Residential Noise Assessment

Site Address: West Wylam Ebenezer Methodist Church, Sales Crescent, Prudhoe

Client Name: Karbon Developments Ltd

Project Reference No: 8814KL

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First Draft	--

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

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1. Introduction

NOVA Acoustics Ltd has been commissioned to prepare a noise assessment for a residential development ('the Proposed Development') at West Wylam Ebenezer Methodist Church, Scales Crescent, West Wylam, Prudhoe, NE42 5DW ('the Site'). The proposal is for the change of use of an existing church building to form 5no. self-contained flats. The site is subject primarily to noise from road traffic.

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

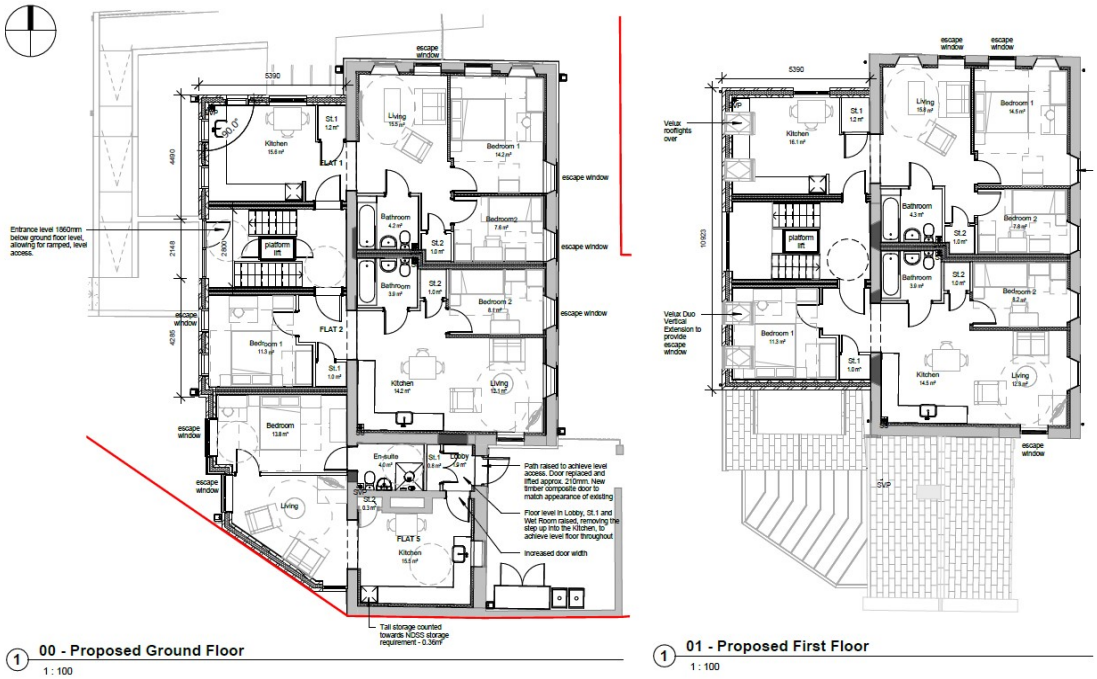
The following performance standards, legislation, policy and guidance have been considered to ensure good acoustic design in the assessment:

- The Local Planning Authorities (LPA) conditional approval for the change of use; specifically, 'Condition 4'.
- National Planning Policy Framework (2021)
- 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 to convert and extend the existing church (Class F1) into a residential dwelling (Class C) (5no. self-contained flats). The figure below shows the Proposed Development (drawing No. 4018 – SK.210 from 'HMH Architects').



Drawing Ref No. 4018 – 2010 & 2011 (HMH Architects February 2023)

Figure 1 – Proposed Development

1.3 Local Planning Authority

The LPA's approval for change of use has the following condition:

> *"**Condition 4:** In accordance with Note 23 of the NCC Planning Validation Checklist, a noise impact assessment prepared by a suitably qualified acoustician must be submitted with any outline or full application where proposed, or existing noise sensitive receptors, may be affected by proposed, or existing noise sources as a result of the development.*
>
> *The noise impact assessment must outline the potential sources of noise generation, and how these may have a negative effect on local amenity and noise sensitive receptors. The assessment should also outline how the developer intends to overcome these issues.*
>
> *If the site is for residential housing, the noise assessment must include full consideration of the acoustic environment of the site and should facilitate the process of good acoustic design, thereby ensuring a good standard of amenity for all future occupants of the development in line with ProPG: Planning and Noise. Professional Guidance on Planning & Noise. New Residential Development (May 2017).*
>
> *The report should include: a clear plan indicating locations of noise sources, sensitive receptors, measurement positions and any mitigation measures if appropriate. Where mitigation is necessary for a development to satisfy noise criteria the report should include a full specification of the mitigation within an acoustic design statement."*

2. Environmental Noise Survey

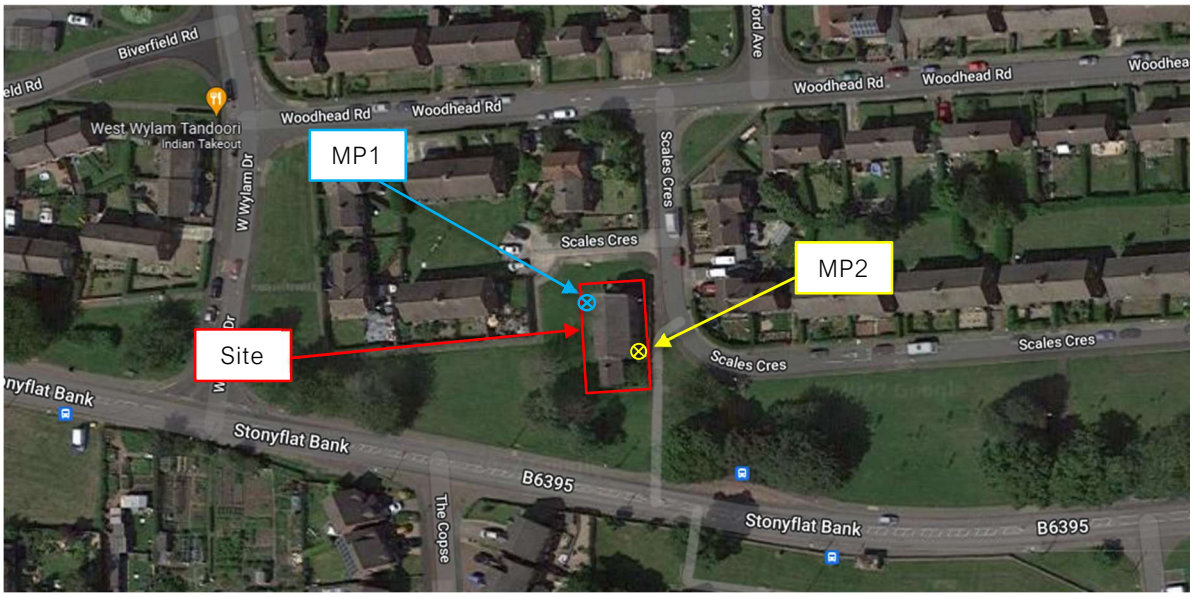
2.1 Measurement Methodology

The following table outlines the measurement dates and particulars.

Location	Survey Dates	Measurement Particulars
MP1	21/12/2022 – 22/12/2022	Equipment mounted on drainpipes at 0.5m distance from the building façades at a height of 3.5m on the existing building on Scales Crescent.
MP2	21/12/2022 – 22/12/2022	

Table 1 – Measurement Methodology

The figure below outlines the site surroundings and measurement locations:



Imagery ©2023 Infoterra Ltd & Bluesky, Maxar Technologies, The GeoInformation Group, Map data ©2023

Figure 2 – Measurement Locations and Site Surroundings

2.2 Context & Subjective Impression

The Proposed Development Site is located on Scales Crescent, Prudhoe. The area surrounding the Site consists primarily of residential dwellings in all directions. Situated 30m from the southern boundary of the Proposed Development Site is the B6395 road, which facilitates moderate levels of traffic flow.

The acoustic environment is deemed to be low in level and the noise profile is dominated by road traffic noise emissions from the B6395 and very infrequent vehicle pass-bys along Scales Crescent.

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 $L_{AFmax,15min}$ (dB)*
		125	250	500	1k	2k	4k		
MP1	$L_{eq,16hour}$ (Day)	52	50	48	52	48	38	54	--
	$L_{eq,8hour}$ (Night)	44	45	42	43	39	31	47	71
MP2	$L_{eq,16hour}$ (Day)	53	51	47	52	48	43	55	--
	$L_{eq,8hour}$ (Night)	45	44	41	43	38	32	46	64

Table 2 – Sound Level Results Summary

**L_{AFmax} value exceeded fewer than 10 times.*

3. Noise Break-in Assessment and Sound Insulation Scheme

3.1 Internal Noise Level Criteria

The measured noise levels are clearly diurnal (standard daytime and night-time fluctuations) and dominated by transport noise, which is considered to be an 'anonymous' source. The following table outlines the internal acoustic design criteria used in the following assessment.

BS8233:2014 Acoustic Design Criteria			
Activity	**Location**	**Daytime (07:00 – 23:00)**	**Night-time (23:00 – 07:00)**
Resting	Living Room	35 dB $L_{Aeq,16hr}$ / NR30	--
Dining	Dining Room/Area	40 dB $L_{Aeq,16hr}$ / NR35	--
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hr}$ / NR30	30 dB $L_{Aeq,8hr}$/ NR25 45 dB 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

3.2 Glazing and Background Ventilation Specification

The following table provides a glazing and background ventilation specification that achieves the relevant internal noise criteria.

Sound Insulation Scheme – All Living and Bedrooms								
Description	Octave Band (Hz)						Overall (dB)	Overall (dB)
	125	250	500	1k	2k	4k		
4mm Glass / 16mm Air Cavity / 4mm Glass (SRI)*	21	17	25	35	37	31	29 (R_W)	25 ($R_W + C_{tr}$)
Titon Standard Vent + C25 (D_{ne})*	36	38	36	32	37	39	35 (D_{ne})	33 ($D_{ne} + C_{tr}$)

Table 4 – Glazing and 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.*

4. Open Window Noise Break-in Assessment

4.1 Internal Noise Levels with Open Windows Criteria

BS8233:2014 states that when relying on closed windows to achieve the internal acoustic design criteria, appropriate alternative ventilation should be provided. Approved Document F states: "*Account should be taken of outside noise when considering whether openable windows are appropriate for purge ventilation*". 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. 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 a 5 dB relaxation of the internal noise criteria and an open window providing 13 dB attenuation. If required, an alternative ventilation strategy compliant with Approved Document F will be proposed.

4.2 Open Window Assessment

This assessment will firstly consider whether the internal noise level criteria can be achieved with open windows. The criteria from Table 3 – 3 of the AVO Guide 'Windows Rarely Open'* is shown in the table below for reference.

External Noise Levels	BS8233 Relaxed Criteria	Exceedance	AVO Guide Windows Rarely Open	Exceedance
Red Façade $L_{Aeq,16hr}$ (Day)	53	+2	63	-8
Red Façade $L_{Aeq,8hr}$ (Night)	48	-1	55	-8
Red Façade L_{AFmax} (Night)	63	+8	78	-7

Table 5 – Open Window Assessment – Yellow Façades

**This criterion is taken from the Acoustics Ventilation and Overheating (AVO) Guide, which is relevant to the planning, design, and commissioning of new dwellings. Whilst the current project relates to dwellings formed by material change of use, the alternative 'new dwelling' criteria supports the principle of "Good Acoustic Design".*

The external noise levels exceed the BS8233 relaxed criteria, but do not exceed the AVO Guide's 'Windows Rarely Open' criteria. This means that open windows can possibly be relied upon to provide purge ventilation (whilst maintaining reasonable internal noise levels) with the specified model of trickle vent providing background ventilation. It should be noted however that this is dependent on how often the windows will need to be open in order to mitigate against overheating. As such, it is recommended that a TM59 assessment is carried out to predict the likelihood of overheating. The TM59 assessor should be provided with this report to base their study.

4.3 External Amenity Areas

All measured noise levels are within the BS8233:2014 external noise criteria. As such, no further mitigation is required to reduce noise levels in the external amenity areas (gardens).

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 systems, or suitable alternatives, should be installed as shown in section 3.2.
2. To assist in the design of the alternative ventilation strategy a TM59 overheating assessment should be undertaken to ascertain how frequently open windows will be required to mitigate overheating. The TM59 assessor should be provided with this report to base their study. It is highlighted that this report also presents an alternative ventilation strategy in section 4.2 should a TM59 assessment not be undertaken.

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: $L_p = 10\log_{10}(p/p_0)^{2.}$ Where: 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 (2021)

Government policy on noise is set out in the National Planning Policy Framework (NPPF), published in 2021. 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 174e, 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 185 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 185 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."

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 6 – 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.

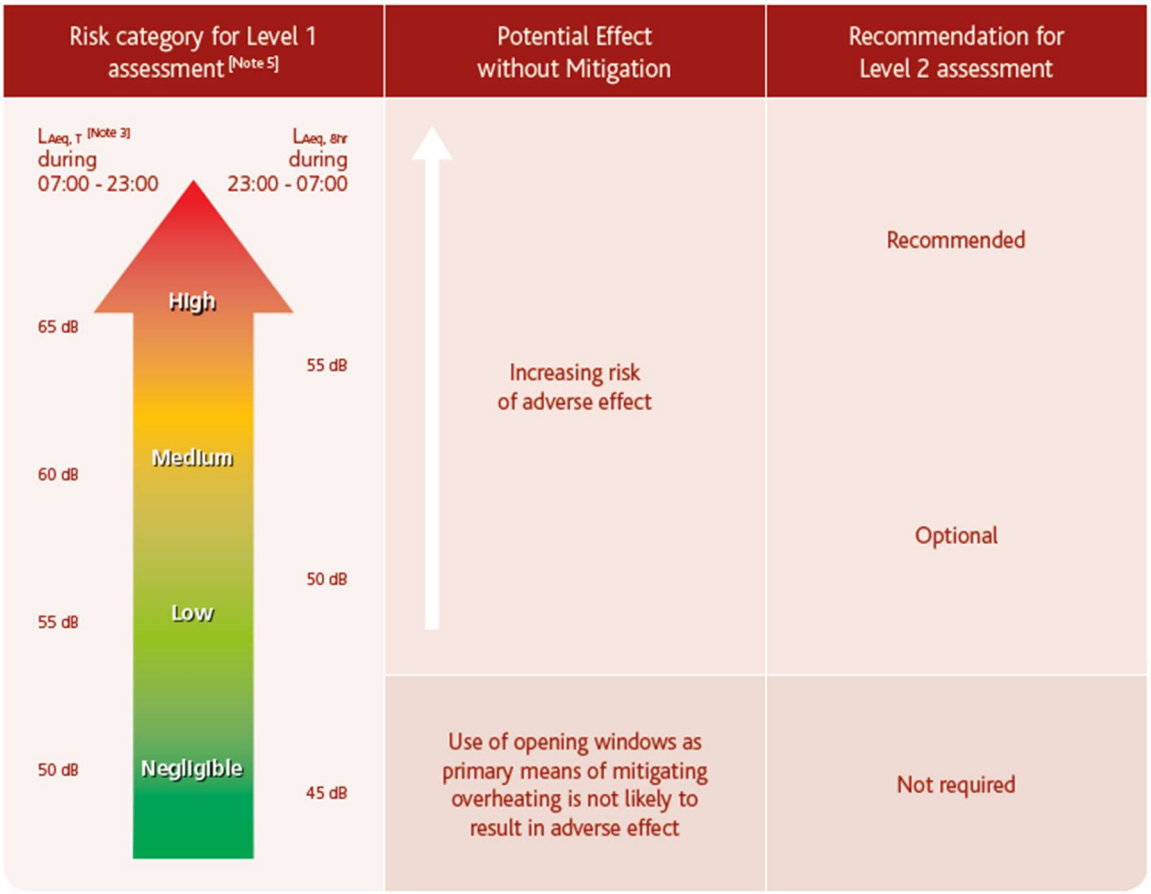


Table 3-2 of AVO Guide (2020)

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 7 – 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.

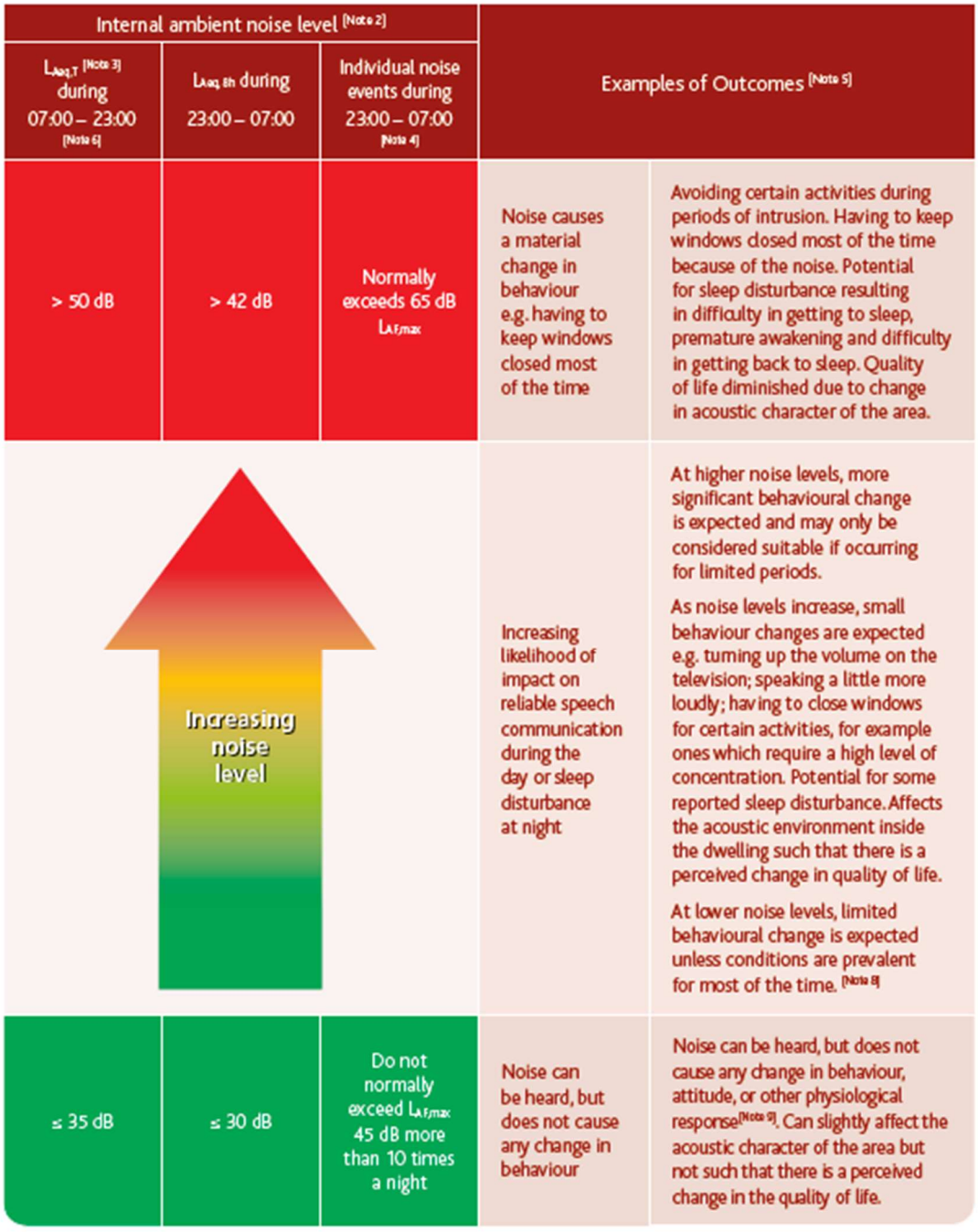


Table 3-3 of AVO Guide (2020)

Figure 4 – AVO Guide Level 2 Internal Ambient Noise Levels

Appendix C – Location Plans

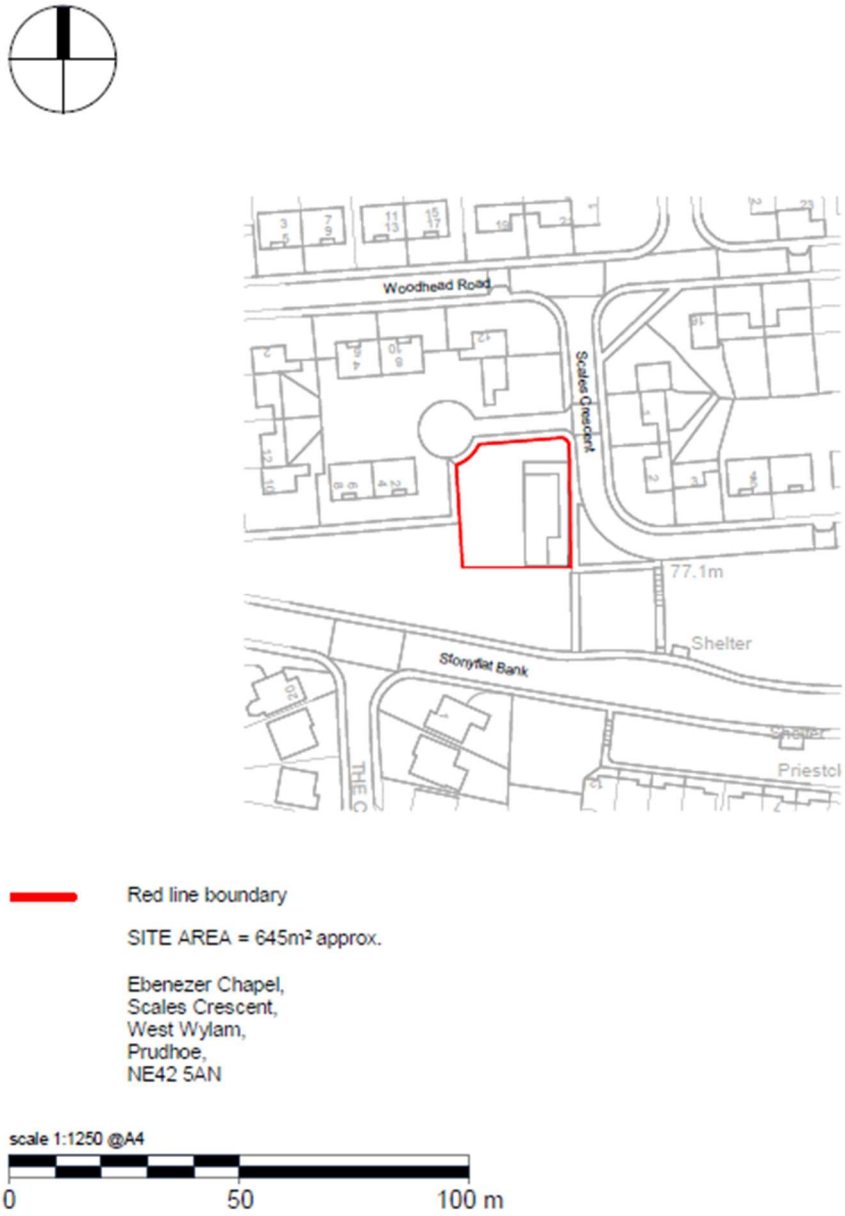


Figure 5 – Location Plans

Appendix D – Environmental Survey

D.1 – Time History Noise Data

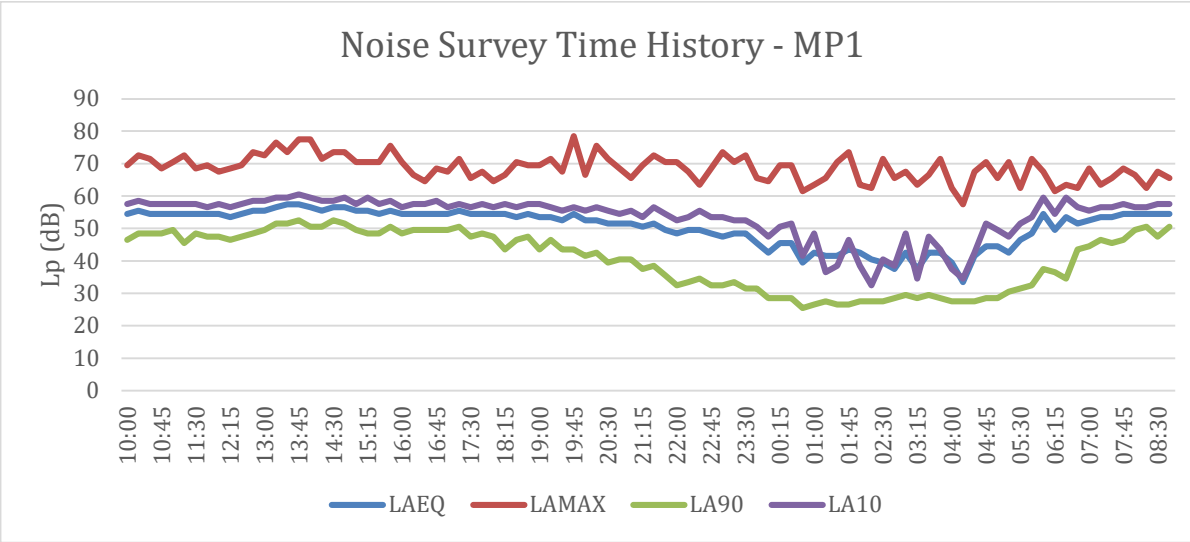


Figure 6 – MP1 Noise Survey Time History

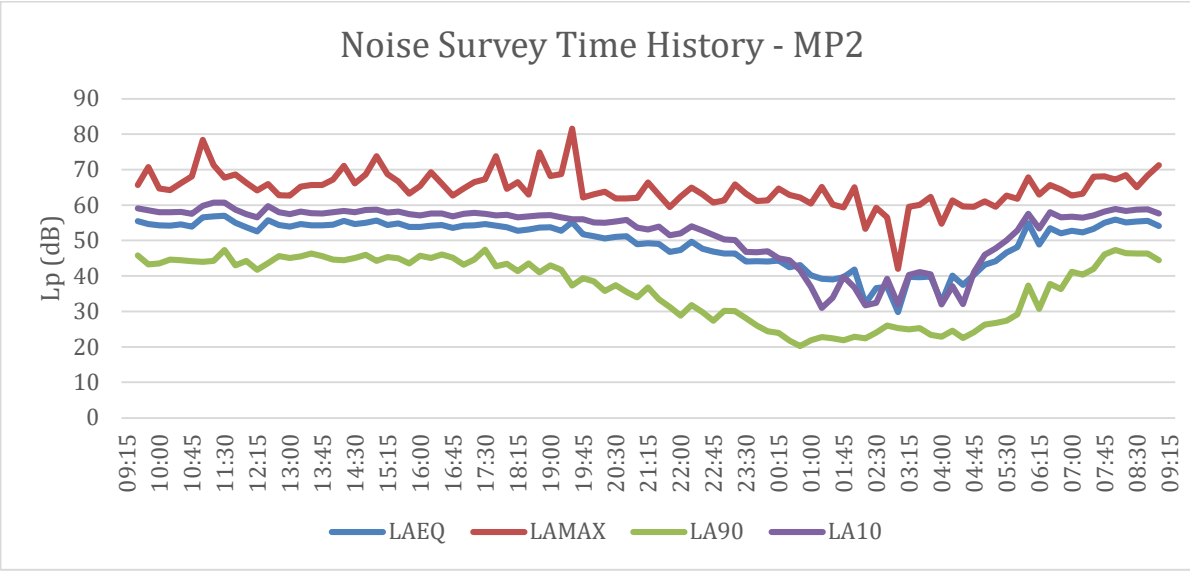


Figure 7 – MP2 Noise Survey Time History

D.2 – Surveying Equipment

Piece of Equipment	Serial No.	Calibration Deviation
CESVA SC420 Class 1 Sound Level Meter	T246471	≤0.2
CESVA CB006 Class 1 Calibrator	901955	
Svantek SV307 Class 1 Sound Level Meter	70884	≤0.2
Svantek SV36 Class 1 Calibrator	106876	

Table 8 – 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 ≤0.2 dB. 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 – Crawcrook (Approx. 3.4km E of Site)				
Time Period	Air Temp (^{0}C)	Rainfall (mm/h)	Prevailing Wind Direction	Wind Speed (m/s)
21/12/22 – 00:00 – 23:59	4.1 – 8.1	0.3	SSW	0.7 – 10.4
22/12/22 – 00:00 – 23:59	3.1 – 7.8	0.0	WSW	0.0 – 6.1

Table 9 – 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:

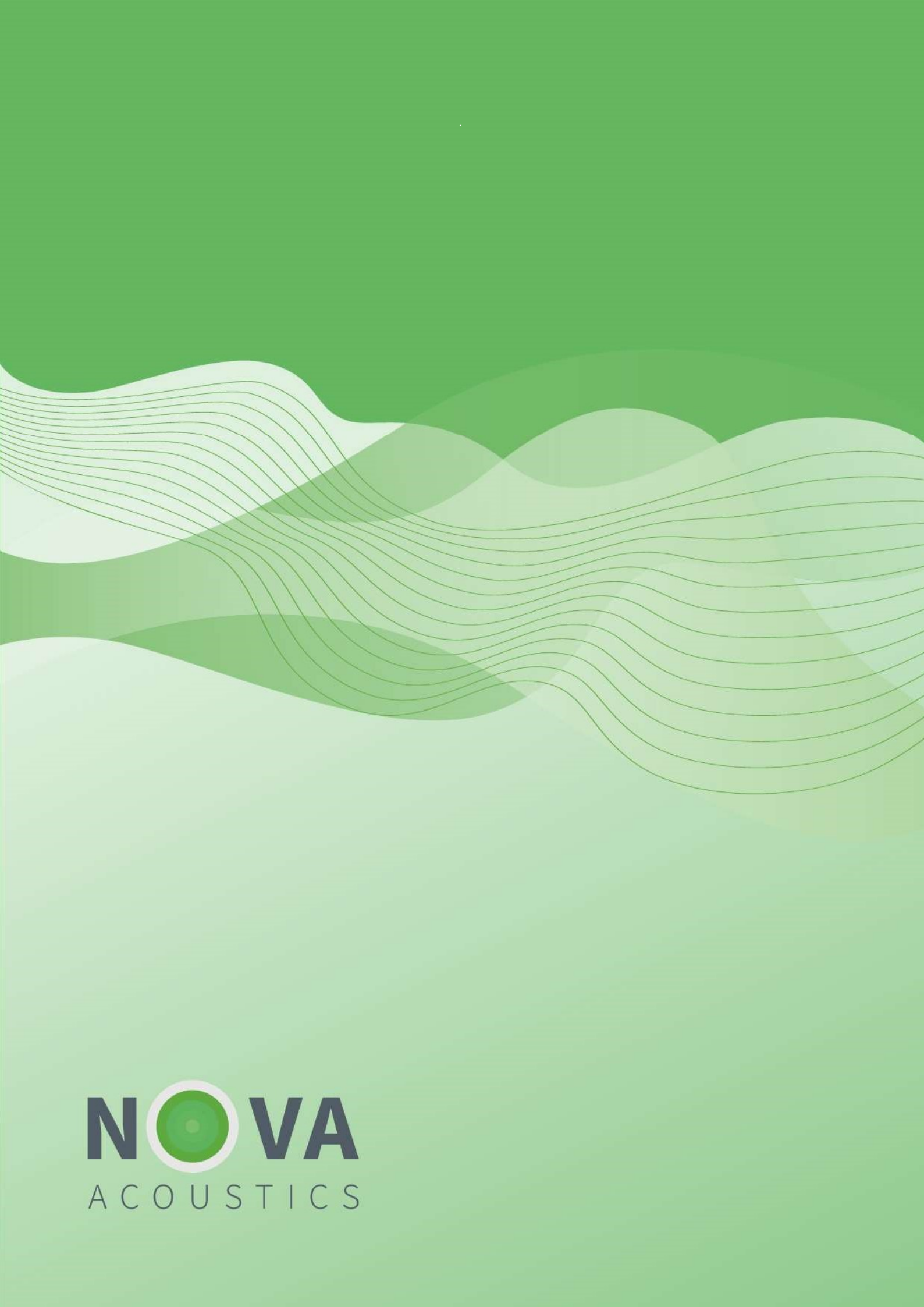
- The calculation method for façade sound reduction is in accordance with BS8233:2014 and BS EN 12354-3.
- The reverberation time is typically 0.5 seconds across the relevant frequency range for a furnished living room in the UK. This value is used for both living rooms and bedrooms.
- Based on the technical drawings provided to NOVA Acoustics, window areas of 2m^2 and room volumes of 30m^3 are used in the calculations for bedrooms as a worst-case scenario. For living rooms, the calculations are based on a window area of 2m^2 and room volume of 39m^3 as a worst-case scenario.
- The acoustic performance of the façade elements are 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).

MP1 Façade Noise Ingress									
Location / Time Period	Description	Octave Band $L_{eq,t}$ (Hz, dB)						Overall (dBA)	$L_{Amax,t}$ (dB)
		125	250	500	1k	2k	4k		
Living Room – Day Time	Façade Noise Ingress	27	28	21	25	16	6	27	--
	NR30 Curve	48	40	34	30	27	25	35	--
	Exceedance of NR30 Curve	-21	-11	-13	-5	-10	-18	-8	--
Bedroom – Day Time	Façade Noise Ingress	28	29	22	26	17	7	28	--
	NR30 Curve	48	40	34	30	27	25	35	--
	Exceedance of NR30 Curve	-20	-10	-12	-4	-9	-17	-7	--
Bedroom – Night Time	Façade Noise Ingress	20	24	16	17	8	0	21	43
	NR25 Curve	44	35	29	25	22	20	30	45
	Exceedance of NR25 Curve	-23	-11	-13	-8	-13	-19	-9	-2

Figure 8 – Noise Break-in Calculation 1

MP2 Façade Noise Ingress									
Location / Time Period	Description	Octave Band $L_{eq,t}$ (Hz, dB)						Overall (dBA)	$L_{Amax,t}$ (dB)
		125	250	500	1k	2k	4k		
Living Room – Day Time	Façade Noise Ingress	29	30	21	26	17	12	28	--
	NR30 Curve	48	40	34	30	27	25	35	--
	Exceedance of NR30 Curve	-19	-9	-13	-4	-9	-12	-7	--
Bedroom – Day Time	Façade Noise Ingress	30	31	22	27	18	13	29	--
	NR30 Curve	48	40	34	30	27	25	35	--
	Exceedance of NR30 Curve	-18	-8	-12	-3	-8	-11	-6	--
Bedroom – Night Time	Façade Noise Ingress	22	24	16	18	8	2	21	36
	NR25 Curve	44	35	29	25	22	20	30	45
	Exceedance of NR25 Curve	-21	-11	-13	-7	-13	-17	-9	-9

Figure 9 – Noise Break-in Calculation 2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