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Castle Hill Road, Birtle, Rochdale

25 June 2024

19238-EBF-01.1

External Building Fabric Report

Project Number
19238

Issued For
Stephen Robinson

EXECUTIVE SUMMARY

This assessment has been undertaken so external building fabric elements can be specified in order to meet appropriate internal noise criteria at Harwood Fields Farm.

The assessment adheres to the Local Authority requirements, the principles provided by the *National Planning Policy Framework: 2023* (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 a stables. Proposals include the redevelopment of a residential house.

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 farm related noise intrusion through the external building fabric. Sound insulation performance specifications have been proposed for glazing systems and trickle ventilators.

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.

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.

CONTENTS

1.0	INTRODUCTION	1
2.0	SITE DESCRIPTION	1
3.0	ARCHITECTURAL ASSUMPTIONS	1
3.1	DRAWINGS	1
3.2	ROOM VOLUME AND WINDOW DIMENSIONS	1
3.3	ROOM FINISHES	1
4.0	CRITERIA	2
4.1	NATIONAL PLANNING POLICY FRAMEWORK: 2023 (NPPF)	2
4.2	BS 8233: 2014 INTERNAL NOISE CRITERIA	2
4.3	WORLD HEALTH ORGANISATION GUIDELINES	3
4.4	EXTERNAL NOISE CRITERIA	3
4.5	PROPOSED NOISE LEVEL CRITERIA	4
4.6	PROFESSIONAL GUIDANCE ON PLANNING & NOISE (PROPG)	4
4.7	GUIDANCE ON VENTILATION	5
5.0	ENVIRONMENTAL NOISE SURVEY	6
5.1	UNATTENDED NOISE SURVEY PROCEDURE	6
5.2	ATTENDED NOISE SURVEY PROCEDURE	6
5.3	WEATHER CONDITIONS	7
5.4	EQUIPMENT	7
6.0	RESULTS	7
6.1	UNATTENDED NOISE SURVEY RESULTS	7
6.2	ATTENDED NOISE SURVEY RESULTS	8
7.0	PROPG INITIAL SITE RISK ASSESSMENT	8
8.0	EXTERNAL BUILDING FABRIC ASSESSMENT	9
8.1	EXTERNAL BUILDING FABRIC - NON GLAZED ELEMENTS	9
8.2	EXTERNAL BUILDING FABRIC - SPECIFICATION OF GLAZED UNITS	9
8.3	EXTERNAL BUILDING FABRIC - SPECIFICATION OF TRICKLE VENTILATORS	10
8.4	OVERHEATING CONSIDERATIONS	10
8.5	FLANKING TRANSMISSION	12
9.0	ASSESSMENT OF EXTERNAL AMENITY SPACE	12
10.0	CONCLUSION	12

LIST OF ATTACHMENTS

19238-SP1	Indicative Site Plan
19238-TH1 & TH2	Environmental Noise Time History
Appendix A	Glossary of Acoustic Terminology
Appendix B	ProPG Initial Site Risk Assessment Guidance

Issue	Date of Issue	Author	Reviewed	Authorised
0	25/06/2024			
		Jamie Newton Senior Consultant BEng (Hons) MIOA	Duncan Martin Director BSc (Hons) MIOA	Duncan Martin Director BSc (Hons) MIOA

Issue	Comment
0	First Issue

1.0 INTRODUCTION

Clement Acoustics has been commissioned by Stephen Robinson to assess the suitability of the site at Harwood Fields Farm for residential development.

Proposals are to redevelop an existing stable building to comprise a residential building.

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 currently used as a stables, with plans to comprise a residential unit. The site is in a mixed residential and industrial area at Harwood Fields Farm. The site is bound by a barn containing a biomass generator to the north, residential buildings to the east, and farm-related buildings to the south and west.

At the time of the survey, the background noise climate was dominated by industrial noise from the adjacent farm, and road traffic from the M66 motorway, 900 m to the west.

3.0 ARCHITECTURAL ASSUMPTIONS

3.1 Drawings

The Rae Connell Associate drawing No. SR-24-09-23-C2 has been used in our assessment.

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.

- Living Room
 - Room Volume: 148 m³
 - Window Area: 10 m²
- Bedroom
 - Room Volume: 43 m³
 - Window Area: 1 m²

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 National Planning Policy Framework: 2023 (NPPF)

The NPPF, which was first published in 2012 with the latest revision in 2023, 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...'*

4.2 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

4.3 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

The document also states:

“For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45dBA L_{max} more than 10-15 times per night, (Vallet & Varnet 1991).”

4.4 External Noise Criteria

The guidance of BS 8233: 2014, with regards to external amenity spaces, is as follows:

“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.”

The site is in an area that would be considered rural. We would therefore recommend the guidance upper guideline value of $L_{Aeq,T}$ 50 dB(A) would be an appropriate target although exceedance of this may also be acceptable where unavoidable.

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	
		$L_{eq, T}$	$L_{max, F}$
Living Rooms	Daytime (07:00-23:00 hours)	35 dB(A)	-
Bedrooms	Night-time (23:00-07:00 hours)	30 dB(A)	45 dB(A)*
External Amenity	24 Hours	55 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 two positions as shown on indicative site drawing 19238-SP1. The choice of these positions was based both on accessibility and on collecting representative noise data in relation to the proposed development.

The surroundings and position used for each monitoring location are described in Table 5.1.

Position No.	Description
1	The microphone was mounted on a tripod at ground level directly north of the site. The microphone was positioned 1 m in front of the wall. ^[1]
2	The microphone was mounted on wall to the south-east of the site. The microphone was positioned >3.5 m in front of any vertical reflective surface. ^[2]

Table 5.1 Description of unattended monitoring locations

Note [1]: 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.

Note [2]: The position was considered to be free-field according to guidance found in BS 8233: 2014, and a correction for reflections has therefore not been applied.

Continuous automated monitoring was undertaken for the duration of the survey between 16:00 on 10 June 2024 and 15:00 on 12 June 2024.

The measurement procedure generally complied with ISO 1996-2: 2017: '*Description, measurement and assessment of environmental noise*'.

5.2 Attended Noise Survey Procedure

Attended noise measurements were undertaken on 10 June to provide further understanding of the impact of the adjacent barn and biomass generator.

Upon inspection of the generator and barn, it was determined that the main noise source of the generator was a small pump on the southern wall of the barn. Due to the consistent nature of the pump noise, a 5 minute measurement was undertaken within the barn, at a distance of 1 m from the pump.

The locations of the measurement positions are shown on attached site plan 19238-SP1.

5.3 Weather Conditions

At the time of set-up and collection of the monitoring equipment and during the attended measurements, the weather conditions were dry with light winds. It is understood that the weather conditions during the unattended survey remained dry with wind speeds below 5 m/s.

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.

5.4 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 977 Class 1 Sound Level Meter
- 1 No. Svantek Type 957 Class 1 Sound Level Meter
- Norsonic Type 1251 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 19238-SP1.

Measured noise levels are shown as time histories in Attachment 19238-TH1 and Figure 19238-TH2. 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)	50	-
	Night-time (23:00 - 07:00)	41	63
2	Daytime (07:00 - 23:00)	56	-
	Night-time (23:00 - 07:00)	41	63

Table 6.1 Average ambient and maximum noise levels

The levels presented in Table 6.1 are as expected considering the sites location adjacent to a working farm. 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.

6.2 Attended Noise Survey Results

Table 6.2 presents the results of the measurements carried out at the attended positions shown in attached site plan 19238-SP1. The $L_{Aeq,15\text{ min}}$ noise levels have been obtained.

Duration	Noise Source Description	Average ambient noise level $L_{Aeq, T}$, dB
5 min	Biomass Generator pump	55

Table 6.2 Average ambient and minimum background noise levels

Due to the low measured source noise levels, and no noise being noted during a subjective listening exercise at the closest façade of the development site, it has been deemed that noise from the adjacent biomass generator does not influence noise levels at the site.

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]	50 dB(A)	Negligible	See Note [1]
	Night-time [23:00 - 07:00]	41 dB(A)		
2	Daytime [07:00 - 23:00]	56 dB(A)	Low	See Note [2]
	Night-time [23:00 - 07:00]	41 dB(A)	Negligible	See Note [1]

Table 7.1 ProPG initial site risk assessment

Note [1]: Negligible – ‘No adverse effect. These noise levels indicate that the development site is likely to be acceptable from a noise perspective, and the application need not normally be delayed on noise grounds.’

Note [2]: 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. Due to similar, low noise levels measured across the site, only one glazing type has been proposed for all facades. **The performance is specified for the whole window unit, including the frame and other design features.**

Façade	Minimum Sound Reduction Index (dB) at Octave Band Centre Frequency (Hz)					
	125	250	500	1k	2k	4k
All	24	22	29	39	33	38

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, a nominal **4 mm glass / 12 mm gap / 4 mm glass; Rw + Ctr 29 dB** double glazing configuration would be expected to meet the required levels of sound insulation.

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.

Façade	Minimum $D_{n,e}$ Values(dB) at Octave Band Centre Frequency (Hz)						$D_{n,eW}^{[1]}$
	125	250	500	1k	2k	4k	
All	29	22	32	30	29	23	23

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.

It should be ensured that all mechanical extract ventilation is designed to not exceed the internal noise criteria stated in Table 4.3.

N.B. This performance should be achievable with standard units;

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 5.1, 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: LAeq,8hr 26 dB
 - Night-time maximum noise level: LAFmax, 48 dB
- Habitable rooms on rear façade:
 - Night-time ambient noise level: LAeq,8hr 26 dB
 - Night-time maximum noise level: LAFmax, 48 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 reach the ADO threshold for significance on the either façade, indicating use of openable windows could be an acceptable solution to control overheating on all facades.

Please note that the above ADO requirements only apply to New Build dwellings. Therefore, the guidance of this section is not mandatory for this refurbishment project and is included as good practice only.

8.5 Flanking Transmission

It is understood that the external building fabric for this development does not include curtain walling or any other lightweight cladding. Therefore, a flanking performance specification should not be required.

Junctions where party walls and floors interface with the external building fabric should however be carefully detailed. Suitable flexible cavity stops should be introduced into cavities at party floor/wall lines.

9.0 ASSESSMENT OF EXTERNAL AMENITY SPACE

This Section can vary significantly depending on the ambient noise levels / proposed site layout etc!

As shown in Section 4.4, the proposed design target for external amenity space is to ensure noise levels do not exceed L_{Aeq} 50 dB.

Comparing the measured daytime ambient noise levels with this upper design range indicates that amenity space, which is to the south of the site could experience ambient noise levels that exceed this requirement.

It is however noted that the proposed amenity space will be surrounded by existing walls, providing mitigation which is expected to be adequate to reduce noise levels in line with the proposed design target.

10.0 CONCLUSION

An environmental noise survey has been undertaken at Harwood Fields Farm 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 and WHO.



Not to scale

Description:

Indicative site plan showing noise monitoring position and nearest sensitive receiver

Date	25 June 2024
Reference	19238-SP1
Project Name	Harwood Fields Farm, Castle Hill Road, Birtle, Rochdale
Image ©	Google Earth

Key:

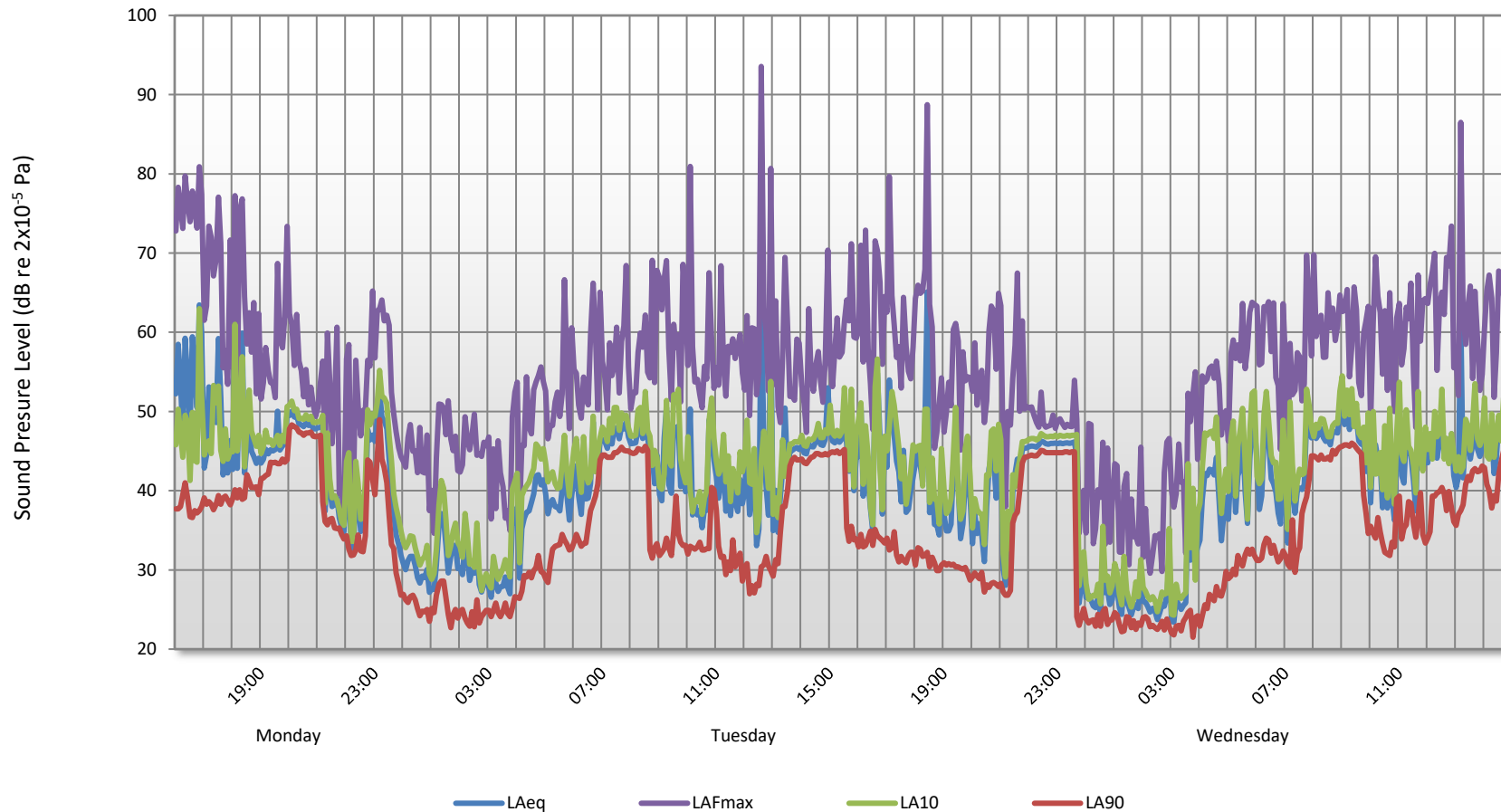
	Unattended Noise Survey Position
	Site Location
	Attended Noise Survey Position

Harwood Fields Farm, Castle Hill Road,
Birtle, Rochdale

Position 1



Environmental Noise Time History
10 June 2024 to 12 June 2024



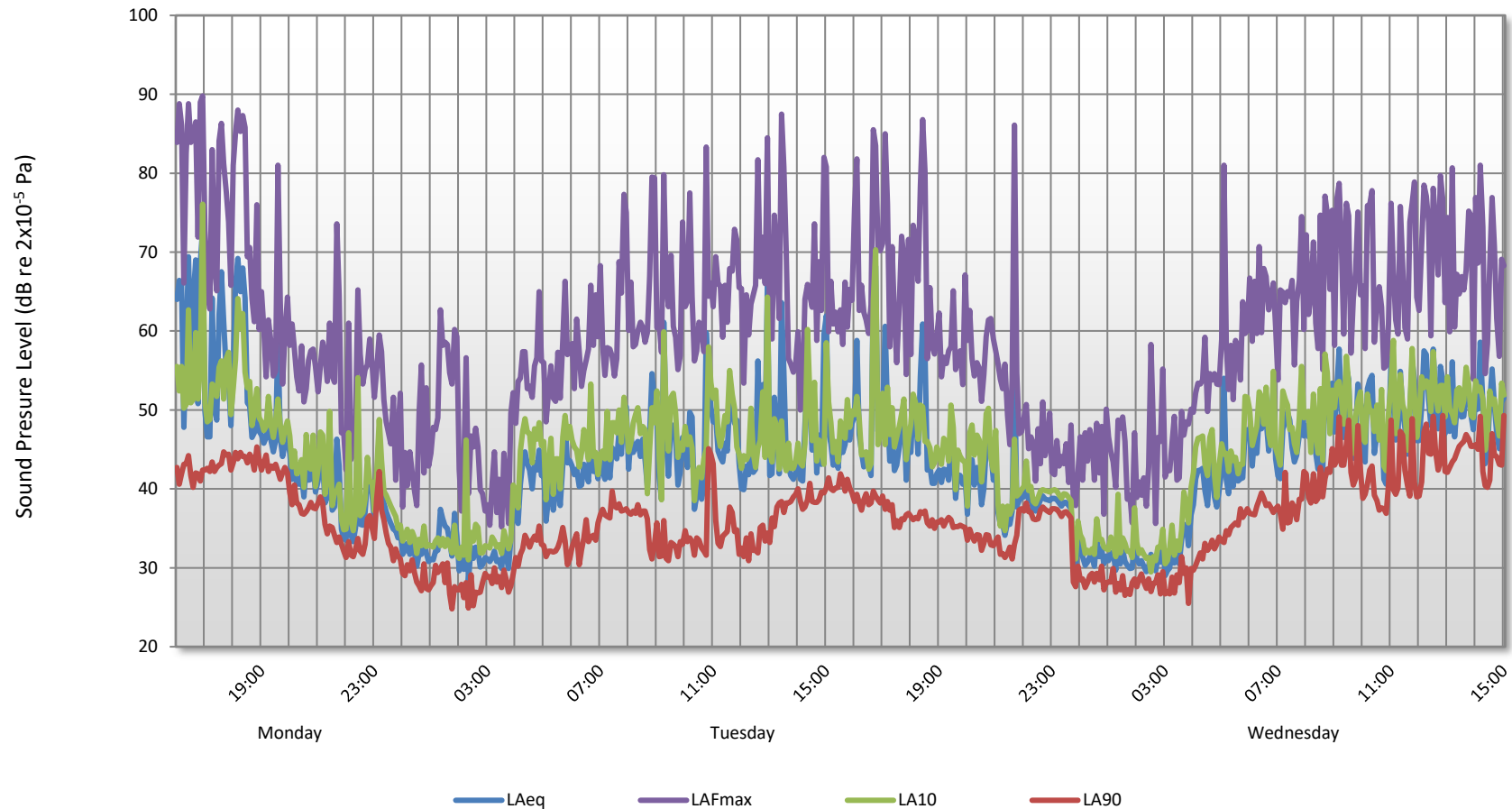
19238-TH1

Harwood Fields Farm, Castle Hill Road,
Birtle, Rochdale

Position 2



Environmental Noise Time History
10 June 2024 to 12 June 2024



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.

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.

ProPG Initial Site Risk Assessment Guidance

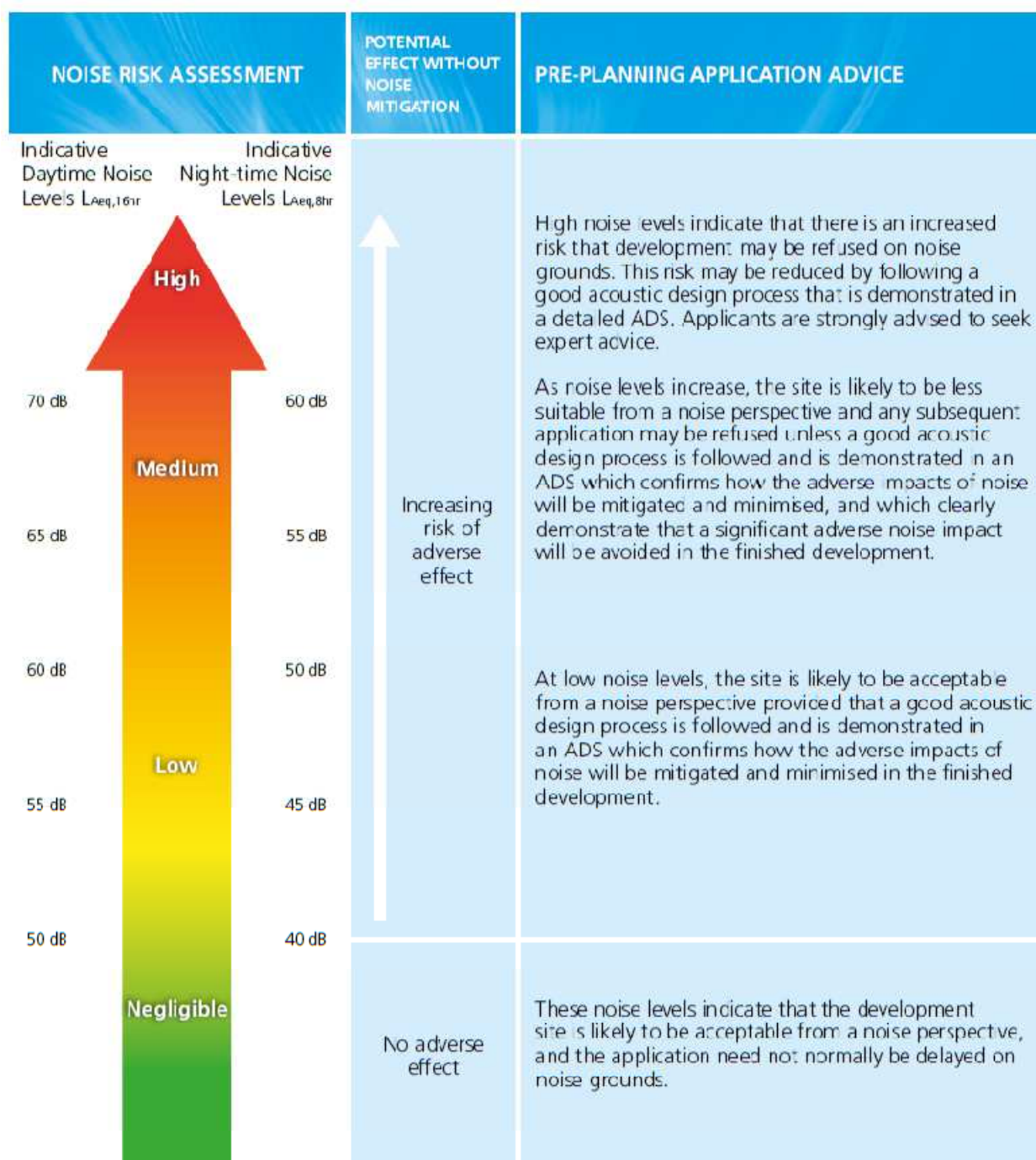


Figure 1 Notes:

- Indicative noise levels should be assessed without inclusion of the acoustic effect of any scheme specific noise mitigation measures.
- Indicative noise levels are the combined free-field noise level from all sources of transport noise and may also include industrial/commercial noise where this is present but is "not dominant".
- $L_{Aeq,16hr}$ is for daytime 0700 – 2300, $L_{Aeq,8hr}$ is for night-time 2300 – 0700.
- An indication that there may be more than 10 noise events at night (2300 – 0700) with $L_{Amax,F} > 60$ dB means the site should not be regarded as negligible risk.

Figure 1. Stage 1– Initial Site Noise Risk Assessment