Residential Noise Assessment

Site Address: Waverley United Reformed Church, Waverley Road, Huddersfield, HD1 5NA

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Delivering sustainable development by promoting good health and well-being through effective management of noise.

Contents

1. INTRODUCTION 4
1.1 Standards, Legislation, Policy & Guidance 4
1.2 Proposal Brief 5
1.3 Local Planning Authority & Background 5
2. ENVIRONMENTAL NOISE SURVEY 7
2.1 Measurement Methodology 7
2.2 Context & Subjective Impression 8
2.3 Environmental Noise Survey Results 8
3. NOISE BREAK-IN ASSESSMENT AND SOUND INSULATION SCHEME 9
3.1 Internal Noise Level Criteria 9
3.2 Determined External Noise Levels 9
3.3 Glazing and Whole Dwelling (Background) Ventilation Specification 10
4. OVERHEATING SCREENING ASSESSMENT 11
4.1 Overheating Criteria 11
4.2 Overheating Assessment 11
5. CONCLUSION AND ACTION PLAN 12
APPENDIX A – ACOUSTIC TERMINOLOGY 13
APPENDIX B – STANDARDS, LEGISLATION, POLICY, AND GUIDANCE 14
B.1 – National Planning Policy Framework (2023) 14
B.2 – Noise Policy Statement for England (2010) 14
B.3 – BS8233:2014 'Guidance on Sound insulation and noise reduction for buildings' 16
B.4 – Approved Document F Volume 1: Dwellings (2021) 17
B.5 – Acoustics Ventilation and Overheating – Residential Design Guide 2020 17
APPENDIX C – LOCATION PLANS 21
APPENDIX D – ENVIRONMENTAL SURVEY 22
D.1 – Time History Noise Data 22
D.2 – Surveying Equipment 23
D.3 – Meteorological Conditions 23
APPENDIX E – NOISE BREAK-IN CALCULATIONS 24
E.1 – Façades with Background Ventilation 24

List of Figures

Figure 1 – Proposed Location and Site Plan 5
Figure 2 – Measurement Locations and Site Surroundings 7
Figure 3 – AVO Guide Level 1 Risk Category 18
Figure 4 – AVO Guide Level 2 Internal Ambient Noise Levels 20
Figure 5 – Location Plans 21
Figure 6 – MP1 Noise Survey Time History 22
Figure 7 – MP2 Noise Survey Time History 22

List of Tables

Table 1 – Measurement Methodology 7
Table 2 – Sound Level Results Summary 8
Table 3 – Internal Acoustic Design Criteria 9
Table 4 – Determined Free-field External Noise Levels 9
Table 5 – Glazing & Background Ventilation Specification 10
Table 6 – External Noise Level Limits for Overheating Criteria 11
Table 7 – BS8233:2014 Internal Ambient Noise Level Criteria 16
Table 8 – AVO Guide (2020) Level 1 Risk Assessment 19
Table 9 – Surveying Equipment 23
Table 10 – Weather Conditions 23

1. Introduction

NOVA Acoustics Ltd has been commissioned to prepare a noise assessment for a residential development ('the proposed development') at Waverley United Reformed Church, Waverley Road, Huddersfield, HD1 5NA ('the site'). The proposed development is for the conversion of the existing Church into 10 apartments.

The applicant has received conditional approval for planning application No. 2023/62/93715/W ('the Application') from Kirklees Council. This report has been prepared to discharge condition 3 imposed by 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:

- The LPA's conditional approval; specifically, 'Condition 3'.
- National Planning Policy Framework (2023).
- Noise Policy Statement for England (2010).
- British Standard BS8233:2014 – 'Guidance on sound insulation and noise reduction for buildings'.
- Approved Document F: Volume 1 Dwellings (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 conversion of the existing church into 10no. apartments. The figure below shows the proposed development.

The site will have 6no. car parking spaces and there will be no external amenity areas or any externally fixed mechanical plant. As a result, an assessment of external amenity space is not presented.

Drawing Ref No. TR-A23-0802-007 from 'Trend Architecture'

Figure 1 – Proposed Location and Site Plan

1.3 Local Planning Authority & Background

The following condition of the approved planning application (No. 3) requires discharging:

- 2023/62/93715/W – Condition 3:

"3. Within 28 days of the date on which permission is granted, a report specifying the measures to be taken to protect the development from noise from all significant noise sources that are likely to affect the proposed development including the adjacent car park at the Masjid Iman Mosque shall be submitted to and approved in writing by the Local Planning Authority. The report shall:

a) Determine the existing noise climate

b) Predict the noise climate in living rooms, bedrooms (night-time) and other habitable rooms of the development

c) Detail the proposed attenuation/design necessary to protect the amenity of the occupants of the new residences (including ventilation if required).

Any dwelling that is found to require noise attenuation works shall not be occupied until all works specified in the approved report have been carried out in full. All such works shall be thereafter retained.

Reason: To ensure that future residents do not suffer loss of amenity arising from noise disturbance, and to accord with the aims of Policies LP24(b) and LP52 of the Kirklees Local Plan."

2. Environmental Noise Survey

2.1 Measurement Methodology

Unattended monitoring was undertaken at the proposed development in two measurement positions (MP1 and MP2). The location of these and the measurement particulars are identified below.

Attended monitoring was also undertaken externally during a prayer session at the Masjid Iman Mosque. The location of this measurement is highlighted as MP3 and further details are also provided below.

All measurements were undertaken under free-field conditions, apart from at MP1. An appropriate 3dB correction has been applied to these figures to convert them to a free-field level in line with appropriate guidance documents.

The following table outlines the measurement dates and particulars. In all instances a 130mm diameter windshield was fitted to the microphones along with a suitable outdoor environmental kit. Details of the equipment used, and the meteorological conditions are available in Appendix D.

Location	Survey Dates	Measurement Particulars
MP1	11/09/2024 – 13/09/2024	Equipment mounted 4m high on a drainpipe fixed to the north-eastern façade of the existing building at 0.5m distance from the building façade.
MP2		Equipment mounted on a tripod 1.5m high on the roof of the ground floor area that is located to the south of the existing building.
MP3	13/09/2024	Equipment mounted on a tripod 1.5m above ground in a free-field location within the south-eastern area of the existing site.

Table 1 – Measurement Methodology

The figure below outlines the site surroundings and measurement locations:

Imagery ©2024 Infoterra Ltd & Bluesky, Maxar Technologies, The GeoInformation Group, Map data ©2024

Figure 2 – Measurement Locations and Site Surroundings

2.2 Context & Subjective Impression

The existing church is located within a predominantly residential area of Huddersfield. The site is bound by Waverley Road to the north, the Masjid Iman Mosque to the east, Back Fitzwilliam Street to the south and houses that face onto Wentworth Street to the west.

Opposite the site, off Waverley Road, is the Waverley Hall Day Centre which functions as a day service for people with a learning disability. The centre is open 09:00 to 16:00, Monday to Friday.

The acoustic environment is deemed to be low to moderate in level and the noise profile is dominated by road traffic noise emissions from the surrounding roads, particularly from Portland Street and the A629 to the east. Intermittent aircraft flyovers also affected the noise climate but to a lesser extent.

During the measurement of the prayer session taking place, there was no audible noise breaking out from the mosque. The only noise source emanating from these sessions is when vehicles arrive and leave. This was also observed to be the case in relation to the Waverley Hall Day Centre.

2.3 Environmental Noise Survey Results

The following section outlines a summary of the average measured free-field sound levels during the survey at MP1 and MP2. A summary of the free-field ambient sound levels measured at MP3 are also presented. The free-field time history results for MP1 and MP2 can be found in Appendix D.

Location	Measurement Period ('T')	Octave Frequency Band (Hz, $L_{eq,T}$, dB)							$L_{Aeq,T}$ (dB)	'Typical' $L_{AFmax,1min}$ [1] (dB)
		63	125	250	500	1k	2k	4k		
MP1	$L_{eq,16hr}$ (Day)	56	49	51	50	50	45	39	53	--
	$L_{eq,8hr}$ (Night)	51	46	47	47	45	41	34	49	68
MP2	$L_{eq,16hr}$ (Day)	54	51	48	47	45	40	39	50	--
	$L_{eq,8hr}$ (Night)	47	42	40	38	37	30	36	41	69
MP3	$L_{eq,1.5hr}$	59	54	51	51	50	47	41	54	--

Note [1] *The 'typical' $L_{AFmax,1min}$ is determined by that value which is not normally exceeded more than 10 times during the night-time.*

Table 2 – Sound Level Results Summary

As identified above, the noise levels measured during the measurement at MP3 were slightly higher than the 16-hour values measured at both MP1 and MP2. In order to form a robust assessment, on the facades overlooking the mosque, the measurement at MP3 will be used to inform the façade sound insulation.

Additional analysis has been undertaken for the early prayer (Fajr), understood to have been between 04:45 and 05:15 hours during the survey. The measured $L_{Aeq,30min}$ during this period was approximately 45dB. However, to provide a worst-case assessment and protect against vehicle movements during the most sensitive periods (i.e. during the night-time), the highest $L_{Aeq,1min}$ has been used at MP1. This was measured to at 52dB L_{Aeq} on the Friday morning.

3. Noise Break-in Assessment and Sound Insulation Scheme

3.1 Internal Noise Level Criteria

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 3 – 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.

3.2 Determined External Noise Levels

Based on the noise levels measured on-site and distance and screening attenuation, where applicable, the determined noise levels external to the different facades of the development are presented in the table below.

Given the similarity in noise levels at all measurement locations, the highest figures at each will be used to inform the below assessment and form a robust and worst-case scenario.

Elevation	Daytime Noise Level	Night-time Noise Level	
	Ambient	Ambient	Maximum
All Facades	≤ 54 dB $L_{Aeq,T}$	≤ 52 dB $L_{Aeq,T}$	≤ 69 dB L_{AFmax}

Table 4 – Determined Free-field External Noise Levels

Allowing for -13dB provided by a partially openable window for whole dwelling (background) ventilation, and considering the noise levels presented in Table 4, calculations indicate that the internal noise criteria shown in Table 3 would be exceeded. Therefore, an alternative means of providing background ventilation would need to be provided to openable windows and this is presented in Section 3.3, below.

3.3 Glazing and Whole Dwelling (Background) Ventilation Specification

The following section provides a glazing and background ventilation specification that achieves the relevant internal noise criteria based on the noise levels presented in Table 4. The calculations considering the following sound insulation scheme can be found in Appendix E.

Description	Octave Frequency Band (Hz, dB)							Overall (dB)
	63	125	250	500	1k	2k	4k	
4mm Glass / 16mm Air Cavity / 4mm Glass	19	21	17	25	35	37	31	29 R_W (-4; C_{tr})
Titon Standard Vent + C25 (2 No. Trickle)	26	36	38	36	32	37	39	35 $D_{ne,W}$ (-2; 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.

Where there is a desire to retain the existing glazing, investigations should be undertaken to ascertain the existing make-up and determine if it is equivalent to that which is presented above. Where this is not the case, glazing should be installed that is equivalent to that which is presented above. Alternatively, secondary glazing could be installed to the existing windows. This may require through-wall passive ventilation or installation of a ducted/mechanical system.

The quality of seals should be inspected and where these are in poor working condition, appropriate mitigation measures will be required.

To not downgrade the performance of the façade, the other elements e.g., wall and roof, should have a sound insulation performance that is 10dB higher than the glazing shown in Table 5 (39dB R'_w).

4. Overheating Screening Assessment

In order to avoid excessively high temperatures and provide adequate levels of thermal comfort within dwellings, an overheating mitigation strategy must be developed. In low noise areas, this strategy can often rely upon opening windows as the primary source of ventilation, however, in areas with higher levels of noise, this would present a risk of adverse effects on health and quality of life.

4.1 Overheating Criteria

Considering that the development is a change of use and not new build, it is not a requirement to achieve the criteria defined in Approved Document O ('ADO'). However, to allow for a reasonable living environment, it is recommended that the less onerous criteria given in the 'Acoustics Ventilation and Overheating Design Guide' ('AVO') should be applied.

Considering that a partially open window provides approximately 13dB of attenuation (as stated in 'AVO') the proposed internal and external noise criteria are summarised are detailed below. A summary of the external noise levels incident on the facades of the proposed development (Table 4) are also presented as well as if there are any resulting exceedances of the criteria.

Period	Proposed Criteria (dB)		External Incident Level (dB)	
	Internal	External	Measured	Exceedance
Daytime ($L_{Aeq,16hr}$)	50 [1]	63	54	-9
Night-time ($L_{Aeq,8hr}$)	42 [1]	55	52	-3
Night-time ($L_{AFmax,T}$) [3]	65 [1]	78	69	-9

Notes:

[1] Criterion taken from the AVO guide. Above this level, it is stated: "Noise causes a material change in behaviour, e.g., having to keep windows closed most of the time."
[2] L_{AFmax} exceeded fewer than 10 times per night.

Table 6 – External Noise Level Limits for Overheating Criteria

4.2 Overheating Assessment

As identified above, the external noise levels incident on the facades of the proposed development are below the threshold criteria shown in the table above. Given this, it is thought that opening windows can be used as the primary means of mitigating overheating. However, it must also be ensured that all ventilation is compliant with the requirements of Approved Document F.

5. 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 3.
    a. As identified, due to the external noise levels, an alternative method of providing whole dwelling (background) ventilation to openable windows, would need to be provided. At this stage, it is determined that this would be provided via trickle ventilation and a minimum performance specification is provided in Section 3 alongside a glazing specification.
2. An overheating assessment has been carried out in line with the guidance presented in AVO and it is determined that the external noise levels incident on the facades of the proposed development are below the AVO limits. Given this, it is thought that opening windows can be used as the primary means of mitigating overheating. This is detailed in Section 4.

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 180e, 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 7 – 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 F Volume 1: Dwellings (2021)

Approved Document F states the following in relation to noise:

- Mechanical ventilation systems, including both continuous and intermittent mechanical ventilation, should be designed and installed to minimise noise. This includes doing all of the following.
    - Correctly sizing and jointing ducts.
    - Ensuring that equipment is appropriately and securely fixed, such as using resilient mountings where noise carried by the structure of the building could be a problem.
    - Selecting appropriate equipment, including following paragraph
- For mechanical ventilation systems, fan units should be appropriately sized so that fans operating in normal background ventilation mode are not overly noisy. This might require fans to be sized so that they do not operate near maximum capacity when in normal background ventilation mode.
- Account should be taken of outside noise when considering whether openable windows are appropriate for purge ventilation.
- If an exposed façade is close to an area of sustained and loud noise (e.g. a main road), then a noise attenuating background ventilator should be fitted.

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 3 – 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.

AVO Guide (2020) Level 1 Risk Assessment			
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 8 – 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 4 – AVO Guide Level 2 Internal Ambient Noise Levels

Appendix C – Location Plans

Proposed Location Plan
1 : 1250

Proposed Site Plan
1 : 200

Figure 5 – Location Plans

Appendix D – Environmental Survey

D.1 – Time History Noise Data

Figure 6 – MP1 Noise Survey Time History

Figure 7 – MP2 Noise Survey Time History

D.2 – Surveying Equipment

Piece of Equipment	Serial No.	Calibration Deviation
Svantek SC420 Class 1 Sound Level Meter	143564	≤0.20
Svantek CB006 Class 1 Calibrator	125695	
Svantek SC420 Class 1 Sound Level Meter	143581	≤0.25
Svantek CB006 Class 1 Calibrator	125695	

Table 9 – Surveying Equipment

All equipment used during the survey was field calibrated at the start and end of the measurement period with a negligible deviation. 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. 2km W of Site)				
Time Period	Air Temp (^{0}C)	Rainfall (mm/h)	Prevailing Wind Direction	Wind Speed (m/s)
11/09/24 – 00:00 – 23:59	6.6 – 12.9	0.0	NE	0.0 – 1.5
12/09/24 – 00:00 – 23:59	5.6 – 12.9	0.0	E	0.0 – 0.4
13/09/24 – 00:00 – 23:59	3.7 – 14.1	0.0	NE	0.0 – 0.7

Table 10 – Weather Conditions

Appendix E – Noise Break-in Calculations

E.1 – Façades with Background Ventilation

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 within bedrooms and living rooms has been set as 0.5 and 0.8 seconds within the calculations. This is deemed typical for furnished room sizes within the UK.
- Based on the technical drawings provided to NOVA Acoustics, window percentage areas of 60% and 45% have been set for living rooms and bedrooms, respectively. Where these figures increase (which may occur because of design changes as the scheme develops i.e. increases window sizes and / or a reduction in room volumes), these calculations will need to be amended.
- 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).
- Calculations have been carried out to the worst-case rooms at ground floor level (a bedroom and living room). Given that the top floor has a lined roof, calculations have also been carried out to the bedrooms on this floor for robustness.

Bedroom (2nd Floor Flat 9) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	54	59	54	51	51	50	47	41	41
Glazing Noise Ingress	18	29	22	23	15	4	-1	-1	-1
Ventilation Noise Ingress	19		18	13	15	18	10	2	2
Wall Noise Ingress	-1	13	10	4	-4	-10	-18	-24	-24
Roof Noise Ingress	17	35	26	19	14	9	4	-11	-11
Room Absorption Correction		2	2	2	1	1	1	0	-2
Total Noise Ingress	**27**	**41**	**33**	**30**	**24**	**23**	**15**	**6**	**5**
NR30	35	59	48	39	33	30	26	24	22
Exceedance of Criteria	-8	-18	-15	-9	-9	-7	-11	-18	-17

Bedroom (2nd Floor Flat 9) Night Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	52	59	43	46	48	49	42	34	24
Glazing Noise Ingress	14	30	12	19	12	4	-5	-7	-18
Ventilation Noise Ingress	18		7	8	11	17	5	-5	-16
Wall Noise Ingress	-5	13	-1	-1	-8	-11	-23	-31	-42
Roof Noise Ingress	14	35	15	14	11	8	-1	-18	-28
Room Absorption Correction		2	2	2	1	1	1	0	-2
Total Noise Ingress	**25**	**42**	**22**	**25**	**21**	**22**	**10**	**0**	**-12**
NR25	30	55	43	35	28	25	21	19	17
Exceedance of Criteria	-5	-13	-21	-10	-7	-3	-11	-19	-29

Bedroom (2nd Floor Flat 9) Night Time Max

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Lmax	69	62	61	65	65	65	61	53	43
Glazing Noise Ingress	31	32	30	38	30	20	14	11	1
Ventilation Noise Ingress	34		25	27	29	33	24	13	3
Wall Noise Ingress	12	15	17	18	10	5	-4	-13	-23
Roof Noise Ingress	30	38	33	33	28	24	18	1	-9
Room Absorption Correction		2	2	2	1	1	1	0	-2
Total Noise Ingress	**41**	**44**	**40**	**44**	**38**	**38**	**29**	**18**	**7**
NR40	45	67	56	49	43	40	37	34	33
Exceedance of Criteria	-4	-23	-16	-5	-5	-2	-8	-16	-26

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