Hawkins environmental

Noise Assessment:

Land north of Lavant Drive, Havant

Perseus Land & Developments

21st August 2026

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This report has been prepared by Hawkins Environmental Limited for the sole purpose of assisting in gaining planning consent for the proposed development described in the introduction of this report.

This report has been prepared by Hawkins Environmental Limited with all reasonable skill, care and diligence, and taking account of the manpower and resources devoted to it by agreement with the client. Information reported herein is based on the interpretation of data collected and has been accepted in good faith as being accurate and valid.

This assessment takes into account the prevailing conditions at the time of the report and assesses the impact of the development (if applicable) using data provided to Hawkins Environmental Limited by third parties. The report is designed to assist the developer in refining the designs for the proposed development and to demonstrate to agents of the Local Planning Authority that the proposed development is suited to its location. This should be viewed as a risk assessment and does not infer any guarantee that the site will remain suitable in future, nor that there will not be any complaints either from users of the development or from impacts emanating from the development site itself.

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1. INTRODUCTION

1.1. Overview

Hawkins Environmental Limited has been instructed by Perseus Land & Developments to undertake a noise assessment for the redevelopment of land at Lavant Drive, Havant.

During the planning process, it has been identified that the site may require a noise assessment to determine whether the site is suitable for use as a care home. 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 Planning Practice Guidance (PPG) 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'.*

The assessment of plant noise egress from the proposed development has been assessed in accordance with British Standard BS 4142: 2014 +A1:2019 *'Methods for rating and assessing industrial and commercial sound'.*

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. Statement of Competency

The assessment has been carried out by Nick Hawkins MSc MIOA MIAQM MIEnvSc PIEMA, the managing director of Hawkins Environmental Limited. Nick is an environmental consultant with over 15 years of experience working in the field of noise/acoustics and environmental impact assessment.

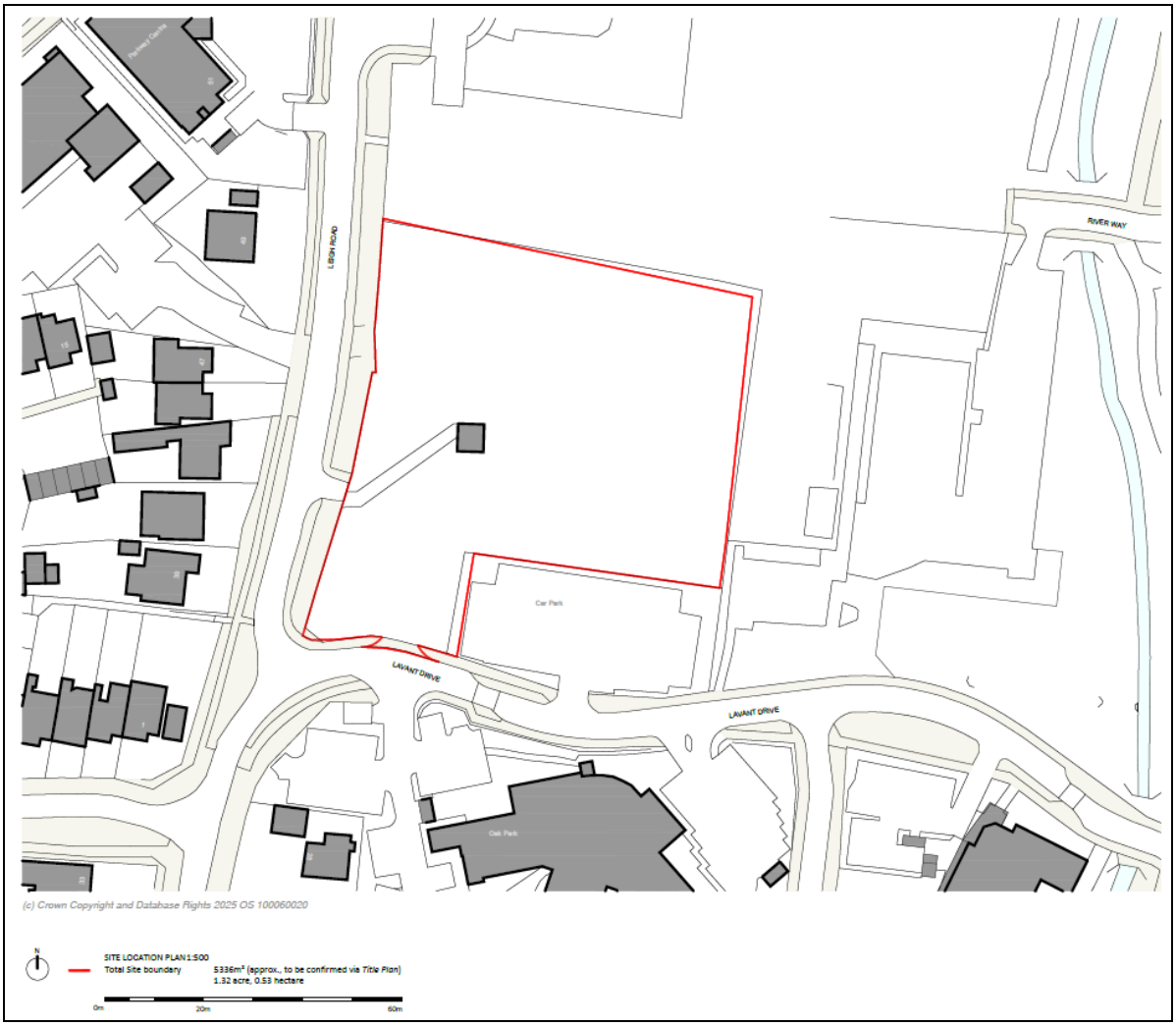
Nick is an alumnus of the University of East Anglia and the University of Southampton. Nick holds the Institute of Acoustics' Certificate of Competence in Environmental Noise Measurement and became a full Member of the Institute of Acoustics in 2010, having previously been an Associate Member. Nick is also a Member of the Institution of Environmental Sciences and a Member of the Institute of Air Quality Management.

Nick has worked on a range of projects, including a number of prestigious projects, including the noise impact assessments of the Thameslink railway scheme through central London, the construction of lines BXD of the Luas Light Rail System in Dublin, the expansion of Bournemouth Airport and the M25 widening between junctions 1b to 3 and 5 to 7. Nick was one of the first acoustic consultants to be given access to the Crossrail tunnels to conduct vibration compliance monitoring. In addition, Nick regularly conducts acoustic assessments for housing developments, wind turbines, air conditioning units, kitchen extract fans, supermarkets, public houses and other commercial developments.

1.4. Site Description

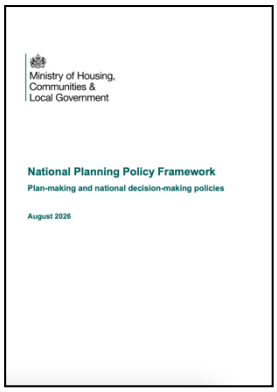
The development site is situated in a residential area in Havant, with healthcare uses to the south of the proposed development. The development will see the construction of an 86-bed care home. A location plan of the proposed site can be seen in **Figure 1.1**.

Figure 1.1: Site Location Plan



2. NATIONAL & LOCAL PLANNING POLICY

2.1. National Planning Policy Framework (2026)



The National Planning Policy Framework (NPPF) was first published on the 27th March 2012 and revised in 2018, 2019, 2021, 2023 (twice) and 2024. The latest version of the NPPF, published in August 2026, sees a major update when compared to earlier revisions.

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 "*a material consideration of critical importance*" (Paragraph 1) when making decisions on development proposals.

The NPPF notes "*The purpose of the planning system is to contribute to the achievement of sustainable development, by managing the use and development of land in the long-term public interest*" (Paragraph 15). The NPPF notes sustainable development should be delivered with three main dimensions: economic; social and environmental (Paragraph 17).

The NPPF notes in policy **P1: Planning for clean and safe places**:

1. *"To support efforts to avoid and mitigate risks from natural and man-made hazards, minimise levels of pollution and create clean, liveable and safe places for people to live, work and visit, development plans should:*
    a. *Allocate land for development where, taking into account the potential for mitigation:*
        i. *Opportunities can be taken to improve local environmental conditions, such as by remediating despoiled, degraded, derelict, contaminated and unstable land;*
        ii. *Ground conditions will not inhibit or pose a risk to the nature of the development proposed (such as due to land instability), and occupiers and users will not be put at risk from, or be adversely affected by, unacceptable levels of pollution;*
        iii. *Development proposals will not cause unacceptable levels of pollution, either alone or in combination with other pollution sources, taking into account communities which may be particularly vulnerable to its effects, such as children and older people, as well as habitats and species which may be vulnerable to pollution; and*
        iv. *The intended uses will not place unreasonable restrictions on the operation of existing businesses, community facilities, public services, defence and security activities.*
    b. *Consider any wider opportunities to reduce air, water, soil, noise or other forms of pollution, and contribute to compliance with national and local environmental targets and objectives, through the spatial strategy and policies for specific parts of the plan area (such as by identifying opportunities for strategic nature-based solutions)"…*

It goes on to note in policy **P3: Living conditions and pollution**:

1. *"Development proposals should be appropriate for their location, taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, whether these effects are on or off-site; and whether this is as a result of the development itself or the product of preexisting conditions in its vicinity. In assessing the potential effects of pollution, consideration should be given to the potential sensitivity of the site, and its intended occupiers and users, as well as that of the environment and population in the surrounding area (including where certain groups could be particularly vulnerable to its effects, such as children and older people).*
2. *Within this context development proposals should:*
    a. *Provide healthy living conditions for occupiers and users in terms of adequate access to light and avoiding exposure to levels of air, noise, artificial light or other sources of pollution which could have an unacceptable adverse effect on health and the quality of life. Where necessary suitable mitigation measures should be incorporated to secure acceptable living conditions;*
    b. *Not give rise to, or contribute to, an unacceptable level of access to daylight and sunlight for neighbouring residents and occupiers, or unacceptable levels of air, noise, artificial light, water, soil or other forms of pollution on or beyond the site. Adverse impacts of this nature should be avoided where possible, or else mitigated to an acceptable degree. Where possible, opportunities should be taken to reduce pollution affecting the wider area (such as through traffic and travel management or improved external lighting);*
    c. *Sustain and contribute to compliance with relevant limit values or national objectives and targets for air pollutants including PM2.5. Development proposals should take account of Air Quality Management Areas and be consistent with the objectives of relevant Air Quality Action Plans, Clean Air Plans and Local Air Quality Strategies;*
    d. *Mitigate and reduce to a minimum potential adverse impacts resulting from noise, not result in levels of noise exposure which would have a significant observed adverse effect, and maintain the character of tranquil areas (those areas that have remained relatively undisturbed by noise from human sources and are prized for their recreational and amenity value for this reason);*
    e. *Limit any adverse impact from artificial light on local amenity, intrinsically dark landscapes (those areas entirely, or largely, uninterrupted by artificial light) and nature…"*

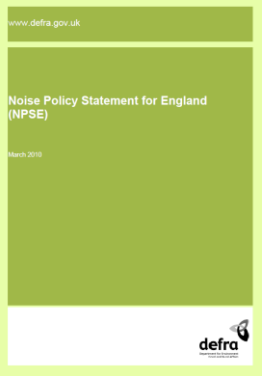
Policy **P4: Impact of development on existing activities notes**:

1. *Existing businesses, community facilities, public services and defence and security activities should not have unreasonable restrictions placed on their current or permitted operation as a result of development being approved after they were established. This means that development proposals should be capable of being integrated effectively with existing business, community and public service activities and infrastructure in their vicinity (including, but not limited to, uses such as pubs, music venues, places of worship, sports clubs, blue light services, defence, electricity network infrastructure and industrial and waste sites).*
2. *Where the operation of an existing activity could have a significant adverse effect on a proposed new development in its vicinity, development proposals should:*

a. *Identify the nature of the potential impacts, informed where necessary by early discussions between the applicant (i.e. the 'agent of change') and those existing uses which could be affected by the proposal to inform the scope for mitigation; and*

b. *Be able to demonstrate that suitable mitigation can be provided before first occupation of the development, if it is to be acceptable. Planning conditions or obligations should be used to secure agreed mitigation measures".*

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:*

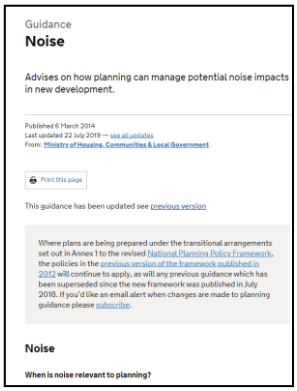
- *avoid significant adverse impacts on health and quality of life;*
- *mitigate and minimise adverse impacts on health and quality of life; and*
- *where possible contribute to the improvement of health and quality of life."*

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. National Planning Practice Guidance



The National Planning Practice Guidance (NPPG) on noise 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 NPPG 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*: "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." (Paragraph: 003 Reference ID: 30-003-20190722)

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".* (Paragraph: 006 Reference ID: 30-006-20190722)

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. (Paragraph: 009 Reference ID: 30-009-20190722)

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". (Paragraph: 009 Reference ID: 30-009-20190722)

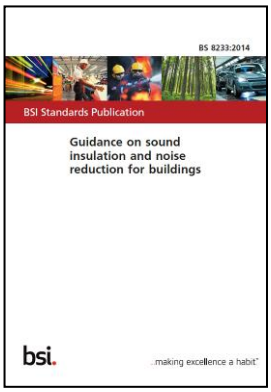
Table 2.1: Noise Exposure Hierarchy

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 PPG 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**.

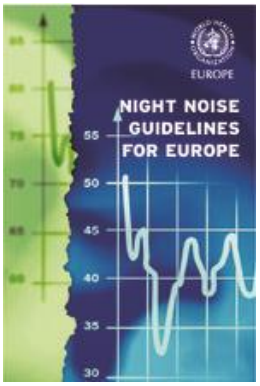
GUIDELINES
FOR
COMMUNITY NOISE

Edited by
Birgitta Berglund
Thomas Lindvall
Dietrich H Schwela

Table 3.2: Summary of Noise Criteria: WHO

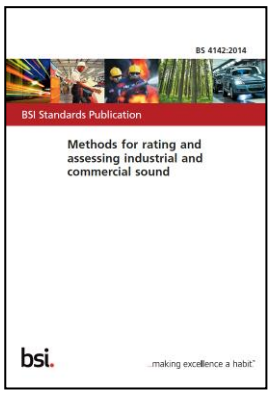
Residential Environment	Critical Heath Effect	L_{Aeq}	L_{AFmax}	Time Base
Outdoor living area	Serious annoyance, daytime and evening	55	-	07:00-23:00
	Moderate annoyance, daytime and evening	50	-	07:00-23:00
Dwelling, indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	-	07:00-23:00
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 provide 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".*

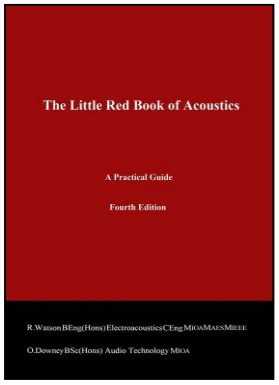
It goes on to provide two examples:

"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.

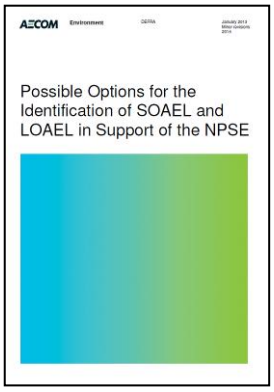
The 4th edition of the book was published in September 2024 and includes recent updates to standards such as BS 8233 and BS 4142, in addition to presenting a new method to assess and determine the representative background sound levels as part of a BS 4142 assessment.

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)

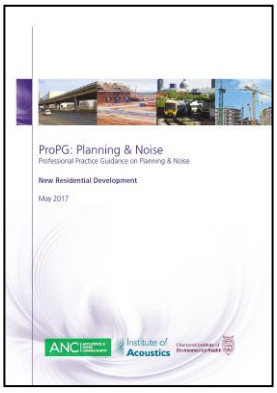


Published by Defra, based on a Research Project prepared by AECOM, *"Possible Options for the Identification of SOAELs and NOAELs in Support of the NPSE"* attempts to give values to the concepts of SOAELs and NOAELs, introduced by the Noise Policy Statement for England (NPSE). After the withdrawal of PPG24: 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)

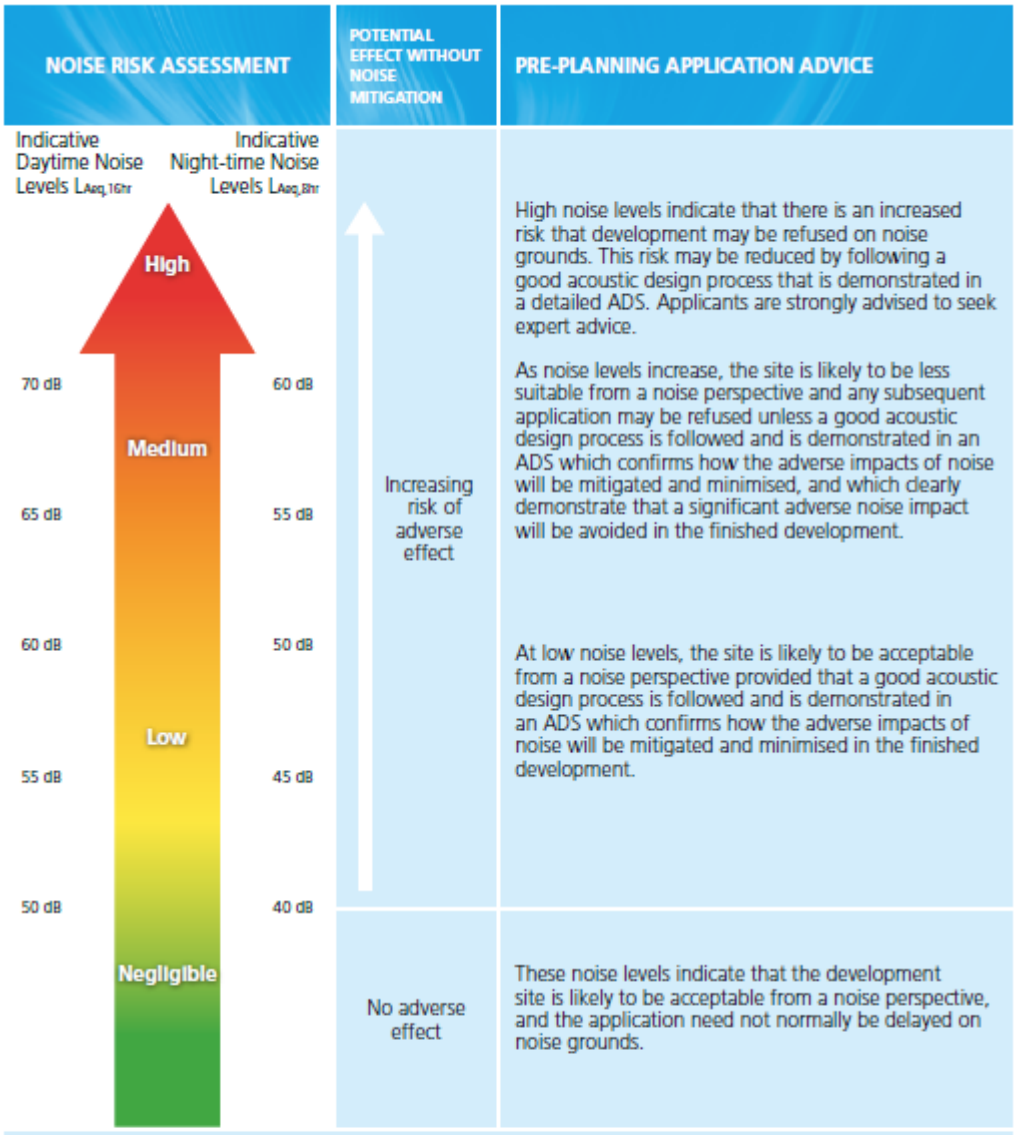


Figure 1 Notes:

a. Indicative noise levels should be assessed without inclusion of the acoustic effect of any scheme specific noise mitigation measures.

b. Indicative noise levels are the combined free-field noise level from all sources of transport noise and may also include industrial/commercial noise where this is present but is "not dominant".

c. $L_{Aeq,16hr}$ is for daytime 0700 – 2300, $L_{Aeq,8hr}$ is for night-time 2300 – 0700.

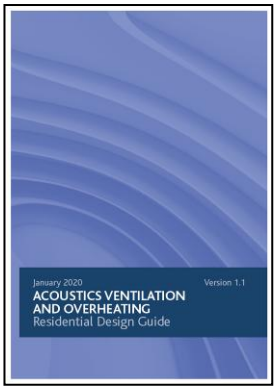
d. An indication that there may be more than 10 noise events at night (2300 – 0700) with $L_{Amax,F}$ > 60 dB means the site should not be regarded as negligible risk.

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"*.

The AVO Guide suggests it is a three-step process when considering noise for residential developments:

1. Quantify external noise levels – as one would in a standard noise assessment in accordance with the ProPG.

2. Access noise & ventilation - consider the effect of the proposed or potential ventilation strategies on the acoustic conditions in living rooms and bedrooms.
3. Assess noise & overheating. - Rooms may be grouped by Negligible, Low, Medium and High-risk categories to determine the extent of further analysis or mitigation required. Consider noise from mechanical systems associated with controlling overheating.

Regarding Step 2, the ventilation condition, suitable internal noise levels must be achievable when providing adequate ventilation. **Figure 3.2** and **Figure 3.3** provides guidance on suitable ventilation strategies based on the external noise level.

It should be noted that the AVO Guide describes ventilation systems in line with those described in Approved Document F of the Building Regulations which state:

- System 1 – Background ventilators and intermittent extract fans
- System 2 – Passive stack ventilation
- System 3 – Continuous mechanical extract (MEV)
- System 4 – Continuously mechanical supply and extract with heat recovery (MVHR)

It should be noted that in **Figure 3.2** and **Figure 3.3** ADF Systems 1/2 would have 2 trickle vents, System 3 would have 1 trickle vent and System 4 would not have any trickle vents.

Regarding Step 3, the overheating condition, *"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 of occupants 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.

Figure 3.2: Guideline Values for Ventilation Strategies Described in Approved Document F – External L_{Aeq} Values

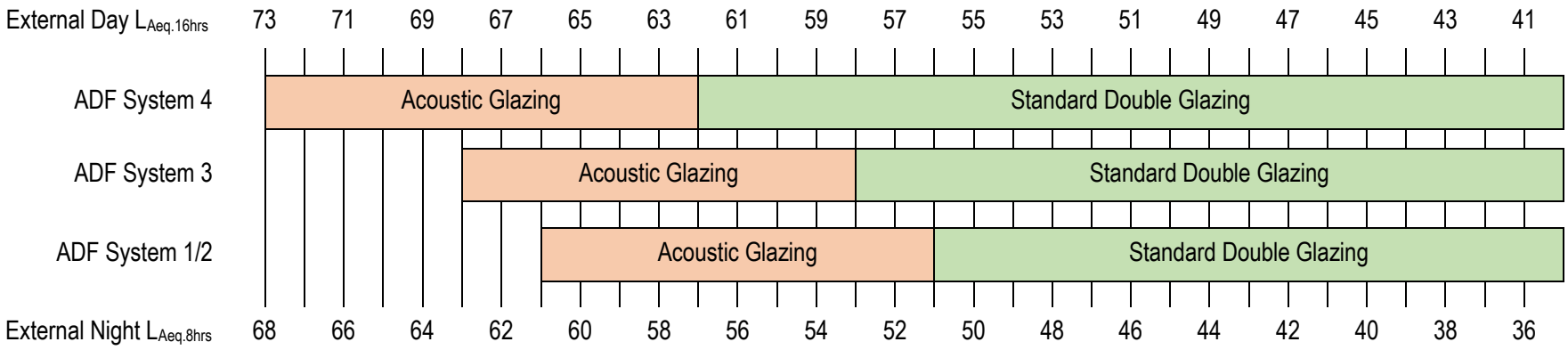
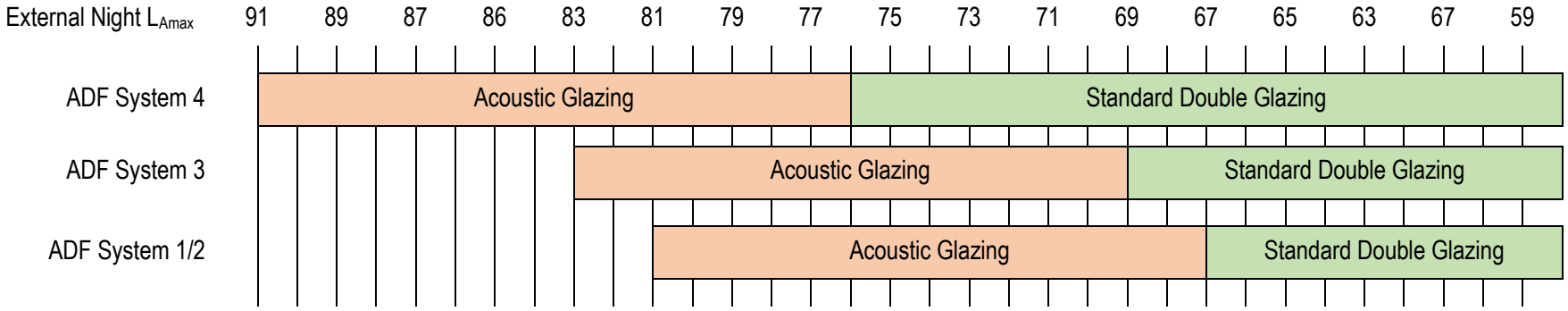


Figure 3.3: Guideline Values for Ventilation Strategies Described in Approved Document F– External L_{Amax} Values



Note: The above external L_{Amax} values should not be exceeded more than 10 times per day.

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

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 21st and 22nd July 2026. The noise monitoring was conducted by Will Totty of Hawkins Environmental Limited. Will holds the Institute of Acoustic's Certificate of Competence in Environmental Noise Measurement.

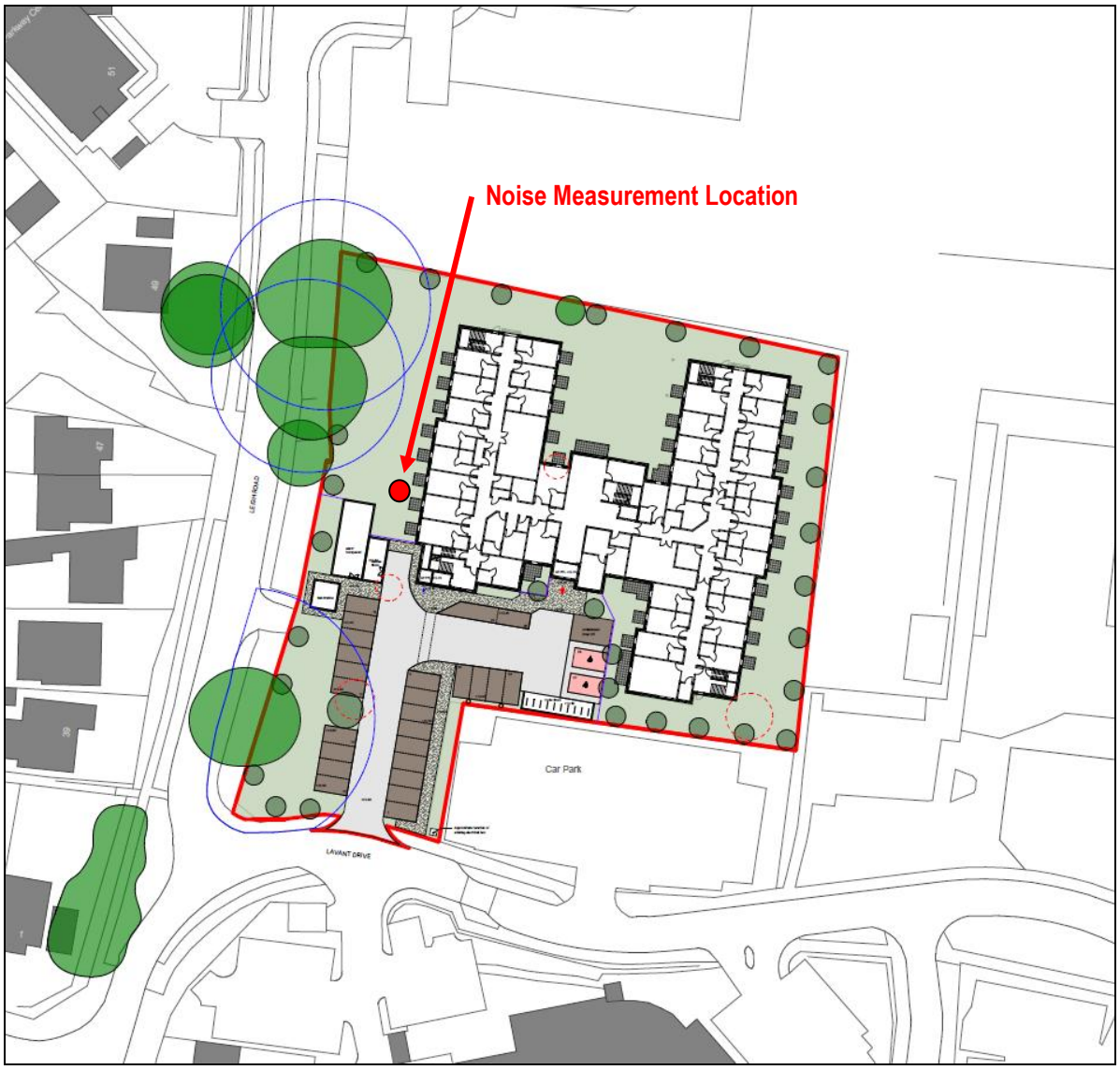
Weather conditions were conducive to successful monitoring. **Table 4.1** summarises the weather conditions during the measurement period.

Table 4.1: Summary of Weather Conditions during the Noise Measurements

General Description	The measurement periods were warm, 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 16°C at night, with daytime temperatures up to 24°C.
Precipitation	The measurement period remained dry.

Noise measurements were conducted within the boundary of the proposed development site, close to Leigh Road at a location representative of the worst affected façade of the proposed development. The measurement location is considered to be a façade 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 Block Plan



Location for illustrative purposes only – do not scale

4.2. Noise Survey Results

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 $L_{A90.5mins}$
Day (7am to 11pm)	44.5	40.1 – 51.7	48.0 – 73.1	34.1 – 45.8
Night (11pm to 7am)	43.0	34.9 – 52.8	44.3 – 76.5	31.6 – 44.2

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: 2014 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 day, the $L_{A90.1hour}$ ranged from 37 dB to 43 dB. Based on the LRB method 38 dB(A) would be accepted as the representative background sound level during the daytime.

At night, it can be seen from **Figure 4.4** that the $L_{A90.15mins}$ ranged from 33 dB to 43 dB. The value with the highest number of occurrences is 34 dB $L_{A90.15mins}$. Based on the LRB method 34 dB(A) would be accepted as the representative background sound level during the daytime.

A summary of the background sound levels are presented below in **Table 4.3**.

Table 4.3: Summary of the Background Sound Level Analysis

Period (Hours)	Representative Background Sound Level, dB(A)
Daytime (07:00 – 23:00)	38
Nighttime (23:00 – 07:00)	34

Figure 4.2: Noise Measurements

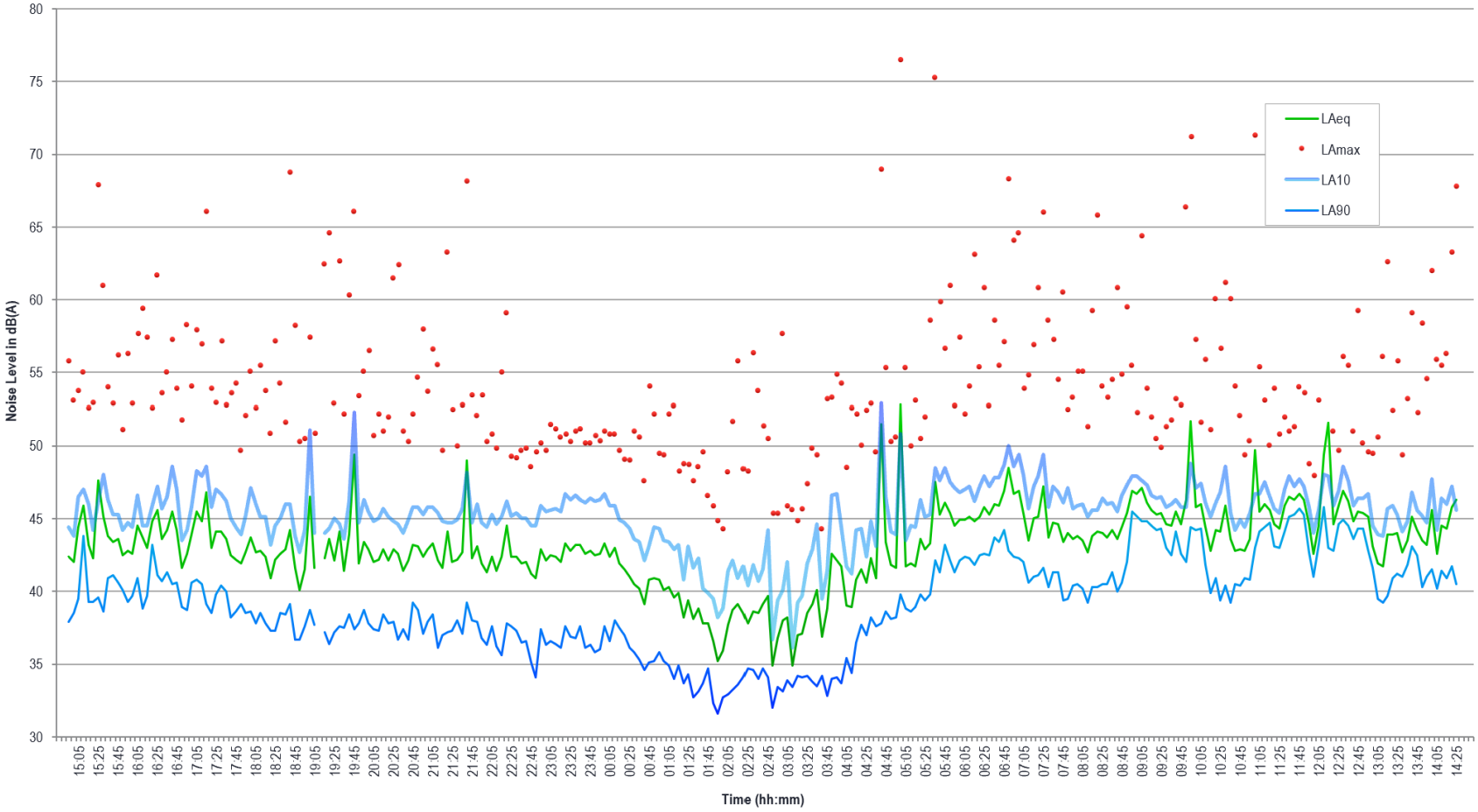


Figure 4.3: Distribution of Day Time $L_{A90.1hour}$ Sound Levels

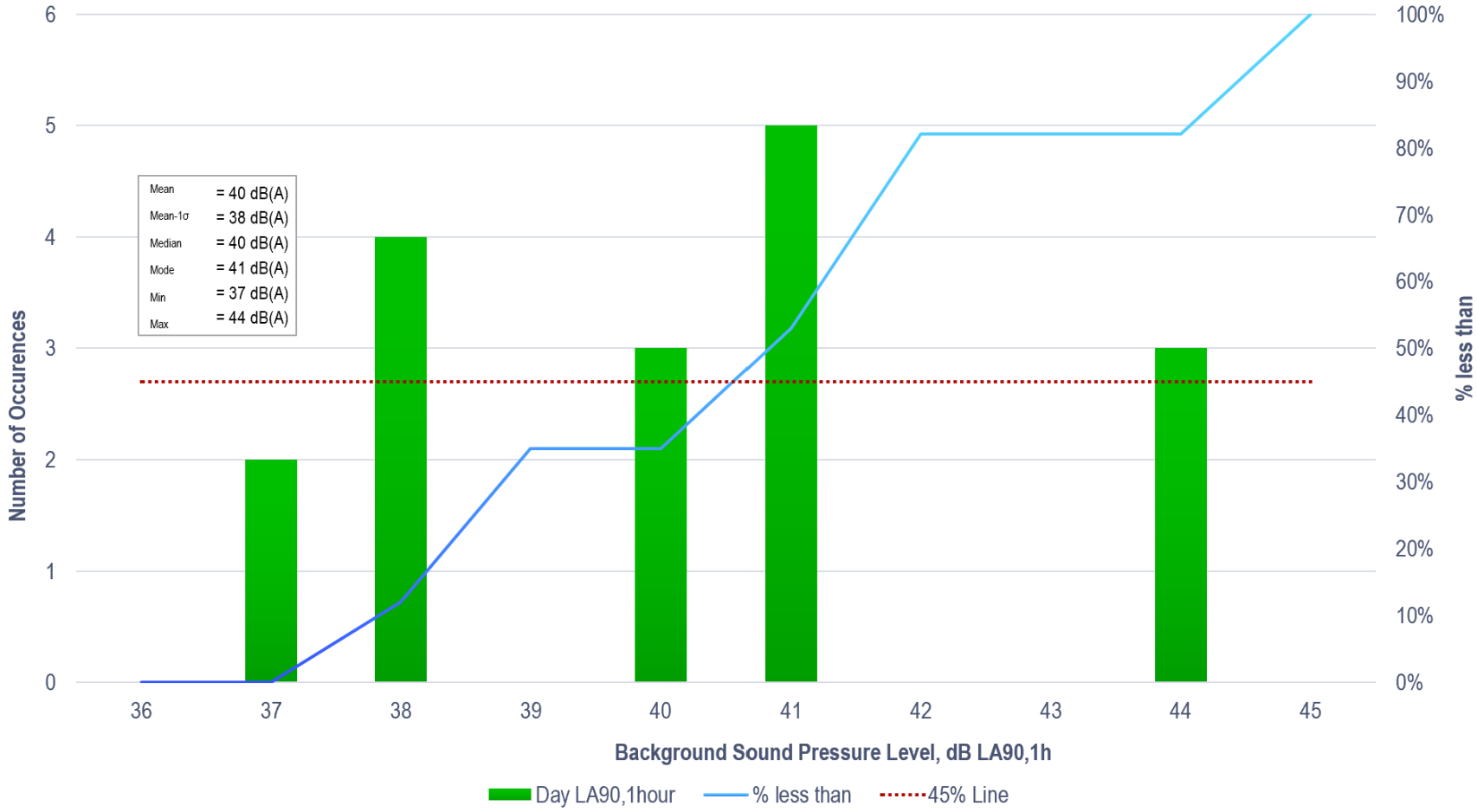
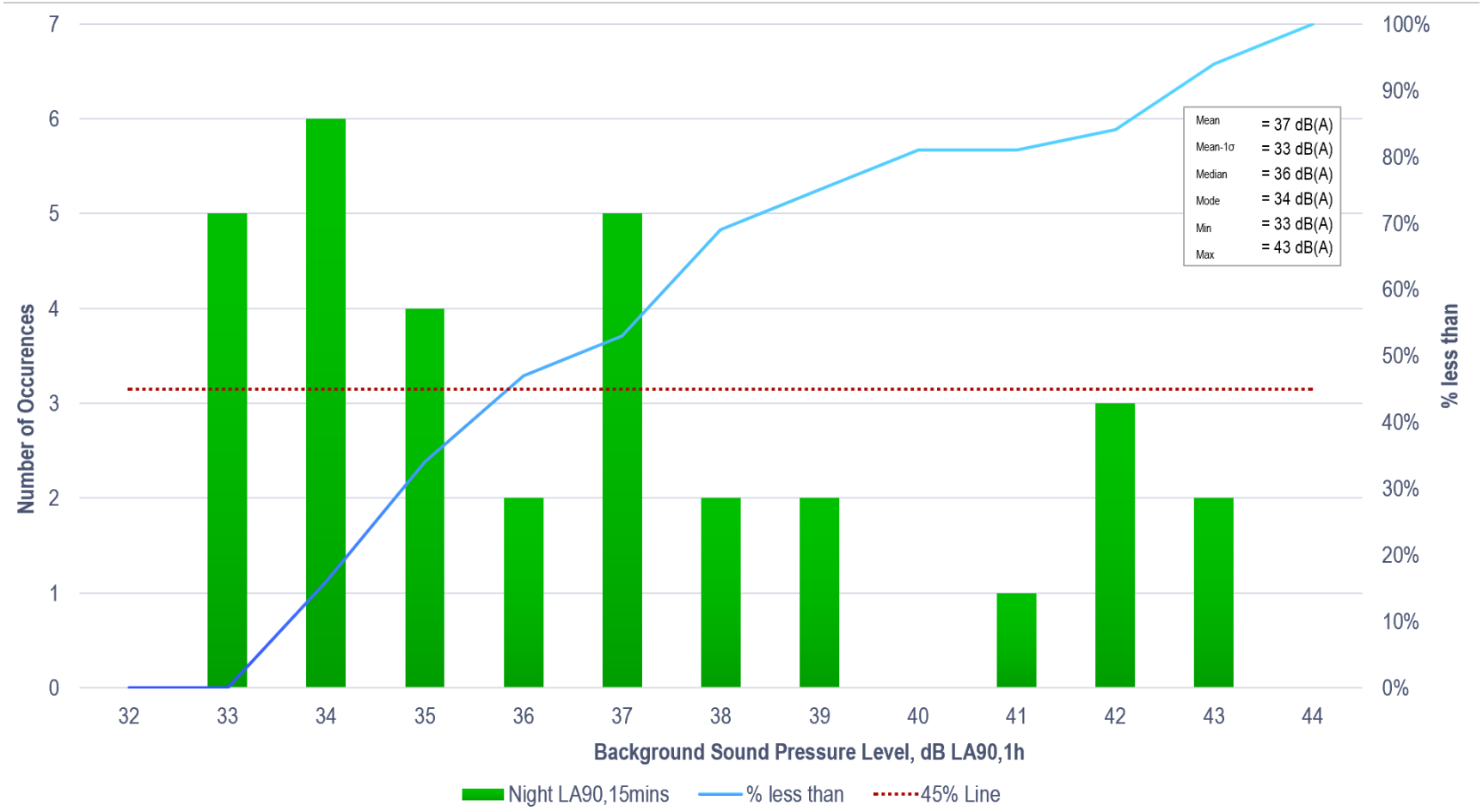


Figure 4.4: Distribution of Night Time $L_{A90,15mins}$ Sound Levels



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	45 dB	43 dB
ProPG Noise Risk	Negligible	Negligible
Effect Level	Below LOAEL	Below LOAEL
Action	No specific measures required	No specific measures required

Based on the results shown in **Table 5.1,** the noise risk of the site is "*Negligible"*, with the effect level less than the LOAEL. For a *"Negligible"* risk site, a Stage 2 assessment with Acoustic Design Statement is not required. Suitable internal noise levels will be achieved with standard double-glazed windows and windows can be opened to deal with overheating.

6. 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 38 dB and 34 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 38 dB(A) during the day and 34 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.

7. CONSTRUCTION NOISE

Due to the size of the development and early 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.

8. 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 use as a care home.

The study has shown that due to noise from surrounding roads and the wider environment, the site is considered a *"negligible risk"* site under the Pro-PG, with noise levels less than the Lowest Observed Adverse Effect Level (LOAEL).

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 8.1** below.

Table 8.1: 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 double glazing, which would typically have a R_w of 33 dB or more	
Ventilation Recommendations in Relation to Noise	Any ventilation system compliant with Approved Document F of the Building Regulations will be suitable. Windows may always be openable to manage purge ventilation throughout.	
Overheating Recommendations in Relation to Noise	Based on the onsite noise levels, windows can be opened to deal with overheating.	

It is always strongly recommended that any final glazing and ventilation combination is tested within the parameters of BS 8233: 2014, using full octave band data to determine suitability.

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 187 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 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 1 - Equipment Set 3056:

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	1403056	U49327	UKAS Calibration: 0789	22nd November 2024	November 2026
Nor-1209 Pre-amplifier	Norsonic	12528	49326	UKAS Calibration: 0789	22nd November 2024	November 2026
Nor-1225 Microphone	Norsonic	98361	49326	UKAS Calibration: 0789	22nd November 2024	November 2026
Nor-1255 Sound Calibrator	Norsonic	2562	U54936	UKAS Calibration: 0789	28th May 2025	May 2027
Nor-1284 Dehumidifier	Norsonic	222	Not Applicable			
Nor- 1212 Weather Protection Kit	Norsonic	Not Applicable				
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 and Conformance

Certificate number: **U49327**

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

Producer: **Norsonic AS.**
Type: **140**
Serial number: **1403056**
Customer: **Hawkins Environmental**
Address: **The Square, Basing View, Basingstoke, Hampshire. RG21 4EB.**
Contact Person: **Nick Hawkins**
Order No:

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	Norsonic	1225	98361	49326
Calibrator*	Norsonic	1255	125525262	U49325
Preamplifier	Norsonic	1209	12528	Included

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

Additional items that have also been submitted for verification:
Wind shield N/A
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	100.04 ±0.05	23.00 ±0.25	35.08 ±1.3

Calibration Dates:

Received date:	15/11/2024	Reviewed date:	22/11/2024
Calibration date:	22/11/2024	Issued date:	22/11/2024

Technicians: (Electronic certificate)

Calibrated by: *Palaniwel Marappan B.Eng (Hons), M.Sc*

Reviewed by: *Darren Batten*

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: Slm-Cert-Master-V3-07

Certificate of Calibration and Conformance

Continuation of Certificate number: **U49327**

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:	**BS EN IEC 61672-2:2003**

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 has successfully completed the periodic tests of the standard listed for the environmental conditions under which the tests were performed. As public evidence(1) was available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with the manufacturer's standard to demonstrate that the model of sound level meter fully conformed to the requirements of the said standard, the sound level meter submitted for testing conforms to the relevant class of the said standard.
(1 - evidence is held on file at the calibration laboratory)

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 **

Laboratory Location

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

CALIBRATION

Certificate of Calibration

Certificate number: **49326**

Test Object: **Measurement Microphone**

Producer: **Norsonic AS.**
Type: **1225**
Serial number: **98361**
Customer: **Hawkins Environmental**
Address: **The Square, Basing View,**
Basingstoke, Hampshire. RG21 4EB.
Contact Person: **Nick Hawkins**
Order No:

Measurement Results	Sensitivity (dB re 1V/Pa)	Sensitivity (mV/Pa)	Capacitance (pF)
Measurement 1	*-25.89*	*50.75*	*26.27*
Measurement 2	*-25.88*	*50.82*	*26.46*
Measurement 3	*-25.89*	*50.77*	*26.50*
Result (Average):	***-25.89***	***50.78***	***26.41***
Expanded Uncertainty:	0.10		2.02
Degree of Freedom:	>100		>100
Coverage Factor:	2		2

The stated sensitivity is the pressure sensitivity at 250Hz, S_{250}, and is valid at reference conditions. The following correction factors have been applied during the measurement:
Pressure:uncertainty dB/kPa Temperature:-0.005 dB/°C Humidity:0 dB/%RH

Conditions	*Pressure kPa*	*Temperature °C*	*Humidty %RH*
Reference conditions	101.325	23	50
Measurement conditions	99.974 ± 0.041	22.9 ± 0.2	35.8 ± 1.3

The calibration test report shown on the next page gives details of the response at other frequencies relative to this 250 Hz reference sensitivity. Results ≥100 Hz are obtained using an electrostatic actuator as described in BS EN 61094-6 and those below 100 Hz are obtained in a reference pressure chamber. Detailed results are available from the calibration laboratory upon request.

The reported expanded uncertainty of measurements is based on a standard uncertainty multiplied by the coverage factor of k=2, providing a coverage probability 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.

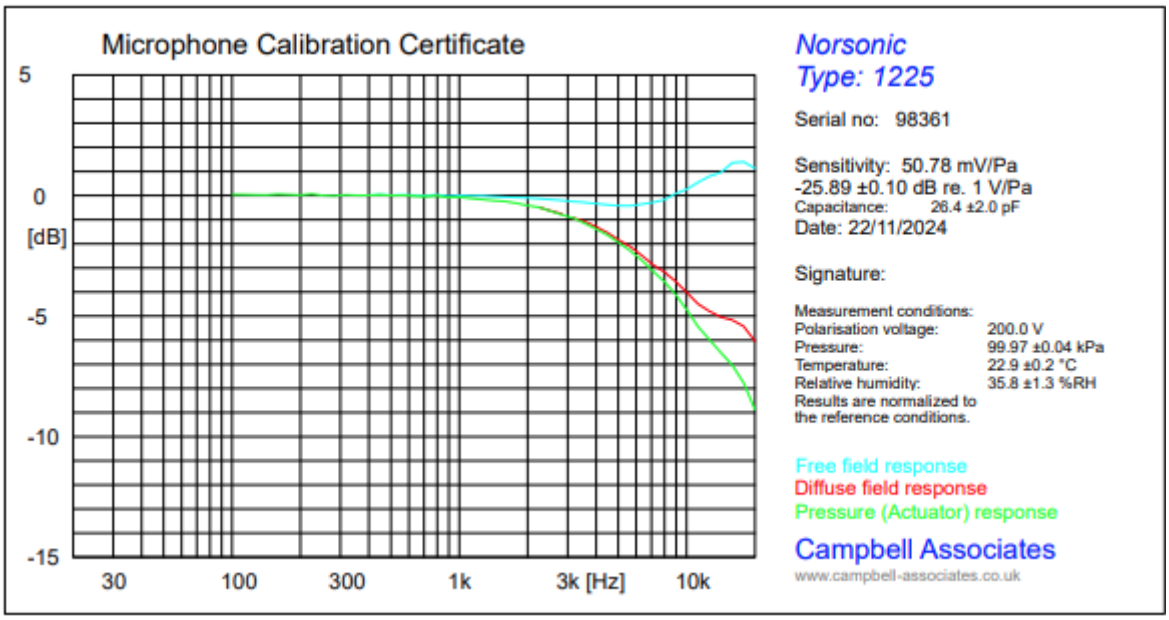
Calibration Dates:

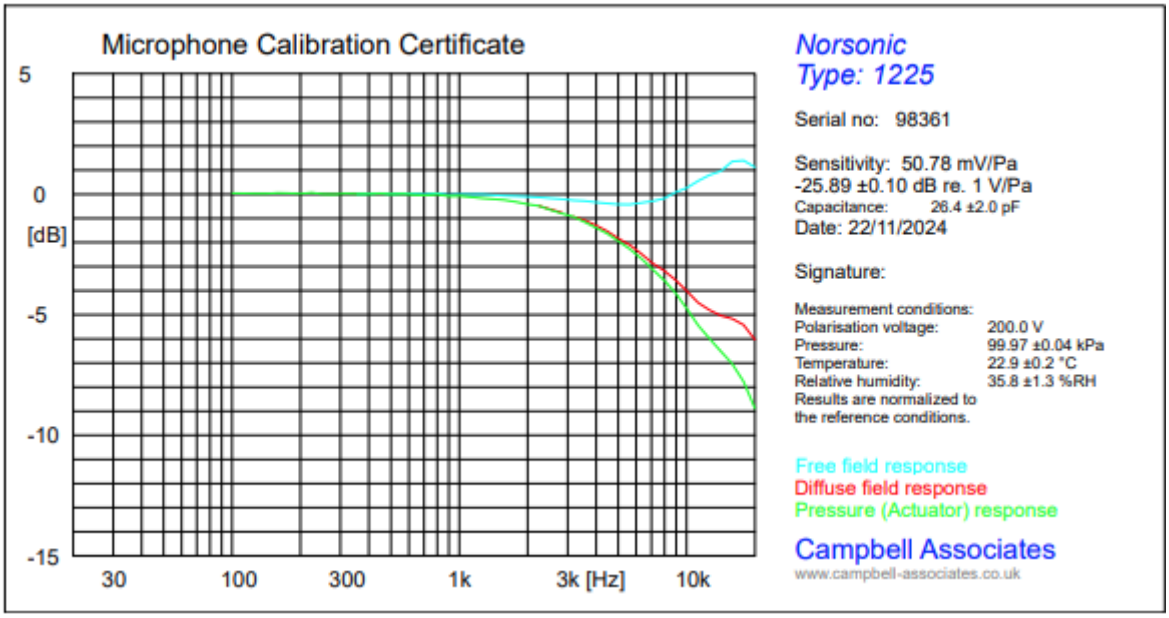
Received date:	15/11/2024	Reviewed date:	22/11/2024
Calibration date:	22/11/2024	Issued date:	22/11/2024

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

This certificate is issued in accordance with the CA Quality Management system. It provides traceability of measurement to recognized national standards, and to the units of measurement realized at the National Physical Laboratory or other recognized national standards laboratories. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

Doc ref: Mic-V6-Cert-Master-V3-05


Microphone Calibration Certificate
5
0
[dB]
-5
-10
-15
30
100
300
1k
3k [Hz]
10k
Norsonic
Type: 1225
Serial no: 98361
Sensitivity: 50.78 mV/Pa
-25.89 ±0.10 dB re. 1 V/Pa
Capacitance: 26.4 ±2.0 pF
Date: 22/11/2024
Signature:
Measurement conditions:
Polarisation voltage: 200.0 V
Pressure: 99.97 ±0.04 kPa
Temperature: 22.9 ±0.2 °C
Relative humidity: 35.8 ±1.3 %RH
Results are normalized to the reference conditions.
Free field response
Diffuse field response
Pressure (Actuator) response
Campbell Associates
www.campbell-associates.co.uk


Microphone Calibration Certificate
5
0
[dB]
-5
-10
-15
30
100
300
1k
3k [Hz]
10k
Norsonic
Type: 1225
Serial no: 98361
Sensitivity: 50.78 mV/Pa
-25.89 ±0.10 dB re. 1 V/Pa
Capacitance: 26.4 ±2.0 pF
Date: 22/11/2024
Signature:
Measurement conditions:
Polarisation voltage: 200.0 V
Pressure: 99.97 ±0.04 kPa
Temperature: 22.9 ±0.2 °C
Relative humidity: 35.8 ±1.3 %RH
Results are normalized to the reference conditions.
Free field response
Diffuse field response
Pressure (Actuator) response
Campbell Associates
www.campbell-associates.co.uk

Laboratory Location

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

Certificate of Calibration

Certificate number: **U54936**

Test Object: **Sound Calibrator**

Producer: **Norsonic AS.**
Type: **1255**
Serial number: **125525262**
Customer: **Hawkins Environmental**
Address: **70 Wentworth Crescent,**
Basingstoke Hants, RG22 4WX
Contact Person: **Nick Hawkins**
Order No:

Measurement Results	Level dB	Level Stability dB	Frequency Hz	Distortion %
Measurement 1	114.08	0.02	1000.00	0.35
Measurement 2	114.09	0.01	1000.00	0.35
Measurement 3	114.08	0.02	1000.00	0.35
Result (Average):	**114.08**	**0.02**	**1000.00**	**0.35**
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 dB/kPa Temp:0 dB/°C Humi:0 dB/%rh Load volume: 0.00015 dB/mm3

Conditions	*Pressure kPa*	*Temperature °C*	*Humidity %RH*
Reference conditions	101.325	23	50
Measurement conditions	101.76 ±0.070	20.7 ±0.2	53.1 ±1.1

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\NOR1255_125525262_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:	21-May-2026	Reviewed date:	29-May-2026
Calibration date:	28-May-2026	Issued date:	29-May-2026

Technicians: (Electronic certificate)
Calibrated by: *Robyn Pecaro*
Reviewed by: *David Egan*

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-V6-Cert-Master-V4-02

Page 1 of 2

Certificate of Calibration

Continuation of Certificate number: **U54936**

Reference Microphone: WSM8 (A) - GRAS-40AG.147852

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	44.9	66.0	47.2	43.3	40.9
08:00	44.3	65.8	46.2	43.3	40.9
09:00	46.7	71.2	46.7	45.2	43.9
10:00	44.2	61.2	46.0	43.1	41.1
11:00	46.2	71.3	46.8	45.3	44.2
12:00	46.8	73.1	46.7	45.2	43.7
13:00	43.5	62.6	45.0	42.6	41.0
14:00	44.7	67.8	45.9	42.7	40.6
15:00	44.2	67.9	45.6	42.4	40.1
16:00	44.0	61.7	45.7	42.6	40.3
17:00	44.0	66.1	46.2	42.2	39.5
18:00	42.4	68.8	44.9	40.7	37.9
19:00	44.4	66.1	46.0	40.5	37.7
20:00	42.5	62.4	45.1	41.1	37.7
21:00	43.7	68.2	45.5	41.1	37.6
22:00	42.2	59.1	45.1	40.7	36.5
23:00	42.7	51.5	46.1	41.1	36.5
00:00	41.4	54.1	44.4	39.8	36.2
01:00	38.7	52.7	41.6	36.5	33.8
02:00	38.1	56.4	40.8	35.8	33.7
03:00	39.1	57.7	41.7	36.3	33.8
04:00	43.8	69.0	44.5	39.5	36.9
05:00	46.1	76.5	46.6	42.9	40.4
06:00	46.0	68.3	47.7	44.7	42.7
Day	**44.5**	**73.1**	**45.9**	**42.6**	**40.2**
Night	**43.0**	**76.5**	**44.2**	**39.6**	**36.8**