

Noise Assessment

Huggens's College – Northfleet



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Non-Technical Summary

What is Proposed?	Demolition of existing buildings and erection of retirement living apartments (Use Class C3), together with the extension of the existing chapel and the provision of associated communal facilities and external amenity space, lodge keeper's and guest accommodation, back-of-house facilities, parking, bicycle/mobility scooter parking, and associated works including the creation of a secondary, emergency access from College Road.
What is the Problem?	Some areas of the site would be situated relatively close to a busy road and could therefore be exposed to elevated levels of traffic induced noise.
What is the Result?	The noise assessment has shown that elevated levels of noise at the façades facing Stonebridge Road can be expected. However, with adequate noise mitigation measures, i.e. suitably specified façade constructions (including ventilation grilles), closed windows and the proposed MVHR, suitable internal noise levels can be achieved. The requirement for closed windows to maintain amenity in some of the future dwellings could have ramifications in respect of ventilation and thermal comfort. Assessment shows that there could be a 'medium risk' of elevated noise during overheating conditions at parts of the site. Whether such excessive noise has the potential for significant adverse effect would depend on the overheating duration and frequency of the overheating conditions. Noise levels within the outdoor amenity areas of the proposed development are expected to remain compliant with the relevant guideline values.

Report Record

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1.0 Introduction

- 1.1 Demolition of existing buildings and erection of retirement living apartments is proposed at the Huggens's College site in Northfleet, Kent. As part of the scheme borders a relatively busy road as well as the proximity of nearby industrial areas, the proposed development could be exposed to elevated levels of noise. There is therefore the potential for future residents to be adversely affected by the noise.
- 1.2 To assess the potential noise effects and to ensure the development meets the Local Authority's noise criteria, a noise assessment has been undertaken. This report presents the findings of the Noise Assessment.

What is a Noise Assessment?

- 1.3 A Noise Assessment will determine if and to what extent existing or future noise sources could affect noise-sensitive receptors, and importantly, if those noise sources could have an adverse impact. If the Noise Assessment finds that the level of risk or impact is unacceptable, mitigation measures will need to be applied to the development.
- 1.4 The Noise Assessment will consider the prevailing sound environment to determine potential noise sources including traffic, aircraft or other noise generating activities, such as mechanical plant, generators etc. The report will provide an impact assessment and give actionable recommendations. Recommendations may include solutions involving changes to design, layout and construction methods, so that the impacts from noise can be reduced to acceptable levels. Often these mitigation measures can be incorporated into standard construction practices. Find out more about how we undertake Noise Assessments including FAQ [here](#).
- 1.5 Understanding and reducing the impacts ensures that you have a safe and compliant site. When dealing with planning, the National Planning Policy Framework (NPPF) and associated policies require an appropriate noise assessment at the initial planning stage, whilst the ProPG: Planning & Noise Professional Practice Guidance on Planning & Noise New Residential Development May 2017 requires delivery of sustainable development by promoting good health and wellbeing through the effective management of noise.

The Subject Site

Table 1 Site Details

Address	College Road, Northfleet, Gravesend, Kent DA11 9DL
Eastings, Northings	561702, 174609
Local Planning Authority	Gravesham Borough Council

- 1.6 The immediate area around the site is of residential nature. Further afield towards the north and west of the site is the Northfleet Industrial Estate.

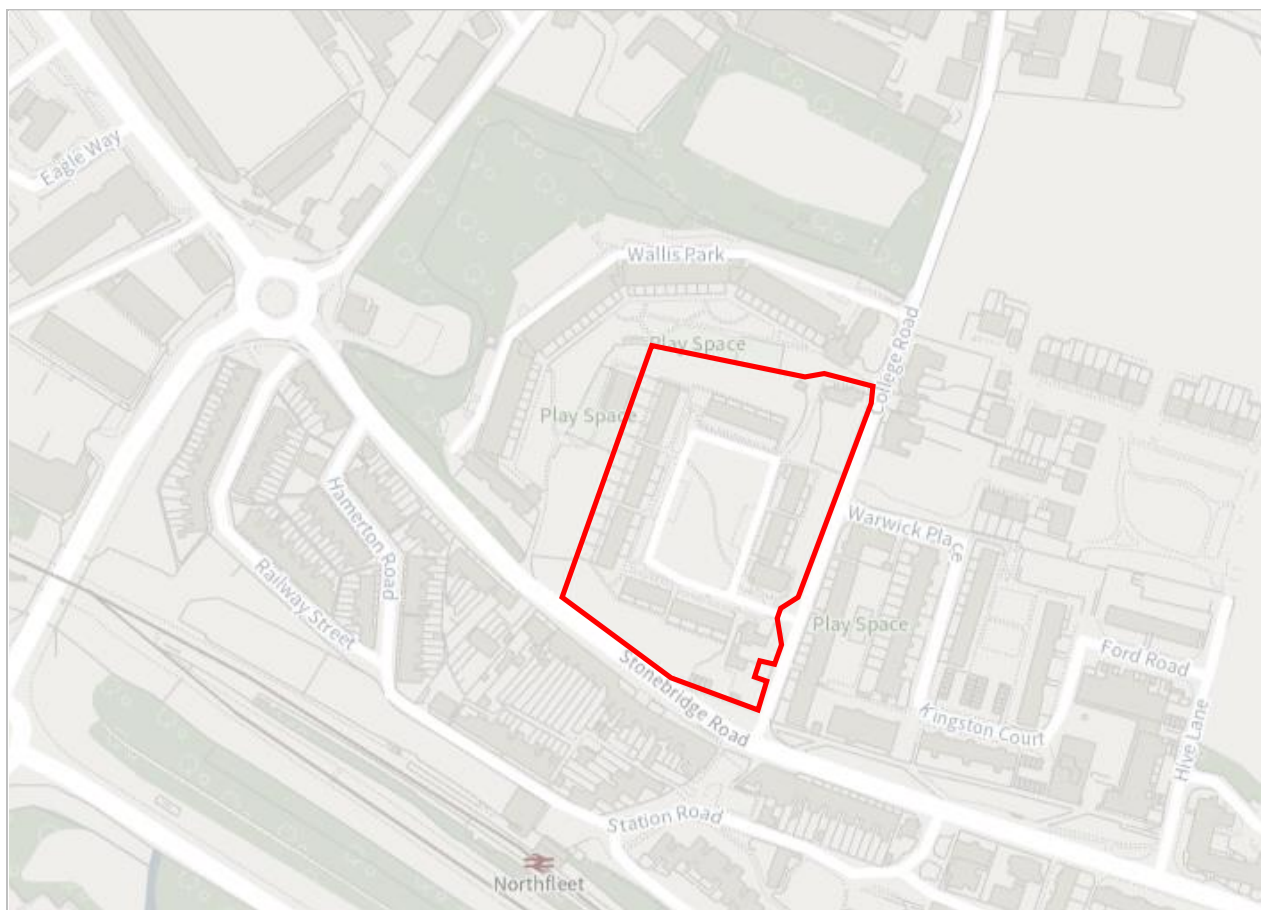


Figure 1 Approximate Site Location

The Proposed Development

- 1.7 Demolition of existing buildings and erection of retirement living apartments (Use Class C3), together with the extension of the existing chapel and the provision of associated communal facilities and external amenity space, lodge keeper's and guest accommodation, back-of-

house facilities, parking, bicycle/mobility scooter parking, and associated works including the creation of a secondary, emergency access from College Road.

1.8 The proposed ground floor site layout plan is shown below in Figure 2.

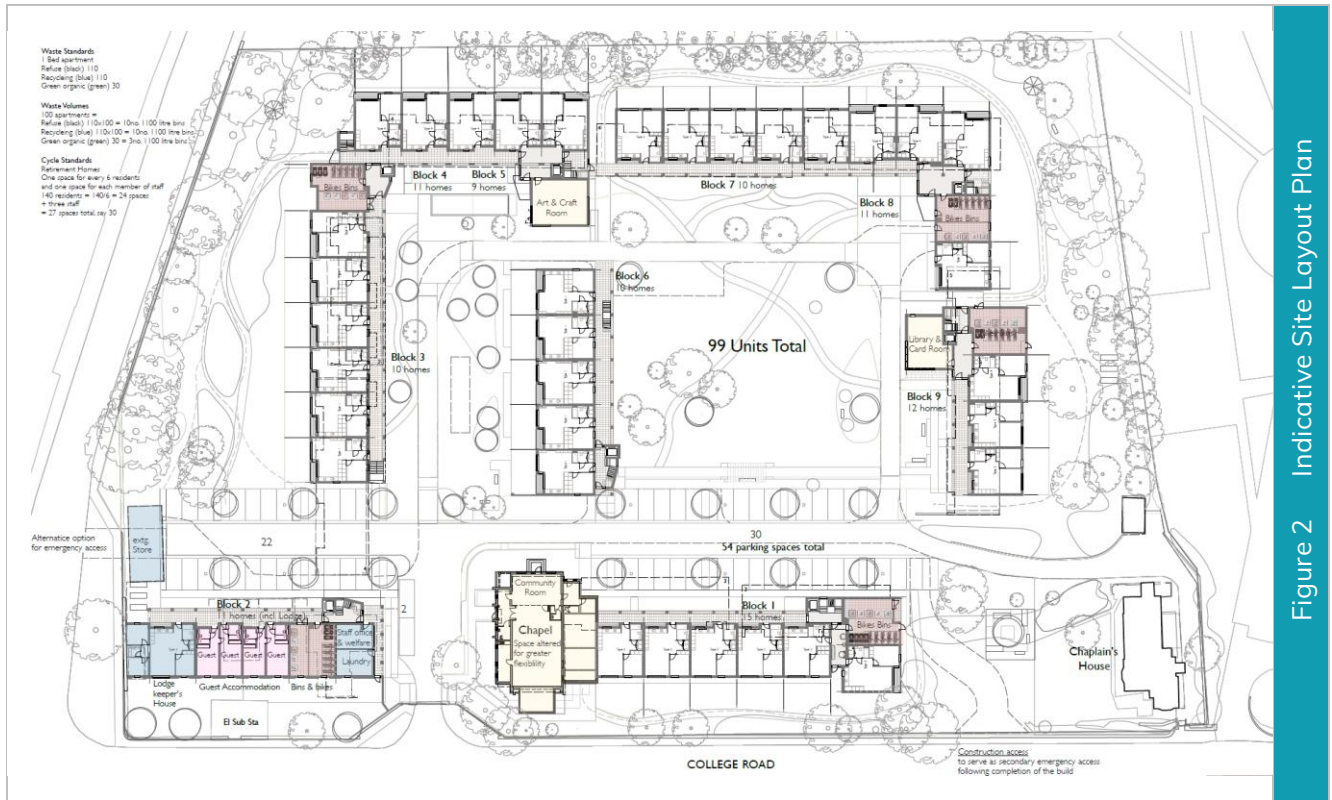


Figure 2 Indicative Site Layout Plan

The Objectives

1.9 The scope of works adopted in this Noise Assessment will address the following potential issues:

- ▶ Potential for noise from traffic, i.e. road, rail and air traffic.
- ▶ Potential for noise from static point sources – this may include nearby generators, air conditioning units.
- ▶ Potential for noisy environments such as active commercial or industrial sites, etc.

1.10 The objective of this report is therefore to determine the noise environment and to provide a general indication of the likely impact on noise levels at the development site which may be present.



Report Structure, Limitations & Changes

- 1.11 The report structure generally follows the pollution linkage approach described above. Chapter 2 of the report sets out the assessment methodology. Chapter 3 discusses the baseline noise conditions, and Chapter 4 details a noise design appraisal – a scheme of acoustic mitigation. Report conclusions and recommendations are set out in Chapter 5.
- 1.12 There are a lot of technical terms in this report and definitions are provided in Appendix A. Appendix B details some of the relevant guidance that this assessment is based on as well as acoustic criteria/thresholds.
- 1.13 This assessment has been undertaken in accordance with our Terms & Conditions. Full details on limitations and reliance are provided in those Terms. Third party information which has been reviewed and used to inform the assessments presented herein, including public records held by various regulatory authorities and environmental database data has been assumed to be true and accurate.
- 1.14 This assessment has been carried out to determine the potential risks posed to future end users, along with other key receptors, based on the current development. Should revisions in the development proposals result in a change in any assessment parameters detailed in this report, a re-assessment of the risk should be carried out.



2.0 Assessment Methodology

Introduction

- 2.1 This chapter lists the target noise sources identified from a review of Google Earth / Street View, from any client or regulator information and from observations made during deployment of monitoring equipment / site visits. In addition, the acoustic assessment criteria are discussed in this section along with details on the methodology for the noise monitoring equipment deployment.

Acoustic Criteria

- 2.2 It is understood that pre-application advice was sought from the Local Planning Authority who requested that a noise assessment be undertaken:

“Due to the proximity of nearby industrial areas, a noise assessment will be needed in order to demonstrate that the internal ambient noise levels in all habitable rooms of the proposed residential dwellings shall not exceed the guideline LAeq values in BS8233:2014. In addition the noise levels in any external amenity areas should also comply with the levels in BS8233.”

- 2.3 In light of the above, this assessment makes reference to BS 8233:2014, which is discussed in more detail below.
- 2.4 In addition to BS 8233:2014 guidance, reference is also made to guidance contained in ProPG: Planning & Noise (2017), and the Acoustics Ventilation and Heating Guide (AVOG), for this assessment. These guidance documents are also discussed below.

BS 8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings

- 2.5 BS 8233 'Guidance on sound insulation and noise reduction for buildings' provides guidance on indoor ambient noise levels for various situations.

2.6 The relevant guideline limits for dwellings are shown in Table 2 below.

Table 2 BS 8233 Indoor Ambient Noise Levels for Dwellings			
Activity	Location	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)
Resting	Living room	35 dB $L_{Aeq,16h}$	—
Dining	Dining room/area	40 dB $L_{Aeq,16h}$	—
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16h}$	30 dB $L_{Aeq,8h}$

2.7 BS 8233:2014 offers the following guidance regarding outdoor amenity space:

“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 50dB LAeq, with an upper guideline value of 55dB LAeq which would be acceptable in noisier environments. However, it is also recognised that these 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.”

2.8 Further details about this British Standard and other policy and guidance documents can be found in Appendix B.

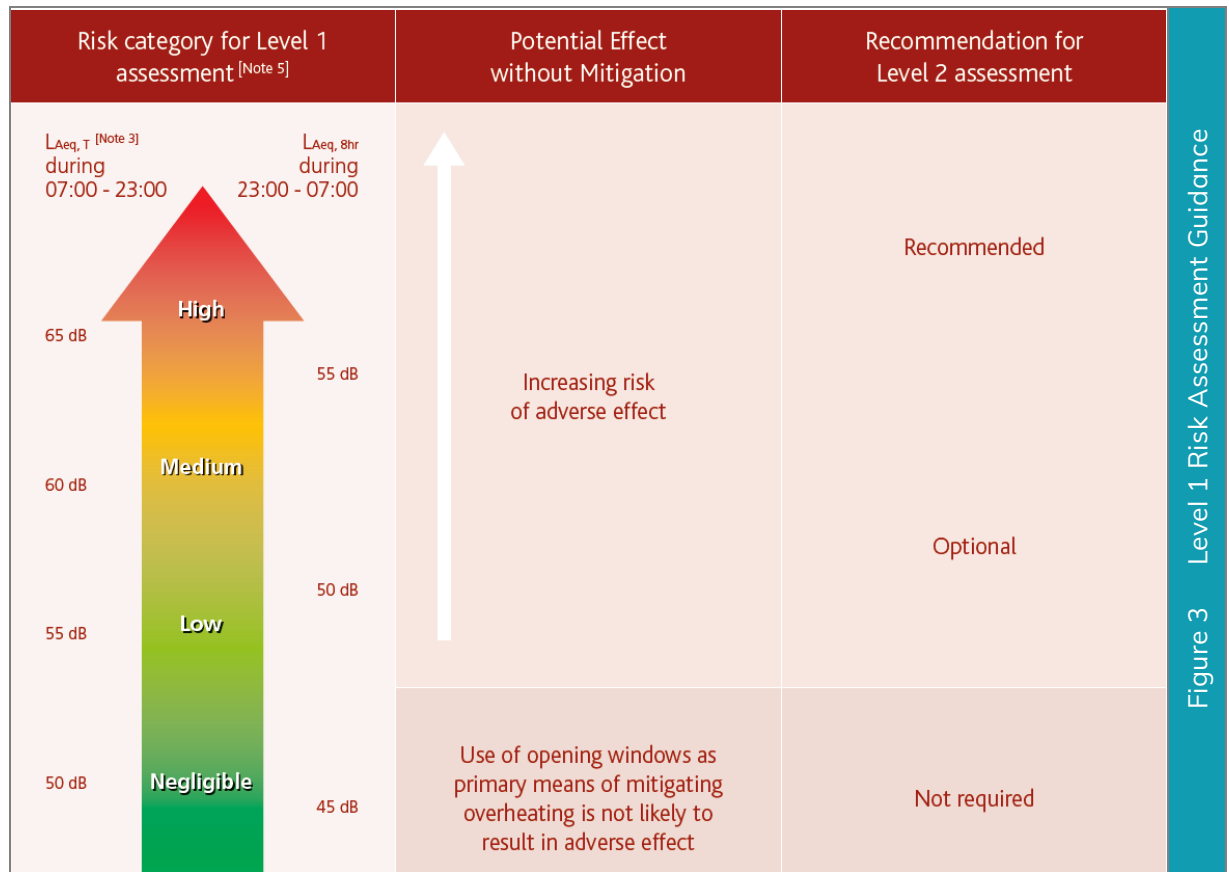
Professional Practice Guidance on Planning & Noise (ProPG) – New Residential Development

- 2.9 Professional Practice Guidance on Planning & Noise (ProPG) is guidance for new residential development that aims to protect people from noise through encouraging better acoustic design. The guidance has been jointly prepared by the Institute of Acoustics (IOA), Chartered Institute of Environmental Health (CIEH), and the Association of Noise Consultants (ANC).
- 2.10 ProPG draws upon legislation and other guidance and standards such as WHO, BS 4142:2014 and BS 8233:2014 (discussed above). In terms of the BS 8233:2014 guidance, ProPG provides supplementary advice with respect to night-time maximum noise levels stating:

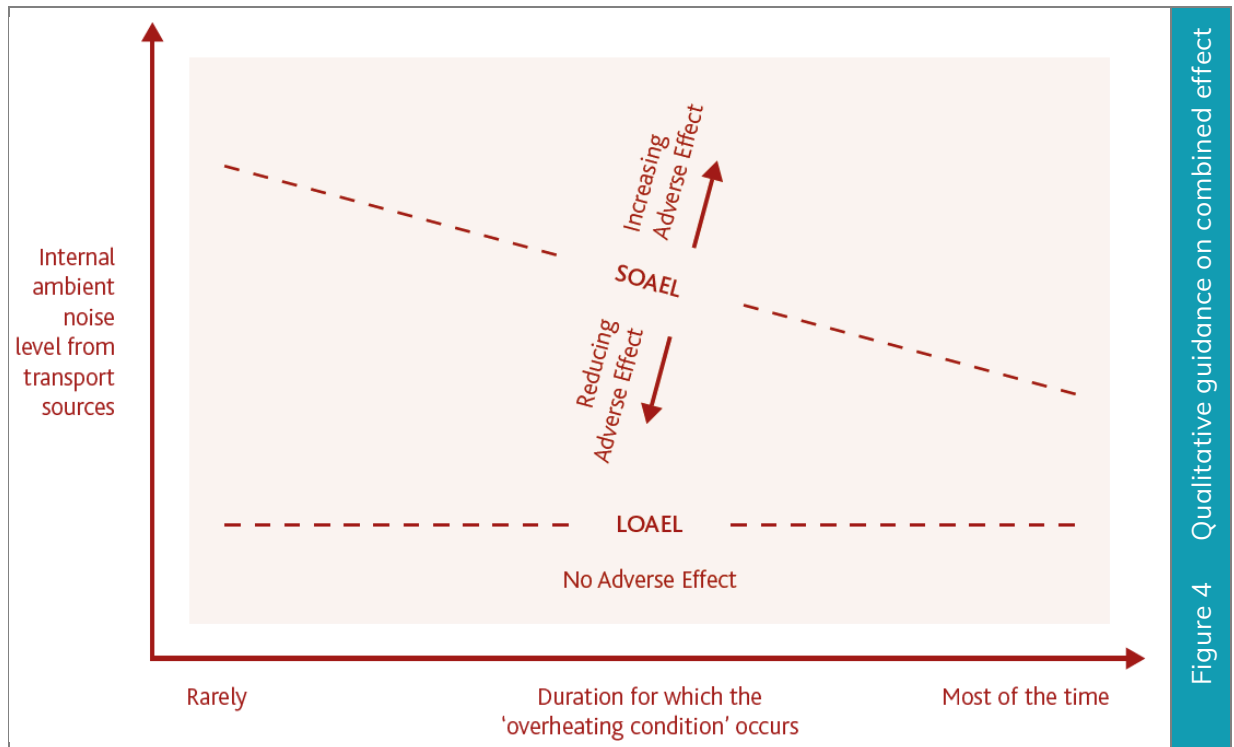
“In most circumstances in noise-sensitive rooms at night (e.g. bedrooms) good acoustic design can be used so that individual noise events do not normally exceed 45dB LA_{max,F} more than 10 times a night. However, where it is not reasonably practicable to achieve this guideline then the judgement of 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”

Acoustics, Ventilation and Overheating Guide

- 2.11 The Acoustics, Ventilation and Overheating Guide (AVOG) provides noise assessment guidance for new residential development at the Planning stage, with the aim of appraising future effects on users taking into consideration the interdependent nature of acoustics, ventilation, and overheating.
- 2.12 The guide sets out a two-level noise assessment procedure to identify where there is a risk and estimate potential impacts where open windows are relied upon to mitigate overheating. A ‘risk based’ approach is taken in the AVOG; a Level 1 site risk assessment and, where required, followed by a Level 2 adverse effect assessment based on duration and the overheating condition. AVOG Level 1 risk guidance is shown in Figure 3 below.



- 2.13 Where there is a 'high risk', a Level 2 assessment for evaluating internal noise levels during overheating conditions is recommended.
- 2.14 For the Level 2 assessment it is not only the internal noise level during the overheating conditions that is important but also the number of such occurrences and their duration, as indicated by the figure below (Figure 3-2 in the AVOG).



- 2.15 Despite the importance of the duration of the overheating condition, no guidance is given as to what 'rarely' or 'most of the time' constitutes, thereby a level of ambiguity for these terms remains.

Baseline Noise Survey

Methodology

- 2.16 An unattended long-term (LT) baseline noise survey was undertaken from Monday 19th February 2024 to Wednesday 21st February 2024 using a Norsonic Nor-140 precision Class I sound level meter (serial no. 1405197). The meter was set to log sound levels in contiguous 5-minute periods. A tripod was used to mount the microphone at the site boundary with Stonebridge Road at an approximate height of 2.5 m above ground in a free-field position. This position had a direct line of sight to Stonebridge Road.
- 2.17 In addition to the long-term survey, several short-term (ST) attended noise surveys within the Huggens's College grounds were undertaken using the same sound level meter as described above. The meter was mounted on a tripod at a height of around 1.5 m above ground in free-field positions.

2.18 The photos below show the LT and one of the ST noise survey locations.



LT noise survey



ST2 noise survey

2.19 The approximate noise monitoring positions are shown in Figure 5 below.

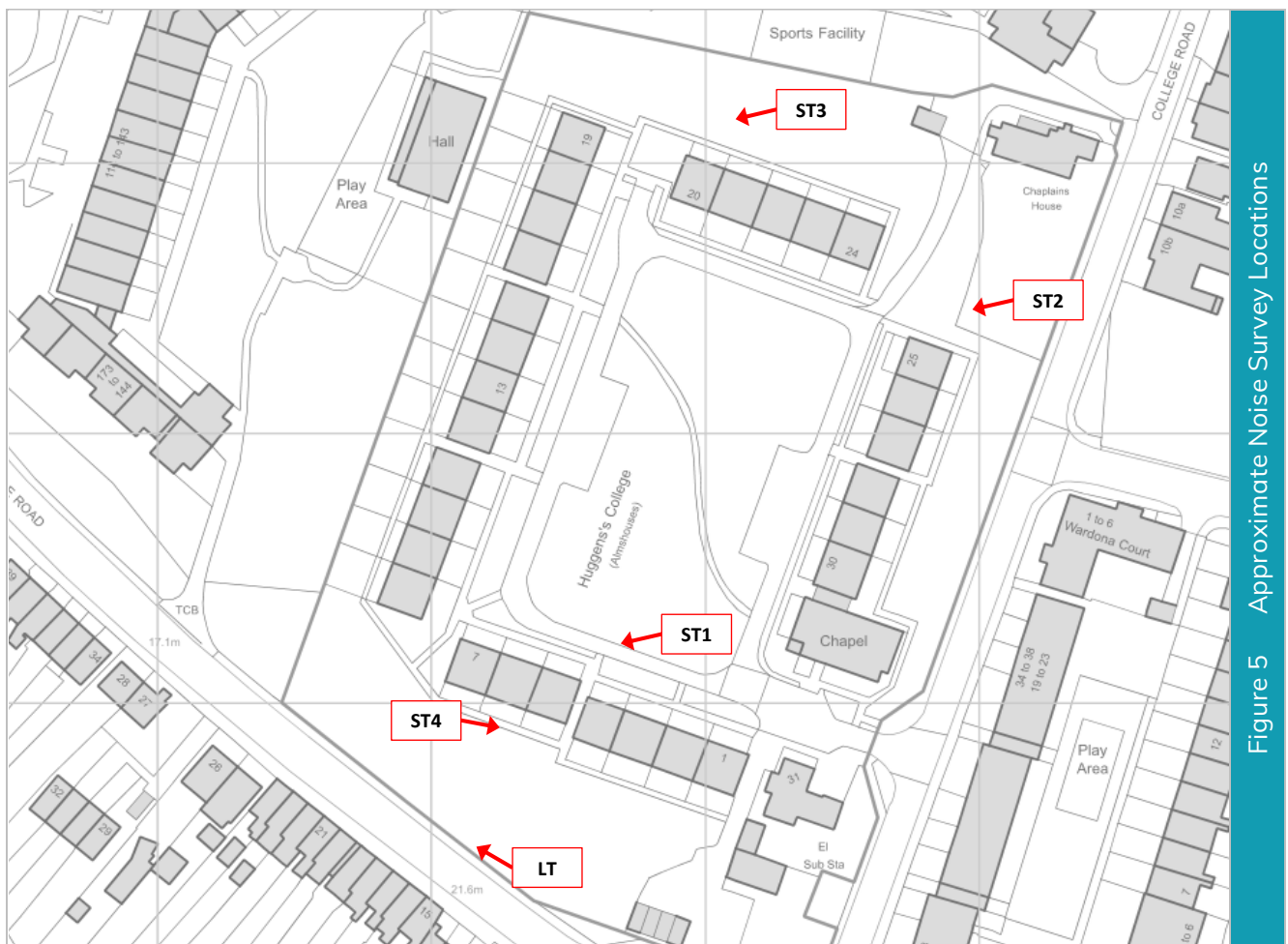


Figure 5 Approximate Noise Survey Locations



- 2.20 Pre- and post-survey calibration checks were carried out which confirmed that no significant drift had occurred during the surveys.

Meteorological Conditions

- 2.21 Meteorological conditions during the measurement period were generally in line with recommendations for environmental noise surveys, with an air temperature between 6 and 13°C noted during the survey. Conditions were generally partly sunny and dry except for the morning of 21st February when it rained. Noise measurement results during the period of precipitation have not been used for this assessment.

Noise Model Predictions

- 2.22 To help assess the potential impact of road traffic noise on the proposed development, a three-dimensional acoustic model of the site and its immediate surroundings has been created using Datakustik CadnaA noise modelling software (version 2022).
- 2.23 For the noise model calculations, ISO 9613¹ calculation settings were used along with the following inputs/settings:
- ▶ Ground absorption coefficient of 0 for areas of hardstanding. Remaining areas set as absorption coefficient of 1 for 'soft' ground;
 - ▶ General building and barrier absorption coefficient of 0.2;
 - ▶ Two orders of reflection;
 - ▶ Topographical survey height data used for the terrain;
 - ▶ Building heights from the elevation drawings; and
 - ▶ For buildings in the wider area, a generic height of 4.5 m plus 2.5 m for each storey has been used.
- 2.24 The noise model predictions were calibrated to match noise level data captured at the 'LT' noise survey location for both the day and night periods.

¹ ISO 9613-2:1996 'Attenuation of sound during propagation outdoors- Part 2: General method of calculation

3.0 Noise Survey and Noise Prediction Results

Existing Noise Environment

- 3.1 At the time of the site visit, traffic noise from Stonebridge Road was the main noise source affecting the site. During the attended short-term survey, occasional aircraft noise and birdsong also contributed to the noise environment. No notable noise from College Road or the nearby industrial estate could be observed. As such, industrial noise has not been considered in this assessment.

Noise Survey Results Summary

- 3.2 The baseline noise levels derived from the survey results are presented below in Table 3. An overview of the long-term survey in graphical format is also available in Appendix C, with full data available if required upon request.

Table 3 Summary of Measured Noise Levels				
Position	Period	Noise Levels (dB)		
		Ambient, $L_{Aeq}^{[1]}$	Maximum, L_{AFmax}	Background, L_{A90}
LT	Daytime	64	80 ^[2]	49 ^[4]
	Night-time	59	78 ^[3]	39 ^[4]
ST1	10:21 – 10:35	47	63 ^[2]	43 ^[2]
ST2	10:37 – 10:50	50	65 ^[2]	45 ^[2]
ST3	10:52 – 11:02	49	61 ^[2]	46 ^[2]
ST4	11:05 – 11:15	52	62 ^[2]	45 ^[2]

Notes to Table 3:

[1] Logarithmic average over denoted period, [2] Arithmetic average of the 5-minute values, [3] Arithmetic average of the 10th highest 5-minute values, [4] Derived based on the most representative 5-minute value.

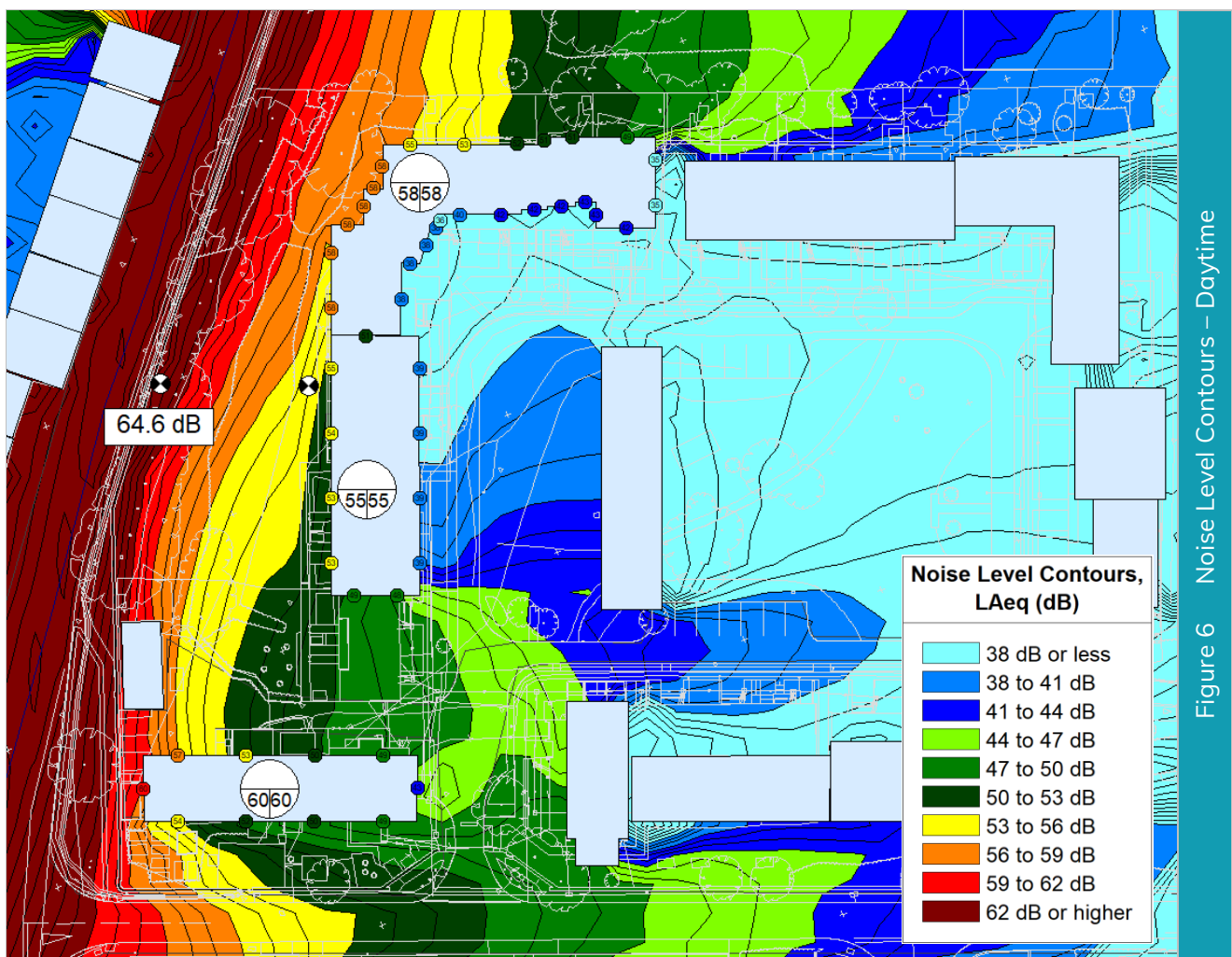
- 3.3 As can be seen from the above results, a daytime (07:00 – 23:00) ambient noise level of around 64 dB L_{Aeq} can be expected at the LT measurement position. At night, this drops to

around 59 dB L_{Aeq} with maximum noise levels shown to be around 78 dB L_{AFmax} . These noise levels were used to calibrate the noise model.

- 3.4 The results from the short-term (ST) survey are, as expected, quieter than those of the long-term (LT) survey next to Stonebridge Road, ranging from 47 dB to 52 dB L_{Aeq} and are considered indicative of existing general daytime noise within the Huggens's College grounds.

Noise Model Results

- 3.5 An overview of the noise model prediction results with the proposed scheme in place are shown in the figures below in the form of first floor daytime and night-time ambient noise level contours.



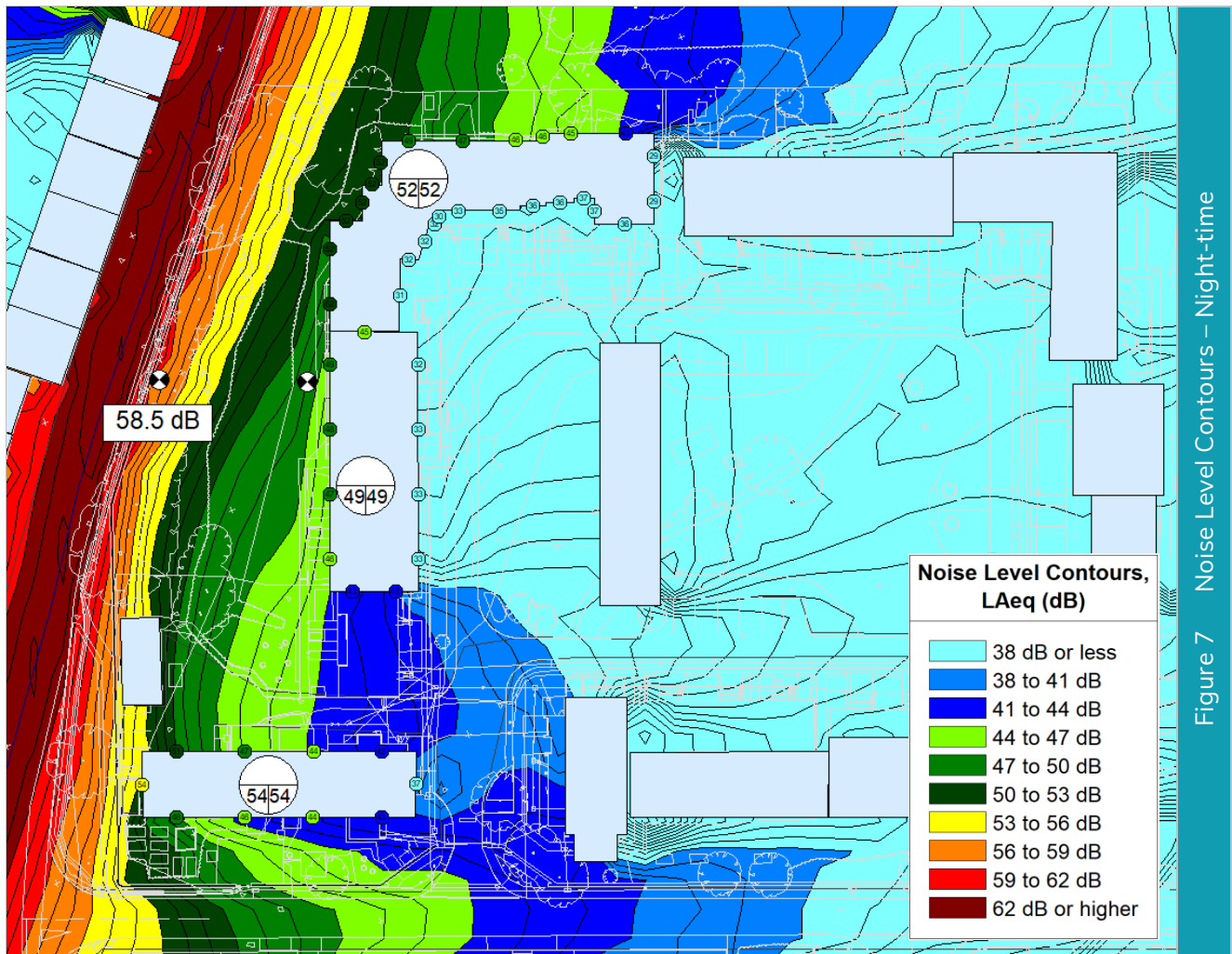


Figure 7 Noise Level Contours – Night-time

3.6 By using the results of the noise model and further calculations, a design appraisal of the building envelopes of the proposed scheme has been undertaken. The results of this exercise are discussed in the following chapter.



4.0 Acoustic Design Statement

- 4.1 This chapter sets out the minimum acoustic mitigation measures which will be required to ensure that the site is compliant with the criteria set out in Section 2 of this report.

The project is still at an early design stage and therefore it is expected that the design will be developed accordingly through the various RIBA stages. This assessment is therefore considered preliminary in this regard.

Building Envelope Assessment

- 4.2 This section sets out the octave spectrum data, interpreted from the predicted noise levels detailed in Chapter 3, and the resultant recommended building exterior make-up or external building envelope specification to mitigate the observed noise levels.
- 4.3 The information in this Chapter regarding mitigation represents both the preliminary and minimum building envelope specification, i.e. the minimum design criteria for glazing, walls and roof build-ups.

Design Assumptions

- 4.4 Noting the stage of the design process, the proposed constructions have been adopted for the environmental noise break-in calculations based on the specifications, detail and plan drawings provided by the client.

Table 4 Calculation Parameters for Assessment

Element	Properties/Parameters	
Façade Wall	Typical cladding and plasterboard on timber frame construction	
Roof	Tiled roofing (clay) with standard plasterboard ceiling and mineral wool in the ceiling void	
Floor Area (Approximate)	Bedroom	15 m ²
	Living Room	18 m ²
Glazing Area (Approximate)	Bedroom	1.5 m ²
	Living Room	6.5 m ²



Table 4 Calculation Parameters for Assessment

Element	Properties/Parameters	
No. of Trickle Vents	Bedroom	None, MVHR proposed
	Living Room	
Reverberation Time	Bedroom	0.5 s
	Living Room	0.6 s

Design Appraisal Noise Data

- 4.5 Reasonably worst-case spectral L_{eq} day and night noise levels along with the night $L_{F,max}$ data, derived from the survey and modelling, used for the building envelope calculations are presented in Table 5.

Table 5 Spectral Noise Data for Building Envelope Assessment (Free-Field)

Façade	Period	Noise level (dB) per octave band centre frequency (Hz)							Overall, dB(A)
		63	125	250	500	1k	2k	4k	
Facing Stonebridge Road	Day L_{eq}	56	53	52	52	54	51	41	58
	Night L_{eq}	51	46	45	44	48	45	39	52
	Night $L_{F,max}$	62	64	62	61	60	58	54	65

Building Envelope Appraisal

- 4.6 A partially open window is generally taken to provide around 13 dB sound reduction. When considering this and the noise levels in Table 5 for the windows facing the Stonebridge Road, average internal noise levels in the region of 44 dB and 38 dB can be expected with partially open windows during the day and night respectively at the worst-case positions. These noise levels would exceed guidance levels of 35 dB and 30 dB L_{Aeq} for 'desirable' acoustic conditions during the day and night respectively (see Table 2).



- 4.7 In terms of maximum noise levels from discrete events, with a partially open window it is estimated that noise levels of around 52 dB would occur more than 10 times per night. This would exceed the generally accepted limit of 45 dB $L_{AF,max}$.
- 4.8 In light of the above, it is evident that some of the windows of the proposed scheme would have to remain closed and alternative means of ventilation provided to ensure satisfactory acoustic conditions in habitable rooms facing Stonebridge Road can be maintained. The proposed scheme achieves this through the provision of MVHR in each dwelling so that residents have the option to keep their windows shut if desired.
- 4.9 Noise break-in calculations in accordance with the 'more rigorous' BS 8233:2014 methodology, which also take into consideration the proposed design, show that desirable internal noise levels in line with BS 8233 criteria should be achievable within the dwellings with standard double glazing, e.g. 4/12/4, providing sound insulation of around 30(-4) dB $R_w (C_{tr})$.
- 4.10 It is understood that the proposed development may employ triple glazing. Calculations show that triple glazing would also be acoustically viable.
- 4.11 The external wall build-up is likely to be of twin frame timber-frame construction. Such a wall has the potential to provide high levels of sound attenuation in excess of 50 dB $R_w + C_{tr}$ and would therefore be acoustically adequate.
- 4.12 In addition to operable windows and MVHR, the proposed development would incorporate ventilation grilles in the building fabric as part of ventilation strategy. It is understood that the main intention for these ventilation grilles is to provide future residents with an additional option for controlling thermal comfort. Nevertheless, as these grilles could be an acoustically weak element (when in open position), it would be prudent for their sound insulation properties to be considered where elevated levels of external noise are expected to occur.
- 4.13 Noise break-in calculations show that a relatively low sound insulation specification of around 9(-2) dB $R_w (C_{tr})$ would be required for the ventilation grille, when in open position, for internal noise conditions to be limited to +5 dB above BS 8233/ProPG noise criteria. Such noise conditions would still be considered as 'reasonable'. Moreover, the noise conditions would also be comfortably compliant with Part O of the Building Regulations.

- 4.14 Given the low sound insulation requirement (at the worst-case position), the proposed ventilation grilles are considered to be acoustically viable. However, it is recommended for this aspect to be considered in more detail as the design progresses. The façades where the acoustic requirement for the ventilation grilles apply are highlighted in the figure below.

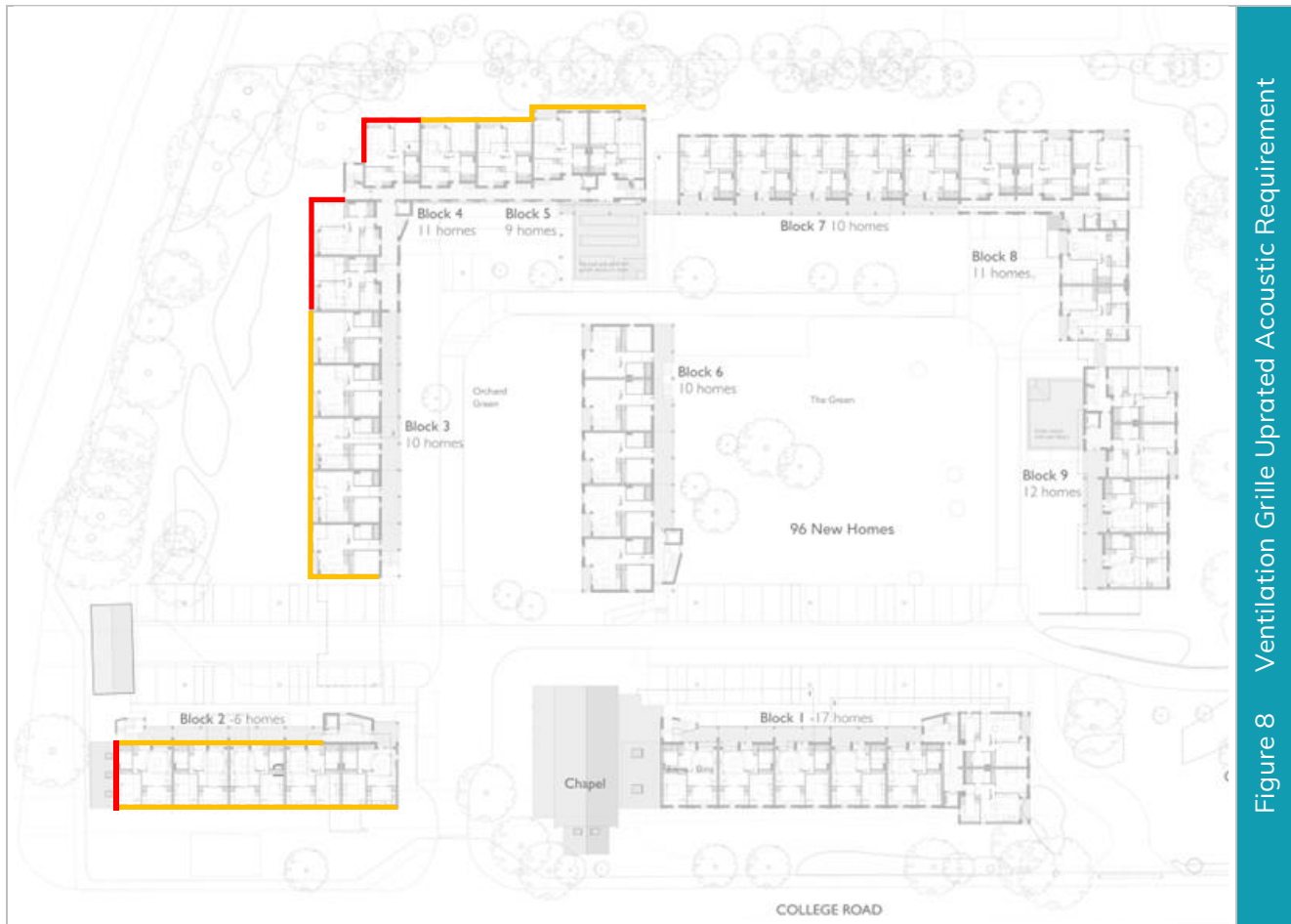


Figure 8 Ventilation Grille Up-rated Acoustic Requirement

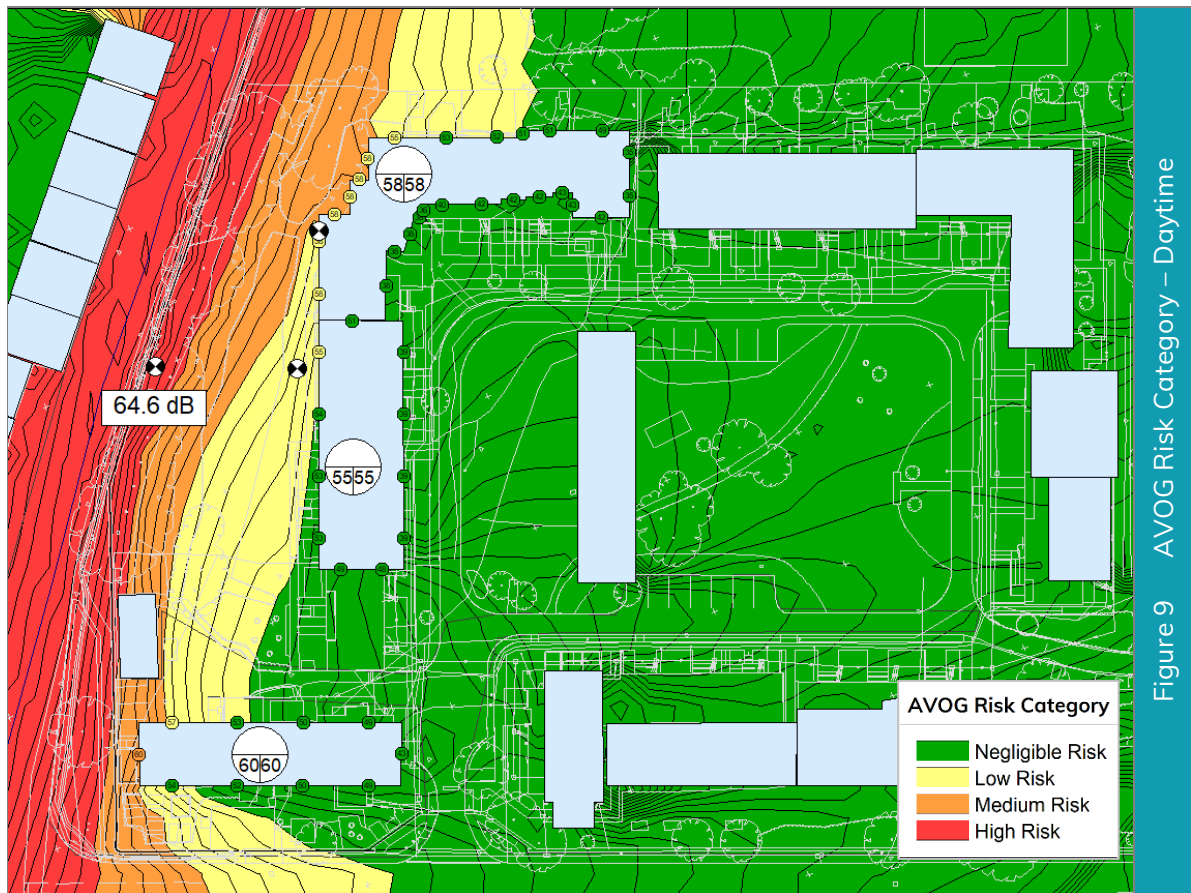
Ventilation

- 4.15 Approved Document F (ADF) of the Building Regulations stipulates the requirement for rapid intermittent ventilation for occupants to have the ability to quickly expel fumes in dwellings.
- 4.16 Whilst windows at some locations would have to remain closed to ensure adequate acoustic conditions, the use of open windows for rapid ventilation is considered acceptable as any increase in noise would be for a short period only and expected by the occupant. The overall exposure to noise would therefore be relatively small.

- 4.17 The provision of MVHR and dedicated ventilation grilles further enhances the residents' options with respect to ventilation.

Noise during Overheating Conditions

- 4.18 The requirement for having closed windows at some locations to achieve satisfactory acoustic conditions could also have ramifications on other aspects of the design. The interdependent nature of acoustics, ventilation and overheating, i.e. windows would have to be opened to mitigate overheating which would then temporarily result in excessive noise, may necessitate these to be considered in an integrated approach during the project's detailed design stage.
- 4.19 To inform the potential combined effect of overheating and excessive internal noise levels, noise level contours at the worst-case location, i.e. first floor height, have been produced. The noise level contours show assessment in line with the AVOG Level 1 qualitative guidance for 'Risk Categories' at the proposed development. The results for the day and night-time periods are show in Figures 9 and 10 below respectively.



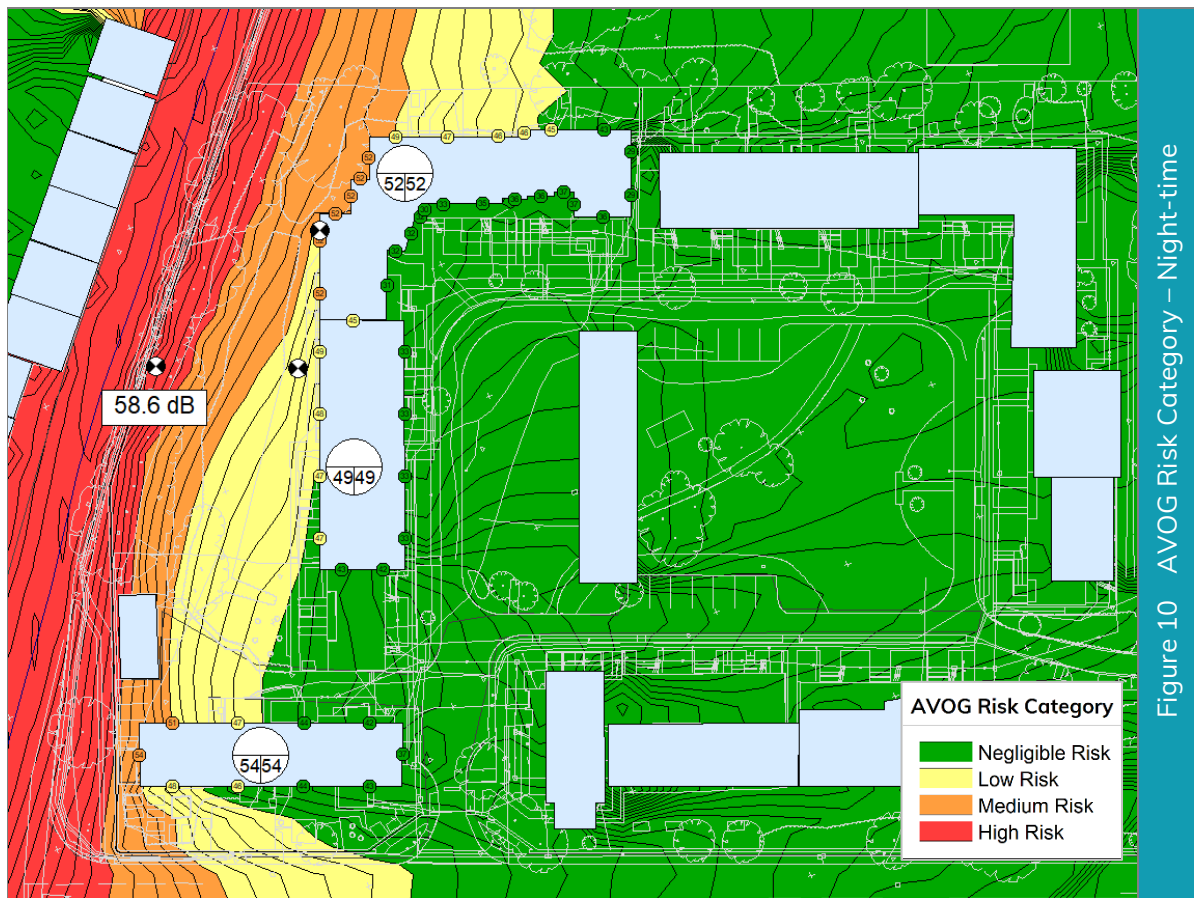


Figure 10 AVOG Risk Category – Night-time

- 4.20 As can be seen from the above figures, parts of the development adjacent to the Stonebridge Road are predicted to be within the 'medium risk' category for excessive noise during overheating conditions for both the day and night periods. This is not unsurprising given the proximity of the busy road.
- 4.21 Nevertheless, for the façades facing away from the road or dwellings at larger distances, the risk level drops to low/negligible, thus doors/windows in these façades can likely be opened during overheating conditions without significantly affecting the internal noise conditions.
- 4.22 It is important to bear in mind that the above does not demonstrate that noise will be an issue during overheating conditions but, rather, assigns a risk category as a recommendation to further inform the (future) detailed design and specification. Whether noise during periods of overheating has the potential for significant adverse effect would be



dependent on the overheating duration and frequency, which, where required, would have to be informed by a detailed overheating assessment such as CIBSE TM59².

- 4.23 Given the relatively high noise levels parts of the proposed site would be exposed to, noise conditions may also have a bearing with respect to compliance with the requirements of Approved Document O of the Building Regulations.
- 4.24 In light of the above, it is recommended that further reference is made to Part O of the Building Regulations and, where required, also the Acoustics Ventilation and Overheating – Residential Design Guide document – as part of the detailed design of the scheme.

Noise within External Amenity Areas

- 4.25 As can be seen from the ST attended noise survey results, see Table 3, existing noise levels within the outdoor amenity areas within the Huggens's College grounds are in line with the 55 dB L_{Aeq} BS 8233:2014 guideline values. These noise levels are not expected to increase due to the proposed development. As such, future noise levels within the proposed outdoor amenity areas are expected to remain compliant with BS 8233:2014 guideline values for outdoor spaces.

² TM59 Design methodology for the assessment of overheating risk in homes (2017)



5.0 Conclusions

- 5.1 This report presents the findings of a Noise Assessment, which identified key sources of road traffic noise, monitored noise levels, assessed conditions against Local and British guidance.
- 5.2 Assessment of prevailing environmental noise levels has been undertaken over what is deemed to have been a typical period. The main noise affecting the proposed development site is road traffic noise from Stonebridge Road with no notable noise from the nearby industrial areas observed.
- 5.3 This assessment has considered the above noise sources, including a detailed noise model of the site and its surroundings, and has shown that with suitably specified building envelope and closed windows for some of the façades facing onto Stonebridge Road, internal noise levels in line with Local and British guidance limits can be achieved. Minimum sound insulation requirements for the proposed ventilation grilles are also included in this report.
- 5.4 As some of the windows would have to remain closed for suitable internal noise conditions to prevail, there is the potential for competing requirements with respect to ventilation, thermal comfort and overheating. Therefore, an AVOG Level 1 risk assessment has been undertaken as part of this assessment with the outcome, as detailed in this report, recommending that this aspect be taken into consideration as the design progresses.
- 5.5 Noise levels within the outdoor amenity areas of the proposed development are expected to remain compliant with BS 8233:2014 guideline values once the scheme is introduced.



APPENDIX A: Acoustic Terminology

Parameter	Description
Sound	A sound wave can be viewed as small pressure fluctuations in an elastic medium such as air. When the frequencies of the pressure fluctuations are within the audible range, the human ear responds to sound waves which produces the sensation of hearing. There are two basic characteristics of sound: amplitude and frequency. Amplitude relates to the perceived loudness of a sound whereas the pitch of a sound corresponds to the frequency.
Noise	Noise, a subjective term, is essentially unwanted sound . It is very much dependent on the receptor's perception of the sound.
Decibel (dB)	The sound pressure is measured in Pascals. The human ear responds to a wide range of sound pressures, from 0.00002 to 20 Pascals. Given this wide range of values, it is convenient to express these in a logarithmic scale, the decibel (dB). The decibel is a logarithmic scale representing the measurement unit of sound pressure levels or noise levels relative to the threshold of hearing (20×10^{-6} Pascals). Zero decibel represents the threshold of hearing. The higher the value the louder the sound, with the value around 110 decibel being the level at which hearing becomes uncomfortable. Around 130 decibel is the threshold of pain at which hearing becomes painful.
Frequency (Hz)	The pitch of a sound relates to the frequency, which is expressed in Hertz (Hz). The audible range for human hearing typically ranges from 20 Hz to 20 kHz, but this tends to decrease with age. A pure tone, e.g. as produced by a tuning fork, contains sound of a single frequency (440 Hz). In real life, most sound consists of complex waves containing sound waves of multiple frequencies.
A-weighting	Human hearing is not linear, i.e. the perceived loudness of sound varies with both frequency and amplitude. To better represent the human hearing response, frequency 'weightings' are applied to sound. There are various weighting networks best suited to specific conditions. However, in practice, the A-weighting network has become the generally accepted 'correction' for representing loudness. When a weighting filter has been applied to a value, the weighting type is added to the descriptor, L_{Aeq}, L_{pA}, etc, or just after the decibel, dBA or dB(A)

Parameter	Description
Octave Bands or 1/3-Octave Bands	Whilst single figure values are useful, often spectral data is required for analysis and/or acoustic specification. To represent the frequency content, sound level or acoustic properties are presented in specific frequency bands, also known as octave bands. The frequencies of octave bands have been internationally standardised. For example, the 500 Hz octave band (500 Hz being the centre frequency) has a range from 354 Hz to 707 Hz. Where finer spectral detail is required, 1/3-octave band data can be used. Each octave band is divided into three 1/3-octave bands.
Sound Pressure Level (SPL or L_p)	The sound pressure level is indicative of the sound wave strength and has good correlation with perceived loudness. Sound pressure is expressed in Pascals and, for convenience, is expressed
Sound Power Level (SWL or L_w)	The sound power is the overall acoustic energy radiated by a source over a specific period and is expressed in Watts. It is an inherent property of the source and, unlike sound pressure, does not depend on the distance to the source. As sound power values vary greatly, it is convenient to express these as a level in decibels, the sound power level, SWL or L_w (referenced to 10^{-12} Watts).
$L_{Aeq,T}$	The A-weighted equivalent continuous sound level over the period T. Often also referred to as the ambient noise level. This is the sound level that is equivalent to the total average energy of noise recorded over a given period.
L_{Amax}	The A-weighted maximum instantaneous noise level.
L_{A10}	The A-weighted statistical sound level which is exceeded 10% of the given measurement period. In the UK, this level is usually used to describe road traffic noise .
L_{A90}	The A-weighted statistical sound level which is exceeded 90% of the given measurement period. This level is usually synonymous with the background sound level and generally describes the underlying level of sound that is experienced when specific events are not taking place.
R_w	The weighted (w) sound reduction index (R), a single figure rating of the laboratory airborne sound insulation performance of a construction, usually measured across the frequency range 100-3150Hz. The higher the value, the greater the sound insulation, and the more onerous the requirement.

Parameter	Description
$D_{nT,w}$	The weighted (w) sound insulation (D), a single figure rating of the in-situ airborne sound insulation performance of a construction. The sound insulation value is standardised (nT) to a reference reverberation time for typical conditions. The higher the value, the greater the sound insulation.
$L'_{nT,w}$	The weighted (w) impact sound pressure level (L), a single figure rating of the in-situ impact sound insulation performance of a construction. The sound insulation value is standardised (nT) to a reference reverberation time for typical conditions. The lower the value, the greater the sound insulation.
C or C_{tr}	These are spectrum adaptation terms for taking into account the effect of different sound spectra. C and C_{tr} are corrections for pink noise and traffic noise respectively and are added to single figure quantities, e.g. $R_w + C_{tr}$
$D_{n,ew}$	The weighted (w) element (e) normalised (n) level difference (D), an indicator of the ability of a small building element (such as a trickle ventilator) to reduce sound in a particular frequency band. The higher the value, the greater the sound reduction, and vice versa.
Reverberation Time (RT60 or T60)	Reverberation time relates to the echoing decay of sound in a room. More specifically, the reverberation time (RT60) is the time it takes for the sound pressure level to drop by 60 dB after excitation. The value is expressed in seconds. In many situations, conditions do not allow for the entire 60 dB decay time to be measured. Where this is the case, a reduced part of the decay can be measured and the results extrapolated; typically these are the T20 or T30. The higher the value, the more reverberant a space is.



APPENDIX B: Planning Policy and Guidance

NATIONAL PLANNING POLICY FRAMEWORK, 2023 (NPPF)

The National Planning Policy Framework (NPPF) includes the following statements relating to noise and the requirement to take it into account in the planning process.

Section 15, paragraph 180 (e) of NPPF 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.*

Section 15, paragraph 191 of NPPF states:

- *(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;*

Paragraph 193 of NPPF further elaborates on the consideration of existing businesses, as follows:

- *Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or ‘agent of change’) should be required to provide suitable mitigation before the development has been completed.*

The NPPF does not provide absolute limits on noise that are acceptable or unacceptable in a given situation. It does, however, set out the “need to ensure that developments do not give rise to significant adverse impacts on health and the quality of life”. In addition, the operations of existing businesses are also protected, with reference to ensuring new developments do not have an adverse effect on their operations.

NOISE POLICY STATEMENT FOR ENGLAND, 2010 (NPSE)

The Noise Policy Statement for England (NPSE) applies to all forms of noise including environmental noise, neighbour noise and neighbourhood noise but does not apply to noise in the workplace. The Government recognizes that the effective management of noise requires a coordinated and long-term approach that encompasses many aspects of modern society.

The long-term vision of Government noise policy is set out 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. This long-term vision is supported by three aims:

- ▶ avoid significant adverse impacts on health and quality of life;
- ▶ mitigate and minimise adverse impacts on health and quality of life; and
- ▶ where possible, contribute to the improvement of health and quality of life.

The NPSE introduces the concept of NOEL, LOAEL and SOAELs, which are described below:

- ▶ NOEL – No Observed Effect Level – This is the level below which no observable effect can be detected.
- ▶ LOAEL – Lowest Observed Adverse Effect Level – This is the level above which adverse effects on health and quality of life can be detected.
- ▶ SOAEL – Significant Observed Adverse Effect Level – This is the level above which significant effects on health and quality of life can be detected.

PLANNING POLICY GUIDANCE – NOISE, 2014

This guidance is provided online within the UK Government Planning System. The guidance expands upon the concepts of Observed Effect Levels and the following table is provided.

Planning Policy Guidance - Noise exposure hierarchy

Perception	Examples of Outcomes	Increasing Effect Level	Outcome
No Observed Effect Level			
Not Noticeable	No Effect	No Observable Effect	No specific measures required
Noticeable but not Intrusive	Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area, but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Noticeable and Intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	/ Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

ProPG: PLANNING & NOISE PROFESSIONAL PRACTICE GUIDANCE ON PLANNING & NOISE NEW RESIDENTIAL DEVELOPMENT MAY 2017

The primary goal of ProPG is to assist the delivery of sustainable development by promoting good health and wellbeing through the effective management of noise. It seeks to do that through encouraging a good acoustic design process in and around proposed new residential development having regard to national policy on planning and noise.

ProPG advocates a systematic, proportionate, risk based, 2-stage, approach. The approach encourages early consideration of noise issues, facilitates straightforward accelerated decision making for lower risk sites, and assists proper consideration of noise issues where the acoustic environment is challenging. It is envisaged that following the guidance contained in this document will increase the likelihood of success of planning applications for new residential development, yet it also provides a clear basis for recommending refusal of new housing development on noise grounds where necessary.

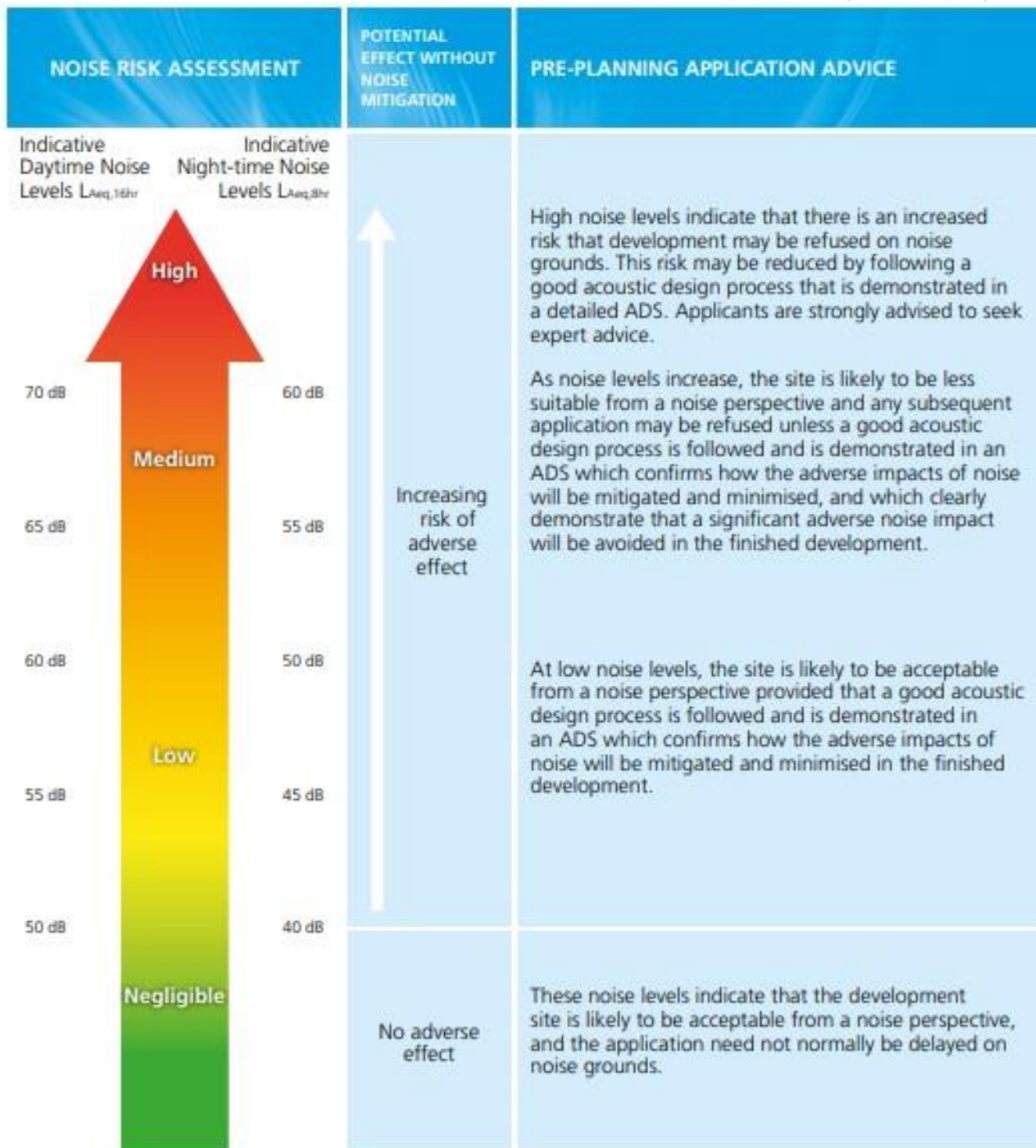
Stage 1: Initial Site Noise Risk Assessment

An initial noise risk assessment of the proposed development site should be conducted by a competent noise practitioner at the earliest opportunity, before any planning application is submitted. The noise risk assessment should provide an indication of the likely risk of adverse effects from noise were no subsequent mitigation to be included as part of the development proposal. It should indicate whether the proposed site is considered to pose a negligible, low, medium or high risk from a noise perspective.

Stage 2: Full Assessment – the four key elements

- ▶ Element 1 – Good Acoustic Design Process Stage 2:
- ▶ Element 2 – Internal Noise Level Guidelines Stage 2:
- ▶ Element 3 – External Amenity Area Noise Assessment Stage 2:
- ▶ Element 4 – Assessment of Other Relevant Issues

Figure: Summary plan for ProPG planning advice



The following British Standards and Building Regulations have been considered for this assessment.

BS 8233:2014 'Guidance on sound insulation and noise reduction for buildings'

This standard provides information and guidance on sound insulation and noise reduction for buildings. It deals with the control of external noise and outlines recommendations for occupied rooms.

The following table is taken from the document outlining requirements for internal noise levels in residential accommodation.

Indoor Ambient Noise Levels for Dwellings (BS 8233:2014)

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living Room	35dB $L_{Aeq,16hr}$	-
Dining	Dining Room/Area	40dB $L_{Aeq,16hr}$	-
Sleeping	Bedroom	35dB $L_{Aeq,16hr}$	30dB $L_{Aeq,8hr}$

The noise levels presented are based on existing WHO guideline values. The document further recommends that guideline value may be set in terms of SEL or $L_{Amax,F}$, if systematic individual noise events are happening. The values are depending on the character and number of events per night. Sporadic noise events could require separate values. In this instance a target value of 45 dB L_{Amax} has been established as the average L_{Amax} level not to be exceeded in bedrooms at night.

External Amenity Space

BS 8233:2014 offers the following guidance regarding outdoor amenity space:

"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 50dB LAeq, with an upper guideline value of 55dB LAeq which would be acceptable in noisier environments. However, it is also recognised that these 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."

BS 4142: 2014 'Methods for rating and assessing industrial and commercial sound'

BS 4142:2014 describes methods for determining and assessing noise levels from noise sources with a view to determining the likelihood of adverse impact.

The document has been developed for the purposes of:

- ▶ Investigating complaints,
- ▶ Assessing sound from proposed new, modified or additional sources of sound of an industrial and / or commercial nature; and
- ▶ Assessing sound at proposed new dwellings or premises used for residential purposes.

The document is now suitable for the determination of noise nuisance. Furthermore, that standard is not intended to apply to the following sources of noise:

- ▶ recreational activities, including all forms of motorsport;
- ▶ music or other entertainment;
- ▶ shooting grounds;
- ▶ construction and demolition;
- ▶ domestic animals;
- ▶ people;
- ▶ public address systems for speech;
- ▶ other sources falling within the scopes of other standards or guidance.

The methodology requires the determination of the specific sound level, corrected for characteristic feature in order to produce a rating level. The rating level is then compared against the background noise level (expressed as $L_{A90,T}$), thereby producing an 'excess of Rating over background sound level' figure. This figure is then used for assessment of likelihood of adverse impact.

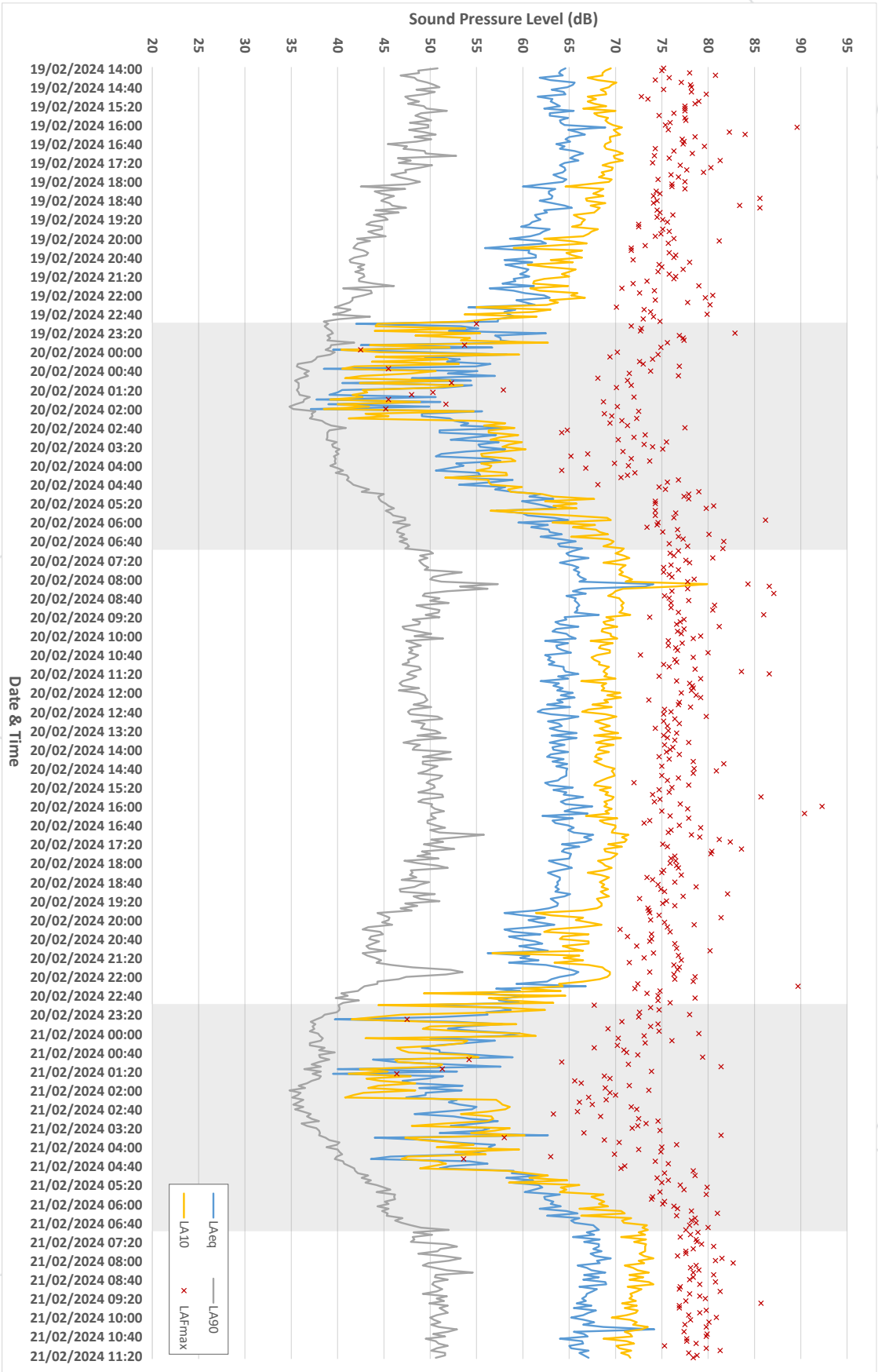
The standard places great emphasis on the context of the sound environment that is being assessed and the development overall. This is an essential part of the assessment process, particularly when predicting likelihood of adverse impact. However, for guidance the following is included in the standard:

- ▶ Typically, the greater the difference, the greater the magnitude of the impact;
- ▶ A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context;

- ▶ A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context; and
- ▶ The lower the rating is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. When the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.



APPENDIX C: Survey Data





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