# Residential Noise Assessment

Site Address: Hyde Park Hayes 3, Hayes, UB3 4AZ

Client Name: Claude Ferdinand – Elmsbrook

Project Reference No: NP-009312

| Authorisation and Version Control | | | |
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| 001 | -- |

## 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 residential development ('the Proposed Development') at Hyde Park Hayes 3, Hayes, UB3 4AZ ('the Site'). The site is subject to noise from road traffic emissions and commercial activity.

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

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

## *1.1 Standards, Legislation, Policy & Guidance*

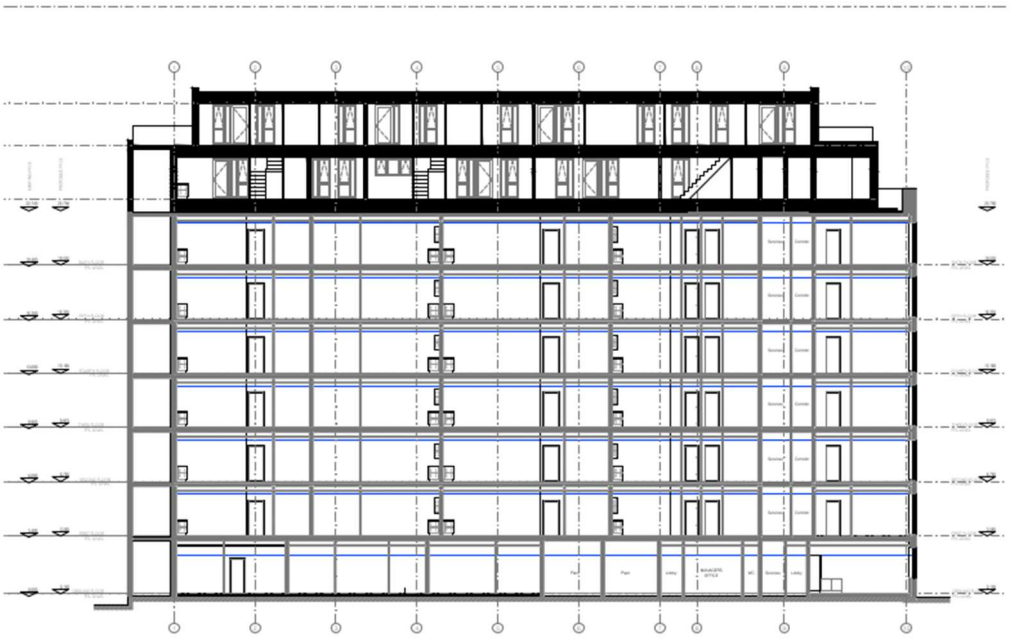
The following performance standards, legislation, policy, and guidance have been considered to ensure good acoustic design in the assessment:

- National Planning Policy Framework (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 for the extension of the existing building from 7-storey to 9-storey height, which will include an extra 9no. residential dwellings. The figure below shows the Proposed Development.



*Drawing Ref No. 207 – P1 from 'Front Architecture Ltd'*

*Figure 1 – Proposed Development*

The development has been conditionally approved by the Council of the London Borough of Hillingdon (application ref: 2360/APP/2021/1709) The following planning conditions have been imposed regarding noise:

*"Condition 4:*

*The noise level in rooms at the development hereby approved shall meet the noise standard specified in BS8233:2014 for internal rooms and external amenity areas.*

*REASON*

*To ensure the development accords with the requirements of Policy DMHB 11 of the Hillingdon Local Plan: Part 2 - Development Management Policies (January 2020), Policy EM8 of the Hillingdon Local Plan: Part 1 - Strategic Policies (November 2012) and Policy D14 of the London Plan (March 2021).*

*Condition 5:*

*Prior to commencement of the development, a revised noise assessment shall be submitted to the local planning authority which provides a conclusive assessment of the worst affected facade of the building. The report should assess whether appropriate mitigation is required by way of the installation of secondary glazing. The recommendations of the report shall be implemented prior to the first occupation of the development and retained/maintained for the life of the development.*

*REASON*

*To ensure the development accords with the requirements of Policy DMHB 11 of the Hillingdon Local Plan: Part 2 - Development Management Policies (January 2020), Policy EM8 of the Hillingdon Local Plan: Part 1 - Strategic Policies (November 2012) and Policy D14 of the London Plan (March 2021)."*

# 2. Environmental Noise Survey

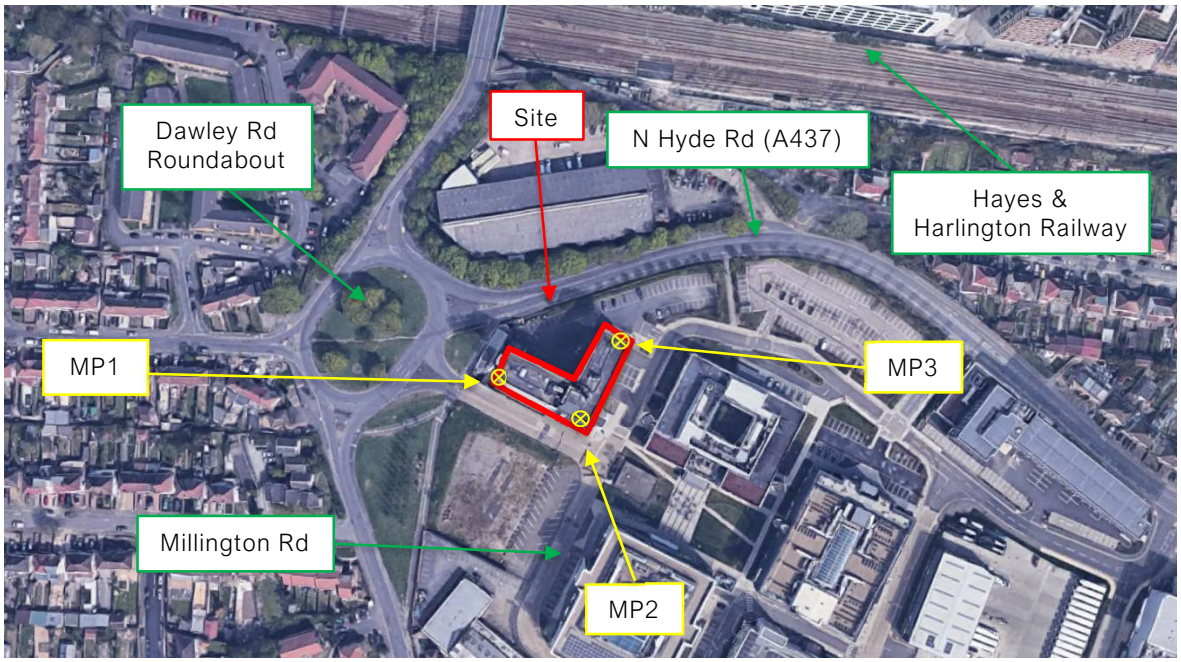
## 2.1 Measurement Methodology

The following table outlines the measurement dates and particulars.

| Location | Survey Dates | Measurement Particulars |
|---|---|---|
| MP1 | 02/05/2023 – 03/05/2023 | Equipment mounted on a tripod at roof level at a height of 1.5m facing Dawley Road roundabout. |
| MP2 | 02/05/2023 – 03/05/2023 | Equipment mounted on a tripod at roof level at a height of 1.5m facing Millington Road. |
| MP3 | 02/05/2023 – 03/05/2023 | Equipment mounted on a tripod at roof level at a height of 1.5m facing N Hyde Road (A437). |

*Table 1 – Measurement Methodology*

The figure below outlines the site surroundings and measurement locations:




Imagery ©2023 Google, Imagery ©2023 Bluesky, Getmapping plc, 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 off Millington Road, Hayes. The area surrounding the Site is mixed in nature with residential dwellings to the west and commercial properties immediately to the east, north and south. Surrounding business appear to be office-based and would therefore be considered low risk in terms of possible noise impact. A number of plant units are visible on the roof of the neighbouring properties; however, it was noted that these units were inaudible against the prevailing residual noise level at the proposed development site.

The acoustic environment is deemed to be low to moderate in level and the noise profile is dominated by road traffic noise emissions from the surrounding road network including A437, Millington Road and the

connecting roundabout. Rail noise was noticed during the site, however, due to distance and shielding from surrounding buildings, this was quiet and not considered to be a cause for concern at the proposed site level.

### *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) | $L_{AFmax,1min}$ (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 63 | 125 | 250 | 500 | 1k | 2k | 4k | | |
| MP1 | $L_{eq,16hr}$ (Day) | 66 | 60 | 58 | 56 | 56 | 50 | 41 | 59 | -- |
| | $L_{eq,8hr}$ (Night) | 59 | 55 | 53 | 52 | 53 | 45 | 34 | 55 | 73 |
| | $L_{eq,1hr}$ (Day) | 67 | 61 | 59 | 57 | 56 | 50 | 43 | 59 | -- |
| | $L_{eq,1hr}$ (Night) | 63 | 58 | 57 | 56 | 57 | 49 | 37 | 59 | 73 |
| MP2 | $L_{eq,16hr}$ (Day) | 68 | 63 | 60 | 58 | 57 | 51 | 46 | 61 | -- |
| | $L_{eq,8hr}$ (Night) | 61 | 58 | 56 | 54 | 54 | 47 | 40 | 57 | 79 |
| | $L_{eq,1hr}$ (Day) | 70 | 64 | 62 | 59 | 58 | 52 | 48 | 62 | -- |
| | $L_{eq,1hr}$ (Night) | 63 | 61 | 58 | 56 | 56 | 49 | 45 | 59 | 79 |
| MP3 | $L_{eq,16hr}$ (Day) | 68 | 62 | 61 | 60 | 60 | 53 | 44 | 63 | -- |
| | $L_{eq,8hr}$ (Night) | 61 | 56 | 56 | 56 | 57 | 49 | 38 | 59 | 77 |
| | $L_{eq,1hr}$ (Day) | 69 | 63 | 61 | 61 | 61 | 54 | 45 | 64 | -- |
| | $L_{eq,1hr}$ (Night) | 64 | 58 | 59 | 59 | 59 | 51 | 40 | 62 | 77 |

*Table 2 – Sound Level Results Summary*

# 3. Noise Break-In Assessment and Sound Insulation Scheme

## *3.1 Internal Noise Level Criteria*

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

| Activity | Location | Daytime (07:00 – 23:00) | Night-time (23:00 – 07:00) |
|---|---|---|---|
| Resting | Living Room | 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<br>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 measured sound levels at the proposed development are assessed against the relevant criteria and a sound insulation scheme is provided to achieve a good internal acoustic environment.

## *3.2 Commercial Noise Sources*

As can be seen in the time history graphs in Appendix D, the measured noise levels are clearly diurnal in nature. It was also noted during the site visits that the noise profile of the area is predominantly "anonymous" steady state noise sources (e.g., road traffic). There are multiple existing residential dwellings in close proximity to the commercial activities, and as such, it is assumed that the existing commercial noise levels are unlikely to have an adverse impact on residential amenity in the area.

Although plant units were noticed during the site the visit, analysis of the measured data shows that any noise generated from these sources is below the residual noise level. As such, it is believed that any impact will be low.

However, to protect future residents in the event of increased noise levels and possible fluctuations, the façade sound reduction will be specified using the loudest 1-hour measurement periods as opposed to

the average 16-hour (daytime) and 8-hour (night-time) periods recommended in BS8233. This methodology is in line with the guidance provided in Note 4 of the table above.

### *Façade Allocation*

The measured sound levels at the façades of the property vary significantly. In order to correctly specify the required sound reduction, the façades have been divided into three colour groups. Appropriate models of glazing and ventilation for each façade colour are shown in Tables 4 and 5 below.

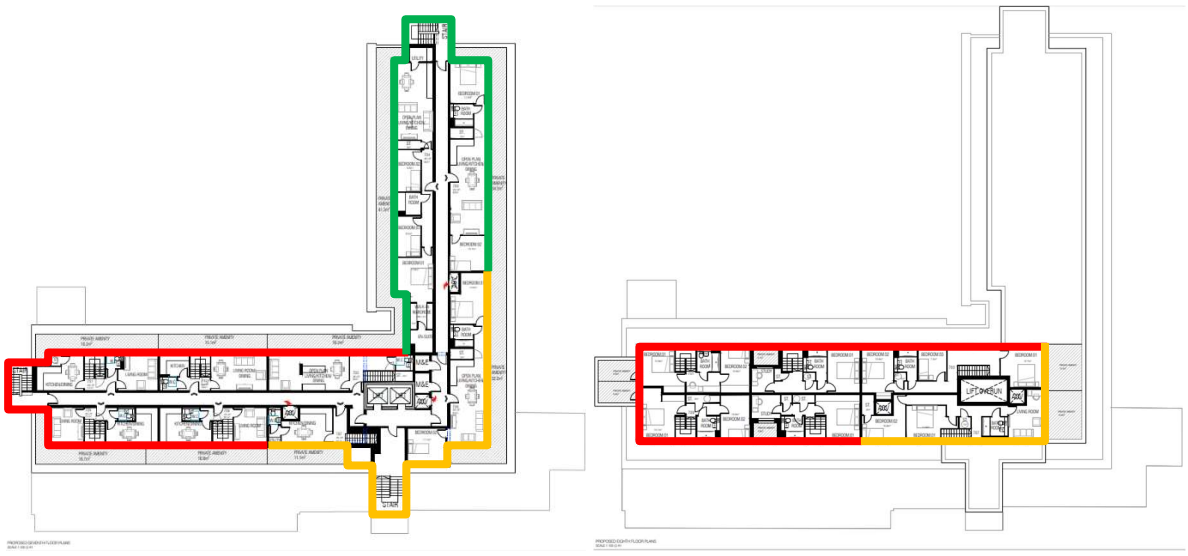


*Figure 3 – Façade Allocation*

### 3.3 *Glazing and Background Ventilation Specification*

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

| Sound Insulation Scheme – Red & Green Façades - Living Rooms & Bedrooms | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Description | Octave Frequency Band (Hz, dB) | | | | | | | Overall (dB) | Overall (dB) |
| | 63 | 125 | 250 | 500 | 1k | 2k | 4k | | |
| 6mm Glass / 16mm Argon Cavity / 6.8mm Optiphon Glass (SRI)* | 21 | 21 | 28 | 37 | 48 | 48 | 54 | 39 ($R_W$) | 33 ($R_W$ + $C_{tr}$) |
| Greenwoods 2500EA.AC1 (2 No. Trickle) ($D_{ne}$)* | 31 | 41 | 40 | 37 | 47 | 43 | 46 | 42 ($D_{ne}$) | 40 ($D_{ne}$ + $C_{tr}$) |
| **Sound Insulation Scheme – Amber Façades - Living Rooms & Bedrooms** | | | | | | | | | |
| Description | Octave Frequency Band (Hz, dB) | | | | | | | Overall (dB) | Overall (dB) |
| | 63 | 125 | 250 | 500 | 1k | 2k | 4k | | |
| Living Rooms: 6mm Glass / 16mm Argon Cavity / 6.8mm Optiphon Glass (SRI)* | 21 | 21 | 28 | 37 | 48 | 48 | 54 | 39 ($R_W$) | 33 ($R_W$ + $C_{tr}$) |
| Bedrooms: 6mm Glass / 16mm Argon Cavity / 8.8mm Optiphon Glass (SRI)* | 24 | 25 | 27 | 38 | 48 | 47 | 55 | 41 ($R_W$) | 34 ($R_W$ + $C_{tr}$) |
| Greenwoods 2500EA.AC1 (2 No. Trickle) ($D_{ne}$)* | 31 | 41 | 40 | 37 | 47 | 43 | 46 | 42 ($D_{ne}$) | 40 ($D_{ne}$ + $C_{tr}$) |

*Table 4 – Glazing 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.

| AVO Open Window Assessment – Red Façades | | | | |
|---|---|---|---|---|
| External Noise Levels | BS8233 Relaxed Criteria | Exceedance | AVO Guide Windows Rarely Open | Exceedance |
| 59 $L_{Aeq,1hr}$ (Day) | 53 | +6 | 63 | -4 |
| 59 $L_{Aeq,1hr}$ (Night) | 48 | +11 | 55 | +4 |
| 73 $L_{AFmax}$ (Night) | 63 | +15 | 78 | -5 |
| **AVO Open Window Assessment – Amber Façades** | | | | |
| External Noise Levels | BS8233 Relaxed Criteria | Exceedance | AVO Guide Windows Rarely Open | Exceedance |
| 62 $L_{Aeq,1hr}$ (Day) | 53 | +9 | 63 | -1 |
| 59 $L_{Aeq,1hr}$ (Night) | 48 | +11 | 55 | +4 |
| 79 $L_{AFmax}$ (Night) | 58 | +21 | 78 | +1 |
| **AVO Open Window Assessment – Green Façades** | | | | |
| External Noise Levels | BS8233 Relaxed Criteria | Exceedance | AVO Guide Windows Rarely Open | Exceedance |
| 64 $L_{Aeq,1hr}$ (Day) | 53 | +11 | 63 | +1 |
| 62 $L_{Aeq,1hr}$ (Night) | 48 | +14 | 55 | +7 |
| 77 $L_{AFmax}$ (Night) | 58 | +19 | 78 | -1 |

*Table 5 – Open Window Assessment*

**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 AVO Guides 'Rarely Open' criteria which means that windows cannot be used for the primary means of ventilation and 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. It is noted that the windows will remain openable at the occupant's choice.

# 5. External Noise Level Assessment

## *5.1 External Noise Level Criteria*

The following table outlines the external acoustic design criteria used in the following assessment.

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

*Table 6 – Acoustic Design Criteria*

## *5.2 External Noise Level Assessment*

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

| External Amenity Area Noise Level Assessment | | | |
|---|---|---|---|
| Façade Area | $L_{Aeq,16hr}$ Noise Level (dB) | BS8233:2014 Criteria (dB) | Exceedance (dB) |
| Red | 59 | 50 – 55 $L_{Aeq,1hr}$ | +4 |
| Amber | 61 | | +6 |
| Green | 63 | | +8 |

*Table 7 – BS8233:2014 External Amenity Area Noise Level Assessment*

As can be seen in the table above, the noise levels within the amenity areas have exceeded the criteria by up to 8 dB. Balconies are known to be complicated areas in which to implement mitigation as methods are limited. Re-orientation of the space is not possible; therefore, it is recommended that an appropriate barrier should be installed to minimise impact from the surrounding unwanted noise. An example of this would be an acoustic screen with a minimum height of 1.5m, a minimum surface mass of 15 kg/m$^2$, and no holes or gaps. It is assumed that future residents will expect higher noise levels in external amenity areas due to the location of the site and the known proximity to local road and rail networks.

Further to this, BS8233 provides commentary on such situations:

*"For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB LAeq,T, with an upper guideline value of 55 dB LAeq,T which would be acceptable in noisier environments. However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces but should not be prohibited. Other locations, such as balconies, roof gardens and terraces, are also important in residential buildings where normal external amenity space might be limited or not available, i.e., in flats, apartment blocks, etc. In these locations, specification of noise limits*

*is not necessarily appropriate. Small balconies may be included for uses such as drying washing or growing pot plants, and noise limits should not be necessary for these uses. However, the general guidance on noise in amenity space is still appropriate for larger balconies, roof gardens and terraces, which might be intended to be used for relaxation. In high-noise areas, consideration should be given to protecting these areas by screening or building design to achieve the lowest practicable levels. Achieving levels of 55 dB LAeq,T or less might not be possible at the outer edge of these areas but should be achievable in some areas of the space."*

The following elements of the design proposals are contingent on the external noise levels being achieved.

- The site layout as per Drawing Ref No. 200-P1 and 201-P1 from 'Front Architecture Ltd'
- The perimeter screening around the external amenity areas is required to be a minimum height of 1.5m, have a minimum surface mass of 15 kg/m$^2$ and have no holes or gaps. The proposed locations of the barriers are shown below:

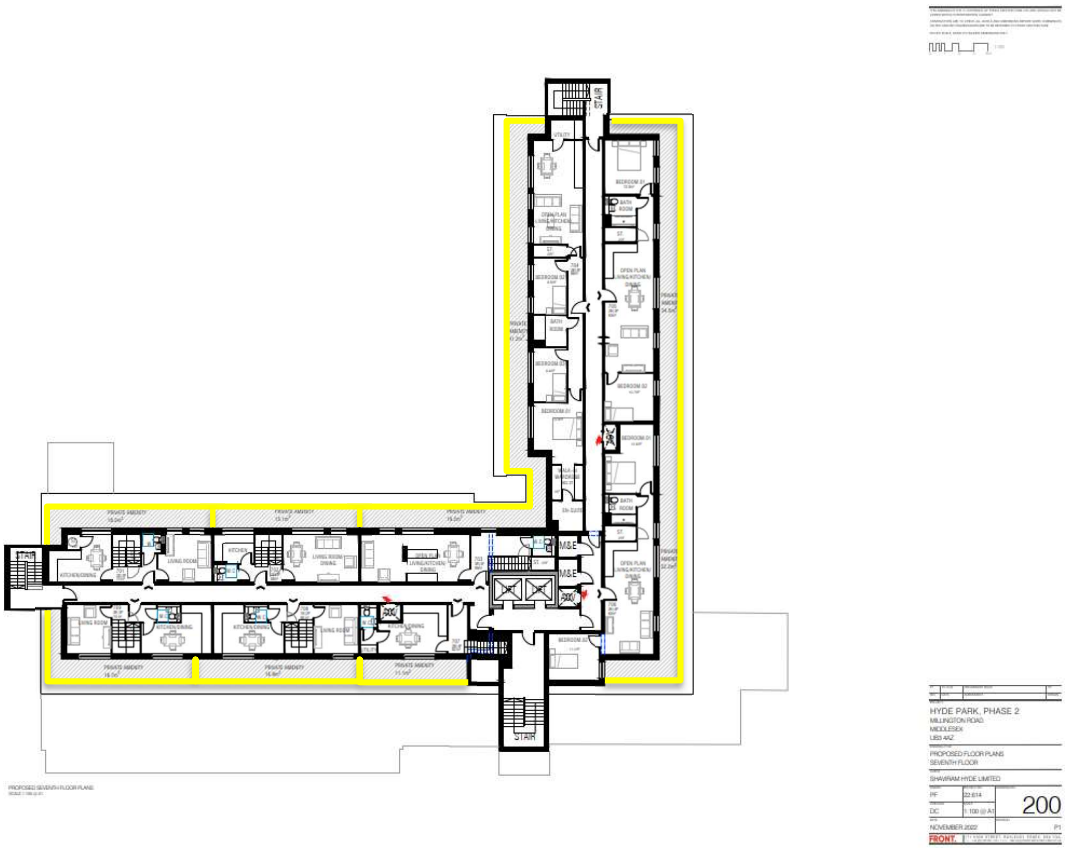



*Figure 4 – Acoustic Barrier Locations – Floor 7*

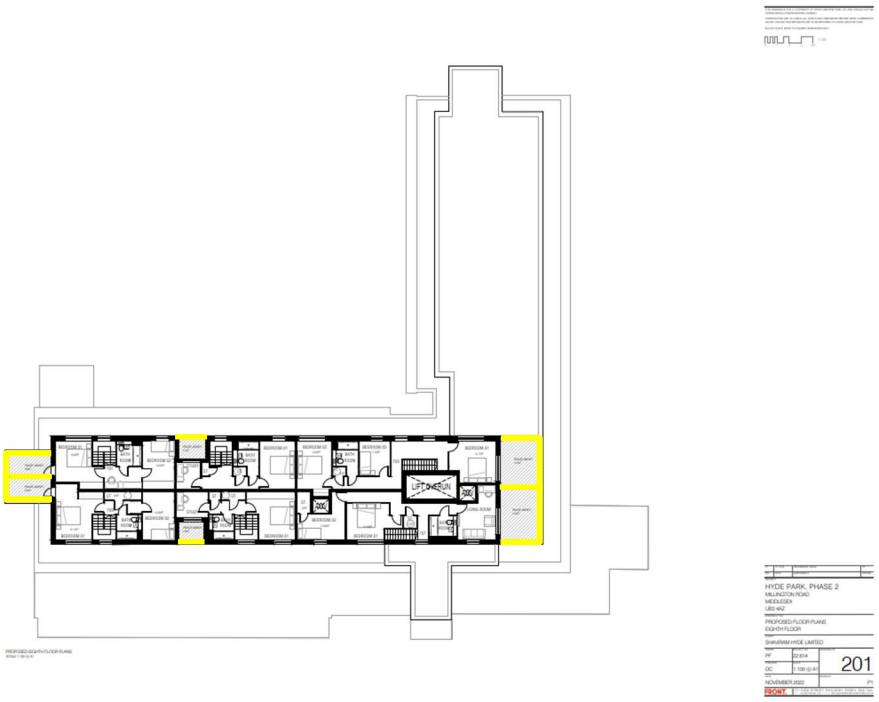



*Figure 5 – Acoustic Barrier Locations – Floor 8*

If the above elements are altered further assessment will be required.

## 6. Conclusion and Action Plan

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

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

1. The proposed glazing and background ventilation system, or a suitable alternative, should be installed as shown in Section 3.
2. A mechanical ventilation system should be installed in all dwellings to provide 'Whole Dwelling Ventilation' in accordance with Approved Document F, as discussed in Section 4.
3. The external amenity areas (balconies and terraces) should be installed as per Section 5.

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 $L_{Aeq,8hour}$<br>45 dB $L_{AFmax}$* |

*Table 8 – 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 the following.
    a) Correctly sizing and jointing ducts.
    b) 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.
    c) 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.

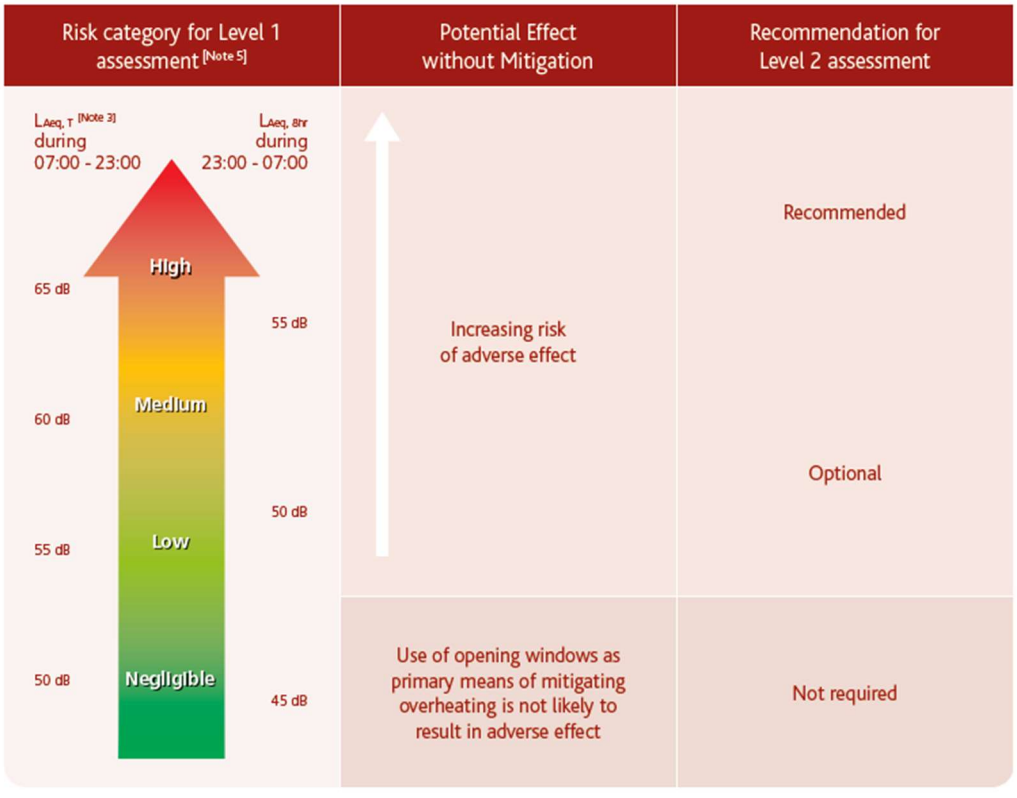



Table 3-2 of AVO Guide (2020)

*Figure 6 – 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 9 – 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.

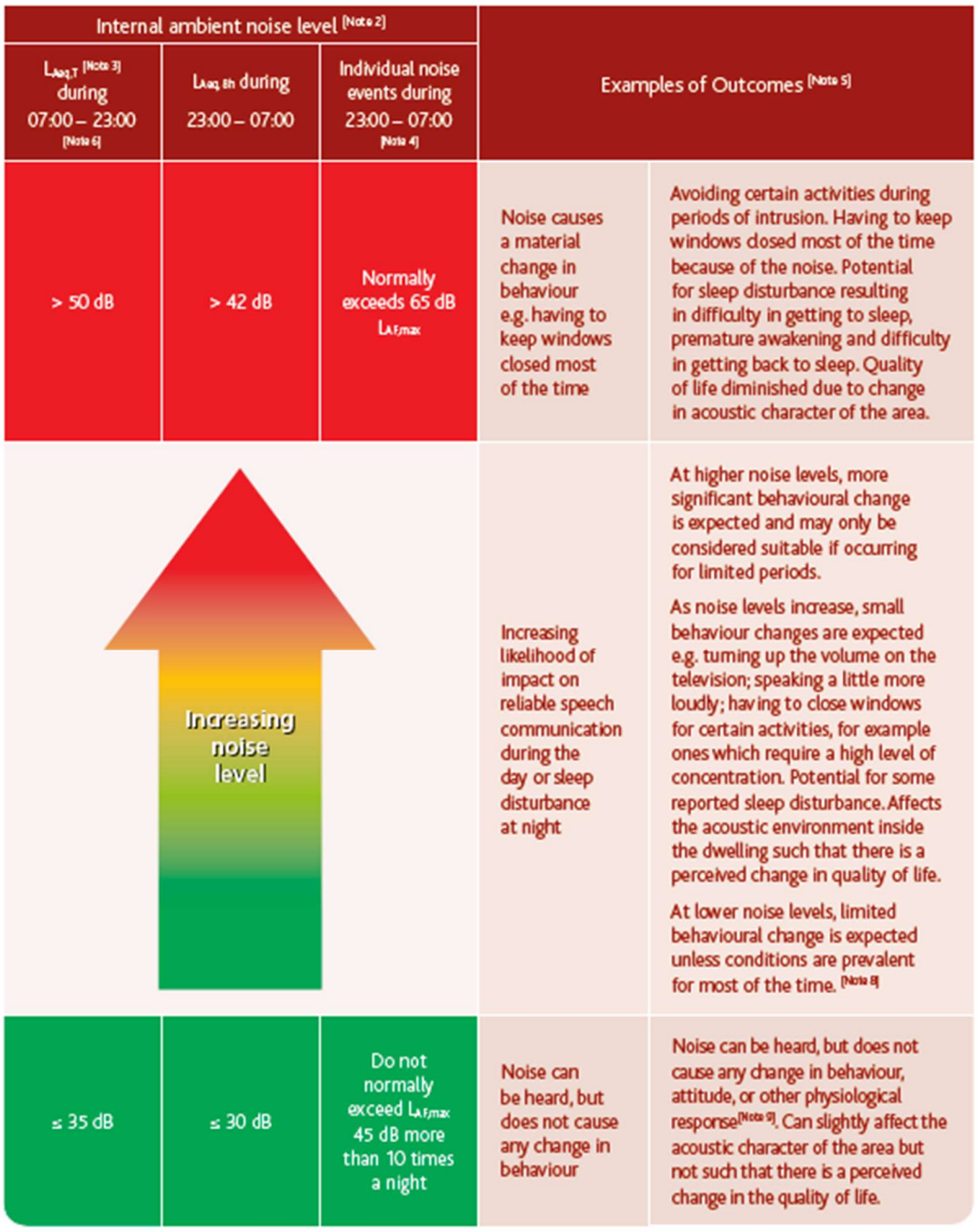



Table 3-3 of AVO Guide (2020)

*Figure 7 – AVO Guide Level 2 Internal Ambient Noise Levels*

# Appendix C – Site Plan


*Figure 8 – Site Plan*

# Appendix D – Environmental Survey

## *D.1 – Time History Noise Data*

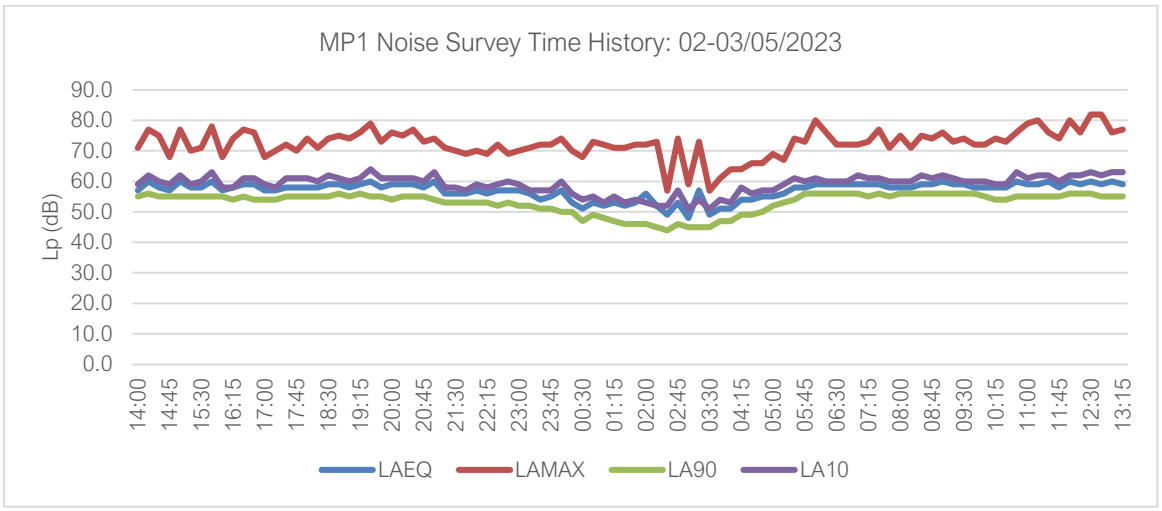



*Figure 9 – MP1 Noise Survey Time History*

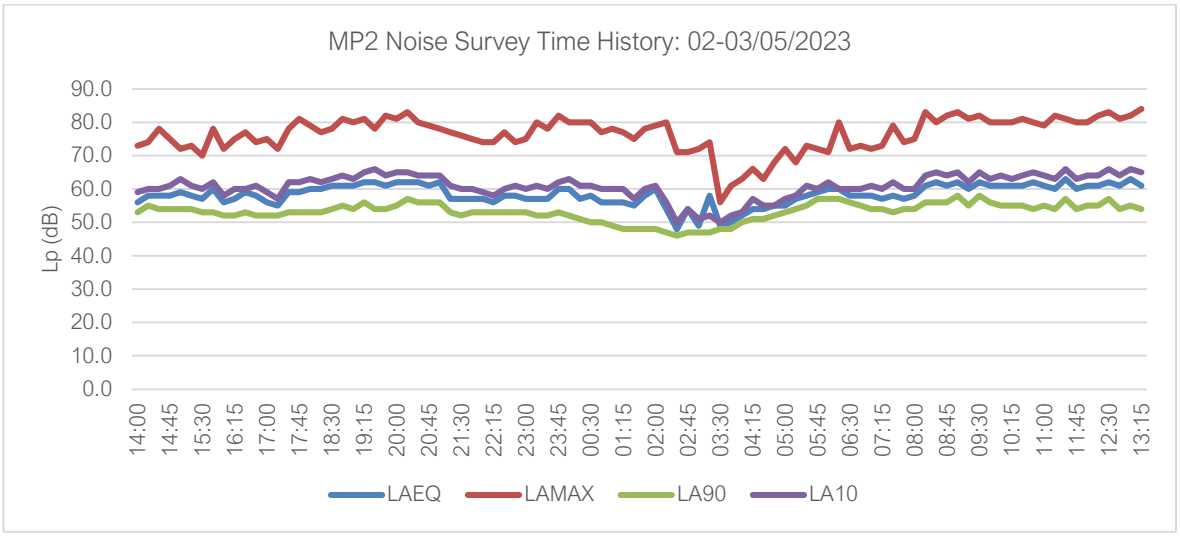



*Figure 10 – MP2 Noise Survey Time History*

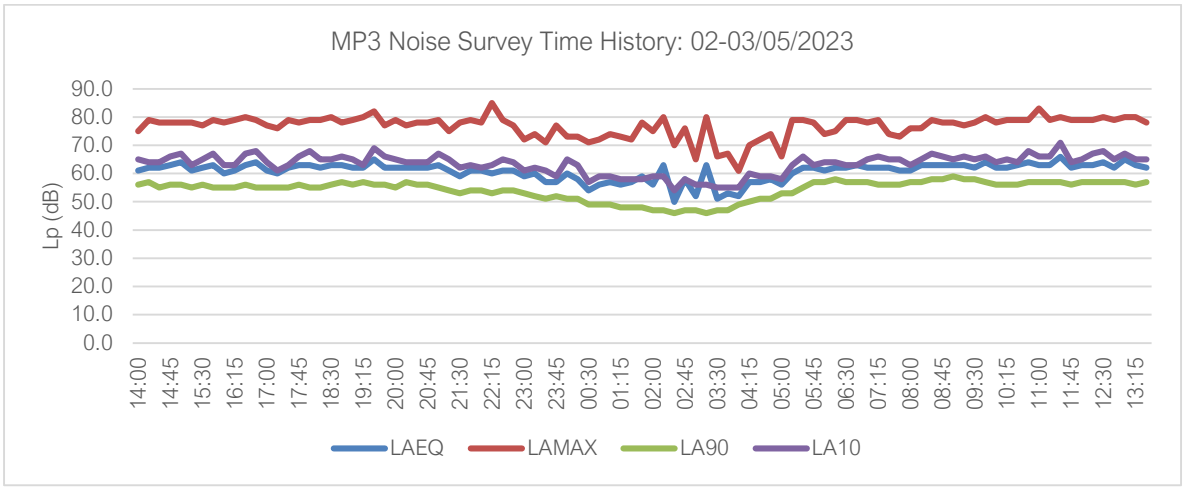



*Figure 11 – MP3 Noise Survey Time History*

### *D.2 – Surveying Equipment*

| Piece of Equipment | Serial No. | Calibration Deviation |
|---|---|---|
| CESVA SC420 Class 1 Sound Level Meter | T238593 | ≤0.1 |
| CESVA CB006 Class 1 Calibrator | 901013 | |
| CESVA SC420 Class 1 Sound Level Meter | T250680 | |
| CESVA CB006 Class 1 Calibrator | 902441 | |
| CESVA SC420 Class 1 Sound Level Meter | T244499 | |
| CESVA CB006 Class 1 Calibrator | 901013 | |

*Table 10 – 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 ≤0.1 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 – Hillingdon (Approx. 4.5km NNW of Site) | | | | |
|---|---|---|---|---|
| Time Period | Air Temp ($^0$C) | Rainfall (mm/h) | Prevailing Wind Direction | Wind Speed (m/s) |
| 02/05/2023 – 00:00 – 23:59 | 6.8 – 21.9 | 0.0 | E | 0.0 – 2.0 |
| 03/05/2023 – 00:00 – 23:59 | 4.1 – 27.1 | 0.0 | ESE | 0.0 – 2.7 |

*Table 11 – 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 5, 7 and 10m$^2$ and room volumes of 21 and 32m$^3$ are used in the calculations for bedrooms as a worst-case scenario. For living rooms, the calculations are based on a window area of 7.5 and 10m$^2$ and room volume of 30, 42 and 62.5m$^3$ as a worst-case scenario.
- The acoustic performance of the façade elements is taken from the relevant manufacturer's 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).

Living Room (Red Façade) Day Time Leq

| Item / Description | dB(A) | 63 | 125 | 250 | 500 | 1k | 2k | 4k |
|---|---|---|---|---|---|---|---|---|
| Measured Leq,T | 59 | 67 | 61 | 59 | 57 | 56 | 50 | 43 |
| Glazing Noise Ingress | 26 | 45 | 39 | 30 | 19 | 7 | 1 | -12 |
| Ventilation Noise Ingress | 22 | 39 | 23 | 22 | 23 | 12 | 10 | 0 |
| Wall Noise Ingress | 0 | 19 | 8 | 4 | -8 | -10 | -16 | -23 |
| Roof Noise Ingress | | | | | | | | |
| Room Absorption Correction | | 0 | 0 | -1 | -1 | -1 | -2 | -3 |
| **Total Noise Ingress** | **30** | **49** | **41** | **33** | **26** | **15** | **12** | **0** |
| NR30 | 35 | 59 | 48 | 39 | 33 | 30 | 26 | 24 |
| Exceednce of Criteria | -5 | -10 | -7 | -6 | -7 | -15 | -14 | -24 |

Bedroom (Red Façade) Day Time Leq

| Item / Description | dB(A) | 63 | 125 | 250 | 500 | 1k | 2k | 4k |
|---|---|---|---|---|---|---|---|---|
| Measured Leq,T | 59 | 67 | 61 | 59 | 57 | 56 | 50 | 43 |
| Glazing Noise Ingress | 27 | 46 | 40 | 31 | 20 | 8 | 2 | -11 |
| Ventilation Noise Ingress | 24 | 40 | 24 | 23 | 24 | 13 | 11 | 1 |
| Wall Noise Ingress | -6 | 13 | 2 | -2 | -14 | -16 | -22 | -29 |
| Roof Noise Ingress | | | | | | | | |
| Room Absorption Correction | | -2 | -3 | -3 | -4 | -4 | -4 | -5 |
| **Total Noise Ingress** | **29** | **47** | **40** | **31** | **25** | **14** | **11** | **-1** |
| NR30 | 35 | 59 | 48 | 39 | 33 | 30 | 26 | 24 |
| Exceednce of Criteria | -6 | -12 | -8 | -8 | -8 | -16 | -15 | -25 |

## Bedroom (Red Façade) Night Time Leq

| Item / Description | dB(A) | 63 | 125 | 250 | 500 | 1k | 2k | 4k |
|---|---|---|---|---|---|---|---|---|
| Measured Leq,T | 59 | 63 | 58 | 57 | 56 | 57 | 49 | 37 |
| Glazing Noise Ingress | 25 | 42 | 37 | 29 | 19 | 9 | 1 | -17 |
| Ventilation Noise Ingress | 22 | 36 | 21 | 21 | 23 | 14 | 10 | -5 |
| Wall Noise Ingress | -8 | 9 | -1 | -4 | -15 | -15 | -23 | -35 |
| Roof Noise Ingress | | | | | | | | |
| Room Absorption Correction | | -2 | -3 | -3 | -4 | -4 | -4 | -5 |
| **Total Noise Ingress** | **27** | **43** | **37** | **29** | **24** | **15** | **10** | **-7** |
| NR25 | 30 | 55 | 43 | 35 | 28 | 25 | 21 | 19 |
| Exceednce of Criteria | -3 | -12 | -6 | -6 | -4 | -10 | -11 | -26 |

## Bedroom (Red Façade) Night Time Max

| Item / Description | dB(A) | 63 | 125 | 250 | 500 | 1k | 2k | 4k |
|---|---|---|---|---|---|---|---|---|
| Corrected Lmax Spectrum | 73 | 77 | 72 | 71 | 70 | 71 | 63 | 51 |
| Glazing Noise Ingress | 39 | 56 | 51 | 43 | 33 | 23 | 15 | -3 |
| Ventilation Noise Ingress | 36 | 50 | 35 | 35 | 37 | 28 | 24 | 9 |
| Wall Noise Ingress | 6 | 23 | 13 | 10 | -1 | -1 | -9 | -21 |
| Roof Noise Ingress | | | | | | | | |
| Room Absorption Correction | | -2 | -3 | -3 | -4 | -4 | -4 | -5 |
| **Total Noise Ingress** | **41** | **57** | **51** | **43** | **38** | **29** | **24** | **7** |
| NR40 | 45 | 67 | 56 | 49 | 43 | 40 | 37 | 34 |
| Exceednce of Criteria | -4 | -10 | -5 | -6 | -5 | -11 | -13 | -27 |

## Living Room (Amber Façade) Day Time Leq

| Item / Description | dB(A) | 63 | 125 | 250 | 500 | 1k | 2k | 4k |
|---|---|---|---|---|---|---|---|---|
| Measured Leq,T | 62 | 70 | 64 | 62 | 59 | 58 | 52 | 48 |
| Glazing Noise Ingress | 30 | 49 | 43 | 34 | 22 | 10 | 4 | -6 |
| Ventilation Noise Ingress | 26 | 43 | 27 | 26 | 26 | 15 | 13 | 6 |
| Wall Noise Ingress | | | | | | | | |
| Roof Noise Ingress | | | | | | | | |
| Room Absorption Correction | | 0 | 0 | -1 | -1 | -1 | -2 | -3 |
| **Total Noise Ingress** | **34** | **53** | **46** | **37** | **30** | **18** | **15** | **7** |
| NR30 | 35 | 59 | 48 | 39 | 33 | 30 | 26 | 24 |
| Exceednce of Criteria | -1 | -6 | -2 | -2 | -3 | -12 | -11 | -17 |

## Bedroom (Amber Façade) Day Time Leq

| Item / Description | dB(A) | 63 | 125 | 250 | 500 | 1k | 2k | 4k |
|---|---|---|---|---|---|---|---|---|
| Measured Leq,T | 62 | 70 | 64 | 62 | 59 | 58 | 52 | 48 |
| Glazing Noise Ingress | 27 | 44 | 37 | 33 | 19 | 8 | 3 | -9 |
| Ventilation Noise Ingress | 24 | 42 | 26 | 25 | 25 | 14 | 12 | 5 |
| Wall Noise Ingress | 3 | 23 | 12 | 8 | -5 | -7 | -13 | -17 |
| Roof Noise Ingress | | | | | | | | |
| Room Absorption Correction | | -1 | -2 | -2 | -2 | -2 | -3 | -4 |
| **Total Noise Ingress** | **30** | **48** | **39** | **35** | **26** | **16** | **13** | **4** |
| NR30 | 35 | 59 | 48 | 39 | 33 | 30 | 26 | 24 |
| Exceednce of Criteria | -5 | -11 | -9 | -4 | -7 | -14 | -13 | -20 |

## Bedroom (Amber Façade) Night Time Leq

| Item / Description | dB(A) | 63 | 125 | 250 | 500 | 1k | 2k | 4k |
|---|---|---|---|---|---|---|---|---|
| Measured Leq,T | 59 | 63 | 61 | 58 | 56 | 56 | 49 | 45 |
| Glazing Noise Ingress | 24 | 37 | 34 | 29 | 16 | 6 | 0 | -12 |
| Ventilation Noise Ingress | 21 | 35 | 23 | 21 | 22 | 12 | 9 | 2 |
| Wall Noise Ingress | -1 | 16 | 9 | 4 | -8 | -9 | -16 | -20 |
| Roof Noise Ingress | | | | | | | | |
| Room Absorption Correction | | -1 | -2 | -2 | -2 | -2 | -3 | -4 |
| **Total Noise Ingress** | **27** | **41** | **36** | **31** | **23** | **14** | **10** | **1** |
| NR25 | 30 | 55 | 43 | 35 | 28 | 25 | 21 | 19 |
| Exceednce of Criteria | -3 | -14 | -7 | -4 | -5 | -11 | -11 | -18 |

## Bedroom (Amber Façade) Night Time Max

| Item / Description | dB(A) | 63 | 125 | 250 | 500 | 1k | 2k | 4k |
|---|---|---|---|---|---|---|---|---|
| Corrected Lmax Spectrum | 79 | 83 | 81 | 78 | 76 | 76 | 69 | 65 |
| Glazing Noise Ingress | 43 | 57 | 54 | 49 | 36 | 26 | 20 | 8 |
| Ventilation Noise Ingress | 41 | 54 | 42 | 40 | 41 | 31 | 28 | 21 |
| Wall Noise Ingress | 19 | 36 | 29 | 24 | 12 | 11 | 4 | 0 |
| Roof Noise Ingress | | | | | | | | |
| Room Absorption Correction | | -1 | -2 | -2 | -2 | -2 | -3 | -4 |
| **Total Noise Ingress** | **46** | **61** | **56** | **51** | **43** | **33** | **29** | **21** |
| NR40 | 45 | 67 | 56 | 49 | 43 | 40 | 37 | 34 |
| Exceednce of Criteria | 1 | -6 | 0 | 2 | 0 | -7 | -8 | -13 |

## Living Room (Green Façade) Day Time Leq

| Item / Description | dB(A) | 63 | 125 | 250 | 500 | 1k | 2k | 4k |
|---|---|---|---|---|---|---|---|---|
| Measured Leq,T | 64 | 69 | 63 | 61 | 61 | 61 | 54 | 45 |
| Glazing Noise Ingress | 29 | 47 | 41 | 32 | 23 | 12 | 5 | -10 |
| Ventilation Noise Ingress | 25 | 40 | 24 | 23 | 26 | 16 | 13 | 1 |
| Wall Noise Ingress | 1 | 20 | 9 | 5 | -5 | -6 | -13 | -22 |
| Roof Noise Ingress | | | | | | | | |
| Room Absorption Correction | | -1 | -1 | -2 | -2 | -2 | -2 | -4 |
| **Total Noise Ingress** | **32** | **50** | **43** | **34** | **29** | **18** | **14** | **1** |
| NR30 | 35 | 59 | 48 | 39 | 33 | 30 | 26 | 24 |
| Exceednce of Criteria | -3 | -9 | -5 | -5 | -4 | -12 | -12 | -23 |

## Bedroom (Green Façade) Day Time Leq

| Item / Description | dB(A) | 63 | 125 | 250 | 500 | 1k | 2k | 4k |
|---|---|---|---|---|---|---|---|---|
| Measured Leq,T | 64 | 69 | 63 | 61 | 61 | 61 | 54 | 45 |
| Glazing Noise Ingress | 28 | 46 | 40 | 31 | 22 | 11 | 4 | -11 |
| Ventilation Noise Ingress | 27 | 42 | 26 | 25 | 28 | 18 | 15 | 3 |
| Wall Noise Ingress | 4 | 22 | 11 | 7 | -3 | -4 | -11 | -20 |
| Roof Noise Ingress | | | | | | | | |
| Room Absorption Correction | | -1 | -1 | -1 | -2 | -2 | -2 | -3 |
| **Total Noise Ingress** | **32** | **50** | **42** | **34** | **30** | **20** | **16** | **3** |
| NR30 | 35 | 59 | 48 | 39 | 33 | 30 | 26 | 24 |
| Exceednce of Criteria | -3 | -9 | -6 | -5 | -3 | -10 | -10 | -21 |

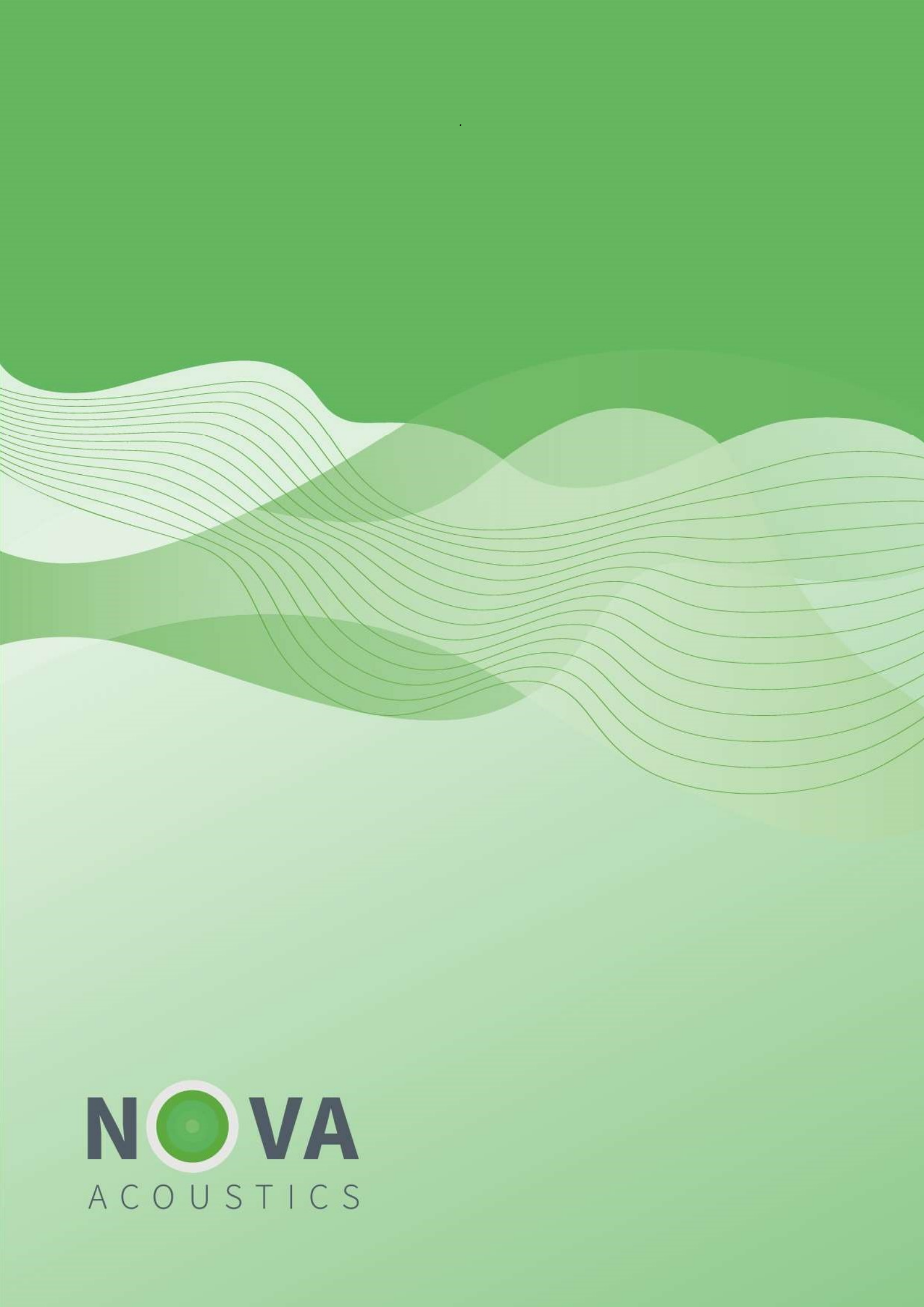
## Bedroom (Green Façade) Night Time Leq

| Item / Description | dB(A) | 63 | 125 | 250 | 500 | 1k | 2k | 4k |
|---|---|---|---|---|---|---|---|---|
| Measured Leq,T | 62 | 64 | 58 | 59 | 59 | 59 | 51 | 40 |
| Glazing Noise Ingress | 25 | 41 | 35 | 29 | 20 | 9 | 1 | -16 |
| Ventilation Noise Ingress | 25 | 37 | 21 | 23 | 26 | 16 | 12 | -2 |
| Wall Noise Ingress | 1 | 17 | 6 | 5 | -5 | -6 | -14 | -25 |
| Roof Noise Ingress | | | | | | | | |
| Room Absorption Correction | | -1 | -1 | -1 | -2 | -2 | -2 | -3 |
| **Total Noise Ingress** | **29** | **45** | **37** | **32** | **28** | **18** | **13** | **-2** |
| NR25 | 30 | 55 | 43 | 35 | 28 | 25 | 21 | 19 |
| Exceednce of Criteria | -1 | -10 | -6 | -3 | 0 | -7 | -8 | -21 |

## Bedroom (Green Façade) Night Time Max

| Item / Description | dB(A) | 63 | 125 | 250 | 500 | 1k | 2k | 4k |
|---|---|---|---|---|---|---|---|---|
| Corrected Lmax Spectrum | 77 | 79 | 73 | 74 | 74 | 74 | 66 | 55 |
| Glazing Noise Ingress | 40 | 57 | 51 | 45 | 36 | 25 | 17 | 0 |
| Ventilation Noise Ingress | 40 | 53 | 37 | 39 | 42 | 32 | 28 | 14 |
| Wall Noise Ingress | 16 | 33 | 22 | 21 | 11 | 10 | 2 | -9 |
| Roof Noise Ingress | | | | | | | | |
| Room Absorption Correction | | -1 | -1 | -1 | -2 | -2 | -2 | -3 |
| **Total Noise Ingress** | **45** | **60** | **53** | **47** | **44** | **34** | **29** | **13** |
| NR40 | 45 | 67 | 56 | 49 | 43 | 40 | 37 | 34 |
| Exceednce of Criteria | 0 | -7 | -3 | -2 | 1 | -6 | -8 | -21 |

*Figure 12 – Noise Break-In Calculations*


NOVA
ACOUSTICS