
Land off Llangollen Road, Acrefair Noise Assessment Report

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1. Introduction

- 1.1 RS Acoustic Engineering Ltd has been appointed by Gower Homes Ltd to undertake a noise assessment with regard to a proposed residential development on land off Llangollen Road, Acrefair, Wrexham, LL14.
- 1.2 It is understood that the proposals are to construct 21 new dwellings with amenity space, access road and parking.
- 1.3 There are existing dwellings immediately north, east and south of the site.
- 1.4 The dominant source of noise at the site is road traffic flow on Llangollen Road (A539) to the north.
- 1.5 A noise assessment has been undertaken with reference to the guidance contained within BS 8233:2014 *Guidance on sound insulation and noise reduction for building*, Professional Practice Guidance on Planning and Noise (ProPG) and also Technical Advice Note (Wales) 11 *Noise*.
- 1.6 This assessment is based on the results of an environmental noise survey undertaken at the site by RS Acoustic Engineering Ltd. Continuous sound level monitoring was conducted over three days to establish the existing noise levels during the daytime and night-time period.
- 1.7 The measured sound level data has been used to determine the acoustic performance requirements for the building envelope construction and to determine whether it will be suitable to naturally ventilate habitable rooms via opening windows alone.
- 1.8 An assessment of noise intrusion through the building envelope with windows open and closed has been undertaken and the resulting sound levels determined.
- 1.9 The survey and assessment was conducted by Mr Ryan Swales (BSc(Hons), MIOA), Principal Acoustic Consultant and Member of the Institute of Acoustics.
- 1.10 The results of the noise survey have been presented, along with the assessment criteria and a discussion of the results with respect to the appropriate guidance and targets.
- 1.11 Recommendations regarding sound insulation, ventilation and noise mitigation are also provided.
- 1.12 This assessment is based on scheme drawings produced by Parry Davies Architects.

2. Assessment Guidance & Criteria

Technical Advice Note (Wales) 11: Noise

2.1 Paragraph 10 of TAN 11 states the following:

Local planning authorities should consider whether proposals for new noise-sensitive development would be incompatible with existing activities, taking into account the likely level of noise exposure at the time of the application and any increase that may reasonably be expected in the foreseeable future. Such development should not normally be permitted in areas which are, or are expected to become, subject to unacceptably high levels of noise and should not normally be permitted where high levels of noise will continue throughout the night.

2.2 With regard to mitigating the impact of noise, Paragraph 11 states the following:

Measures introduced to control the source of, or limit exposure to, noise should be proportionate and reasonable, and may include:

i. engineering: reduction of noise at point of generation (e.g. using quiet machines and/or quiet methods of working); containment of noise generated (e.g. insulating buildings which house machinery and/or providing purpose-built barriers around sites); protection of surrounding noise-sensitive buildings (e.g. improving sound insulation in these buildings and/or screening them by purpose-built barriers);

ii. lay-out: adequate distance between noise source and noise-sensitive building or area; screening by natural barriers, other buildings, or non-critical rooms in a building;

iii. administrative: limiting operating time of noise source; restricting activities allowed on the site; specifying an acceptable noise limit.

Noise Exposure Categories for Dwellings

2.3 When assessing a proposal for residential development near a source of noise, TAN 11 states that local planning authorities should determine into which of the following four noise exposure categories (NECs) the proposed site falls, taking into account both daytime and night-time noise levels.

Table 2.1 – Noise exposure categories

A	Noise need not be considered as a determining factor in granting planning permission, although the noise level at the high end of the category should not be regarded as desirable.
B	Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection.
C	Planning permission should not normally be granted. Where it is considered that permission should be given, for example, because there are no alternative quieter sites available, conditions should be imposed to ensure a commensurate level of protection against noise.
D	Planning permission should normally be refused.

2.4 A recommended range of noise levels is given in Table 2.2 for each of the NECs for dwellings exposed to noise from road, rail, air and mixed sources. However, in some cases it may be appropriate for local planning authorities to determine the range of noise levels they wish to attribute to the various NECs. Where there is a clear need for new residential development in an

already noisy area some or all NECs might be increased by up to 3 dB(A) above the recommended levels. In other cases, a reduction of up to 3 dB(A) may be justified.

Table 2.2 – Recommended noise exposure categories for new dwellings near existing noise sources

Noise Levels(1) corresponding to the Noise Exposure Categories for New Dwellings L_{Aeq,T} dB					
Noise Source		Noise Exposure Category			
		A	B	C	D
Road traffic	0700-2300	<55	55-63	63-72	>72
	2300-0700	<45	45-57	57-66	>66
Rail traffic	0700-2300	<55	55-66	66-74	>74
	2300-0700	<45	45-59	59-66	>66
Air traffic	0700-2300	<57	57-66	66-72	>72
	2300-0700	<48	48-57	57-66	>66
Mixed sources	0700-2300	<55	55-63	63-72	>72
	2300-0700	<45	45-57	57-66	>66

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

- 2.5 BS 8233 provides guidance regarding acoustic criteria and noise levels appropriate for various types of space that have different functions.
- 2.6 With regard to dwellings, appropriate internal ambient sound levels are given for bedrooms, living rooms and dining rooms (habitable rooms). The guidelines take into consideration the effect of internal noise on sleep and also the effect of noise on resting, listening and communicating.
- 2.7 The internal sound level targets presented in Table 2.3 have been reproduced directly from Table 4 of BS 8233.

Table 2.3 – Indoor ambient noise levels for dwellings

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35 dB L _{Aeq,16hour}	---
Dining	Dining room/area	40 dB L _{Aeq,16hour}	---
Sleeping (daytime resting)	Bedroom	35 dB L _{Aeq,16hour}	30 dB L _{Aeq,8hour}

- 2.8 Note 7 of the standard also suggests that in some circumstances it may be appropriate to relax the indoor ambient noise level targets by up to 5 dB:

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

2.9 Note 5 also states:

If relying on closed windows to meet the guide values, there needs to be appropriate alternative ventilation that does not compromise the facade insulation or the resulting noise level. If applicable, any room should have adequate ventilation (e.g. trickle ventilators should be open) during assessment.

2.10 With regard to outdoor living areas (gardens), the following guidance is given:

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 recognised 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.

World Health Organisation: Guidelines for community noise (1999)

2.11 To help avoid sleep disturbance within bedrooms, the now superseded guidance document recommends that the night-time internal ambient sound level should not exceed 30 dB $L_{Aeq,T}$ and the maximum sound level should not typically exceed 45 dB $L_{AFmax,T}$.

2.12 The corresponding values directly outside of bedroom windows are therefore 45 dB $L_{Aeq,8hour}$ and 60 dB $L_{AFmax,T}$. This is based on the assumption that a partially open window provides approximately 15 dB of sound attenuation (from external noise).

2.13 With regard to sleep disturbance and maximum L_{AFmax} sound levels, the study undertaken by Vallet & Vernet (1991) suggests that for good sleep, indoor sound pressure levels should not exceed approximately 45 dB L_{Amax} more than 10-15 times per night.

3. Environmental Noise Survey

Survey methodology

- 3.1 Continuous sound level monitoring was conducted over a 72-hour period at the northern boundary line, directly adjacent to Llangollen Road.
- 3.2 Measurements were performed from 14:00 hours on Tuesday 13th through to 14:00 hours on Friday 16th July 2021.
- 3.3 A measurement interval of 5 minutes was used during the survey and measurements were considered to be subject to free-field conditions (away from reflective surfaces).
- 3.4 The microphone was fixed to boundary fencing at a height of approximately 2.1 metres from the ground.
- 3.5 One-third octave band and A-weighted broadband sound pressure levels were recorded during the survey.
- 3.6 The site location, surrounding area and survey measurement positions are shown in Figure 3.1 and Figure 3.2. The proposed site layout is presented in Appendix A.

Figure 3.1 - Site location and survey measurement positions (Source: Google Maps)



Figure 3.2 - Photographs showing survey measurement positions



Survey equipment

- 3.7 The survey was conducted using the following equipment:
- Brüel & Kjaer 2250-Light data logging sound level meter, with microphone type 4189 and pre-amplifier type ZC0032.
 - CEL-120/1 Acoustic calibrator.
- 3.8 Calibration of the sound level meter and microphone used for the measurements are traceable to UKAS accredited laboratories (calibration certificates are available upon request).
- 3.9 The calibration of both sound level meter and microphone was checked using a 1 kHz tone at 94 dB prior to and following the measurements performed. The drift in calibration was less than 0.1 dB.

Weather conditions

- 3.10 The weather conditions during the survey were generally dry and fine with a light cloud cover. Wind speed measurements taken on-site were typically 1 to 3 m/s⁻¹.
- 3.11 The air temperature during the survey ranged between 12°C and 22°C. The overall weather conditions were considered suitable to obtain representative measurements.

Subjective observations of the acoustic environment

- 3.12 The dominant and consistent source of noise at the site is road traffic on Llangollen Road.
- 3.13 Noise from intermittent vehicles on nearby access roads was negligible (Maes Derwydd and Willow Court).
- 3.14 During the survey, no disruptions in traffic flow along the local road network were observed (due to road works) and therefore traffic conditions were considered to be typical.
- 3.15 There was no audible building services plant noise at the site during the daytime and night-time period.
- 3.16 Other noted sources of noise include high altitude aircraft, passing pedestrians and domestic activity from adjacent dwellings.

Measured indices

3.17 Although a wide range of statistical sound level data was recorded during the survey, the L_{Aeq} and L_{AFmax} indices are of most interest here:

- $L_{Aeq,T}$ - The A-weighted equivalent continuous sound pressure level over a period of time, T. Representative of the 'average' sound pressure level over a given period (commonly used to describe the 'ambient' sound level).
- $L_{AFmax,T}$ - The A-weighted 'maximum' sound pressure level that occurred during a given period, T (commonly used for the assessment of occasional loud noises).

3.18 Sound pressure level measurements are taken with an A-weighting (denoted by a subscript 'A', e.g. L_{Aeq}) to approximate the frequency response of the human ear.

Results summary

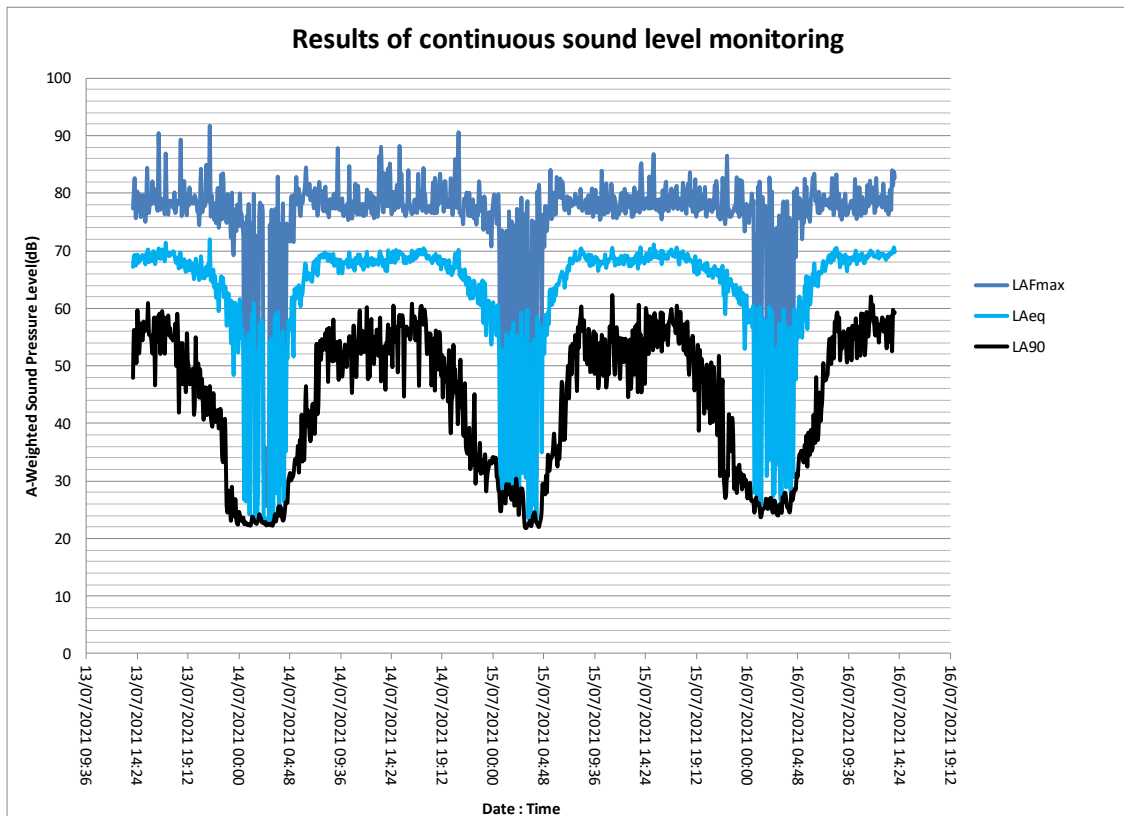
3.19 Table 3.1 presents a summary of the measured sound pressure levels from the continuous monitoring position. Measured values have been rounded to the nearest whole number.

Table 3.1 – Summary of continuously measured sound pressure levels

Date	Period	Duration, T (hours)	$L_{Aeq,T}$ dB	Average $L_{AFmax,T}$ dB	10 th Highest $L_{AFmax,T}$ dB ¹
Tuesday 13/07/2021 to Wednesday 14/07/2021	Daytime (07:00-23:00)	16	68	---	---
	Night-time (23:00-07:00)	8	60	66	80
Wednesday 14/07/2021 to Thursday 15/07/2021	Daytime (07:00-23:00)	16	68	---	---
	Night-time (23:00-07:00)	8	59	68	80
Thursday 15/07/2021 to Friday 16/07/2021	Daytime (07:00-23:00)	16	68	---	---
	Night-time (23:00-07:00)	8	60	70	81
¹ The 10 th highest value from 96 measurement periods					

3.20 The results of the sound level monitoring are also presented graphically in Figure 3.3 overleaf.

Figure 3.3 - Graph showing results of continuous sound level monitoring



Sample measurement results

- 3.21 At the sample measurement position, the daytime (afternoon) sound pressure level ranged between 49 to 51 dB $L_{Aeq,5min}$ and the maximum sound pressure level was 57 to 60 dB $L_{AFmax,5min}$.
- 3.22 The measured sound pressure levels at the sample position were approximately 17 to 20 dB L_{Aeq} lower than those measured at the continuous monitoring position.

4. Assessment & Discussion

Noise Exposure Category

- 4.1 The measurement results indicate an equivalent continuous sound pressure level of 68 dB $L_{Aeq,16\text{hour}}$ during the daytime and 59 to 60 dB $L_{Aeq,8\text{hour}}$ during the night-time.
- 4.2 Since the dominant source of noise is road traffic, this places the development site in Noise Exposure Category C for the daytime and night-time period.
- 4.3 With regard to Category C, TAN 11 states *Planning permission should not normally be granted. Where it is considered that permission should be given, for example, because there are no alternative quieter sites available, conditions should be imposed to ensure a commensurate level of protection against noise.*
- 4.4 However, the above applies to the measurement position on the northern boundary line. At the rear of the site towards the southern boundary line, Noise Exposure Category A applies for the daytime and night-time period.
- 4.5 With regard to Category A, TAN 11 states *Noise need not be considered as a determining factor in granting planning permission, although the noise level at the high end of the category should not be regarded as desirable.*

Building envelope construction and acoustic performance

- 4.6 External walls are expected to be of a brickwork/cavity/blockwork construction. The sound insulation performance of such a construction is typically in the region of 45 to 55 dB R_w+C_{tr} .
- 4.7 A tiled roof construction with mineral wool (loft) insulation and an internal plasterboard finish typically provides a sound insulation performance in the region of 39 to 43 dB R_w+C_{tr} .
- 4.8 Standard thermal double glazing typically provides a sound insulation performance in the region of 25 to 30 dB R_w+C_{tr} .
- 6 mm glass / 16 mm - 20 mm cavity / 4 mm glass (28 - 30 dB R_w+C_{tr})
 - 6 mm glass / 16 mm - 20 mm cavity / 6 mm glass (27 - 29 dB R_w+C_{tr})
 - 4 mm glass / 16 mm - 20 mm cavity / 4 mm glass (25 - 27 dB R_w+C_{tr})
- 4.9 Laminated (acoustic) double glazing as is commonly used within dwellings provides a sound insulation performance in the region of 31 to 37 dB R_w+C_{tr} .
- 6 mm glass / 16 mm - 20 mm cavity / 10.8 mm acoustic laminate (35 - 37 dB R_w+C_{tr})
 - 6 mm glass / 16 mm - 20 mm cavity / 8.8 mm acoustic laminate (33 - 35 dB R_w+C_{tr})
 - 6 mm glass / 16 mm - 20 mm cavity / 6.8 mm acoustic laminate (31 - 33 dB R_w+C_{tr})
- 4.10 As an example, Pilkington Optiphon is a high performing acoustic laminate that can be used within double glazed systems.
- www.pilkington.com/en-gb/uk/products/product-categories/noise-control/pilkington-optiphon/
- 4.11 The glazing is expected to be the weakest element with regard to the building envelope sound insulation (excluding ventilator units).
- 4.12 With standard double glazing, the 'composite' sound insulation of the building envelope is expected to be in the region of 31 to 34 dB R_w+C_{tr} , whereas with acoustically laminated double glazing the composite performance is expected to increase to at least 39 dB R_w+C_{tr} .

- 4.13 The quantity R_w is the weighted sound reduction index expressed in dB. It is a single number quantity for rating airborne sound insulation. The ' C_{tr} ' term is added to the single number rating R_w to take account of the characteristics of particular sound spectra (e.g. road traffic).
- 4.14 The acoustic performance of a particular construction may differ slightly between manufacturers and therefore the sound insulation performance should be verified where possible.
- 4.15 To achieve the optimum performance, external windows should be well sealed around the frame when installed. Large gaps between the frame and the brickwork and poorly sealed frames can notably reduce performance.

Noise ingress with windows closed

Elevations facing and adjacent to Llangollen Road

- 4.16 Table 4.1 presents the calculation results for a north west facing habitable room (bedroom) adjacent to Llangollen Road.
- 4.17 Double glazing consisting of 6 mm glass / 16 – 20 mm cavity / 6.8 mm acoustic laminate has been assumed for the habitable room.
- 4.18 It should be noted that the resulting internal sound level with standard thermal double-glazing (e.g. 4 mm glass / 16 – 20 mm cavity / 4 mm glass) will slightly exceed the daytime sound level target.
- 4.19 The calculation below takes into account the typical sound insulation performance of each building element, surface area and estimated room dimensions.
- 4.20 The consistently measured daytime sound pressure level has been used for this assessment (68 dB $L_{Aeq,16hour}$). The measured octave band sound levels and the typical reverberation time for a habitable room have also been taken into consideration.

Table 4.1 – Noise ingress calculation results

Title: Llangollen Road												
Noise Break In (ISO 12354-3)												
Formula/Comment	Single Value		63	125	250	500	1000	2000	4000	8000	Rw	(C,C _{tr})
				25.6	29.6	36.9	42.7	46.1	48.5			
L _{in}				38.4	36.4	29.1	27.3	13.9	0.5			
Materials												
6mm glass/16 - 20 mm cavity/6.8mm lam	1.4										37	(-2,-6)
Brickwork / blockwork cavity wall	6.9										51	(-1,-4)
Tiled roof, rockwool insulation, plasterboard	12.2										44	(-2,-5)
L _{outs}												
L _{out,2m}	Add Element		64.0	66.0	66.0	70.0	60.0	49.0			71	
L _{out,free field}			61.0	63.0	63.0	67.0	57.0	46.0			68	
Element 1												
Plane façade	?L _{ts}	20.5	25.6	29.6	36.9	42.7	46.1	48.5				
Visible	X _{ts}	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
L _{p,out,2m}			25.6	29.6	36.9	42.7	46.1	48.5				
L _{p,in}			64.0	66.0	66.0	70.0	60.0	49.0			71	
			38.4	36.4	29.1	27.3	13.9	0.5			32	dBA

- 4.21 The calculation results indicate a daytime internal sound level of approximately 32 dB $L_{Aeq,16hour}$ with acoustically laminated double glazing.
- 4.22 The daytime sound level target of 35 dB $L_{Aeq,16hour}$ will therefore be achieved with windows closed.
- 4.23 Since the night-time $L_{Aeq,8hour}$ sound level is approximately 8 to 9 dB lower than the daytime sound level, the night-time target of 30 dB $L_{Aeq,8hour}$ will also be achieved.
- 4.24 With regard to maximum L_{AFmax} internal sound levels, for the majority of the night-time period the recommended target of 45 dB L_{AFmax} will also be achieved.

- 80 dB L_{AFmax,5min} – 37 dB R_w = 43 dB L_{AFmax,5min} (internally)

Elevations set-back and/or facing away from Llangollen Road

- 4.25 The rear elevations and elevations that face away from Llangollen Road (i.e. where there is no line-of-sight) will be acoustically screened from passing road traffic and will therefore be subjected to notably lower sound levels (15 to 20 dB lower) compared to the front elevations.
- 4.26 Similarly, elevations that are set back from the road will also experience notably lower sound levels. For example, the ambient sound level at dwellings 30 to 40 metres from the carriageway edge will be at least 8 to 9 dB L_{Aeq,T} lower than those measured adjacent to the road.
- 4.27 In both instances, the daytime and night-time sound level targets will be satisfied in habitable rooms with standard thermal double glazing (4 or 6 mm glass / 16 – 20 mm cavity / 4 or 6 mm glass).
- 4.28 Figure 4.1 shows the site layout and recommended glazing types for the front and rear elevations.
- 4.29 Elevations with acoustically laminated double glazing are highlighted in red, whereas the elevations with standard thermal double glazing are highlighted in blue.

Figure 4.1 - Site layout showing recommended glazing types



Noise ingress with windows open

4.30 The level of sound attenuation through an open window is dependent on the type and size of window, the extent of opening, the angle of sound incidence and the characteristics of the noise source in question.

4.31 It is considered reasonable to assume a sound attenuation performance of approximately 15 dBA for a partially open window. Partially open windows are expected to provide background ventilation only (as opposed to rapid/purge ventilation).

North west facing elevations (plot no's 1 to 5 & 17 to 21)

4.32 The measured free-field daytime sound pressure level was 68 dB $L_{Aeq,16hour}$ and the night-time sound pressure level was 59 to 60 dB $L_{Aeq,8hour}$.

4.33 At the front elevation of the dwellings nearest to Llangollen Road, the free-field sound pressure level is expected to be approximately 2 to 3 dB lower than that captured at the monitoring position.

4.34 On this basis, the resulting internal sound pressure level is approximately 51 dB $L_{Aeq,16hour}$ during the daytime and approximately 43 dB $L_{Aeq,8hour}$ during the night-time.

- 66 dB $L_{Aeq,16hour}$ – 15 dB = 51 dB $L_{Aeq,16hour}$
- 58 dB $L_{Aeq,8hour}$ – 15 dB = 43 dB $L_{Aeq,8hour}$

4.35 The recommended 35 dB $L_{Aeq,16hour}$ daytime and 30 dB $L_{Aeq,8hour}$ night-time sound level targets will therefore be exceeded with windows open.

4.36 The night-time target of 45 dB $L_{AFmax,T}$ will also be exceeded with windows open.

4.37 It should be noted that BS 8233 suggests that 'reasonable' acoustic conditions can be achieved where the internal targets are relaxed by 5 dB.

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

4.38 However, the relaxed target levels will also be exceeded within the worst-case habitable rooms with windows open.

4.39 BS 8233 states that where occupants rely on closed windows to meet the internal noise limits, there needs to be appropriate 'alternative' ventilation that does not compromise the facade sound insulation or resulting internal sound level.

4.40 The standard also provides the following comment with regard to ventilation:

The Building Regulations' supporting documents on ventilation recommend that habitable rooms in dwellings have background ventilation. Where openable windows cannot be relied upon for this ventilation, trickle ventilators can be used and sound attenuating types are available. However, windows may remain openable for rapid or purge ventilation, or at the occupant's choice.

4.41 It is therefore recommended that an alternative means of ventilation is provided to habitable rooms adjacent to and facing Llangollen Road (i.e. those with a line-of-sight to passing road traffic).

4.42 As a minimum mitigation measure, it is recommended that sound attenuating (acoustically rated) ventilator units are installed to habitable rooms, since it will allow occupants to keep windows closed during noisy periods whilst maintaining background ventilation.

4.43 Bathrooms, toilets and circulation areas should not require any specific noise mitigation.

4.44 Alternatively, a mechanically assisted ventilation system could be used to serve the worst-case habitable rooms.

- 4.45 Taking into consideration the existing ambient sound levels, it is considered appropriate for openable windows to provide rapid/purge ventilation.
- 4.46 Figure 4.2 shows the proposed site layout and the dwellings/elevations where alternative ventilation is recommended (elevations are highlighted in green).

Figure 4.2 – Site layout showing elevations with recommended alternative ventilation



- 4.47 It is anticipated that the daytime and night-time sound level targets will be achieved with windows open on the elevations facing away from the main road (with the exception of plot no.15).
- 4.48 The ambient sound levels will be approximately 15 to 20 dB lower compared to the front elevation and therefore it will be suitable to naturally ventilate these elevations by opening windows alone.
- 4.49 An alternative method of ventilation such as acoustic ventilator units to habitable rooms in this instance is therefore considered unnecessary.
- 4.50 Standard (non-acoustic) hit-and-miss trickle vents could be installed to such rooms in order to provide background ventilation when windows are closed.

Garden ambient sound levels

4.51 With regard to outdoor living areas (gardens), BS 8233 provides the following guidelines:

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 recognised 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.

4.52 It is considered appropriate to design a site so that at least one garden space to a dwelling will achieve the guideline values. It is assumed that the main garden area for resting and relaxation will generally be to the rear of the property.

4.53 The measured daytime ambient sound pressure level was consistently 68 dB $L_{Aeq,16hour}$ at the continuous monitoring position. However, the ambient sound level within the rear gardens adjacent to Llangollen Road will be approximately 5 dB lower.

- 10 log (5metres/15metres) = -5 dB

4.54 A noise barrier will therefore be required to achieve the upper guideline value within the rear gardens closest to the main road.

4.55 Calculations have been undertaken in order to determine the potential sound attenuation that is achievable from an effective barrier at the rear garden boundary.

4.56 A barrier height of 1.9 metres and a receptor height of 1.2 metres above ground (a tall person sitting down) have been assumed for the calculation.

4.57 Table 4.2 presents a results summary for the barrier calculation. Octave-band sound level data has been used in the calculation since barrier attenuation is frequency dependent.

Table 4.2 – Predicted sound attenuation for a 1.9 metre high noise barrier

Frequency (Hz)	125	250	500	1000	2000	4000	L_{Aeq} dB
Source sound level L_{eq} dB	56	58	58	62	52	41	63
Barrier attenuation dB	7	8	10	13	15	18	---
Receptor sound level L_{eq} dB	49	50	48	49	37	23	55

4.58 The results indicate that approximately 8 dBA of sound attenuation can be achieved with an effective barrier and therefore the guideline values of 50 to 55 dB $L_{Aeq,T}$ can be achieved within rear gardens.

4.59 It is worth noting that a fence height of 1.8 metres will reduce the sound attenuation performance by approximately 1 dBA (i.e. the resulting sound level will be 55 to 56 dB $L_{Aeq,T}$ in the worst-case gardens). A reduction of 1 dBA is negligible in this instance and the resulting sound level would still be appropriate, should a fence height of 1.8 metres be preferred from an aesthetic point of view.

- 4.60 Figure 4.3 shows potentially suitable locations for a noise barrier. Alternative locations may be acceptable and should be checked with the project Acoustician prior to construction.

Figure 4.3 - Site layout showing potential location for noise barrier



- 4.61 An effective barrier can be constructed from a close-boarded timber fence, a masonry/brickwork wall or from a combination of the two different materials (e.g. brick walls with pillars and infill timber panels).
- 4.62 The barrier should be impermeforate, sealed at the base, sealed between panels (no gaps) and have a mass per unit area of at least 12.5 kg/m^2 . Hit and miss fencing, slatted fencing, waney lap fencing and foliage do not make effective noise barriers.
- 4.63 The dwellings/gardens set furthest back from the road should not require a noise barrier to the garden boundary since they will experience lower ambient sound levels and will be partially acoustically screened by the new dwellings adjacent to the road.
- 4.64 Further guidance can be provided with regard to barrier construction in due course.

5. Ventilation & Noise Mitigation Options

Acoustically rated ventilator units

- 5.1 Manually controlled trickle ventilators (the most common type of background ventilators) can be located over the window frames, in window frames, just above the glass or directly through the wall.
- 5.2 Sound attenuating ventilator units can be installed to habitable rooms, in order to allow background ventilation whilst maintaining a high sound insulation performance from the facade.
- 5.3 At this stage, it is recommended that the ventilator unit provides a sound insulation performance of at least 41 dB $D_{n,e,w}$ (in the open position). Further guidance regarding ventilator performance can be provided in due course.
- 5.4 Example manufacturers of acoustically-rated ventilator units include:
 - www.aereco.co.uk/products-and-systems/
 - www.greenwood.co.uk/acoustic
 - <http://brookvent.co.uk/product/airvent-sm-acoustic/>

Mechanically assisted ventilation

- 5.5 A further option with regard to ventilating and cooling habitable rooms whilst achieving a high facade sound insulation would be to use a mechanical ventilation system, such as a heat recovery system (MVHR) or positive input ventilation system (PIV).
- 5.6 Example suppliers of MVHR and PIV systems include:
 - www.nuaire.co.uk/residential/positive-input-ventilation
 - www.envirovent.com/specifier/products/heat-recovery-systems/
 - www.envirovent.com/specifier/products/positive-input-ventilation/
 - www.greenwood.co.uk/range/5/heat-recovery-mvhr.html
- 5.7 Appropriate ventilation rates depend on the number of bedrooms within the dwelling and the anticipated occupancy rate (refer to Approved Document F for guidance).
- 5.8 Such systems can also be supplied with a 'boost' function in order to reduce the need to open windows for purge ventilation.
- 5.9 With a loft mounted motor and control unit, particular attention should be paid to the construction of bedroom ceilings and the mounting of the motor unit in order to minimise the noise transmission into adjacent rooms. It is commonplace for a double-boarded ceiling construction and acoustically enhanced loft-hatch to be used where there is a loft mounted motor/control unit.

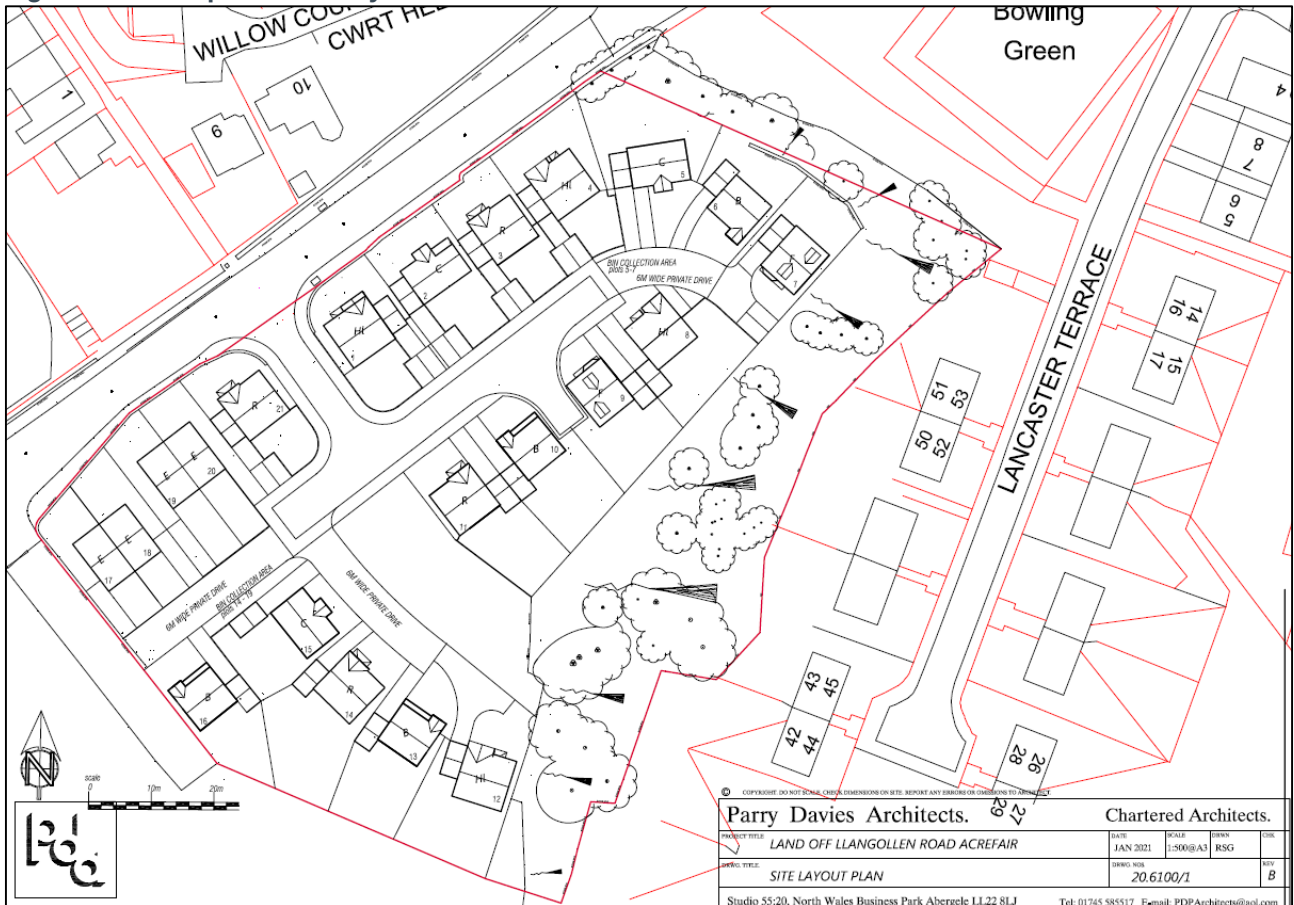
6. Conclusion

- 6.1 The proposed development site falls within Noise Exposure Category C directly adjacent to the northern boundary line and reduces to Noise Exposure Category A towards the southern boundary line.
- 6.2 The recommended daytime and night-time sound level targets can be achieved within all dwellings with windows closed.
- 6.3 Double glazing consisting of 6 mm glass / 16 – 20 mm cavity / 6.8 mm acoustic laminate will provide sufficient sound insulation for the worst-case habitable rooms (i.e. those adjacent to and facing Llangollen Road).
- 6.4 Standard thermal double glazing and traditional building envelope constructions will provide sufficient sound insulation for habitable rooms facing away from Llangollen Road. A suitable glazing construction would be 4 mm glass / 16 – 20 mm cavity / 4 mm glass.
- 6.5 It is recommended that an alternative means of ventilation is provided to habitable rooms adjacent to and facing Llangollen Road.
- 6.6 As a minimum mitigation measure, it is recommended that sound attenuating (acoustically rated) ventilator units are installed to habitable rooms, since it will allow occupants to keep windows closed during noisy periods whilst maintaining background ventilation.
- 6.7 Alternatively, a mechanically assisted ventilation system could be used to serve the worst-case habitable rooms.
- 6.8 It is anticipated that the daytime and night-time sound level targets will be achieved with windows open on the elevations facing away from the main road. An alternative method of ventilation such as acoustic ventilator units to habitable rooms in this instance is considered unnecessary.
- 6.9 Predictions indicate that for an effective barrier approximately 1.9 metres high, the guideline value of 50 to 55 dB $L_{Aeq,16\text{hour}}$ can be achieved within rear garden areas.
- 6.10 Changes to the site layout are considered unnecessary at this stage.
- 6.11 On the basis of the measured sound levels and site layout design, the proposed site is considered suitable for residential development.

Appendix A

Site location plan and proposed layout

Figure A.2 – Proposed site layout



Appendix B

Assessment terminology

Assessment terminology

Term	Description
dB (decibel)	The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and a reference pressure ($2 \times 10^{-5} \text{Pa}$).
dB(A)	The most widely used weighting mechanism that best corresponds to the response of the human ear is the 'A'-weighting scale. This is widely used for environmental noise measurement, and the levels are denoted as dB(A) or L_{Aeq} , L_{A90} etc, according to the parameter being measured.
Acoustic environment	Sound from all sources as modified by the environment.
Ambient sound level	The totally encompassing sound in a given situation at a given time; it is usually composed of sound from many sources, near and far.
Equivalent continuous sound level - $L_{Aeq,T}$	The A-weighted equivalent continuous sound pressure level over a period of time, T. Representative of the 'average' sound pressure level over a given period (commonly used to describe the 'ambient' sound level).
Maximum sound level - $L_{AFmax,T}$	The A-weighted 'maximum' sound pressure level that occurred during a given period, T (commonly used for the assessment of intermittent loud noises).
Background sound level - $L_{A90,T}$	The sound pressure level that is exceeded for 90% of the measurement time interval, T. $L_{A90,T}$ is often used to describe the 'background' sound level.
Habitable room	Any room used or intended to be used for sleeping, cooking, living or eating purposes (enclosed spaces such as bath or toilet facilities, service rooms, corridors, laundries, hallways, utility rooms or similar spaces are excluded from this definition).
R_w	The weighted sound reduction index expressed in dB. A single number quantity for airborne sound insulation rating.
Free-field level	A sound field determined at a point away from reflective surfaces other than the ground with no significant contributions due to sound from other significant reflective surfaces. Generally as measured outside and away from buildings (>3.5metres).