Hawkins environmental

Noise Assessment:

Queensmere House, East Grinstead

RH19 Estates Ltd

4th November 2024

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1.

1. INTRODUCTION

1.1. Overview

Hawkins Environmental Limited has been instructed by RH19 Estates Ltd to undertake a noise assessment for the redevelopment of land at Queensmere House, East Grinstead.

During the planning process, it has been identified that the site may require a noise assessment to determine whether the site is suitable for residential use, due to its proximity to a number of busy roads. Consequently, a noise survey was conducted to characterise the noise climate of the site with the proposed layout. By measuring both the ambient and maximum noise levels it has been possible to determine whether mitigation is necessary to achieve reasonable internal and external noise levels. The results of the survey also give an indication of acceptable limits for plant noise emission.

The assessment adheres to the principles of Government planning policy in relation to noise, specifically enacted by the *National Planning Policy Framework (NPPF), the National Planning Practice Guidance (NNPPG) on Noise* and *the Noise Policy Statement for England (NPSE).*

The recommended approach for assessing noise in relation to residential development has been adopted, which is currently the *Professional Practice Guidance on Planning and Noise: New Residential Development* (the "ProPG"), which adopts the criteria contained within *BS 8233: 2014 'Guidance on sound insulation and noise reduction for buildings'.* Consideration has also been given to the Association of Noise Consultants' *Acoustics, Ventilation and Overheating (AVO) Guide.*

All noise measurements were conducted in accordance with BS 7445-2: 1991 *'Description and measurement of environmental noise Part 2: Guide to the acquisition of data pertinent to land use'.*

1.2. The Nature, Measurement and Effect of Noise

Noise is often defined as sound that is undesired by the recipient. Whilst it is impossible to measure nuisance caused by noise directly, it is possible to measure the loudness of that noise. 'Loudness' is related to both sound pressure and frequency, both of which can be measured. The human ear is sensitive to a wide range of sound levels. The sound pressure level of the threshold of pain is over a million times that of the quietest audible sound. In order to reduce the relative magnitudes of the numbers involved, a logarithmic scale of decibels (dB) is normally used, based on a reference level of the lowest audible sound.

The response of the human ear is not constant over all frequencies. It is therefore usual to weight the measured frequencies to approximate the human response. The resulting 'A' weighted decibel, dB(A), has been shown to correlate closely to the subjective human response.

When related to changes in noise, a change of ten decibels from say 60 dB(A) to 70 dB(A) would represent a doubling in 'loudness'. Similarly, a decrease in noise from 70 dB(A) to 60 dB(A) would represent a halving in 'loudness'. A change of 3 dB(A) is generally considered to be just perceptible. **Table 1.1** details typical noise levels. A glossary of acoustic terms can be found in **Appendix 1**.

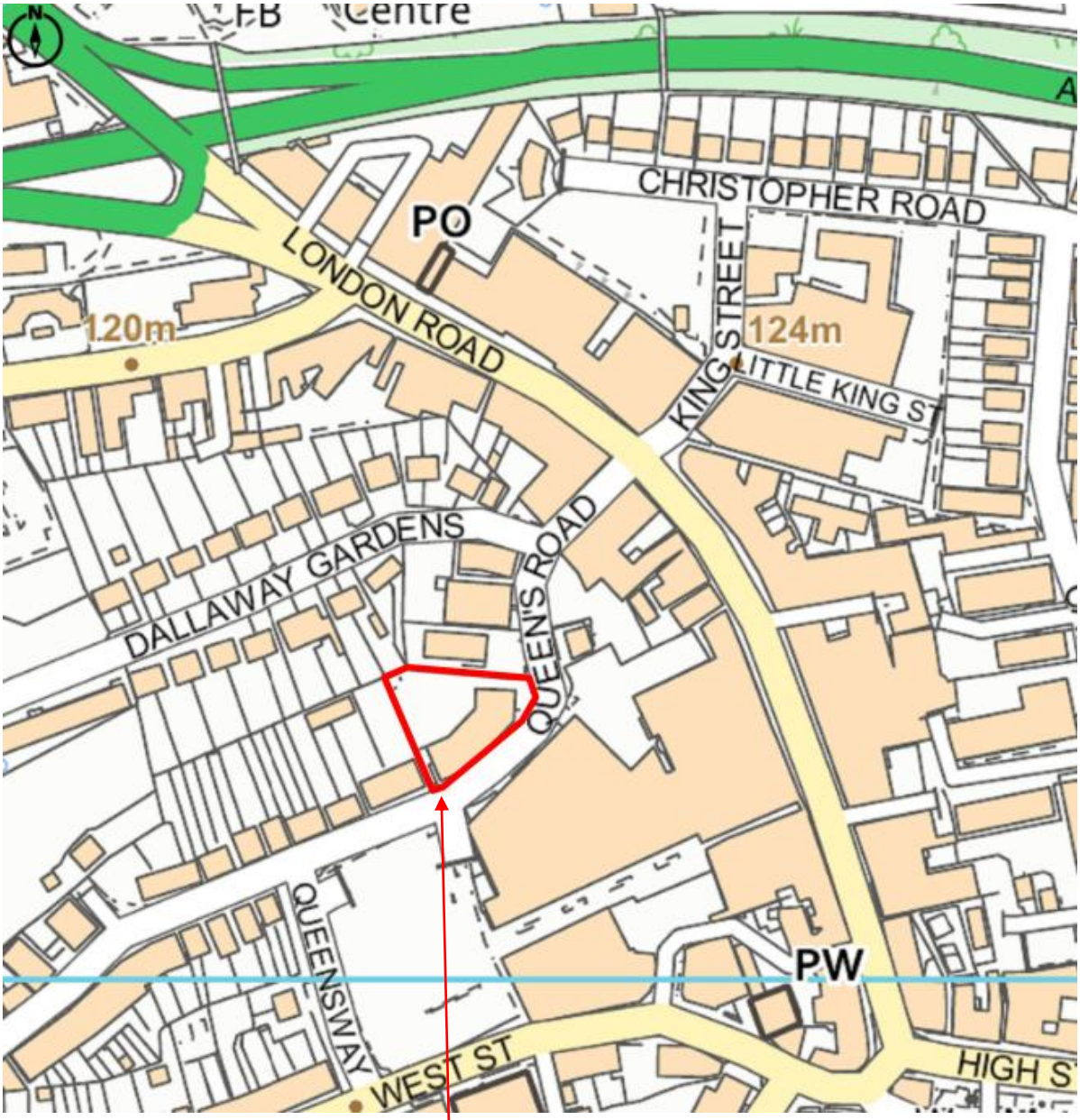
Table 1.1: Typical Noise Levels

Approximate Noise Level (dB(A))	Example
0	Limit of hearing
30	Rural area at night
40	Library
50	Quiet office
60	Normal conversation at 1 m
70	In car noise without radio
80	Household vacuum cleaner at 1 m
100	Pneumatic drill at 1 m
120	Threshold of pain

1.3. Site Description

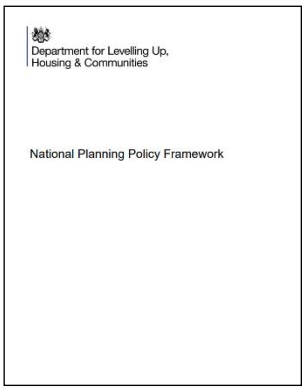
The development site is situated on a parcel of land which fronts Queen's Road in East Grinstead, West Sussex. The site currently comprises a disused former office building with hardstanding to the rear. The proposed development will see the refurbishment of the existing building to form 25 new flatted dwellings with external amenity and private residential car parking to the rear. A location plan of the proposed site can be seen in **Figure 1.1**.

Figure 1.1: Site Location Plan



2. NATIONAL & LOCAL PLANNING POLICY

2.1. National Planning Policy Framework (2023)



The National Planning Policy Framework (NPPF) was first published on the 27th March 2012 and revised July 2018, February 2019, July 2021 and September 2023, with the latest version published in December 2023 in response to the Levelling-up and Regeneration Bill.

The NPPF outlines the Government's planning policies for England and determines how they should be applied. It provides a framework within which Local Planning Authorities are required to prepare their own locally-prepared plans, where both the policies within the NPPF and the local plan are material planning considerations against which planning decisions are determined. These distinctive local and neighbourhood plans should be interpreted and applied in order to meet the needs and priorities of their communities.

The NPPF notes *"The purpose of the planning system is to contribute to the achievement of sustainable development, including the provision of homes, commercial development, and supporting infrastructure in a sustainable manner"* (Paragraph 7). The NPPF notes sustainable development should be delivered with three main dimensions: economic; social and environmental (Paragraph 8).

The NPPF supports a presumption in favour of development, unless the adverse impacts of that development outweighs the benefits it notes "*that sustainable development is pursued in a positive way, at the heart of the Framework is a presumption in favour of sustainable development*" (Paragraph 10).

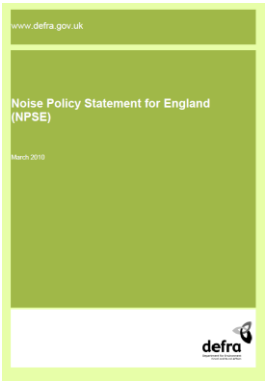
The NPPF states that in the planning system *"Planning policies and decisions should contribute to and enhance the natural and local environment by… e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels 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 180).

Paragraph 191 of the NPPF talks specifically about noise stating that *"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 impacts 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…"*

Specifically in relation to noise from existing commercial premises, Paragraph 193 of the NPPF notes: *"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".

2.2. Noise Policy Statement for England (2010)



The Noise Policy Statement for England (NPSE) provides further guidance which is relevant to the policies set out in the NPPF and states that: *"Within the context of sustainable development:*

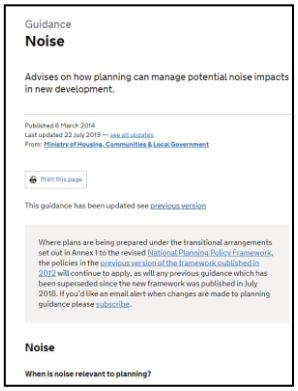
- *avoid significant adverse impacts on health and quality of life;*
- *mitigate and minimise adverse impacts on health and quality of life; and*
- *where possible contribute to the improvement of health and quality of life."*

NPSE introduces established concepts originally from the field of toxicology that are now being applied to noise impacts. They are:

- **NOEL – No Observed Effect Level** - This is the level of noise 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.
- **LOAEL – Lowest Observed Adverse Effect Level** - This is the level of noise 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 adverse effects on health and quality of life occur.

NPSE goes on to state that *"it is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It is acknowledged that further research is required to increase our understanding of what may constitute a significant adverse impact on health and quality of life from noise. However, not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available."*

2.3. Planning Practice Guidance



The Noise Planning Practice Guidance (NPPG) was launched on 6th March 2014 and has undergone regular revision, with the most recent changes to Noise Guidance published in July 2019. NPPG provides additional guidance and interpretation to the Government's strategic policies, outlined within the NPPF, in a web-based resource.

The NNPPG provides more guidance on the assessment of noise for planning purposes and builds on the concepts of NOEL, LOAEL and SOAEL introduced in NPSE to establish whether noise is a factor that needs to be taken into account. It states*: "Local planning authorities' plan-making and decision taking should take*

account of the acoustic environment and in doing so consider:

- *whether or not a significant adverse effect is occurring or likely to occur;*
- *whether or not an adverse effect is occurring or likely to occur; and*
- *whether or not a good standard of amenity can be achieved.*

In line with the Explanatory Note of the Noise Policy Statement for England, this would include identifying whether the overall effect of the noise exposure (including the impact during the construction phase wherever applicable) is, or would be, above or below the significant observed adverse effect level and the lowest observed adverse effect level for the given situation."

However, it goes into more detail about the subjective nature of noise and how the results of any assessment must be treated flexibly and pragmatically. The guidance states: *"The subjective nature of noise means that there is not a simple relationship between noise levels and the impact on those affected. This will depend on how various factors combine in any particular situation. These factors include:*

- *the source and absolute level of the noise together with the time of day it occurs. Some types and level of noise will cause a greater adverse effect at night than if they occurred during the day – this is because people tend to be more sensitive to noise at night as they are trying to sleep. The adverse effect can also be greater simply because there is less background noise at night;*
- *for a new noise making source, how the noise from it relates to the existing sound environment;*
- *for non-continuous sources of noise, the number of noise events, and the frequency and pattern of occurrence of the noise;*
- *the spectral content of the noise (i.e. whether or not the noise contains particular high or low frequency content) and the general character of the noise (i.e. whether or not the noise contains particular tonal characteristics or other particular features), and;*
- *the local arrangement of buildings, surfaces and green infrastructure, and the extent to which it reflects or absorbs noise.*

More specific factors to consider when relevant include:

- *the cumulative impacts of more than one source of noise;*
- *whether any adverse internal effects can be completely removed by closing windows and, in the case of new residential development, if the proposed mitigation relies on windows being kept closed most of the time (and the effect this may have on living conditions). In both cases a suitable alternative means of ventilation is likely to be necessary. Further information on ventilation can be found in the Building Regulations.*
- *In cases where existing noise sensitive locations already experience high noise levels, a development that is expected to cause even a small increase in the overall noise level may result in a significant adverse effect occurring even though little to no change in behaviour would be likely to occur.*
- *Noise Action Plans (where these exist), and, in particular the Important Areas identified through the process associated with the Environmental Noise Directive and corresponding regulations should be*

taken into account. Defra's website has information on Noise Action Plans and Important Areas. Local authority environmental health departments will also be able to provide information about Important Areas.

- *the effect of noise on wildlife. Noise can adversely affect wildlife and ecosystems. Particular consideration needs to be given to the potential effects of noisy development on international, national and locally designated sites of importance for biodiversity;*
- *where external amenity spaces are an intrinsic part of the overall design, the acoustic environment of those spaces should be considered so that they can be enjoyed as intended.*
- *some commercial developments including restaurants, hot food takeaways, night clubs and public houses can have particular impacts, not least because activities are often at their peak in the evening and late at night. Local planning authorities will wish to bear in mind not only the noise that is generated within the premises but also the noise that may be made by customers in the vicinity".*

Table 2.1 shows examples of the noise hierarchy (adapted from the NPPG) and shows that that the aim is to identify where the overall effect of the noise exposure falls in relation to SOAEL, LOAEL and NOEL. The implication of the advice is only noise that is 'noticeable and very disruptive' would be considered unacceptable and therefore, should be prevented. The inference, therefore, is that all other outcomes can be acceptable, depending upon the specific circumstances and level of mitigation.

Regarding noise from existing commercial premises, the NPPG provides additional guidance on the "*Agent of Change*" principle, introduced in the NPPF. The NPPG notes that where existing commercial premises could have a significant adverse effect on residents or users of the proposed scheme *"the applicant (or 'agent of change') will need to clearly identify the effects of existing businesses that may cause a nuisance (including noise, but also dust, odours, vibration and other sources of pollution) and the likelihood that they could have a significant adverse effect on new residents/users. In doing so, the agent of change will need to take into account not only the current activities that may cause a nuisance, but also those activities that businesses or other facilities are permitted to carry out, even if they are not occurring at the time of the application being made"*. Consequently, it is important to consider not just what noise the commercial premises currently make, but what they *could* make.

The NPPG goes on to note that "*The agent of change will also need to define clearly the mitigation being proposed to address any potential significant adverse effects that are identified. Adopting this approach may not prevent all complaints from the new residents/users about noise or other effects, but can help to achieve a satisfactory living or working environment, and help to mitigate the risk of a statutory nuisance being found if the new development is used as designed (for example, keeping windows closed and using alternative ventilation systems when the noise or other effects are occurring).*

It can be helpful for developers to provide information to prospective purchasers or occupants about mitigation measures that have been put in place, to raise awareness and reduce the risk of post-purchase/occupancy complaints".

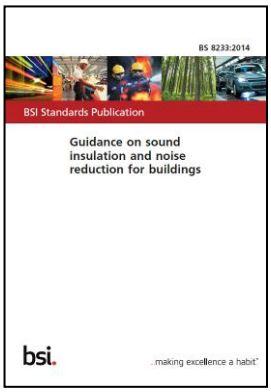
Table 2.1: Noise Exposure Hierarchy

Perception	Examples of outcomes	Increasing effect level	Action	
No Observed Effect Level - NOEL				Low Noise Level
Not Present	No Effect	No Observed Effect	No specific measures required	
No Observed Adverse Effect Level - NOAEL				
Present and not intrusive	Noise can be heard, but does not cause any change in behaviour, attitude or other physiological response. Can slightly affect the acoustic character of the area but not such that there is a change in the quality of life.	No Observed Adverse Effect	No specific measures required	
Lowest Observed Adverse Effect Level - LOAEL				
Present and intrusive	Noise can be heard and causes small changes in behaviour, attitude or other physiological response, 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 small actual or perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum	
Significant Observed Adverse Effect Level - SOAEL				
Present and disruptive	The noise causes a material change in behaviour, attitude or other physiological response, 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	
Present and very disruptive	Extensive and regular changes in behaviour, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory.	Unacceptable Adverse Effect	Prevent	High Noise Level

Increasing Noise Levels ↓

3. ASSESSMENT METHODOLOGY & GUIDANCE

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



Originally published in 1999, the 2014 edition of BS 8233, significantly updates the guidance in light of the policy changes as a result of the advent of the NPPF and the withdrawal of NPPG 24. The 2014 edition of BS 8233 sees a change in the title of the Standard, moving from a *'Code of Practice'* to *'Guidance'*, as the text '*largely comprises guidance that does not support claims of compliance'*.

BS 8233:2014 indicates that to control external noise ingress into a proposed development, a number of planning stages should occur as follows:

a) *"Assess the site, identify significant existing and potential noise sources, measure or estimate noise levels, and evaluate layout options.*

b) *Determine design noise levels for spaces in and around the building(s).*

c) *Determine sound insulation of the building envelope, including the ventilation strategy".*

BS 8233:2014 suggests design noise levels for various types of building. The recommended noise levels for dwelling houses, flats and rooms in residential use (when unoccupied) can be seen in **Table 3.1** below. This is replicated from Table 4 of Section 7.7.2 of BS 8233:2014. The guidance suggests that *"In general, for steady external noise sources, it is desirable that the internal ambient noise level does not exceed the guideline values"*. The noise levels in **Table 3.1** are marginally different to those published in BS 8233:1999 *'Sound insulation and noise reduction for buildings – Code of practice'*, but are based on the existing guidance from the current World Health Organisation (WHO) "Guidelines on Community Noise".

Table 3.1: Summary of Noise Criteria: BS 8233: 2014

Activity	Location	07:00 To 23:00	23:00 To 07:00
Resting	Living room	35 dB $L_{Aeq.16hour}$	-
Dining	Dining room/area	40 dB $L_{Aeq.16hour}$	-
Sleeping	Bedroom	35 dB $L_{Aeq.16hour}$	30 dB $L_{Aeq.8hour}$

When considering the noise level criteria considered in **Table 3.1**, the following points should be noted:

- BS 8233: 2014 suggests that the above criteria should be adopted flexibly and that *"where development is considered necessary or desirable... the internal target level may be relaxed by up to 5 dB and reasonable internal conditions still achieved"*.
- The noise levels quoted above are annual averages and *"do not need to be achieved in all circumstances*" e.g. New Year's Eve or fireworks night.

- The noise levels in **Table 3.1** are *"for steady external noise sources"* such as traffic noise or plant noise. This is a departure from the 1999 version of BS 8233, where the recommended internal noise levels were irrespective of the external noise source and therefore included the suggestion that in order to achieve *"reasonable"* noise levels within bedrooms at night, L_{AFmax} noise levels should not exceed 45 dB. Whilst this has been omitted from the 2014 version of BS 8233, it does state that *"Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$, depending on the character and number of events per night. Sporadic noise events could require separate values."* Therefore, at sites which may be affected by individual noise events, it is more appropriate to use the guidance contained within the WHO *"Guidelines on Community Noise"* which suggest that good sleep will not generally be affected if internal levels of L_{AFmax} 45 dB are not exceeded more than 10-15 times per night.
- BS 8233:2014 notes that if the design of the building is *"relying on closed windows to meet the guide values, there needs to be appropriate alternative ventilation that does not compromise the facade insulation or resulting noise level".*
- BS 8233 provides guidance for noise in gardens and outdoor amenity space. It suggests that *"it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments."* The guidance does go on to say that these guideline values are not achievable in all circumstances and in some 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."*

3.2. World Health Organisation Guidelines for Community Noise (1999)

The 1999 World Health Organisation (WHO) guidance *"Guidelines for Community Noise"*, provides recommendations on maximum internal and external noise levels in a range of situations. The WHO guidelines are a consequence of a comprehensive review of the scientific evidence in relation to community noise exposure and the health and social aspects of such exposure. Whilst not adopted policy, the recommendations within the WHO Guidelines are often quoted and form the basis of the recommendations within BS 8233 and other similar guidance. A summary of the noise criteria can be seen in **Table 3.2**.


GUIDELINES
FOR
COMMUNITY NOISE

Edited by
Birgitta Berglund
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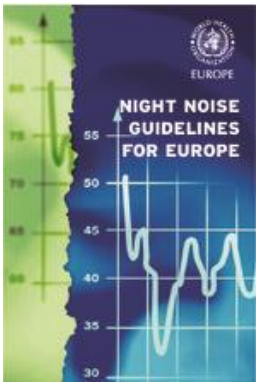
Dietrich H Schwela

Table 3.2: Summary of Noise Criteria: WHO

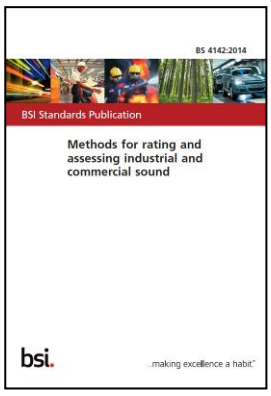
Residential Environment	Critical Heath Effect	L_{Aeq}	L_{AFmax}	Time Base
Outdoor living area	Serious annoyance, daytime and evening	55	-	07:00-23:00
	Moderate annoyance, daytime and evening	50	-	07:00-23:00
Dwelling, indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	-	07:00-23:00
Inside bedrooms	Sleep disturbance, night-time	30	45	23:00-07:00
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	60	23:00-07:00

3.3. WHO Night Noise Guidelines for Europe (2009)



In 2009, the World Health Organisation published the *"Night Noise Guidelines for Europe"* as a partial update and extension to the *"Guidelines for Community Noise*", specifically in relation to development on the scientific evidence of night noise exposure. The 2009 guidance suggests that a *"$L_{night,outside}$ of 40 dB should be the target of the night noise guideline (NNG) to protect the public, including the most vulnerable groups such as children, the chronically ill and the elderly"*. However, since that target would be impossible to achieve in many situations, a *"$L_{night,outside}$ value of 55 dB is recommended as an interim target for the countries where the NNG cannot be achieved in the short term for various reasons, and where policy-makers choose to adopt a stepwise approach"*.

3.4. BS 4142: 2014 +A1:2019 Methods for Rating and Assessing Industrial and Commercial Sound



British Standard BS 4142: 2014 +A1:2019 *"Methods for rating and assessing industrial and commercial sound"* provides a method for the measurement and rating of industrial noise or noise of an industrial nature and background noise levels outside dwellings in mixed residential and industrial areas. The rating level (defined in the BS) is used to rate the industrial noise source outside residential dwellings (this is defined as the "specific noise source").

The procedure defined in BS 4142 for predicting the likelihood of complaints is based on establishing the difference between the rating level and the background level outside the residential property of interest. The greater the difference the greater the likelihood of complaints and more specifically:

- *"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;*
- *The lower the rating level 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. Where 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.*
- *Adverse impacts include, but are not limited to, annoyance and sleep disturbance. Not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact."*

The guidance goes on to state *that "where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night."* Consequently, when considering the impact of a BS 4142 assessment, it is often also necessary to consider the absolute noise levels experienced at the receptor location in relation to BS 8233 and World Health Organisation guidelines.

3.5. BS 4142:2014+A1:2019 Technical Note (2020)

In March 2020, Acoustic and Noise Consultants (the ANC) published a guidance note to accompany BS 4142.

The Technical Note states *"remain concerns for some users of BS 4142 and this guidance is designed to assist readers with a reasonable interpretation and application of BS 4142 as a whole"*. It notes *"In the production of this guidance, the ANC Working Group (WG) has reviewed BS 4142 and attempted to address any content regarded as ambiguous"*. Consequently, whilst not an official guidance document, the Technical Note provides advice of the interpretation of BS 4142 and provides examples of best practice with regards to the application of the BS.

The following sub-sections contain clarifications from the Technical Note that are particularly pertinent to this assessment.

3.5.1. Internal Noise Levels

The Technical Note notes "*BS 4142 'is not intended to be applied to the assessment of indoor sound levels' (Subclause 1.3) and cannot, therefore, be used for façade design. Whilst BS 4142 can be used to assist in the determination of the likelihood of an adverse or significant adverse impact, guidance on internal design criteria and mitigation is provided elsewhere".* The Technical Note goes on to state that in conjunction with BS 4142, the use of BS 8233 may be appropriate to determine internal noise levels "*although recognition should be given to the associated scope and/or limitations".*

3.5.2. Introduction of a New Noise-Sensitive Receptors

One of the major short-comings of BS 4142 is the lack of differentiation between the assessment of new noise sources verses the assessment of new noise-sensitive receptors. Subclause 8.5 of BS 4142 states *"Where a new noise-sensitive receptor is introduced and there is extant industrial and/or commercial sound, it ought to be recognized that the industrial and/or commercial sound forms a component of the acoustic environment. In*

such circumstances other guidance and criteria in addition to or alternative to this standard can also inform the appropriateness of both introducing a new noise-sensitive receptor and the extent of required noise mitigation".

The Technical Note clarifies this position by noting "*where BS 4142 is used in this situation, its fundamental principles, in terms of what constitutes the residual, background and specific sources, should not be compromised. Where other standards or guidance document are used, care should be taken with regard to their own stated scope or limitations. Examples of such guidance might include:*

- *BS8233: 2014 where an industrial/commercial sound source is constant and new residential development is proposed nearby;*
- *Elements of ProPG where the impact of regular night time maximum sound events is the critical consideration;*
- *DMRB where impacts relate solely to changes to vehicular movements within or around a site; or*
- *BS 5228 where activities are temporary and of a similar nature to the construction activities considered by that Standard.*

These documents, or others, may help to inform the contextual elements of a BS 4142 assessment or help where a numerical assessment fully in accordance with BS 4142 may not be possible".

In this regard the Technical Note that when assessing new noise-sensitive receptors close to commercial noise sources, it may not be possible to use BS 4142 as difficulties in disaggregating *"legitimate commercial residual sources to the background sound level could potentially lead to unrepresentatively adverse outcomes"*. Consequently, *"alternative guidance and standards should be referenced, although care should be taken not to apply them beyond their own stated scope or limitations"*. It goes on to note that *"different approaches might be adopted depending on whether the industrial/commercial source is continuous or intermittent, whether there are ancillary sources present, or where one particular industrial/commercial premises dominates"*.

3.5.3. Background Sound Levels

BS 4142 does not provide a definitive method for calculating or determining a background sound level. The Technical Note does not a definitive method either, but does provide more clarification. It notes *"it was the view of the WG that it is not always appropriate to define a singular background sound level for use in an assessment. In such cases, a range of values over one or more time periods may be more appropriate. An assessment should generally focus on the sound levels measured during the period of greatest interest, which may be the quietest part of the night, or the time period relating to a complaint. Determining the period of greatest interest should be judged on a case-by-case basis"*.

The Note points out that "*it is important that the established background sound level is representative of typical conditions*". It goes on to provide a number of examples whereby time history, histogram and cumulative distribution data is presented, along with the range of values selected by the WG as being representative. *"These examples are included to illustrate the range of views in the WG as to how best to identify representative background sound levels for particular datasets and serve to highlight the sensitivity of the outcome to individual interpretations of measurement data. It must be remembered that there are no 'correct' answers, only judgement and justification. In many instances, additional information beyond that presented in these examples would be required to inform the judgement of representative levels".*

3.5.4. Context

The criteria used to determine the acceptability of an impact with BS 4142 talks about the requirement to consider "*context*". However, BS 4142 does not provide much detail as to what one might consider in relation to context.

BS 4142 notes that absolute levels of sound can be of significance, where residual values are both high and low. In particular, BS 4142 notes that absolute levels may be as, or more, important than relative outcomes where background and rating levels are low, but does not provide further commentary.

The Technical Note points out that "*BS 4142 does not indicate how the initial estimate of impact should be adjusted when background and rating levels are low, only that the absolute levels may be more important than the difference between the two values. It is likely that where the background and rating levels are low, the absolute levels might suggest a more acceptable outcome than would otherwise be suggested by the difference between the values. For example a situation might be considered acceptable where a rating level of 30dB is 10dB above a background sound level of 20dB, i.e. an initial estimate of a significant adverse impact is modified by the low rating and background sound levels.*

There may be situations where the opposite is true, and it is for the assessor to justify any modifications to the initial estimate of impact.

BS 4142 does not define 'low' in the context of background sound levels nor rating levels. The note to the Scope of the 1997 version of BS 4142 defined very low background sound levels as being less than about 30 dB L_{A90}, and low rating levels as being less than about 35 dB $L_{Ar,Tr}$.

The WG suggest that similar values would not be unreasonable in the context of BS 4142, but that the assessor should make a judgement and justify it where appropriate".

The Technical Note suggests other areas one might consider when looking at context:

- *"character of a particular neighbourhood;*
- *former uses at or close to a site;*
- *legitimacy of the industrial use, e.g. planning permissions or environmental permits;*
- *implementation of best practicable means for a given process or activity; or*
- *local convention or perceptions".*

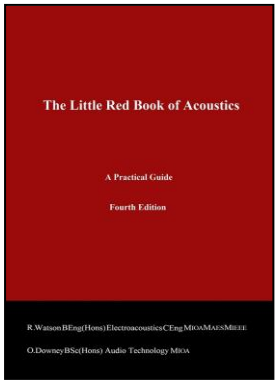
It goes on to provide two examples:

"For example; a former industrial use may be less relevant if it ceased 10 years previously, than a use that ceased within the previous six months. Setting out the context in this way is important so that the reader is fully aware of the point being made".

"For example; a coffee shop with drive thru facility located adjacent to a fairly busy road with traffic lights and constant stop/start traffic, with residential properties nearby. In these circumstances the noise climate is unlikely to change in any perceptible way due to the addition of vehicles moving and idling in the drive thru area. However, during the evening, the gaps in the general traffic could reduce the background sound level sufficiently that an adverse or significant adverse impact is suggested. An intermittency correction could also be

considered appropriate. In this example, the assessor might legitimately take the view that the context is at odds with the initial (numerical) assessment, and substantially adjust the conclusions of the assessment on the basis of the context".

3.6. The Little Red Book of Acoustics (4th ed.) (2024)



First published in 2007, *'The Little Red Book of Acoustics: A Practical Guide'* remains an industry-standard textbook. Appreciated by professionals and beginners alike for being clear and straightforward, the book has also been included in recommended reading lists for Institute of Acoustics accredited courses.

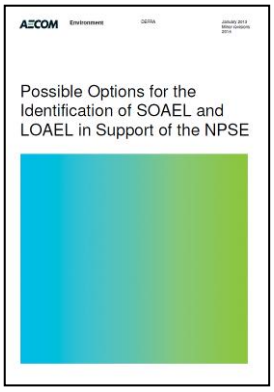
The 4th edition of the book was published in September 2004 and includes recent updates to standards such as BS 8233 and BS 4142, in addition to presenting a new method to assess and determine the representative background sound levels as part of a BS 4142 assessment.

The book recognises that BS 4142 does not give a single fixed method for assessing the representative background sound level and proposes the *'LRB Method'* which considers a modal approach with a distribution threshold criterion.

The LRB Method requires each of the background sound level integer values to be counted. The analysis of the candidate values for the background sound level first starts with the candidate with the highest number of occurrences. If there are multiple values with the same number of occurrences, then the analysis will first consider the lowest of these candidate values.

Each candidate value is tested based on whether or not there is less than or equal to 45% of the data below the candidate value. If the candidate value features more than 45% of the data below the candidate value, then it should be rejected. Once the candidate value features less than or equal to 45% of the data below the candidate value, then it should be accepted as the representative background sound level.

3.7. Possible Options for the Identification of SOAELs and LOAELs in Support of the NPSE (2014)

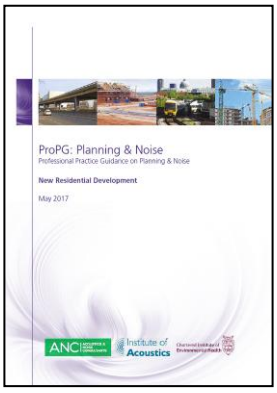


Published by Defra, based on a Research Project prepared by AECOM, *"Possible Options for the Identification of SOAELs and NOAELs in Support of the NPSE"* attempts to give values to the concepts of SOAELs and NOAELs, introduced by the Noise Policy Statement for England (NPSE). After the withdrawal of NPPG24: Planning and Noise in 2012, which included Noise Exposure Categories, with specific numerical boundaries, the NPSE was heavily criticised for having no specific numerical guidance. Whilst the NPSE and NPPF encourage the development of location-specific criteria, in the context of the specific environment, the absence of guidance meant the implementation of the NPSE was difficult. Consequently, the project identifies both specific possible values and possible ranges of values for SOAELs and NOAELs for different noise sources. These values can be seen in **Table 3.3**.

Table 3.3: Possible Value & Ranges of Values for LOAEL & SOAEL

Source	Effect	LOAEL	SOAEL
Road	Annoyance (Daytime)	**56** *(53-59)*	**66** *(64-68)*
	Sleep (Night-time)	**46** *(43-52)*	**56** *(51-64)*
Rail	Annoyance (Daytime)	**63** *(61-66)*	**72** *(70-74)*
	Sleep (Night-time)	**55** *(52-63)*	**68** *(61-77)*
Air	Annoyance (Daytime)	**52** *(50-54)*	**60** *(58-62)*
	Sleep (Night-time)	**41** *(40-49)*	**53** *(47-60)*

3.8. ProPG: Planning & Noise Professional Practice Guidance (2017)



Planning & Noise: Professional Practice Guidance on Planning and Noise: New Residential Development (the "ProPG"), published May 2017, provides a recommended approach for dealing with noise within the planning process, specifically in relation to new residential developments.

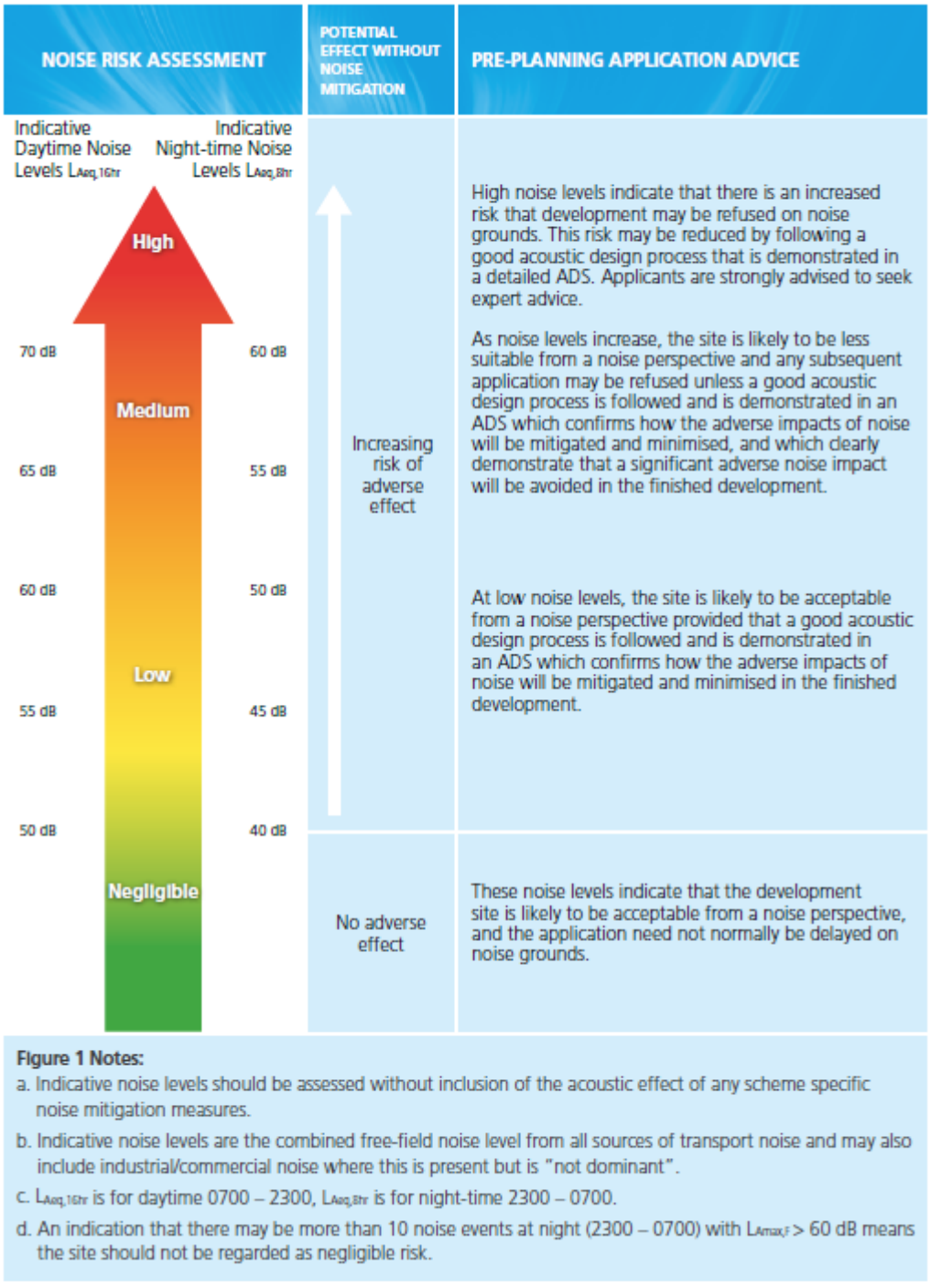
The ProPG follows a systematic, proportionate, risk-based, 2-stage approach. The two stages of the approach are:

- Stage 1 – an initial assessment where external noise is rated against the risk of adverse effect; and
- Stage 2 – a systematic consideration of four key elements to determine the suitability of the site for housing.

The results of the initial Site noise risk assessment will determine the appropriate risk of developing the Site from a noise perspective. This approach is intended to give the developer, the noise practitioner, and the decision maker an indication only of the likely suitability of the site for new residential development from a noise perspective. Thus, a site with a higher risk will be recognised as presenting more acoustic challenges than a site with a low or negligible risk.

Figure 3.1 outlines the initial site risk assessment. Stage 2 of the approach looks to determine whether a site is suitable for housing based on the noise risk of the site. Stage 2 essentially attempts to determine that good acoustic design principles have been incorporated into the design from the outset, that suitable internal noise levels can be achieved in habitable rooms and that suitable external noise levels can be achieved in gardens and outdoor amenity space.

Figure 3.1: Initial Site Risk Assessment (from the ProPG)

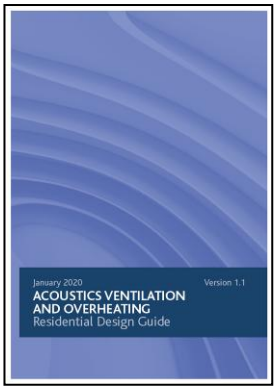


The ProPG encourages good acoustic design for all developments with the aim of protecting future residents from the effects of noise. Para 2.21 of the ProPG notes that in the first instance, it would be necessary to try to achieve suitable internal noise levels with windows open:

"Using fixed unopenable glazing for sound insulation purposes is generally unsatisfactory and should be avoided; occupants generally prefer the ability to have control over the internal environment using openable windows, even if the acoustic conditions would be considered unsatisfactory when open. Solely relying on sound insulation of the building envelope to achieve acceptable acoustic conditions in new residential development, when other methods could reduce the need for this approach, is not regarded as good acoustic design."

However, the ProPG notes that in some instances it is not possible to achieve suitable internal noise levels when windows are open. The notes to Figure 2 of the ProPG note *""designing the site layout and the dwellings so that the internal target levels can be achieved with open windows in as many properties as possible demonstrates good acoustic design. Where it is not possible to meet target internal levels with windows open, internal noise levels can be assessed with windows closed…".* In these instances, one must consider the impacts of ventilation and overheating, with the need to provide a good acoustic environment. The ProPG notes in Para 2.36 that where a *"scheme is reliant on open windows to mitigate overheating, itis also necessary to consider the potential noise impact during the overheating condition. In this case a more detailed assessment of the potential impact on occupants should be provided*".

3.9. Acoustics, Ventilation and Overheating Residential Design Guide (2020)



Published by the Association of Noise Consultants; the *Acoustics, Ventilation and Overheating (AVO) Guide* recommends an approach for acoustic assessments to take due regard of the interdependence of acoustics, ventilation and overheating. The approach ensures that the ventilation strategy of a building becomes an integral part of the acoustic design process.

The AVO Guide notes that *"The starting position when considering mitigation of noise impact on new residential development is to apply good acoustic design, site-wide, as described in the ProPG"*. Since the ProPG advocates the importance of at least attempting to achieve suitable internal noise levels with windows open, the starting point of the AVO Guide is to first see whether windows can be opened; therefore, it is clear that the AVO Guide should be applied after good acoustic design principles have been applied.

The AVO Guide makes it clear that as part of the acoustic design process, one needs to consider both whole house ventilation (which the AVO calls the *"ADF ventilation condition"*) and provisions for ventilation cooling to mitigate overheating (the *"overheating condition"*). The Guide notes that *"In terms of noise effect, the important distinction between these two situations is that the ADF ventilation condition applies for the entire time whereas the overheating condition applies only for part of the time"*.

Regarding the overheating condition, the AVO Guide notes *"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 basis for this is that the overheating condition occurs for only part of the time. During*

this period, occupants may accept a trade-off between acoustic and thermal conditions, given that they have some control over their environment. In other words, occupants may, at their own discretion, be more willing to accept higher short-term noise levels in order to achieve better thermal comfort. The importance of control is relevant to daytime exposure, but not to night time exposure where the consideration is sleep disturbance".

To estimate the potential impact in the overheating condition, a two-stage approach has been taken. The two levels of the approach are:

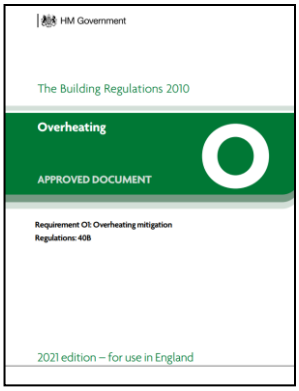
- Level 1 - an initial assessment where external noise is rated against the risk of adverse effect based on the assumption that opening windows are the primary means of mitigating overheating; and
- Level 2 – a systematic consideration of the potential for adverse effect on occupants based on internal ambient noise levels.

A Level 1 assessment looks at the external noise levels to determine whether a partially open window can be used to manage overheating, assuming a 13 dB attenuation for an open window. For *"negligible"* sites, no further action is required and open windows will be sufficient to manage overheating. For *"high"* risk sites, a Level 2 assessment is required. This is also recommended for *"medium"* risk sites. For a Level 2 assessment, the internal noise levels are calculated with windows open to determine the likely impact when windows are open to satisfy the overheating condition. **Table 3.4** summarises the approach and guidance from the AVO Guide. Essentially the guidance is used to determine whether or not windows can or cannot be opened. This guidance should be read in conjunction with Approved Document O of the Building Regulations.

Table 3.4: Initial Site Risk Assessment and Subsequent Guidance in Relation to the Overheating Condition

Daytime $L_{Aeq.16hour}$	Night-time $L_{Aeq.8hour}$	Night-time L_{AFmax}	Level 1 Risk	Level 2 Assessment	Outcome	Openable Windows?
≤ 48 dB(A)	≤ 43 dB(A)	-	***Negligible***	Not Required	*Noise can be heard, but does not cause any change in behaviour or attitude*	Yes
> 48 dB(A) to ≤ 53 dB(A)	> 43 dB(A) to ≤ 48 dB(A)	-	***Low***	Optional	*Limited behavioural change is expected unless conditions are prevalent for most of the time.*	Yes
> 53 dB(A) to ≤ 63 dB(A)	> 48 dB(A) to ≤ 55 dB(A)	Normally Exceeds > 74 dB(A) to ≤ 78 dB(A)	***Medium***	Recommended	*At higher noise levels, more significant behavioural change is expected and may only be considered suitable if occurring for limited periods.*	Yes, Depending on Duration
> 63 dB(A)	> 55 dB(A)	Normally Exceeds 78 dB(A) at night	***High***	Recommended	*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.*	No

3.10. Approved Document O: Overheating (2021)



Approved Document O of the Building Regulations 'Overheating' (AD-O) was released in December 2021 and came into effect in England on 15th June 2022. It aims to protect the health and welfare of occupants of the building by reducing the occurrence of high indoor temperatures

AD-O requires the residential premises to:

- *limit unwanted solar gains in summer; and*
- *provide an adequate means to remove heat from the indoor environment.*

In meeting these requirements:

- *account must be taken of the safety of any occupant, and their reasonable enjoyment of the residence; and*
- *mechanical cooling may only be used where insufficient heat is capable of being removed.*

Whilst this is a standard in relation to the Building Regulations and not planning (i.e. compliance does not need to be demonstrated in order to obtain planning consent), consideration of the amenity of future residents (and therefore the overheating management strategy) is a material planning consideration and consequently it is recommended that AD-O is considered as part of the overall glazing, ventilation and overheating strategy of the development.

AD-O includes two methods for demonstrating compliance – the *"Simplified Method"*, which relies on limiting the glazed area of a room based on the location and orientation of the rooms, as well as whether the dwelling is cross ventilated, and the "*Dynamic Thermal Modelling Method"*. The "*Dynamic Thermal Modelling Method"* should be used for dwellings that do not satisfy the *"Simplified Method"* and relies on detailed modelling of the building and may require additional mechanisms to remove excess heat. These include:

- Opening windows;
- Ventilation louvres in external walls;
- A mechanical ventilation system; and
- A mechanical cooling system.

It is noted in paragraph 3.2 of AD-O that *"In locations where external noise may be an issue (for example, where the local planning authority considered external noise to be an issue at the planning stage), the overheating mitigation strategy should take account of the likelihood that windows will be closed during sleeping hours (11pm to 7am)"*.

It is noted in paragraph 3.3 of AD-O that windows are likely to be closed during sleeping hours if noise within bedrooms exceeds the following limits:

- 40 dB $L_{Aeq,T}$, averaged over 8 hours (between 11pm and 7am); and
- 55 dB L_{AFmax}, more than 10 times per night (between 11pm and 7am).

3.11. Guide to Demonstrating Compliance with the Noise Requirements of Approved Document O (2022)

Guide to Demonstrating Compliance with the Noise Requirements of Approved Document O was published jointly by the Institute of Acoustics and Acoustics and Noise Consultants in July 2022. The guide was compiled to aid acoustic professionals in demonstrating compliance with Approved Document O (AD-O) of the Building Regulations.

As noted above, AD-O provides guidance on when an open window cannot be used to deal with overheating. Whilst AD-O provides internal noise levels, the IOA/ANC Guidance translates this into external noise levels.

Table 3.5 shows the external noise levels above which it will not be possible to use the *"Simplified Method"* to demonstrate compliance with AD-O. The IOA/ANC Guidance notes that *"It may be possible to increase these values and still satisfy the requirements of the simplified method using acoustically specified balconies"*.

The Guidance goes on to note that *"Based on the external noise levels presented in (Table 3.5), it is likely that external noise will be an issue for many sites exposed to only modest levels of noise"*.

Table 3.5: External Noise Levels Above Which The Simplified Method Cannot Be Used

Parameter	High Risk Location[1]	Medium Risk Location[2]
$L_{Aeq,T}$, averaged over 8 hours (between 11pm and 7am)	44 dB	49 dB
L_{AFmax}, more than 10 times per night (between 11pm and 7am)	59 dB	64 dB

Note 1: High Risk Locations have been identified in Appendix C of AD-O as certain postcodes in London and select postcodes in Central Manchester .
Note 2: Medium Risk Locations are all other locations in England not previously identified as High Risk Locations.

If noise levels exceed the levels identified in **Table 3.5**, it will be necessary to use the "*Dynamic Thermal Modelling Method"* to demonstrate compliance with AD-O. It should be noted that exceedances of the above noise thresholds do not necessarily mean that windows cannot be opened or that mechanical ventilation is required. For example, it may be possible to remove adequate heat from the rooms using a combination of smaller openable windows areas (through either smaller openable glazed panels or by fitting window restrictors) and ventilation louvres in external walls. The AVO Guide provides more definitive guidance on when windows can and cannot be opened in relation to noise.

4. ENVIRONMENTAL NOISE SURVEY

4.1. Survey Overview

In order to determine the extent to which the site is affected by noise, a detailed noise measurement study has been carried out on the proposed development site. Noise measurements have been carried out in order to determine the overall $L_{Aeq.16hrs}$ and $L_{Aeq.8hrs}$ for the day and night time periods. In addition, the L_{Amax} L_{A10}, L_{A50}, and L_{A90} noise levels have also been measured.

All noise monitoring was conducted using a Norsonic 140 sound level meter, which conforms to BS EN IEC 61672-1: 2003 as a Class 1 precision measurement system. A Norsonic 1251 field calibrator was used before and after the measurement periods in order to ensure that the equipment had remained within reasonable calibration limits (+/- 0.5 dB).

All of the equipment used has been calibrated in accordance with the procedures set out in BS EN IEC 61672-2: 2003 and for the electrical testing of frequency filters as set out in BS EN IEC 61260. The equipment was calibrated at Campbell Associates Limited, in Great Dunmow, Essex. Campbell Associates Limited meets the laboratory accreditation requirements of the United Kingdom Accreditation Service (UKAS Lab No. 0789). Sound level meters are laboratory calibrated every two years, with field calibrators laboratory calibrated every twelve months. **Appendix 2** summarises the equipment used including serial numbers and calibration certificates.

All noise monitoring has been conducted in accordance with the guidance set out in BS 7445-2: 1991 *'Description and measurement of environmental noise Part 2: Guide to the acquisition of data pertinent to land use*'. This standard details information that should be recorded in addition to the actual measured levels such as meteorological data, and a description of the noise source itself.

The survey was conducted on the 17th and 18th of October 2024. The noise monitoring was conducted by Mathew Vaughan of Hawkins Environmental Limited. Mathew is an Associate Member of the Institute of Acoustics and holds a Masters of Science in Applied Acoustics from Solent University.

Weather conditions were conducive to successful monitoring. **Table 4.1** summarises the weather conditions during the measurement period.

Table 4.1: Summary of Weather Conditions during the Noise Measurements

General Description	The measurement periods were warm for the time of year, with some sunshine during the day with light winds.
Windspeed	Average wind speeds were low, typically less than 0.5 m/s.
Temperature	The temperature went down to around 7°C at night, with daytime temperatures up to 19°C.
Precipitation	The measurement period remained dry.

Noise measurements were conducted from the site boundary alongside the temporary hoarding. The measurement location is considered representative of the worst affected façade of the proposed development. The measurement location is considered to be a free-field position. A map showing the measurement location in relation to the new site layout can be seen in **Figure 4.1**.

Figure 4.1: Noise Measurement Location & Proposed Ground Floor Plan

4.2. Noise Survey Results

The noise measurement study has identified that the primary noise source is road traffic noise attributable to Queen's Road, which passes adjacent to the south-eastern boundary of the development site. Aircraft noise is also occasionally audible.

The noise measurement data is detailed in **Appendix 3** and **Figure 4.2** and summarised in **Table 4.2** below.

Table 4.2: Summary of the Noise Level Measurements

Period (hours)	Measured Noise Level dB			
	$L_{Aeq,T}$	Range $L_{Aeq,5mins}$	Range $L_{Amax,5mins}$	Range $L_{A90,5mins}$
7am to 11pm	57.2	40.9 – 67.2	57.1 – 87.7	36.6 – 54.8
11pm to 7am	49.9	33.1 – 60.7	42.7 – 78.8	30.9 – 42.3

4.3. Background Sound Levels

The background sound levels have been calculated in accordance with BS 4142:2014, which represents the most up-to-date guidance on the subject. Prior to the publication of the 2014 version of BS 4142, acousticians would use the lowest measured background sound levels; however, BS 4142: 2104 provides substantially more guidance on the determination of background sound levels. Section 8.1 of BS 4142: 2014 states that "*for this purpose, the objective is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods. Among other considerations, diurnal patterns can have a major influence on background sound levels and, for example, the middle of the night can be distinctly different (and potentially of lesser importance) compared to the start or end of the night-time period for sleep purposes*". The guidance goes on to say that *"a representative level ought to account for the range of background sound levels and ought not automatically to be assumed to be either the minimum or modal value"*.

In order to determine the background sound levels for the day and night-time periods, the background sound levels have been analysed over the appropriate time periods, i.e. 15 minutes for night-time (11 pm to 7 am) and 1 hour for the daytime periods. **Figure 4.3** and **Figure 4.4** detail the distribution of the background sound levels as described in BS 4142: 2014 for the day and night-time periods respectively.

It can be seen from **Figure 4.3** that during the daytime, the $L_{A90,1hour}$ ranged from 38 to 43 dB(A). It can be seen that less than 45% of the data is below 43 dB(A), which is also the value that features the highest number of occurrences. Therefore, 43 dB(A) is considered to be the representative daytime background sound level.

During the nighttime, **Figure 4.4** shows that the $L_{A90,15mins}$ ranged from 32 to 40 dB(A). 33 dB(A) is the value with the highest number of occurrences with less than 45% of the data below this value. As such, 33 dB(A) is considered to be the representative nighttime background sound level.

Figure 4.2: Noise Measurements

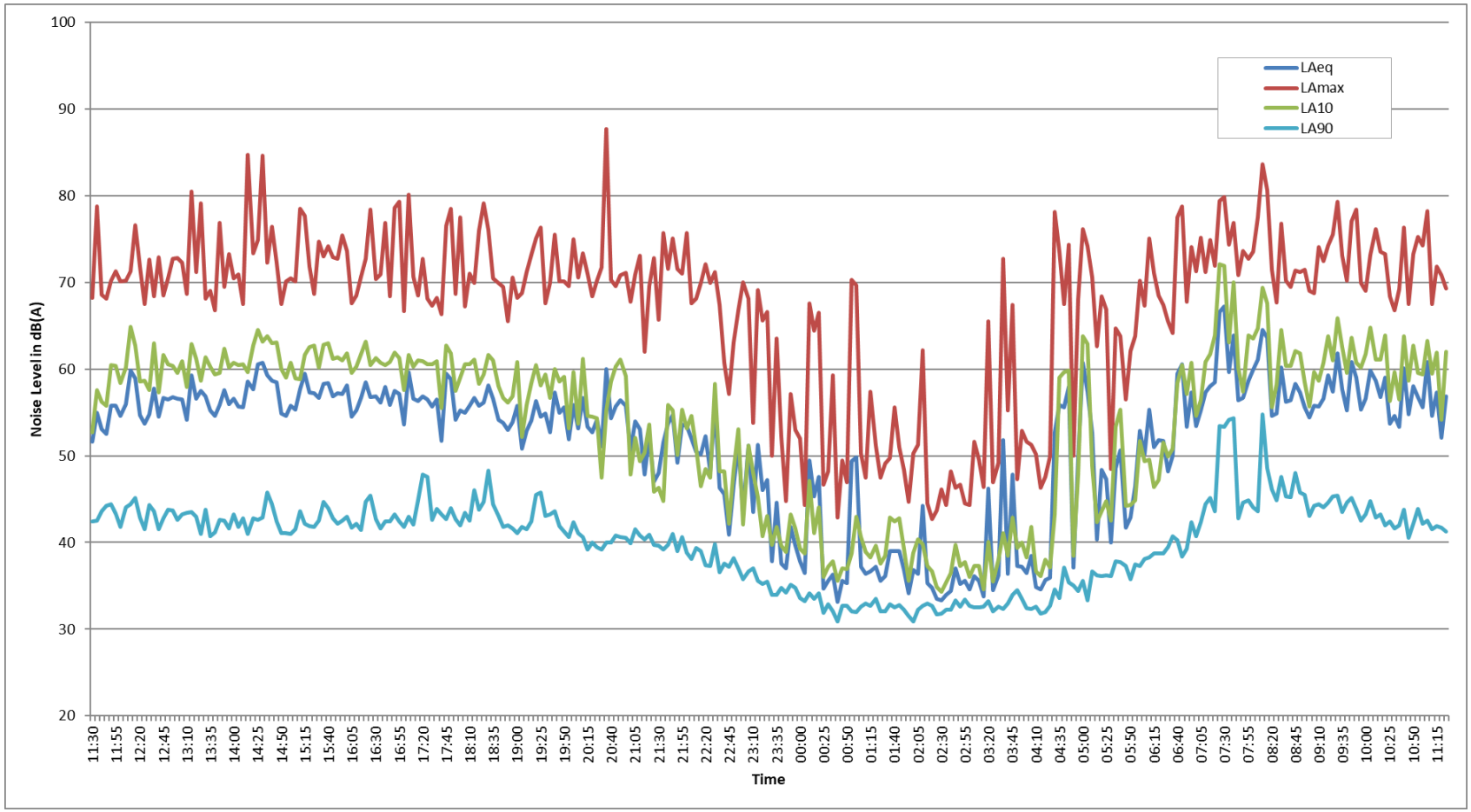


Figure 4.3: Distribution of Day Time $L_{A90.1hour}$ Sound Levels

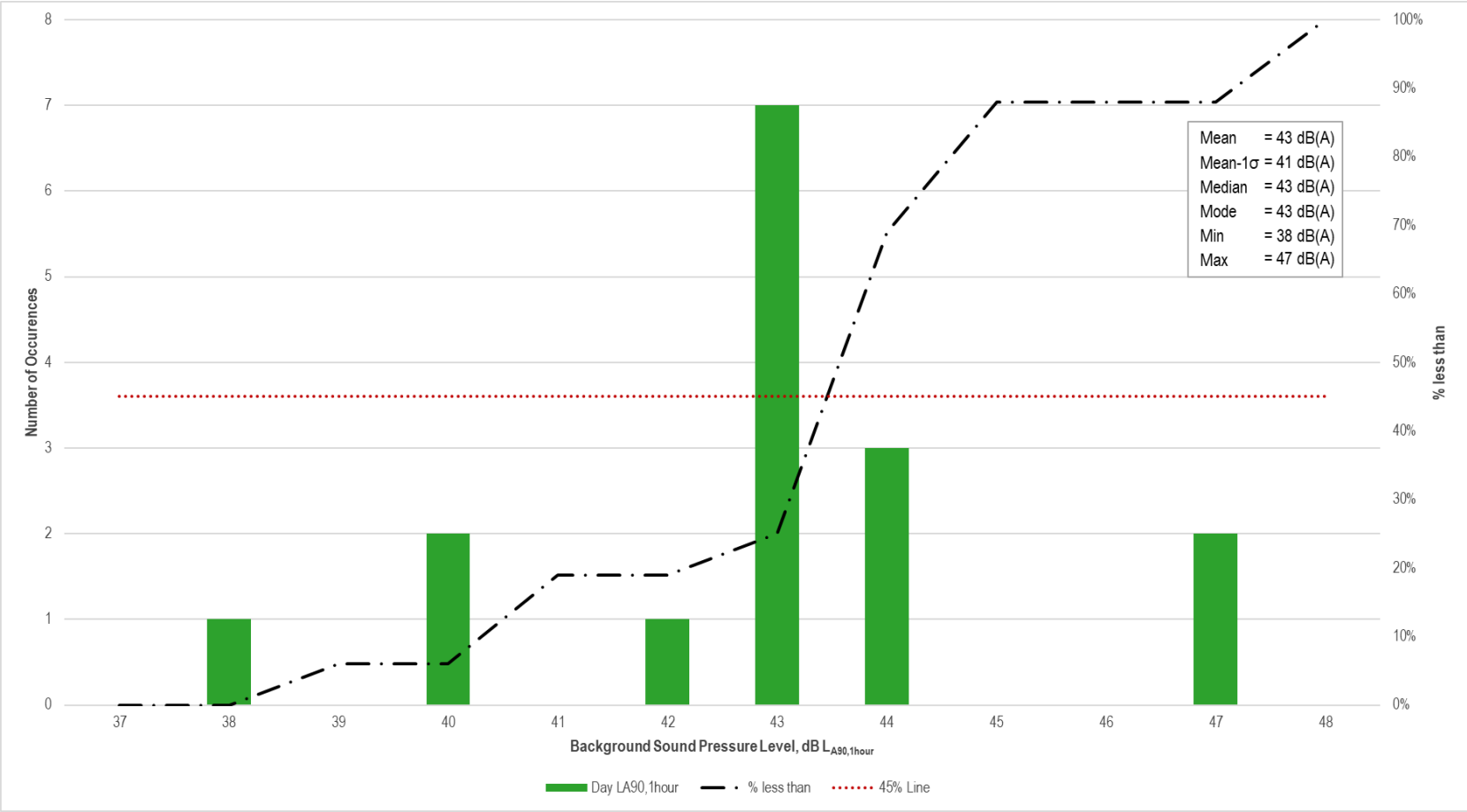
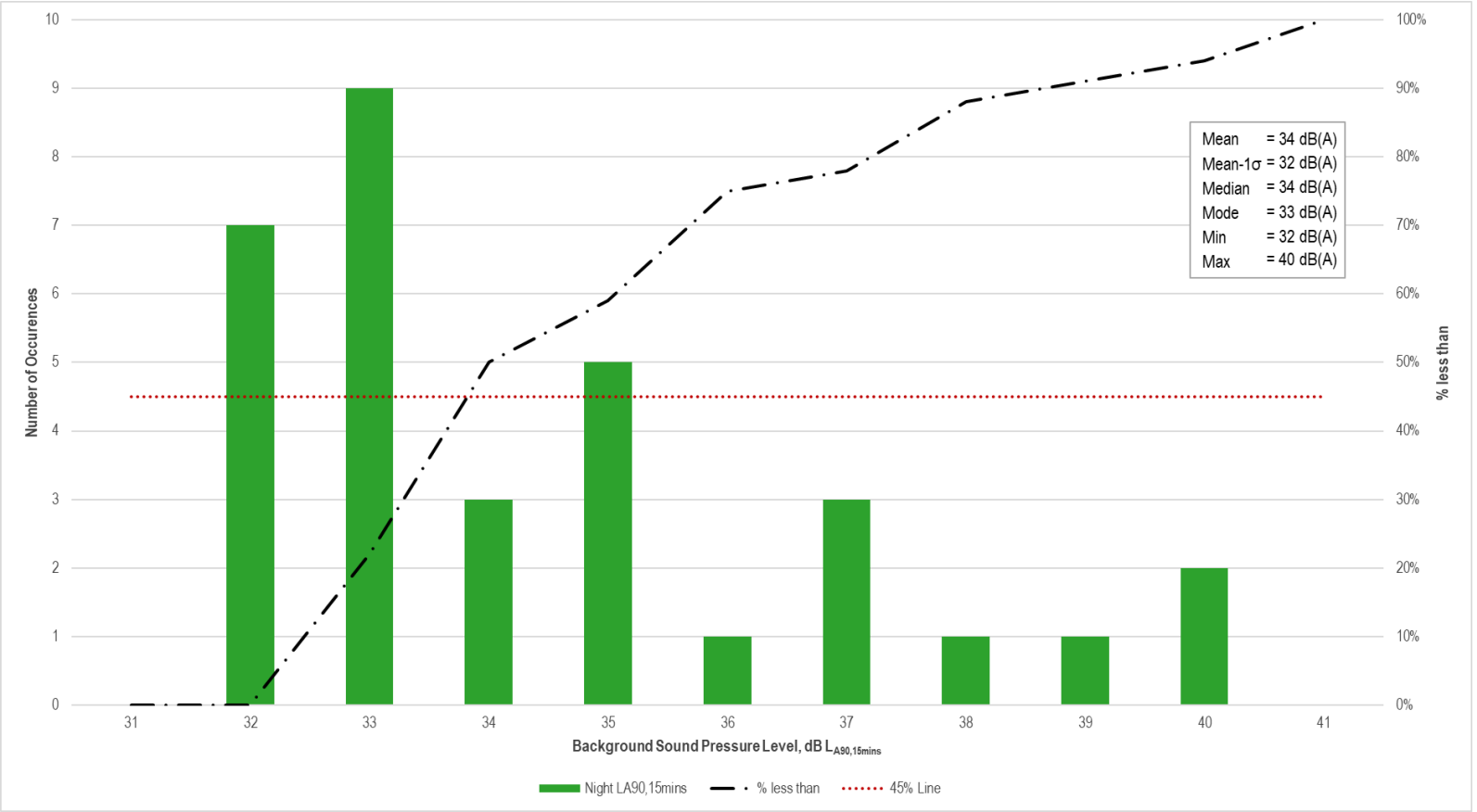


Figure 4.4: Distribution of Night Time $L_{A90.15mins}$ Sound Levels



5. PROPG STAGE 1: INITIAL SITE NOISE RISK ASSESSMENT

5.1. Site Classification - ProPG

The noise measurement survey determined the on-site noise levels. For the purposes of the assessment, the LOAEL and SOAEL levels have been determined from the Defra/AECOM research on LOAEL and SOAEL levels for road traffic sources. The Defra/AECOM research indicates that the typical average LOAEL would be around 56 dB(A) for the onset of daytime annoyance, with the SOAEL around 66 dB(A). For the onset of night time sleep disturbance, the LOAEL would be around 46 dB(A) and the SOAEL around 56 dB(A).

Table 5.1: Initial Site Noise Risk Assessment

Criteria	Daytime $L_{Aeq.16hr}$	Night time $L_{Aeq.8hr}$
Result	57 dB	50 dB
ProPG Noise Risk	Low	Low
Effect Level	Between LOAEL and SOAEL	Between LOAEL and SOAEL
Action	Mitigate and reduce to a minimum	Mitigate and reduce to a minimum

Based on the results shown in **Table 5.1,** the noise risk of the site is "*Low*", with the effect level in excess of the SOAEL. This suggests that there could be an observed effect of noise on the proposed development site and as a consequence, it will be necessary to mitigate and reduce noise for the future residents to a minimum. For a *"Low"* risk site, a Stage 2 assessment with Acoustic Design Statement will still be required, demonstrating a good acoustic design process has been followed, demonstrating how the adverse impacts of noise have been mitigated and minimised.

6. PROPG STAGE 2: ACOUSTIC DESIGN STATEMENT

The Stage 1 Initial Site Risk Assessment has identified that the noise risk is "*Low*" and therefore, a Stage 2 assessment will be required, demonstrating a good acoustic design process has been followed, demonstrating how the adverse impacts of noise have been mitigated and minimised.

6.1. Element #1: Good Acoustic Design Process

Following a good acoustic design process is an implicit part of Government planning and noise policy and it is imperative that acoustic design is considered at an early stage of the development control process.

The ProPG requires the consideration of acoustic design and requires considerations such as checking the feasibility of relocating, or reducing noise levels from, relevant sources; considering options for planning the site or building layout; considering the options for screening buildings or sources; and considering the orientation of proposed buildings. These considerations will then inform how best to deal with excessive noise by either:

- Quietening or removing the source of noise;
- Attenuating the sound on its path to the receiver;
- Obstructing the sound path between the source and receiver; or
- Improving the sound insulation of the building envelope.

The orientation and layout of the proposed development has been designed with noise in mind, in combination with a number of other considerations as required by planning. Alternative approaches to the layout were explored as part of a rigorous design process. The proposed scheme has been designed to deliver high quality accommodation that appropriately considers functionality, amenity, privacy, daylight and outlook as well as the ability to obstruct the sound path from external sources. Therefore, the optimum layout has been achieved in terms of acoustic design.

6.2. Element #2: Internal Noise Levels

6.2.1. Criteria

The Initial Site Risk Assessment and good acoustic design process indicates that the sound insulation of the building envelope requires improvement and noise does need to be taken into account in the design of the building in order to meet the internal noise criteria contained within BS 8233 and the ProPG, and to comply with the guidance contained within the NPPF.

The appropriate design noise levels at this site are those identified in **Table 6.1** below.

Table 6.1: Summary of Noise Criteria: BS8233:2014 and ProPG

Activity	Location	07:00 to 23:00	23:00 to 0700
Resting	Living room	35 dB $L_{Aeq.16hour}$	-
Dining	Dining room/area	40 dB $L_{Aeq.16hour}$	-

Activity	Location	07:00 to 23:00	23:00 to 0700
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq.16hour}$	30 dB $L_{Aeq.8hour}$ 45 dB L_{Amax} NOTE

Note: For a reasonable standard in noise-sensitive rooms at night (e.g. bedrooms) individual noise events should not normally exceed 45dB L_{Amax} more than 10 times a night.

Annex G of BS 8233 provides a rigorous calculation method for determining the internal noise levels within a proposed development.

6.2.2. Glazing Specification

The Sound Reduction Index (R_w sometimes noted as SRI) is the level of sound attenuation afforded by a particular material. It is possible to calculate the R_w of a particular facade to determine the internal noise level based on the noise survey results. It is widely known that a masonry wall will have a R_w of at least 50 dB. sometimes as high as 55 to 60 dB. The R_w of individual glazing solutions will vary considerably. However, BS 8233 notes that good quality insulating double glazed window units will typically have an R_w of 33 dB.

Using the equation in Annex G of BS 8233, it is possible to calculate the internal noise levels based on typical construction details. However, Annex G first suggests conducting simple calculations, to determine whether more detailed calculations are required.

The simple calculation procedure in Annex G notes that:

"The windows, and any trickle ventilators, are normally the weakest part of a brick and block facade. Insulating glass units have an insulation of approximately 33 dB R_w… assuming suitable sound attenuating trickle ventilators are used…". Consequently, it is possible to arithmetically subtract 33 dB from the external (freefield) noise levels to determine internal noise levels. The results of these calculations can be seen in **Table 6.2** below.

Table 6.2: The Simple Calculation Procedure from Annex G of BS 8233: 2014

Criteria	Daytime $L_{Aeq.16hr}$	Night time $L_{Aeq.8hr}$
External (freefield)	57 dB	50 dB
Criteria	35 dB	30 dB
Internal Noise Level (assuming R_w of 33)	24 dB	17 dB
Comparison to Criteria	-9 dB	-13 dB
Action	*More detailed calculation will not be required. Suitable internal noise levels can be achieved with a standard double glazed window system with a R_w of 33.*	

The above approximation includes a certain margin of error, since the R_w is based on insulation values relating to a pink noise spectrum - actual values achieved are lower for traffic noise. In addition, the above simple calculations do not take account of absorption, such as furnishings in the room. Consequently, the above is only a rough calculation which could underestimate noise levels by as much as 5 dB. Therefore, more detailed calculations may be required if the predicted internal noise levels higher are than 30 dB daytime and 25 dB night-time.

The results of the calculations in **Table 6.2** show that the internal noise levels will be more than 5 dB lower than the criteria; consequently, suitable internal noise levels can be achieved with standard double-glazed windows, which would typically have an R_w of 33 dB.

It should be noted that the acoustic performance of the façade is dependent upon the relative performance of each element. For example, it may be possible to have a lower acoustic rated glazing system if the acoustic performance of the ventilation system is improved. Similarly, it may be necessary to have an improved glazing and ventilation package, if the walls of the proposed development are not typical brick and blockwork. It is also important to note that acoustic performance is frequency dependent and other window specifications may be suitable providing that they perform well in the frequencies pertinent to the noise levels measured at this particular site.

The R_w is the rating sound insulation of a building element. BS 8233: 2014 notes that *"these single-figure ratings are generally good predictors of subjective assessments of insulation of similar constructions. However, this is not always the case for different constructions, for example the low-frequency performance of a lightweight partition might be significantly different from that of a masonry partition with the same single-number rating, so it is prudent to examine the full measurement data in critical situations"*. One way that can be used to check for variations in frequency performance is to consider the C_{tr} correction quoted for glazing. The $R_w + C_{tr}$ is the dB insulation value against a standardised road traffic noise spectrum. For example, where a window is quoted as R_w (C_{tr}) = 33 (-3), this will perform better in the frequencies pertinent to traffic noise, when compared to a window quoted R_w (C_{tr}) = 33 (-7), despite the same R_w.

As a consequence of the above, it is always strongly recommended that any glazing solution is tested within the parameters of BS 8233: 2014, using full octave band data to determine suitability.

6.2.3. Ventilation, Overheating & the Opening of Windows

The ProPG notes that in the first instance, it would be necessary to try to achieve suitable internal noise levels with windows open. However, the ProPG notes that in some instances it is not possible to achieve suitable internal noise levels when windows are open.

The ProPG recommends a conservative estimate of 13 dB attenuation for a partially opened window. **Table 6.3** determines the internal noise levels with windows open. **Table 6.3** notes that suitable internal noise levels cannot be achieved within windows open. Therefore, one must consider the impacts of ventilation and overheating, with the need to provide a good acoustic environment.

Table 6.3: Internal Noise Levels Assuming a Partially Opened Window

Criteria	Daytime $L_{Aeq.16hr}$	Night time $L_{Aeq.8hr}$
External (freefield)	57 dB	50 dB
Criteria	35 dB	30 dB
Internal Noise Level Assuming a Partially Opened Window	44 dB	37 dB

The AVO Guide makes it clear that one needs to consider both whole house ventilation (which the AVO calls the *"ADF ventilation condition"*) and provisions for ventilation cooling to mitigate overheating (the *"overheating condition"*). The Guide notes that *"In terms of noise effect, the important distinction between these two situations is that the ADF ventilation condition applies for the entire time whereas the overheating condition applies only for part of the time"*.

The site cannot rely on the windows being opened for ventilation. Therefore, an alternative source of ventilation is required. The AVO Guide provides comprehensive guidance in relation to appropriate ventilation strategies.

It should be noted that if it is proposed to install trickle vents or any other acoustic ventilator that connects directly through the wall or window, it will be necessary to ensure that the acoustic performance of the ventilator is appropriate for the location. The performance of the acoustic ventilator will be presented as a $D_{n,e,w}$ rating, which is not directly comparable to a R_w rating used for windows. The $D_{n,e,w}$ is the weighted average composite loss of a typical wall with the vent installed; therefore, the R_w of the vent on its own will be less. Therefore, when selecting a vent, the $D_{n,e,w}$ value needs to be higher than the minimum R_w needed for the window, otherwise the this could lessen the sound reduction performance of the window. As a rough guide, the R_w is generally between 5 and 10 dB lower than the equivalent $D_{n,e,w}$ and it is therefore recommended that the $D_{n,e,w}$ of the vent is at least 7 dB higher than the R_w recommended for the window. For example, if a R_w of 30 dB is recommended for the window, the $D_{n,e,w}$ of the vent should be at least 37 dB.

With regards to overheating, the AVO Guide has determined that the site is a *"Medium"* risk site based on the criteria contained within **Table 3.4** of this report and the measured noise levels.

For a *"Medium"* risk site, windows can be opened to deal with overheating. However, the duration that the windows are expected to be opened is a factor when considering whether it is acceptable to rely on openable windows to deal with overheating. The guidance indicates that if the windows were *"rarely"* opened to deal with overheating, for example during the hottest nights of the year, this would be considered acceptable. However, if the windows were opened *"most of the time"* to deal with overheating, for example continuously from the end of May to the end of September, this may be considered unacceptable.

6.2.4. Consideration of Approved Document O of the Building Regulations

Under the guidance contained within Appendix C of AD-O, the site is located within a *"Medium Risk Location"*. It can be seen that the measured onsite noise levels are in excess of the maximum recommended levels displayed in **Table 3.5** pertinent to the Risk Location.

As the noise levels exceed the levels identified in **Table 3.5**, it will be necessary to use the "*Dynamic Thermal Modelling Method"* to demonstrate compliance with AD-O. It should be noted that exceedances of the above noise thresholds do not necessarily mean that windows cannot be opened or that mechanical ventilation is required. For example, it may be possible to remove adequate heat from the rooms using a combination of smaller openable windows areas (through either smaller openable glazed panels or by fitting window restrictors) and ventilation louvres in external walls. It should be noted that consideration of AD-O is only in relation to night time noise in bedrooms.

6.2.5. Variation Across the Development Site

Section 6.2.2 and **Section 6.2.3** of this report outline the glazing, ventilation and overheating requirements for the front of the site facing Queen's Road, where the measurements were undertaken. This is considered to be the worst affected façade. However, accommodation to the rear of the development, without a direct view of Queen's Road, is likely to benefit from lower noise levels.

Regarding glazing requirements, **Section 6.2.2** of this report notes that standard double glazed windows will be adequate on the front façade; as noise levels will be lower to the rear, it is possible to conclude that standard double glazed windows will be also be suitable for windows without a direct view of Queen's Road.

Regarding overheating and whether windows can be opened, **Section 6.2.3** notes that the noise levels would result in a *"medium"* risk under the AVO Guide. Whilst noise levels to the rear may be quieter, it is possible that the levels of noise may continue to result in a *"medium"* risk under the AVO Guide, and therefore, the opening of windows where internal noise levels exceed the recommended levels within BS 8233 may be acceptable to address overheating, depending on the duration that windows need to be opened.

6.3. Element #3: External Amenity Areas

BS 8233 provides guidance for noise in gardens and outdoor amenity space. It suggests that *"it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments."* The guidance does go on to say that these guideline values are not achievable in all circumstances and in some 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."*

At the development site, the $L_{Aeq.16hours}$ was measured to be 57 dB(A), which is greater than the *"upper guideline value"* of 55 dB(A). However the site layout with the communal and majority of external amenity space to the rear of the building with screening provided by the building itself, this is likely to result in external noise levels that are significantly less than the *"upper guideline value"* of 55 dB(A) within the external amenity space. Attenuation as a result of distance from Queen's Road, and barrier attenuation of the building.

6.4. Element #4: Other Relevant Issues

Good acoustic design principles which have been followed mean that the proposed development is in general compliance of the ProPG.

The proposed façade sound insulation performances mean that internal noise levels when windows are closed will be in line with ProPG internal noise criteria. When windows are open, for example to manage overheating, internal noise.

6.5. Recommendations to the Decision Maker

Since the internal and external noise criteria contained within BS 8233 and the ProPG guidance framework can be achieved and a reasonable level of acoustic design has been demonstrated, it is recommended to the decision maker that planning consent may be granted, subject to the inclusion of suitable noise conditions, to ensure suitable internal and external noise levels.

7. PLANT NOISE LIMITS

At this stage in the design process, the noise output of specific items of plant has yet to be determined; therefore it is not possible to provide a full and detailed assessment of the likely impact of plant noise. As a consequence, environmental noise limits for plant associated with the development should be set to protect the amenity of nearby noise sensitive premises, as well as future residents of the development itself in accordance with BS 4142: 2014 *'Methods for rating and assessing industrial and commercial sound'.*

Prior to the publication of the 2014 version of BS 4142, acousticians would use the lowest measured background noise levels; however, BS 4142: 2014 provides substantially more guidance on the determination of background noise levels. Section 8.1 of BS 4142: 2014 states that *"for this purpose, the objective is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods. Among other considerations, diurnal patterns can have a major influence on background sound levels and, for example, the middle of the night can be distinctly different (and potentially of lesser importance) compared to the start or end of the night-time period for sleep purposes"*. The guidance goes on to say that *"a representative level ought to account for the range of background sound levels and ought not automatically to be assumed to be either the minimum or modal value"*.

The background noise levels have been determined to be 43 dB and 33 dB during the day and night respectively. To ensure that an adverse impact as a consequence of plant noise is unlikely, it recommended that the Rating noise level from the plant is below background noise level, i.e. the Rating noise level should be no more than 43 dB(A) during the day and 33 dB(A) during the night at the closest residential property. The Rating noise level is the predicted cumulative noise level from all plant at the receptor location and should include penalties for tonality, impulsivity and/or intermittency if appropriate. The lower the Rating level 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.

8. CONSTRUCTION NOISE

Due to the size of the development and early outline stage of the proposals, a quantitative construction noise and vibration assessment has not been carried out. Instead, a qualitative assessment focussing on best practicable means has been completed. In general, the construction works with the greatest potential to generate noise are initial earthworks to level out the site, demolition and the piling of foundations. Building construction itself generally results in lower noise levels.

It is proposed that to minimise construction noise impacts, all construction work should take place in standard construction hours, which are:

Monday – Friday: 08:00 – 18:00

Saturdays: 08:00 - 13:00; and

Sundays and Public Holidays: No construction

It is recommended that the contractor would be required to follow Best Practicable Means to reduce the noise impact upon the local community including the following:

- Operating hours should be adhered to, with local residents being notified of any changes to the operating hours of the site;
- All construction plant and equipment should comply with EU noise emission limits;
- Where practicable, design and use of site hoardings and screens to provide acoustic screening of noise emitting equipment;
- Proper use of plant with respect to minimising noise emissions and regular maintenance. All vehicles and mechanical plant used for the purpose of the works should be fitted with effective exhaust silencers and should be maintained in good efficient working order;
- Selection of inherently quiet plant where appropriate. All major compressors should be 'sound reduced' models fitted with properly lined and sealed acoustic covers which should be kept closed whenever the machines are in use and all ancillary pneumatic percussive tools should be fitted with mufflers or silencers of the type recommended by the manufacturers;
- Machines in intermittent use should be shut down in the intervening periods between work or throttled down to a minimum;
- Plant and equipment such as flatbed lorries, skips and chutes should be lined with noise attenuating materials. Materials should be handled with care and be placed, not dropped. Materials should be delivered during normal working hours.
- All ancillary plant such as generators, compressors and pumps should be positioned so as to cause minimum noise disturbance, i.e. furthest from receptors or behind close boarded noise barriers. If necessary, acoustic enclosures should be provided and/or acoustic shielding;

- Making positive contact with local residents and providing information on the construction can be the most effective method of reducing the impact of construction noise on sensitive receptors. If appropriate, the above measures can be incorporated into a construction environmental management plan;
- Construction contractors should be obliged to adhere to the codes of practice for construction working given in BS 5228 and the guidance given therein regarding minimising noise emissions from the site; and
- Reference should be made to the Building Research Establishment, BRE 'Pollution Control' guidelines, Parts 1-57.Noise Monitoring.

9. OVERALL CONCLUSIONS AND RECOMMENDATIONS

A detailed noise measurement study has been carried out at the site in order to determine whether as a result of noise, there are any significant constraints on developing the site for residential purposes.

The study has shown that due to noise from surrounding roads and the wider environment, the site is considered a *"low risk"* site under the Pro-PG, with noise levels between the Lowest Observed Adverse Effect Level (LOAEL) and the Significant Observed Adverse Effect Level (SOAEL); therefore, if the site is to come forward for residential development, noise must be considered and it must be mitigated and reduced to a minimum.

Using the guidance and calculation methods contained within BS 8233: 2014 '*Guidance on sound insulation and noise reduction for buildings',* it has been shown that the recommended maximum internal noise levels for each room use under BS 8233 can be achieved through the provision of suitable glazing and ventilation. A summary of the recommendations can be seen in **Table 9.1** below.

Table 9.1: Summary of Recommendations to Achieve Suitable Internal Noise Levels

	All facades	
	Bedrooms	Living Rooms
Minimum Sound Reduction of the Glazing in Relation to Noise	Standard doubling glazing, which would typically have a R_w of 33 dB or more	
Ventilation Recommendations in Relation to Noise	Based on the onsite noise level, any ventilation system should be appropriate.	
Overheating Recommendations in Relation to Noise	Based on the onsite noise levels, windows can be opened to deal with overheating, depending on duration.	

Since the internal noise criteria contained within BS 8233 and the ProPG guidance framework can be achieved and a reasonable level of acoustic design has been demonstrated, it is recommended to the decision maker that planning consent may be granted, subject to the inclusion of suitable noise conditions, to ensure suitable internal and external noise levels. Similarly, plant noise limits can be secured by a suitably worded condition, and construction impacts can be controlled via a CEMP which can also be secured by a suitably worded pre-commencement condition.

Since it has been shown that the proposed development meets the guidance contained within BS 8233: 2014, it is considered that the proposed development complies with Paragraph 185 of the National Planning Policy Framework since the new development will not be *"put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution".* Since it has been shown that in terms of noise, the proposals adhere to local and national planning policy, it is considered that the noise environment of the site should not be a constraint on the proposed residential development.

Appendix 1
Glossary of Acoustic Terms

Appendix 1: Glossary of Acoustic Terms

Decibel (dB)	This is a tenth (deci) of a bel. Decibel can be a measure of the magnitude of sound, changes in sound level and a measure of sound insulation. Decibels are not an absolute unit of measurement but are an expression of the ratio between two quantities expressed in logarithmic form.
dB(A)	A-weighted decibels, i.e. decibel level incorporating a frequency weighting (A-weighting), which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB(A) broadly agree with people's assessment of loudness.
Freefield	A situation in which the radiation from a sound source is completely unaffected by the presence of any reflecting boundaries.
Hertz (Hz)	Unit of frequency, equal to one cycle per second. The frequency of sound waves refers to the number of pressure fluctuations per second. Frequency is related to the pitch of a sound.
$L_{Aeq,T}$	The equivalent steady sound level in dB(A) containing the same acoustic energy as the actual fluctuating sound level over the given period, T. For example, daytime noise is generally measured over a 16 hour period, so T is 16 hours. $L_{Aeq,T}$ can be measured directly with an integrating sound level meter.
L_{A10}	The 'A'-weighted sound pressure level of the residual noise in decibels exceeded for 10 percent of a given time and is the $L_{A10.T}$. The L_{A10} is used to describe the levels of road traffic noise at a particular location.
L_{A50}	The 'A'-weighted sound pressure level of the residual noise in decibels exceeded for 50 percent of a given time and is the $L_{A50.T}$.
L_{A90}	The 'A'-weighted sound pressure level of the residual noise in decibels exceeded for 90 percent of a given time and is the $L_{A90.T}$. The L_{A90} is used to describe the background noise levels at a particular location.
L_{Amax}	The 'A'-weighted maximum sound pressure level measured over a measurement period.
R_w (or SRI)	The weighted sound reduction index as a single number laboratory measured rating used to describe the sound insulation of building elements.

Appendix 2
Schedule of Equipment

Appendix 2: Schedule of Equipment

Hawkins Noise Kit 3 - Equipment Set 2918:

Equipment Type	Manufacturer	Serial Number	Calibration Certification Number	Calibration Type	Date of Last Calibration Check	Date of Next Calibration Check
Nor-140 Type 1 Sound Level Meter	Norsonic	1402918	U47824	UKAS Calibration: 0789	16th May 2024	May 2026
Nor-1211-C Weather protected measurement microphone	Norsonic	8706	48196	Traceable Calibration – Campbell Associates	26th June 2024	June 2026
Nor-1251 Sound Calibrator	Norsonic	31233	U47822	UKAS Calibration: 0789	16th May 2024	May 2025
Nor1408A/10 Extension Cable	Norsonic/Lemo	Not Applicable				

Laboratory Location
Campbell Associates Ltd
5b Chelmsford Road Industrial Estate
GREAT DUNMOW, Essex, GB-CM6 1HD
Phone 01371 871030

0789

Certificate of Calibration

Certificate number: **U47824**

Test Object: **Sound Level Meter, BS EN IEC 61672-1:2003 Class 1**

Producer: **Norsonic AS.**
Type: **140**
Serial number: **1402918**
Customer: **Hawkins Environmental Ltd**
Address: **The Square, Basing View, Basingstoke, Hampshire. RG21 4EB.**
Contact Person: **Nick Hawkins**
Order No: **PO-0376**

Introduction:
Calibration has been performed as set out in CA Technical Procedures which are based on the procedures for periodic verification of sound level meters as per the **Test Object** listed above. Results and conformance statement are overleaf and detailed results, where appropriate, are provided in the attached Measurement Report.

Tested:	*Producer*	*Type*	*Serial No*	*Certificate No*
Microphone	CEL	192/2F	28241	U47823
Calibrator*	Norsonic	1251	31233	U47822
Preamplifier	Norsonic	1209	12207	Included

* The calibrator was complete with any required coupler for the microphone specified.

Additional items that have also been submitted for verification:

Wind shield	Norsonic	Nor1451 (ø 60mm)
Attenuator	N/A	
Extension cable	N/A	

These items have been taken into account wherever appropriate.

Instruction Manual: Im140_1Ed8R0En Firmware Version: v2.1.670 The test object is a single channel instrument.

Conditions	*Pressure kPa*	*Temperature °C*	*Humidity %RH*
Reference conditions	101.325	23	50
Measurement conditions	99.89 ±0.01	23.05 ±0.85	55.25 ±2.55

Calibration Dates:

Received date:	10/05/2024	Reviewed date:	16/05/2024
Calibration date:	16/05/2024	Issued date:	16/05/2024

Technicians: (Electronic certificate)

Calibrated by: *Martyna Silva*

Reviewed by: *Jenny Crawford*

Doc ref: Slm-Cert-Master-V3-07

Certificate of Calibration

Continuation of Certificate number: **U47824**

The statements of conformance and observation notes detailed in this certificate are made with reference to the following standards in respect of the calibration of the test object.

Manufactured:	**BS EN IEC 61672-1:2003**
Periodic Tests:	**BS EN IEC 61672-3:2006**
Pattern Evaluation:	**Not Applicable**

Conformance:
From markings on the sound level meter or by reference to the manufacturer's published literature it has been determined that the instrument submitted for verification was originally manufactured to the listed standard and similarly that the associated sound calibrator conforms to the BS EN IEC 60942 standard.

Measurement Summary:

Indication at the calibration check frequency - IEC61672-3 Ed.1 #9	Passed
Self-generated noise - IEC 61672-3 Ed.1 #10.2	Passed
Acoustical signal tests of a frequency weighting - IEC 61672-3 Ed.1 #11	Passed
Electrical signal tests of frequency weightings - IEC 61672-3 Ed.1 #12	Passed
Frequency weightings: A Network - IEC 61672-3 Ed.1 #12.3	Passed
Frequency weightings: C Network - IEC 61672-3 Ed.1 #12.3	Passed
Frequency weightings: Z Network - IEC 61672-3 Ed.1 #12.3	Passed
Frequency and time weightings at 1 kHz IEC 61672-3 Ed.1 #13	Passed
Level linearity on the reference level range - IEC 61672-3 Ed.1 #14	Passed
Toneburst response - IEC 61672-3 Ed.1 #16	Passed
Peak C sound level - IEC 61672-3 Ed.1 #17	Passed
Overload indication - IEC 61672-3 Ed.1 #18	Passed

Comments
Correct level with associated calibrator is 113.9dB(A).

Statement of Conformance
The sound level meter submitted for testing has successfully completed the periodic tests for the environmental conditions under which the tests were performed. However, no general statement of conclusion can be made about conformance of the sound level meter to the full requirements of the manufactured standard because evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in the manufacturer's standard and because the periodic tests completed cover only a limited subset of the specifications in the relevant standard

Observations
The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k = 2, providing a coverage probability of approximately 95 %. The uncertainty evaluation has been carried out in accordance with UKAS requirements. Details of the uncertainty for each measurement are available from the Calibration Laboratory upon request. Details of the sources of corrections and their associated uncertainties that relate to this verification are contained within the test report accompanying this certificate.

Decision Rule
Basic Meter Function - The decision rules will be applied in accordance with the procedure as described in BS EN 61672-3:2006.

This certificate relates only to the items tested above.

** End of Certificate **

Certificate of Conformance

Laboratory Location

Campbell Associates Ltd
5b Chelmsford Road Industrial Estate
GREAT DUNMOW, Essex, GB-CM6 1HD
Phone 01371 871030

CALIBRATION

Certificate Number	48196
Date of verification	June 26, 2024

Weather protected measurement microphone

Manufacturer	Norsonic
Type	1211
Variant	C
Serial number	8706

Issued to

Hawkins Environmental Ltd
70 Wentworth Crescent
Basingstoke

Hampshire RG22 4WX

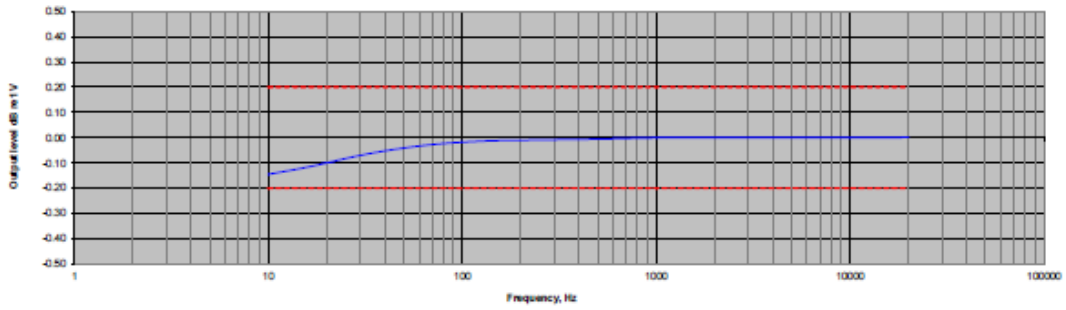
These weather protected measurement microphones comprise a microphone capsule and an associated preamplifier, the types and serial numbers fitted to this unit are noted below. Each of these elements have been tested separately and then the overall acoustic performance of the system verified.
Calibration Report & Certificate Number 48195 for the microphone are attached and form part of this certificate.

Microphone type	GRAS-40AS	Serial number	9466	Sensitivity	-27.63 dB
Preamplifier type	NOR-1201	Serial number	23667		

Comments: Electrical self noise and acoustic tests carried out using Nor-140.1406335.

Preamplifier conformance
Relative gain test. An input signal was connected via a 18pF line input adaptor. The signal source was a Stanfor Research DS360 Signal Synthesizer serial number 88732 and the output levels were read on an Agilent (HP) 34401. Precision Digital Voltmeter serial number MY41015704. Power supplies for the preamplifier were supplied by a Norsoni Nor-483B SMS unit serial number 31072. Valid traceable calibration certificates are held for all this equipment. Verificatio was performed to the procedure TP 08. The relative gain with frequency of the preamplifier is given in the graph below wit the absolute gain at 1kHz given in the table.

Relative gain at 1V input



Continued overleaf ....

Absolute gain at 1k Hz

Absolute gain test		
Frequency	Gain	Result
Hz	dB	
1k	-0.24	Pass

Electrical self noise tests

Self noise in dB, at -26dB re 1V/Pa with 18pF load		Result
dB(A)	9.5	Pass
dB(C)	13.4	Pass

Acoustic tests

The weather protected measurement microphone was coupled to the Reference Calibrator Nor-1253 serial number 27765 using the supplied coupler Gras-RA0010 s/n 599 and the correct SPL was set on the laboratory analyser. The acoustic cover was then placed over the microphone and the acoustic noise floor checked and the level expressed in dB(A).

The system was then calibrated with Nor-1251 serial number 30873 and the insertion loss of the coupler determined.

Acoustic coupler Gras-RA0010 serial number 599

Acoustic tests	Reference	Measured	Result
	dB	dB	
Acoustic calibration @ 250 Hz	124	124.0	Pass

Acoustic noise floor	Lab ambient	Measured	Result
	dB	dB	
A weighting	35.9	17.2	Pass

Acoustic coupler verification with 1kHz test calibrator	Nominal Level	Measured	k factor
	dB	dB	
	124	114.7	0.71

When using the specified acoustic coupler with the test calibrator given above the correct calibration level for this weather protected measurement microphone is given below.

Calibration level = Calibrator nominal level + Coupler k factor
113.99 + 0.71
= 114.7 dB

The correct reference angle for this measurement microphone is 90 degrees, when mounted vertically it is correct for measurement of sources co-planar to the horizon.

Environmental conditions at time of tests
Temperature 23.9 °C Humidity 50.3 % RH Pressure 1004.91 mBar

These test indicate that the subject device complies with the requirements of the manufacturer's specification at the time of its manufacture. Repeat verification is recommended within 24 months

Technician: (Electronic certificate)

Verification performed by: *Martyna Silva* Date of verification: 26 June 2024

Certificate Number: 48196

Laboratory Location
Campbell Associates Ltd
5b Chelmsford Road Industrial Estate
GREAT DUNMOW, Essex, GB-CM6 1HD
Phone 01371 871030

0789

Certificate of Calibration

Certificate number: **U47822**

Test Object: **Sound Calibrator**

Producer: **Norsonic AS.**
Type: **1251**
Serial number: **31233**
Customer: **Hawkins Environmental Ltd**
Address: **The Square, Basing View, Basingstoke, Hampshire. RG21 4EB.**
Contact Person: **Nick Hawkins**
Order No: **PO-0376**

Measurement Results	Level dB	Level Stability dB	Frequency Hz	Distortion %
Measurement 1	114.10	0.05	1000.56	0.43
Measurement 2	114.09	0.04	1000.57	0.43
Measurement 3	114.09	0.05	1000.57	0.44
Result (Average):	**114.09**	**0.05**	**1000.56**	**0.43**
Expanded Uncertainty:	0.1	0.02	1	0.1
Degree of Freedom:	>100	>100	>100	>100
Coverage Factor:	2	2	2	2

The stated level is relative to 20µPa. The level is traceable to National Standards. The stated level is valid at reference conditions. The following correction factors have been applied during the measurement
Pres:0.0005 dB/kPa Temp:0.003 dB/°C Humi:0 dB/%RH Load volume: 0.0003 dB/mm3

Conditions	*Pressure kPa*	*Temperature °C*	*Humidity %RH*
Reference conditions	101.325	23	50
Measurement conditions	99.88 ±0.040	21.4 ±0.1	59.3 ±0.7

The reported expanded uncertainty of measurements is based on a standard uncertainty multiplied by the coverage factor of k=2, providing a level of confidence of approximately 95%. Where the degrees of freedom are insufficient to maintain this confidence level, the coverage factor is increased to maintain this confidence level. The uncertainty has been determined in accordance with UKAS requirements.

Records: K:\C A\Calibration\Nor-1504\Nor-1018 CalCal\Current Year\NOR1251_31233_M1.nmf

Preconditioning
The equipment was preconditioned for more than 4 hours in the specified calibration environment.

Method
Calibration has been performed as set out in the current version of CA Technical procedure TP01

Calibration Dates:

Received date:	10/05/2024	Reviewed date:	16/05/2024
Calibration date:	16/05/2024	Issued date:	16/05/2024

Technicians: (Electronic certificate)
Calibrated by: *Palanivel Marappan B.Eng(Hons), M.Sc*
Reviewed by: *Jenny Crawford*

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

Doc ref: Calb-Cert-Master-V3-07

Certificate of Calibration

Continuation of Certificate number: **U47822**

Reference Microphone: WSM11 (C) - GRAS40AG-291442

Measurements

The calibrator has been tested as described in the following annexes to BS EN IEC60942:2003 Sound Calibrators; B3.4 for sound pressure level, B3.5 for frequency, B3.6 for total distortion and A4.4 for short term stability of the pressure level.

Instruments and Program

A complete list of instruments, hardware and software that have been used for this calibration is available from the calibration laboratory

Comments

Statement of Calibration

The sound calibrator has been shown to conform to the class 1 requirements for periodic testing, described in annex B of BS EN IEC 60942:2003 for the sound pressure levels and frequencies stated, for the environmental conditions under which the tests were performed. However, as public evidence was not available, from a testing organisation responsible for pattern approval, to demonstrate that the model of sound calibrator conformed to the requirements for pattern evaluation described in annex A of BS EN IEC 60942:2003, no general statement of conclusion can be made about conformance of the sound calibrator to the requirements of BS EN IEC 60942:2003.

Notes:

The sound pressure level generated by the calibrator in its ½ inch configuration was measured five times and averaged by a WS2P working standard microphone for class 1 or 2 devices or a LS2P reference microphone for class 0 or LS devices as specified in the International Standard BS EN 61094-4. The results of three replications and the mean of the measurements obtained are given in the measurement results table of this certificate. The frequency and distortion were measured in a similar manner. The figures in BOLD are the final results; a small correction factor may need to be added to the sound pressure level quoted here if the device is used to calibrate a sound level meter that is fitted with a free field response microphone. See manufacturer's handbooks for full details of this and other corrections that may be applicable.

Observations:

Decision Rule:

The decision rules have been applied in accordance with the procedure as described in BS EN 60942:2003

This certificate relates only to the items tested above.

** End of Certificate **

Appendix 3
Summary of Noise Measurements

Appendix 3: Summary of Noise Measurements

Time	L_{Aeq}	L_{Amax}	L_{A10}	L_{A50}	L_{A90}
07:00	61.6	79.9	63.0	50.3	47.0
08:00	59.8	83.6	62.2	51.3	46.6
09:00	58.0	79.3	61.0	48.6	44.2
10:00	57.4	76.3	60.8	47.6	42.7
11:00	55.9	78.8	58.6	46.7	42.6
12:00	56.6	76.6	60.3	47.9	43.3
13:00	56.6	80.5	60.4	47.4	42.4
14:00	58.1	84.7	61.7	48.7	42.7
15:00	57.4	78.5	61.2	48.0	42.6
16:00	56.9	79.3	61.1	47.5	42.8
17:00	56.9	80.1	60.1	48.6	43.9
18:00	55.6	79.1	59.1	48.0	43.6
19:00	54.7	76.3	57.7	46.1	42.7
20:00	55.6	87.7	56.7	43.9	40.3
21:00	52.0	75.7	50.6	42.8	40.2
22:00	50.9	75.7	50.0	41.1	38.0
23:00	46.0	70.0	42.9	37.7	35.2
00:00	44.0	70.3	39.1	34.7	32.8
01:00	41.1	69.7	40.0	34.8	32.5
02:00	37.2	62.2	37.4	33.7	32.4
03:00	43.8	72.7	38.4	34.6	33.0
04:00	51.5	78.1	44.7	36.9	33.7
05:00	52.9	76.2	49.2	41.8	36.4
06:00	55.3	78.8	52.8	42.7	39.2
Day	**61.6**	**79.9**	**63.0**	**50.3**	**47.0**
Night	**59.8**	**83.6**	**62.2**	**51.3**	**46.6**