Residential Noise Assessment

Site Address: 235-237 Broadway, Bexleyheath, Kent, DA6 7EJ

Client Name: Pagecolt Ltd c/o Englander Group

Project Reference No: NP-010389

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01	--

Disclaimer

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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 new residential development ('the Proposed Development') at 235-237 Broadway, Bexleyheath, Kent, DA6 7EJ ('the Site'). The site is subject to noise from traffic and patrons and the front façade and noise from distant road traffic and surrounding plant units at the rear façade.

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 application ref. 22/02438/FUL; specifically, 'Conditions 8 and 10'.
- 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 includes the demolition of the existing building and the erection of a new 4-story residential building. The figure below shows the layout of the Proposed Development.

Drawing Ref No. A200 EXISTING AND PROPOSED 1ST FLOOR PLANS REV C from 'MAB Architects'

Figure 1 – Proposed Development

1.3 Local Planning Authority

The applicant is preparing a full planning application to be submitted to the London Borough of Bexley. The new application will replace a previous full planning application which was conditionally approved (*22/02438/FUL – 'Part one/part two storey rear extension and provision of two additional storeys to provide one commercial unit and 9 residential units comprising of 5x2 bed and 4x1 bed flats.*'). It is assumed that the acoustic conditions imposed on the new development will be similar to the conditions imposed for the previous application as the proposals are very similar in nature.

The conditions are reproduced below:

"Condition 8

A. *Prior to first occupation, details which shall demonstrate that the level of acoustic protection to all habitable rooms will be sufficient to achieve the internal levels specified in BS8233: 2014 shall be submitted to and approved in writing by the Local Planning Authority.*
B. *Each residential unit shall not be occupied until such time as the approved measures have been implemented for that unit. The approved measures shall be retained and maintained thereafter in accordance with the manufacturer's recommendations.*
C. *Verification that works have been carried out in full accordance with the approved scheme shall be submitted to and approved in writing by the Local Planning Authority within three months of first occupation.*

Reason: To protect future occupants of the development from excessive external noise and to ensure that internal noise levels achieve the BS:8233 noise criteria.

Condition 10

A. *Prior to the first operation of any plant/equipment, an acoustic report prepared by a suitably qualified acoustician, shall be submitted to and approved in writing by the Local Planning Authority. The report shall demonstrate how the cumulative noise rating levels from all fixed plant will be 5dB below the representative background level when measured at any nearby residential façade. Measurements shall be undertaken in accordance with the methodology specified in "BS4142: 2014: Methods for rating industrial and commercial sound".*
B. *All installed plant and acoustic attenuation measures shall be in accordance with the approved details and maintained thereafter in accordance with the manufacturer's recommendations.*

Reason: To protect the amenity of residential occupants."

2. Environmental Noise Survey

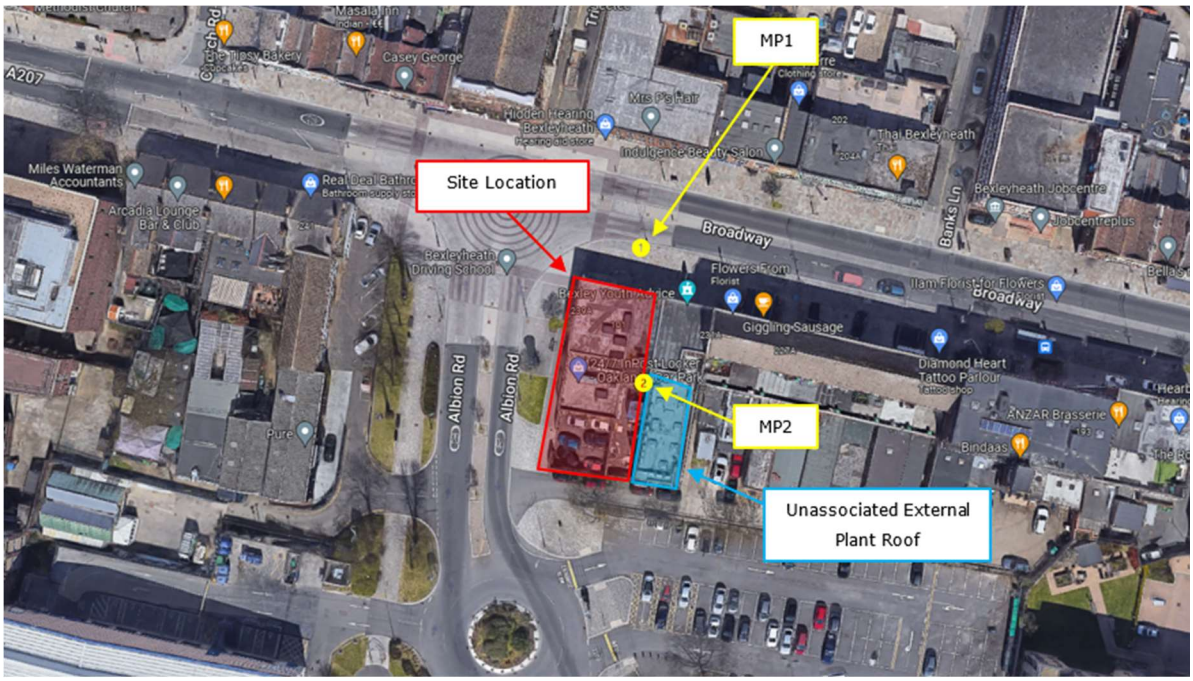
2.1 Measurement Methodology

The following table outlines the measurement dates and particulars. The noise assessment was carried out for a previous report undertaken by NOVA Acoustics Ltd (Ref. 8261JL).

Location	Survey Dates	Measurement Particulars
MP1	12/08/2022 – 15/08/2022	Equipment mounted on a lamp post at a height of 4m on Broadway and at least 3m from any other large reflective surface (free filed).
MP2	13/08/2022 – 15/08/2022	Equipment mounted on a drainpipe at the rear of the façade (façade correction applied).

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 area surrounding the site contains a mixture of residential dwellings and commercial premises. To the north runs Broadway, which facilitates moderate to high level of traffic flow. Further to the north are commercial premises such as restaurants (Fireway Bexleyheath, Stuzzichini, Wimpy, etc.), The Rose Public House, and shops (Real Deal Bathrooms, Flowers From, Hidden Hearing Bexleyheath, etc). To the west of the site runs Albion Road, which facilitates moderate traffic flow levels, and to the south is a small road which gives access to the service yards associated with the surrounding commercial businesses. Adjacent to the east are a number of plant units located on the roof of the adjacent building.

It is important to note that there are numerous residential premises in a similar location to the Proposed Development. As such, it is likely that the area is suitable for residential development providing an effective sound insulation scheme is installed.

During the site visits, it was found that the noise profile of the area was dominated by traffic and patrons at Measurement Position 1 (MP1). The noise profile at MP2 was found to be low in level, and noise from the adjacent plant units was audible alongside distant traffic noise.

2.3 Environmental Noise Survey Results

The following section outlines the measured sound levels during the survey. The 'typical' $L_{AFmax,1min}$ value is determined by that which is not normally exceeded more than 10 times during the night-time. 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)	$L_{AFmax,1min}$ (dB)
		63	125	250	500	1k	2k	4k		
MP1	$L_{eq,16hr}$ (Day)	76	72	70	68	67	64	58	71	--
	$L_{eq,8hr}$ (Night)	73	68	67	67	65	63	53	69	93
MP2	Highest $L_{eq,1hr}$ (Day)	67	59	51	45	46	44	40	51	--
	Highest $L_{eq,1hr}$ (Night)	66	56	46	42	43	38	32	46	64

Table 2 – Sound Level Results Summary – Long-term Measurements

Discussion

Further assessment has been undertaken of the measurements at the rear façade to ensure noise from the surrounding external plant units will not cause adverse impact. As can be seen in Figure 3 below, there is no correlation between the measured noise levels and the operational periods of the surrounding external plant units. The measured noise levels are clearly diurnal in nature, with typical daytime and night-time peaks and troughs, which is generally synonymous with traffic flow variations.

It is therefore concluded that plant noise is not significantly dominant above the residual noise climate, and providing adequate acoustic glazing and ventilation systems are installed, then a satisfactory level of amenity should be readily achievable.

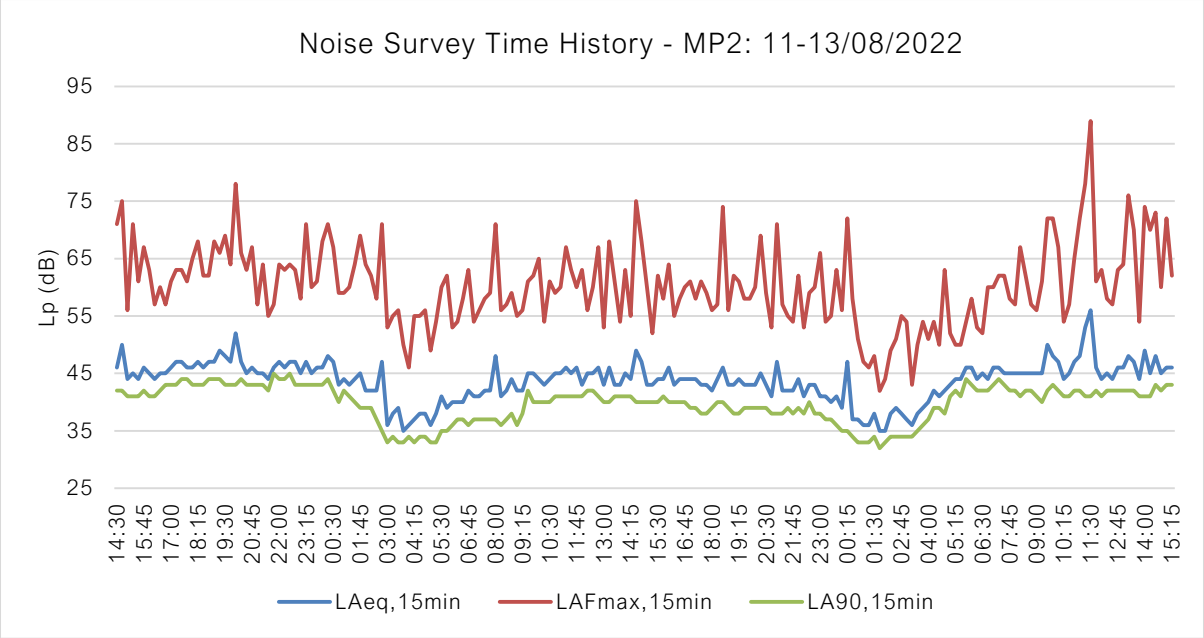


Figure 3 – MP2 Noise Survey Time History

2.4 Background Sound Level Analysis

The following section outlines the measured background sound levels that have been used as the baseline for the subsequent BS4142:2014+A1:2019 noise assessment. The figures below show the histogram graphs of the background sound levels measured during the day and night-time periods at both MPs. The complete time history results can be found in Appendix D.

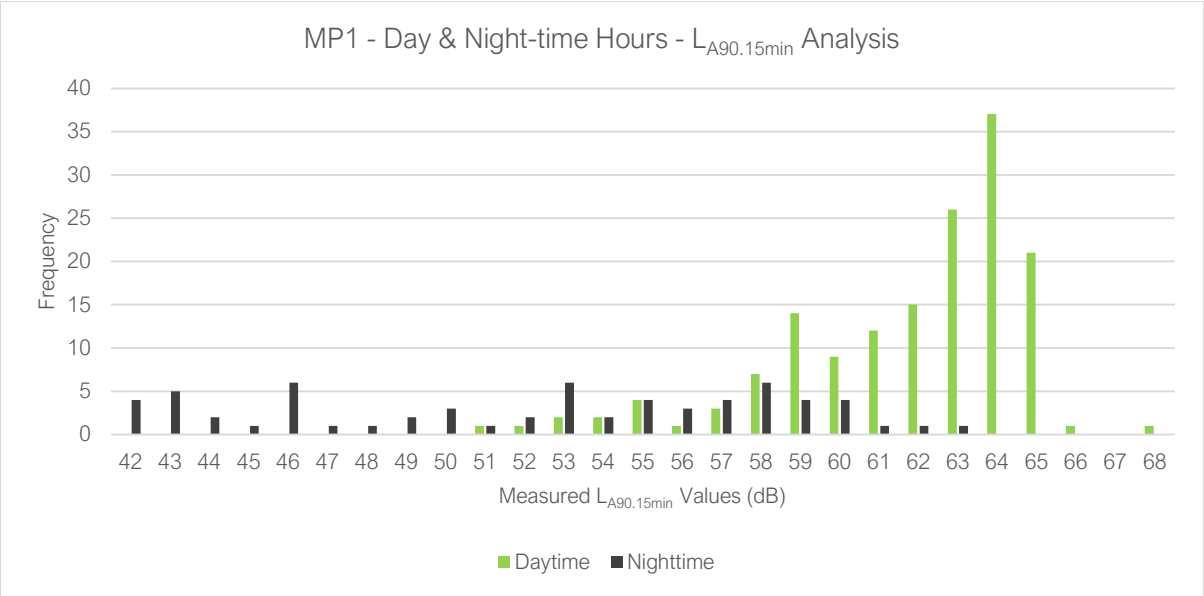


Figure 4 – MP1 Day and Night-time Background Sound Level Analysis

As can be seen in the figure above, the modal $L_{A90,15min}$ values measured during the day and night-time periods are 64 dB and 46 dB, respectively. However, the measured $L_{A90,15min}$ values of **59 dB** and **46 dB** are deemed to be the 'lowest typical' background sound levels and, as such, these levels will be used in the following assessment.

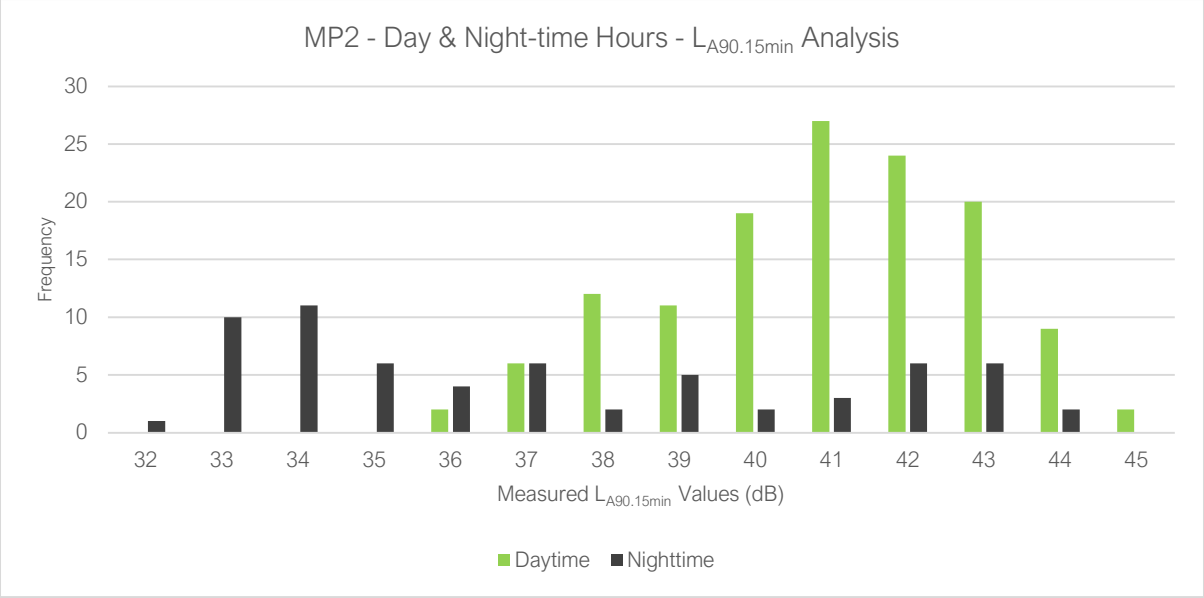


Figure 5 – MP2 Day and Night-time Background Sound Level Analysis

As can be seen in the figure above, the modal $L_{A90,15min}$ values measured during the day and night-time periods are **41 dB and 34 dB**, respectively. These levels will be used in the following assessment.

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.

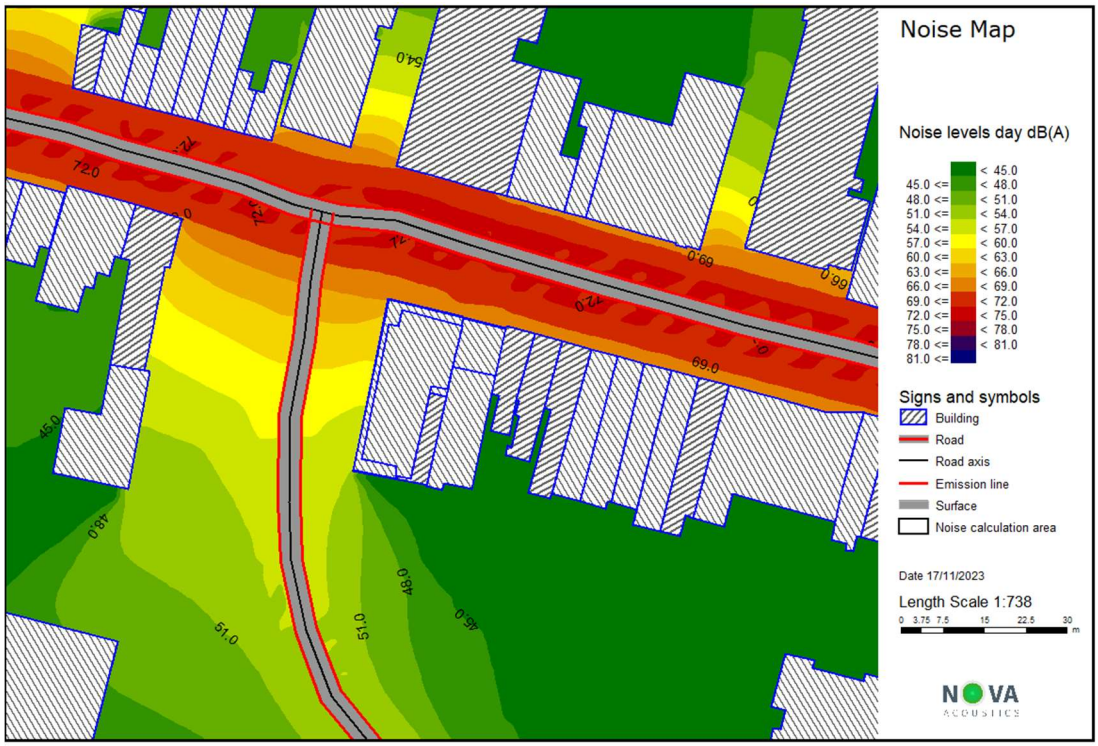


Figure 6 – $L_{Aeq,16hr}$ Ambient Sound Map (1.5m Grid Map Height)

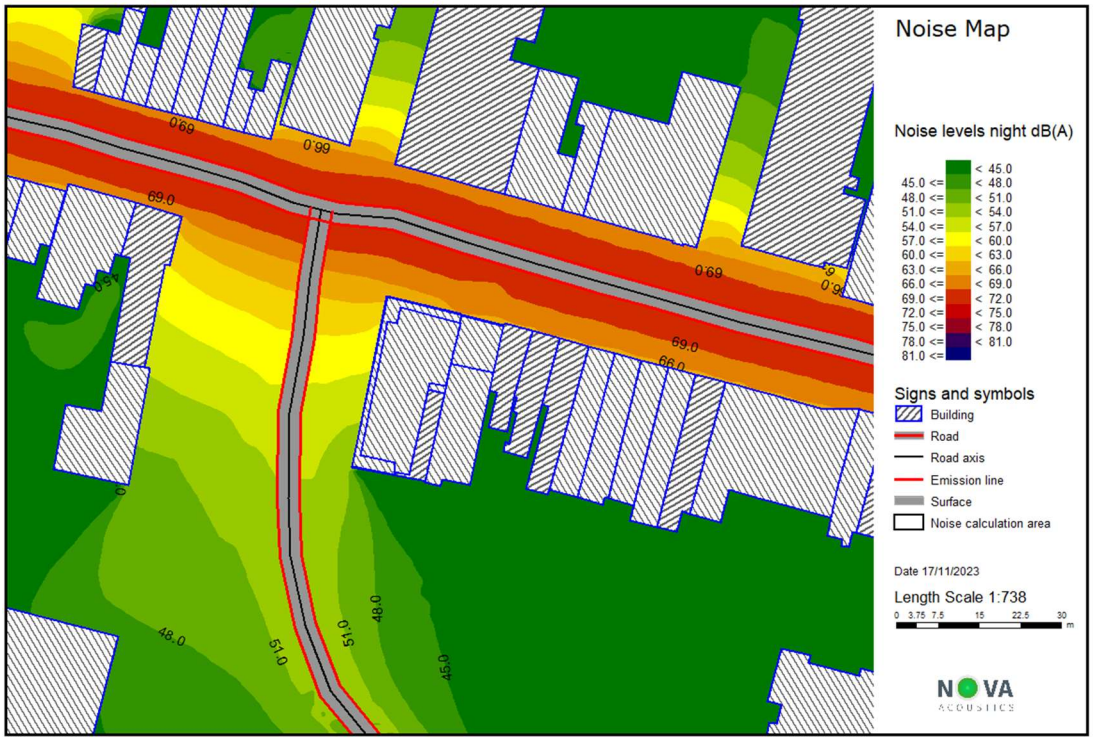


Figure 7 – $L_{Aeq,8hr}$ Ambient Sound Map (1.5m Grid Map Height)

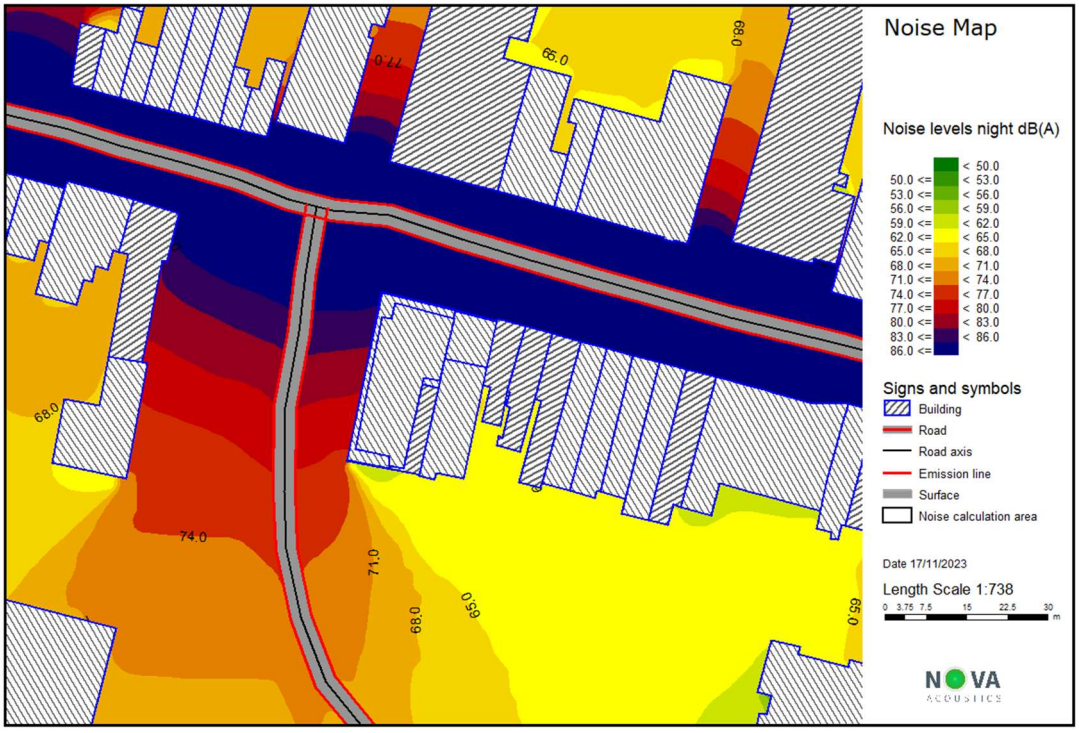


Figure 8 – $L_{AFmax,1min}$ Sound Map (1.5m Grid Map Height)

4. Noise Break-in Assessment and Sound Insulation Scheme

4.1 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	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 – Acoustic Design Criteria

The noise profile of the area is predominantly "anonymous" steady state noise sources e.g., transport. However, due to the noise from plant units located at the rear façade, the assessment period has been shortened to 1-hour, as opposed to the average 16-hour and 8-hour integration periods. This is thought to present a robust assessment, which is in line with Note 4 shown above.

4.2 Glazing and Background Ventilation Specification

The following section provides a glazing and background ventilation specification that achieves the relevant internal noise criteria for each one of the facades. The façade allocation can be found in Appendix C. The calculations considering the following sound insulation scheme can be found in Appendix E.

Red Façades										
Rooms	Description	Octave Frequency Band (Hz, dB)							Overall (dB)	
		63	125	250	500	1k	2k	4k		
Glazing										
Living Rooms and Bedrooms	10mm Glass / 16mm Argon Cavity / 8.8mm Optiphon Glass	25	28	31	42	45	50	58	44 (R_W)	38 (R_W + C_{tr})
Background Trickle Ventilation										
Living Rooms	Greenwoods 2500EA.AC1 (Through-Frame Trickle Ventilation)	31	41	40	37	47	43	46	42 ($D_{n,e}$)	40 ($D_{n,e,W}$ + C_{tr})
Bedrooms	Greenwoods MA3051 (Through-Wall Trickle Ventilation)	30	46	45	50	55	65	67	55 ($D_{n,e}$)	52 ($D_{n,e,W}$ + C_{tr})

Table 4 – Glazing and Ventilation Specification – Red Façades

Blue Façades										
Rooms	Description	Octave Frequency Band (Hz, dB)							Overall (dB)	
		63	125	250	500	1k	2k	4k		
Glazing										
Living Rooms and Bedrooms	6mm Glass / 16mm Argon Cavity / 6.8mm Optiphon Glass	24	25	27	38	48	47	55	41 (R_W)	34 (R_W + C_{tr})
Background Trickle Ventilation										
Living Rooms	Greenwoods 2500EA.AC1 (Through-Frame Trickle Ventilation)	31	41	40	37	47	43	46	42 ($D_{n,e}$)	40 ($D_{n,e,W}$ + C_{tr})
Bedrooms	Greenwoods MA3051 (Through-Wall Trickle Ventilation)	30	46	45	50	55	65	67	55 ($D_{n,e}$)	52 ($D_{n,e,W}$ + C_{tr})

Table 5 – Glazing and Ventilation Specification – Blue Façades

Yellow Façades										
Rooms	Description	Octave Frequency Band (Hz, dB)							Overall (dB)	
		63	125	250	500	1k	2k	4k		
Glazing										
Living Rooms and Bedrooms	4mm Glass / 16mm Air Cavity / 4mm Glass	19	21	17	25	35	37	31	29 (R_W)	25 ($R_W + C_{tr}$)
Background Trickle Ventilation										
Living Rooms and Bedrooms	Titon Standard Vent + C25 (Through-Frame Trickle Ventilation)	--	36	38	36	32	37	39	35 ($D_{n,e}$)	33 ($D_{n,e,W} + C_{tr}$)

Table 6 – Glazing and Ventilation Specification – Yellow Façades

Any other window 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.

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	50 dB $L_{Aeq,16hour}$	42 dB $L_{Aeq,8hour}$ Normally Exceeds 65 dB L_{AFmax}	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	40 dB $L_{Aeq,16hour}$	35 dB $L_{Aeq,8hour}$ Normally Exceeds 45 dB L_{AFmax}	Noise can be heard, but does not cause any change in behaviour	Not Required

Table 7 – 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.

5.2 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.

Location	External Noise Levels	AVO Guide Windows Open Often	Exceedance	AVO Guide Windows Rarely Open	Exceedance
Red Façades	68 $L_{Aeq,16hr}$ (Day)	53	+15	63	+5
	66 $L_{Aeq,16hr}$ (Night)	48	+18	55	+11
	91 L_{AFmax} (Night)	58	+33	78	+13
Blue Façades	63 $L_{Aeq,1hr}$ (Day)	53	+10	63	0
	61 $L_{Aeq,8hr}$ (Night)	48	+13	55	+6
	86 L_{AFmax} (Night)	58	+28	78	+8
Yellow Façades	52 $L_{Aeq,1hr}$ (Day)	53	-1	63	-11
	48 $L_{Aeq,8hr}$ (Night)	48	0	55	-7
	67 L_{AFmax} (Night)	58	+6	78	-14

Table 8 – Open Window Assessment

As can be seen in the table above, for the red and blue façades, the external noise levels exceed the AVO Guides 'Rarely Open' criteria which means that windows cannot be used for the primary means of ventilation. An alternate ventilation strategy is required that is capable of a higher rate of ventilation. A mechanical extract ventilation system should be installed to provide 'Whole Dwelling Ventilation' in accordance with Approved Document F. It is understood that continuous MEV extract fans installed in accordance with the specified trickle ventilators to allow the ingress of fresh air will be adequate. The ventilation system should be designed by an appropriately qualified person to ascertain compliance with the relevant Building Regulations. Special consideration should be given to 1.5 to 1.7 of Approved Document F to assist in the design of the ventilation system and to ensure the self-generated noise levels from the MEV extract fans to not exceed the specified criteria.

For the yellow façades, the external noise levels exceed the AVO Guides 'Windows Open Often' criteria which means that windows being used for the primary means of ventilation (whilst maintaining reasonable internal noise levels) could vary dependent on the outcome of a TM59 overheating assessment. 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. If the TM59 is not undertaken, the same ventilation strategy as proposed for the red and blue facades should be implemented throughout the entire development.

6. Noise Breakthrough Assessment and Sound Insulation Scheme

6.1 Noise Breakthrough Criteria

The proposed development structurally adjoins a commercial property via a separating floor. BS8233:2014 states that the internal noise criteria from Table 1.0 includes 'overall noise' which is the sum of structure borne and airborne noise sources. Noise breaking through from structurally adjoining commercial property will be considered to ensure the total noise from both structurally adjoining commercial properties and external noise ingress, does not exceed the proposed acoustic design criteria. 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."*

The higher standard of sound insulation required is dependent on the level of noise generated within the commercial property. Noise from structurally adjoining commercial sources can lead to elevated impact and as such further consideration is given to the level of audibility, dominance, attention grabbing features, spectral distribution, regularity, change in level, duration, and time of day the sound is occurring. The commercial properties 'Use Classes' can assist in defining a suitable higher standard of sound insulation.

6.2 Noise Breakthrough Assessment and Specification

The following table outlines the expected level of risk associated with the 'Class Use' of the structurally adjoining commercial property and provides a required sound insulation standard including a discussion to justify the standard.

Planning Class	Level of Risk from Noise	Required Sound Insulation Standard (dB)
Class E Commercial	Medium	≥55 $D_{nT,w}$ + C_{tr}
Discussion: The use of the ground floor commercial property is not yet finalised; however, businesses defined as 'Class E – Commercial Use' generally include noise from patrons and background music. Any music in these types of premises would be normally of a low level to facilitate easy conversation and as such, music is not a primary concern. The noise from patrons can vary significantly and is highly dependent on the nature of the establishment. The required level of sound insulation should consider raised and elevated vocal efforts occurring regularly. Based on the previous commercial usage and the operational hours of the surrounding premises, it is assumed that the permitted opening hours will not extend into the night-time period (23:00 – 07:00). It is recommended that this reassessed if the property will be used for a business that generates higher levels of noise.		

Table 9 – Noise Breakthrough Assessment

NOVA Acoustics has been informed by that the proposed partition floor will be comprised of 250mm reinforced concrete slab with 100mm PIR insulation and 65mm screed. The airborne sound reduction provided by the proposed system has been modelled in INSUL 9.0 and further upgrade works will be required to meet the required sound insulation standard presented in Table 9.

An indicative specification that can achieve the required sound insulation standard is outlined below.

- Finished floor covering
- 65mm screed topping (min. surface mass of 80 kg/m²)
- 100mm PIR insulation (min. density of 10kg/m^2)
- 250mm reinforced concrete slab (min. density of 2000 kg/m³)
- 150mm drop lightweight suspended ceiling with 50mm mineral wool insulation (Min. 10-12 kg/m²)
- 1No. 15mm SoundBloc Plasterboard

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. BS4142:2014 Fixed Plant Noise Limit Levels

Currently, no external fixed plant has been specified for the Proposed Development, however, it is thought that it is possible that plant may be required in the future. For this reason, in line with Condition 10 of the planning application, plant noise limit levels have been defined to ensure that the noise emissions do not exceed the background sound levels at the closest NSRs. The limit levels are inclusive of any rating penalties that should be applied to account for audible characteristics of the noise which could be deemed to cause increased annoyance, such as intermittency, impulsivity, or tonality. The limit levels have been calculated for the daytime and night-time periods, depending on when the plant will be operational.

The calculated plant noise limit levels are shown in the tables below.

Location	Description	Daytime Period (dB)	Night-time Period (dB)
MP1	Background Sound Level ($L_{A90,T}$)	59	46
	Cumulative Plant Noise Limit Level at NSR ($L_{Aeq,T}$)	54	41
MP2	Background Sound Level ($L_{A90,T}$)	41	34
	Cumulative Plant Noise Limit Level at NSR ($L_{Aeq,T}$)	36	29

Table 10 – External Plant Limit Levels

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 ventilation systems, or suitable alternatives, should be installed as shown in Sections 4.2 and 5.2.
2. The separating floor between the structurally adjoining commercial property and the proposed development should be designed to achieve the required sound insulation. An indicative specification has been provided in Section 6. Further design assistance can be provided by NOVA Acoustics if required.
3. The plant limit levels shown in Section 7 should be achieved at all surrounding receptors.

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 (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 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 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 – ProPG: Planning and Noise (2017)

ProPG Planning and Noise published May 2017 by the Association of Noise Consultants (ANC) was produced to provide practitioners with guidance on a recommended approach to the management of noise within the planning system in England. ProPG aims to encourage better acoustic design of new residential developments promoting good health and wellbeing through the effective management of noise. It therefore outlines four key elements which should be considered in the assessment of noise:

- Element 1 – demonstrating a "Good Acoustic Design Process".
- Element 2 – observing internal "Noise Level Guidelines".
- Element 3 – undertaking an "External Amenity Area Noise Assessment"; and
- Element 4 – consideration of "Other Relevant Issues".

The ProPG supplementary document 2 provides the following 'Good Acoustic Design' hierarchy of noise management measures which LPAs should encourage. These are shown below, In descending order of preference:

Order of Preference	Noise Management Measure
1	Reduction of the noise generated at source by redesign, relocation, or containment. *
2	Maximising the spatial separation of noise source(s) and receptor(s).
3	Using existing topography and existing structures (that are likely to last the expected life of the noise-sensitive scheme) to screen the proposed development site from significant sources of noise.
4	Investigating the necessity and feasibility of reducing existing noise levels and relocating existing noise sources.
5	Incorporating noise barriers as part of the scheme to screen the proposed development site from significant sources of noise.
6	Using the layout of the scheme to reduce noise propagation across the site.
7	Using the orientation of buildings to reduce the noise exposure of noise sensitive rooms.
8	Using the building envelope to mitigate noise to acceptable levels.

Table 12 – Hierarchy of Noise Management Measures

**Not from ProPG*

B.5 – 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.6 – 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.

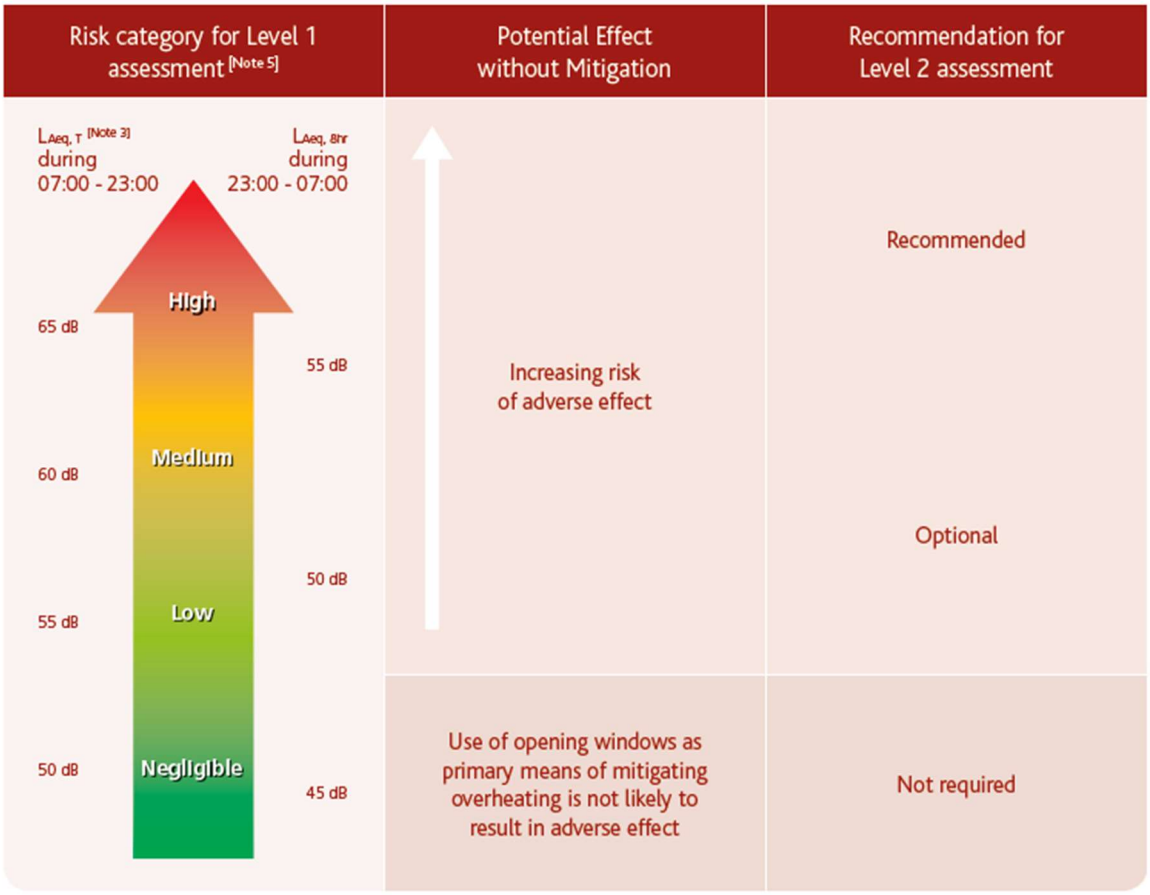


Table 3-2 of AVO Guide (2020)

Figure 9 – 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 13 – 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.

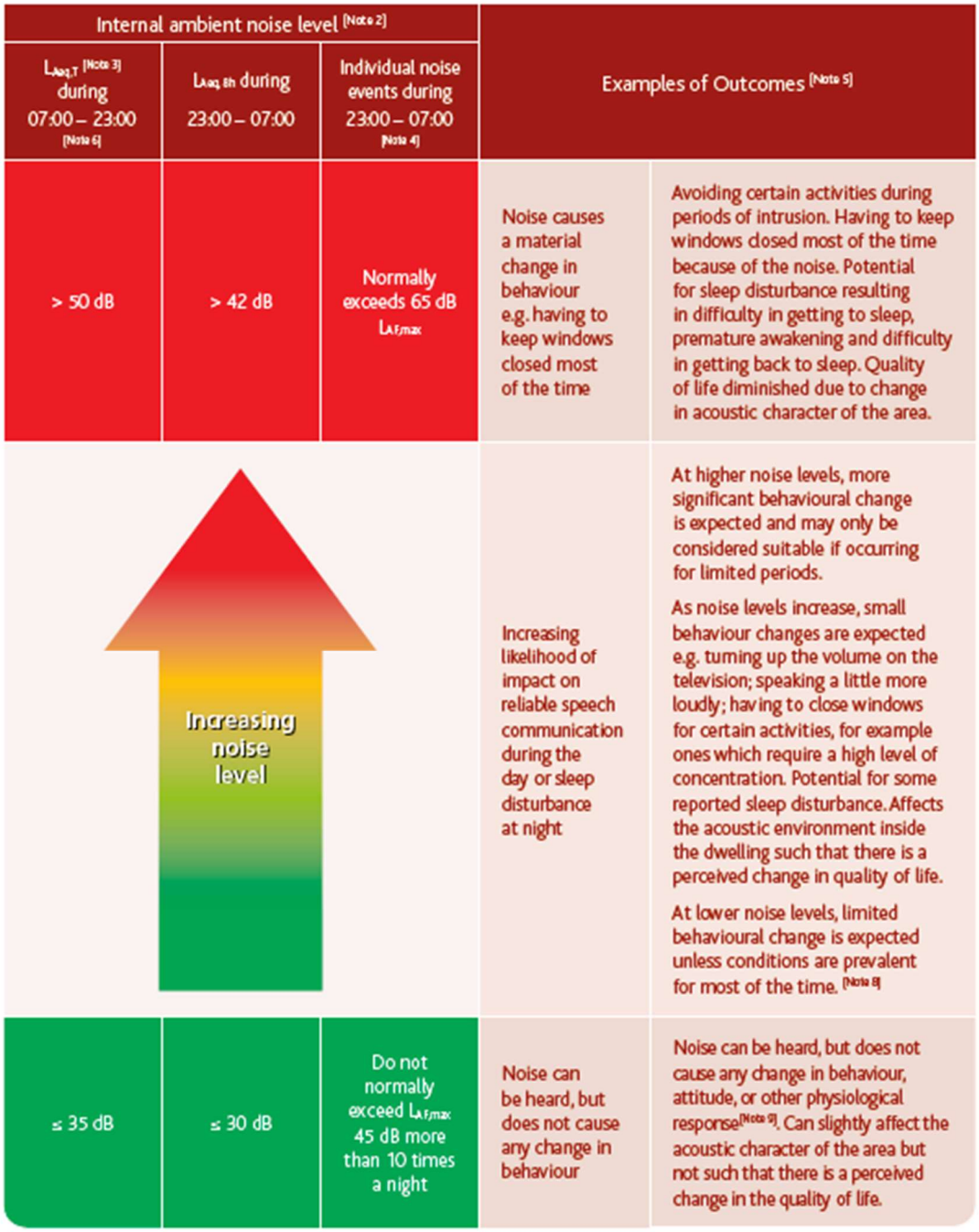
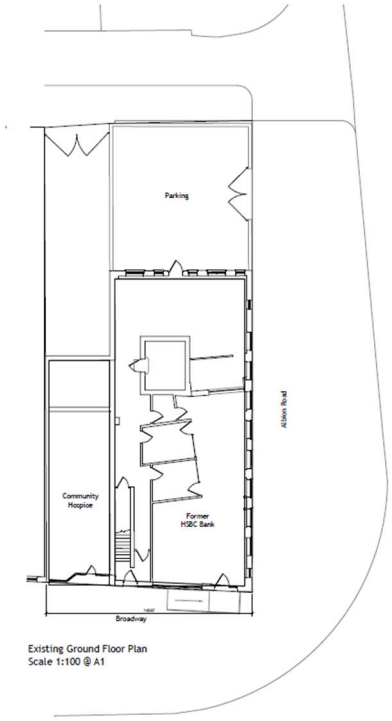


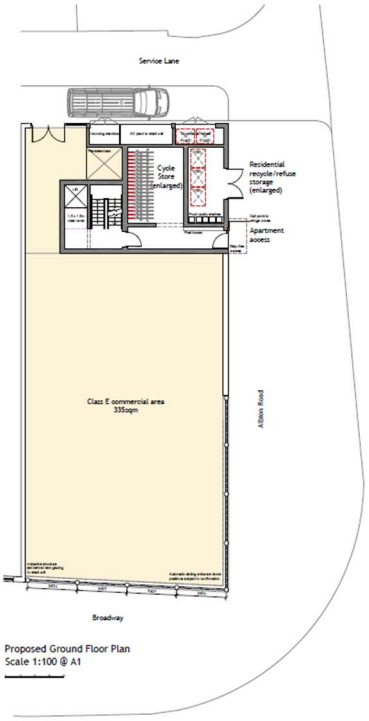
Table 3-3 of AVO Guide (2020)

Figure 10 – AVO Guide Level 2 Internal Ambient Noise Levels

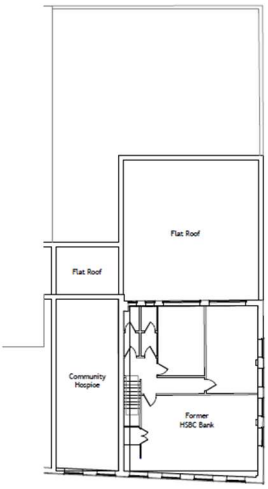
Appendix C – Location Plans



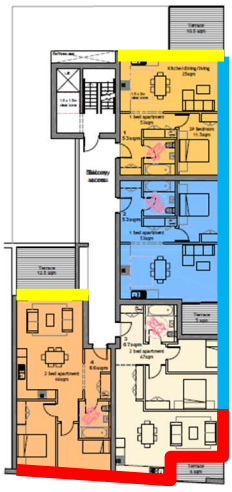
Existing Ground Floor Plan
Scale 1:100 @ A1



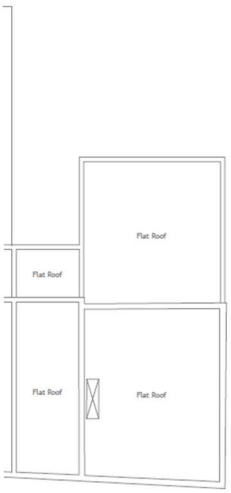
Proposed Ground Floor Plan
Scale 1:100 @ A1



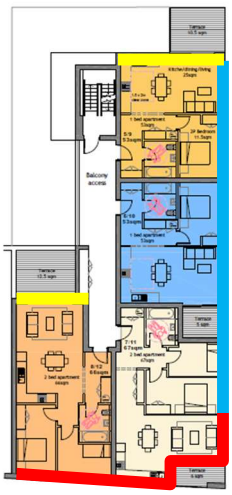
Existing First Floor Plan
Scale 1:100 @ A1



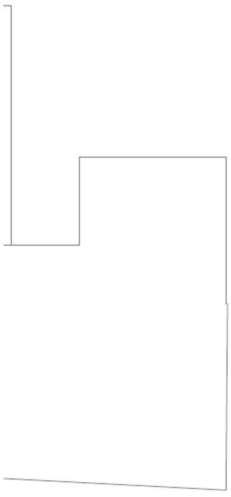
Proposed 1st Floor Plan
Scale 1:100 @ A1



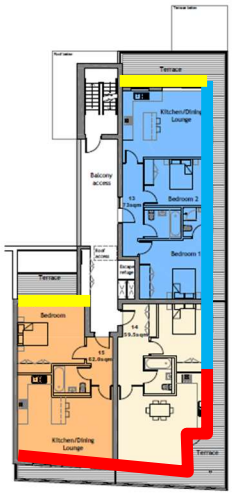
Existing Roof Plan
Scale 1:100 @ A1



Proposed Second & Third Floor Plan
Scale 1:100 @ A1

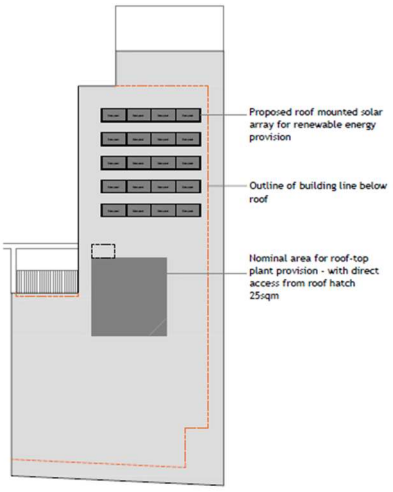


Existing Roof Plan below
Scale 1:100 @ A1



Proposed Fourth Floor Plan
Scale 1:100 @ A1

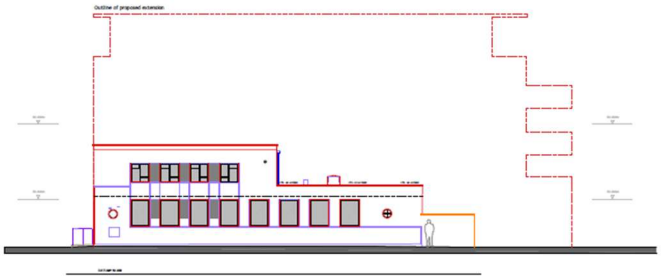
Existing Roof Plan below
Scale 1:100 @ A1



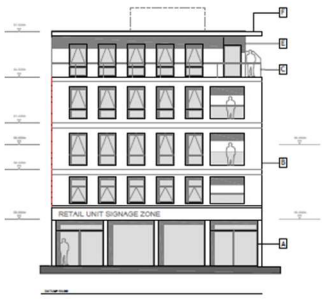
Proposed roof Plan
Scale 1:100 @ A1

mab
Planning application

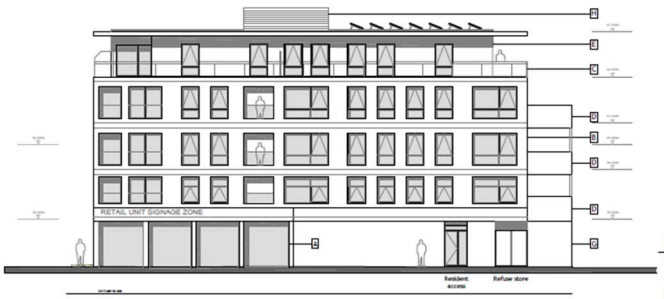
Existing Front elevation - North
Scale 1:100 @ A1



Existing Side elevation - West
Scale 1:100 @ A1



Proposed Front elevation - North
Scale 1:100 @ A1



Proposed Side elevation - West
Scale 1:100 @ A1

mab
Planning application

Appendix D – Environmental Survey

D.1 – Time History Noise Data

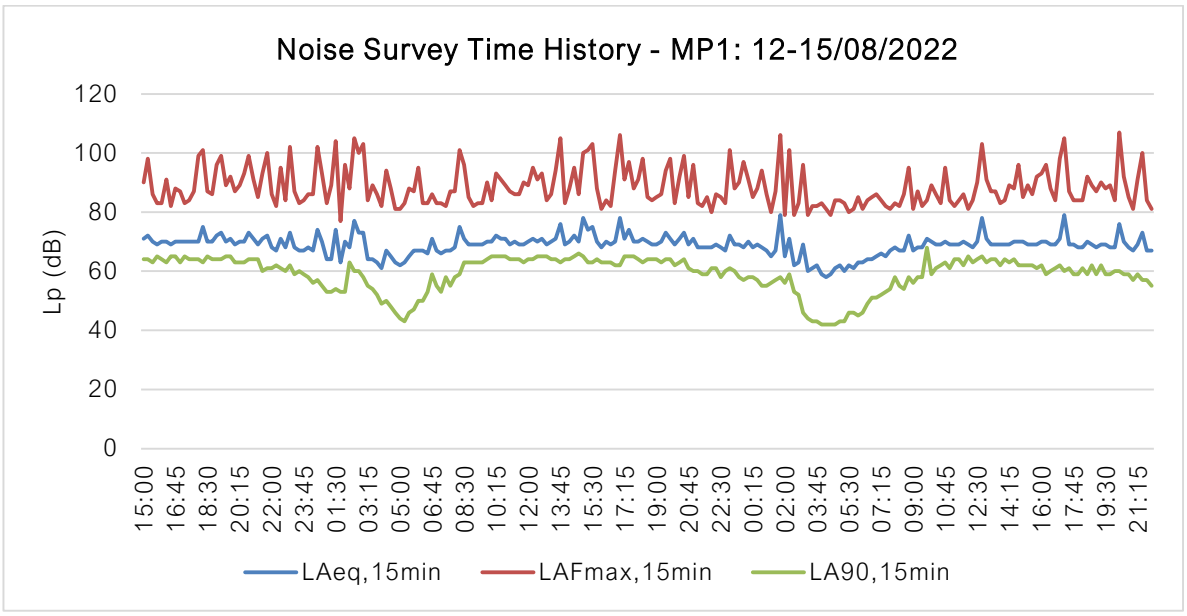


Figure 11 – MP1 Noise Survey Time History

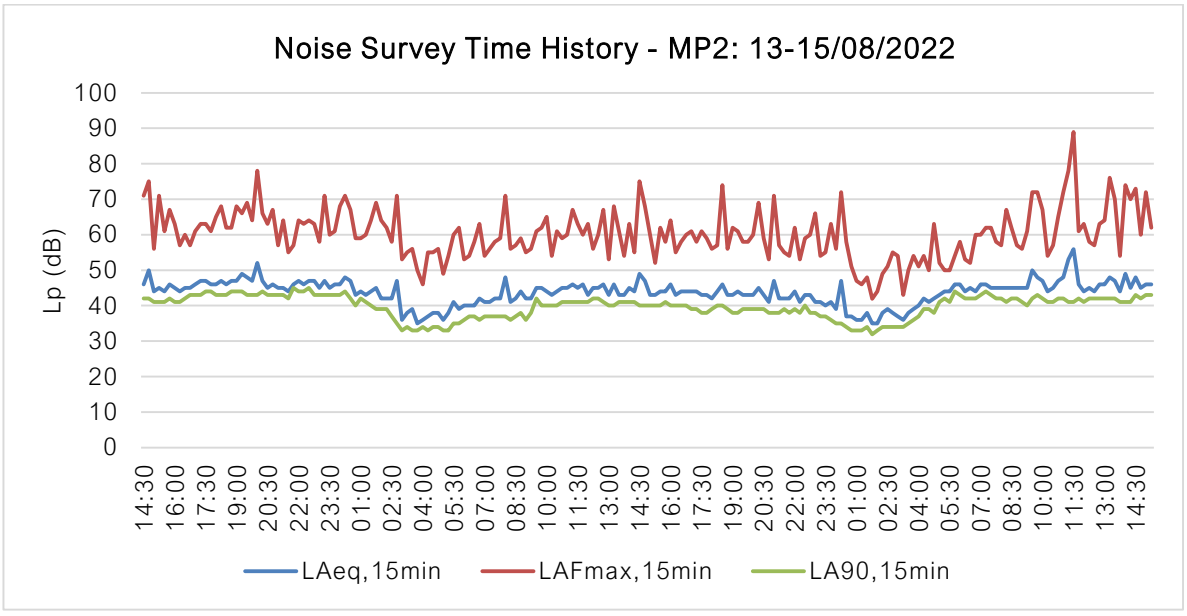


Figure 12 – MP2 Noise Survey Time History

D.2 – Surveying Equipment

Piece of Equipment	Serial No.	Calibration Deviation
CESVA SC420 Class 1 Sound level meter	T244499	≤0.5
CESVA CB006 Class 1 Calibrator	902441	
CESVA SC250 Class 1 Sound level meter	T252917	≤0.5
CESVA CB006 Class 1 Calibrator	902441	

Table 14 – 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 ≤0.5 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 – Barnehusrt Weather Station (Approx. 2km NE of Site)				
Time Period	Air Temp (^{0}C)	Rainfall (mm/h)	Prevailing Wind Direction	Wind Speed (m/s)
12/08/2022 – 00:00 – 23:59	15.7 – 35.2	0.0	NE	0.0 – 0.6
13/08/2022 – 00:00 – 23:59	16.3 – 39.4	0.0	ENE	0.0 – 0.8
14/08/2022 – 00:00 – 23:59	16.2 – 35.3	0.0	ENE	0.0 – 0.6
15/08/2022 – 00:00 – 23:59	19.4 – 32.3	0.0	SSW	0.0 – 1.2

Table 15 – 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 and BS EN 12354-3.
- The reverberation time is typically 0.5 and 0.3 seconds across the relevant frequency range for a furnished living room and bedrooms in the UK, respectively.
- Windows areas and room volumes have been taken from the technical drawings provided to UK Building Compliance. Detailed details can be provided upon request.
- 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. The current roof make up must be upgraded as below:
    - Existing roof tiles
    - Existing roof rafters
    - 100mm Rockwool insulation (e.g., RWA45, in. density of 45 kg/m^3)
    - Resilient Bars fixed to the rafters
    - 2 no. 15mm SoundBloc plasterboards (min. surface mass of 12.6 kg/m^2 per board)
- For background trickle ventilation a total Equivalent Area of 5000mm^2 per bedroom and living room has been used in the calculations, which equates to 2 No. trickle vents (2500mm^2 each).

It should be noted that assessment against the equivalent Noise Rating (NR) curves are included in the noise break calculations. As can be seen in the image below, there is a slight exceedance of 1 dB of the NR criteria however, the single-figure values (as provided in BS8233) are achieved and therefore the recommended glazing and ventilation specifications are considered suitable.

Living Room (Red Façade) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Corrected Leq,T Spectrum	68	73	69	67	65	64	61	55
Glazing Noise Ingress	28	45	38	33	20	16	8	-6
Ventilation Noise Ingress	25	40	26	25	26	15	16	7
Wall Noise Ingress	9	26	17	13	1	-1	-4	-10
Roof Noise Ingress								
Room Absorption Correction		2	2	1	1	1	0	-1
Total Noise Ingress	**34**	**51**	**43**	**38**	**31**	**22**	**20**	**9**
NR30	35	59	48	39	33	30	26	24
Exceedance of Criteria	-1	-8	-5	-1	-2	-8	-6	-15

Bedroom (Red Façade) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Corrected Leq,T Spectrum	68	73	69	67	65	64	61	55
Glazing Noise Ingress	24	41	34	29	16	12	4	-10
Ventilation Noise Ingress	20	43	23	22	15	9	-4	-12
Wall Noise Ingress	12	29	20	16	4	2	-1	-7
Roof Noise Ingress								
Room Absorption Correction		2	2	1	1	1	0	-1
Total Noise Ingress	**30**	**51**	**39**	**34**	**23**	**18**	**9**	**-2**
NR30	35	59	48	39	33	30	26	24
Exceedance of Criteria	-5	-8	-9	-5	-10	-12	-17	-26

Bedroom (Red Façade) Night Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Corrected Leq,T Spectrum	66	71	62	59	61	60	58	61
Glazing Noise Ingress	18	39	27	21	12	8	1	-4
Ventilation Noise Ingress	17	42	17	15	12	6	-6	-5
Wall Noise Ingress	8	28	14	9	1	-1	-3	0
Roof Noise Ingress								
Room Absorption Correction		2	2	1	1	1	0	-1
Total Noise Ingress	**26**	**49**	**32**	**27**	**19**	**14**	**6**	**5**
NR25	30	55	43	35	28	25	21	19
Exceedance of Criteria	-4	-6	-11	-8	-9	-11	-15	-14

Bedroom (Red Façade) Night Time Max

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Corrected Lmax Spectrum	91	85	75	77	84	89	84	71
Glazing Noise Ingress	40	53	41	39	36	37	27	6
Ventilation Noise Ingress	38	56	30	32	35	35	20	5
Wall Noise Ingress	30	42	27	27	24	28	23	10
Roof Noise Ingress								
Room Absorption Correction		2	2	1	1	1	0	-1
Total Noise Ingress	**46**	**63**	**46**	**44**	**42**	**44**	**32**	**15**
NR40	45	67	56	49	43	40	37	34
Exceedance of Criteria	1	-4	-10	-5	-1	4	-5	-19

Figure 13 – Noise Break-In Calculation – Red Façades

Living Room (Blue Façade) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Corrected Leq,T Spectrum	63	68	64	62	60	59	56	50
Glazing Noise Ingress	26	43	39	30	19	7	4	-8
Ventilation Noise Ingress	21	35	21	20	21	10	11	2
Wall Noise Ingress	5	23	14	10	-2	-4	-7	-13
Roof Noise Ingress								
Room Absorption Correction		2	2	2	1	1	1	0
Total Noise Ingress	**32**	**49**	**44**	**35**	**27**	**16**	**16**	**5**
NR30	35	59	48	39	33	30	26	24
Exceedance of Criteria	-3	-10	-4	-4	-6	-14	-10	-19

Bedroom (Blue Façade) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Corrected Leq,T Spectrum	63	68	64	62	60	59	56	50
Glazing Noise Ingress	22	39	35	26	15	3	0	-12
Ventilation Noise Ingress	16	39	19	18	11	5	-8	-16
Wall Noise Ingress	7	25	16	12	0	-2	-5	-11
Roof Noise Ingress								
Room Absorption Correction		3	2	2	1	1	1	0
Total Noise Ingress	**28**	**48**	**40**	**32**	**21**	**12**	**6**	**-5**
NR30	35	59	48	39	33	30	26	24
Exceedance of Criteria	-7	-11	-8	-7	-12	-18	-20	-29

Bedroom (Blue Façade) Night Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Corrected Leq,T Spectrum	61	66	57	54	56	55	53	56
Glazing Noise Ingress	17	37	28	18	11	-1	-3	-6
Ventilation Noise Ingress	13	37	12	10	7	1	-11	-10
Wall Noise Ingress	3	23	9	4	-4	-6	-8	-5
Roof Noise Ingress								
Room Absorption Correction		3	2	2	1	1	1	0
Total Noise Ingress	**23**	**46**	**33**	**24**	**17**	**8**	**3**	**1**
NR25	30	55	43	35	28	25	21	19
Exceedance of Criteria	-7	-9	-10	-11	-11	-17	-18	-18

Bedroom (Blue Façade) Night Time Max

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Corrected Lmax Spectrum	86	80	70	72	79	84	79	66
Glazing Noise Ingress	35	51	42	36	35	28	23	4
Ventilation Noise Ingress	33	51	26	28	31	31	15	1
Wall Noise Ingress	26	37	22	22	19	23	18	5
Roof Noise Ingress								
Room Absorption Correction		3	2	2	1	1	1	0
Total Noise Ingress	**42**	**60**	**47**	**42**	**41**	**38**	**29**	**12**
NR40	45	67	56	49	43	40	37	34
Exceedance of Criteria	-3	-7	-9	-7	-2	-2	-8	-22

Figure 14 – Noise Break-In Calculation – Blue Façades

Living Room (Yellow Façade) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Measured Leq,T	52	67	59	51	45	46	44	40
Glazing Noise Ingress	18	38	28	24	10	1	-3	-1
Ventilation Noise Ingress	12		18	8	4	9	2	-4
Wall Noise Ingress	-3	21	8	-2	-18	-18	-20	-24
Roof Noise Ingress	8	33	11	-2	-13	-12	-14	-18
Room Absorption Correction		5	5	4	4	4	3	2
Total Noise Ingress	**27**	**47**	**36**	**31**	**18**	**17**	**10**	**6**
NR30	35	59	48	39	33	30	26	24
Exceedance of Criteria	-8	-12	-12	-8	-15	-13	-16	-18

Bedroom (Yellow Façade) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Measured Leq,T	52	67	59	51	45	46	44	40
Glazing Noise Ingress	21	40	30	26	12	3	-1	1
Ventilation Noise Ingress	14		20	10	6	11	4	-2
Wall Noise Ingress	-2	21	8	-2	-18	-18	-20	-24
Roof Noise Ingress	7	33	11	-2	-13	-12	-14	-18
Room Absorption Correction		3	3	3	2	2	2	1
Total Noise Ingress	**27**	**47**	**37**	**32**	**18**	**17**	**10**	**7**
NR30	35	59	48	39	33	30	26	24
Exceedance of Criteria	-8	-12	-11	-7	-15	-13	-16	-17

Bedroom (Yellow Façade) Night Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Measured Leq,T	48	66	56	46	42	43	38	32
Glazing Noise Ingress	17	39	27	21	9	0	-7	-7
Ventilation Noise Ingress	10		17	5	3	8	-2	-10
Wall Noise Ingress	-5	20	5	-7	-21	-21	-26	-32
Roof Noise Ingress	6	32	8	-7	-16	-15	-20	-26
Room Absorption Correction		3	3	3	2	2	2	1
Total Noise Ingress	**24**	**46**	**34**	**27**	**15**	**14**	**4**	**-1**
NR25	30	55	43	35	28	25	21	19
Exceedance of Criteria	-6	-9	-9	-8	-13	-11	-17	-20

Bedroom (Yellow Façade) Night Time Max

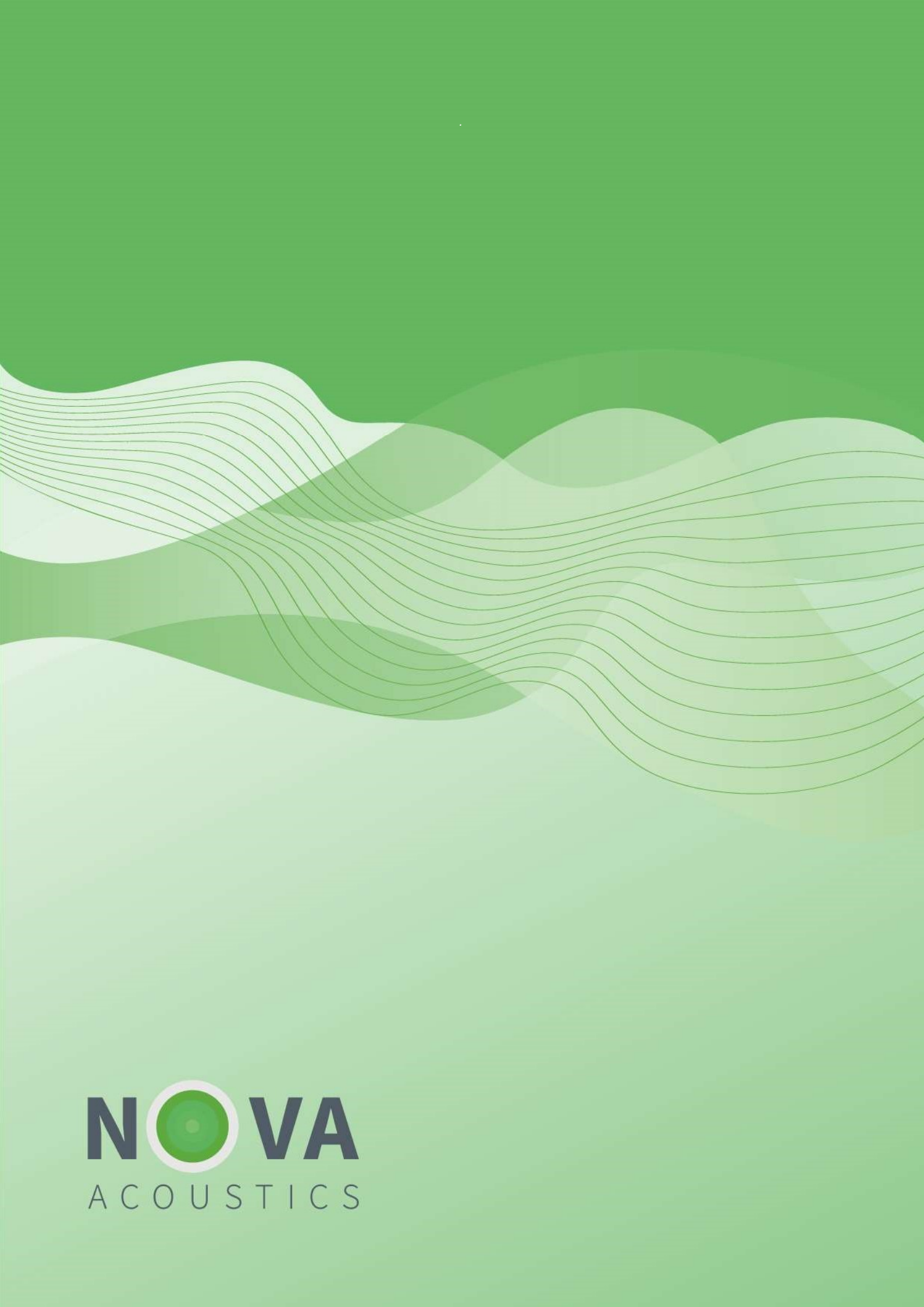
Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Corrected Lmax Spectrum	67	85	75	65	61	62	57	51
Glazing Noise Ingress	36	58	46	40	28	19	12	12
Ventilation Noise Ingress	29		36	24	22	27	17	9
Wall Noise Ingress	15	39	24	12	-2	-2	-7	-13
Roof Noise Ingress	25	51	27	12	3	4	-1	-7
Room Absorption Correction		3	3	3	2	2	2	1
Total Noise Ingress	**43**	**65**	**53**	**46**	**34**	**33**	**23**	**18**
NR40	45	67	56	49	43	40	37	34
Exceedance of Criteria	-2	-2	-3	-3	-9	-7	-14	-16

Figure 15 – Noise Break-In Calculation – Yellow Façades

Appendix F – Noise Modelling Particulars

The SoundPlan 8.2 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.
- For the purpose of the assessment, the ground between the source and receiver is considered to consist primarily of acoustically 'soft' surfaces.
- 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 3 have been used to calibrate the noise model.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