RSK Acoustics

North West Bicester – Hawkwell Village

Outline Acoustic Assessment

Appendix 7.1

North West Bicester – Hawkwell Village

Outline Acoustic Assessment

Appendix 7.1

Hallam Land Management Limited

3 Apex Court
Woodlands
Bradley Stoke Bristol
BS32 4JT

Description	Date	Prepared	Approved
Final Issue	20 December 2021	Tim Fox	Adam Sharpe

RSK Acoustics Limited Reg. in England and Wales No. 7102436
rskacoustics.com info@rskacoustics.com +44 (0)1932 829007
Registered Office: Spring Lodge, 172 Chester Road, Helsby, WA6 0AR
Addlestone | Bristol | Coventry | Glasgow | Helsby | Hemel | Leeds | Manchester

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Outline Acoustic Assessment

1 Introduction

1.1 Planning permission is sought for mixed use development to include up to 3,100 residential dwellings, a primary school and commercial spaces on a broad area of land to the northwest of Bicester.

1.2 RSK Acoustics have been instructed to conduct a noise impact assessment for the proposed development and provide details of any mitigation measures required to ensure that a good level of amenity can be achieved within the new dwellings.

1.3 This report provides details of an environmental noise survey undertaken at the site along with an assessment of noise break-in to the proposed dwellings in line with relevant planning and guidance documentation. Where necessary, details of mitigation measures have been provided.

2 Site Description

2.1 The proposed development site is located to the north west of Bicester. The site is currently farmland which has been allocated for a residential development as well as the development of a new primary school, together with social and community facilities, business and retail accommodation. The site and its surrounds are illustrated on attached site plan 206/0079/SP1 rev.1.

2.2 The site is bound to the south by the A4095 beyond which is the town of Bicester and to the west by a trainline which runs the length of the site. The A4095 is to be realigned within the southern parcel of the site. The rail line is raised approximately 5 m above the level of the field. Bucknell Road leading to Bicester Road runs through the site on the west side.

2.3 To the north of the site is arable land leading up to the small village of Bucknell. To the east of the site is Elmsbrook containing residential and business properties as well as a primary school, the 1st phase of the North West Bicester development. The B4100 is beyond this development.

2.4 There are existing properties located within the development area which will be retained. These include Hawkwell Farm towards the western side of the site and Blanchford Building Supplies in the south west corner of the site.

3 Planning Guidance and Criteria

3.1 **Planning Guidance**

3.1.1 Guidance is available from various sources to aid the assessment and establish suitable criteria which the development should strive towards. Full details of relevant national planning guidance, local planning policy and design criteria are included in attached Annex A.

3.2 Proposed Residential Noise Criteria

3.2.1 Based on the guidance as set out in attached Annex A, the following noise level criteria are proposed:

Road traffic and railway noise

- Daytime $L_{Aeq,16hour}$ within habitable rooms no greater than 35 dB;
- Night time $L_{Aeq,8hour}$ within all bedrooms no greater than 30 dB;
- Night time L_{Amax} within bedrooms no greater than 45 dB (for typical[1] events).

3.2.2 We note the 'typical' event for maximum noise levels should apply to regularly occurring maximum noise levels experienced.

External amenity areas

3.2.3 External areas cannot, by definition, be contained or benefit from the levels of noise mitigation that are available to internal spaces within buildings. As a consequence, design standards for external noise cannot be considered as thresholds that determine whether a high quality design has been implemented and a good level of amenity achieved. Rather, the external noise standards should be used to establish whether mitigation is appropriate as a means of minimising the adverse impacts of environmental noise.

3.2.4 Paragraph 7.7.3.2 of BS 8233:2014 states:

"For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited."

3.2.5 The important principle here is that sustainable development sites will often be exposed to relatively high levels of environmental noise, and while means are available to insulate internal spaces, they are not always available to protect external spaces. This is why the external target of 55 dB $L_{Aeq,16hr}$ shall be viewed as an aspirational target or trigger where mitigation measures should be considered rather than thresholds not to be exceeded in all circumstances.

[1] Typical L_{Amax} corresponding to the level not exceeded more than 10 times per night-time period.

3.3 Proposed School Noise Criteria

Building Bulletin 93 (BB93)

3.3.1 The proposed new school block will have to be fully compliant with BB93 as it is a means of complying with Building Regulations' requirements.

3.3.2 BB93 indicates the minimum required performance standards for teaching spaces within school buildings, in terms of noise ingress and other acoustic parameters. Section 1.1 is related to indoor ambient noise levels (IANLs).

3.3.3 The assessment IANLs should include noise contributions from external sources outside the school premises (including, but not limited to, noise from road, rail and air traffic, industrial and commercial premises) as well as building services (i.e. mechanical ventilation systems).

3.3.4 The IANLs should exclude noise contributions from teaching activities within the school premises, including noise from staff, students and equipment within the building or in the playground. This is specifically set out in section 1.1.1 of BB93.

3.3.5 The criterion for typical classrooms is 35 dB $L_{Aeq,30mins}$. There is some flexibility on these limits depending on ventilation strategy; under some circumstances the limits can be relaxed.

Ventilation Design Requirements

3.3.6 Table 2 of BB93 and its accompanying notes set out the following requirements in terms of IANLs for different ventilation methods.

- With normal condition ventilation provided mechanically, either via fully mechanical or hybrid systems, IANLs from the mechanical elements should not exceed those levels set out in BB93 Table 1
- With normal condition ventilation provided naturally, or using a hybrid system, IANLs from total system noise should not exceed those levels set out in BB93 Table 1 by more than 5 dB
- With summertime and intermittent boost ventilation provided mechanically, IANLs should not exceed those levels set out in BB93 Table 1 by more than 5 dB
- With summertime and intermittent boost ventilation provided naturally, IANLs should not exceed 55 dB $L_{Aeq,30min}$
- Normal condition for a mechanical supply is typically equivalent to approximately 8l/s per person (additional carbon dioxide concentration requirements apply)
- Normal condition for a natural or hybrid supply is typically equivalent to approximately 5l/s per person (additional carbon dioxide concentration requirements apply)

- The + 5 dB criteria do not apply to teaching and learning spaces where the Table 1 level is 45 dB or greater

3.3.7 In addition to the above, noise from ventilators actuators or dampers should not exceed 5 dB above the resultant IANL based on the points set out above.

3.3.8 Discrete noise events, such as aircraft flyovers, should not exceed 60 dB $L_{A1,\ 30mins}$. It is stated within BB93 that this is achieved by default for spaces with IANLs up to 40 dB $L_{Aeq,\ 30min}$.

4 Environmental Noise Survey

4.1 **Methodology & Instrumentation**

4.1.1 An unattended environmental noise survey was undertaken at the site between 25th February 2021 and 1st March 2021.

4.1.2 Noise measurements were used to quantify the ambient noise levels at the site during day and night time periods at key locations around the site. The sound level meters were left for multiple days to ensure that the measured noise levels were representative.

4.1.3 The measurement positions are marked on the attached site plan 206/0079/SP1 rev.1 and are described as follows.

- MP1 – Free-field position located 1.5 m above local ground level on the southern boundary of the site approximately 12 m from the kerb of the A4095.
- MP2 – Free-field position located 4 m above local ground level on the western boundary of the site, approximately 16 m from the raised rail line that runs parallel with the site boundary.
- MP3 – Free-field position located 1.5 m above local ground level approximately 6 m from the kerb of Bicester Road.

4.1.4 Measurements at all positions were made in the L_{Aeq}, L_{Amax}, L_{A10} and L_{A90} indices (see the Glossary of Acoustic Terms for an explanation of the noise units used). All attended measurements were made over 15-minute periods.

4.1.5 The noise measurements were made using the equipment detailed in table T1.

Item	Manufacturer	Type
Sound Level Analyser (x1)	Norsonic	118
Sound Level Analyser (x2)	Rion	NL-52
Acoustic Calibrator (x1)	Norsonic	1251
Acoustic Calibrator (x2)	Rion	NC-74
Weatherproof windshield (x1)	Norsonic	1212
Weatherproof windshield (x2)	Rion	WS-15

T1 Equipment used during unattended noise survey

4.1.6 The microphones were extended from the sound level meters with cables and were fitted with weatherproof windshields.

4.1.7 Sound level meters were calibrated before and after measurement periods to ensure an acceptable level of accuracy. No significant drift was observed.

4.1.8 Weather conditions when setting up the noise monitors were clear, dry and cold with little wind and dry roads. On collection the weather was overcast, still, dry and cold. Analysis of publicly available weather data from local stations show that the weather conditions were suitable for noise measurements throughout the survey.

4.1.9 The noise climate at MP1 was controlled by road noise from the A4095. At MP2, the noise climate was controlled by road noise from the M40 and intermittent railway traffic and at MP3 the noise climate was controlled by traffic noise from Bicester Road and the M40. It was noted on collection that industrial farm noise was being undertaken at Hawkwell Farm and muck spreading had been carried out near measurement position MP2.

4.2 Results

4.2.1 The unattended noise survey results can be seen in the attached time history graphs 206/0079/TH1 to TH3.

4.2.2 The calculated ambient noise levels during the day and night-time periods, as well as the typical short-duration maximum levels at night are shown in table T2 below.

Location	Daytime (0700-2300)	Night time (2300-0700)	
	$L_{Aeq,16hr}$	$L_{Aeq,8hr}$	Typical $L_{Amax,F}$
MP1 – A4095 boundary	68	60	77
MP2 – Western boundary	55	50	74
MP3 – Bicester Road	61	53	77

T2 Measured $L_{Aeq,16hr}$, $L_{LAeq,8hr}$ and typical $L_{Amax,F}$ noise levels

5 Residential Noise Control Strategy

5.1 Overview and Assumptions

5.1.1 This section of the report provides guidance with respect to potential residential development constraints and mitigation requirements relating to key noise sources surrounding the site.

5.1.2 As the development is currently conceptual, the construction type of the proposed dwellings is unknown. It is assumed for the purposes of the assessment that the dwellings will be up to four storeys of traditional masonry construction with a tiled roof and plasterboard ceilings. Any alternative constructions should be reviewed and confirmed to ensure suitable sound insulation.

5.1.3 It is on this basis that the glazing and ventilation elements have been assessed, as discussed below. Typical room sizes have been assumed as follows:

- Living rooms 5 x 4 x 2.7 m with 3.6 m^2 of glazed elements
- Bedrooms 4 x 3 x 2.7 m with 1.8 m^2 of glazed elements

5.1.4 These dimensions are provided for information only, to illustrate the assumptions made for the purposes of assessment. They should not be taken as constraints in terms of the design of the proposed dwellings.

5.1.5 For the purposes of this indicative assessment, three types of glazing have been used in the calculations, as stated in table T3 below, and are referred to in the following sections. Where an indicative configuration or product is suggested, alternatives can be employed, so long as they perform to an equal or better performance than the octave band specification stated. These are to provide an indication of the amount of mitigation needed at set distances from the roads and railway line and are not restricting factors.

Glazing Type	Sound Reduction Index (dB) at Octave Band Centre Frequency (Hz)					
	125	250	500	1k	2k	4k
G1	28	29	39	44	50	56
G2	26	27	34	40	39	46
G3	20	19	29	38	36	45
G5	Good quality standard thermal double glazing achieving an acoustic performance of R_w 30 dB					

T3 Glazing performance requirements

5.1.6 The table provides the specification necessary when each Glazing Type is referred to. These must be met in full in each octave band (where provided) and is to be achieved by the window system as a whole; i.e. no part of the window system, including frame, can allow these octave band figures to not be achieved.

5.1.7 It is expected that the performances for each Glazing Type set out within table T3 can typically be achieved by the following configurations.

- Glazing Type G1: 8.4mm acoustic laminate glass / 16mm airgap / 10.4 acoustic laminate glass
- Glazing Type G2: 10 mm glass / 16 mm airgap / 6 mm glass;
- Glazing Type G3: 6 mm glass / 16 mm airgap / 6 mm glass;
- Glazing Type G5: 4 mm glass / 16 mm airgap / 4 mm glass.

5.1.8 Two ventilator types have been used in the calculations and as with glazing types, are to provide an indication of mitigation necessary, rather than to serve as a restricting factor. These are:

Ventilator Type	Sound Reduction Index (dB) at Octave Band Centre Frequency (Hz)					
	125	250	500	1k	2k	4k
V1	48	39	44	52	66	61
V2	35	35	34	35	34	29

T4 Ventilator performance requirements

5.1.9 Theses specifications must be met in full at each octave band. It is expected that the specifications can typically be met by the following:

- Vent Type 1: *Passivent* Fresh 80 dB;
- Vent Type 2: Direct path trickle ventilators.

5.1.10 The important principle here is that the mitigation measures proposed are by no means the only solution to adequately control noise but represent an example of how the means of mitigation could be approached.

5.2 Internal Noise

5.2.1 The A4095 is the principal noise source across the southern boundary of the site. The railway to the west of the site is seen to be the principal noise source in this part of the site. Bicester Road, which dissects the site in two towards the western side has also been noted as a significant noise source and has been considered in our assessment.

5.2.2 Just as an example, if façade mitigation measures were to be selected, to the first row of dwellings at **10 m from the A4095**, Glazing Type G1 and Vent Type V1 would be appropriate on any façades with a view of road.

5.2.3 For dwellings near to the western boundary, at the first row of dwellings at **15 m from the railway**, Glazing Type G3 and Vent Type V1 would be appropriate on any façades with a view of the railway lines.

5.2.4 For dwellings near Bicester Road, at the first row of dwellings at **12 m from Bicester Road**, Glazing Type G2 and Vent Type V1 would be appropriate on any façades with a view of the road.

5.2.5 With the above mitigation measures in place, it will be possible to achieve the internal noise criteria as set out within section 3.2 in the dwellings adjacent to the A4095, set back by 10 m, those adjacent to the railway line by 15 m and those set back by 12 m from Bicester Road. Dwellings behind these would typically be screened and could utilise good quality standard thermal double glazing and non-acoustic trickle ventilators. The general principles of this are shown in Diagram 1 below:

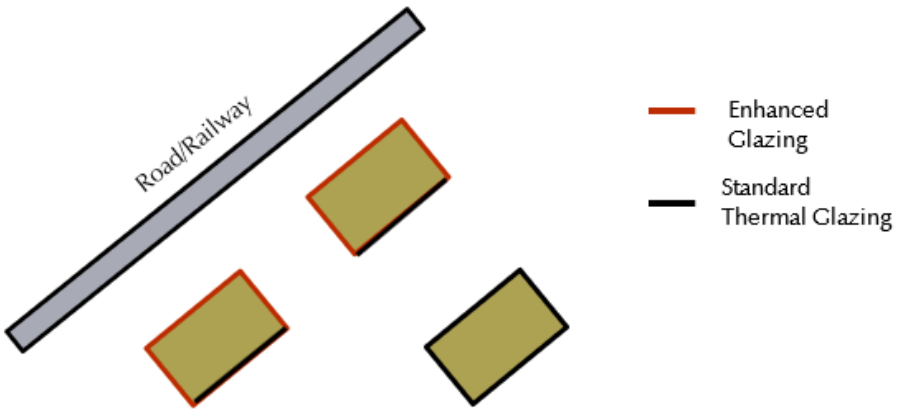

Diagram 1: Indicative Layout of Approach 1

5.2.6 It is noted that the distances above of 10m, 12m, and 15m are not a restriction - dwellings are not prohibited from being positioned closer than this but may require enhanced or different glazing and ventilation compared to the examples provided.

5.2.7 Within the site, the need for mitigation along the realigned A4095 will need to be considered at the reserved matters stage and have regard also to place-making principles requiring a strong design response close to the edge of the carriageway. Close proximity to the carriageway has been successfully achieved elsewhere within the North West Bicester development without onerous limitations or mitigation.

5.3 External Amenity Areas

5.3.1 If it is preferable to avoid the need for acoustic fences, dwellings should be orientated such that their associated external amenity areas are screened by the dwellings themselves.

5.3.2 This would mean locating external amenity areas for dwellings adjacent to the A4095 to the north of the associated dwellings and to the east for dwellings adjacent to the railway. By doing this noise levels within garden spaces should fall at or below the aspirational target of 55 dB $L_{Aeq,16hr}$.

5.3.3 Any gardens directly adjacent to the road or rail sources may require acoustic fencing, potentially up to 2.1m tall to achieve the aspirational target of 55 dB $L_{Aeq,16hr}$.

6 School Noise Control Strategy

6.1 A similar approach has been undertaken for assessing noise to the proposed primary school, based on noise breaking into a standard classroom space.

6.2 For the purposes of this indicative assessment, two types of glazing have been used in the calculations, as stated in table T5.

Glazing Type	Sound Reduction Index (dB) at Octave Band Centre Frequency (Hz)					
	125	250	500	1k	2k	4k
G4	17	22	22	28	39	39
G5	Good quality standard thermal double glazing achieving an acoustic performance of R_w 30 dB					

T5 Glazing performance requirements

6.3 The table provides the specification necessary when each Glazing Type is referred to. These must be met in full in each octave band (where provided) and is to be achieved by the window

system as a whole; i.e. no part of the window system, including frame, can allow these octave band figures to not be achieved.

6.1.1 It is expected that the performances for each Glazing Type set out within table T5 can typically be achieved by the following configurations.

- Glazing Type G4: 6 mm glass / 16 mm airgap / 4 mm glass;
- Glazing Type G5: 4 mm glass / 16 mm airgap / 4 mm glass.

6.1.2 One passive ventilator has been used in the calculations, and as with glazing types, are to provide an indication of the mitigation necessary rather than to serve as a restricting factor. The required performance is as follows:

Ventilator Type	**Sound Reduction Index (dB) at Octave Band Centre Frequency (Hz)**					
	125	**250**	**500**	**1k**	**2k**	**4k**
V3	18	21	24	32	40	42

T6 Ventilator performance requirements

6.1.3 Theses specifications must be met in full at each octave band. It is expected that the specifications can typically be met by the following:

- Vent Type V3: *Passivent* Aircool 265mm deep internal louvre with 40% free area.

6.1.4 The important principle here is that the mitigation measures proposed are by no means the only solution to adequately control noise but represent an example of how the means of mitigation could be approached.

6.4 If teaching spaces were to be located at **10 m from the railway** or **10m from Bicester Road**, it would be necessary to utilise Glazing Type G4 and Vent Type V3 on any façades with a view of the noise source.

6.5 If a buffer zone strategy were to be selected, Glazing Type G5 and Vent Type V3 would suffice on all façades if the teaching spaces were **20 m from the railway** and **15m from Bicester Road**.

7 Conclusions

7.1 Planning permission is sought for mixed use development to include up to 3,100 residential dwellings, a primary school and commercial spaces on a broad area of land to the northwest of Bicester.

7.2 RSK Acoustics have undertaken a noise survey at the site and a subsequent assessment to advise as to any design constraints on the site, and to provide an initial acoustic mitigation strategy to help guide the development of a layout.

7.3 Generally, the development behind the first line of building fronting the peripheral road, will require only the use of standard thermal double glazing and non-acoustic trickle ventilators will be an acceptable noise mitigation strategy.

7.4 As a general principle, external amenity areas adjacent to either road or railway noise sources should be provided with screening either by their adjoining dwelling or by suitable acoustic fencing. The exact requirements of this can be determined once an initial layout has been determined.

7.5 It is recommended that the school building is not positioned closer than 10 metres from the railway line and 10 metres from Bicester Road. If the school is positioned at least 20 metres from the railway line and 35 metres from Bicester Road, the use of standard thermal double glazing and wall mounted ventilators will be an acceptable noise mitigation strategy.

7.6 In principle therefore, the site is suitable for residential and school development providing suitable mitigation measures are put in place, where appropriate.

End of Section

Glossary of Acoustic Terms

L_{Aeq}:

The notional steady sound level (in dB) which over a stated period of time, would have the same A-weighted acoustic energy as the A-weighted fluctuating noise measurement over that period. Values are sometimes written using the alternative expression dB(A) L_{eq}.

L_{Amax}:

The maximum A-weighted sound pressure level recorded over the period stated. L_{Amax} is sometimes used in assessing environmental noise when occasional loud noises occur, which may have little effect on the L_{Aeq} noise level. Unless described otherwise, L_{Amax} is measured using the "fast" sound level meter response.

L_{A10} & L_{A90}:

If non-steady noise is to be described, it is necessary to know both its level and degree of fluctuation. The L_{An} indices are used for this purpose. The term refers to the A-weighted level (in dB) exceeded for n% of the time specified. L_{A10} is the level exceeded for 10% of the time and as such gives an indication of the upper limit of fluctuating noise. Similarly L_{A90} gives an indication of the lower levels of fluctuating noise. It is often used to define the background noise.

L_{A10} is commonly used to describe traffic noise. Values of dB L_{An} are sometimes written using the alternative expression dB(A) L_{n}.

L_{AX}, L_{AE} or SEL

The single event noise exposure level which, when maintained for 1 second, contains the same quantity of sound energy as the actual time varying level of one noise event. L_{AX} values for contributing noise sources can be considered as individual building blocks in the construction of a calculated value of L_{Aeq} for the total noise. The L_{AX} term can sometimes be referred to as Exposure Level (L_{AE}) or Single Event Level (SEL).

End of Section

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Figure206/0079/SP1

Title:

Site plan showing measurement positions

Project:

North West Bicester - Hawkwell Village

Date:

December 2021

Revision:

1

Scale:

Not to scale

RSK Acoustics Limited Addlestone | Bristol | Coventry | Glasgow
t +44 (0)1932 829007 Helsby | Hemel | Leeds | Manchester

Registered Office: Spring Lodge, 172 Chester Road, Helsby, WA6 0AR
e info@rskacoustics.com **w** www.rskacoustic.com

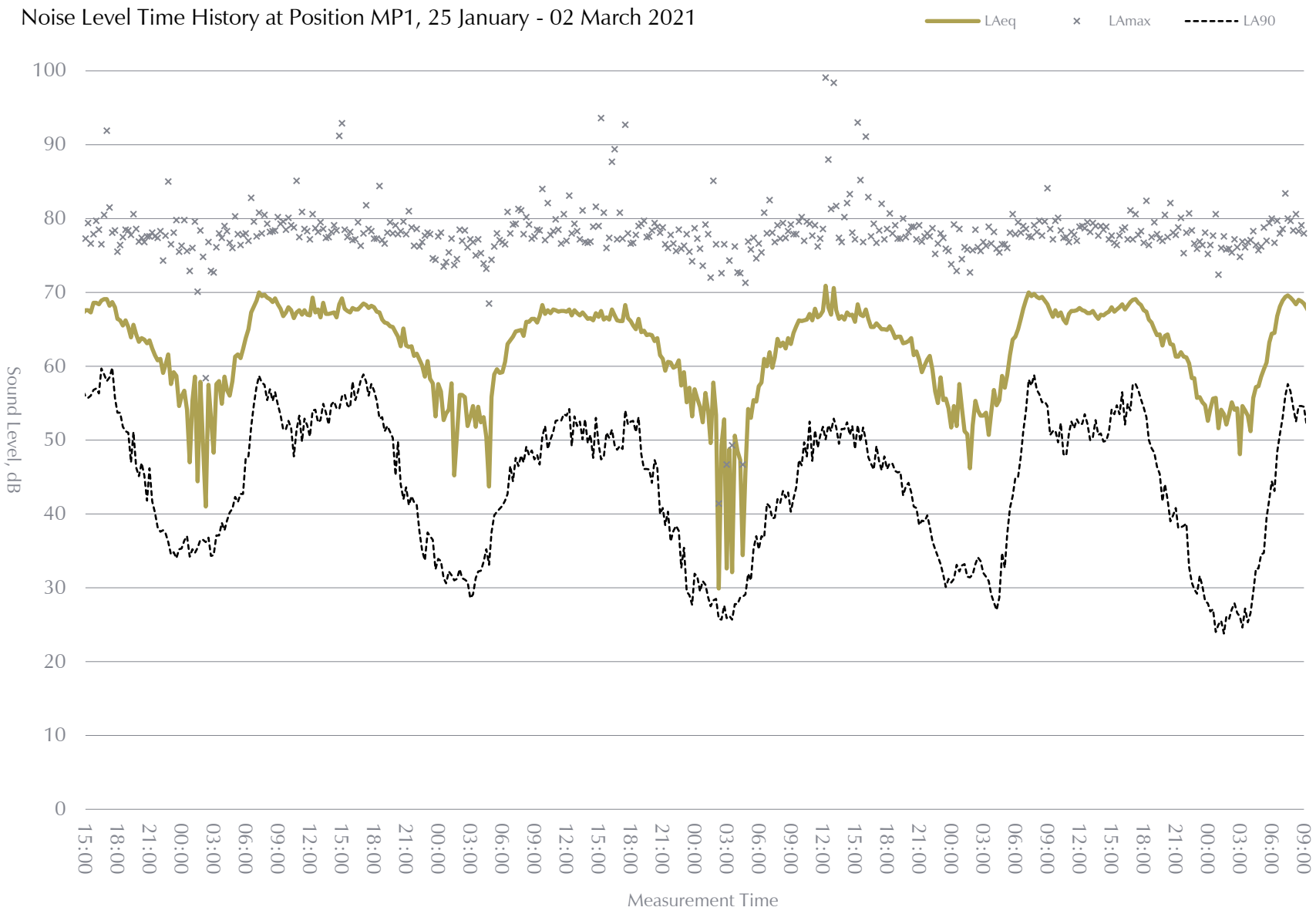


Figure 206/0079/TH01

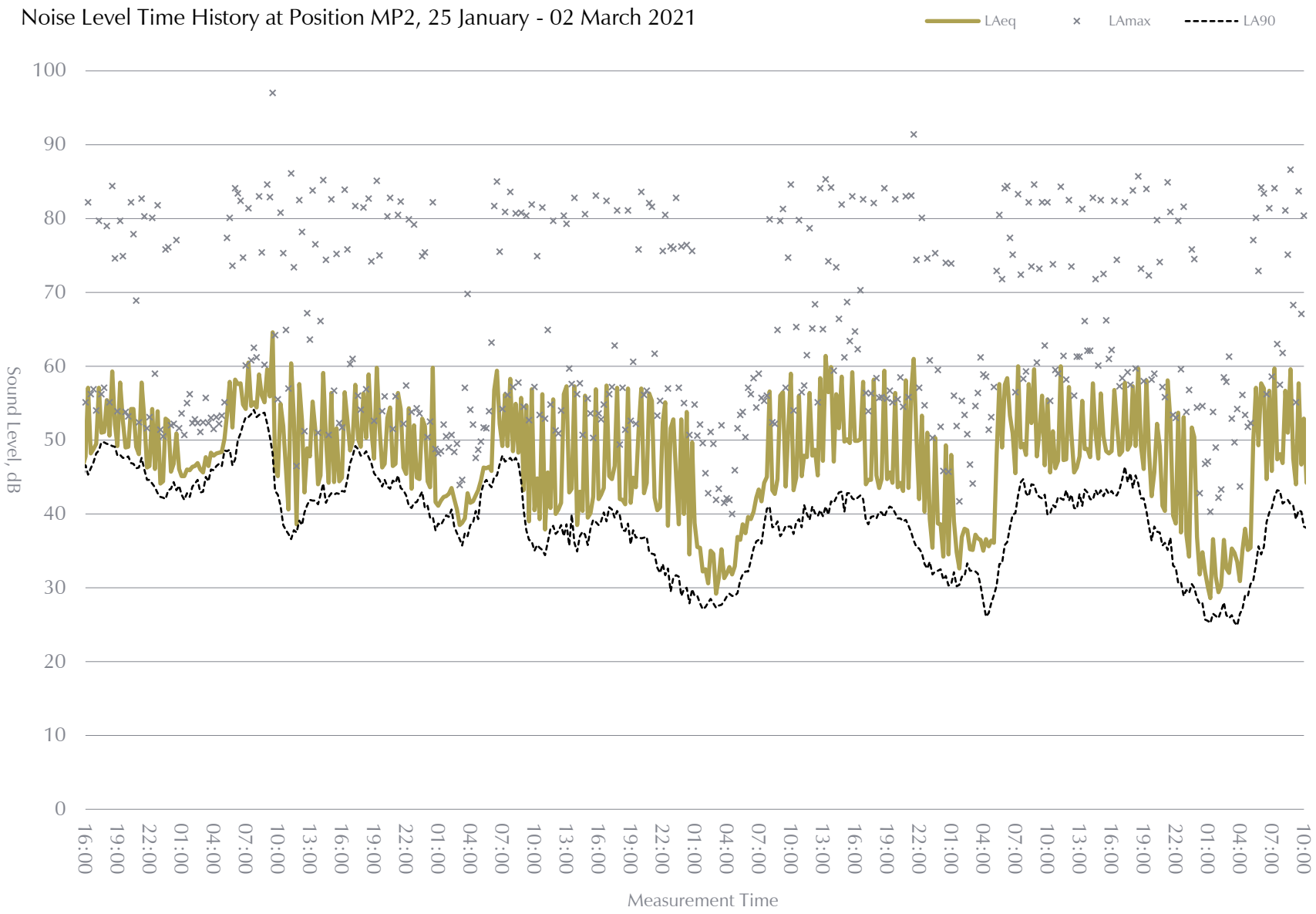


Figure 206/0079/TH02

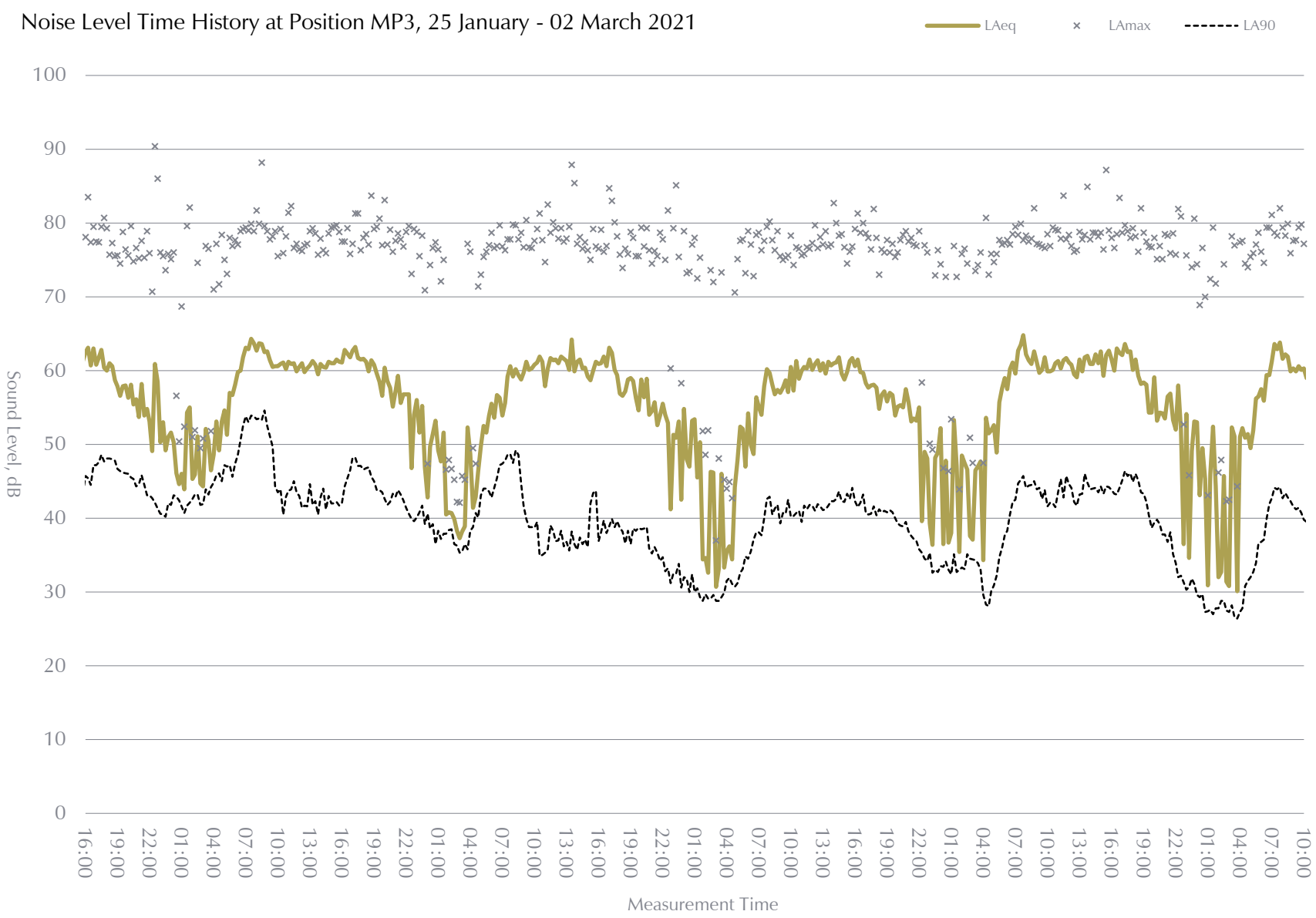


Figure 206/0079/TH03

RSK Acoustics

Annex A

Subject:	**Planning Considerations and Guidance**		
Project:	**North of Lords Lane, Bicester**		
Date:	**September 2021**	**Prepared:**	**TF/FD**
Revision:	**0**	**Approved:**	**AS**

This document sets out the various standards and national guidance upon which the design advice has been based.

A1 National Planning Policy Framework (NPPF)

A1.1 The National Planning Policy Framework (NPPF), published in March 2012 and updated in July 2021, is currently the relevant document for defining the national policy toward noise sensitive development. It refers to the Noise Policy Statement for England (NPSE), which is discussed in the subsequent section.

A1.2 The current policy on sustainable development influences the emphasis of any noise assessment. The development of a quiet, rural site is by most measures less sustainable than the development of a site located near existing infrastructure and facilities. The rating of development sites based on prevailing noise levels should reflect this.

A1.3 Specifically, on the subject of noise, paragraph 185 of NPPF states:

"Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

a. mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;

b. identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason;"

A1.4 Paragraph 185 references the Noise Policy Statement for England and no other particular standards.

A1.5 On the general issue of amenity, paragraph 130 states that planning policies and decisions should ensure that developments:

"create places that […] promote health and well-being, with a high standard of amenity for existing and future users…"

A1.6 Further to this, paragraph 174 states that planning policies and decisions should contribute to and enhance the natural and local environment by:

"preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution"

A1.7 A notable inclusion in the July 2018 edition of NPPF is the 'agent of change' principle in paragraph 187. In terms of noise, this principle requires that those proposing a new noise sensitive development incorporate sufficient mitigation such that the operation of existing premises in the area is not unreasonably restricted in order to control noise impact upon the new development:

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

A2 Noise Policy Statement for England (NPSE)

A2.1 This NPSE does not set quantitative guidelines for the suitability of noise sensitive development in an area depending on the prevailing levels of noise. Absent, therefore, is reference to specific noise thresholds which determine whether noise sensitive development is suitable and, if so, whether particular mitigation factors need to be considered.

A2.2 Instead, the NPSE sets out three aims:

The first aim of the Noise Policy Statement for England

"Avoid significant adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development."

The second aim of the Noise Policy Statement for England

"Mitigate and minimise adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development."

The third aim of the Noise Policy Statement for England

"Where possible, contribute to the improvement of health and quality of life through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development."

A2.3 Paragraph 2.24 states that all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life. It also states that this does not mean that such adverse effects cannot occur.

A2.4 In essence, therefore, each development site must be judged on its ability to deliver on each of the stated aims. Quantifying the prevailing noise levels is therefore an essential first step in assessing a given site.

A2.5 The NPSE refers to SOAEL, the Significant Observed Adverse Effect Level. This is defined as the level above which significant adverse impacts on health and quality of life occur. Given the overall thrust of the NPSE, the SOAEL is therefore an important assessment standard although the document also comments 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."

A2.6 Attention is drawn to the fact that the SOAEL is the level above which significant adverse effects can be observed. Importantly, it should be noted that the overall objective is to avoid or minimise significant adverse impacts; some degree of impact is acceptable and it is not necessary to seek to achieve no impact at all.

A3 Planning Practice Guidance (PPG)

A3.1 The Department for Communities and Local Government 'Planning Practice Guidance' (PPG) was published on 6 March 2014 and updated in July 2019.

A3.2 The PPG on Noise expands upon the NPPF and NPSE and sets out more detailed guidance on noise assessment. Like the NPPF and NPSE, the guidance does not include any specific noise levels but sets out further principles that should underpin an assessment.

A3.3 The PPG includes a section on noise, which states:

"*Plan-making and decision making need to 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."

A3.4 It then refers to the NPSE and states that the aim is to identify where the overall effect of the noise exposure falls in relation to Significant Observed Adverse Effect Level [1] (SOAEL), the Lowest Observed Adverse Effect Level [2] (LOAEL) and the No Observed Effect Level [3] (NOEL).

A3.5 The guidance then presents a table, which is reproduced as table 0 overleaf. The implication of the final line of the table is that only the 'noticeable and very disruptive' outcomes are unacceptable and should be prevented. All other outcomes (i.e. all other lines in the table) can be acceptable, depending upon the specific circumstances and factors such as the practicalities of mitigation.

[1] The level of noise exposure above which significant adverse effects on health and quality of life occur.
[2] The level of noise exposure above which adverse effects on health and quality of life can be detected.
[3] The level of noise exposure below which no effect at all on health or quality of life can be detected.

Response	Examples of Outcomes	Increasing effect level	Action
NOEL *(No Observed Effect Level)*			
Not present	No Effect	No Observed Effect	No specific measures required
NOAEL *(No Observed Adverse Effect Level)*			
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
LOAEL *(Lowest Observable Adverse Effect Level)*			
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
SOAEL *(Significant Observed Adverse Effect Level)*			
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

AT1 Summary of Noise Exposure Hierarchy (from PPG)

A3.6 Under the topic of further considerations relating to mitigating the impact of noise on residential developments, the PPG states:

"Noise impacts may be partially offset if residents have access to one or more of:

a relatively quiet facade (containing windows to habitable rooms) as part of their dwelling;

a relatively quiet external amenity space for their sole use, (e.g. a garden or balcony). Although the existence of a garden or balcony is generally desirable, the intended benefits will be reduced if this area is exposed to noise levels that result in significant adverse effects;

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, external publically accessible 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 minute walking distance)."

A4 Internal and External Noise Design Criteria

A4.1 The World Health Organisation (WHO) Guidelines 1999

A4.1.1 The Guidelines for Community Noise (World Health Organisation, 1999) included values for community noise in specific environments.

A4.1.2 It is important to note that the WHO Guidelines are aspirational, as illustrated by the National Noise Incidence Study (NNIS, 2000), which indicates that 55% of the population of England and Wales are exposed to external noise levels above 55 dB $L_{Aeq,\ day}$. A National Physical Laboratory (NPL) report (with reference CMAM 16, dated September 1998) reviewing the original 1980 WHO Guidelines and the 1995 draft version of the current Guidelines stated:

"*Exceedances of the WHO guideline values do not necessarily imply significant noise impact and indeed, it may be that significant impacts do not occur until much higher degrees of noise exposure are reached*."

"*As such, it would be unwise to use the WHO guidelines as targets for any form of strategic assessment, since, given the prevalence of existing noise exposure at higher noise levels, there might be little opportunity for and little real need for any across the board major improvements. On the other hand, the most constructive use for the WHO guidelines will be to set thresholds above which greater attention should be paid to the various possibilities for noise control action when planning new developments. It is important to make clear at this point that exceedances do not necessarily imply an over-riding need for noise control, merely that the relative advantages and disadvantages of noise control action should be weighed in the balance*."

A4.1.3 To prevent moderate annoyance in outdoor living areas, such as gardens and balconies of dwellings, the WHO guideline value is 50 dB $L_{Aeq,\ 16h}$. This can be described as an upper limit for the average noise level across the daytime and evening period (07:00h to 23:00h). The corresponding guideline value to prevent serious annoyance is stated as 55 dB $L_{Aeq,\ 16h}$.

However, it is again noted that these levels are aspirational in nature, as described in A4.1.2 above.

A4.1.4 In terms of the internal noise environment, in order to achieve maximum speech intelligibility and to avoid moderate annoyance, the guideline value for noise levels within dwellings is stated as 35 dB $L_{Aeq,\ 16h}$ (covering the day and evening 07:00h to 23:00h). The corresponding value for the night period (23:00h to 07:00h) to avoid sleep disturbance is 30 dB $L_{Aeq,\ 8h}$.

A4.1.5 Additionally in terms of sleep disturbance, a guideline value of 45 dB L_{Amax} is given. In relation to this value, the Guidelines state:

"When the background noise is low, noise exceeding 45 dB L_{Amax} should be limited, if possible…"

"For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dB L_{Amax} more than 10–15 times per night…"

A4.2 WHO Environmental Noise Guidelines 2018

A4.2.1 An updated version of the Guidelines was published in October 2018. It constitutes a significant revision of the 1999 Guidelines, rather than comprising minor amendments. In relation to road traffic and railway noise, the guidance states the following:

Road Traffic Noise

For average noise exposure, the GDG strongly recommends reducing noise levels produced by road traffic below **53 decibels (dB)** L_{den}, as road traffic noise above this level is associated with adverse health effects.

For night noise exposure, the GDG strongly recommends reducing noise levels produced by road traffic during night time below **45 dB** L_{night}, as night-time road traffic noise above this level is associated with adverse effects on sleep.

To reduce health effects, the GDG strongly recommends that policy-makers implement suitable measures to reduce noise exposure from road traffic in the population exposed to levels above the guideline values for average and night noise exposure. For specific interventions, the GDG recommends reducing noise both at the source and on the route between the source and the affected population by changes in infrastructure.

Railway Noise

For average noise exposure, the GDG strongly recommends reducing noise levels produced by railway traffic below **54 dB** L_{den}, as railway noise above this level is associated with adverse health effects.

For night noise exposure, the GDG strongly recommends reducing noise levels produced by railway traffic during night time below **44 dB** L_{night}, as night-time railway noise above this level is associated with adverse effects on sleep.

To reduce health effects, the GDG strongly recommends that policy-makers implement suitable measures to reduce noise exposure from railways in the population exposed to levels above the guideline values for average and night noise exposure. There is, however, insufficient evidence to recommend one type of intervention over another.

A4.2.2 The L_{den} is an equivalent sound level that represents the situation over the full 24 hour day, taking account of the L_{day} (0700-1900h), with a penalty of 5dB(A) for evening noise $L_{evening}$ (1900-2300h) and a penalty of 10dB(A) for night time noise L_{night} (2300-0700). The L_{night} index is equivalent to the $L_{Aeq,\ 8h}$ index as used in other standards such as BS 8233 (but not necessarily with the same numerical guidelines).

A4.2.3 The guidance no longer specifies L_{Amax} criteria but states in section 2.2.2:

"In many situations, average noise levels like the L_{den} or L_{night} indicators may not be the best to explain a particular noise effect. Single-event noise indicators – such as the maximum sound pressure level ($L_{A,max}$) and its frequency distribution – are warranted in specific situations, such as in the context of night-time railway or aircraft noise events that can clearly elicit awakenings and other physiological reactions that are mostly determined by $L_{A,max}$. Nevertheless, the assessment of the relationship between different types of single-event noise indicators and long-term health outcomes at the population level remains tentative. The guidelines therefore make no recommendations for single-event noise indicators."

A4.2.4 As with the 1999 WHO document, the guideline values in the 2018 document represent aspirational targets to be achieved in the long term, rather than values that should immediately be adopted into relevant policy.

A4.2.5 This is reflected in the following excerpt from the government's Aviation 2050 consultation document (which relates to aircraft noise but the principle of the statement is relevant to other noise sources):

"The government is considering the recent new environmental noise guidelines for the European region published by the World Health Organisation (WHO). It agrees with the ambition to reduce noise and to minimise adverse health effects, but it wants policy to be underpinned by the most robust evidence on these effects, including the total cost of action and recent UK specific evidence which the WHO report did not assess."

A4.2.6 Therefore, other current standards and guidance, such as BS 8233, still represent the most relevant and appropriate basis for assessment.

A4.3 British Standard BS 8233:2014

A4.3.1 Guideline values for dwellings with respect to internal and external noise levels are included in BS 8233:2014 Guidance on sound insulation and noise reduction for buildings (BSi).

A4.3.2 The standard states 50 dB $L_{Aeq,\,T}$ as being desirable as a steady state noise level not to be exceeded in gardens. It also states 55 dB $L_{Aeq,\,T}$ as an upper guideline value. The time period T is usually taken to be the 16 hour day (07:00h to 23:00h).

A4.3.3 Paragraph 7.7.3.2 of the standard goes on to say the following:

"For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.

Other locations, such as balconies, roof gardens and terraces, are also important in residential buildings where normal external amenity space might be limited or not available, i.e. in flats, apartment blocks, etc. In these locations, specification of noise limits is not necessarily appropriate. Small balconies may be included for uses such as drying washing or growing pot plants, and noise limits should not be necessary for these uses. However, the general guidance on noise in amenity space is still appropriate for larger balconies, roof gardens and terraces, which might be intended to be used for relaxation. In high-noise areas, consideration should be given to protecting these areas by screening or building design to achieve the lowest practicable levels. Achieving levels of 55 dB $L_{Aeq,T}$ or less might not be possible at the outer edge of these areas, but should be achievable in some areas of the space."

A4.3.4 It can be seen that external noise levels, especially on small balconies to apartment blocks, are not proposed to be a controlling index by which suitability of a residential site is defined.

A4.3.5 Therefore, when designing noise sensitive developments that incorporate gardens or other external amenity areas, the intent shall be to provide an area for each property in which the noise levels are consistent with these standards. Where these standards cannot be achieved, then reasonable measures shall be employed to provide screening or other forms of mitigation so as to minimise the noise levels in the external amenity areas.

A4.3.6 An important principle here is that sustainable development sites will often be exposed to relatively high levels of environmental noise, and while means are available to insulate internal

spaces, they are not always available to protect external spaces. Strict adherence to the enforcement of such external noise criteria would preclude development in the majority of areas considered for development in semi-urban or urban environments or in areas in the vicinity of transportation noise sources. This is why the external standards shall be viewed as targets or triggers of mitigation measures rather than thresholds not to be exceeded in all circumstances.

A4.3.7 Buildings can be designed to achieve specific levels of insulation against external noise. It is reasonable, therefore, to set specific internal noise standards as the test of whether a development satisfies the requirements of the NPPF and the aims of the NPSE. In essence, these require a high quality design that achieves a good standard of amenity.

A4.3.8 Guidance in respect of indoor ambient noise levels is contained in Table 4 of BS 8233:2014 and tabulated below.

Activity	**Location**	**07:00 to 23:00**	**23:00 to 07:00**
Resting	Living room	35 dB $L_{Aeq,\ 16h}$	-
Dining	Dining room/area	40 dB $L_{Aeq,\ 16h}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,\ 16h}$	30 dB $L_{Aeq,\ 8h}$

Note 7 Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved.

AT2 Table 4 of BS 8233:2014

A4.3.9 The previous edition of BS 8233 included quantitative guidance with respect to night-time L_{Amax} noise levels in bedrooms. BS 8233:2014 does not provide such guidance, however in paragraph 7.7.5.1.1 it is noted that the recommendations for ambient noise in hotel bedrooms are similar to those for living accommodation and Table H.3 in Annex H.3 gives example night-time L_{Amax} limits in hotel bedrooms of 45-55 dB.

A4.3.10 The WHO study informing the 1999 Guidelines derived the L_{Amax} night time noise standard on the basis of 10 to 15 occurrences per night.

A4.4 ProPG: Planning and Noise (2017)

A4.4.1 ProPG is a guidance document prepared by a working group consisting of representatives of the Association of Noise Consultant (ANC), Institute of Acoustics (IOA) and Chartered Institute of Environmental Health (CIEH). It provides professional practice guidance on Planning and Noise with regard to new residential development that will be exposed to airborne noise from transport sources. It is also noted that good professional guidance should have regard to any

reasonably foreseeable changes to existing, and/or new sources, as well as sources currently effecting the site.

A4.4.2 ProPG provides two stages of assessment, the first being an initial site risk assessment and the second being a full assessment. The second is only necessary when the initial risk assessment and circumstances dictate.

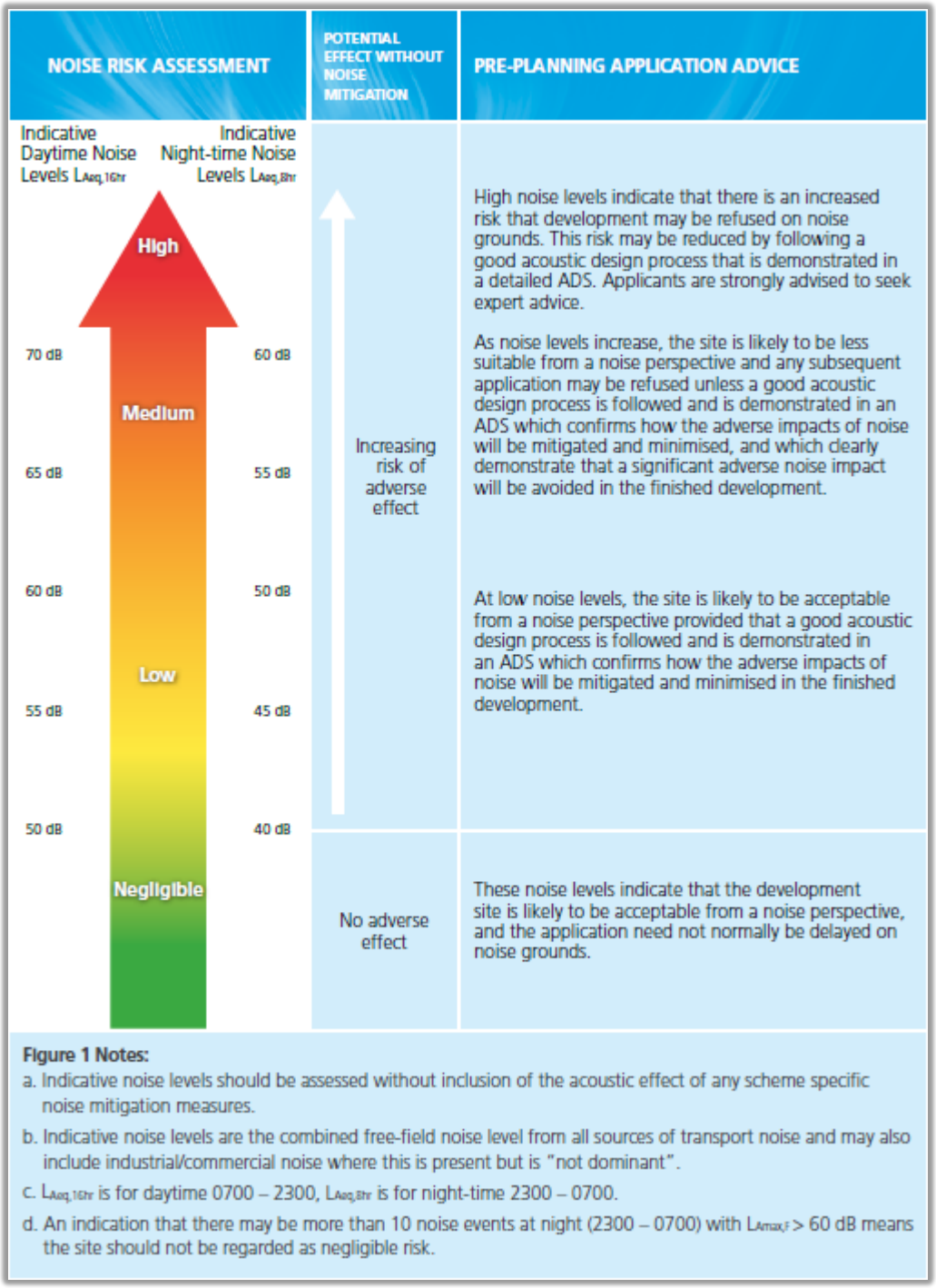
Stage 1: Initial Site Noise Risk Assessment

A4.4.3 ProPG suggests that a Stage 1 initial site risk assessment should be undertaken on all sites at the earliest possible opportunity in order to gauge the potential effect of noise on future residential premises, without the benefit of any noise mitigation measures.

A4.4.4 It is important to note that the initial 'Stage 1' assessment at a proposed residential development is not the basis for the eventual recommendation to the decision maker. It is intended to highlight the importance of good acoustic design within a scheme. For example, a site with a high risk of adverse effect without noise mitigation may not necessarily be unsuitable for development; however, the importance of good acoustic design provided by experts would be critical at such a site, with a detailed acoustic design statement provided.

A4.4.5 ProPG states that a site which displays a low risk of adverse effect without noise mitigation is more likely to be acceptable from a noise perspective, provided that a good acoustic design process is followed, and sites with no risk of adverse effect need not normally be delayed on noise grounds.

A4.4.6 The criteria provided for Stage 1 assessment of the L_{Aeq} noise levels for day and night within the initial site risk assessment are provided below:



A4.4.7 The initial noise risk assessment also considers the effect of L_{Amax} maximum noise levels at night (2300-0700h), where the guidance states:

"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 a negligible risk."

Stage 2: Overview

A4.4.8 Stage 2 of the ProPG guidance provides a systematic consideration of key elements of acoustic design. The guidance advocates a proportional, risk based approach to the Stage 2 assessment. The Stage 1 risk assessment should inform whether careful consideration is required, with the detailed input of specialist acoustic consultants essential at higher risk sites, or straightforward accelerated decision making potentially possible in relation to lower risk sites.

Stage 2: Element 1 – Good Acoustic Design Process

A4.4.9 ProPG states that a good acoustic design process is an implicit part of achieving the requirements of government noise policy, as set out in the NPSE and NPPF, and outlined in Supplementary Document 1 of the ProPG.

A4.4.10 However, it is also stated that good acoustic design does not simply constitute compliance with recommended internal and external criteria, if the solution adversely affects living conditions within the spaces, and hence the quality of life of the inhabitants. The following example is provided:

"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 the approach, is not regarded as good acoustic design."

A4.4.11 Applicants must therefore consider all possibilities for mitigation including but not limited to:

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

Stage 2: Element 2 – Internal Noise Level Guidelines

A4.4.12 ProPG considers the guidance provided within BS 8233:2014 to be suitable for the assessment of internal noise levels. However, the ProPG provides additional commentary. The following table reproduces the internal ambient criteria provided within Figure 2 of ProPG. The guidance from BS 8233:2014 is displayed in black, with additional comments and criteria from ProPG in blue:

Activity	Location	0700h to 2300h	2300h to 0700h
Resting	Living room	35 dB $L_{Aeq, 16h}$	-
Dining	Dining room/area	40 dB $L_{Aeq, 16h}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq, 16h}$	30 dB $L_{Aeq, 8h}$ 45 dB $L_{AMax,F}$ (Note 4)

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 [which advocates reference to available dose-response relationships appropriate for the types of noise source being considered]).

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 [which states that if certain criteria are fulfilled the noise practitioner should recommend refusal on noise grounds alone, regardless of any case for the development]).

AT3 Table 4 of BS 8233:2014 with ProPG annotations in blue

A4.4.13 It should be noted that the guidance above includes criteria for L_{Amax} noise levels, along with further guidance relating to the assessment of maximum levels in Note 4.

Stage 2: Element 3 – External Amenity Area Noise Assessment

A4.4.14 With regard to external amenity spaces, ProPG references the guidance provided within BS 8322:3014, section 6. ProPG presents a statement summarising BS 8233:2014 section 6 which states:

"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 $L_{Aeq, 16h}$"

A4.4.15 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."

A4.4.16 ProPG also references guidance within the PPG on noise, which 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"

A4.4.17 It is highlighted within ProPG that both BS 8233:2014 and the PPG on noise require a decision to be made as to whether or not external amenity areas are intrinsically important to the required design. However, it is noted that the PPG also states that noise impacts may be partially offset if the residents of affected dwellings are provided, through the design of the development or the planning process, with access to alternative spaces as set out in paragraph A3.6 of this appendix.

A4.4.18 ProPG section 2.51 states that Local Planning Authorities (LPAs) will be best placed to provide guidance in relation to what is 'relatively quiet', as the concept will inherently vary between scenarios.

A4.4.19 The advice in section 2.52 of ProPG highlights the increased importance of LPAs protecting publically accessible external amenity spaces in areas that typically exhibit heightened existing noise climates, such as cities, where development is necessary but private external amenity areas below 55 dB $L_{Aeq,16h}$ are not practicable. Publically accessible spaces such as parks and squares in these areas may be providing respite for nearby residents and, therefore, should be protected.

Stage 2: Element 4 – Assessment of Other Relevant Issues

A4.4.20 This section of the guidance relates to all other relevant issues and seeks to build upon relevant national and local planning and noise policies. Examples are provided including, but not limited to, the following:

- Compliance with relevant national and local policy
- Magnitude and extent of compliance with ProPG
- Likely occupants of the development
- Acoustic design v unintended adverse consequences
- Acoustic design v wider planning objectives

A4.4.21 Other issues specific to the site may be added by the LPA, where relevant.

End of Section

RSK Acoustics Limited Reg. in England and Wales No. 7102436
rskacoustics.com info@rskacoustics.com +44 (0)1932 829007

Registered Office: Spring Lodge, 172 Chester Road, Helsby, WA6 0AR
Addlestone | Bristol | Coventry | Glasgow | Helsby | Hemel | Leeds | Manchester