



**Land at Church Avenue
and Hillbank Street,
Middleton, Manchester
M24:**

Noise Assessment

Harrison Construction

16 January 2025

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EXECUTIVE SUMMARY

The results of a noise measurement survey and desk-based assessment of noise are presented, with respect to the proposed residential development of land at Church Avenue and Hillbank Street, Middleton, Manchester M24.

The assessment shows that the site is principally affected by noise from traffic during both the day and night time but is deemed to be at a 'negligible' to 'low' risk from noise, in accordance with the guidance in the ProPG.

Calculated external and internal noise levels are shown to be at, or below, the BS 8233 guideline noise levels except for bedrooms in Unit 1 with windows on the building's northern and western facades; for these rooms, windows will need to remain closed to achieve the BS 8233 guideline levels and alternative means of achieving background ventilation will be required.

Consequently, the site is deemed to be suitable for residential development, without the need for specific noise mitigation measures and noise need not be a reason for refusal of planning permission.

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1. INTRODUCTION

- 1.1 EnviroSolution Ltd was commissioned by Harrison Construction to undertake an assessment of noise affecting the proposed residential development of two immediately adjacent parcels of land at Middleton, Manchester M24; the northern parcel is off Church Avenue and the southern parcel is at Hillbank Street. Both sites are currently occupied by a number of private 'lock-up' style garages.
- 1.2 The site, indicated in Figure 1, is set within a primarily residential area on the outskirts of Greater Manchester; the dominant noise affecting the sites are traffic noise from A664 Rochdale Road, in addition to distant noise from the M62 motorway, approximately 1km to the north, the A627(M), approximately 900m to the east and the A627(M) Western Spur, approximately 300m to the south-southeast. The site is also affected, during the day time, by occasional/intermittent industrial/commercial noise from Stakehill Industrial Park, approximately 500m to the south. Additional contributions are associated with bird song, the church bells and overflights of commercial aircraft approaching/departing Manchester airport.

Figure 1: Site area and surroundings



The proposals, presented in Figure 2, involve the demolition of the garages and the construction of 2 houses on Church Avenue and 3 houses on Hillbank Street.

Figure 2: Indicative site layouts



- 1.3 This report presents the results of a noise measurement survey and a desk-based assessment of environmental noise affecting the site with respect to its proposed residential use. Where appropriate, recommendations for suitable noise control and mitigation measures are discussed.
- 1.4 A glossary of acoustic terminology is provided at Appendix A.

2. GUIDANCE

Noise – national and local policy guidance

- 2.1 Planning policies are set at both a national and local level. With respect to national policy, assessment of the suitability of a site for residential development is guided by the National Planning Policy Framework (NPPF), issued in March 2012 and amended in 2018, 2019, 2021, 2023 and 2024.
- 2.2 With regard to noise, the NPPF (“the Framework”) does not provide specific noise policies or defined noise limits but, rather, is intended to enable the planning system to support the Government’s aims and objectives with respect to sustainable development and “provides a framework within which locally-prepared plans can provide for housing and other development in a sustainable manner”.
- 2.3 None of the current local or national planning policies preclude recreational development of the site for residential use.
- 2.4 The National Planning Policy Framework does state that “Planning policies and decisions should contribute to and enhance the natural and local environment by ... preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability.
- 2.5 Additional national planning guidance is provided in the Government’s Noise Policy Statement for England (NPSE – “the Noise Policy”), to which the Framework makes specific reference as the main source of national guidance specifically on planning and noise.
- 2.6 The Noise Policy has a long term vision to *“Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development”*. The vision is supported by three key aims intended to promote sustainable development with respect to noise so that *“Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:*
- *avoid significant adverse impacts on health and quality of life;*
 - *mitigate and minimise adverse impacts on health and quality of life; and*
 - *where possible, contribute to the improvement of health and quality of life”*.
- 2.7 Health is defined by the World Health Organisation as *“a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity, and recognises the enjoyment of the highest attainable standard of health as one of the fundamental rights of every human being”* and the Noise Policy makes *“a distinction between ‘quality of life’ which is a subjective measure that refers to people’s emotional, social and physical well being and ‘health’ which refers to physical and mental well being”*.
- 2.8 However, the Noise Policy recognises that it is not currently possible to define a single objective noise level having specific effects on people, hence the emphasis on “promoting” improvements to health and quality of life through effective management of noise, considered in the context of the wider environment and factors other than noise.
- 2.9 Additional guidance is given in the Planning Practice Guidance Note (PPG) on noise, issued in March 2014, alongside the NPPF and updated in 2018 and July 2019. This *“advises on how planning can manage potential noise impacts in new development”*. The PPG suggests the following noise exposure hierarchy, based on average responses to noise:

Table 1: PPG noise exposure and response hierarchy

Perception	Examples of outcomes	Increasing effect level	Action
<i>No Observed Effect Level (NOEL)</i>			
Not noticeable	No Effect	No Observed Effect	No specific measures required
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
<i>Lowest Observed Adverse Effect Level (LOAEL)</i>			
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; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
<i>Significant Observed Adverse Effect Level (SOAEL)</i>			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
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

2.9 Beyond this, however, the guidance is relatively generic. It avoids specifying ‘acceptable’ environmental noise levels as the acceptability of a source of is both subjective and context-dependant.

2.10 Local planning policy is defined in the Council’s Core Strategy (CS) adopted in October 2016.

2.11 Policy **DM1 General Development Requirements** states:

“All development proposals, including changes of use of land and buildings, extensions and alterations, will be expected to demonstrate that they:

....

d. Mitigate against any impacts due to noise, air, dust, light and odour pollution, traffic generation or inadequate access, where such mitigation is identified as being necessary”.

2.12 Nothing in local planning policy precludes the proposed development.

Noise – technical guidance

2.13 In May 2017, a Working Group consisting of representatives of the Association of Noise Consultants (ANC), Institute of Acoustics (IOA) and Chartered Institute of Environmental Health (CIEH) produced a Professional Practice Guidance (Pro PG) document¹. The guidance was produced *“to provide practitioners with guidance on a recommended approach to the management of noise within the planning system in England”* and *“which encourages better acoustic design for new residential development and aims to protect people from the harmful effects of noise”*. Its primary aim is *“to assist the delivery of sustainable development by promoting good health and wellbeing through the effective management of noise. It seeks to do that through encouraging a good acoustic design process in and around proposed new residential development having regard to national policy on planning and noise”*.

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

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

2.15 It should be noted that the Pro PG *“does not constitute an official government code of practice and neither replaces nor provides an authoritative interpretation of the law or government policy on which users should take their own advice as appropriate”*.

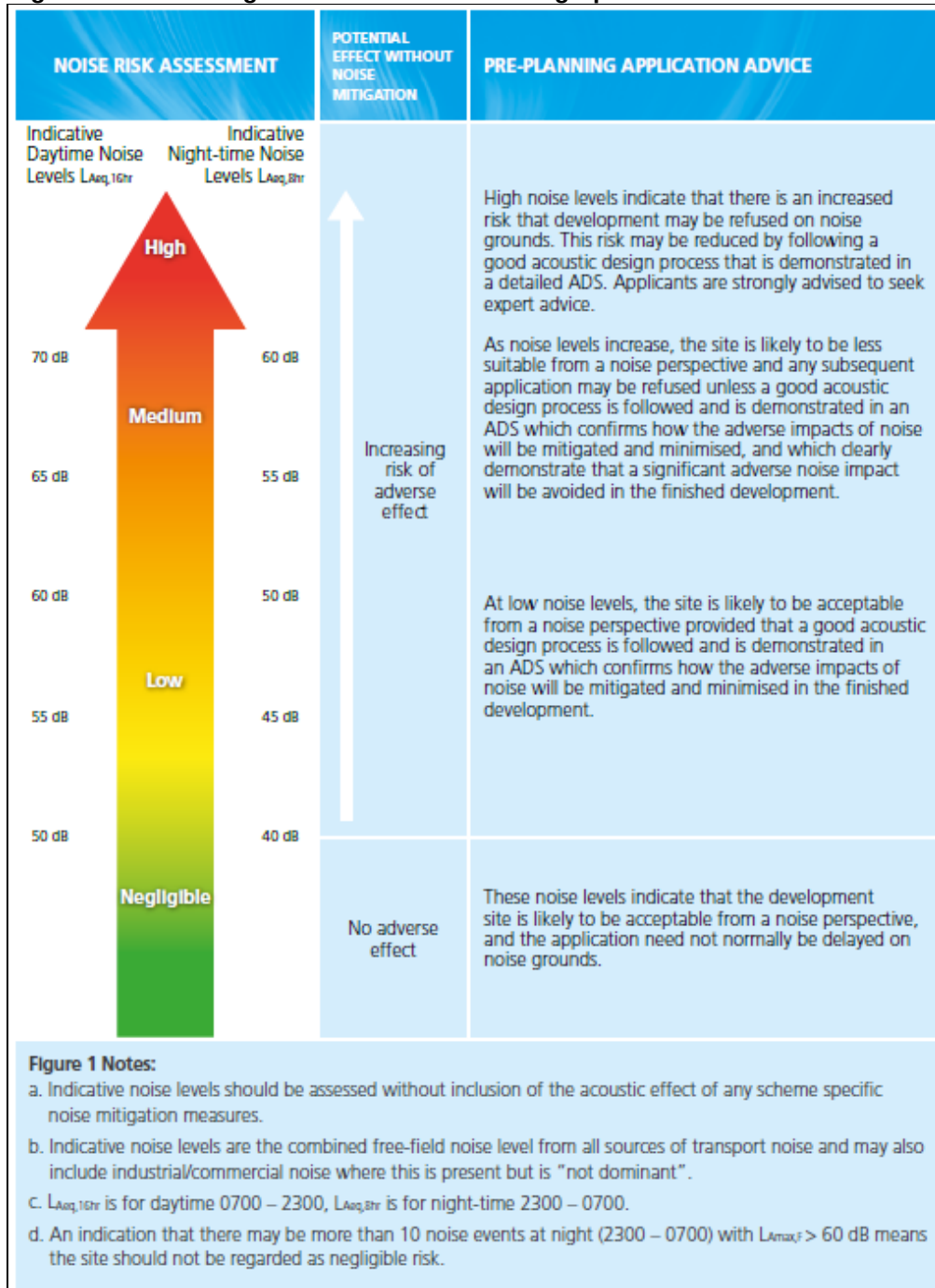
2.16 The guidance *“advocates a systematic, proportionate, risk based, 2-stage, approach. The approach encourages early consideration of noise issues, facilitates straightforward accelerated decision making for lower risk sites, and assists proper consideration of noise issues where the acoustic environment is challenging”*. The two sequential stages are:

- Stage 1 – an initial noise risk assessment of the proposed development site; and
- Stage 2 – a systematic consideration of four key elements.

2.17 Figure 1 of the guidance provides a useful graphical overview of the Stage 1 risk assessment considerations, reproduced as Figure 3.

¹ ANC, IOA & CIEH (2017) *Pro PG: Planning & Noise Professional Practice Guidance on Planning & Noise: New Residential Development*

Figure 3: ProPG Stage 1 risk assessment info-graphic



2.18 The four key elements to be undertaken in parallel during Stage 2 of the recommended approach are:

- Element 1 – demonstrating a “*Good Acoustic Design Process*”;
- Element 2 – observing internal “*Noise Level Guidelines*”;
- Element 3 – undertaking an “*External Amenity Area Noise Assessment*”; and
- Element 4 – consideration of “*Other Relevant Issues*”.

2.19 “*The approach is underpinned by the preparation and delivery of an “Acoustic Design Statement” (ADS). An ADS for a site assessed as high risk should be more detailed than for a*

site assessed as low risk. An ADS should not be necessary for a site assessed as negligible risk”.

- 2.20 Additional specific advice is provided in Manchester City Council's document “*Planning and Noise: Technical Guidance*” issued in October 2022. This references British Standard (BS) 8233: 2014 *Guidance on sound insulation and noise reduction for buildings* gives recommendations for internal noise levels for residential dwellings in order to protect residential amenity, based on health-based research, as follows:
- Living rooms during the day 35 dB $L_{Aeq,16hour}$
 - Dining rooms during the day 40 dB $L_{Aeq,16hour}$
 - Bedrooms during the day 35 dB $L_{Aeq,16hour}$
 - Bedrooms during the night 30 dB $L_{Aeq,8hour}$
- 2.21 These values can be taken to be broadly equivalent with the LOAEL in the PPG. Note that these are not specific criteria or ‘target’ noise levels, merely indicative recommendations which will be context-dependant. However, most Local Authorities tend to apply the recommended noise levels as strict criteria.
- 2.22 In most standard modern properties, the walls and roof provide relatively high levels of sound insulation of greater than 40 dB; the weakest part of a building facade, with respect to noise, is generally the windows. Modern construction methods for new residential properties incorporate standard thermal double-glazing which, the standard suggests, will provide approximately 33 dB R_w of sound attenuation when closed. The standard does not specifically give sound attenuation values for partially open windows, although the worked example (G.1) at Annex G of the Standard indicates that a partially open window would provide 15 dB of sound attenuation.
- 2.23 For calculation of noise ingress through a closed window, this requires that the external measured/calculated sound pressure level is a ‘façade’ level i.e. subject to the addition of façade-reflected sound energy; this requires the addition of 3 dB to any measured/calculated ‘free-field’ levels.
- 2.24 Conversely, calculation of noise ingress through a partially open window, requires that the external measured/calculated sound pressure level is a ‘free-field’ level i.e. without the addition of façade-reflected sound energy; this requires the subtraction of 3 dB from any measured/calculated ‘façade’ levels.
- 2.25 With regard to night time maximum (L_{AFmax}) noise levels, BS 8233 (Note 4) states the following:
“Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$, depending on the character and number of events per night. Sporadic noise events could require separate values”.
- 2.26 Other recent guidance² states “it is considered that if, in bedrooms at night, the $L_{Amax,F}$ from individual noise events (from all sources) would not normally exceed 45dB more than 10 times a night, then this represents a reasonable threshold below which the effects of individual noise events on sleep can be regarded as negligible”. Consequently, the 10th highest measured night time maximum noise level is used.

² ANC, IOA & CIEH (2017) Pro PG: Planning & Noise Professional Practice Guidance on Planning & Noise: New Residential Development

- 2.27 The assessment also makes reference to the recently published Approved Document (AD) O of the Building Regulations 2010 “Overheating”. This is applicable to new dwellings and, whilst, technically, an issue for Building Control determination at a later stage in the development process, the requirements for ventilation affect the noise mitigation provided by the building envelope and its design; hence, it is necessary to consider the implications of the AD at the Planning Stage.
- 2.28 Requirement 01 of the AD “Overheating mitigation” states that:
- (1) Reasonable provision must be made in respect of a dwelling, institution or any other building containing one or more rooms for residential purposes, other than a room in a hotel (“residences”) to-*
- (a) limit unwanted solar gains in summer;*
 - (b) provide an adequate means to remove heat from the indoor environment.*
- (2) In meeting the obligations in paragraph (1)-*
- (a) account must be taken of the safety of any occupant, and their reasonable enjoyment of the residence; and*
 - (b) mechanical cooling may only be used where insufficient heat is capable of being removed from the indoor environment without it”.*
- 2.29 With respect to categorising residential buildings, the document provides a “Simplified method” under which this site would be categorised as being a “moderate risk location” for overheating; this applies to all properties in “England, excluding high risk parts of London in (b)”.
- 2.30 Paragraph 1.4 states:
- “For the purposes of following the simplified method, it should be identified whether the dwellinghouse or each residential unit, shared communal room and common space is able to have cross-ventilation, i.e. it has openings on opposite façades”.* Openings on adjacent facades is insufficient.
- 2.31 The significance of referencing the AD is demonstrated in Section 2 of the document:
- “2.10 Excess heat should be removed from the residential building by any of the following means.*
- a. Opening windows (the effectiveness of this method is improved by cross-ventilation).*
 - b. Ventilation louvres in external walls.*
 - c. A mechanical ventilation system.*
 - d. A mechanical cooling system*
- 2.11 The building should be constructed to meet requirement O1 using passive means as far as reasonably practicable. It should be demonstrated to the building control body that all practicable passive means of limiting unwanted solar gains and removing excess heat have been used first before adopting mechanical cooling. Any mechanical cooling (air-conditioning) is expected to be used only where requirement O1 cannot be met using openings”.*
- 2.32 In other words, any requirement for windows to remain closed to achieve suitable (guideline) internal noise conditions, may affect the overheating/cooling strategy and, subsequently, the design of the building(s). This is clarified further on in Section where it is stated that:
- “In the Secretary of State’s view, requirement O1(2)(a) is met in a new residential building if the building’s overheating mitigation strategy for use by occupants takes account of all of the*

following.

- a. Noise at night – paragraphs 3.2 to 3.4.
- b. Pollution – paragraph 3.5.
- c. Security – paragraphs 3.6 and 3.7.
- d. Protection from falling – paragraphs 3.8 to 3.10.
- e. Protection from entrapment – paragraph 3.11”.

2.33 Section 3 of the AD provides the following noise-specific guidance:

“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 $L_{Aeq,T}$, averaged over 8 hours (between 11pm and 7am).
- b. 55dB L_{AFmax} , more than 10 times a night (between 11pm and 7am)”.

3. METHODOLOGY

- 3.1 The assessment incorporated a noise measurement survey comprising the use of two sound level meters, one placed at each site. The meters recorded continuous, consecutive 1-minute and 5-minute free-field sound pressure levels between 10:15am on Tuesday 23 July and 10:15am on Wednesday 24 July 2024. 2023. Additionally, the meters recorded 1/3rd octave band acoustic frequency data for every 5-minute measurement sample and the meter at Hillbank Street gathered audio recording throughout the survey.
- 3.2 The measurement positions are shown in Figure 4 and Figures 7 and 8 at Appendix B.

Figure 4: Noise measurement positions

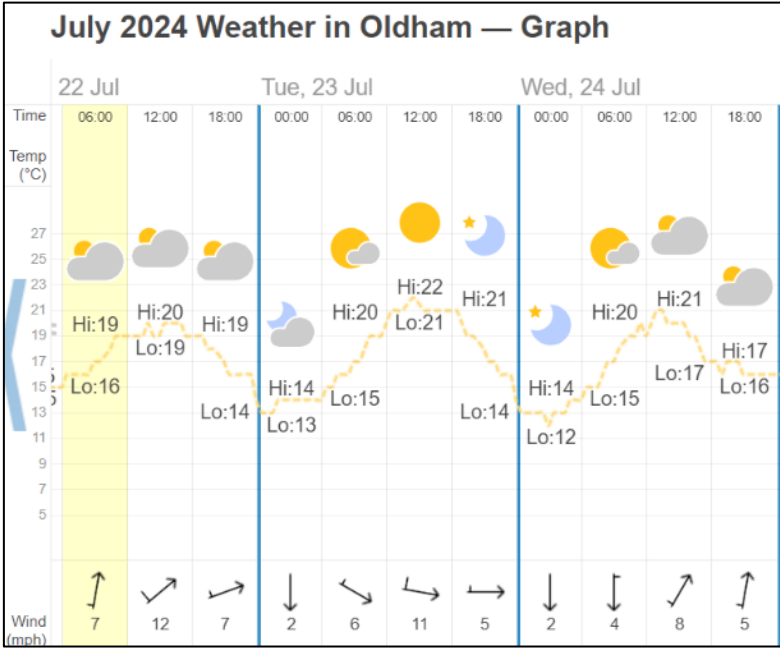


- 3.3 Position 1, being largely screened from traffic noise on Rochdale Road, was selected to measure noise from the surrounding motorway network, as might affect the rear facades of the properties. The data gathered at this position were 'façade' levels, being recorded close to the solid wall at the rear of a garage.
- 3.4 Position 2, adjacent the small brook at the rear of the site, was selected to measure noise from all roads including Rochdale Road as well as contributions of noise from the Industrial Estate. The position is approximately 60 metres from Rochdale Road, whilst the front of the proposed houses will be approximately 35 metres from the road; in the subsequent assessment,

therefore, the measured levels were adjusted accordingly to account for the reduced separation distance between the road and the houses. The data gathered at this position were ‘free-field’ levels, being recorded away from buildings, walls or other structures.

- 3.5 The measurements were undertaken using a CEL 633C Class 1 (IEC 61672: 2013) integrating, averaging sound level meter at position 1 and an NTI XL2 Class 1 (IEC 61672: 2013) integrating, averaging sound level meter at position 2.
- 3.6 The meters were placed in locked, weatherproof cases with the microphones protected by proprietary wind-shields.
- 3.7 The meters were field-calibrated before and after the survey and no variation in calibration tone was observed. The weather during the survey was warm with light to moderate, westerly to northerly winds, as presented in Figure 5.

Figure 5: Weather data for Oldham



- 3.8 The assessment was undertaken principally with respect to the requirements of the Council’s adopted criteria, as specified in paragraph 2.31.

4 DATA, RESULTS, ASSESSMENT & DISCUSSION

Survey results

- 4.1 The recorded measurement data, rounded to the nearest whole integer, for the day time (7:00am to 11:00pm) and night time (11:00pm to 7:00am) periods, are summarised in Table 2; the 2 partial daytime data sets were combined to produce a single day time data set. The night time maximum (L_{AFmax}) is the 10th highest level.

Table 2: Measurement data

Position	Period	Measured noise (dB)	
		L_{Aeq}	L_{AFmax}^*
1	Day	49	-
	Night	45	62
2	Day	46	-
	Night	43	58

* 10th highest

- 4.2 The 5-minute data and 1-second data are too numerous to present in this report in tabular format but are available on request, as are the audio recordings.
- 4.3 The data for position 1 were converted to 'free-field' levels by the subtraction of 3 dB whilst the data for position 2 were adjusted for a distance 35 metres from the road; the results of this are presented in Table 3.

Table 3: Adjusted data

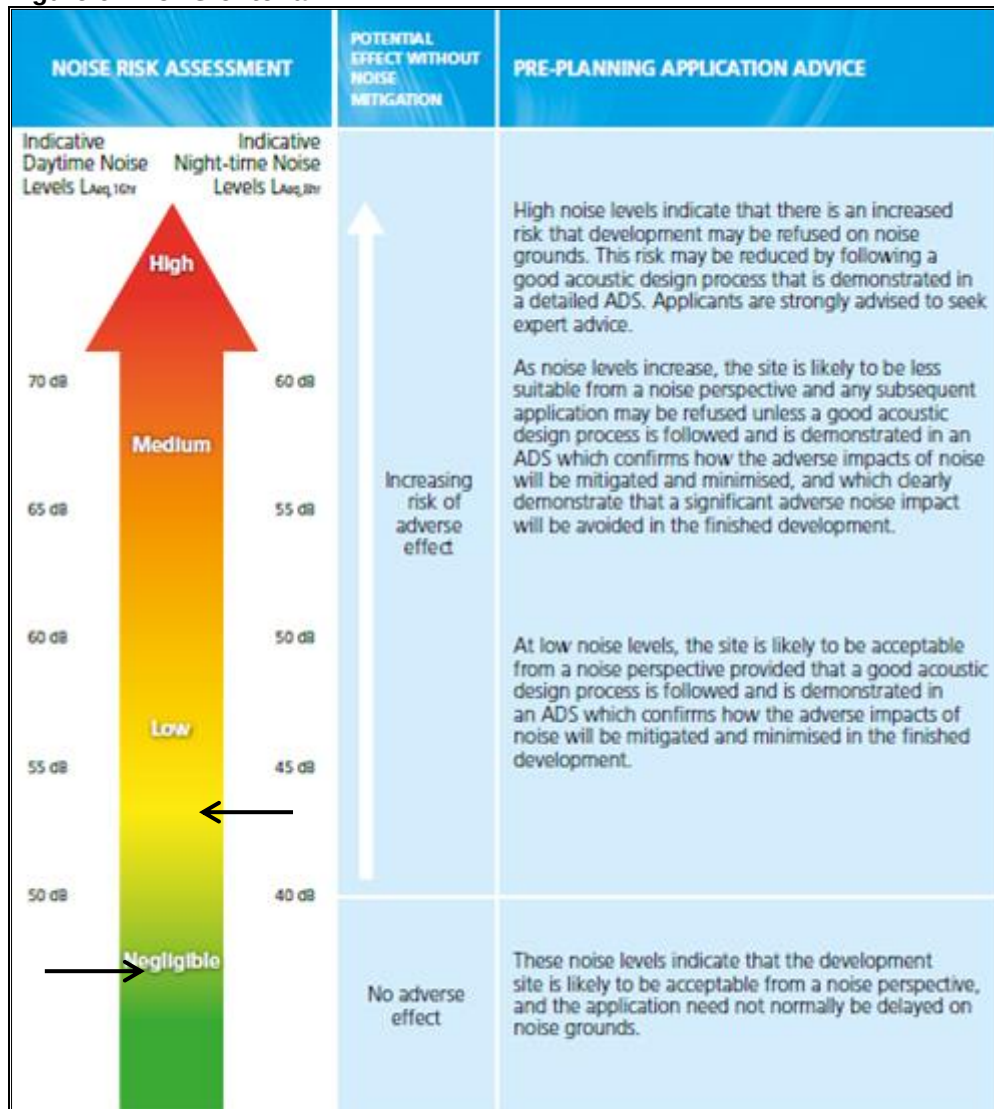
Position	Period	Calculated noise (dB)	
		L_{Aeq}	L_{AFmax}
1	Day	46	-
	Night	42	59
2	Day	48	-
	Night	46	62

- 4.4 Examination of the audio recording identified traffic on Rochdale Road as being the dominant noise during the day and night time; this included the occasional passage of emergency vehicles. Distant road traffic from the motorways was audible but at very low levels.
- 4.5 Very little commercial/industrial noise was evident.
- 4.6 Additional, occasionally significant, but brief contributions of noise were associated with the passage of commercial aircraft (arriving/departing Manchester Airport), light aviation aircraft, bird song and vehicles arriving at/departing the garages themselves.

Pro-PG risk assessment

- 4.7 With respect to the Pro PG Stage 1 risk assessment (Figure 6), the data indicate that the site at a 'negligible' risk from noise during the day time and a 'negligible' to 'low' risk at night.
- 4.8 As a consequence of these findings, further detailed, technical assessment is required with respect to night time noise; the chart indicate that *"the site is likely to be acceptable from a noise perspective"*; this assessment is provided as the Acoustic Design Statement (ADS) for the development.

Figure 6: ProPG criteria



BS8233 external noise assessment

- 4.9 The data indicate that general day time noise affecting garden areas are below the BS 8233 lower guideline value of 50 dB $L_{Aeq, 16h}$. **Specific noise mitigation measures will not be required.**

BS8233 internal noise assessment

- 4.10 Table 4 presents the calculated internal noise levels in habitable rooms closest to, and facing, the road and commercial uses, assuming 15 dB and 33 dB RW of sound attenuation through an open and closed window, respectively; the calculation of noise ingress through a closed window is undertaken using 'façade' noise levels; the free-field data from Table 3 were, therefore adjusted by the addition of 3 dB, as described in paragraph 2.23.

Table 4: Calculated internal noise levels in habitable rooms

Table 4: Calculated internal noise levels in dB			
Position	Period	Calculated noise (dB)	
		L _{Aeq}	L _{AFmax}
Windows closed			
1	Day	16	-
	Night	12	29
2	Day	18	-
	Night	16	32
Windows open (Unit 1/2)			
1	Day	31	-
	Night	27	44
2	Day	33	-
	Night	31/30	47/45

- 4.11 The data in Table 4 show that, for the properties on Church Avenue, with windows both open and closed, internal ambient (L_{Aeq}) noise levels in habitable rooms will be at or below the BS 8233 guideline values presented at paragraph 2.20. **Specific noise mitigation measures will not be required.**
- 4.12 For the properties on Hillbank Street, with windows closed, internal noise levels will be suitable for the preservation of residential amenity.
- 4.13 For Unit 1, the current layout shows that the opening of windows results in calculated night time noise levels marginally above the BS 8233 guideline values, **for bedroom windows on the building's northern and western facades only**; the current plans (Figures 7 & 8) show a bedroom at first floor with a window on the building's northern façade and a bedroom at second floor with a small window on the building's western façade (it is not clear from the plans if it is intended that this will be an openable window).

Figure 7: Unit 1 & 2 internal layout

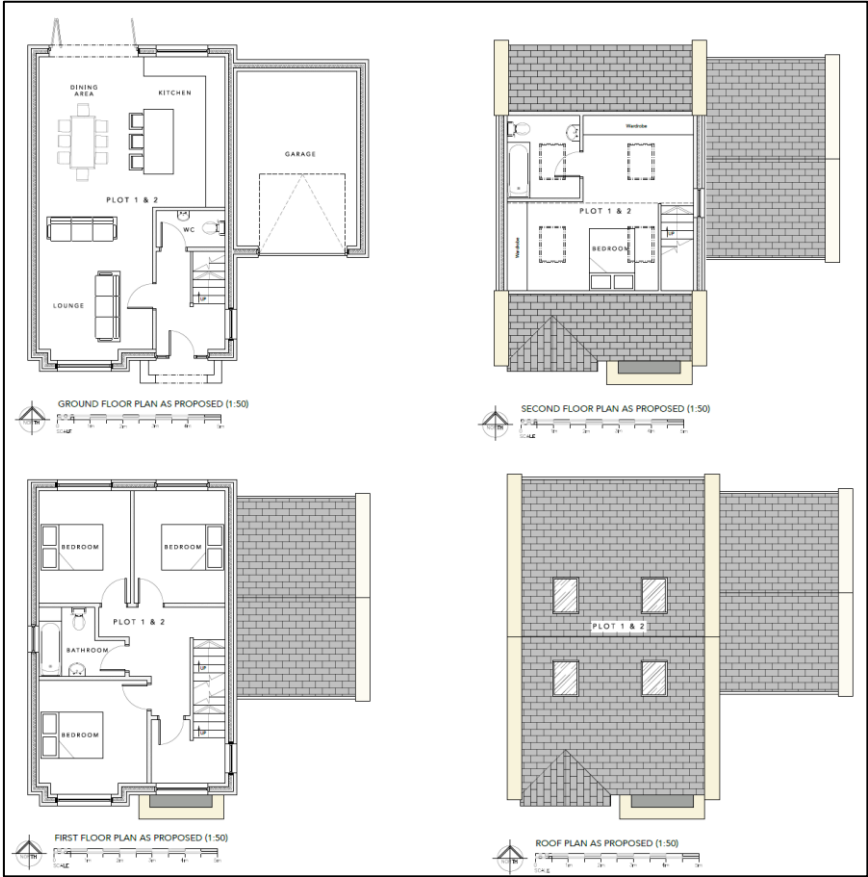


Figure 8: Unit 1 western facade elevation



- 4.14 The first floor bedroom windows on the southern facade of Unit 1 will be suitably screened from the road and Units 2 and 3 are sufficiently set-back from the roads, that calculated internal noise levels are at, or below, the BS 8233 guideline levels.
- 4.15 Consequently, for Unit 1 only, it will be necessary to keep northern and western façade bedroom windows closed to achieve the BS 8233 guideline values, meaning that alternative means of providing background ventilation would be required; this can be achieved using standard trickle ventilation units achieving a sound insulation performance of 31 dB $D_{n,e,w}$ when open.
- 4.16 For the first floor bedroom windows on the southern facade of Unit 1, and for Units 2 and 3, **no specific noise mitigation measures are required**.

5 CONCLUSION

- 5.1 The assessment has shown that the site is principally affected by noise from traffic during both the day and night time.
- 5.2 The site is shown to be at a 'negligible' to 'low' risk from noise, in accordance with the guidance in the ProPG.
- 5.3 For all properties, calculated external and internal noise levels are shown to be at, or below, the BS 8233 guideline noise levels for all properties, with windows closed.
- 5.4 However, for Unit 1 on Hillbank Street, the opening of first and second floor bedroom windows (on northern and western facades only) was calculated to give rise to internal night time levels marginally above the BS 8233 guideline values and alternative means of providing background ventilation will be required, namely standard trickle ventilation units.
- 5.5 For Units 2 and 3, for the lounge/dining area of Unit 1 and for bedrooms with windows on the southern and eastern facades of Unit 1, internal noise levels, with windows open, were calculated to be suitable for the preservation of residential amenity and no specific noise mitigation measures will be required.
- 5.6 Consequently, with the provision of the recommended noise mitigation measures, the site is suitable for residential development and noise need not be a reason for refusal of planning permission.

APPENDIX A

Glossary of acoustic terms

Ambient noise: the noise from all sources, both near and far, at any given time. Conventionally defined using the A-weighted equivalent continuous noise level (L_{Aeq}) [see below].

Background noise level (dB L_{A90}): In the UK, the 90th percentile noise level (L_{A90}) is generally used to define 'background' noise. This is a statistical parameter describing the noise level that is exceeded for 90% of the measurement or assessment time. Its value lies in the fact that it is a statistical value, towards the lower end of a measured range of data, and which is relatively 'stable' i.e. not adversely affected by occasional high-energy noise events.

Decibel (dB): a unit of level derived from the logarithm of the ratio between the value of a quantity and a reference value. It is used to describe the level of many different quantities. For sound pressure level the reference quantity is 20 micro-Pascals (μPa), the threshold of normal hearing is in the region of 0 dB, and 140 dB is the threshold of pain. A change of 1 dB is only perceptible under controlled conditions.

dB(A) / A-weighting: decibels measured on a sound level meter incorporating a frequency weighting (A weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB(A) broadly agree with people's assessment of loudness. A change (in steady noise) of 3 dB(A) is the minimum perceptible under normal conditions and a change of 10 dB(A) corresponds roughly to halving or doubling the *loudness* of a sound. The background noise level in a living room may be about 30 dB(A); normal conversation about 60 dB(A) at 1 metre; heavy road traffic about 80 dB(A) at 10 metres; the level near a pneumatic drill about 100 dB(A).

$L_{Aeq,T}$: the equivalent continuous sound level - the sound level of a notionally steady sound having the same energy as a fluctuating sound over a specified measurement period (T). L_{Aeq} is used to describe many types of noise and can be measured directly with an integrating sound level meter.

L_{Amax} : the maximum single-event noise level attained during a measurement period.

Noise: any audible sound. Often defined as unwanted sound. Can be damaging to hearing if it is too loud or can be just annoying if it interferes with the normal enjoyment of others.

Sound / sound pressure: a fluctuation in air pressure over the static ambient pressure.

Sound pressure level: the sound pressure relative to a standard reference pressure of 20 μPa (20×10^{-6}) on the decibel scale.

APPENDIX B: Images of measurement positions

Figure 9: Meter at position 1



Figure 10: Measurement position 2 - microphone position circled

