



ProPG: Planning & Noise

Professional Practice Guidance on Planning & Noise

New Residential Development

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Chartered Institute of
Environmental Health



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Foreword

This Professional Practice Guidance on Planning and Noise (ProPG) has been produced to provide practitioners with guidance on a recommended approach to the management of noise within the planning system in England.

The National Planning Policy Framework (NPPF) encourages improved standards of design. The CIEH, IOA and the ANC have worked together to produce this guidance which encourages better acoustic design for new residential development and aims to protect people from the harmful effects of noise.

Good acoustic design is about more than the numbers. It is a holistic design process that creates places that are both comfortable and attractive to live in, where acoustics is considered integral to the living environment.

Good acoustic design can involve, for example, careful site layouts and better orientation of rooms within dwellings. Good acoustic design does not mean “gold plating” or significantly increasing costs. This guidance seeks to encourage and promote design outcomes that are proportionate and reasonable in the particular circumstances of each development site.

The Working Group recognises that whilst current Government planning and noise policy and guidance sets clear objectives it does not prescribe specific numerical acoustics standards and it allows a range of different approaches to be used. The Working Group believes that the approach encouraged by this ProPG will be suitable in the majority of situations likely to be encountered in practice. The use of this guidance will result in a more consistent approach which should help enable the speedier delivery of new homes.

The recommended approach detailed in this guidance includes a framework to enable situations where noise is not an issue to be clearly determined, and to help identify the extent of risk at noisier sites. Higher development costs should invariably be anticipated in those areas exposed to high levels of noise that may be harmful or otherwise unacceptable. The recommended approach provides opportunities to incorporate effective design interventions that will enable residential development to proceed in areas that might otherwise have been considered unsuitable. Inevitably, there may be some situations where it is not appropriate to build new dwellings. Even in those situations, this guide will assist as it encourages early identification of the risk of refusal and supports early decision making – thereby avoiding unnecessary development and design costs.

This guidance is aimed at practitioners rather than the general public and some, though not expert, knowledge of planning and acoustics principles is assumed. The document draws upon legislation, guidance and standards that were current at the time of publication.

This Professional Practice Guidance does not constitute an official government code of practice and neither replaces nor provides an authoritative interpretation of the law or government policy on which users should take their own advice as appropriate.

“Good acoustic design is about more than the numbers. It is a holistic design process...”

1. Introduction

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- 1.1 Noise can have a significant effect on the environment and on the health and quality of life of individuals and communities. Noise can interfere with residential and community amenity and the utility of noise-sensitive land uses. Noise exposure can lead to a range of adverse effects including sleep disturbance and annoyance. There is evidence that exposure to aviation noise while at school can impair cognitive learning in children. It is also agreed by many experts that there is an association between long term exposure to environmental noise and chronic health effects. For example, associations have been found between long term exposure to transport noise, particularly from aircraft and road traffic, and an increase in the risk of cardiovascular effects (heart disease and hypertension).
- 1.2 For these reasons, **noise is a material consideration in the planning process** and a **key aspect of sustainable development**. Noise must therefore be given serious attention when new developments might create additional noise and when new developments would be sensitive to prevailing acoustic conditions.
- 1.3 The scope of this ProPG is restricted to the consideration of new residential development that will be exposed predominantly (*see Section 2*) to airborne noise from transport sources (noting that good professional practice should have regard to any reasonably foreseeable changes in existing and/or new sources of noise). New apartments, flats and houses are the most common type of new residential development, however the guidance can also be applied to other types of residential developments such as residential institutions, care homes etc. Some of the content is relevant to other types of noise-sensitive development and to other sources of noise. However, detailed consideration of other noise-sensitive development (such as schools and hospitals), other sources of noise (such as dominant noise from industrial, commercial or entertainment premises) and of ground-borne noise and vibration, is outside the scope of this document.
- 1.4 This ProPG encourages improvements in the consistency and quality of plan-making and decision-taking in relation to acoustic matters. The context is primarily development control, although some of the content is relevant to strategic planning. Similarly, although the policy coverage is limited to England, the approach may be useful in other parts of the UK.
- 1.5 The preparation of this ProPG acknowledges and reflects the Government's overarching Noise Policy Statement for England (NPSE), the National Planning Policy Framework (NPPF) and Planning Practice Guidance (including PPG-Noise), as well as other authoritative sources of guidance.
- 1.6 This ProPG provides advice for Local Planning Authorities (LPAs) and developers, and their respective professional advisers. It aims to complement Government planning and noise policy and guidance. In particular, it strives to:
- advocate full consideration of the acoustic environment from the earliest possible stage of the development control process;
 - encourage the process of **good acoustic design** in and around new residential developments;
 - outline what should be taken into account in deciding planning applications for new noise-sensitive developments;
 - improve understanding of how to determine the extent of potential noise impact and effect; and
 - assist the delivery of sustainable development.



- 1.7 It is Government policy that noise should not be considered in isolation or separately from the economic, social and other environmental dimensions of proposed development. Furthermore, the NPPF states (para.152) that economic, social and environmental gains from development should ideally be sought jointly and advises LPAs to seek net gains across all three dimensions of sustainable development. However, there may be circumstances where the development need is such that it outweighs the adverse noise impacts. Conversely, unacceptable noise impacts may at times override other planning considerations. Recommendations are provided in this document on where such situations might arise.
- 1.8 It is also Government policy that LPAs should seek opportunities to protect, improve and enhance the environment, and this requires proper consideration of the acoustic environment around new residential developments. LPAs should develop policies that do more than simply tackle the highest noise levels, local policies should promote an acoustic environment that is appropriate to the local context.
- 1.9 The NPPF states (para.17) that planning should always seek to secure high quality design and a good standard of amenity for all existing and future occupants of land and buildings. This is considered to include securing good acoustic design in and around new residential development. Therefore this document describes an acoustic design process which seeks to deliver the best acoustic outcome for a particular site. In the longer term it is hoped that the publication of this ProPG will be a catalyst for new initiatives to recognise and promote good acoustic design in new residential development.
- 1.10 *Section 2* outlines a recommended approach to the management of noise with respect to new residential development within the planning system. The approach involves an initial, and relatively simple, risk assessment of the site to determine the likely importance of noise issues. A more detailed second stage includes a systematic assessment of relevant aspects of the development proposal supported by an Acoustic Design Statement. *Section 3* shows how following this approach leads the noise practitioner to a choice of one of four recommendations to the decision maker. A discussion supporting the approach to dealing with occasional loud noise events is included at *Appendix A*. Key aspects of the planning policy framework at the time of publication are described in *Supplementary Document 1*. Guidance on good acoustic design is contained in *Supplementary Document 2*.

“LPAs should seek opportunities to protect, improve and enhance the environment”

2. Recommended Approach for New Residential Development

Overview

- 2.1 The primary goal of this ProPG is to assist the delivery of sustainable development by promoting good health and well-being through the effective management of noise. It seeks to do that through encouraging a good acoustic design process in and around proposed new residential development having regard to national policy on planning and noise. This chapter describes the recommended approach for new residential development that would be exposed predominantly to noise from existing transport sources (noting that good professional practice should have regard to any reasonably foreseeable changes in existing and/or new sources of noise). The recommended approach is also considered suitable where some industrial or commercial noise contributes to the acoustic environment provided that it is “not dominant” (*see below*).
- 2.2 This ProPG advocates a systematic, proportionate, risk based, 2-stage, approach. The approach encourages early consideration of noise issues, facilitates straightforward accelerated decision making for lower risk sites, and assists proper consideration of noise issues where the acoustic environment is challenging. It is envisaged that following the guidance contained in this document will increase the likelihood of success of planning applications for new residential development, yet it also provides a clear basis for recommending refusal of new housing development on noise grounds where necessary.
- 2.3 The two sequential stages of the overall approach are:
- Stage 1 – an initial noise risk assessment of the proposed development site; and
 - Stage 2 – a systematic consideration of four key elements.
- 2.4 The four key elements to be undertaken in parallel during Stage 2 of the recommended approach are:
- Element 1 – demonstrating a “Good Acoustic Design Process”;
 - Element 2 – observing internal “Noise Level Guidelines”;
 - Element 3 – undertaking an “External Amenity Area Noise Assessment”;
 - Element 4 – consideration of “Other Relevant Issues”.
- 2.5 The approach is underpinned by the preparation and delivery of an “Acoustic Design Statement” (ADS). An ADS for a site assessed as high risk should be more detailed than for a site assessed as low risk. An ADS should not be necessary for a site assessed as negligible risk.
- 2.6 Having followed this approach to its end, it is envisaged that noise practitioners will then have a choice of one of four possible recommendations to present to the decision maker. In simple terms the choice of recommendation is as follows: grant without conditions, grant with conditions, “avoid” or “prevent” (*see Section 3*).



Stage 1: Initial Site Noise Risk Assessment

- 2.7 An initial noise risk assessment of the proposed development site should be conducted by a competent noise practitioner at the earliest opportunity, before any planning application is submitted. The noise risk assessment should provide an indication of the likely risk of adverse effects from noise were no subsequent mitigation to be included as part of the development proposal. It should indicate whether the proposed site is considered to pose a negligible, low, medium or high risk from a noise perspective.
- 2.8 The risk assessment should not include the impact of any new or additional mitigation measures that may subsequently be included in development proposals for the site and proposed as part of a subsequent planning application. In other words, the risk assessment should include the acoustic effect of any existing site features that will remain (e.g. retained buildings, changes in ground level) and exclude the acoustic effect of any site features that will not remain (e.g. buildings to be demolished, fences and barriers to be removed) if development proceeds.
- 2.9 The noise risk assessment may be based on measurement or prediction (or a combination) as appropriate, and should aim to describe noise levels over a “typical worst case” 24 hour day either now or in the foreseeable future. It may often be useful to liaise with the LPA regarding the most appropriate typical worst case scenario for the particular site. Care should be taken so that the risk assessment

includes the combined free-field noise level from all relevant sources of transport noise that affect the site. The assessment may also include industrial/commercial noise where this is present but is “not dominant” (see below).

- 2.10 Figure 1 summarises the Stage 1 Initial Site Noise Risk Assessment. The figure illustrates how an initial noise risk assessment is linked with an increasing risk of adverse effect from noise and how this in turn is broadly associated with indicative noise levels derived from current guidance and experience. The indicative noise levels are intended to provide a sense of the noise challenge at a potential residential development site and should be interpreted flexibly having regard to the locality, the project and the wider context. In the final column, the initial noise risk assessment is aligned with pre-planning application guidance that highlights the increasing importance of good acoustic design as the noise risk increases.
- 2.11 The overall Stage 1 approach is considered to support wider Government planning and noise policy and guidance at the date of publication of this document, including the NPPF, NPSE and PPG-Noise (*see Supplementary Document 1*).

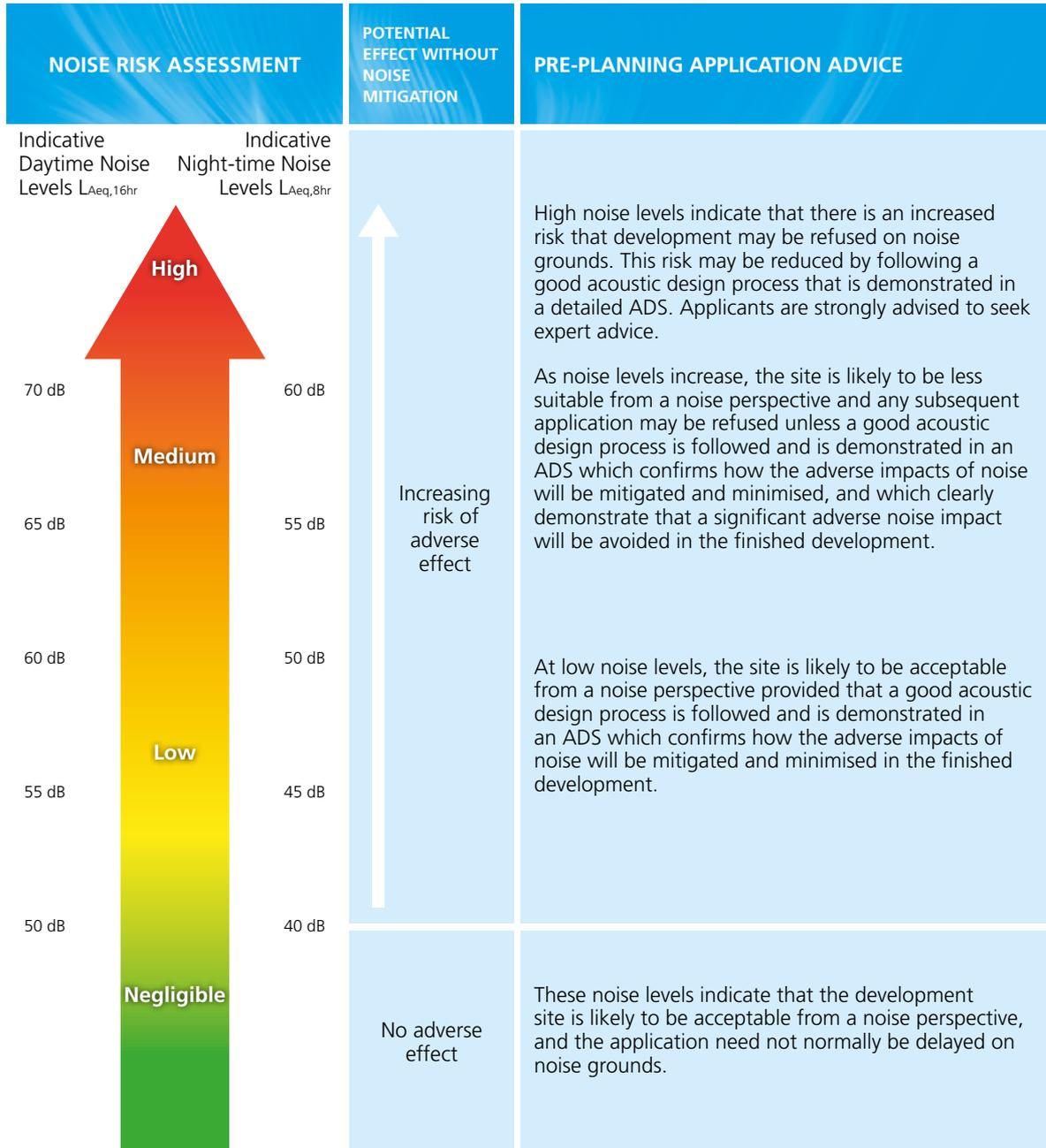


Figure 1 Notes:

- 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.

Figure 1. Stage 1– Initial Site Noise Risk Assessment



2.12 It is important that **the assessment of noise risk at a proposed residential development site is not the basis for the eventual recommendation to the decision maker.** The recommended approach is intended to give the developer, the noise practitioner, and the decision maker an early indication of the likely initial suitability of the site for new residential development from a noise perspective and the extent of the acoustic issues that would be faced. Thus, a site considered to be high risk will be recognised as presenting more acoustic challenges than a site considered as low risk. A site considered as negligible risk is likely to be acceptable from a noise perspective and need not normally be delayed on noise grounds. A potentially problematical site will be flagged at the earliest possible stage, with an increasing risk indicating the increasing importance of good acoustic design.

In the case of sites exposed to industrial and/or commercial noise:

2.13 As stated in the Introduction, the scope of this ProPG is restricted to sites that are exposed predominantly to noise from transportation sources. The key concerns regarding new residential development near existing industrial and/or commercial land uses are:

- The future occupants of the new noise sensitive development may be subject to adverse effects of noise, and
- The existing industrial and/or commercial business may become subject to complaints from future occupants of the new noise sensitive development and at risk of having to modify operations and/or incur additional costs.

2.14 In the special case where industrial or commercial noise is present on the site but is “not dominant” (i.e. where

the impact would be rated as lower than adverse (subject to context) if a BS4142:2014 assessment was to be carried out), its contribution may be included in the noise level used to establish the degree of risk (and if included, this should be clearly stated).

2.15 Where industrial or commercial noise is present on the site and is considered to be “dominant” (i.e. where the impact would be rated as adverse or greater (subject to context) if a BS4142:2014 assessment was to be carried out), then the risk assessment should not be applied to the industrial or commercial noise component and regard should be had to the guidance in BS4142:2014. The judgement on whether or not to undertake a BS4142 assessment to determine dominance should be proportionate to the level of risk. In low risk cases a subjective judgement of dominance, based on audibility, would normally be sufficient.

“increasing risk
indicating the
increasing importance
of good **acoustic
design**”

Stage 2: Full Assessment – the four key elements

2.16 Stage 2 of the recommended approach contains four key elements to be undertaken in parallel and each is considered in turn below in the following sub-sections.

STAGE 2: FULL ASSESSMENT – THE FOUR KEY ELEMENTS

Stage 2: Element 1 – Good Acoustic Design Process

Stage 2: Element 2 – Internal Noise Level Guidelines

Stage 2: Element 3 – External Amenity Area Noise Assessment

Stage 2: Element 4 – Assessment of Other Relevant Issues

Stage 2: Element 1 – Good Acoustic Design Process

- 2.17 Following a good acoustic design process is an implicit part of achieving good design as required by Government planning and noise policy, set out in the NPSE and NPPF, and as outlined in *Supplementary Document 1*.
- 2.18 It is imperative that acoustic design is considered at an early stage of the development control process.
- 2.19 A good acoustic design process takes a multi-faceted and integrated approach to achieve optimal acoustic conditions, both internally (inside noise-sensitive parts of the building(s)) and externally (in spaces to be used for amenity purposes).

- 2.20 Good acoustic design should avoid “unreasonable” acoustic conditions and prevent “unacceptable” acoustic conditions (these terms are defined in Element 2). Good acoustic design does not mean overdesign or gold plating of all new development but seeking to deliver the optimum acoustic outcome for a particular site.
- 2.21 Good acoustic design is not just compliance with recommended internal and external noise exposure standards. Good acoustic design should provide an integrated solution whereby the optimum acoustic outcome is achieved, without design compromises that will adversely affect living conditions and the quality of life of the inhabitants or other sustainable design objectives and requirements.
- 2.22 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. Any reliance upon building envelope insulation with closed windows should be justified in supporting documents.
- 2.23 Planning applications for new residential development should include evidence that the following aspects of good acoustic design have been properly considered:

THE PLANNING APPLICATION MUST (MAY BE ITERATIVE PROCESS):

- Check the feasibility of relocating, or reducing noise levels from relevant sources.
- Consider options for planning the site or building layout.
- Consider the orientation of proposed building(s).
- Select construction types and methods for meeting building performance requirements.
- Examine the effects of noise control measures on ventilation, fire regulation, health and safety, cost, CDM (construction, design and management) etc.
- Assess the viability of alternative solutions.
- Assess external amenity area noise.

2.24 *Supplementary Document 2* contains additional advice and guidance, and also outlines a proposal for a recognition/ award scheme intended to help encourage good acoustic design in new residential development and the dissemination of information in respect of good acoustic design practice.

2.25 Evidence that a good acoustic design process has been followed, suitably cross referenced to relevant features of the submitted application, should be included in a supporting **Acoustic Design Statement (ADS)** (*see below*).

Stage 2: Element 2 – Internal Noise Level Guidelines

2.26 The second element of Stage 2 is to seek to achieve recommended noise levels inside noise sensitive rooms in new residential development.

2.27 It is considered that suitable guidance on internal noise levels can be found in “BS8233:2014: Guidance on sound insulation and noise reduction for buildings”. Table 4 in Section 7.7.2 of the standard suggests indoor ambient noise levels for dwellings (when unoccupied) and states that “*in general, for steady external noise sources, it is desirable that the internal ambient noise level does not exceed the guideline values*”. The standard states (Section 7.7.1) that “*occupants are usually more tolerant of noise without a specific character*” and only noise without such character is considered in Table 4 of the standard.

“it is imperative that **acoustic design** is considered at an **early stage** of the development process”

ACTIVITY	LOCATION	07:00 – 23:00 HRS	23:00 – 07:00 HRS
Resting	Living room	35 dB $L_{Aeq,16\text{ hr}}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16\text{ hr}}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16\text{ hr}}$	30 dB $L_{Aeq,8\text{ hr}}$ 45 dB $L_{Amax,F}$ (Note 4)

NOTE 1 The Table provides recommended *internal* L_{Aeq} target levels for overall noise in the design of a building. These are the sum total of structure-borne and airborne noise sources. Ground-borne noise is assessed separately and is not included as part of these targets, as human response to ground-borne noise varies with many factors such as level, character, timing, occupant expectation and sensitivity.

NOTE 2 The *internal* L_{Aeq} target levels shown in the Table are based on the existing guidelines issued by the WHO and assume normal diurnal fluctuations in external noise. In cases where local conditions do not follow a typical diurnal pattern, for example on a road serving a port with high levels of traffic at certain times of the night, an appropriate alternative period, e.g. 1 hour, may be used, but the level should be selected to ensure consistency with the *internal* L_{Aeq} target levels recommended in the Table.

NOTE 3 These *internal* L_{Aeq} target levels are based on annual average data and do not have to be achieved in all circumstances. For example, it is normal to exclude occasional events, such as fireworks night or New Year's Eve.

NOTE 4 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. In most circumstances in noise-sensitive rooms at night (e.g. bedrooms) good acoustic design can be used so that individual noise events do not normally exceed 45dB $L_{Amax,F}$ more than 10 times a night. However, where it is not reasonably practicable to achieve this guideline then the judgement of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number, distribution, predictability and regularity of noise events (see Appendix A).

NOTE 5 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 internal target levels with windows open, internal noise levels can be assessed with windows closed, however any façade openings used to provide whole dwelling ventilation (e.g. trickle ventilators) should be assessed in the "open" position and, in this scenario, the internal L_{Aeq} target levels should not normally be exceeded, subject to the further advice in Note 7.

NOTE 6 Attention is drawn to the requirements of the Building Regulations.

NOTE 7 Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal L_{Aeq} target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved. The more often internal L_{Aeq} levels start to exceed the internal L_{Aeq} target levels by more than 5 dB, the more that most people are likely to regard them as "unreasonable". Where such exceedances are predicted, applicants should be required to show how the relevant number of rooms affected has been kept to a minimum. Once internal L_{Aeq} levels exceed the target levels by more than 10 dB, they are highly likely to be regarded as "unacceptable" by most people, particularly if such levels occur more than occasionally. Every effort should be made to avoid relevant rooms experiencing "unacceptable" noise levels at all and where such levels are likely to occur frequently, the development should be prevented in its proposed form (see Section 3.D).

Figure 2. ProPG Internal Noise Level Guidelines (additions to BS8233:2014 shown in blue)



- 2.28 The recommended ProPG internal noise level guidelines are described in *Figure 2*. These guidelines reflect and extend current practice contained in BS8233:2014. For clarity, blue italic font is used to highlight additions to the guidance contained in Table 4 of BS8233:2014. The dB values provided in the table for different activities are target levels. The table plus supporting notes are referred to as ProPG internal noise level guidelines.
- 2.29 External noise levels vary from day-to-day at most sites hence the internal L_{Aeq} target noise levels are annual averages (Note 3) and would normally represent typical conditions. Where there is significant variability in the noise exposure across the year and where annual average noise levels are not considered representative, then it may be more appropriate to average over a shorter time period. This situation may arise, for example, in the vicinity of airports that are likely to be busier in the summer months.
- 2.30 LPAs should initially seek to achieve the internal noise level guidelines in noise-sensitive rooms in new residential developments. However, national planning and noise policy does not require that those levels are always achieved, in particular, if to do so would disproportionately increase the cost of the development, or would lead to an outcome that does not meet the test of good acoustic design. Note 7 to BS8233:2014 provides advice on the possible relaxation of the internal target levels by up to 5 dB and Note 7 to *Figure 2* provides additional derived guidance on the circumstances when most people are likely to regard the internal L_{Aeq} noise levels as “unreasonable” or “unacceptable”. The use of these two terms is intentional and they form an integral part of the choice of recommendations to the decision maker as described in *Section 3*. Where internal levels are considered “unreasonable”, applicants should be required to show how the relevant number of rooms affected has been kept to a minimum. Every effort should be made to avoid occupants of relevant rooms experiencing “unacceptable” noise levels at all and where such levels are likely to occur frequently, the development should be prevented in its proposed form (see *Section 3D*).
- 2.31 Note 4 to BS8233:2014 highlights the potential impact of noise events on sleep but does not provide any specific guidance. Note 4 to *Figure 2* has been expanded to provide recommended guidelines for the maximum internal level of noise from individual external noise events. In noise-sensitive rooms at night (e.g. bedrooms) individual noise events (from all sources) should not normally exceed 45dB $L_{Amax,F}$ more than 10 times a night as this represents a threshold below which the effects of individual noise events on sleep can be regarded as negligible. *Appendix A* includes further discussion on the relationship between sleep and the maximum level of, and the number of, individual noise events. It is difficult, based on currently available evidence, to reach a clear conclusion on when the impact of individual noise events should be regarded as “unreasonable” or “unacceptable”. It is therefore recommended that a more detailed site and scheme specific assessment of the potential impact on occupants should be undertaken where individual noise events are expected to exceed 45dB $L_{Amax,F}$ more than 10 times a night.
- 2.32 The recommended internal noise level guidelines are supported by advice contained in the WHO Community Noise Guidelines (2000). More recent advice from the WHO (e.g. Table 1 in the WHO Night Noise Guidelines for Europe), indicates that more stringent control of maximum event noise levels inside buildings can avoid all risk of any detectable physiological effect (NOEL – no observed effect level). However, controlling to these values is not currently required by planning or noise policy and there is

substantial uncertainty regarding any resulting significant long term pathological effects of being exposed to these lower levels.

- 2.33 It should be noted that the acoustic performance of the building envelope will be reduced in the event windows are opened for ventilation or cooling purposes, typically reducing the insulation to no more than 10 to 15 dB(A). Most residents value the ability to open windows at will, for a variety of reasons, and LPAs should therefore normally request that designers principally aim, through the use of good acoustic design, to achieve the internal noise level guidelines in noise-sensitive rooms with windows open. Where internal noise levels are assessed with windows closed the justification for this should be included in the ADS.
- 2.34 Where the LPA accepts that there is a justification that the internal target noise levels can only be practically achieved with windows closed, which may be the case in urban areas and at sites adjacent to transportation noise sources, special care must be taken to design the accommodation so that it provides good standards of acoustics, ventilation and thermal comfort without unduly compromising other aspects of the living environment. In such circumstances, internal noise levels can be assessed with windows closed but with any façade openings used to provide “*whole dwelling ventilation*” in accordance with Building Regulations Approved Document F (e.g. trickle ventilators) in the open position (see *Supplementary Document 2*). Furthermore, in this scenario the internal L_{Aeq} target noise levels should not generally be exceeded.
- 2.35 It should also be noted that the internal noise level guidelines are generally not applicable under “*purge ventilation*” conditions as defined by Building Regulations Approved Document F, as this should only occur occasionally (e.g. to remove odour from painting and decorating or from burnt food).
- 2.36 In addition to providing purge ventilation, open windows can also be used to mitigate overheating. Therefore, should the LPA accept a scheme is to be assessed with windows closed, but this scheme is reliant on open windows to mitigate overheating, it is 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 in the ADS. It should be noted that overheating issues will vary across the country and any specific design solutions will need to be developed alongside advice from energy consultants.
- 2.37 Care should be taken when providing very high façade sound insulation in order to reduce the level of internal noise from external sources, as this may also reduce the extent to which a low level of steady external noise can help to mask any noise from neighbours. In such circumstances, it may therefore be necessary to consider improving the standard of sound insulation between dwellings to reduce the risk of hearing noise from neighbours.
- 2.38 Where mechanical services are used as part of the ventilation or thermal comfort strategy for the scheme, the impact of noise generated by these systems on occupants should also be assessed.
- 2.39 Evidence that internal noise levels are expected to be in accordance with the guidelines in *Figure 2* and the additional guidance above should be included in an accompanying **Acoustic Design Statement** (ADS) (see *below*).

In the case of sites exposed to industrial and/or commercial noise:

- 2.40 To be clear, where industrial and/or commercial noise is present on the site and is considered to be “dominant” (i.e. where the impact would be rated as adverse or greater (subject to context)) then this is outside the scope of this ProPG and regard should be had to the guidance in BS4142:2014.
- 2.41 In the special case where industrial and/or commercial noise is present on the site but is “not dominant” (i.e. where the impact would be rated as lower than adverse (subject to context) if a BS4142:2014 assessment was to be carried out), its contribution may be included in the noise level used to establish the degree of risk in Stage 1 and may also be included in the consideration of Stage 2 Element 2 Internal Noise Level Guidelines (and if included, this should be clearly stated).
- 2.42 However, great care should be taken when considering using the noise level guidelines in Figure 2 in circumstances where industrial and/or commercial noise is present but “not dominant”. Issues that may arise include:
- Are there particular acoustic features (tones, impulses etc.) in the industrial and/or commercial noise that may increase its effect compared to sounds without such features? Are there any non-acoustic features that may also have an effect?
 - Will the time averaging over the 16 hour day or 8 hour night intervals used in Figure 2 lead to underestimation of the impacts of industrial and/or commercial noise that may occur for shorter but still substantial periods at a higher level?

- 2.43 Professional judgement will have to be exercised in addressing these sorts of issues. One possible approach may be to apply BS4142:2014 character corrections to the noise level guideline values in order to derive suitable effect thresholds and/or mitigation design targets and to use the same reference time periods recommended in the standard.
- 2.44 It should also be noted that the presence of industrial and/or commercial noise on the site, even if it is “not dominant”, may also raise wider issues that should be addressed under the other elements of Stage 2.

Stage 2: Element 3 – External Amenity Area Noise Assessment

- 2.45 The third element of Stage 2 is a noise assessment of external amenity areas. The term “assessment” is deliberately used because this element concerns more than just the level of noise outside.
- 2.46 BS8233:2014 states that *“the acoustic environment of external amenity areas that are an intrinsic part of the overall design should always be assessed and noise levels should ideally not be above the range 50 – 55 dB LAeq,16hr”*. The standard continues... *“These guideline values may not be achievable in all circumstances where development might be desirable. In such a situation, development should be designed to achieve the lowest practicable noise levels in these external amenity spaces but should not be prohibited.”*
- 2.47 PPG-Noise states: *“If 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”*.

- 2.48 It is notable that both documents require a decision to be made regarding whether or not an external amenity area (or amenity space) is intrinsic to the required design for acoustic, or for other, reasons. However, the advice in BS8233:2014 states that the resulting noise levels outside are never a reason for refusal as long as levels are designed to be as low as practicable. Whereas, to comply with policy guidance any amenity space must have an acoustic environment so that it can be enjoyed as intended.
- 2.49 Developers are particularly encouraged to enter into pre-application discussions with the LPA where noise levels in proposed amenity spaces are likely to be above 55 dB $L_{Aeq,16hr}$ during a reasonably foreseeable typical worst case day. In particular, a professional judgement should be made on the need to provide access to a quiet or relatively quiet external amenity space as an intrinsic part of a good acoustic design process. This judgement will partly depend on the type of residential development and the intended occupancy, which, in turn, may need to be secured by condition.
- 2.50 Therefore the ProPG external amenity area noise assessment reflects and extends the advice contained in BS8233:2014 and the current Government guidance in PPG-Noise as detailed in the Element 3 box below. Full details of the external amenity area noise assessment should be included in an **Acoustic Design Statement** (ADS) (see below).

Element 3 – External Amenity Area Noise Assessment

- 3(i) *“If 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”.*
- 3(ii) *“The acoustic environment of external amenity areas that are an intrinsic part of the overall design should always be assessed and noise levels should ideally not be above the range 50 – 55 dB $L_{Aeq,16hr}$.”*
- 3(iii) *“These guideline values may not be achievable in all circumstances where development might be desirable. In such a situation, development should be designed to achieve the lowest practicable noise levels in these external amenity spaces.”*
- 3(iv) *Whether or not external amenity spaces are an intrinsic part of the overall design, consideration of the need to provide access to a quiet or relatively quiet external amenity space forms part of a good acoustic design process.*
- 3(v) *Where, despite following a good acoustic design process, significant adverse noise impacts remain on any private external amenity space (e.g. garden or balcony) then that impact may be partially off-set if the residents are provided, through the design of the development or the planning process, with access to:*
- *a relatively quiet facade (containing openable windows to habitable rooms) or a relatively quiet externally ventilated space (i.e. an enclosed balcony) as part of their dwelling; and/or*
 - *a relatively quiet alternative or additional external amenity space for sole use by a household, (e.g. a garden, roof garden or*



large open balcony in a different, protected, location); and/or

- *a relatively quiet, protected, nearby, external amenity space for sole use by a limited group of residents as part of the amenity of their dwellings; and/or*
- *a relatively quiet, protected, publically accessible, external amenity space (e.g. a public park or a local green space designated because of its tranquillity) that is nearby (e.g. within a 5 minutes walking distance). The local planning authority could link such provision to the definition and management of Quiet Areas under the Environmental Noise Regulations.*

- 2.51 LPAs will be best placed to provide guidance on the meaning of “relatively quiet” in any given location as this concept will inherently vary from one place to another. In addition, it may not be necessary for the whole of an external amenity area to be relatively quiet, nor for it to be relatively quiet all of the time. It is proposed that it may be helpful to define “relatively quiet” for the purposes of Element 3 as any situation where the typical average hourly daytime L_{A90} is more than 10 dB below the typical average hourly daytime L_{A90} noise levels in the immediate locality. However, other definitions of “relatively quiet”, including the use of other noise metrics or a locally set absolute noise level, may also be suitable depending on local circumstances.
- 2.52 PPG-Noise states that the availability of suitably protected quiet and tranquil outdoor places within, or close to, proposed new residential development in noisier locations may be regarded as a mitigating factor when such applications are determined. LPAs are therefore encouraged to formalise the protection

of quiet and tranquil places, including those within and near to existing and proposed residential areas, as part of their local plan making activities.

In the case of sites exposed to industrial and/or commercial noise:

- 2.53 Where external amenity areas are exposed to “dominant” industrial and/or commercial noise, the impact of the noise should be assessed in accordance with BS4142:2014 over the time period that the amenity area is likely to be used.
- 2.54 In the special case where industrial and/or commercial noise is present on the site but is “not dominant”, its contribution may be included in the noise level used to establish the degree of risk in Stage 1 and may also be included in the consideration of Stage 2 Element 3 External Amenity Area Noise Assessment (and if included, this should be clearly stated).

Stage 2: Element 4 – Assessment of Other Relevant Issues

- 2.55 The fourth and final element of Stage 2 is an assessment of other relevant issues. This element seeks to build upon relevant national and local planning and noise policies (item 4(i)) to provide a systematic list of recommendations for the issues that should be considered before making a judgement about the noise aspects of a particular planning proposal for new residential development.
- 2.56 Full details of the assessment of other relevant issues should be included in an **Acoustic Design Statement (ADS)** (see below).

Stage 2: Element 4 – Assessment of Other Relevant Issues

- 4(i) compliance with relevant national and local policy
- 4(ii) magnitude and extent of compliance with ProPG
- 4(iii) likely occupants of the development
- 4(iv) acoustic design v unintended adverse consequences
- 4(v) acoustic design v wider planning objectives

2.57 Not all of the issues listed above will arise in every planning application and some may already have been addressed as an inherent part of good acoustic design. In addition, LPAs may wish to add other relevant issues depending on local circumstances and priorities.

Element 4(i) compliance with relevant national and local policy

2.58 The NPSE sets out the Government's long term vision and aims for noise policy and the NPPF sets out relevant policies on planning and noise. Successful applications for new residential development will need to be in line with relevant national and local policy.

2.59 Further information on relevant national policy and guidance is contained in **Supplementary Document 1**. It can be seen that current national planning and noise policy does not take a prescriptive approach. For example, it is stated in the NPPF (para 109) that the planning system should prevent both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of noise pollution. In addition, the NPPF (para 123) states that that *significant* observed adverse effects should be avoided and further guidance in

PPG-Noise states that *unacceptable* adverse effects should be prevented. Subject to other issues, national planning policy does not require the prevention of adverse impacts, but instead requires that adverse impacts be mitigated and reduced to a minimum. Whilst current national planning and noise policy provides a clear steer it also contains sufficient flexibility to allow local interpretation.

2.60 In this regard, the NPSE encourages LAs to develop local noise policies that implement the national noise policy goals in a local context. The NPPF requires LPAs to prepare Local Plans with the objective of contributing to delivering sustainable development. Furthermore, planning and noise guidance in PPG-Noise currently permits LPAs to include specific noise standards in their Local Plans whilst cautioning that *"care should be taken... to avoid these being implemented as fixed thresholds as specific circumstances may justify some variation being allowed"*.

2.61 PPG-Noise (para. 6) already lists examples of the sorts of acoustic factors that influence whether noise could be a concern – these include the source and absolute level of the noise; the time of day noise occurs; the number, frequency and pattern of noise events; the spectral content of the noise (i.e. whether or not the noise contains particular high or low frequency content); the character of the noise (i.e. the presence of tones or other features such as impulsiveness), possible cumulative impacts from several sources as well as local topography. PPG-Noise also mentions some wider acoustic-related factors such as the planned character of the area (this should include consideration of the acoustic environment); the possible need to keep windows closed *"most of the time"* to keep out the noise; the possible need to provide acoustically suitable outdoor amenity space; and the potential effect on an existing business. These issues will always need to be considered as part of determining the extent of the noise impact and effect.



2.62 The Environmental Noise (England) Regulations (as amended) require the preparation of Noise Action Plans for certain major roads, railways and airports as well as large agglomerations. These Noise Action Plans and their supporting materials contain information which may be relevant to a proposed development site. In addition, a number of Important Areas that are exposed to the highest levels of noise are identified and are under investigation by the relevant transport authority to see what measures, if any, might be taken in order to assist with the implementation of the Government's policy on noise. LPAs may have specific local policies regarding new residential development in these Important Areas that will need to be considered.

2.63 It can be seen that there may be variation in the implementation of national planning and noise policy at the local level and, similarly, that there may be variation in the content, and flexibility in the application, of any local planning and noise policies.

Element 4(ii) magnitude and extent of compliance with ProPG

2.64 This ProPG primarily seeks to encourage a good acoustic design process (Stage 2 Element 1) for new residential development. It is recognised that it may not always be possible to achieve the internal noise level guidelines (Stage 2 Element 2) in all rooms within noise-sensitive developments. Where it is not possible to achieve the recommended standards in every respect, regard should be had to the number of dwellings and number of habitable rooms in each of the dwellings where the recommended standard cannot be achieved. Similarly, regard should be had to the extent to which the guidance on the external amenity area noise assessment (Stage 2 Element 3) has been followed, including whether access to a quiet or relatively quiet external amenity areas is considered necessary, and the extent of any adverse

impacts on external amenity areas that are an intrinsic part of the overall design.

2.65 It is recommended that supporting evidence demonstrating the magnitude and extent of compliance with this ProPG should be included in an ADS (*see below*).

Element 4(iii) likely occupants of the development

2.66 The detailed design may, to a certain extent, both reflect and influence the likely occupants of a new residential development. LPAs should bear in mind the extent to which occupants are likely to be able to exercise choice about living with the acoustic conditions in and around the proposed residential development. In addition, certain groups such as families with young children, students and the elderly may all have different requirements and sensitivities as regards acoustic conditions and, in particular, varying needs for access to quiet external space. Care should additionally be taken as far as possible to anticipate future changes in types of occupancy that may result in differing acoustic requirements.

Element 4(iv) acoustic design v unintended adverse consequences

2.67 Design measures taken to reduce intrusion by noise may have unintended adverse consequences for the building or the nearby environment and may affect the attractiveness of the living environment for the occupants. Examples include sealed up balconies that result in a lack of connection with the external environment, roadside barriers that remove views or prevent crossing roads, sealed facades that affect personal control over the internal environment etc. Wherever possible, such unintended adverse consequences should be obviated by good acoustic design.

Element 4(v) acoustic design v wider planning objectives

- 2.68 Some wider planning objectives may have unforeseen acoustic implications. For example, the encouragement of 'active facades' that overlook public footpaths etc. to ensure 'safe by design' could result in some residential units facing noisy streets or railways. The encouragement of active outdoor lifestyles may require the careful protection of amenity spaces from sources of transport noise. The creation of vibrant mixed use commercial and residential neighbourhoods can introduce particular challenges that will need to be overcome by careful acoustic design.

Acoustic Design Statement

- 2.69 An Acoustic Design Statement (ADS) should provide sufficient evidence that the ProPG Stage 1 and Stage 2 Elements 1 to 4 have been followed.
- 2.70 An ADS should be proportionate to the scale of the development and to the degree of noise risk at the proposed development site. An ADS should not normally be necessary where the noise risk has been properly assessed as negligible during Stage 1. The level of detail provided in an ADS should increase with increasing level of risk.
- 2.71 Applicants should always have regard to any local planning and noise policies and seek prior agreement from the LPA before deciding what level of detail is expected in an ADS to avoid misunderstanding and possible delays.
- 2.72 In general terms an ADS should be expected to address the following issues:
- a) Present the initial site noise risk assessment. This should include a description of the acoustic conditions prior to development and should determine the appropriate level of noise risk to the finished development were

no additional noise mitigation measures undertaken. Particular care should be taken to ensure that any noise events (as quantified by $L_{Amax,F}$) have been properly identified and assessed (see Appendix A). **(Stage 1)**.

- b) Describe the external noise levels that occur across the site (before and after any noise mitigation measures) in an appropriate level of detail that reflects the scale and height of the proposed development. The external post mitigation noise assessment should use an informed judgement of typical worst case conditions over the foreseeable future, but it should exclude atypical noise events. Noise mapping and modelling techniques are likely to be useful for more complex sites **(Stage 2)**.
- c) Demonstrate how good acoustic design is integrated into the overall design and how the proposed acoustic design responds to the specific circumstances of the site (exploiting opportunities and reflecting constraints) **(Stage 2 Element 1)**.
- d) Confirm how the internal noise level guidelines in Figure 2 will be achieved. Include, where relevant, full details of the design measures and building envelope specifications that will achieve the internal noise level guidelines. The LPA may request evidence of underlying calculations, in order to assist them in understanding any specific aspects of the assessment, which would need to be undertaken by a suitably qualified practitioner.
- e) A detailed assessment of the potential impact on occupants should be undertaken where individual noise events are expected to exceed 45 dB $L_{Amax,F}$ more than 10 times a night inside bedrooms (see Appendix A).



- f) Priority should be given, as part of good acoustic design, to enable the use of openable windows as extensively as is practical across the development site. Where it is not considered practical to achieve the internal noise level guidelines with windows open a justification should be provided to the LPA setting out the reasons for this. Where it is proposed that windows need to be closed in order to meet the internal noise guidelines then full details of the proposed ventilation and thermal comfort arrangements must be provided.
- g) Where the LPA accepts that there is a justification that the internal L_{Aeq} target noise levels can only be practically achieved with windows closed, and provided care has been taken to design the accommodation so that it provides good living conditions (in respect of acoustics, ventilation and thermal comfort), then internal noise levels can be assessed with windows closed. In this scenario any systems used to provide “whole dwelling ventilation” (e.g. trickle ventilators) should be in the open position and the internal L_{Aeq} target noise levels should not generally be exceeded. It should also be noted that the internal noise level guidelines are generally not applicable when windows or other natural ventilators are open solely to provide “purge ventilation” as this should only occur occasionally.
- h) Reasonable steps should be taken to minimise overheating during summer months through good design¹. Where openable windows / ventilators are proposed to mitigate overheating and where the internal noise level guidelines are likely to be exceeded when they are open a more detailed assessment of the potential impact on occupants during the overheating condition should be provided in the ADS. This more detailed assessment may include:
- (i) the alternative design measures considered / applied to reduce noise impact on occupants, (ii) the expected internal noise levels when windows / ventilators are opened to provide relief from overheating, and (iii) an estimate of the amount of time that windows are likely to be open to provide relief from overheating (*see above and Supplementary Document 2 Section 2.4*). It should be borne in mind that it can be difficult to undertake detailed overheating calculations at the planning stage as the required information may not be available (particularly for smaller schemes). **(Stage 2 Element 2)**.
- i) Present the findings of the external amenity area noise assessment – applying the information on external noise from (b) above to a wider consideration of the effects of noise on external amenity areas. This assessment should be more detailed in medium and high noise risk sites because of the higher external noise levels on site prior to development **(Stage 2 Element 3)**.
 - j) Present the findings of the assessment of other relevant issues. Close liaison with the LPA is recommended to fully address any local issues and local policies that are of particular importance to the specific scheme and locality **(Stage 2 Element 4)**.
 - k) Confirm, for a low noise risk site, how the adverse impacts of noise will be mitigated and minimised in the finished development **(NPPF)**.
 - l) Confirm, for a medium or high noise risk site, how the adverse impacts of noise will be mitigated and minimised and clearly demonstrate that a significant adverse noise impact has been avoided in the finished development **(NPPF)**.

¹ For more information refer to the UK Green Building Council Guide on Health and Wellbeing in Homes (July 2016)

Figure 3 provides an example of the typical *acoustic design* issues that are expected to be included in an ADS depending on the level of noise risk at a proposed development site. Other ADS requirements are as described above.

LPA's may wish to consider arranging an independent review of an ADS should they have any concerns about the contents of the submitted document.

Acoustic Design Statement (ADS)

An ADS for new housing should be proportionate to the scale of development and the extent of noise risk at the development site. An ADS should typically address the following issues:

TYPICAL ISSUES FOR LOW NOISE RISK SITES	ADDITIONAL ISSUES FOR MEDIUM/HIGH NOISE RISK SITES
Relevant noise sources identified	Multiple source contributions carefully quantified
Assess extent of noise risk for unmitigated site (current and foreseeable future, 15 years ahead)	Greater coverage across the site (all buildings, all relevant heights)
	Alternative site layouts considered
	Adequate non-sensitive use for screening
Opportunities to mitigate the noise source within the site	Opportunities to mitigate the noise source outside owned land Physical mitigation, operational management
Maximise separation	Existing topographical advantages Change site level
Noise barriers – screening opportunities	Barriers inside and outside the site
Site layout – protecting residential units	Design external amenity spaces (e.g. balconies) to reduce noise entering sensitive rooms
Site layout – protecting external amenity space	Access to quiet open space on or off-site
Non-sensitive elements as screens	Non-sensitive elements designed as screens
Building layout to self-screen sensitive rooms	Orientation of noise sensitive rooms away from the source of noise exposure i.e. quiet facades
Building treatment to screen openings	Consideration of alternative acoustic options
Window location & size on affected facades	Innovative facade and window designs e.g. plenum windows
	Facade insulation design
Ventilation – natural, from quiet facade	Acoustic performance of ventilation, thermal comfort
	Complete Acoustic Design Process throughout

Figure 3. Typical acoustic design issues to be included in an ADS

3. RECOMMENDATIONS TO THE DECISION MAKER

Overview

- 3.1 As indicated in *Section 2*, following the ProPG approach will lead to the choice of one of four possible recommendations from the noise practitioner to the decision maker:
- A. Planning consent may be granted without any need for noise conditions;
 - B. Planning consent may be granted subject to the inclusion of suitable noise conditions;
 - C. Planning consent should be refused on noise grounds in order to avoid significant adverse effects (“avoid”); or
 - D. Planning consent should be refused on noise grounds in order to prevent unacceptable adverse effects (“prevent”).

Recommendation – No objection on noise grounds

A. Grant consent without the need for noise conditions

- 3.2 Where the ProPG Stage 1 guidance has been followed and where a potential residential development site poses a negligible risk from a noise perspective, it should be possible for the noise practitioner to expedite consideration of the planning application on noise grounds and to recommend that planning consent may be granted without the need for noise conditions.
- 3.3 Similarly, and irrespective of the initial site noise risk assessment, where the ProPG Stage 2 guidance has been followed, and where the submitted development proposal is supported by an ADS that adequately demonstrates good acoustic design, then it should also be possible for the noise practitioner to recommend that planning consent may be granted without the need for additional noise conditions.

B. Grant consent with suitable noise conditions

- 3.4 In some circumstances it may be necessary for the noise practitioner to recommend that planning consent may be granted subject to the inclusion of suitable noise conditions, for example to address specific acoustic design aspects of a particular site, and/or to ensure that specific acoustic design details contained in an ADS are included in the finished development.
- 3.5 In most circumstances it is likely that following the ProPG guidance, in particular following a good acoustic design process and producing an accompanying ADS, should reduce delays and reduce the need for noise conditions.
- 3.6 *Supplementary Document 1* (Section 6) includes a summary of current Government guidance on the use of planning conditions and planning obligations.

Recommendation – Objection on noise grounds

- 3.7 Government policy contained in both the NPSE and the NPPF (see Supplementary Document 1) is to “aim to **avoid** noise from giving rise to significant adverse impacts on health and quality of life”. The Government’s subsequent guidance (PPG-Noise) contained advice that the planning process should be used to **avoid** a significant observed adverse effect, and to **prevent** an unacceptable adverse effect, from occurring.
- 3.8 The following two subsections therefore use the four elements of the ProPG Stage 2 guidance to seek to provide clarity on making the necessary distinction.

C. Recommend refusal – in order to “avoid” significant adverse effects

- 3.9 Accepting that there may be overwhelming reasons to the contrary, the noise practitioner should recommend that consent for a new housing development in its proposed form should be refused on noise grounds if:
- (1) There is a failure to follow a good acoustic design process (as part of the broader requirement for good design set out in the NPPF); OR
 - (2) Internal noise levels are regarded as “unreasonable” and the applicant has not shown that this impact has been mitigated and minimised; OR
 - (3) There is an unacceptable “external amenity area noise assessment” OR
 - (4) There is an unacceptable “assessment of other relevant issues”.
- 3.10 Note – The noise practitioner should also consider the need for inclusion of suitable noise conditions in the event that overwhelming reasons to override the recommendation are under consideration. In such cases close liaison with the planning decision maker will be essential.

D. Recommend refusal – in order to “prevent” unacceptable adverse effects

- 3.11 Notwithstanding that a good acoustic design process has been demonstrated, the noise practitioner should recommend that consent for a new housing development in its proposed form is prevented on noise grounds alone, regardless of any case for the development to proceed if:
- (1) Internal noise levels are regarded as “unreasonable” **AND either** there is an unacceptable “external amenity area noise assessment” **or** an unacceptable “assessment of other relevant issues”; OR
 - (2) Internal noise levels are regarded as “unacceptable”.

Recommendations concerning outline planning permission

- 3.12 Details submitted as part of an outline application must be treated by the LPA as forming part of any subsequent "full" application; conditions cannot be used to reserve consideration of these details for subsequent approval unless the applicant has made it clear that they were only illustrative. It is therefore recommended that an initial site noise risk assessment should be undertaken and that LPAs should not grant outline planning permission for new residential developments at sites considered to pose a medium or high noise risk without first being satisfied that good acoustic design will be able to overcome the acoustic challenges.
- 3.13 In particular, where a site is considered medium or high risk following an initial site noise risk assessment, it is recommended that the examination of acoustically critical issues such as site layout, building heights, materials, landform contouring, detailed design and landscaping, the location of vehicle and pedestrian access, boundary treatments, amenity spaces etc. should not be left for agreement at a later stage. Any changes in acoustically critical issues following grant of outline consent should be fully assessed in an ADS.

Recommendations to help improve future decision making

- 3.14 It is recommended that records should be kept of the location and scale of all new residential development that is permitted in circumstances where there is a potential risk of significant adverse effects arising from noise so that such properties (and any special acoustic design measures) can be specifically identified in the future. This information may be useful when interpreting any local or national analysis of population noise exposure, for example in connection with local noise strategies, noise maps, aircraft noise contours and Noise Action Plans.
- 3.15 It is recommended that LPAs should encourage developers to obtain post occupancy feedback from new residents on acoustic design issues for all new residential development that is permitted in circumstances where there is a potential risk of significant adverse effects arising from noise and that the lessons learned from such surveys should inform future good practice, including local and national plan-making and decision-taking activities.

Summary

3.16 A summary of the overall ProPG approach is provided in *Figure 4*.

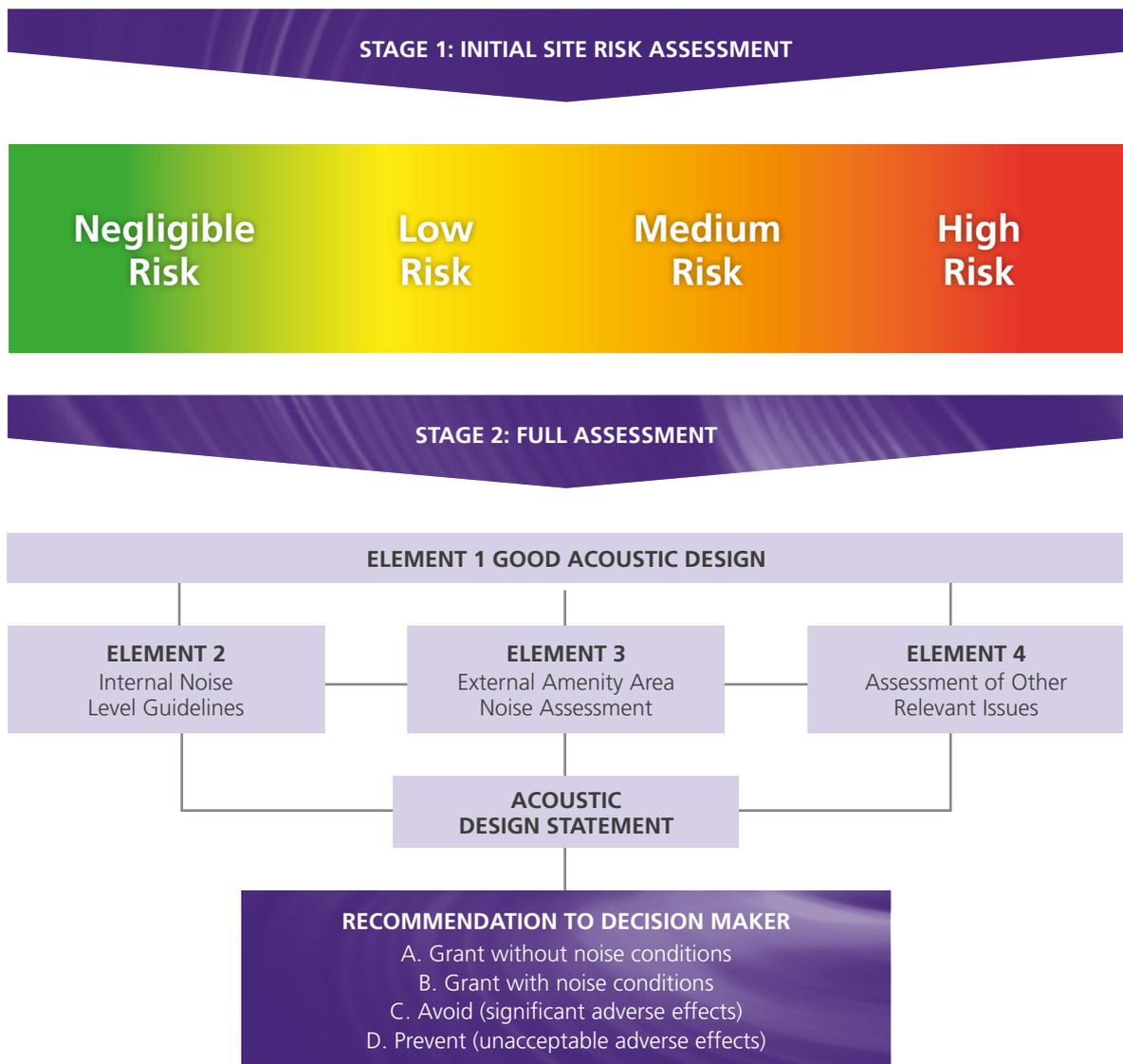


Figure 4 Summary of overall ProPG approach

4. FURTHER SPECIALIST ASSISTANCE

- 4.1 PPG-Noise currently contains the following advice:

“Noise is a complex technical issue, it may be appropriate to seek experienced specialist assistance when applying this policy.”

- 4.2 When seeking specialist assistance on noise matters it is essential that LPAs ensure that the assistance is provided from persons with specialist training, relevant up to date knowledge, appropriate experience, and access to suitable noise monitoring equipment. Noise surveys, noise impact assessments, acoustic mitigation design and report writing are best carried out by suitably qualified persons with appropriate knowledge, skills and experience. Specialist advice will also be useful when drafting, monitoring compliance with, and enforcing technical planning policies and planning obligations and conditions intended to control noise.

- 4.3 In the noise field, an indication of relevant experience will come from membership of a recognised body such as:

The Institute of Acoustics

45-49 Victoria Street, St Albans
Hertfordshire, AL1 3WZ, UK
Tel: +44(0) 1727 848195
www.ioa.org.uk

The Association of Noise Consultants

Airport House, Purley Way
Croydon, CR0 0XZ, UK
Tel: +44(0) 208 2534518;
www.theanc.co.uk

The Chartered Institute of Environmental Health

Chadwick Court, 15 Hatfields
London, SE1 8DJ
Tel: +44 (0) 207 827 6307
www.cieh.org

- 4.4 Similar principles apply when seeking “experienced specialist assistance” on planning matters. However, planning is made of a diversity of disciplines that together comprise the overall profession including local plan makers and decision takers, academics, specialist consulting firms, specialist stakeholder negotiators, and specialist planning law firms. In the planning field relevant professional expertise may be indicated by membership of the Royal Town Planning Institute (RTPI) although other affiliations may be appropriate depending on the nature of the assistance required.

APPENDIX A. DEALING WITH NOISE EVENTS

- A.1 The WHO Guidelines for Community Noise and the current edition of BS8233 recognise that assessing the impacts of noise on sleep only in terms of overall energy averaging metrics, such as the $L_{Aeq,T}$, can be insufficient to address all noise related sleep impacts. For example, research suggests that *“The equivalent noise level [i.e. $L_{Aeq,T}$] seems to be a suitable predictor for subjectively evaluated sleep quality but not for physiological disturbances of sleep”*². Furthermore many studies³ have shown clear exposure response relationships between the maximum level of individual noise events and impacts during sleep such as arousals, awakenings or body movements. Consequently, when assessing impacts of noise on sleep it is often appropriate to supplement the assessment of the overall noise levels at night measured using the $L_{Aeq,T}$ index by also considering the noise from individual noise events, typically described with the L_{Amax} or the SEL noise metrics.
- A.2 Before going on to consider how to use L_{Amax} or the SEL metrics to assess the impacts of discrete noise events on sleep it is worthwhile considering how noise can effect sleep. Phrases like “sleep disturbance”, “sleep interference” or ‘sleep interruption’ imply that the noise from individual noise events would fully awaken people who are asleep i.e. they would become completely conscious. However, the ‘effects’ of noise on sleep referred to in the WHO Guidelines and the vast majority of research and wider literature etc. cover many impacts during sleep, not solely being woken up. In order to understand the effects of these impacts it is important to recognise that sleep consists of a cycle of alternating stages which during a typical night repeats roughly every 90 minutes. This cycle consists of stages 1 and 2 of light non-rapid eye movement (NREM) sleep, a stage 3 of heavy sleep followed by a stage of rapid eye movement (REM) heavy sleep.
- A.3 The noise level threshold for awakening is highest in the stage 3 and REM stages of heavy sleep, and is lower in the light sleep stages 1 and 2⁴. The awakening noise threshold also depends on the characteristics of the noise e.g. intermittent noises or rapid on-set⁵ noise events have greater impact than continuous noise or slower onset noise events; as well as the connotation of the noise. For example, whispering the sleeper’s name can awake the person more easily than a much louder but anonymous noise⁶. Similarly the noise of an alarm or warning will awaken a sleeper more easily than a noise of similar level without any particular meaning.
- A.4 Noise effects on sleep increase arousal levels leading to a redistribution of time spent in the different stages of sleep, with typically an increase in the duration of the awake and light sleep stages 1 and 2 as these are more easily disturbed by noise; and a reduction of time in the heavy sleep stage 3 and REM parts of the cycle. Such sleep fragmentation has been shown to affect, among other effects, waking psychomotor function, next day performance, memory, creativity, risk-taking behaviour, mood, signal detection performance, daytime fatigue and

² B Griefahn, A Marks, C Kuenemund & M Basner, Awakenings by Road, rail and Air traffic noise, Forum Acusticum, 2005.

³ E.g. Basner M, Isermann U, Elmenhorst D et al. Effects of nocturnal aircraft noise (Vol1): executive summary. Deutsches Zentrum Fur Luft-und Raumfahrt (DLR) Cologne, Germany 2004:FB2004-07/E; Marks A, Griefahn B, Basner M, Event related awakenings caused by nocturnal transportation noise. Noise Control Eng J 2008; 31:569-77; and, Passchier-Vermeer, Vos H, Stenbeekeers J H M, Van der Ploeg FD, Groothuis-Oudshoorn K. Sleep disturbance and aircraft noise exposure effect relationships. TNO Netherlands 2002: Report 2002.027:1-245.

⁴ Muzet A. Re’activite’ de l’Homme endormi. In: Benoit O, Foret J, editors. Le Sommeil humain. Bases experimentales physiologiques et physiopathologiques. Paris: Masson; 1992. p. 77–83.

⁵ The rate at which the instantaneous noise levels rise from around the ambient level to the maximum level during the noise event e.g. road vehicle or train pass by or aircraft over flight.

⁶ Oswald I, Taylor AM, Treisman M. Discriminative responses to stimulation during human sleep. Brain 1960; 83:440–53.



tiredness and to increase accident risks. The degree to which these effects occur varies at any particular sound level and the association with noise in some cases is not particularly strong.

A.5 Classification and determination of sleep states is best achieved using a polysomnograph (a multi-channel electronic device which records brainwave, heart, muscle and breathing data). An important general finding of sleep research is that the noise levels at which impacts occur in laboratory-based studies are lower, often by a substantial degree, than those found in field studies⁷. This is thought to be due to the unfamiliar nature of laboratory conditions compared to the circumstances in a test subject's own bedroom to which they have adapted/habituated over time. Consequently, field sleep studies in the subject's home are regarded as a more reliable means of testing the effects of noise on sleep than laboratory based experiments. Until relatively recently polysomnographs were large, complex and cumbersome items of equipment best used in controlled laboratory conditions rather than in a bedroom at home. However, modern sleep studies benefit from the availability of smaller and more convenient polysomnographs better suited to use in field studies than previous generations of equipment. Even so, there are currently only a small number of suitable polysomnography based field studies on the effects of noise on sleep⁸. Consequently other studies using different means of appraising noise effects on sleep also need to be considered e.g. motility and self-recording and reporting.

A.6 It is important to recognise that typically many awakening events are unrelated to noise and that normally the average person is subject to several spontaneous awakenings per night independent of any effects of noise. For example the WHO Community Noise Guidelines at section 3.4 advises that *"It is estimated that 80-90% of the reported cases of sleep disturbance in noisy environments are for reasons other than noise originating outdoors. For example, sanitary needs; indoor noises from other occupants; worries; illness; and climate (e.g. Reyner & Horne 1995)"*.

A.7 It is also important to understand what the word 'awakening' means. When the word is used colloquially, most regard it as meaning being fully awake to the degree that they can recall having been awakened the following morning. Some noise and sleep research has focussed on this type of awakening by requiring the subject to press a button to record their awakening (this is called a 'behavioural awakening'). However, the scientific meaning of the term awakening covers a wider range of responses, many of which do not involve awareness or recollection of being conscious. In order to understand the results of the research of the effects of noise on sleep it is therefore important to be able to distinguish between various kinds of awakening, for example:

- Behavioural awakening - equivalent to the everyday understanding of conscious 'awakening', when the subject is usually aware of being conscious at the time and can often recall being 'awake' the next day;

⁷ See Section 3.4 in the WHO Community Noise Guidelines

⁸ For example, M Basner and S McGuire. Update on the WHO's Community Noise Guidelines: Evidence review on the effects on sleep, Inter-Noise 2016 - identifies only 4 polysomnographic studies on air, road and rail sources suitable for consideration in the revision of the WHO guidance.

- Physiological awakening - defined by changes in sleep stages measured by a polysomnograph or an EEG, which the subject may not be aware of at the time or recall the next day; and
- The onset and degree of 'motility' i.e. body movements which the subject may not be aware of at the time or recall the next day – typically measured using wrist watch like actimeters.

A.8 Where research is in terms of physiological awakenings measured using polysomnography or an EEG, it should be noted that typically only around 1 in 12 awakenings is of sufficient duration to become a behavioural awakening. In addition it should be recognised that physiological awakenings are part of the normal architecture of sleep with on average 24 EEG awakenings occurring at night independent of any noise effects⁹.

A.9 The above shows that at a physiological level sleep disturbance due to noise can occur, although behavioural awakening may not result. In other words, there are noise impacts on sleep that can be measured by examining changes in EEG patterns or a person's motility, but the person would not necessarily be aware of these impacts and they may not have adverse or significant adverse pathological effects. Therefore care should be taken to not ascribe significance to impacts on sleep detectable at a physiological level, that may occur or appear to occur as a result of noise impacts, as they may not reflect significant pathological effects or even the impact of noise (because they are part of normal sleep).

A.10 The distinction between detectable impacts and adverse and significant adverse effects of noise on sleep is highlighted in the Government's Planning Practice Guidance in the table summarising the noise exposure hierarchy where it states that:

- Noise with the "potential for some reported sleep disturbance" is an "Observed Adverse Effect" that should be mitigated and reduced to a minimum; and
- Noise with the "potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep" is a "Significant Observed Adverse Effect" that should be avoided; and
- Noise that causes "regular sleep deprivation/awakening" is a "Significant Observed Adverse Effect" that should be prevented.

A.11 The relationship between the maximum noise level of a noise event and the number of intermittent noise events and the effects upon sleep has been debated for many years. It is generally accepted, however, that the smaller the number of noise events, the higher the maximum levels that can be withstood without adverse effects on sleep¹⁰ (up to an upper limit, and providing the overarching noise level during the overall sleep period e.g. $L_{Aeq,T}$ does not exceed a suitable threshold).

⁹ Rechtschaffen A, Kales A, Berger R J et al. A manual of standardised terminology, techniques, and scoring system for sleep stages of human subjects. Public Health Service, US Government, Printing Offices, Washington DC 1968.

¹⁰ B Grieffahn (1992). Noise control During the Night. Proposals for Continuous and Intermittent Noise. B Grieffahn. Acoustics Australia. Vol 20 No 2 43 -47.



- A.12 Consequently, the L_{Amax} of noise events plus the number of events can be used as the basis of assessing impact; although this is subject to an upper limit. For example work¹¹ which informs the WHO community noise guidelines recommendation that peak noise in bedrooms should not exceed 45 dB L_{Amax} more than 10 to 15 times per night concluded that *“It will be noted in particular that the tolerance to noise in regard to sleep passes through a maximum value for an optimum number of 10 to 15 flights per night and that beyond 20 to 25 occurrences of noise per night the aircraft need to be very quiet or the dwellings provided with excellent sound proofing”*.
- A.13 Separate work in the publication *“Public health impact of large airports”* by the Netherlands Health Council (Gezondheidsraad 1999), based on data from an evaluation of literature, concluded that a sound exposure level (SEL) of 50 dB (A) at the ear of a sleeping person is the onset point of awakenings. This value corresponds with a maximum noise level event of L_{Amax} around 43 dB, assuming that the time taken for the noise level to fall from its peak value to a level 10 dB lower is 10 seconds. In addition other work¹² has demonstrated that the number of tolerable night noise events ranges from 10 to 15 per night for indoor L_{Amax} noise levels of around 55 dB to 45 dB respectively. More recent work¹³ has concluded that whilst *“given a certain equivalent noise level, additional information [i.e. L_{Amax} data] on the overall number of events does not improve the prediction of sleep quality. However, the number of events above L_{Amax} of 60 dB was related to an increase in mean motility, indicating lower sleep quality”*.
- A.14 In a laboratory study on the effects of both intermittent and continuous road traffic noise, the noise of 50 lorry pass-bys of both 45 and 55 dB L_{Amax} was presented and EEG traces examined¹⁴. Changes in sleep stages were seen for the 45 dB L_{Amax} lorry pass-bys, but it required the 55 dB L_{Amax} pass-bys to induce EEG awakenings.
- A.15 However, there is research that indicates impacts of individual noise events on sleep at relatively low maximum noise levels. For example studies¹⁵ have found that *“the threshold of aircraft noise-induced motility during events is L_{max} indoor of 32dBA”*. At these levels the probability of increased motility associated with a noise event was found to increase just above the equivalent probability with no noise event taking place i.e. there appeared to be no observed effect below this level. This should be considered in the light of the finding in the same study that the probability of awakening at a L_{Amax} noise level at the ear of around 27 dB was 7.2% and rose to only 18.4% at around L_{Amax} 73 dB.

¹¹ Vallet M and Vernet I 1991 Night aircraft noise index and sleep research results. In A. Lawrence (ed.), *Inter-Noise 91. The Cost of Noise*, Vol. 1, pp. 207-210. Noise Control Foundation, Poughkeepsie, NY, USA.

¹² Spreng, M. (2002) Cortisol excitation, cortisol excretion, and estimation of tolerable nightly overflights. *Noise and health*. (4) 39-46; and; Basner, M., Samel, A., Isermann, U. (2006) Aircraft noise effects on sleep: Application of the results of a large polysomnographic field study. *J. Acoust. Soc. Am.* (119) 2772-2784

¹³ S.A. Janssen et al. The effect of the number of aircraft noise events on sleep quality. *Applied Acoustics* 84 (2014) 9–16

¹⁴ Eberhardt JL et al. The influence of continuous and intermittent traffic noise on sleep. Eberhardt JL et al. *Journal of Sound and Vibration* 116(3) 1987.

¹⁵ Passchier-Vermeer W. et al. 2002. Sleep disturbance and aircraft noise exposure, Exposure effects relationships, TNO report 2002-027; and; Basner, M., et al. “Aircraft noise effects on sleep: final results of DLR laboratory and field studies of 2240 polysomnographically recorded subject nights.” 33rd International Congress and Exposition on Noise Control Engineering (Internoise 2004), Prague/Czech Republic. 2004.

- A.16 Intermittent heavy vehicle noise has also been used as the basis for specific research on the importance of the number of noise events¹⁶. However, rather than physiologically-based measures of sleep depth, the quality of sleep was assessed using a questionnaire completed within 15 minutes of the subjects waking in the morning. The subjects were exposed to 4, 8, 16 and 64 heavy vehicle pass-bys at both 50 and 60 dB L_{Amax} . The results for the higher (60 dB L_{Amax}) noise level pass-bys showed decreases in the quality of sleep for both 16 and 64 events but there was only a marked deterioration in the reported quality of sleep when subjects were exposed to 64 of the lower noise events (50 dB L_{Amax}).
- A.17 Various studies¹⁷ have linked the L_{Amax} from individual noise events to behavioural awakenings. For example one study found that the *“Probability of sleep stage changes to wake/S1 from railway noise increased significantly from 6.5% at 35 dB(A) to 20.5% at 80 dB(A) $L_{Amax,F}$ ”*; whilst another study concluded that *“noise disturbance of sleep may be expected to become significant once the outdoor L_{Aeq} exceeds 55 dB provided peak noise levels do not exceed 75 to 80 dB. Higher L_{Aeq} values up to 60 dB may be allowed providing the peak levels do not exceed 85 dB, and the number of such events is less than about 20 per night”*. Based on these studies it can be concluded that at night (2300 - 0700 hrs) a significant effect on sleep disturbance e.g. behavioural awakening, is likely to occur where the maximum sound level at the façade of a building with partially open windows is above:
- 85 dB $L_{Amax,F}$ (where the number of events exceeding this value is ≤ 20); or
 - 80 dB $L_{Amax,F}$ (where the number of events exceeding this value is > 20).
- A.18 The main body of sleep research is consistent with a careful interpretation of the viewpoint set out in the World Health Organisation Guidelines which for the ordinary population is that:
- Impacts on sleep can be detected from relatively low level maximum noise events, however the degree of resulting harm may not be significant.
 - ‘Effects’ on sleep (such as EEG awakenings and sleep stage changes) occur spontaneously in the general population many times per night regardless of any impacts due to noise.
 - The smaller the number of noise events, the louder the maximum noise level that can be tolerated without adverse effects upon sleep; subject to an upper limit.
 - At relatively low levels e.g. around 45 dB $L_{Amax,F}$ when sufficient number of such events take place during the night the adverse effects of individual noise events are likely to be limited to sleep disturbance in the form of changes in sleep state or perhaps some EEG awakenings.
 - It normally requires noise levels higher than 45 dB $L_{Amax,F}$ before significant adverse effects such as behavioural awakenings, difficulty getting to sleep, premature awakening or difficulty

¹⁶ Sleep disturbance by road traffic noise – a laboratory study on number of noise events. Ohstrom E and Rylander R. Journal of Sound and Vibration 143 (1) 1990.

¹⁷ For example; E M. Elmenhorst, et al (2012), Examining nocturnal railway noise and aircraft noise in the field: sleep, psychomotor performance and annoyance. Science of the Total Environment, 424; and, M. Basner et al. (2011), Single and Combined Effects of Air, Road, and Rail Traffic Noise on Sleep and Recuperation. SLEEP 34(1); and, C.G. Rice and P.A. Morgan (1982). A synthesis of studies on noise induced sleep disturbance. ISVR Memorandum No. 623.

getting back to sleep generally occur (and the latest field research on rail and aircraft noise suggest that it requires internal L_{Amax} noise levels of around 65 dB before noise induced awakenings become distinguishable from spontaneous awakenings).

- A.19 In the light of the above it is clear, as recognised by BS8233, that the effects of noise on sleep from individual noise events are an important consideration; and that the initial site noise risk assessment should include the consideration of the individual noise events when the external $L_{Amax,F}$ exceeds 60 dB. A site should not be regarded as negligible risk if the $L_{Amax,F}$ exceeds, or is likely to exceed 60 dB more than 10 times a night. A site should be regarded as high risk if the $L_{Amax,F}$ exceeds, or is likely to exceed 80 dB more than 20 times a night.
- A.20 In the context of providing new residential accommodation good acoustic design can normally be used to avoid the potential significant adverse effects of individual noise events on sleep i.e. behavioural awakenings, and to appropriately mitigate and minimise the adverse effects of noise from individual noise events on sleep i.e. physiological impacts. Therefore, it is considered that if, in bedrooms at night, the $L_{Amax,F}$ from individual noise events (from all sources) would not normally exceed 45dB more than 10 times a night, then this represents a reasonable threshold below which the effects of individual noise events on sleep can be regarded as negligible.
- A.21 In most circumstances in noise-sensitive rooms at night (e.g. bedrooms) good acoustic design can be used so that individual noise events do not normally exceed 45dB $L_{Amax,F}$ more than 10 times a night. However where it is not reasonably practicable to achieve this guideline then the judgement of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number, distribution, predictability and regularity of noise events.
- A.22 In such a case it is recommended that a more detailed assessment should be undertaken using available dose-response relationships appropriate for the types of noise sources being considered, in line with the WHO Night Noise Guidelines publication and any other relevant research. This assessment should advise decision makers to what extent adverse effects from individual noise events on sleep will be mitigated and minimised, and report the likely residual effects on sleep of affected persons.
- A.23 Further advice from the WHO (e.g. Table 1 in the WHO Night Noise Guidelines for Europe) and the relevant underlying studies indicates that more stringent control of maximum noise levels could eliminate all risk of any detectable physiological effect i.e. achieve NOEL – No Observed Effect Level. However, controlling to these values is not at present required by policy in England; or considered to be a realistic or achievable goal given there is substantial uncertainty regarding any resulting significant pathological effects at these lower maximum noise levels; and in the context of the current night time acoustic environment across most of urban England¹⁸ which shows that such low values are likely to be exceeded in bedrooms with windows partially open in all but the most remote and quietest parts of the country.

¹⁸ The National Noise Incidence Study 2000/2001 (United Kingdom): Volume 1 Noise Levels. Prepared by the Building Research Establishment for DEFRA, The National Assembly for Wales, the Scottish Executive and the Department of the Environment for Northern Ireland. February 2002.

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