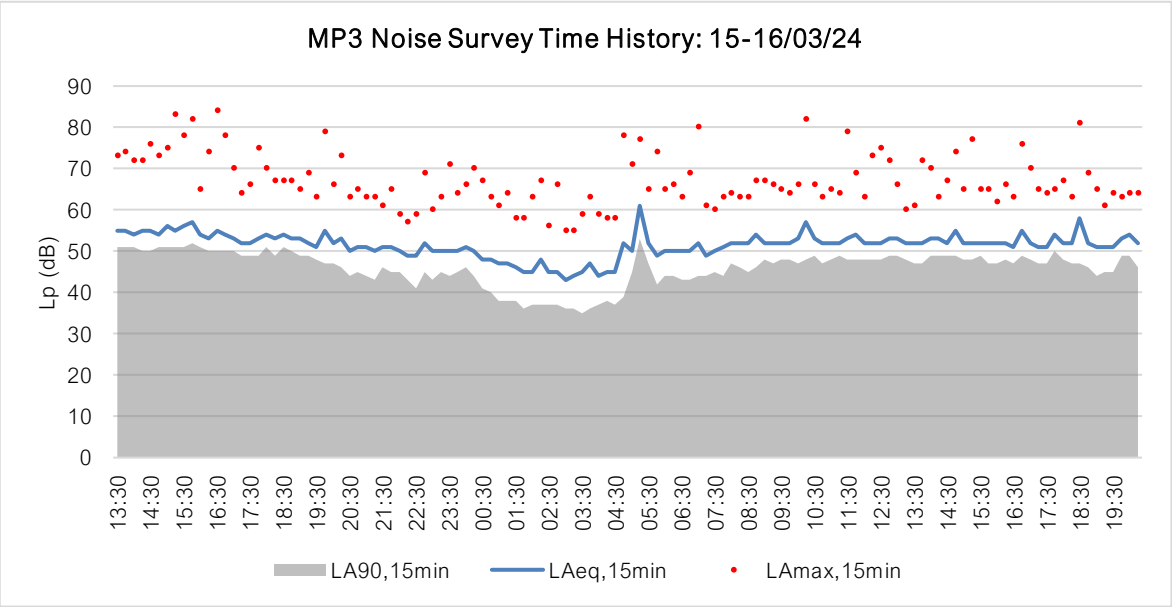


Figure 11 – MP3 Noise Survey Time History

D.2 – Surveying Equipment

Piece of Equipment	Serial No.	Calibration Deviation
Svantek SC307 Class 1 Sound Level Meter	87871	≤0.1
Svantek SV33B Class 1 Calibrator	125695	
CESVA SC420 Class 1 Sound Level Meter	T246471	≤0.5
CESVA CB006 Class 1 Calibrator	901955	

Table 13 – Surveying Equipment

All equipment used during the survey was field calibrated at the start and end of the measurement period with a negligible deviation of ≤0.5dB. All sound level meters are calibrated every 24 months and all calibrators are calibrated every 12 months, by a third-party calibration laboratory. All microphones were fitted with a protective windshield for the entire measurements period. Calibration certificates can be provided upon request.

D.3 – Meteorological Conditions

As the environmental noise survey was carried out over a long un-manned period no localised records of weather conditions were taken. However, all measurements have been compared with met office weather data of the area, specifically the closest weather station, and the data from the weather station is outlined in the table below. When reviewing the time history of the noise measurements, any scenarios that were considered potentially to be affected by the local weather conditions have been omitted. The analysis of the noise data includes statistical and percentile analysis and review of minimum and maximum values, which aids in the preclusion of any periods of undesirable weather conditions. The weather conditions were deemed suitable for the measurement of environmental noise in accordance with BS7445 Description and Measurement of Environmental Noise. The table below presents the average temperature, wind speed and rainfall range for each 24-hour period during the entire measurement.

Weather Conditions – Reinwood (Approx. 2.3km NWW of Site)				
Time Period	Air Temp (ºC)	Rainfall (mm/h)	Prevailing Wind Direction	Wind Speed (m/s)
15/10/23 – 00:00 – 23:59	3.7 – 10.8	0.0 – 2.3	ENE	0.0 – 2.9
16/10/23 – 00:00 – 23:59	1.9 – 10.4	0.0 – 1.0	NNE	0.0 – 0.9
17/10/23 – 00:00 – 23:59	8.1 – 15.2	0.0 – 0.5	NE	0.0 – 2.5
18/10/23 – 00:00 – 23:59	5.8 – 13.8	0.0 – 0.3	NE	0.5 – 2.2

Table 14 – Weather Conditions

Appendix E – Noise Break-in Calculations

The façade sound reduction and predicted internal noise levels are calculated assuming the following:

- The calculation method for façade sound reduction is in accordance with BS8233:2014 and BS EN 12354-3.
- The reverberation time is typically 0.5 seconds across the relevant frequency range for a furnished living room in the UK. This value is used for both living rooms and bedrooms.
- Based on the technical drawings provided to NOVA Acoustics, for the southern façades window areas of 1.7m^2 and room volumes of 34.4m^3 are used in the calculations for bedrooms as a worst-case scenario. For the eastern façades window areas of 1.8m^2 and room volumes of 30.3m^3 are used in the calculations for bedrooms as a worst-case scenario. For other façades window areas of 2.7m^2 and room volumes of 90m^3 are used for the Common Room, and window areas of 1.5m^2 and room volumes of 34.7m^3 are used for the bedroom as a worst-case scenario.
- The acoustic performance of the façade elements is taken from the relevant manufacturers' technical information, or the sound reduction has been predicted using INSUL 9.0.
- For background trickle ventilation a total Equivalent Area of 5000mm^2 per habitable room has been used in the calculations, which equates to 2 No. trickle vents (2500mm^2 each).

Cluster Bedroom (Red Façades Bedrooms) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Leq,T Spectrum	74	72	67	67	67	70	67	60	60
Glazing Noise Ingress	24	41	36	29	20	12	9	-4	-4
Ventilation Noise Ingress	21	42	21	22	17	15	2	-7	-7
Wall Noise Ingress	15	30	20	18	8	10	7	0	0
Roof Noise Ingress									
Room Absorption Correction		2	1	1	0	0	0	-1	-3
Total Noise Ingress	**30**	**49**	**40**	**34**	**25**	**21**	**14**	**4**	**2**
NR30	35	59	48	39	33	30	26	24	22
Exceedance of Criteria	-5	-10	-8	-5	-8	-9	-12	-20	-20

Cluster Bedroom (Red Façades Bedrooms) Night Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Leq,T Spectrum	69	66	61	62	63	65	62	56	56
Glazing Noise Ingress	19	34	29	23	15	6	3	-9	-9
Ventilation Noise Ingress	16	36	15	17	13	10	-3	-11	-11
Wall Noise Ingress	10	24	14	13	4	5	2	-4	-4
Roof Noise Ingress									
Room Absorption Correction		2	1	1	0	0	0	-1	-3
Total Noise Ingress	**25**	**43**	**34**	**28**	**21**	**16**	**9**	**0**	**-2**
NR25	30	55	43	35	28	25	21	19	17
Exceedance of Criteria	-5	-12	-9	-7	-7	-9	-12	-19	-19

Cluster Bedroom (Red Façades Bedrooms) Night Time Max

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Lmax Spectrum	84	81	76	77	78	80	77	71	71
Glazing Noise Ingress	35	50	45	39	31	22	19	7	7
Ventilation Noise Ingress	31	51	30	32	28	25	12	4	4
Wall Noise Ingress	26	39	29	28	19	20	17	11	11
Roof Noise Ingress									
Room Absorption Correction		2	1	1	0	0	0	-1	-3
Total Noise Ingress	**40**	**58**	**49**	**44**	**36**	**31**	**25**	**15**	**13**
NR40	45	67	56	49	43	40	37	34	33
Exceedance of Criteria	-5	-9	-7	-5	-7	-9	-12	-19	-20

Figure 12 – Southern Façade Window Calculations

Bedroom (Yellow Façade Bedrooms) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Leq,T Spectrum	65	64	59	59	59	62	59	52	52
Glazing Noise Ingress	24	34	28	29	23	14	12	3	3
Ventilation Noise Ingress	13	34	13	14	9	7	-6	-15	-15
Wall Noise Ingress	7	21	11	9	-1	1	-2	-9	-9
Roof Noise Ingress									
Room Absorption Correction		2	1	1	0	0	0	-1	-3
Total Noise Ingress	**28**	**42**	**32**	**33**	**27**	**18**	**15**	**5**	**4**
NR25	30	55	43	35	28	25	21	19	17
Exceedance of Criteria	-2	-13	-11	-2	-1	-7	-6	-14	-13

Bedroom (Yellow Façade Bedrooms) Night Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Leq,T Spectrum	60	57	52	53	54	56	53	47	47
Glazing Noise Ingress	19	28	22	24	19	9	7	-1	-1
Ventilation Noise Ingress	8	28	7	9	5	2	-11	-19	-19
Wall Noise Ingress	2	15	5	4	-5	-4	-7	-13	-13
Roof Noise Ingress									
Room Absorption Correction		2	1	1	0	0	0	-1	-3
Total Noise Ingress	**23**	**35**	**26**	**27**	**22**	**13**	**10**	**1**	**-1**
NR30	35	59	48	39	33	30	26	24	22
Exceedance of Criteria	-12	-24	-22	-12	-11	-17	-16	-23	-23

Bedroom (Yellow Façade Bedrooms) Night Time Max

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Lmax Spectrum	78	75	70	71	72	74	71	65	65
Glazing Noise Ingress	37	45	39	41	36	26	24	16	16
Ventilation Noise Ingress	26	46	25	27	23	20	7	-1	-1
Wall Noise Ingress	19	33	23	22	13	14	11	5	5
Roof Noise Ingress									
Room Absorption Correction		2	1	1	0	0	0	-1	-3
Total Noise Ingress	**41**	**53**	**44**	**45**	**40**	**31**	**28**	**19**	**17**
NR40	45	67	56	49	43	40	37	34	33
Exceedance of Criteria	-4	-14	-12	-4	-3	-9	-9	-15	-16

Figure 13 – Eastern Façade Window Calculations

Living Room (Green Façades Common Room) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Leq,T Spectrum	63	62	57	57	57	60	57	50	50
Glazing Noise Ingress	22	31	25	26	20	11	9	0	0
Ventilation Noise Ingress	22		17	18	20	18	13	3	3
Wall Noise Ingress	5	19	9	7	-3	-1	-4	-11	-11
Roof Noise Ingress									
Room Absorption Correction		1	1	1	0	0	0	-1	-3
Total Noise Ingress	**28**	**36**	**30**	**30**	**26**	**22**	**17**	**6**	**5**
NR30	35	59	48	39	33	30	26	24	22
Exceedance of Criteria	-7	-23	-18	-9	-7	-8	-9	-18	-17

Bedroom (Green Façades Bedrooms) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Leq,T Spectrum	63	62	57	57	57	60	57	50	50
Glazing Noise Ingress	21	30	24	25	19	10	8	-1	-1
Ventilation Noise Ingress	23		19	20	22	20	15	5	5
Wall Noise Ingress	5	19	9	7	-3	-1	-4	-11	-11
Roof Noise Ingress									
Room Absorption Correction		2	1	1	0	0	0	-1	-3
Total Noise Ingress	**29**	**35**	**30**	**30**	**27**	**23**	**18**	**8**	**6**
NR25	30	55	43	35	28	25	21	19	17
Exceedance of Criteria	-1	-20	-13	-5	-1	-2	-3	-11	-11

Bedroom (Green Façades Bedrooms) Night Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Leq,T Spectrum	58	55	50	51	52	54	51	45	45
Glazing Noise Ingress	16	24	18	20	15	5	3	-5	-5
Ventilation Noise Ingress	19		12	14	17	14	9	0	0
Wall Noise Ingress	0	13	3	2	-7	-6	-9	-15	-15
Roof Noise Ingress									
Room Absorption Correction		2	1	1	0	0	0	-1	-3
Total Noise Ingress	**24**	**29**	**23**	**25**	**23**	**18**	**13**	**3**	**2**
NR30	35	59	48	39	33	30	26	24	22
Exceedance of Criteria	-11	-30	-25	-14	-10	-12	-13	-21	-20

Bedroom (Green Façades Bedrooms) Night Time Max

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Lmax Spectrum	75	72	67	68	69	71	68	62	62
Glazing Noise Ingress	33	41	35	37	32	22	20	12	12
Ventilation Noise Ingress	36		29	31	34	31	26	17	17
Wall Noise Ingress	17	30	20	19	10	11	8	2	2
Roof Noise Ingress									
Room Absorption Correction		2	1	1	0	0	0	-1	-3
Total Noise Ingress	**41**	**46**	**40**	**42**	**40**	**35**	**30**	**20**	**19**
NR40	45	67	56	49	43	40	37	34	33
Exceedance of Criteria	-4	-21	-16	-7	-3	-5	-7	-14	-14

Figure 14 – Western Façade Window Calculations

Cluster Bedroom (Red Façades Bedrooms with Room In Roof Detail) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Leq,T Spectrum	74	72	67	67	67	70	67	60	60
Glazing Noise Ingress	22	38	33	26	17	9	6	-7	-7
Ventilation Noise Ingress	19	40	19	20	15	13	0	-9	8
Wall Noise Ingress	13	28	18	16	6	8	5	-2	-2
Roof Noise Ingress	17	37	18	13	8	11	8	1	1
Room Absorption Correction		4	3	3	3	3	2	1	0
Total Noise Ingress	**31**	**50**	**40**	**34**	**25**	**22**	**17**	**8**	**12**
NR30	35	59	48	39	33	30	26	24	22
Exceedance of Criteria	-4	-9	-8	-5	-8	-8	-9	-16	-10

Cluster Bedroom (Red Façades Bedrooms with Room In Roof Detail) Night Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Leq,T Spectrum	69	66	61	62	63	65	62	56	56
Glazing Noise Ingress	17	32	27	21	13	4	1	-11	-11
Ventilation Noise Ingress	14	34	13	15	11	8	-5	-13	-13
Wall Noise Ingress	8	21	11	10	1	2	-1	-7	-7
Roof Noise Ingress	11	31	12	8	4	6	3	-3	-3
Room Absorption Correction		4	3	3	3	3	2	1	0
Total Noise Ingress	**26**	**44**	**34**	**29**	**21**	**17**	**12**	**4**	**2**
NR25	30	55	43	35	28	25	21	19	17
Exceedance of Criteria	-4	-11	-9	-6	-7	-8	-9	-15	-15

Cluster Bedroom (Red Façades Bedrooms with Room In Roof Detail) Night Time Max

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Lmax Spectrum	84	81	76	77	78	80	77	71	71
Glazing Noise Ingress	32	48	43	37	29	20	17	5	5
Ventilation Noise Ingress	29	49	28	30	26	23	10	2	2
Wall Noise Ingress	23	37	27	26	17	18	15	9	9
Roof Noise Ingress	27	47	28	24	20	22	19	13	13
Room Absorption Correction		4	3	3	3	3	2	1	0
Total Noise Ingress	**41**	**60**	**49**	**44**	**37**	**33**	**27**	**19**	**17**
NR40	45	67	56	49	43	40	37	34	33
Exceedance of Criteria	-4	-7	-7	-5	-6	-7	-10	-15	-16

Figure 15 – Red Façade Window Calculations with Room-in-Roof Detail

Bedroom (Yellow Façade Bedrooms with Room in Roof Detail) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Leq,T Spectrum	65	64	59	59	59	62	59	52	52
Glazing Noise Ingress	22	32	26	27	21	12	10	1	1
Ventilation Noise Ingress	11	32	11	12	7	5	-8	-17	-1
Wall Noise Ingress	5	19	9	7	-3	-1	-4	-11	-11
Roof Noise Ingress	8	29	10	5	0	3	0	-7	-7
Room Absorption Correction		4	3	3	3	3	2	1	0
Total Noise Ingress	**28**	**43**	**32**	**33**	**27**	**19**	**16**	**6**	**6**
NR25	30	55	43	35	28	25	21	19	17
Exceedance of Criteria	-2	-12	-11	-2	-1	-6	-5	-13	-11

Bedroom (Yellow Façade Bedrooms with Room in Roof Detail) Night Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Leq,T Spectrum	60	57	52	53	54	56	53	47	47
Glazing Noise Ingress	17	25	19	21	16	6	4	-4	-4
Ventilation Noise Ingress	6	26	5	7	3	0	-13	-21	-21
Wall Noise Ingress	-1	13	3	2	-7	-6	-9	-15	-15
Roof Noise Ingress	3	23	4	0	-4	-2	-5	-11	-11
Room Absorption Correction		4	3	3	3	3	2	1	0
Total Noise Ingress	**23**	**36**	**26**	**28**	**22**	**13**	**10**	**1**	**0**
NR30	35	59	48	39	33	30	26	24	22
Exceedance of Criteria	-12	-23	-22	-11	-11	-17	-16	-23	-22

Bedroom (Yellow Façade Bedrooms with Room in Roof Detail) Night Time Max

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Lmax Spectrum	78	75	70	71	72	74	71	65	65
Glazing Noise Ingress	35	43	37	39	34	24	22	14	14
Ventilation Noise Ingress	23	44	23	25	21	18	5	-3	-3
Wall Noise Ingress	17	31	21	20	11	12	9	3	3
Roof Noise Ingress	21	40	21	17	13	15	12	6	6
Room Absorption Correction		4	3	3	3	3	2	1	0
Total Noise Ingress	**41**	**54**	**44**	**45**	**40**	**31**	**28**	**19**	**18**
NR40	45	67	56	49	43	40	37	34	33
Exceedance of Criteria	-4	-13	-12	-4	-3	-9	-9	-15	-15

Figure 16 – Yellow Façade Window Calculations with Room-in-Roof Detail

Appendix F – Noise Modelling Particulars

The SoundPlan 9.0 noise model has been setup with the following inputs and assumptions:

- To accurately model the land surrounding the development the topographical data has been taken from the EAs 'National LIDAR Programme' on the DEFRA Data Services Platform.
- The sound map grid height has been set to 1.5m, however, the noise levels used in the assessment will be taken form the most exposed point on each NSR façade.
- All buildings and any intervening objects have been modelled according to the technical drawings provided by the applicant, and those provided by the LIDAR data.
- The noise levels presented in Table 2 have been used to calibrate the noise model.

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