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12 January 2024

18845-EBF-01

External Building Fabric Report

Project Number
18845

Issued For
Rollestone Street Limited

Company registered in England & Wales no. 07958744
UKAS accreditation is only applicable to pre-completion sound insulation testing services for building regulations and is not linked to the endorsements and certifications shown above

EXECUTIVE SUMMARY

This assessment has been undertaken so external building fabric elements can be specified in order to meet appropriate internal noise criteria at 35 Rollestone Street, Salisbury.

The assessment adheres to the Local Authority requirements, the principles provided by the *National Planning Policy Framework*: 2021 (NPPF) and internal noise criteria stated within BS 8233: 2014 *'Guidance on sound insulation and noise reduction for buildings'.*

The Institute of Acoustics' *Professional Guidance on Planning & Noise*: 2017 (ProPG) recommended approach for determining site risk due to environmental noise has also been adopted.

The site currently comprises an unused commercial site. Proposals include the redevelopment of 4 No. residential units for residential purposes.

A noise survey has been undertaken as detailed in the report, in order to establish the prevailing environmental noise levels at the site.

A subsequent detailed analysis has been carried out of road traffic and commercial noise intrusion through the external building fabric. Sound insulation performance specifications have been proposed for glazing.

The assessment has demonstrated that appropriate internal noise levels should be achievable with the installation of nominal glazing systems and typical trickle ventilators.

It is essential that certificated performances should be sought from the manufacturer(s) of the proposed glazing/cladding systems and trickle ventilators.

Surveys and assessment undertaken to assess existing building fabric elements indicate that existing glazing and a separating wall to the adjacent public house indicate that these are suitable as existing, should they be retained.

This report is designed to be suitable to discharge typical noise planning conditions, as per our original scope of work. The report should not be relied upon for further reasons, such as the detailed design of mitigation measures.

Clement Acoustics has used all reasonable skill and professional judgement when preparing this report. The report relies on the information as provided to us at the time of writing and the assumptions as made in our assessment. This report contains confidential information and should not be disclosed to third parties.

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18845-TH1	Environmental Noise Time History
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Appendix A	Glossary of Acoustic Terminology
Appendix B	ProPG Initial Site Risk Assessment Guidance

Issue	Date of Issue	Author
0	12/01/2024	**Duncan Martin** Director BSc (Hons) MIOA

Issue	Comment
0	First Issue

1.0 INTRODUCTION

Clement Acoustics has been commissioned by Rollestone Street Limited to assess the suitability of the site at 35 Rollestone Street, Salisbury for residential development.

It is understood that the existing building, comprising Class E uses at ground and first floors, will be developed to form 4 residential apartments on ground and first floors.

This report presents the results of environmental noise surveys undertaken in order to measure prevailing background levels and details the proposed internal noise level criteria.

Full details of necessary mitigation measures in order to meet the proposed criteria are also provided.

2.0 SITE DESCRIPTION

The proposed development site is a previous commercial unit currently unused, with plans to comprise 4 residential apartments over ground and first floors. Ground floor apartments will be studio type accommodation with a single living and sleeping area, while first floor apartments will have separate living rooms and bedrooms.

The site is in a mixed residential and commercial area facing on to Rollestone Street, a street largely populated by residential houses and commercial units. The site is bound by Rollestone Street to the east, a local pub to the south, and an unused commercial unit to the north and west. The Pheasant Inn, the public house to the south, is connected to the development site.

At the time of the survey, the background noise climate was dominated by road traffic.

3.0 ARCHITECTURAL ASSUMPTIONS

3.1 Drawings

The following drawings have been used in our assessment:

- pd005
- pd006

3.2 Room Volume and Window Dimensions

Based on the above drawings we have based our calculations on the following worst case living room and bedroom and window dimensions.

- Studio
  - Room Volume: 98 m^3
  - Window Area: 12.8 m^2
- Bedroom
  - Room Volume: 32 m^3
  - Window Area: 3.7 m^2

3.3 Room Finishes

Our assessment assumes that bedrooms and living rooms will contain typical amounts of soft furnishings, including sofas, chairs, beds and curtains.

4.0 CRITERIA

4.1 Local Authority Requirements

It is understood that as the application is classed as a 'permitted development', noise from commercial sources in the area must be considered in terms of the effect on residential amenity.

4.2 National Planning Policy Framework: 2021 (NPPF)

The NPPF, which was first published in 2012 with the latest revision in 2021, outlines the Government's environmental, economic and social policies for England. The NPPF aims to enable local authorities to produce their own distinctive local and neighbourhood plans, which should be applied in order to meet the needs and priorities of their communities.

Paragraph 185 of The *Ground Conditions and Pollution* section of the NPPF relates specifically to noise stating that:

> *'Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:*
>
> *a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;*

b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason…'

4.3 BS 8233: 2014 Internal Noise Criteria

BS 8233: 2014: '*Guidance on sound insulation and noise reduction for buildings*' describes recommended acceptable internal noise levels for residential spaces during daytime and night-time hours. These levels are shown in Table 4.1.

Activity	Location	Design Range $L_{eq,T}$	
		Daytime (07:00 - 23:00)	Night-time (23:00 – 07:00)
Resting	Living Room	35 dB(A)	-
Dining	Dining Room/Area	40 dB(A)	-
Sleeping	Bedroom	35 dB(A)	30 dB(A)

Table 4.1 BS 8233: 2014 recommended internal background noise levels

4.4 World Health Organisation Guidelines

The World Health Organisation (WHO) document on *'Guidelines for Community Noise'* 1999 states the internal noise level guidelines as summarised in Table 4.2.

Specific Environment	Critical Health Effects	$L_{eq,T}$	$L_{max,\ F}$
Dwelling, Indoors	Speech Intelligibility and moderate annoyance, daytime and evening	35 dB(A)	-
Inside Bedrooms	Sleep disturbance, night-time	30 dB(A)	45 dB(A)

Table 4.2 WHO Internal noise level guidelines

4.5 Proposed Noise Level Criteria

On the basis of Sections 4.1 to 4.4. above, Table 4.3 presents our proposed minimum design targets to be achieved in the worst affected dwellings.

Location	Period	Design Target $L_{eq,\,T}$
Living Rooms	Daytime (07:00-23:00 hours)	35 dB(A)
Bedrooms	Night-time (23:00-07:00 hours)	30 dB(A)

Table 4.3 Proposed noise level criteria

***Please note that this is not an absolute limit, however, $L_{max,\,F}$ 45 dB(A) should not be regularly exceeded.**

The external building fabric would need to be carefully designed to achieve these recommended internal levels.

4.6 Professional Guidance on Planning & Noise (ProPG)

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

The ProPG follows 2-stage risk assessment approach. The two stages are as follows:

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

The results of the initial Site noise risk assessment will determine the appropriate risk of developing the site and therefore how appropriate it is from a noise perspective.

Appendix B presents the Initial Site Risk assessment as presented in ProPG.

Stage 2 attempts to determine that good acoustic design principals have been incorporated into the design so that suitable internal noise levels can be achieved in habitable rooms and that suitable external noise levels can be achieved in outdoor amenity space.

4.7 Guidance on Ventilation

Guidance on ventilation and associated acoustic considerations is given in Acoustic Ventilation and Overheating – Residential Design Guide [AVO] issued jointly by the Association of Noise Consultants and the Institute of Acoustics.

In this guide, the need for ventilation (which falls under the requirements of Approved Document F [ADF]) are covered in three main requirements as follows:

- Whole Dwelling Ventilation
    - General ventilation – continuous ventilation of rooms or spaces at a relatively low rate
- Extract Ventilation
    - Removal of air from a space or spaces (typically stale air from bathrooms or kitchens) to outside
- Purge Ventilation
    - Manually controlled removal of air at a high rate to eliminate fumes and odours, e.g. during painting and decorating or from burnt food. May be provided by natural or mechanical means.

Four main template systems for providing each of the above ADF ventilation requirements are summarised in the AVO guide as shown in Table 4.4.

Ventilation System	Method of Whole Dwelling Ventilation	Method of Extract Ventilation	Method of Purge Ventilation
System 1 [Background ventilators and intermittent extract fans]	Background ventilators (trickle vents)	Intermittent extract fans	Typically provided by opening windows
System 2 [Passive Stack]	Background ventilators (trickle vents) & passive stack	Continuous via passive stack	Typically provided by opening windows
System 3 [Continuous Mechanical Extract (MEV)]	Continuous mechanical extract (low rate), trickle vents provide fresh air	Continuous mechanical extract (high rate), trickle vents provide fresh air	Typically provided by opening windows
System 4 [Continuously mechanical supply and extract with heat recovery (MVHR)]	Continuous mechanical supply and extract (low rate)	Continuous mechanical supply and extract (high rate)	Typically provided by opening windows

Table 4.4 Summary of template systems for ADF ventilation requirements

Where possible, natural forms of ventilation are typically preferred. However, in high noise areas, it may be necessary to recommend System 4, in order to minimise penetrations through the external building façade, which weaken the overall sound reduction performance.

Ventilation requirements will be assessed with consideration to the above systems.

5.0 ENVIRONMENTAL NOISE SURVEY

5.1 Unattended Noise Survey Procedure

Measurements were undertaken at one position as shown on indicative site drawing 18845-SP1. The choice of this position was based both on accessibility and on collecting representative noise data in relation to proposed residential window locations.

The microphone was mounted on a first storey window at the front of the building. The microphone was positioned 1 m in front of the window.

The position was not considered to be free-field according to guidance found in BS 8233: 2014, and a correction for reflections has therefore been applied. Based on the presence of the reflective surface and the nature of surrounding noise sources, a correction for reflections of 3 dB has been applied, in line with the recommendations of the standard.

Continuous automated monitoring was undertaken for the duration of the survey between 14:53 on 5 January 2024 and 3:48 on 7 January 2024.

The measurement procedure generally complied with BS 7445: 1991: 'Description and measurement of environmental noise, Part 2- Acquisition of data pertinent to land use'.

5.2 Weather Conditions

At the time of set-up and collection of the monitoring equipment, the weather conditions were cloudy and dry with light winds. It is understood that the weather conditions during the unattended survey were generally dry with medium to light winds.

It is considered that the weather conditions did not significantly adversely affect the measurements and are therefore considered suitable for the measurement of environmental noise.

5.3 Equipment

The equipment calibration was verified, by means of a field verification check, before and after use and no abnormalities were observed.

The equipment used was as follows.

- 1 No. Svantek Type 957 Class 1 Sound Level Meter
- Rion Type NC-74 Class 1 Calibrator

6.0 RESULTS

6.1 Unattended Noise Survey Results

The $L_{Aeq:\ 5min}$, $L_{Amax:\ 5min}$, $L_{A10:\ 5min}$ and $L_{A90:\ 5min}$ acoustic parameters were measured at the location shown in site drawing 18845-SP1.

Measured noise levels are shown as a time history in Figure 18845-TH1. A summary of the measured noise levels is presented in Table 6.1.

Position	Time Period	Average ambient noise level $L_{Aeq:\ T}$, dB	Maximum noise level $L_{AFmax:\ 5min}$, dB
1	Daytime (07:00 - 23:00)	56	-
	Night-time (23:00 - 07:00)	45	70

Table 6.1 Average ambient and maximum noise levels

The levels presented in Table 6.1 are as expected considering the site location. Outline mitigation measures are described in Section 8.0 of this report.

Maximum noise levels shown in Table 6.1 are deemed to be 'not regularly exceeded' as required for maximum internal noise level specification purposes.

7.0 PROPG INITIAL SITE RISK ASSESSMENT

The environmental noise survey has determined the onsite noise levels. Table 6.1 shows the calculated day and night-time noise levels to be used in the noise assessment.

With reference to the ProPG risk assessment guidance presented in Appendix B, Table 7.1 shows the identified risk level of this site.

Position	Period	Measured Noise Level	ProPG Noise Risk	ProPG Action Guideline
1	**Daytime** [07:00 - 23:00]	56 dB(A)	Low	See Note [1]
	Night-time [23:00 - 07:00]	45 dB(A)	Low	See Note [1]

Table 7.1 ProPG initial site risk assessment

Note [1]: Low – '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 Acoustic Design Statement (ADS) which confirms how the adverse impacts of noise will be mitigated and minimised in the finished development.'

In consideration of the above, we would therefore recommend that assessing the site according to the guidance of British Standard 8233: 2014 will demonstrate that the impacts of noise can be suitably mitigated to avoid an adverse impact.

Provided adequate mitigation measures are put in place during the design and construction phase of the development, recommended internal noise levels can be achieved. Outline mitigation measures are described in Section 8.0 of this report.

8.0 EXTERNAL BUILDING FABRIC ASSESSMENT

8.1 External Building Fabric - Non Glazed Elements

It is currently assumed that the non-glazed external building fabric elements of the proposed development would be comprised of existing masonry. This would contribute towards a significant reduction of ambient noise levels in combination with a good quality window configuration, as shown in Section 8.2.

All non-glazed elements of the building facades should be designed to provide a sound reduction performance of at least the figures shown in Table 8.1 when tested in accordance with BS EN ISO 140-3: 1995.

Element	Octave band centre frequency SRI, dB					
	125	250	500	1k	2k	4k
Non glazed element SRI	41	43	48	50	55	55

Table 8.1 Minimum required sound reduction performance from non-glazed elements

8.2 External Building Fabric - Specification of Glazed Units

Sound reduction performance calculations have been undertaken in order to specify the minimum performance required from glazed elements in order to achieve recommended internal noise levels shown in Table 4.3. This specification therefore presents the most robust assessment, for BS 8233: 2014 criteria for internal noise levels in a bedroom at all affected facades.

The minimum sound reduction index (SRI) value required for all glazed elements to be installed is shown in Table 8.2. **The performance is specified for the whole window unit, including the frame and other design features.**

Type	Façade	Minimum Sound Reduction Index (dB) at Octave Band Centre Frequency (Hz)					
		125	250	500	1k	2k	4k
A	Front	24	20	25	34	37	35

Table 8.2 Required glazing performance

Where non-vision spandrel panels are proposed, they should provide sound reduction performance at least equal to that required of the glazing in order to maintain the acoustic integrity of the external building fabric.

It is essential that prospective glazing system suppliers can demonstrate compliance with the acoustic performance detailed in our specification rather than simply offering a generic glazing configuration. The complete glazing system should achieve the performance requirements stated in Table 8.2 when tested in accordance with BS EN 10140-2: 2010.

It is essential that the performance presented in Table 8.2 is met. However, the following typical configurations would be expected to meet the required levels of sound insulation.

- Type A: 4 mm Glass / 12 mm Air / 4 mm Glass; $R_w + C_{tr}$ 27 dB

Please note that the above guidance only considers acoustic performance. Other disciplines, which consider thermal, safety, durability etc. should be consulted to ensure suitability.

8.3 External Building Fabric - Specification of Trickle Ventilators

It is understood the proposal on this site is to use System 1 ventilation as summarised in Table 4.4.

In order to comply with Building Regulations (Part F), fresh air ventilation to habitable rooms is required via trickle ventilators.

The trickle ventilators should comply with the minimum octave band normalised weighted level differences stated in Table 8.3.

Type	Façade	Minimum $D_{n,e}$ Values(dB) at Octave Band Centre Frequency (Hz)						$D_{n,eW}$[1]
		125	250	500	1k	2k	4k	
A	Front	33	27	27	28	26	27	27

Table 8.3 Required ventilator performance

Note 1 The $D_{n,eW}$ should be considered an indication of the overall performance of the ventilator. The minimum performance values per octave bands must be achieved.

8.4 Overheating Considerations

Through the proposed external façade and glazing configurations detailed in Sections 8.1 and 8.2, in combination with the trickle ventilation summarised in Section 8.3, it can be demonstrated that acceptable internal noise levels will be achieved with windows closed and background ventilation provided in accordance with System 1 ventilation as summarised in Table 4.4.

Purge ventilation can typically be provided through openable windows, as during periods when purge ventilation is required, internal noise levels are less critical.

Further consideration has also been given to possible overheating requirements. As the overheating strategy is not currently known, consideration has been given to the worst case scenario of openable windows being used.

Overheating noise criteria are presented in Approved Document O [ADO] which states the following:

> ***Noise***
>
> *3.2 In locations where external noise may be an issue (for example, where the local planning authority considered external noise to be an issue at the planning stage), the overheating mitigation strategy should take account of the likelihood that windows will be closed during sleeping hours (11pm to 7am).*
>
> *3.3 Windows are likely to be closed during sleeping hours if noise within bedrooms exceeds the following limits.*
>
> *a. 40dB LAeq,T, averaged over 8 hours (between 11pm and 7am).*
>
> *b. 55dB LAFmax, more than 10 times a night (between 11pm and 7am).*
>
> *3.4 Where in-situ noise measurements are used as evidence that these limits are not exceeded, measurements should be taken in accordance with the Association of Noise Consultants' Measurement of Sound Levels in Buildings with the overheating mitigation strategy in use.*
>
> *NOTE: Guidance on reducing the passage of external noise into buildings can be found in the National Model Design Code: Part 2 – Guidance Notes (MHCLG, 2021) and the Association of Noise Consultants' Acoustics, Ventilation and Overheating: Residential Design Guide (2020).*

According to BS 8233, a typical building facade with a partially open window offers 15 dB attenuation.

Based on the measured ambient noise levels shown in Table 6.1 the predicted internal ambient noise levels within habitable rooms with partially open windows used to prevent overheating would be as follows:

- Habitable rooms on front façade:
    - Night-time ambient noise level: $L_{Aeq,8hr}$ 30 dB
    - Night-time maximum noise level: $L_{AFmax,}$ 55 dB

Note: The above levels assume windows would be partially opened to prevent overheating for an entire night-time period.

The calculated internal levels do not exceed the ADO threshold for significance, indicating use of openable windows could be an acceptable solution to control overheating.

9.0 CONSIDERATION OF EXISTING BUILDING ELEMENTS

As the proposals are a change of use, the existing building elements including external façade elements and the separating wall to the adjacent public house have been considered. This section describes the surveys and assessments undertaken to assess existing performances and summarises resulting findings and recommendations.

9.1 Internal Noise Survey Procedures

Concurrently with the external survey described in Section 5.1, measurements were undertaken at two internal positions as shown on existing ground and first floor layout plans in . The choice of these positions was based on the sensitivity of rooms and the position of identified surrounding noise sources.

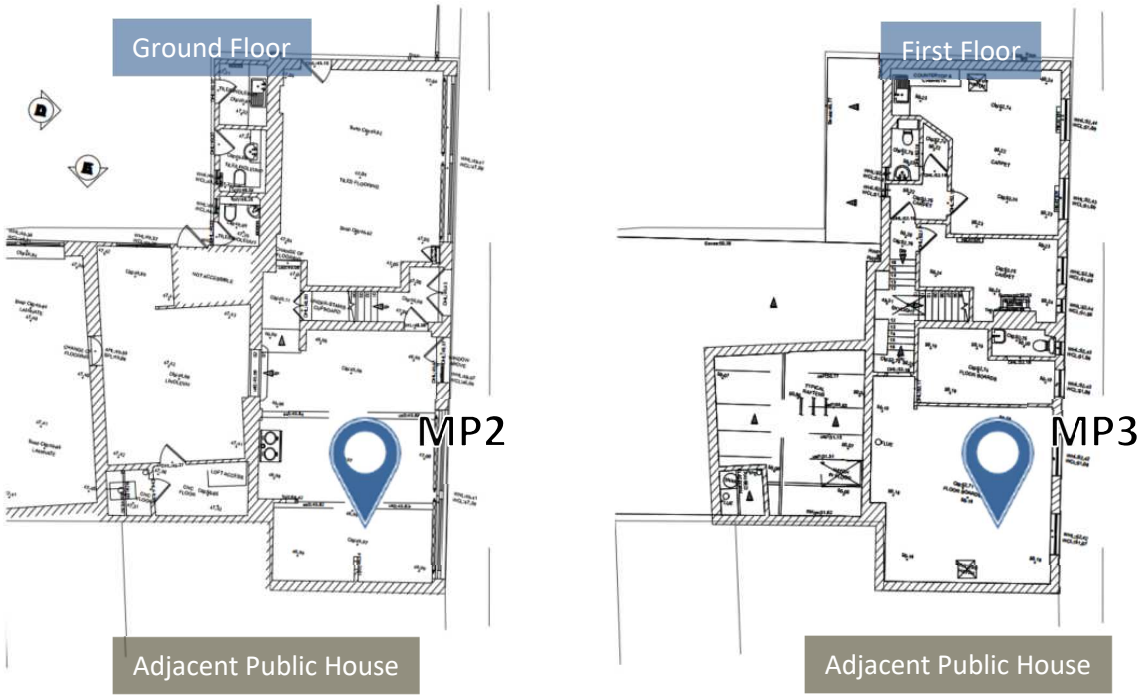


Figure 9.1 Floor layout plans indicating internal monitoring positions

All microphones were mounted on tripods, approximately 1.5 m above ground, close to the centre of the room in question. The monitoring locations are described in Table 9.1.

Position No.	Description
2	The microphone was mounted in the ground floor area, adjacent to the public house. Windows to the room overlook Rollestone Street
3	The microphone was mounted in the first floor area, adjacent to the public house. Windows to the room overlook Rollestone Street

Table 9.1 Description of unattended monitoring locations – internal survey

At both internal monitoring positions, the ambient and maximum noise levels were monitored, with audio recording also enabled to allow a detailed review of measured noise levels.

9.2 Equipment

The equipment calibration was verified, by means of a field verification check, before and after use and no abnormalities were observed. The equipment used was as follows.

- 2 No. Svantek Type 977 Class 1 Sound Level Meter
- Norsonic Type 1251 Class 1 Calibrator

9.3 Unattended Internal Noise Survey Results

The $L_{Aeq:\ 5min}$, $L_{Amax:\ 5min}$, $L_{A10:\ 5min}$ and $L_{A90:\ 5min}$ acoustic parameters were measured at the locations shown in Figure 9.1.

Measured noise levels are shown as time histories in 18845-TH2 and TH3. A summary of the measured noise levels is presented in Table 9.2.

Position	Time Period	Average ambient noise level $L_{Aeq:\ T}$, dB
MP2[1]	Daytime[2] (07:00 - 23:00)	35
	Night-time (23:00 - 07:00)	22
MP3	Daytime[2] (07:00 - 23:00)	35
	Night-time (23:00 - 07:00)	26

Table 9.2 Average ambient noise levels - internal

[1] For position MP2, a review of the audio recording indicates that a 'low battery' alarm for smoke alarms was regularly audible at the monitoring position. This has dominated the ambient and maximum noise level profiles, resulting in a 'flat line' shape as shown in time history 18845-TH2. The alarm was observed to be sounding approximately every 40 seconds. In order to present an analysis of internal noise levels, this has therefore been predicted based on the 'LA10' noise level, i.e. the value that is exceeded 10% of the time. This discounts the alarm sound, but is still considered a robust way to assess internal noise levels, as the LA10 is typically louder than the corresponding ambient noise level LAeq.

[2] At both positions, extraneous events during daytime hours have been omitted from the analysis. These include instantaneous events not attributable to typical outdoor noise sources, and a prolonged period on the morning of Sunday 7 January, when it appears cleaners were working in the building.

9.4 Discussion

9.4.1 Existing External Building Fabric

Measured internal noise levels summarised in Table 9.2 indicate that the existing external building fabric elements are suitable to ensure acceptable internal noise levels are achieved.

Where any new elements are proposed, for example replacement external doors or windows, or new trickle ventilators to support the proposed residential use, the guidance shown in Section 8.0 should be followed to maintain acceptable levels.

Where external doors at ground floor level are retained, we would recommend ensuring that good quality acoustic perimeter and threshold seals are installed to ensure doors form an airtight seal when closed. The same advice applies to any new doors installed.

9.4.2 Existing Separating Wall to Public House

The measured internal noise levels summarised in Table 9.2 indicate that residential amenity is being preserved by the existing separating wall to the public house. It is also noted that noise levels during evening hours (19:00 to 23:00) reduce compared with the middle of the day, indicating that noise due to peak public house periods do not become dominant.

Available information regarding the Pheasant Inn have been reviewed. The public house's listing on Google states the following:

> *"Comfy armchairs, open fires, brick and timber walls, hand-pulled ales and a menu of pub classics."*

This does not indicate a venue that has music or entertainment events. A further review of online reviews and social medial posts indicates the same.

The audio recordings at both internal positions have been reviewed, with particular attention to late evening periods. The review indicates that no public house noise is audible at either position.

The measured noise levels, audio recordings and available online information all indicate that noise from the public house is not expected to present a negative impact on residential amenity.

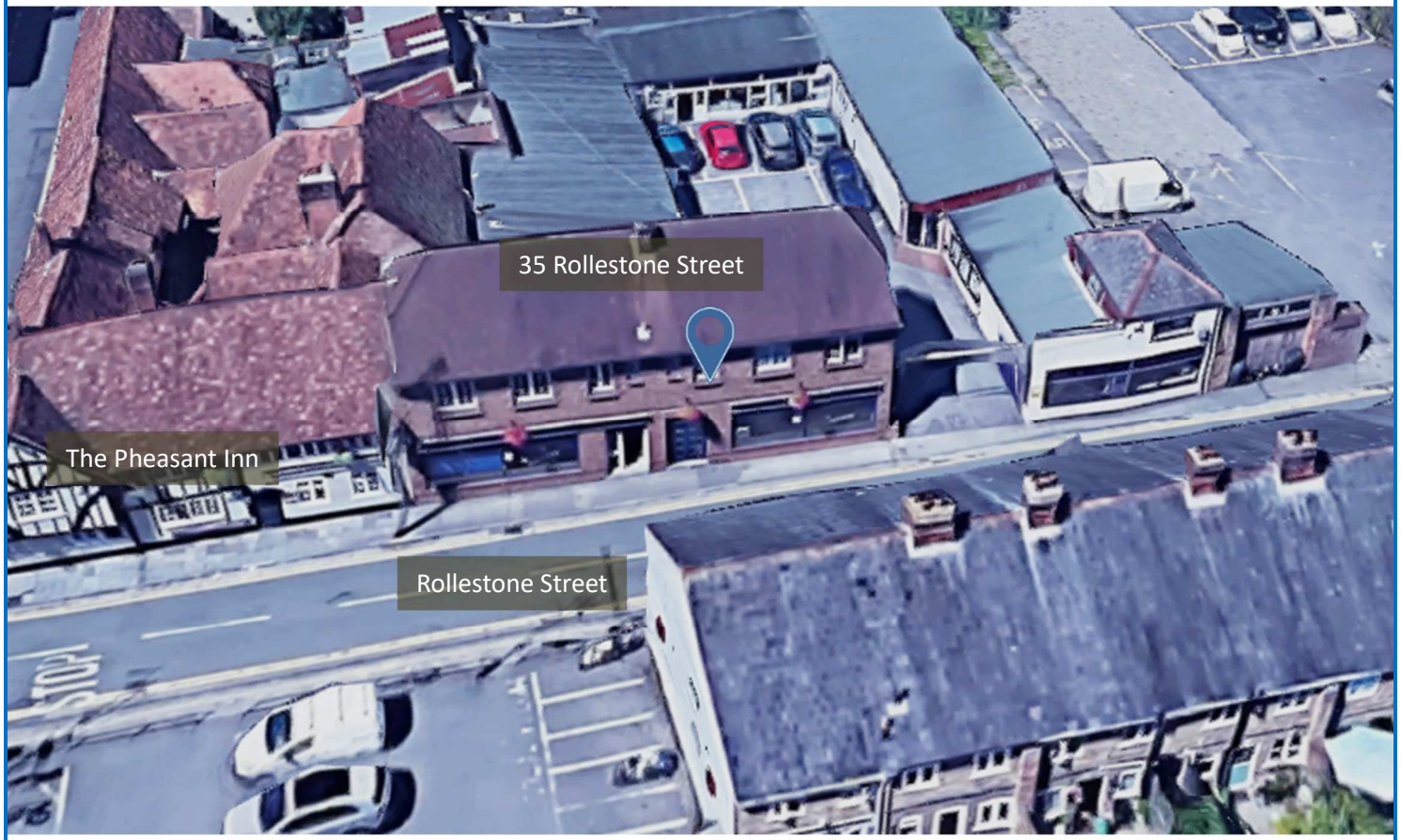
10.0 CONCLUSION

An environmental noise survey has been undertaken at 35 Rollestone Street, Salisbury. in order to measure ambient noise levels in the area.

Measured noise levels have allowed an assessment of the level of exposure to noise of the proposed development site to be made.

Outline mitigation measures, including a glazing specification and the use of appropriate ventilation have been recommended and should be sufficient to achieve recommended internal noise levels for the proposed development according to BS 8233: 2014, WHO and the requirements of Wiltshire Council.

An assessment of existing building fabric elements indicates that all existing features would be suitable to support the proposed residential development should these be retained.



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Not to scale

Description:
Indicative site plan showing external noise monitoring position

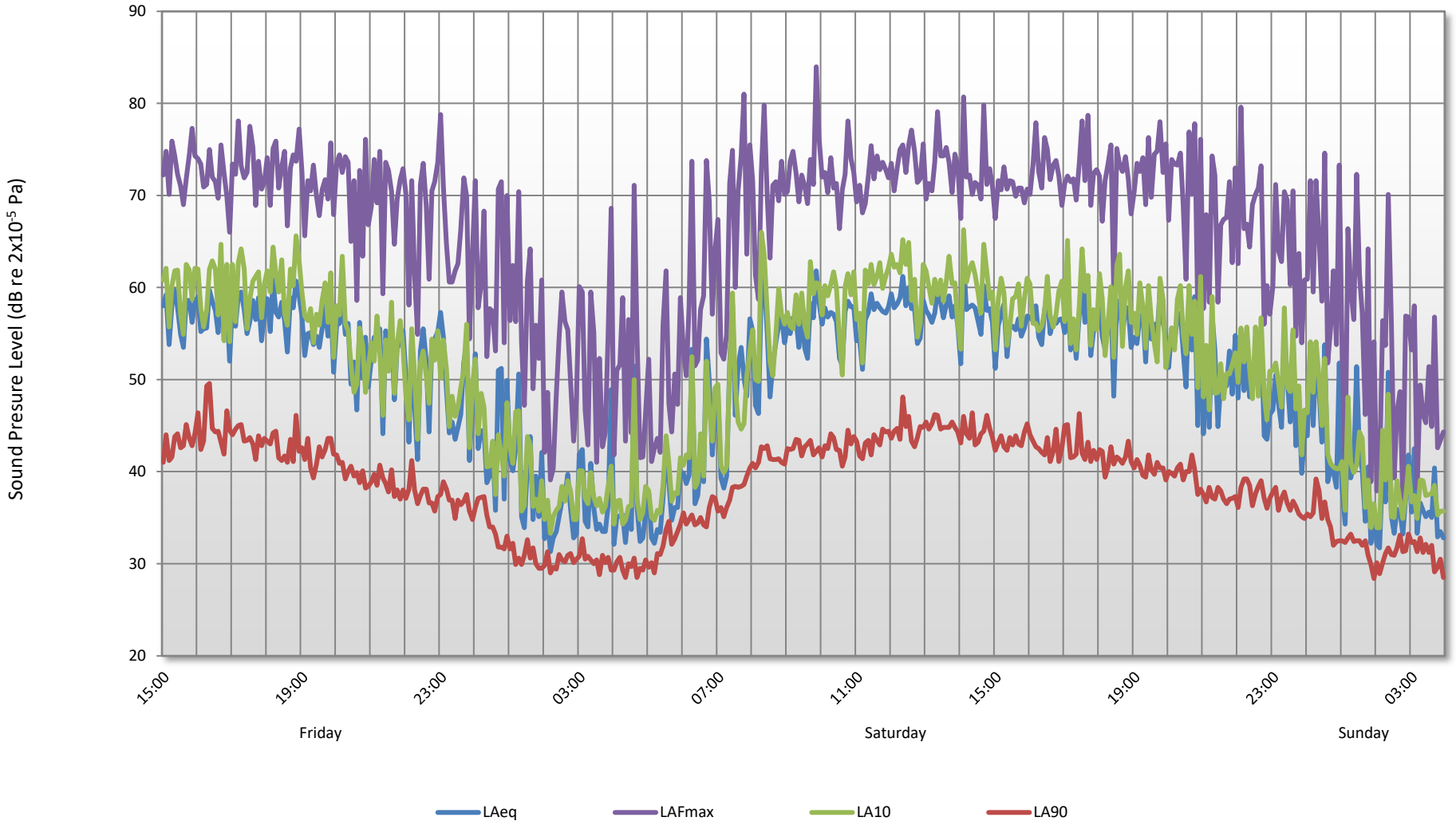
Date	12 January 2024
Reference	18845-SP1
Project Name	35 Rollestone Street, Salisbury
Image ©	Google Earth

Key:	
	Unattended Noise Survey Position

35 Rollestone Street, Salisbury

Position 1

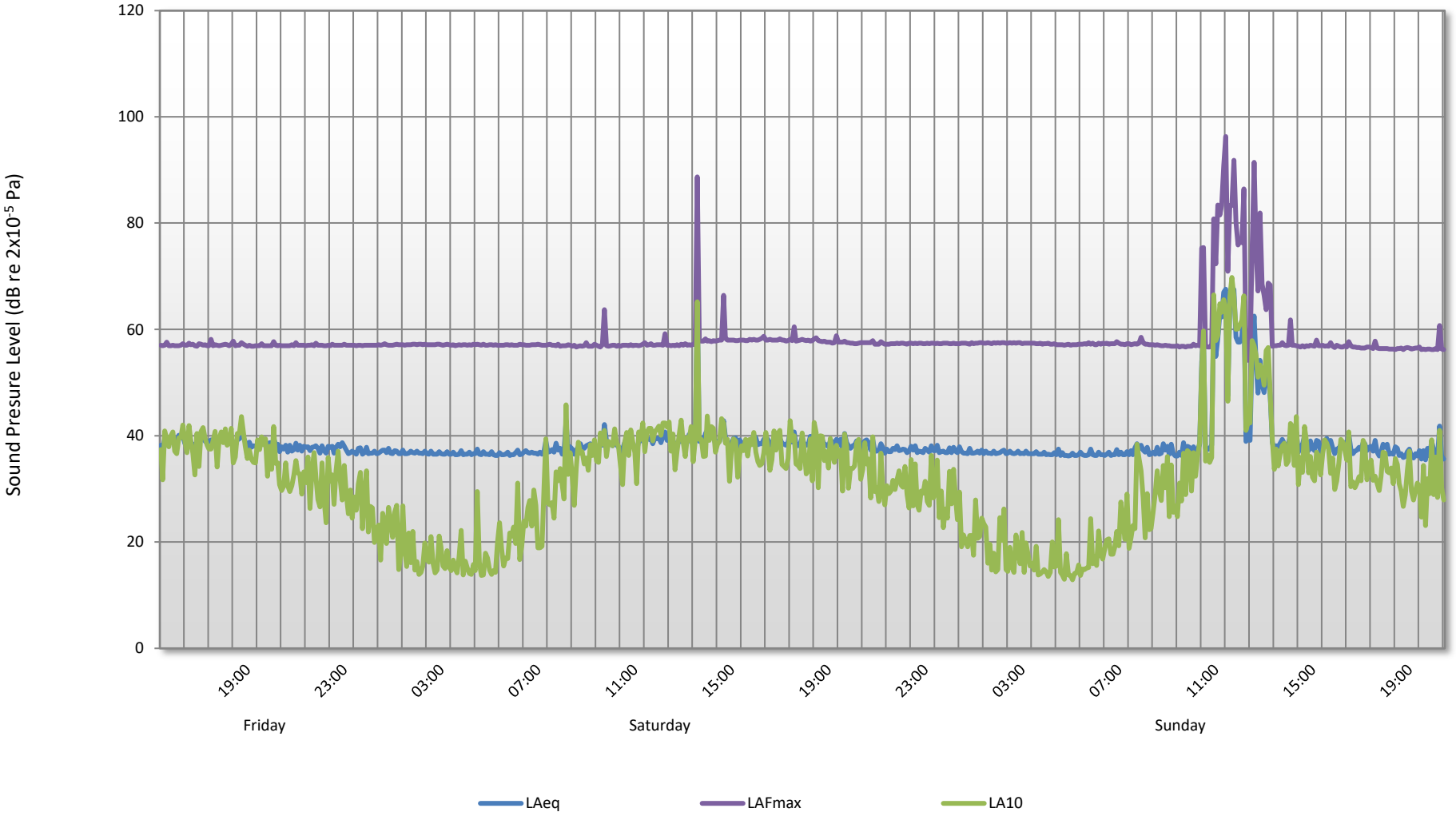
Environmental Noise Time History
05 January 2024 to 07 January 2024



35 Rollestone Street, Salisbury

Position 2

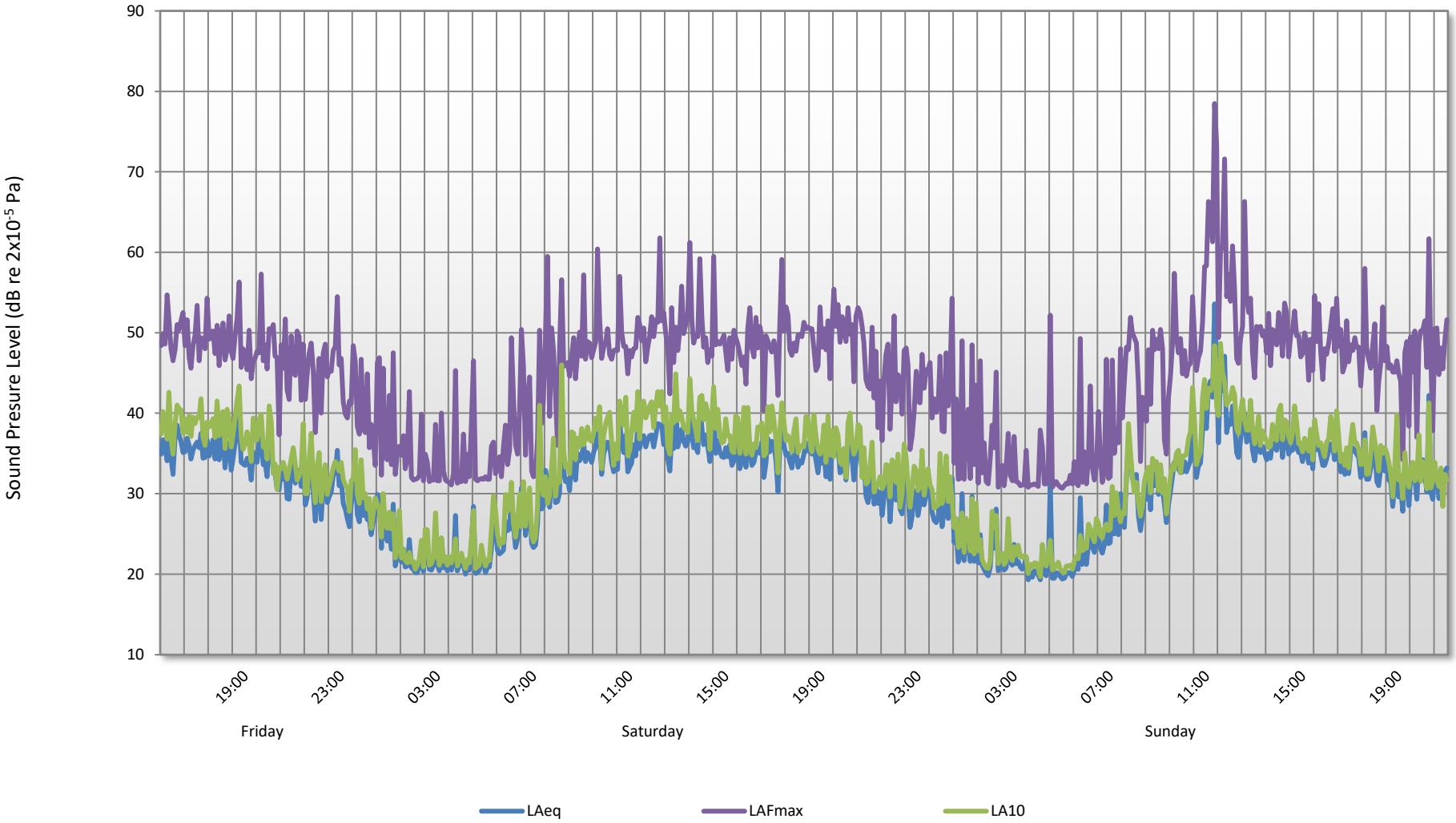
Internal Noise Time History
05 January 2024 to 07 January 2024



35 Rollestone Street, Salisbury

Position 3

Internal Noise Time History
05 January 2024 to 07 January 2024



APPENDIX A

GLOSSARY OF ACOUSTIC TERMINOLOGY

dB(A)

The human ear is less sensitive to low (below 125Hz) and high (above 16kHz) frequency sounds. A sound level meter duplicates the ear's variable sensitivity to sound of different frequencies. This is achieved by building a filter into the instrument with a similar frequency response to that of the ear. This is called an A-weighting filter. Measurements of sound made with this filter are called A-weighted sound level measurements and the unit is dB(A).

L_{eq}

The sound from noise sources often fluctuates widely during a given period of time. An average value can be measured, the equivalent sound pressure level L_{eq}. The L_{eq} is the equivalent sound level which would deliver the same sound energy as the actual fluctuating sound measured in the same time period.

L_{10}

This is the level exceeded for not more than 10% of the time. This parameter is often used as a "not to exceed" criterion for noise

L_{90}

This is the level exceeded for not more than 90% of the time. This parameter is often used as a descriptor of "background noise" for environmental impact studies.

L_{max}

This is the maximum sound pressure level that has been measured over a period.

Octave Bands

In order to completely determine the composition of a sound it is necessary to determine the sound level at each frequency individually. Usually, values are stated in octave bands. The audible frequency region is divided into 10 such octave bands whose centre frequencies are defined in accordance with international standards.

Addition of noise from several sources

Noise from different sound sources combines to produce a sound level higher than that from any individual source. Two equally intense sound sources operating together produce a sound level which is 3dB higher than one alone and 10 sources produce a 10 dB higher sound level.

Attenuation by distance

Sound which propagates from a point source in free air attenuates by 6dB for each doubling of distance from the noise source. Sound energy from line sources (e.g. stream of cars) drops off by 3 dB for each doubling of distance.

APPENDIX A

Subjective impression of noise

Sound intensity is not perceived directly at the ear; rather it is transferred by the complex hearing mechanism to the brain where acoustic sensations can be interpreted as loudness. This makes hearing perception highly individualised. Sensitivity to noise also depends on frequency content, time of occurrence, duration of sound and psychological factors such as emotion and expectations. The following table is a reasonable guide to help explain increases or decreases in sound levels for many acoustic scenarios.

Change in sound level (dB)	Change in perceived loudness
1	Imperceptible
3	Just barely perceptible
6	Clearly noticeable
10	About twice as loud
20	About 4 times as loud

Barriers

Outdoor barriers can be used to reduce environmental noises, such as traffic noise. The effectiveness of barriers is dependent on factors such as its distance from the noise source and the receiver, its height and its construction.

Reverberation control

When sound falls on the surfaces of a room, part of its energy is absorbed and part is reflected back into the room. The amount of reflected sound defines the reverberation of a room, a characteristic that is critical for spaces of different uses as it can affect the quality of audio signals such as speech or music. Excess reverberation in a room can be controlled by the effective use of sound-absorbing treatment on the surfaces, such as fibrous ceiling boards, curtains and carpets.

APPENDIX B

ProPG Initial Site Risk Assessment Guidance

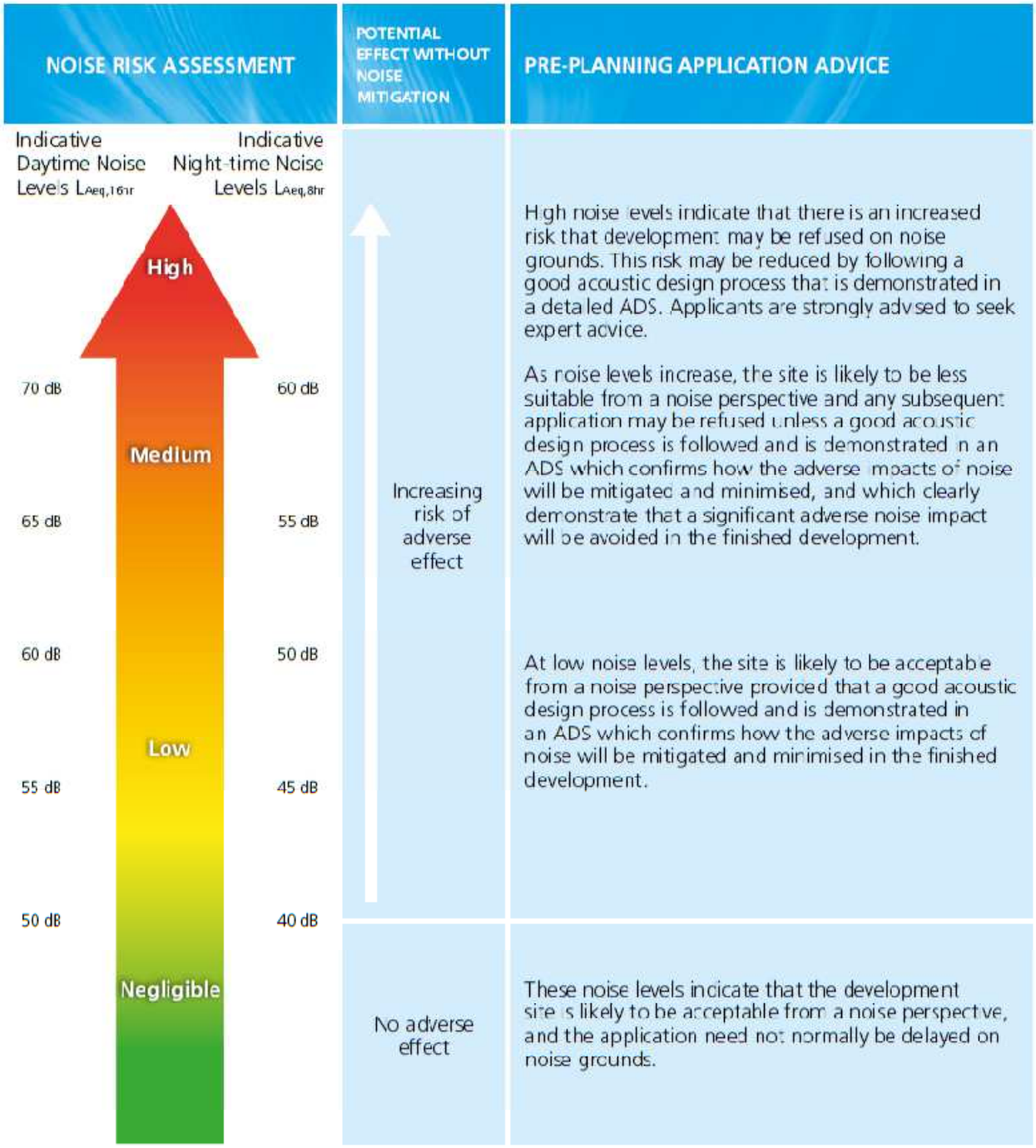


Figure 1. Stage 1– Initial Site Noise Risk Assessment

ProPG – Figure 1 – Initial Site Risk Assessment