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M SCOTT PROPERTIES LTD

MARRIOTT'S PARK, TAVERHAM

PRELIMINARY ACOUSTIC APPRAISAL

JUNE 2019

the journey is the reward

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Project Code:	**SPMarriottsPark(N).9**
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1 Introduction

1.1 Mayer Brown Limited has been commissioned by M Scott Properties Ltd to undertake a preliminary acoustic appraisal of the proposed residential development of land at Marriott's Park, Taverham. The proposed development area is located to the south of the recently completed Norwich Northern Distributor Road. Mayer Brown Limited has therefore been instructed to provide a preliminary acoustic appraisal of noise levels characterising the site, in order that the suitability of the site for residential development can be assessed.

1.2 This Preliminary Acoustic Appraisal is structured as follows:

- **Section 2** describes the location of the site in relation to the existing transport infrastructure and neighbouring land uses;
- **Section 3** outlines the noise constraints of the site;
- **Section 4** discusses national and local planning policy and 'industry standard' design guidance relevant to noise;
- **Section 6** presents the results of baseline computational noise modelling of the site;
- **Section 7** presents an initial site noise risk assessment of the site in line with "ProPG" guidance;
- **Section 8** considers the mitigation strategies that could need to be implemented within the masterplanning proposals for the site, to deliver governmental planning objectives for sustainable development;
- **Section 9** considers the suitability of the site for educational uses (i.e. the proposed primary school);
- **Section 10** assesses the potential indirect off-site noise impacts of the development due to increased vehicular traffic on existing local roads.
- Conclusions are presented in **Section 11.**

1.3 A glossary of the acoustic terminology and nomenclature used in this statement is presented in **Appendix A**.

2 Site Description

2.1 The location of the site is shown in **Figure 2.1** below:

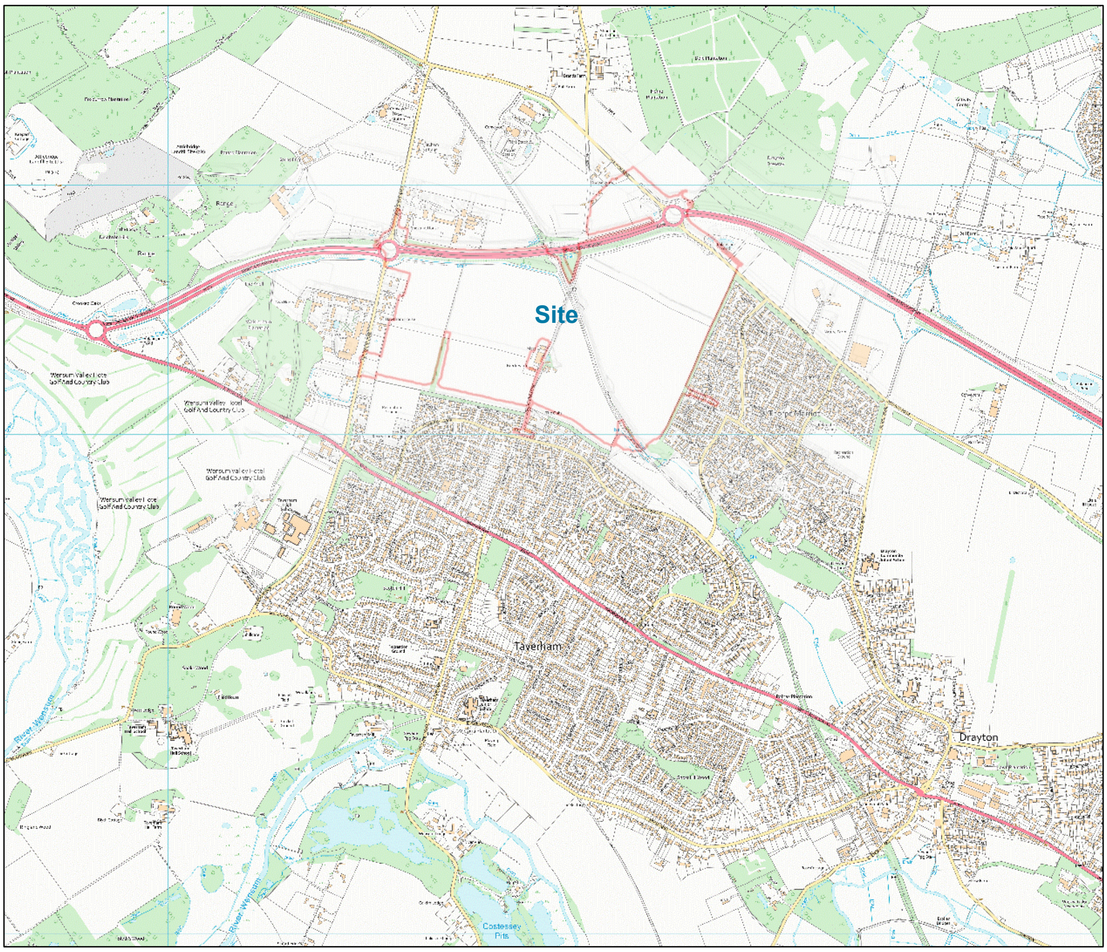

Figure 2.1: Site Location

2.2 The site is located to the south of the A1270 (Norwich Northern Distributor Road).

2.3 The eastern boundary of the site is formed with an existing residential area principally characterised by two storey, detached and semi-detached family homes (including the residential roads of Coopers, Freeland Close, Pyehurn Mews, Harewood Drive, Naber Furlong & Ganners Hill).

2.4 The southern boundary of the site is also an established residential area, characterised by a mix of detached, semi-detached and terraced properties (including dwellings in Hinks Close, Kingswood Avenue, Broom Close, Wylde Croft, Foregate Close, Isbets Dale and Kingswood Court). Hinks Meadow Community Centre and playing fields are also located to the south west of the site.

The western boundary of the site is predominantly formed with the rear boundaries of dwellings fronting Fir Covert Road. The opposing side of Fire Covert Road has existing commercial uses.

3 Concept Masterplan

3.1 The concept masterplan for the site is shown in **Figure 3.1** below.

Figure 3.1: Concept Masterplan

3.2 The objectives of the masterplan are to:

- Create a series of distinctive new neighbourhoods within a high quality landscape led setting;
- Retain and enhance existing mature landscape features;
- Create a sense of place at the centre of the new community;
- Create links and permeability to the existing community and facilities; and
- Enhance Marriot's Way where it passes through the site.

3.3 It is intended that the proposed development will deliver up to 1400 new homes, a new primary school, new 5 acre sports site and a new 1 hectare commercial space with visibility to the NDR (suitable for use as a petrol filling station or similar).

4 Existing Noise Constraints

4.1 The principal noise constraint affecting the proposed development is road traffic noise, most particularly from the Norwich Northern Distributor Road (NDR) – a dual carriageway linking the A1067 Fakenham Road, near Attlebridge to the A47 Trunk Road at Postwick and which was fully opened in April 2018.

4.2 The site is also affected by road traffic noise from other local roads, including Fir Covert Road to the west, Fakenham Road to the south and Reepham Road to the east.

4.3 In order to provide an initial appraisal of the acoustic conditions characterising the site, a computational noise model has been constructed using Datakustic CadnaA noise modelling software. This software implements the *"Calculation of Road Traffic Noise"*[1] (CRTN), *"Calculation of Railway Noise"*[2] (CRN) and ISO 9613[3] (for the calculation of outdoor industrial noise propagation).

4.4 The model is based on:

- OS mapping data;
- Topographical survey data for the site and LIDAR data for off-site areas;
- Building heights taken from OS Data or estimated from visual observations;
- Road traffic flow data provided by Canon Consulting Engineers;
- Technical information supporting the Development Consent Order for the NDR;
- Historic noise monitoring data for local roads.

4.5 Daytime and night-time noise models have prepared.

4.6 The daytime noise model is presented in **Figure 4.1** overleaf and is based on a 5m calculation grid set at 1.5m above local ground level.

4.7 The night-time noise model is presented in **Figure 4.2** overleaf and is based on a 5m calculation grid set at 4m above local ground level.

[1] Department of Transport. (1988). *"Calculation of Road Traffic Noise"*. HMSO, London.

[2] The Department of Transport (1995). *"Calculation of Railway Noise"*. HMSO, London.

[3] International Organization for Standardization, ISO 9613-1:1993: ***"Acoustics*** *-- Attenuation of sound during propagation outdoors - Part 1: Calculation of the absorption of sound by the atmosphere and Part 2: General method of calculation"*.

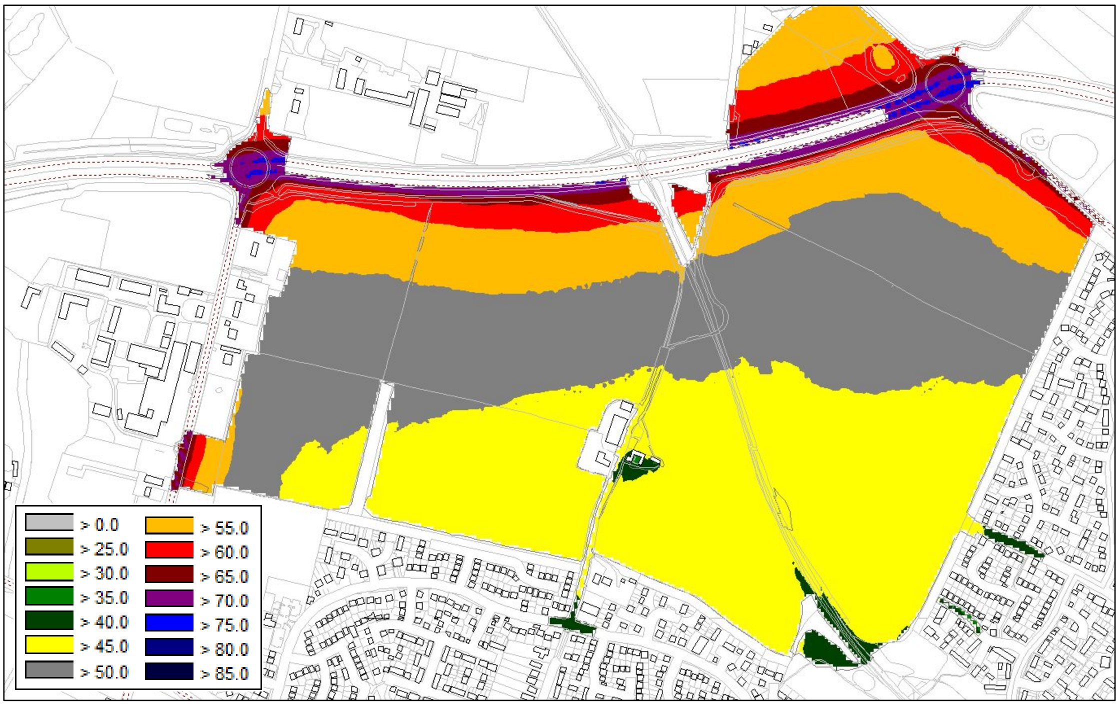

Figure 4.1: Daytime Noise Model

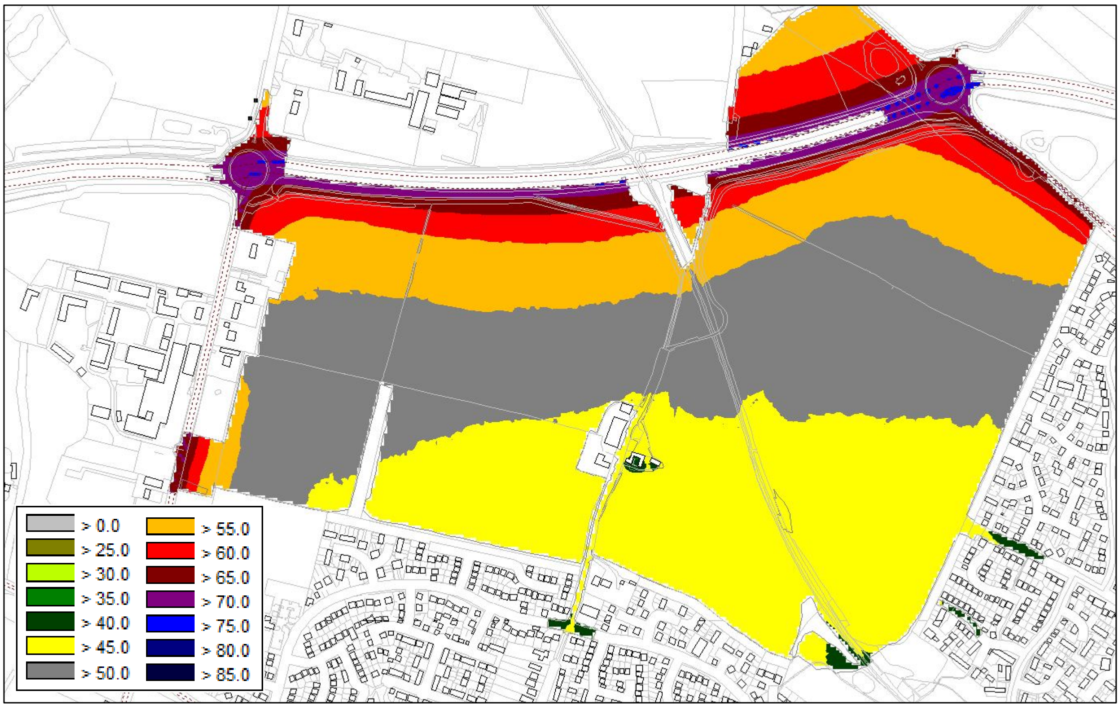

Figure 4.2: Night-time Noise Model

5 Panning Policy Context Policy Context

National Planning Policy

National Planning Policy Framework, (NPPF, 2019)

5.1 Current governmental guidance for the determination of planning applications is given in the revised "National Planning Policy Framework" (NPPF), published in February 2019.

5.2 Paragraph 170 of the NPPF advises:

> *"Planning policies and decisions should contribute to and enhance the natural and local environment by:*
>
> *….. e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability."*

5.3 With specific regard to noise, paragraph 180 of the 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; and*
>
> *c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation."*

5.4 Paragraph 182 of the NPPF draw specific attention to the need to ensure that new development is compatible with existing businesses and community facilities and introduces and "agent of change" principle:

> *"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."

5.5 With regard to 'adverse' impacts and 'significant adverse' impacts, the NPPF directs the reader to the advice contained in DEFRA's "*Noise Policy Statement for England*" (NPSE). This Policy Statement introduces the concept of a "*Significant Observed Adverse Effect Level*" (SOAEL), "*Lowest Observed Adverse Effect Level*" (LOAEL) and "*No Observed Adverse Effect Level*" (NOAEL). These are concepts aligned with toxicology outcomes derived from guidance given by the World Health Organisation.

Noise Policy Statement for England

5.6 Whilst the intent of the NPSE in relation to the NPPF is clear, the NPSE does not, at this time, provide any quantitative threshold values for each identified level of *"effect"*. Indeed, the NPSE carefully highlights that:

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

National Planning Practice Guidance

5.7 The application of national planning is amplified in the governments *"National Planning Practice Guidance"* (NPPG). This seeks to help clarify understanding the perception of noise effects, outcomes and actions that should be taken to align decision making with the NPPF. In line with the NPPF concept of basing decision making on the identification of "significant" or "other" impacts on health and quality of life, the NPPG aligns its guidance with the NPSE.

5.8 This guidance is summarised in **Table 4.1** below:

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

Table 5.1: NPSE Guidance

5.9 Whilst the NPPF and associated planning practice guidance sets out stringent imperatives to ensure the satisfactory development of land in relation to possible noise impacts, this policy and guidance does not generally provide any detailed technical guidance defining what may be considered to constitute a *"significant"* or *"other"* adverse impact. In the absence of such technical guidance, reference needs to be been made to sustainable development standards set out in local policy and/or relevant *'industry standard'* guidance.

Local Planning Policy

5.10 Broadland District Council's current local plan includes:

- Joint Core Strategy DPD (Broadland, Norwich and South Norfolk) adopted 2011, amendments adopted January 2014
- Development Management DPD adopted August 2015

Joint Core Strategy for Broadland, Norwich and South Norfolk [4]

5.11 The Joint Core Strategy sets out the strategic planning aims for the local plan.

Development Management DPD 2015 [5]

5.12 The Development Management DPD includes the following general policy relevant to noise:

> **Policy EN4 – Pollution**
>
> Development proposals will be expected to include an assessment of the extent of potential pollution. Where pollution may be an issue, adequate mitigation measures will be required. Development will only be permitted where there will be no significant adverse impact upon amenity, human health or the natural environment.

Design Guidance

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

5.13 British Standard 8233: 2014 recommends the control of noise both in and around buildings.

5.14 The relevant section of this document is shown in **Table 5.2**.

[4] Greater Norwich Development Partnership, March 2011, amendment Jan 2014, Joint Core Strategy for Broadland, Norwich and South Norfolk.

[5] Planning Department, Broadland District Council, 2015, Development Management DPD, Planning Development, Broadland District Council, Norwich,

Activity	Location	Daytime 07:00 to 23:00	Night-time 23:00 to 07:00
Resting	Living Room	$L_{Aeq,16\ hour}$ 35 dB	-
Dining	Dining Room	$L_{Aeq,16\ hour}$ 40 dB	-
Sleeping (daytime resting)	Bedroom	$L_{Aeq,16\ hour}$ 35 dB	$L_{Aeq,8\ hour}$ 30 dB

Table 5.2: Extract from BS 8233: 2014

5.15 The above guidance values are considered to represent *"Lowest Observed Adverse Effect Levels"* (LOAEL's).

5.16 With regard to external amenity areas, Section 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.*

5.17 A value of 55dB $L_{Aeq,T}$ is routinely adopted as an appropriate LOAEL.

5.18 BS 8233 does not provide any guidance that might inform a judgement on "Significant Observed Adverse Effects Levels" (SOAEL). General acoustics research does however indicates that SOAEL values will occur at a level significantly higher than a LOAEL – a conservative estimate being a numerical value around 10-15 dB(A) higher.

WHO Guidelines for Community Noise

5.19 The guidance in this document details suitable noise levels for various activities within and around residential and commercial buildings.

5.20 The relevant sections of this document are shown in **Table 5.3.**

Criterion	Environment	Design Range $L_{Aeq,T}$ dB
Maintain speech intelligibility and avoid moderate annoyance, daytime and evening	Living Rooms	35
Prevent Sleep disturbance, night-time	Bedrooms	30

Table 5.3: WHO Guidelines for Community Noise

5.21 The above values are consistent with those set out in BS 8233: 2014 and are taken to represent LOAEL's.

5.22 The guidelines also state:

> *"For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately L_{Amax} 45 dB more than 10-15 times a night (Vallet & Vernet 1991)".*

5.23 As with BS 8233, the WHO Guidelines do not provide any guidance that might inform a judgement on *"Significant Observed Adverse Effects Levels"* (SOAEL). However, as noted earlier, general acoustics research indicates that SOAEL values will occur at a level significantly higher than a LOAEL – a conservative estimate being a numerical value around 10-15 dB(A) higher in terms of the $L_{Aeq,T}$ noise index and 20dB(A) higher in terms of the $L_{Amax,fast}$ noise index.

ProPG: Planning and Noise

5.24 *"Professional Practice Guidance*: *Planning & Noise"* (ProPG) was published in May 2017 and is co-authored by the Chartered Institute of Environmental Health (CIEH), Institute of Acoustics (IOA) and Association of Noise Consultants (ANC).

ProPG seeks to consolidate and standardise existing industry best practice in order to expedite the planning process for new residential development with regard to the consideration of noise.

5.25 ProPG suggests a two stage methodology for the acoustic assessment of a proposed residential development.

5.26 Stage 1 involves an "Initial Site Risk Assessment", to identify the likely risk of adverse effects from noise, were no subsequent mitigation to be included as part of the development proposal. The categorisation of potential risk is presented in Figure 1 of the guidance which is reproduced in **Figure 4.1** below:

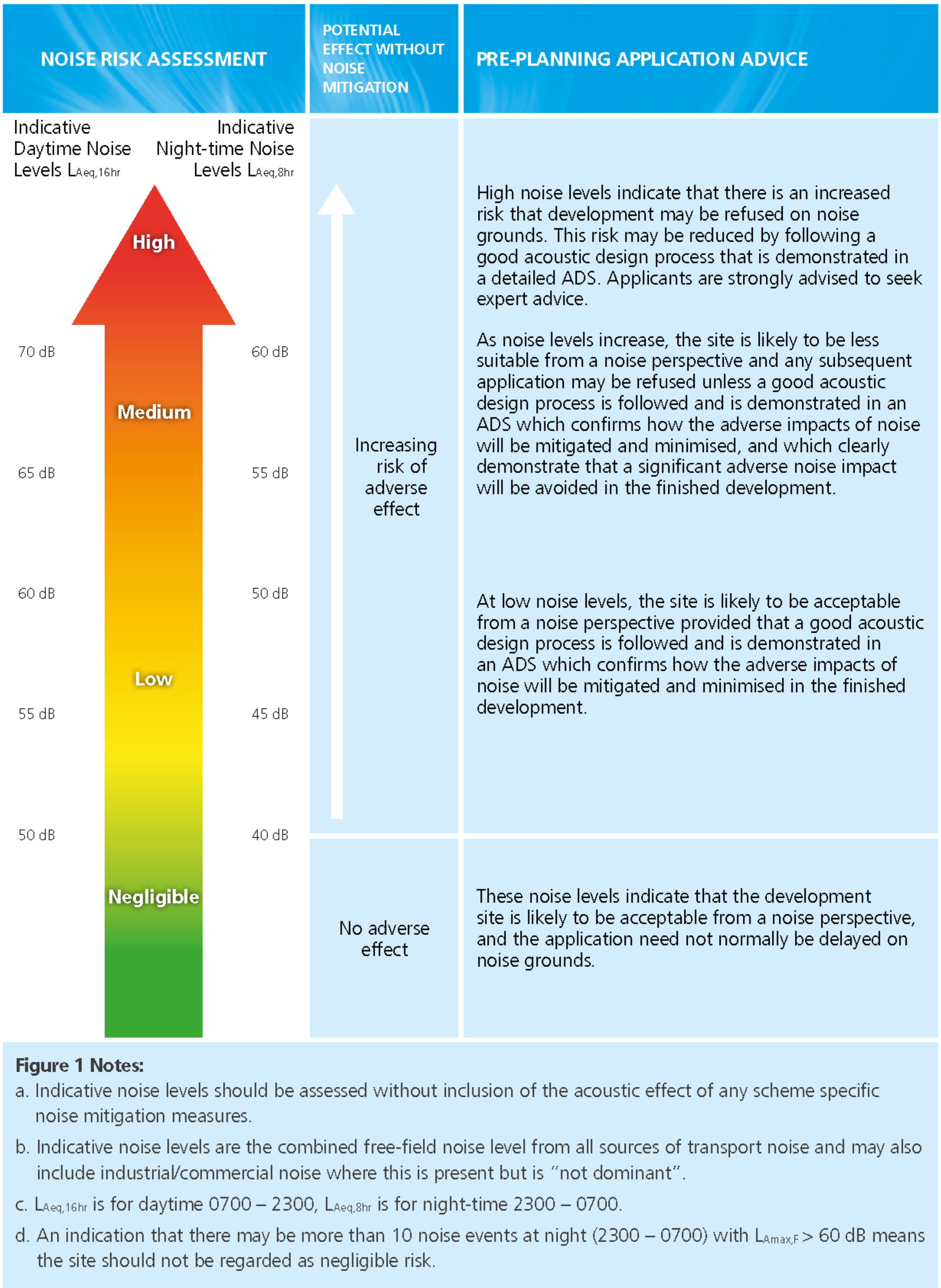

Figure 1. Stage 1– Initial Site Noise Risk Assessment

Figure 5.1: ProPG Initial Site Noise Risk Assessment Guidance

5.27 Paragraph 2.11 of ProPG states:

> *"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"*

5.28 This guidance is therefore considered to provide appropriate pre-planning noise risk assessment guidance.

Schools

5.29 The acoustic design of teaching spaces within schools is statutorily controlled through Requirement E4 of Approved Document E (ADE) of the Building Regulations 2010 (as amended). This requires that:

> *"Each room or other space in a school building shall be designed and constructed in such a way that it has the conditions and the insulation against disturbance by noise appropriate to its intended use."*

5.30 Section 8.1. of ADE states:

> *"In the Secretary of State's view the normal way of satisfying Requirement E4 will be to meet the values for sound insulation, reverberation time and internal ambient noise which are given in Building Bulletin 93: Acoustic Design for Schools: Performance Standards available on the internet at www.gov.uk.".*

5.31 Matters of sound insulation, reverberation times, etc. are detailed design matters that will generally be unaffected by the acoustic environment within which a proposed school will be located. It is, however, clear that indoor ambient noise levels may potentially be influenced by the external noise environment (e.g. level of sound insulation required of the external building fabric and ventilation strategy that may be required). There is therefore an obvious planning need to consider the suitability of the site for educational uses.

5.32 Tables 1 and 2 of *"Building Bulletin 93: Acoustic Design for Schools: Performance Standards"* (February 2015) presents guidance on indoor ambient noise levels for various teaching and non-teaching spaces within schools. The relevant value depends on both the room function and proposed ventilation strategy. Recommended indoor ambient noise levels range from 30dB $L_{Aeq,30mins}$ (for teaching spaces intended specifically for hearing impaired students with special hearing needs, and "specialist" areas such as recording studios) to 50dB $L_{Aeq,30mins}$ ancillary non-teaching areas (e.g. kitchens, changing rooms, etc.) where rooms are to be mechanically ventilated, with a permitted 5dB uplift on these values, where rooms are to be naturally ventilated (subject to an over-riding limit of 50dB).

5.33 Given the primary aim of governmental planning policy is to deliver sustainable development, it is considered desirable that new build schools should ideally have the ability to be naturally ventilated.

5.34 In order to consider what the above means in terms of external site noise levels, the guidance given in Note 2 to Table 2 of BB93 is apposite:

> *"Where external ambient free field noise levels at the façade expressed as the $L_{Aeq,30mins}$, do not exceed the IANL figures given in Table 1 by more than 16dB for single sided ventilation spaces and 20dB for cross ventilated or roof ventilated spaces, the criteria for natural ventilation can normally be achieved."*

5.35 As noted above, the most stringent design target given in BB93 is 30dB $L_{Aeq,30mins}$. It can therefore be concluded that acceptable noise levels within even the most stringent of rooms within schools should be achievable if the external noise level does not exceed a value of 46 to 50 dB $L_{Aeq,30mins}$. A noise level of up to 50dB is therefore considered to represent a "negligible" noise impact in relation to the suitability of a site for school use.

5.36 For general teaching classrooms, Table 1 of BB93 recommends an upper ambient indoor sound level of 35dB $L_{Aeq,30mins}$. It can therefore be concluded that acceptable noise levels in general teaching accommodation should be achievable if the external noise level does not exceed a value of 51 to 55 dB $L_{Aeq,30mins}$. A noise level of between 51 and 55dB is therefore considered to represent a "low" impact magnitude.

5.37 For general teaching classrooms, Table 2 of BB93 also recommends that, in order to provide thermal control and minimise the risks of summertime overheating, an indoor ambient noise level of up to 55dB $L_{Aeq,30mins}$ would be permissible. Assuming that overheating control would be provided by opening windows, this implies that the external outdoor noise level should not exceed around 70dB $L_{Aeq,16hour}$ (assuming a notional 15dB(A) sound reduction for an open window). Since this value should not be exceeded (i.e. should be prevented) this is considered to represent an "unacceptable" impact, i.e. a "high" impact. In broad terms, this would generally mean that it will be undesirable to build on sites exposed to noise levels > 70dB $L_{Aeq,30mins}$, because the delivery of satisfactory internal conditions would only be achievable with full mechanical ventilation and no ability to open windows (even for relatively brief periods of time).

5.38 Reconciling the above leaves a relatively large range (56-70dB $L_{Aeq,30mins}$) which would be considered to represent a "medium" risk. In practical terms, this means that the site is likely to be more problematic in terms of providing a natural ventilation strategy, but this would not preclude the feasibility of maintaining acceptable internal conditions with appropriate mitigation (i.e. the appropriate specification of enhanced sound insulation, mechanical ventilation strategies, etc.).

5.39 The above consideration give rise to the following definitions for determining the potential suitability of the site for educational use:

Negligible	Low	Medium	High
≤50dB	51-55 dB	56-70 dB	>70 dB

Table 5.4: Definitions of Magnitude of Impact – External Ambient Noise Levels

6 Initial Site Noise Risk Assessment

6.1 An initial noise risk assessment of the site has been considered by reference to the ProPG *"Stage 1 Initial Site Noise Risk Assessment"* guidance and adopting the following semantic boundaries.

Time Period	Negligible	Low	Medium	High
Daytime 07.00 – 23.00	≤50dB	51-63 dB	63-68 dB	>69 dB
Night-time 23.00 – 07.00	<45dB	40-54 dB	55-59 dB	>60 dB

Table 6.1: ProPG Initial Site Risk Assessment Categorisation

6.2 It is, however, important to stress that the ProPG guidance is not intended to provide "absolute" boundaries of noise impact. The guidance is intended to be applied flexibly and is a concept supported by government Planning Practice Guidance (Ref. 15. 1), e.g. Paragraph: 010 Reference ID: 30-010-20140306 cautions that "*Care should be taken, however, to avoid these [noise standards] being implemented as fixed thresholds as specific circumstances may justify some variation being allowed".*

6.3 Notwithstanding this, the use of semantic boundaries is considered to provide a useful means of providing an initial, broad visual characterisation of the potential noise risk at the site.

6.4 The daytime and night-time initial noise risk assessment of the site is shown in **Figures 6.1** and **6.2** overleaf.

Figure 6.1: Daytime Initial Site Noise Risk Assessment

Figure 6.2: Night-time Initial Site Noise Risk Assessment

6.5 The above figures show the "unmitigated" classification of noise risk. This shows that the northern boundary of the site (closest to the NDR) would be categorised as having a "high" noise risk (without mitigation), with noise levels reducing in a southerly direction across the site. The figures also shown that during the daytime, noise levels across much of the site reduce to a "low" or "negligible" risk. During the night-time, noise levels reduce to a "low" risk.

6.6 For low risk sites, ProPG states:

> *At low noise levels, the site is likely to be acceptable from a noise perspective provided that a good acoustic design process is followed and is demonstrated in an ADS which confirms how the adverse impacts of noise will be mitigated and minimised in the finished development.*

6.7 For medium risk sites, ProPG states:

> *"As noise levels increase, the site is likely to be less suitable from a noise perspective and any subsequent application may be refused unless a good acoustic design process is followed and is demonstrated in an ADS which confirms how the adverse impacts of noise will be mitigated and minimised, and which clearly demonstrate that a significant adverse noise impact will be avoided in the finished development.*

6.8 ProPG also advises:

> *"As noise levels increase, the site is likely to be less suitable from a noise perspective and any subsequent application may be refused unless a good acoustic design process is followed and is demonstrated in an ADS which confirms how the adverse impacts of noise will be mitigated and minimised, and which clearly demonstrate that a significant adverse noise impact will be avoided in the finished development. The above initial risk assessment concludes that, subject to adherence to a "good acoustic design process", the site should be suitable for residential development."*

> and

> *"High noise levels indicate that there is an increased risk that development may be refused on noise grounds. This risk may be reduced by following a good acoustic design process that is demonstrated in a detailed ADS. Applicants are strongly advised to seek expert advice."*

6.9 In light of the above, the site is considered suitable for residential development, but consideration would need to be given to mitigation where noise sensitive development is proposed in higher noise risk areas.

6.10 A more detailed consideration of noise impacts for the site and potential mitigation strategies, is presented in the following section.

7 Mitigation

7.1 A preferred hierarchy of strategies for mitigating noise impacts is set out below:

- Reducing noise "at source";
- Providing "buffer" zones to limit noise exposure;
- Reducing noise propagation across site (e.g. through the use of barriers);
- Developing the layout of the site to optimise acoustic protection (e.g. through the use of "barrier" blocks to help further limit noise propagation and the use of courtyard style development to protect external amenity areas);
- The orientation/general internal arrangement of buildings (e.g. by locating non-habitable rooms on 'noisier' facades and more sensitive uses on acoustically screened facades; and
- Providing buildings with appropriate sound insulation through the specification of appropriate external fabric constructions (in particular windows) and providing appropriate alternative means of ventilation if acceptable internal noise levels cannot be achieved if windows are open.

7.2 The relevance and practicability of each of the above strategies is discussed below

Reducing Noise "At Source"

7.3 As noted earlier, the principal source of noise affecting the site is road traffic from the A1270 NDR. Based on information contained within the technical documents supporting the Development Consent Order for the construction of the NDR, it is understood that the road scheme has been constructed using a "Thin Surface Course" (STC) to the carriageways along the length of the NDR. This material reduces the generation of tyre noise relative to hot-rolled asphalt and other surface treatments. As such, the NDR already embeds "at source" noise mitigation.

Buffer Zones

7.4 Sound energy naturally decreases with increasing distance from a source. Consideration could there for be given to the provision of "buffer" zones to avoid areas exposed to the highest noise levels.

7.5 **Figure 7.1** below shows the daytime initial noise risk categorisation overlaid on the concept masterplan for the development.

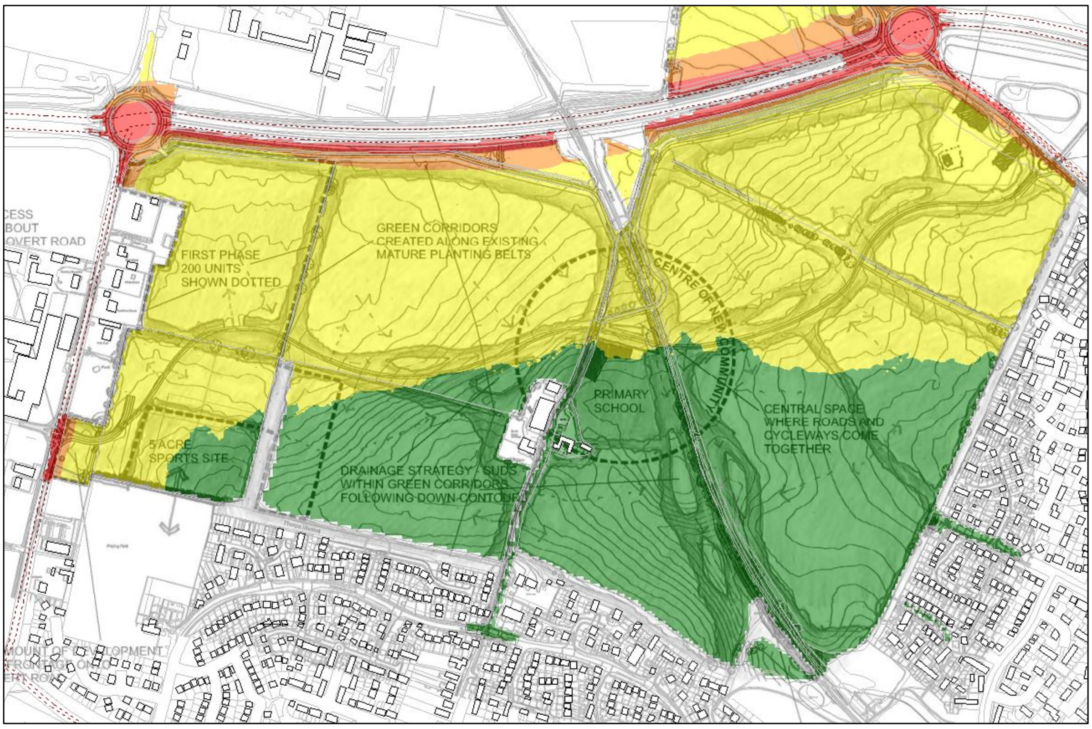

Figure 7.1: Initial Daytime Risk Overlaid on Concept Masterplan

7.6 The above image shows that no development is proposed in high risk noise areas (indicated in red).

7.7 **Figure 7.2** below shows the night-time categorisation.

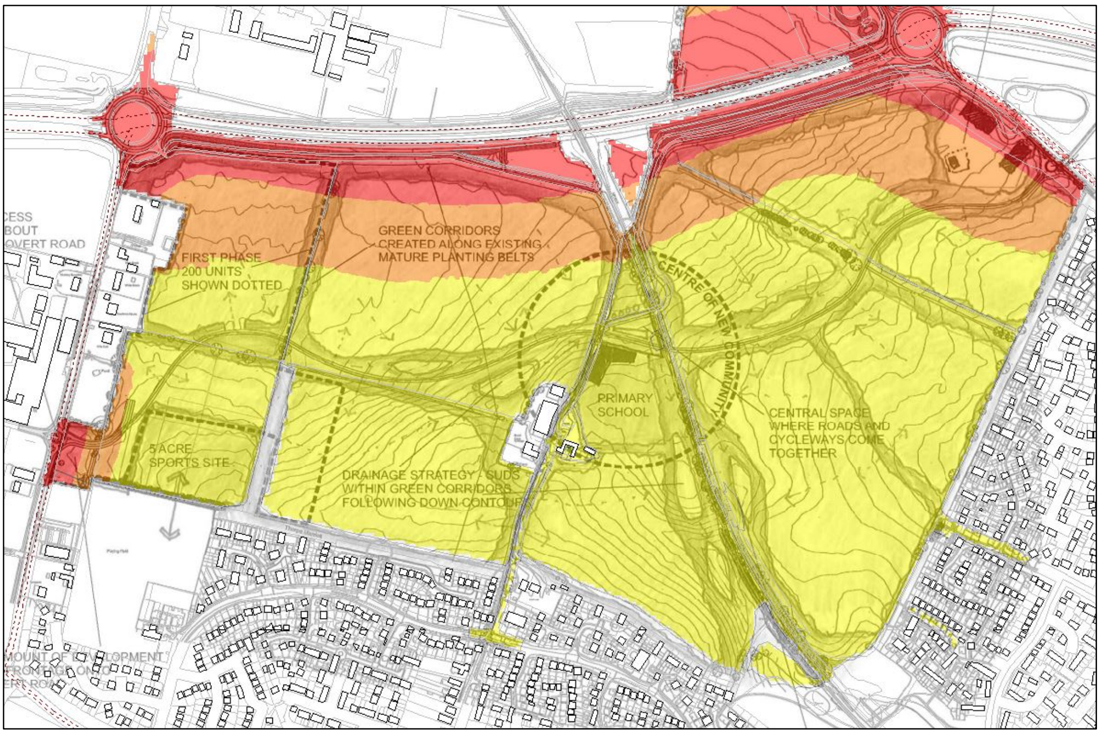

Figure 7.2: Initial Night-Time Risk Overlaid On Concept Masterplan

7.8 The above figures show that the current concept plans seek to minimise development proposed in high risk noise areas. It is important to note that development in a high risk area is not in itself an unacceptable proposition, subject to other mitigation strategies could be implemented if required (e.g. developing the internal arrangement of bedrooms such that these are on the "quiet" side of a building rather than facing towards the NDR).

7.9 In light of the above, the concept masterplan is considered to support a good acoustic design approach to the site.

Noise Barriers

7.10 Acoustic screens (e.g. noise barriers, bunds, etc.) can usefully reduce noise propagation across the site. In order for a barrier to be effective, it must obviate the direct line of sight between a noise source and receptor location. The amount of acoustic screening provided is dependent on the geometric relationship between the "direct" path noise would travel (without the barrier in place), and the "indirect" path sound would need to travel "up and over" the barrier bund. The greater this path difference, the greater the attenuation provided, as shown in **Figure 7.3** below:

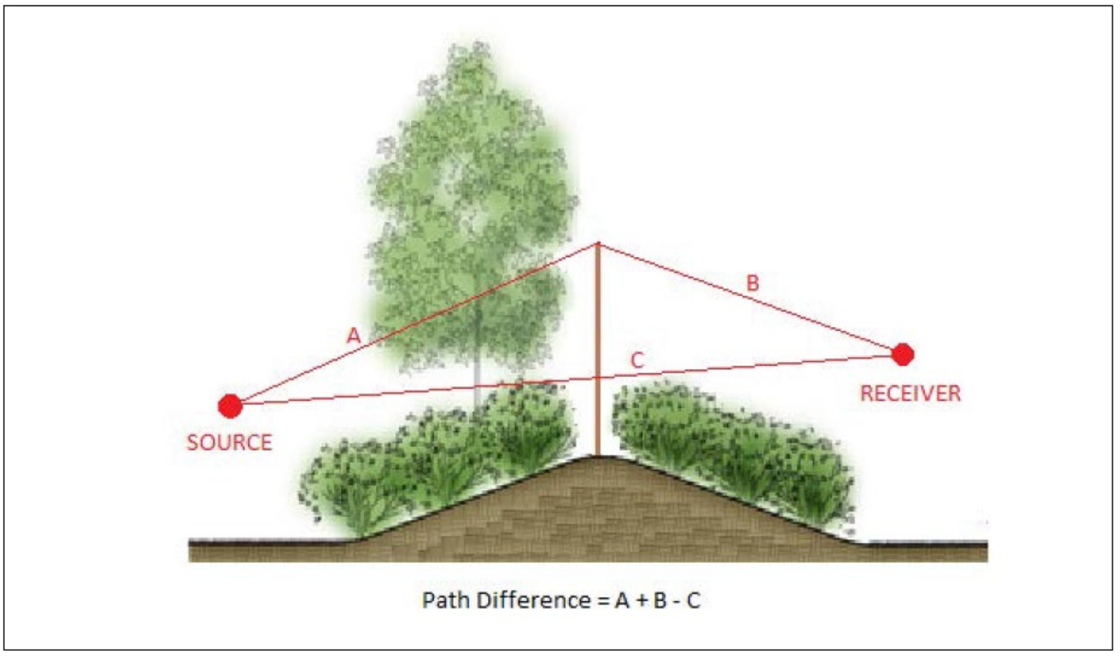

Figure 7.3: Calculation of Barrier Path Difference

7.11 As shown in the photographs below, the NDR has been constructed with earth bunds along the northern boundary of the site.

Figure 7.4: Photographs Showing Existing Earth Bunds

7.12 Allowance for this mitigation already embedded into the site has been made within the acoustic modelling. Notwithstanding this, it would be feasible to explore supplementing the existing bunding to increase its height and/or adding an additional acoustic barrier to the top of the existing bund to increase the potential acoustic screening capability if this was considered necessary.

Barrier Blocks

7.13 It is also possible to limit noise propagation across a site through the judicious spacing and massing of buildings along the boundaries with adjacent noise sources to help act as "barrier blocks", (i.e. using buildings themselves to provide some degree of acoustic screening). The largest benefit can be achieved where buildings are orientated "parallel" to the noise sources to be protected against (rather than "normal" to the noise source), as shown in **Figure 7.5** below. Protection can be further enhanced by creating 'courtyard' type arrangements:

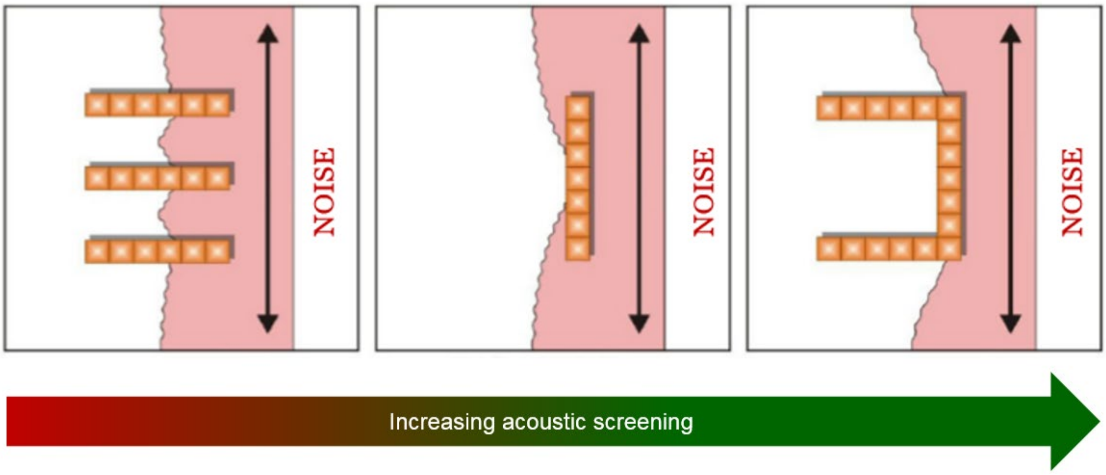

Figure 7.5: Effectiveness of Barrier Blocks

7.14 Barrier blocks do not necessarily have to be "continuous" to provide a benefit – individual blocks can also prove effective if the gaps between the houses are minimised, as shown in **Figure 8.4**[6] below:

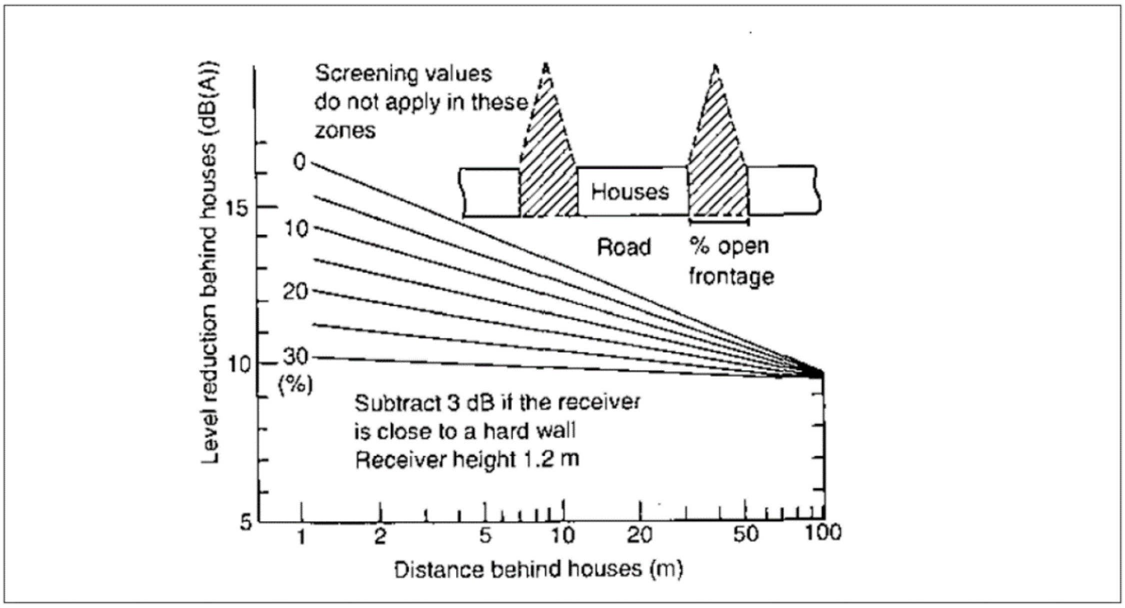

Figure 7.6: Screening from Individual Rows of Buildings

7.15 The above shows that even if the gaps between the houses amount to as much as 30% of the frontage length, a sound reduction of 10dB(A) (subjectively, a halving in sound level) should still be achievable over much of the site.

7.16 The masterplan for the site can be further developed in line with these principles to help minimise existing levels of noise across the wider site, i.e. through a strong

[6] Reproduced from *"Sound Control for Homes"* (BRE Report 238 / CIRIA Report 127), Building Research Establishment / Construction Industry Research and Information Association (1993)

massing of buildings along the northern side of the site, which can act as a barrier block to the remaining site, as illustrated in **Figure 7.7** below:

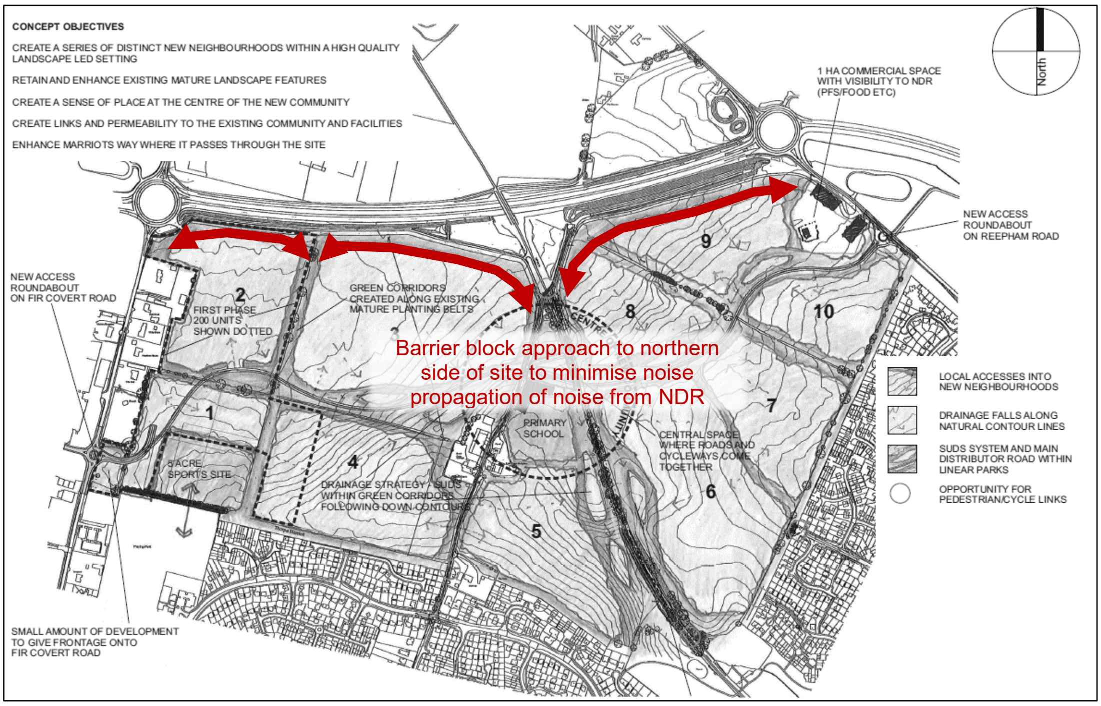

Figure 7.7: Recommended Massing of Barrier Blocks

7.17 The potential benefits of dwellings arranged as barrier blocks (with gaps) is further demonstrated in Section 8 below.

Building Orientation

7.18 Where possible, it is generally desirable that where buildings "overlook" noise sources, the buildings are arranged with the "front" of the property looking towards the sound source, with any amenity space on the "rear" of the building. This enables external amenity spaces to benefit from the inherent acoustic screening that can be provided by the massing of the building.

7.19 The internal arrangement of the dwellings should also be arranged, where possible, to locate non-habitable rooms on the 'noisier' side of the building and habitable rooms on the screened facades (quiet) facades. This approach maximises the potential for habitable rooms to be able to rely on natural ventilation. This is obviously a detailed design matter but is a robust strategy that can minimise the noise impact on future occupants.

Sound Insulation

7.20 Noise intrusion into dwellings can normally be readily controlled through the appropriate specification of external building fabric elements - windows normally being the "weakest" component.

7.21 However, it is important to appreciate that the sound insulation of windows will be substantially reduced when open. As such, it will also be necessary to ensure that, where properties cannot achieve acceptable internal noise levels when windows are open, properties are provided with appropriate alternative means of ventilation. In addition to the statutory ventilation requirements of Approved Document F of the Building Regulations 2010 (as amended), appropriate consideration should also be given to the potential ability of the future dwellings to rely on natural ventilation to assist with the ventilative cooling and the thermal control of the properties

7.22 Professional judgement is that the site does not present any technological difficulties in relation to the delivery of full compliance with the internal noise design guidance recommended in BS 8233: 2014. The WHO's *"Guidelines for Community Noise"* and ProPG guidance.

7.23 Notwithstanding the above, the implementation of other acoustic design strategies, as outlined above, should help in reducing sound insulation requirements to a minimum and optimise opportunities for natural ventilation.

Conclusions

7.24 Whilst the site is constrained by road traffic noise given the obvious proximity of the NDR, a number of acoustic design strategies, i.e. adherence to a good acoustic design process, can be implemented within the masterplanning for the site to deliver residential development in line with national planning and noise objectives for sustainable development.

8 External Amenity Areas

8.1 As noted earlier, in order to provide good quality amenity space, external noise levels should (ideally) not exceed a sound level of 55dB $L_{Aeq,16hour}$ (consistent with the guidance of BS 8233: 2014 and WHO).

8.2 ProPG also guides that that:

> *"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".*
>
> *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 $L_{Aeq,16hr}$."*

8.3 It is therefore clearly desirable for noise mitigation strategies to aim to reduce noise levels in external amenity spaces in line with the BS 8233/WHO/ProPG aspirational design guidance. **Figure 8.1** presents the daytime noise modelling of the site, re-categorised into areas at or below 55dB $L_{Aeq,16hour}$ (shown in "**GREEN**") and noise levels above 55dB $L_{Aeq,16hour}$ (shown in "**RED**").

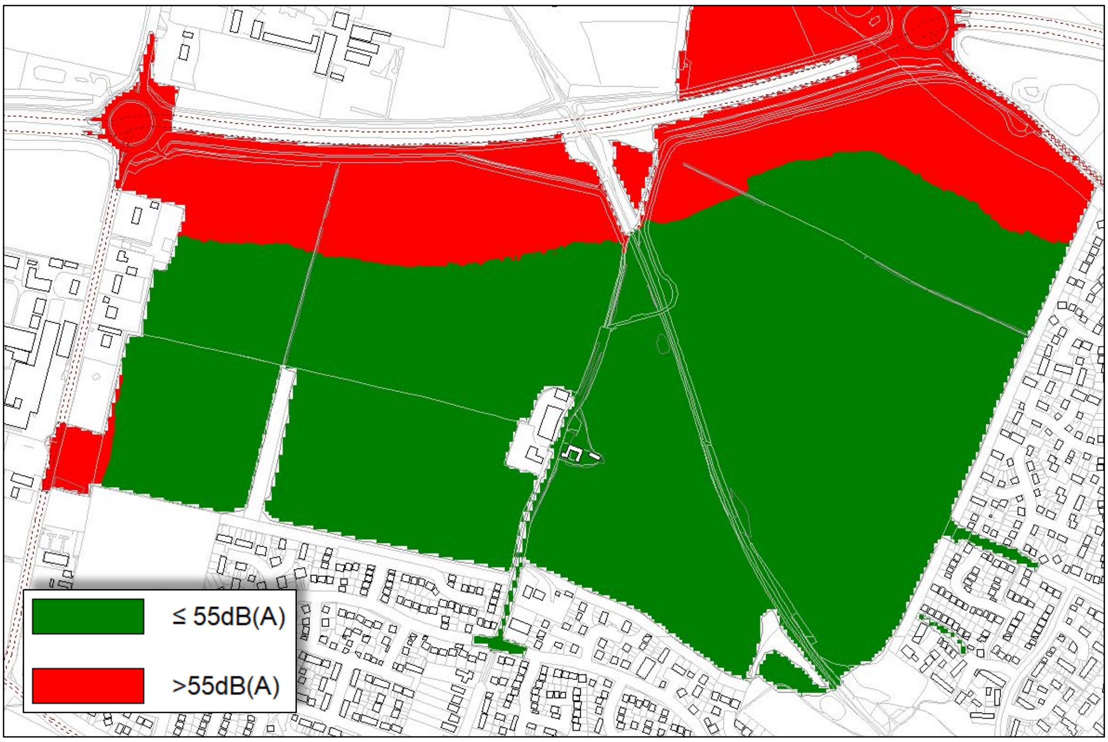

Figure 8.1: Amenity Area Noise Assessment

8.4 The above figure shows that much of the site is already compliant with the suggested 55dB(A) upper limit for external amenity spaces, without any additional mitigation (other than that already embedded into the site, such as the low noise road surface and earth bunds to the northern perimeter of the site implemented as mitigation for the NDR).

8.5 As noted earlier, noise mitigation can also be implemented by the use of strategies such as the creation of barrier blocks. To demonstrate the potential effectiveness of such a strategy, some barrier blocks (a linear array of detached properties with 'gaps') have been overlaid onto the concept masterplan and which has then been re-modelled to show resultant noise levels, categorised in line with areas above or below the upper limited of 55dB(A) recommended for external amenity areas.

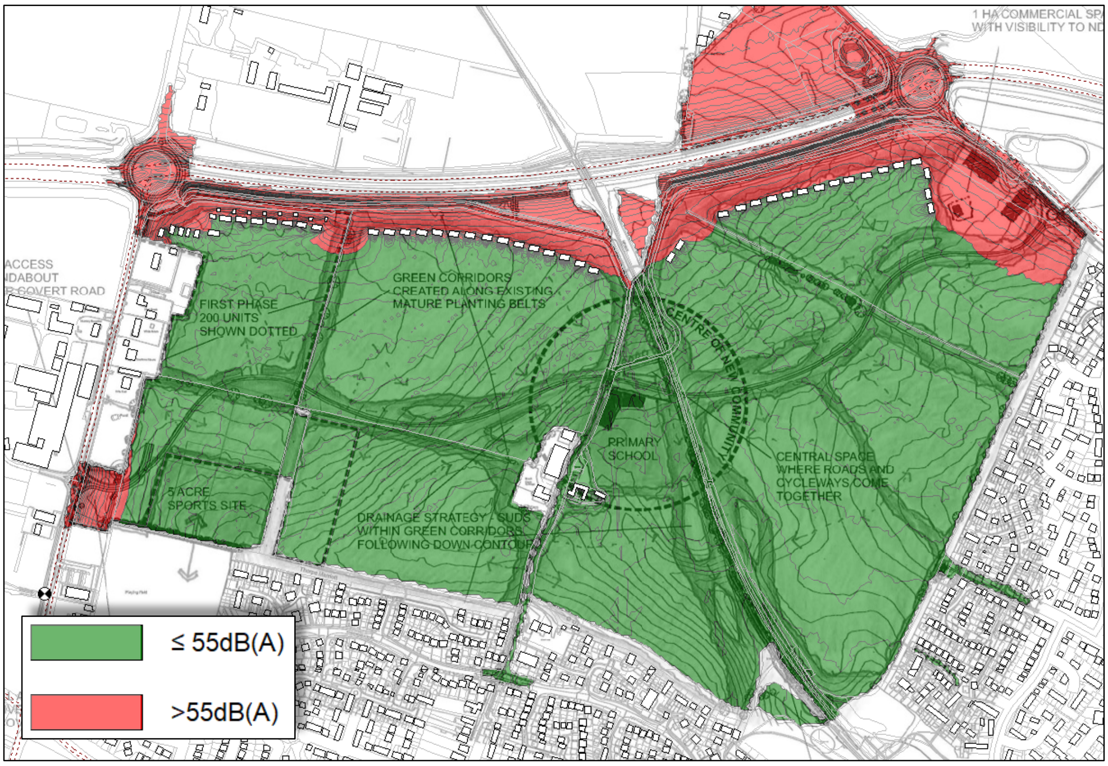

Figure 8.2: Mitigation with Implementation of Barrier Blocks

8.6 The above figure shows that implementing barrier blocks to the northern boundary of the site should reduce amenity areas noise levels within the remaining site area to below 55dB(A).

8.7 It is therefore concluded that effective mitigation can be implemented to provide good quality amenity space for future residents.

9 Traffic Noise

9.1 The proposed development will inevitably introduce additional vehicular traffic to the area.

9.2 Preliminary estimates of potential traffic generation from the proposed development have been provided by Cannon Consulting Engineers.

9.3 Potential traffic generation has been provided for 6 road links, as identified in **Figure 9.1** below.

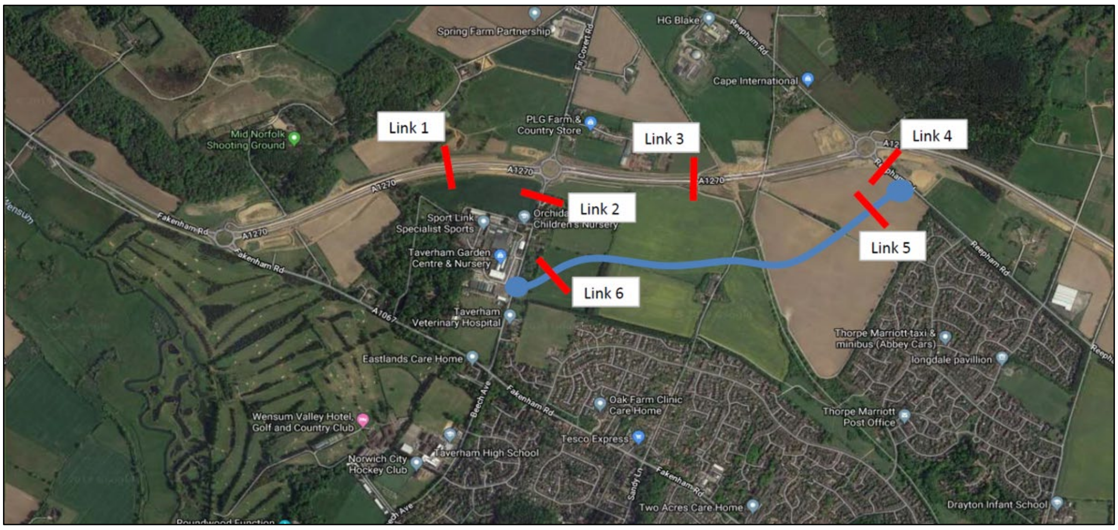

Figure 9.1: Road Link Identification

9.4 It can be seen that four of the road links (Links 1 to 4) relate to existing roads, whilst Links 5 and 6 relate to a new distributor road that would be created as part of the development.

9.5 The "long term" effect of development traffic on existing roads has been assessed by comparing 2034 traffic flows (including factored growth and development traffic) with baseline (2019) flows.

9.6 The significance of any noise change is assessed in line with "long term" significance criteria, set out in the "Design Manual for Roads and Bridges". Volume 11, Section 3, Part 7 (HD 213/11). Clause 3.33 of this document identifies that:

> *"A change in road traffic noise of 1 dB(A) in the short term (e.g. when a project is opened) is the smallest that is considered perceptible. In the long term, a 3 dB(A) change is considered perceptible. The magnitude of impact should,*

therefore, be considered different in the short term and long term. The classification of magnitude of impacts to be used for traffic noise is given in Table 3.1 (short term) and Table 3.2 (long term)."

9.7 The short and long term guidance is presented in **Tables 9.1** and **9.2** below.

Noise Change, $L_{A10,18hour}$	Magnitude of Impact
0	No Change
0.1 – 0.9	Negligible
1 – 2.9	Minor
3 – 4.9	Moderate
5+	Major

Table 9.1: Classification of Magnitude of Noise Impacts in the Short Term

Noise Change, $L_{A10,18hour}$	Magnitude of Impact
0	No Change
0.1 – 0.9	Negligible
1 – 2.9	Minor
3 – 4.9	Moderate
5+	Major

Table 9.2: Classification of Magnitude of Noise Impacts in the Long Term

9.8 The results of the assessment is presented in **Table 9.3** below:

Road Link	Baseline 2019		Future Year 2034 + Development Traffic		Relative change in Traffic Noise Level	Magnitude of Effect
	AAWT	%HDV's	AAWT	%HDV's		
Link 1	8239	9%	10664	9%	+1.1	Negligible
Link 2	8851	3%	12950	2%	+1.6	Negligible
Link 3	12576	6%	17144	6%	+1.4	Negligible
Link 4	5645	3%	8865	3%	+2.0	Negligible

Table 9.3: Assessment of "Long Term" Traffic Noise Changes

9.9 Whilst traffic flows on local roads will generally increase as a result of the proposed development, the long term change in noise level associated with future forecast traffic volumes will be "negligible" for all link roads. As such, the proposed development should not have a significant adverse impact on existing residential receptors fronting existing roads.

9.10 The new distributor road is located some distance from existing receptors and is therefore also considered unlikely to have any significant adverse impact. Notwithstanding this, the masterplanning proposals for the scheme can be developed to minimise noise impacts on both existing and future residential receptors.

10 Proposed Primary School

10.1 **Figure 10.1** below re-categorises the noise levels shown in **Figure 9.2** in line with the educational use risk categories presented in **Table 5.4** above. The proposed location of the school towards the centre of the site is shown hatched in black.

Figure 10.1: Site Risk Categorisation for Education Use

10.2 The above model shows that the school is to be located in an areas that would be classified to be a "negligible" risk, in relation to the suitability of the site for educational use.

10.3 On this basis, it is concluded that the site is suitable for development as a school and that noise levels should be compatible with a suitably designed natural ventilation strategy, in line with the government's aim for delivering sustainable development.

11 Conclusions

11.1 Preliminary computational noise modelling has been undertaken to assess existing baseline noise level charactering the proposed development site.

11.2 The output of the noise model has been assessed to determine the initial (unmitigated) noise 'risk' for the future residential development of the site, in line with ProPG guidance.

11.3 This initial assessment indicates that there is a 'high' noise risk towards the northern boundary of the site (adjacent to the NDR), but noise levels reduce in a southerly direction across the site reducing to a "negligible" daytime noise risk and "low" night-time noise risk.

11.4 As such, the development is considered suitable for residential development subject to effective noise mitigation strategies for the higher noise risk areas, in line with good acoustic design principles.

11.5 The concept masterplan already makes appropriate provisions for buffer zones along the northern boundary of the site which generally avoids development in higher noise risk areas. The following additional mitigation measures could also be implemented:

- Enhancing existing screening to the northern side of the site by increasing the height of existing earth bunds or supplementing these with additional barriers.
- The use of "barrier" blocks to minimise noise propagation across the site and the creation of courtyard type arrangement to minimise noise levels in external amenity spaces;
- Optimising the orientation/internal arrangement of dwellings (e.g. by locating non-habitable rooms on 'noisier' facades and more sensitive uses on acoustically screened facades); and
- Providing buildings with appropriate sound insulation through the specification of appropriate external fabric constructions (in particular windows) and providing appropriate alternative means of ventilation if acceptable internal noise levels cannot be achieved if windows are open.

11.6 Implementation of the above good acoustic design principles should enable the delivery of full compliance with the internal noise design guidance recommended in BS 8233: 2014. The WHO's *"Guidelines for Community Noise"* and ProPG guidance, this delivering residential development in line with national planning and noise objectives for sustainable development.

11.7 Preliminary noise modelling also concludes that the site is suitable for development as a primary school and that noise levels should be compatible with a suitably designed natural ventilation strategy, in line with the government's aim for delivering sustainable development.

11.8 A preliminary assessment of the long term change in road traffic noise levels on existing roads as a result of the proposed development has been undertaken. This concludes that local roads will increase. However, the long term change in noise level associated with future forecast traffic volumes is assessed to be of "negligible" significance based on DMRB assessment guidance. As such, the proposed development should not have a significant adverse impact on existing residential receptors fronting existing roads.

11.9 It is therefore concluded that whilst noise is an obvious constraint at the site, the residential-led development of the site will be deliverable though adherence to a good acoustic design process and in full compliance with the national and local planning and noise policy objectives.

APPENDIX A: Glossary of Acoustic Terminology

GLOSSARY OF ACOUSTIC TERMINOLOGY

mayer brown

General

A vibrating surface or turbulent fluid flow will cause pressure fluctuations in the surrounding air. These pressure fluctuations are perceived by the human ear as “sound”.

Measurement Units

The human ear can detect sound pressures as low as about 20 μPa, and can tolerate (for short periods) sound pressures as high as 200 Pa, an amplitude range of 10 million times. To take account of this huge amplitude range, sound pressure levels (often written in “acoustic shorthand” as SPL or Lp) are quantified using a logarithmic scale, the decibel (dB) scale. This is based on a reference pressure of 20μPa, thus a sound pressure of 20μPa would equate to 0dB and a pressure of 200Pa would equate to 140dB.

Frequency (Pitch) Characteristics

The sound received at any particular location is not solely influenced by the sound pressure level, the frequency characteristics (pitch) of the noise is also an important factor. Noise audible to a human (with “normal” hearing), typically covers the frequency range 20 Hertz to 20,000 Hertz. Hertz (Hz) are defined as the number of times the sound pressure fluctuates in one second. “Low” pitched sounds fluctuate less times per second than “high” pitched sounds. Whilst humans are capable of detecting a wide range of frequencies, the ear is not equally sensitive to all frequencies – the ear is most sensitive at frequencies towards the middle of the audible range and less sensitive to the lower and higher frequencies.

To take account of this frequency response, sound pressure fluctuations are normally quantified by applying a frequency-weighting network or filter which simulates the frequency response of the ear. In essence, this means that more significance is given to the frequencies at which the ear is most sensitive and less significance to those at which the ear is less sensitive. Noise measurements relating to human reaction are generally made using an “A-weighting” network. These measurements are reported as A-weighted decibels or dB(A). The A-weighted sound pressure level is written in “acoustic shorthand” as L_A.

Variation of Sound with Time

It will be appreciated that the sound pressure level of most noise sources will fluctuate with time. In order to take account of the way in which the human ear perceives noise, it is normal for the sound pressure level to be quantified using a time weighting network, to mimic the speed of response of the human ear. The standardised setting for most types of noise is a “Fast” time weighting.

The manner in which sound fluctuates with time can also influence the subjective manner in which noise is perceived. Noise can be continuous (showing no significant variation with time as in the case of a fan), intermittent (i.e. the noise is transient in it’s nature, such as a train pass-by) or impulsive (i.e. there is a sudden build up of noise - this can range from “clanking” types sounds as might be experienced next to railway goods yard or a high energy discharge such as an explosion)

Measurement of Sound

Sound pressure levels are measured using equipment comprising a pressure-sensitive microphone, associated amplifier, frequency weighting network, time weighted network and output indicator. In its simplest form this is a small hand-held instrument called a sound level meter. More sophisticated instrumentation (a sound level analyser) is also available which allows the real-time output of the frequency characteristics of the sound to be quantified.

Comparison of Sound Levels

To put the significance of noise measurement into context, the following Table presents the A-weighted sound pressure level of some typical sources:

Sound Pressure Level, dB(A)	Typical Noise Source . Activity
160	Saturn Rocket Taking Off
140	Military Jet Taking Off at 30m
100	Nightclub
90	Heavy goods vehicle driving past at 7m
80	Busy urban road
70	Domestic vacuum cleaner at 3m
60	Busy office environment
55	Normal speech at 1m
40	Whispered conversation at 2m
30	Bedroom at night (BS 8233: 1999)
20	Remote country location
0	Threshold of hearing – a very eery silence

Addition of Sound Levels

It is important to note that the use of a logarithmic scale to describe noise does not allow normal arithmetic addition. This means that two noise sources each generating a level of, say, 60dB(A) will not generate a combined sound level of 120dB(A). The values must be added logarithmically, which would actually yield a combined sound level of 63dB(A) in this example.

Subjective Perception of Sound Levels Changes

With regard to the human perception of sound level changes, the human ear:

- Cannot generally perceive a sound level difference of less than 3dB(A)
- Will perceive a sound level difference of 4-5dB(A) as “noticeable”
- Will perceive a sound level difference of 10dB(A) as a doubling (or halving) of loudness.

Acoustic Terminology

As stated previously, most sources of noise will fluctuate with time. In order to characterize such noise, it is therefore normal to represent the noise climate using a variety of noise parameters and statistical indices. The most commonly adopted noise parameters are described below:

$L_{Aeq,T}$ This is the equivalent continuous A-weighted sound level measured over a specified time period "T". This is the notional continuous sound level which, over the time T, contains the same amount of energy as the actual fluctuating sound being measured. This parameter is widely accepted as being the most appropriate noise descriptor for most environmental noise and the effects of noise on humans.

$L_{Amax,fast}$ This is maximum A-weighted sound pressure measured with a fast frequency response recorded during the stated measurement period. It is typically used to characterise the highest sound level caused during a noise event.

$L_{A90,T}$ This is the A-weighted sound pressure level exceeded for 90% of the specified time period "T". It is normally used to describe the underlying background noise level of an environment since it inherently excludes the effects of transient noise sources.

Noise Rating (NR) Level

When describing noise from building services installations, it is common to express noise levels in terms of a Noise Rating (NR) Level. The NR level is determined by plotting the measured frequency spectrum of a noise against a series of reference curves, which roughly approximate to equal loudness values. This method permits higher sound levels at low frequencies corresponding to the sensitivity of the human ear. The NR level is defined as the value of the highest curve "touched" by the plotted frequency spectrum. For typical sources of building services noise, the overall A-weighted sound level is numerically around 5-6dB higher than the NR level of the noise.

Airborne Sound Insulation Measurement Parameters

The ability of a building element to reduce airborne noise can be described by a number of different parameters relevant to both laboratory and on-site performance evaluation. In general, the higher these values, the better the resistance of the construction to the transmission of airborne sound. The most commonly used parameters include:

R_w The **"Weighted Sound Reduction Index"** (R_w) is a single value measure of the intrinsic sound reduction capabilities of a construction, as measured in an acoustic laboratory. Measurement values are determined in accordance with the BS EN ISO 10140 series of standards and weighted in accordance with BS EN ISO 717-1: 2013.

R'_w The **"Weighted Apparent Sound Reduction Index"** (R'_w) is a single value measure of the apparent sound reduction capabilities of a construction, when installed on-site (which will normally be some way lower than the laboratory value due to less favourable installation conditions, the quality of workmanship, etc.). Measurement values are determined in accordance with the BS EN ISO 10140 series of standards and weighted in accordance with BS EN ISO 717-1: 2013. In practice, the R'_w of a construction can only be reliably determined if "direct" sound transfer through the partition can confidently be taken as the dominant noise transfer path (i.e. there is no "flanking" sound transmission.

D_w The **"Weighted Sound Level Difference"** (D_w) is a single value measure of the on-site sound reduction between two rooms. This value inherently includes "direct" sound transmission through any separating construction and "flanking" transmission through other building elements. Measurement values are determined in accordance with BS EN ISO 140-4: 1998 (for Building Regulations compliance purposes) or BS EN ISO 16283-1: 2014 and weighted in accordance with BS EN ISO 717-1: 2013.

$D_{n,fw}$ The "**Weighted Normalised Flanking Level Difference**" ($D_{nf,w}$) is a single figure measure of the sound reduction between two rooms solely due to sound transmission through a specified flanking path. This parameter is frequently used to provide an indication of the sound reduction capabilities of suspended ceiling and raised access floor constructions where there is common void between adjacent rooms or as a measure of sound that may be transmitted between rooms through external curtain walling. Measurements are undertaken in accordance with BS EN ISO 10848-2: 2017 and weighted in accordance with BS EN ISO 717-1: 2013.

Impact Sound Insulation Measurement Parameters

Some building elements also have the potential to generate "impact" noise, for example due to human "footfall" on floor structures, or the impact of rainfall on lightweight roofing components. A variety of parameters are again available to define the amount of noise likely to be generated. In general, the lower these values, the less sound the construction will generate as a result of impacts. Typical measurements parameters include:

$L_{nT,w}$ The "**Standardised Impact Sound Pressure Level**" is a "single number" rating describing the intrinsic impact sound insulation capabilities of a construction (such as a floor system) as measured in an acoustics laboratory. Values are determined in a vertical sound transmission suite by locating a "tapping machine" in the upper room of the suite and measuring the amount of sound radiated by the floor in the room below. Measurement values are determined in accordance with the BS EN ISO 10140 series of standards and weighted in accordance with BS EN ISO 717-2: 2013.

$L_{nf,w}$ The "**Normalised Flanking Impact Sound Pressure Level**" is a "single number" rating describing the amount of flanking sound that would be transmitted to an adjoining space (separated by a partition) due to impacts on the test sample. It is, for example, used to indicate the amount of noise that may be generated due to footfall noise on a raised access floor system. Values are determined in a horizontal sound transmission suite by locating a "tapping machine" one side of a separating partition built off the test sample and measuring the amount of noise radiated by the floor in the adjoining space on the other side of the partition. Measurement values are determined in accordance with BS EN ISO 10848-2: 2017 and weighted in accordance with BS EN ISO 717-2: 2013.

Room Acoustic Measurements

T The "**Reverberation Time**" (T) of a room is defined as the time taken for the sound energy produced by a source Time (RT) to decay by 60 dB after the source has been switched off. The reverberation time of a space can be calculated by considering the volume of the room and the areas and sound absorption qualities of room surface finishes. Small, "soft" rooms tend to give low reverberation times, whilst large, "hard" rooms tend to give long reverberation times.

α_p The "**Practical Acoustic Absorption Coefficient**" (α_p) is a measure of how much sound energy is absorbed by a building element at a particular frequency, as measured in accordance with BS EN ISO 354: 2003.

α_w The "**Weighted Absorption Coefficient**" (α_w) is a single figure measure of the overall sound absorption capabilities of a building element determined in accordance with BS EN ISO 11654: 1997.