

REPORT
of
SOUND MEASUREMENTS AND RECOMMENDATIONS
at
PROPOSED RENOVATION OF EXISTING FARMHOUSE AND
ERECTION OF 4 DWELLINGS,
WESTFIELD FARM,
BARNSELY ROAD,
FLOCKTON,
HUDDERSFIELD
WF4 4DW

Dates of measurements: 4th – 10th August 2022

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1.0 **Summary and Conclusions**

- 1.1 An application is in place to renovate an existing farmhouse and create four new dwellings at Westfield Farm, Barnsley Road, Flockton. As part of the application, and to address the associated Planning Condition (Condition 14 of Application Number 2019/62/92238/E), the client has commissioned an acoustic survey of the site.
- 1.2 The design targets for indoor sound level adopted in this report are:
- 30 dB LA_{eq} in bedrooms from 2300-0700 hours,
 - 35 dB LA_{eq} in all habitable rooms from 0700-2300 hours
 - 45 dB LA_{max,f} in bedrooms from 2300-0700 hours from regular events
- 1.3 Measurements of sound were taken from 11.30 on Thursday 4th August to 09.15 on Wednesday 10th August 2022. Sound levels were measured with a calibrated type I sound level meter, full details of which are given in the appendices of this report.
- 1.4 The overall daytime ambient sound levels was 65.4 59.8 dB LA_{eq} and at night 59.8 59.8 dB LA_{eq} Sound levels during the first and last hours of night were 59.6 and 63.2 dB LA_{eq} respectively. Night time maxima per 15 minute logging period were 79 - 81 dB LA_{max,f}.
- 1.5 The internal sound level targets can be achieved using the following glazing and ventilator specification. All top floor ceilings should be constructed using two layers of 12.5mm plasterboard

Unit and Elevation	Room	Glazing	Ventilator
1 & 2 overlooking Barnsley Road	Bedroom	10 – 16 – 6.8 acoustic	Greenwood MA3051 in wall ventilator
	Living room, kitchen , dining room	6 – 16 – 6.8 acoustic	Greenwood 5000 EAW.AC1 or Titon SFX V50 + C25 acoustic trickle vent
1 & 2 facing courtyard	Bedroom, Living room, kitchen , dining room	4 – 16 – 4	Greenwood 5000 EAW or Titon SFX V25 + C25
Farmhouse east elevation	Living room, kitchen , dining room	4 – 16 – 6.8 acoustic	Greenwood 5000 EAW.AC1 or Titon SFX V50 + C25 acoustic trickle vent
Farmhouse facing courtyard	Bedroom, Living room, kitchen , dining room	4 – 16 – 4	Greenwood 5000 EAW or Titon SFX V25 + C25

Unit and Elevation	Room	Glazing	Ventilator
3 & 4	Bedroom, Living room, kitchen , dining room	4 – 16 – 4	Greenwood 5000 EAW or Titon SFX V25 + C25

- 1.6 With the provision of a 2.0m high acoustic fence the predicted sound levels in the garden areas are expected to comply with the upper limit of 55 dB LA_{eq} set by the WHO and BS 8233 for garden amenity.
- 1.7 Commentary on internal sound levels with windows left open for purge ventilation or control of thermal comfort is given in the report using the recently released acoustics, ventilation and overheating (AVO) guide.

2.0 **Introduction**

It is proposed to renovate an existing farmhouse and create four new dwellings at Westfield Farm, Barnsley Road, Flockton. The site lies immediately adjacent to the A637, Barnsley Road and so as part of the planning application the applicant has commissioned this acoustic survey for submission to the Local Planning Authority. Road traffic sound is the dominant source at the site.

The relevant policies, guidance and standards relating to this development are described in the following subsections.

2.1 **Central Government Policies**

The government's planning policies are described in the National Planning Policy Framework (NPPF) which includes consideration of potential adverse impacts of noise on new development. The NPPF makes reference to the Noise Policy Statement for England (NPSE) which includes an Explanatory Note describing three incremental categories of noise impact:

- No Observed Effect Level (NOEL) being the situation below which no effect caused by noise can be detected,
- Lowest Observable Adverse Effect Level (LOAEL) being the situation above which adverse effects caused by noise can be detected,
- Significant Observed Adverse Effect Level (SOAEL) being the level above which significant adverse effects caused by noise occur.

Stated objectives of the NPSE are:

1. Avoid significant adverse impacts, usually interpreted as calling for sound levels above SOAEL to be avoided.
2. Mitigate and minimise adverse impacts, usually interpreted as calling for noise mitigation to be used within the bounds of practicality for situations between LOAEL and SOAEL.
3. Where possible contribute to the improvement of health and quality of life, usually interpreted as calling for noise reductions to be made where possible for situations between NOEL and LOAEL.

Although introducing these subjective concepts for the assessment of noise impact, the NPPF and NPSE documents do not provide

quantitative values against which the suitability of a site for development can be assessed in terms of sound levels.

2.2 **BS 8233: 2014**

BS 8233 provides guidance on interior sound levels inside various building interiors caused by external sources of an anonymous nature, for example flowing road traffic. It is recommended that the internal ambient sound levels in dwellings do not exceed:

Living rooms	35 dB LA _{eq}	from 07.00-23.00
Dining rooms	40 dB LA _{eq}	from 07.00-23.00
Bedrooms	35 dB LA _{eq}	from 07.00-23.00
	30 dB LA _{eq}	from 23.00-07.00
Gardens	50 dB LA _{eq}	is the desirable limit
	55 dB LA _{eq}	is the upper guideline value.

The above sound limits are described in BS 8233 as applying to “steady external noise sources”. A note in paragraph 7.7.1 of the same document states that “Noise has a specific character if it contains features such as a distinguishable, discrete and continuous tone, is irregular enough to attract attention, or has strong low-frequency content, in which case lower noise limits might be appropriate.”

BS 8233 describes a ‘More Rigorous’ calculation procedure for the prediction of internal sound levels and this guidance is adopted for this report.

2.3 **World Health Organisation: 2000**

Guidance from the WHO gives additional guidance to BS 8233 on the interior sound levels in bedrooms at which sleep disturbance can be expected to occur:

Bedrooms	30 dB LA _{eq}	} to avoid sleep disturbance
	45 dB LA _{max}	

The guidance on LA_{max} is usually intended to apply to sound from regular and typical events only. The definition of ‘regular and typical’ is open to some interpretation and depends on the context and sources being considered.

2.4 **Acoustics, Ventilation and Overheating**

The Acoustics, Ventilation and Overheating (AVO) guide seeks to provide guidance on the interaction between these three factors. It is an in depth document that covers many types of ventilation systems. There are three types of ventilation condition identified, which are given in the table below, taken from the AVO guide.

Ventilation system	Provision with ADF system / purpose		
	Whole dwelling ventilation	Extract ventilation	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 ("natural")	Background ventilators (trickle vents) and passive stack ventilation	Continuous via passive stack	Typically provided by opening windows
System 3: Continuous mechanical extract (MEV)	Continuous mechanical extract – minimum low rate Trickle vents provide inlet air	Continuous mechanical extract – minimum high rate Trickle vents provide inlet air	Typically provided by opening windows
System 4: Continuously mechanical supply and extract with heat recovery (MVHR)	Continuous mechanical supply and extract – minimum low rate	Continuous mechanical supply and extract – minimum high rate	Typically provided by opening windows

In addition to this, the control of overheating should be considered. The conventional way of controlling overheating is to open window casements, but this leads to an increase in indoor sound levels. It may be accepted that slightly elevated sound levels are permissible during the control of overheating, and a relatively low chance of adverse impact exists if internal conditions remain reasonable.

High levels of outdoor sound may result in unacceptable acoustic conditions inside dwellings with open windows, forcing a decision from the resident to have either acoustic or thermal comfort. Depending how often these conditions occur, significant adverse effect may be caused to living amenity.

If the various recommendations in the AVO guide are followed, the table below gives the level of risk to acoustic comfort during overheating conditions, if a partially open window casement is used (typical attenuation 13 dBA).

These are not fixed thresholds and use the full day and night time averaging periods of 16 and 8 hours, but give an indication as to the suitability of open windows to be the sole method of controlling overheating.

3.1 Sound Measurements

Full measurement data, including frequency spectra are given in the appendices of this report. The table below shows a summary of overall dBA measurements representative of the elevation closest to Barnsley Road. The measurement position available was located closer to Barnsley Road than the nearest proposed elevations of units 1 & 2 therefore distance calculations have been performed in accordance with the propagation principles of the Rathe theory, treating the road noise as a line source. This is expected to give in a conservative reduction, therefore allowing a reasonable worst case scenario result.

Period Description	Start Time	End Time	Ambient (Mean)	Background (Mean)	Maximum (Mean)
			<i>dB LA_{eq,15min}</i>	<i>dB LA_{90,15min}</i>	<i>dB LA_{max,f}</i>
Peak Traffic am	08:00	09:30	65.3	50.1	82.1
Typical Daytime	10:00	15:00	65.5	51.5	82.5
Peak Traffic pm	16:30	18:30	65.9	53.1	82.8
Evening	19:00	22:00	63.7	42.3	83.1
Early Night	23:00	00:00	59.6	31.6	80.3
Night	00:00	04:00	56.0	25.7	79.3
Early Morning	05:30	07:00	63.2	40.8	81.2

The overall noise levels for the full combined daytime periods (375 individual measurements) is 65.4 dB LA_{eq}, and the full combined night time periods (192 individual measurements) is 59.8 dB LA_{eq}.

4.0 Suggested Building Specification

Internal sound levels are predicted to mostly comply with the requirements outlined in section 2 of this report if the glazing and ventilator specifications shown below are used with the proposed external wall and roof construction.

Suggested models of ventilator are given. If a different model of ventilator is preferred, calculations can be undertaken by us to advise suitability.

4.1 **Units 1 & 2**

Bedrooms Overlooking Barnsley Road:

- Glazing comprising 10mm float glass and 8.8mm acoustic glass such as Pilkington Optiphon with a 16mm airgap between, eg 10-16-8.8 acoustic
- Greenwood MA3051 in wall acoustic ventilator. In frame acoustic trickle vents are not acoustically suitable for bedrooms overlooking Barnsley Road.
- Ceilings to be constructed using two layers of 12.5mm plasterboard

Living Rooms and Kitchen / Dining Rooms Overlooking Barnsley Road

- Glazing comprising 6mm float glass and 6.8mm acoustic glass such as Pilkington Optiphon with a 16mm airgap between, eg 6-16-6.8
- Greenwood 5000 EAW.AC1 or Titon SFX V50 + C25 acoustic in frame trickle ventilator

Bedrooms, Living Rooms and Kitchen / Dining Rooms Facing Courtyard

- Glazing comprising two leaves of 4mm float glass with a 16mm airgap between, eg 4-16-4.
- Greenwood 5000 EAW or Titon SFX V25 + C25 in frame trickle ventilator
- Ceilings on top floors to be constructed using two layers of 12.5mm plasterboard

4.2 **Units 3 & 4**

All Bedrooms, Living Rooms and Kitchen / Dining Rooms

- Glazing comprising two leaves of 4mm float glass with a 16mm airgap between, eg 4-16-4.
- Greenwood 5000 EAW or Titon SFX V25 + C25 in frame trickle ventilator

- Ceilings on top floors to be constructed using two layers of 12.5mm plasterboard

4.3 **Existing Farmhouse**

It is understood that there are no windows in habitable rooms overlooking Barnsley Road, and only windows for bathrooms or the stairwell. The proposed eastern elevation has a side view of Barnsley Road but the first floor windows on the eastern elevation are into the corridors only.

Living Room and Kitchen / Dining Room in eastern elevation

- Glazing comprising 4mm float glass and 6.8mm acoustic glass such as Pilkington Optiphon with a 16mm airgap between, eg 4-16-6.8
- Greenwood 5000 EAW.AC1 or Titon SFX V50 + C25 acoustic in frame trickle ventilator

Bedrooms, Living Room and Kitchen / Dining Room Facing Courtyard

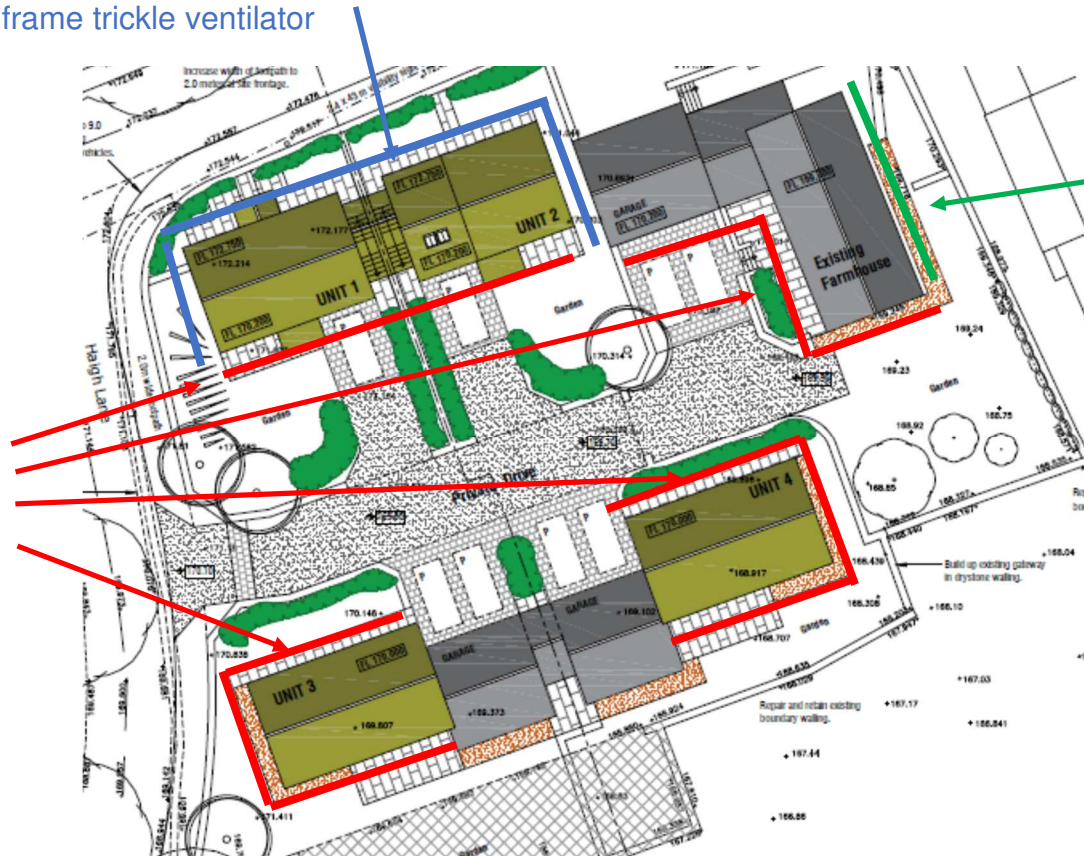
- Glazing comprising two leaves of 4mm float glass with a 16mm airgap between, eg 4-16-4.
- Greenwood 5000 EAW or Titon SFX V25 + C25 in frame trickle ventilator
- Ceilings on top floors to be constructed using two layers of 12.5mm plasterboard

4.4 Summary of Glazing and Ventilator Specification

Bedrooms: 10 – 16 – 8.8 acoustic glazing, Greenwood MA3051 in wall acoustic vent

Living rooms & kitchen / dining rooms: 6 – 16 – 6.8 acoustic glazing, Greenwood 5000 EAW.AC1 or Titon SFX V50 + C25 acoustic in frame trickle ventilator

Bedrooms, living rooms and kitchen / dining rooms: 4 – 16 – 4 glazing, Greenwood 5000 EAW or Titon SFX V25 + C25 in frame trickle ventilator



Living room & kitchen / dining room: 4 – 16 – 6.8 acoustic glazing, Greenwood 5000 EAW.AC1 or Titon SFX V50 SFSA acoustic in frame trickle ventilator

5.0 Interior Sound Levels

The design targets summarised in 2.0 of this report are that the external fabric of the building must reduce the outdoor sound from road traffic and general sources to indoor sound levels not exceeding:

- 30 dB LA_{eq} in bedrooms from 2300-0700 hours,
- 35 dB LA_{eq} in all habitable rooms from 0700-2300 hours
- 45 dB LA_{max,f} in bedrooms from 2300-0700 hours from regular events

5.1 Predicted Internal Sound Levels

Internal sound levels have been calculated using the more rigorous method of BS 8233: 2014. Full predictions are given in the appendices of this report. A summary of predicted internal sound levels is given below, including all measured events. In total the survey period included 375 fifteen minute daytime measurements and 192 fifteen minute night time measurements. Examples have been provided as to how these measurements rank against the acceptance criteria

Units 1 & 2 Overlooking Barnsley Road

Living Room

Quantity / Rank	Living Room, Day LA _{eq}
Mean	30.5
Maximum	38.0
7	34.7
38 (10% of 375)	32.7
Min	23.3

Bedroom

Quantity / Rank	Bedroom, Day LA _{eq}	Bedroom, Night LA _{eq}	Bedroom, Night LA _{max}
Mean	22.9	14.6	39.1
Maximum	29.6	25.7	52.6
17	26.4	20.4	44.6
20 (10% of 192)	26.3	20.1	44.4
38 (10% of 375)	25.3	17.9	43.0
Min	14.9	3.2	27.1

Units 1 & 2 Facing Courtyard

Living Room

Quantity / Rank	Living Room, Day LA_{eq}
Mean	24.6
Maximum	32.0
5	29.5
38 (10% of 375)	26.8
Min	17.7

Bedroom

Quantity / Rank	Bedroom, Day LA_{eq}	Bedroom, Night LA_{eq}	Bedroom, Night LA_{max}
Mean	23.6	15.9	39.5
Maximum	30.8	25.9	50.5
12	26.8	22.2	45.0
20 (10% of 192)	26.1	21.1	44.0
38 (10% of 375)	25.7	18.7	42.3
Min	16.8	5.0	28.8

Units 3 & 4

Living Room

Quantity / Rank	Living Room, Day LA_{eq}
Mean	23.8
Maximum	31.2
5	28.8
38 (10% of 375)	26.0
Min	17.0

Bedroom

Quantity / Rank	Bedroom, Day LA_{eq}	Bedroom, Night LA_{eq}	Bedroom, Night LA_{max}
Mean	22.9	15.4	38.8
Maximum	30.2	25.3	49.8
11	26.7	21.8	44.7
20 (10% of 192)	25.5	20.6	43.2
38 (10% of 375)	25.1	18.3	41.8
Min	16.3	4.6	28.2

Farmhouse

Quantity / Rank	Living Room, Day LA_{eq}
Mean	30.9
Maximum	38.2
8	35.0
38 (10% of 375)	33.2
Min	23.5

Quantity / Rank	Bedroom, Day LA_{eq}	Bedroom, Night LA_{eq}	Bedroom, Night LA_{max}
Mean	23.5	15.9	39.7
Maximum	31.3	26.1	52.4
17	26.2	21.5	45.0
20 (10% of 192)	26.2	21.1	44.6
38 (10% of 375)	25.6	19.0	42.8
Min	16.6	4.6	28.3

The overall predictions are generally in compliance with the criteria outlined in section 2. There are 6 out of a total of 375 day time periods in which the living rooms overlooking Barnsley Road exceed the 35 dB $LA_{eq,15min}$ target. It is widely agreed that 'irregular' events may cause acceptable exceedances.

16 out of a total of 192 night time periods in bedrooms overlooking Barnsley Road exceed the 45 dB LA_{max} by a margin of up to 7.2 dBA. These periods do comply comfortably with the $LA_{eq,15min}$ levels. These levels are predicted with a high attenuation specification, in order to improve these levels the in wall ventilators would have to be removed meaning that mechanical ventilation would be required instead. If this were to be the case then the resulting noise levels in the bedrooms overlooking Barnsley Road would be calculated as shown below. This would not account for noise created by the mechanical ventilation system itself.

Bedrooms of Units 1 & 2 Overlooking Barnsley Road (No In Wall Ventilators)

Quantity / Rank	Bedroom, Day LA_{eq}	Bedroom, Night LA_{eq}	Bedroom, Night LA_{max}
Mean	21.4	12.9	37.7
Maximum	28.0	24.3	51.7
12	25.4	19.3	45.0
20	24.9	18.4	43.0
38	23.9	16.5	41.7
Min	13.1	1.4	25.3

6.0 Purge Ventilation & Thermal Comfort

Background ventilation can be provided by trickle ventilators, either in wall or in frame as described in this report. During times when purge ventilation is required or flow rates above background ventilation are desired for control of thermal comfort, the default method is to open windows.

6.1 Sound Levels with Windows Open

The sound attenuation across an open window casement is typically 12 -15 dBA depending on casement detail. It is likely that internal sound levels would be generally above normal internal acceptance criteria with window casements open, to an extent that depends on position and time of day or night.

Historically, exceedances above internal sound level criteria have been generally accepted by Planning Authorities in most cases, but more recent guidance encourages consideration of thermal comfort against acoustic conditions, especially in noisy areas or where potentially annoying sources exist. It is generally accepted that some exceedances above normal sound level requirements when windows are open is unlikely to have significant impact on living amenity, but excessive sound levels can force a choice between thermal or acoustic comfort.

6.2 Acoustics, Ventilation and Overheating Guide

The measured day and night time sound levels are used for comparison to the recommendations of the AVO guide. This document is not regulatory, but provides guidance and commentary on this topic.

Using the results measured at the front elevation of units 1 & 2, the overall daytime levels of 68 dB LA_{eq} and night time overall levels of 62 dB LA_{eq} means that units 1 & 2 and the farmhouse fall into the **high risk** category.

The calculated overall daytime levels at the front of units 3 & 4 of 53 dB LA_{eq} and night time overall levels of 47 dB LA_{eq} means that units 3 & 4 fall into the **low - medium risk** category

The conclusion is that reasonable internal conditions are unlikely to be achieved in units 1 & 2 and the farmhouse if open windows are relied upon for ventilation however it is noted that the farmhouse only has openable windows in the living rooms with a side view of Barnsley Road. Units 3 & 4

can expect reasonable conditions with open windows with a risk of adverse impact depending upon overheating regularity.

6.3 **Building Regulations Part O**

The new Part O of The Building Regulations deals with overheating and also the noise indications of relying on open windows for control of thermal comfort.

This is a brand-new piece of regulation (June 2022), so full adoption may take some time. It forms part of Building Regulations compliance, which is generally beyond the scope of requirements for planning application submissions. However, there are instances where the inclusion of a mechanical ventilation system may have some influence on details submitted with a planning application and so it is prudent to bear these potential requirements in mind from the early stages of a development proposal.

If this development will be subject to the requirements of the new Part O then we can provide assistance at the required stage.

From the information we have gathered so far at site, it appears likely that outdoor sound levels are sufficiently high that the recommendation of the AVO guide and Part O compliance will be for the fitment of a mechanical ventilation supply in Units 1 & 2 and possibly the farmhouse.

We can provide further assistance if required depending on the version of Building Regulations adopted, requirements of the LPA and Building Control, but at this stage it would appear prudent to consider fitment of mechanical ventilation system at this development.

7.0 **Sound Levels in Private Gardens**

BS 8233: 2014 and the World Health Organisation Guidelines on Community Noise make recommendations in terms of the outdoor sound levels from sources such as road traffic affecting garden amenity spaces:

- 50 dB LA_{eq} is the desirable limit (BS 8233) in which few people are moderately annoyed (WHO),
- 55 dB LA_{eq} is the upper guideline value (BS 8233) in which few people are seriously annoyed (WHO).

According to guidance contained in BS 5228 the provision of an acoustic barrier would typically reduce the outdoor noise levels in gardens by 10dB so long as the barrier completely hides the source from the receiver. Allowing for a distance correction of 2.5 dB in line with Rathe's theory it is concluded that if the garden areas are provided with a 2.0m high imperforate timber fence, then outdoor sound levels in the rear gardens of units 1 & 2 will equate to an overall daytime level of 52.9 dB LA_{eq}, and so comply with the upper target of 55 dB LA_{eq}. Allowing for further distance correction to the gardens of the farmhouse and units 3 & 4 the overall daytime sound levels in these gardens is expected to 51.4 dB LA_{eq}.

It is recommended that all garden areas are surrounded by a 2.0m high imperforate timber fence constructed using overlapped or tightly butted boards with no sightlines or gaps through them. Gravel or similar should be used at the bottom of the fence to prevent any gaps between the bottom edge of the fence and the earth.

APPENDIX 1

QUALIFICATIONS AND EQUIPMENT

S & D Garritt Ltd are members of the Association of Noise Consultants (ANC). All work related to this report was undertaken by Liz Garritt and checked by David Garritt..

Liz Garritt is an Associate Member of the Institute of Acoustics and holds an honours degree in Biomedical Science.

David Garritt has been a full member of the Institute of Acoustics since 2005 and holds an honours degree in Electronic and Computer Systems Engineering. David teaches acoustics at post graduate level on a part time basis. David sits on the ANC Communications and PR Committee.

The equipment used during the site visits is shown in the table below. The sound level meter was calibrated before and after use; no drift was apparent.

Equipment Description	Type number	Manufacturer	Date of expiration of Calibration	Calibration Certificate Number
Sound Level Meter	XL2 TA s/n A2A-10019-EO	NTi Audio	25.08.2022	145408
Microphone	MK 224 s/n 210762A	Cirrus Research	20.08.2022	145404
Calibrator	4231 s/n 2402706	Bruel & Kjaer	20.07.2023	177551

APPENDIX 2

UNCERTAINTY

The uncertainties apparent in this acoustic survey and how they have been minimised are considered in this section.

Measurements of the existing sound climate have been undertaken on site using unattended measurements over full daytime and night time periods to include the times of highest road traffic sound. Predictions have been undertaken on each 15 minute logged measurement to more accurately allow for the perception of sound, as opposed to predictions that rely on time averaging over a full 16 hour daytime or eight hour night-time.

The procedures used for the calculation of sound levels at the different elevations are based on fundamental principles of acoustics. Sound decay with distance from the sources has been calculated using the principles and methods recommended in BS 5228, including the method of Rathe that takes account of the size of the building elevation and the decay characteristics of it. Internal sound levels have been calculated using the more rigorous method of BS 8233 : 2014, which considers transmission through each of the building elements.

The addition and subtraction of sound levels was done logarithmically on an energy basis, which is the correct method for decibel calculations. It is anticipated that this method would be considered by other suitably qualified acousticians to be relevant, correct and appropriate for this survey and is a method examined by the Institute of Acoustics on their post graduate diploma course.

All sound level measurements were taken with a calibrated type 1 sound level meter, which represents the most accurate type of SLM available. Sound levels were measured to the nearest 0.1 dB, time periods were measured and recorded to the nearest second. No rounding was done in any calculations, the only rounding being done on final results. The sound level meter was calibrated before and after each survey period and no drift was apparent.

It is concluded that the uncertainty in this survey has been minimised as far as possible and is believed to be below the level at which it would have an impact on the assessment conclusions contained in this report.

APPENDIX 3

INTERIOR SOUND CALCULATIONS

MORE RIGOROUS CALCULATION METHOD OF BS 8233: 2014

The method in BS 8233:2014 requires certain building parameters to be known or assumed as part of the calculation procedure. The interior layout and room dimensions have been taken from layouts supplied to us and included later in the appendices.

Living Rooms

Building Element	Value (m ²)
Reference absorption A_0	10
Total façade area S_f	9.1
Window area S_{wi}	1.8
External Wall area S_{ew}	7.3
Ceiling area S_{rr}	19.25
Total area $S = S_f + S_{rr}$ calculated	28.35

Bedrooms

Building Element	Value (m ²)
Reference absorption A_0	10
Total façade area S_f	8.06
Window area S_{wi}	1.2
External Wall area S_{ew}	6.86
Ceiling area S_{rr}	8.68
Total area $S = S_f + S_{rr}$ calcul	16.74

The sound reduction indices of the recommended building specifications are:

Sound reduction indices. dB

Frequency (Hz)	63	125	250	500	1k	2k	4k	8k
Outer Walls	34	41	45	50	56	65	69	72
4-16-4 glazing	18	21	17	25	35	37	31	35
4-16-6.8 acoustic	19	20	27	36	47	47	52	55
6-16-6.8 acoustic	21	21	28	37	48	48	54	57
10-16-8.8 acoustic	24	28	31	42	45	50	58	62
Greenwood 5000EA	33	39	37	31	32	31	35	38
Titon SFX V25 + C25	33	37.8	37.6	34.4	32.1	42.4	48.8	55.4
5000EAW.AC1 ventilator	33	39	38	31	44	43	46	49
Titon SFX V50 / SFSA C25	34	37.9	37.7	33.4	36.3	47.1	49.2	57
Greenwood MA3051 Acoustic Vent	40	47	46	49	56	66	65	69
Double Board	35	40	46	51	55	52	54	56

The overall outdoor-to-indoor sound level difference represented by the building elements is calculated using the method in BS 8233:2014 as:

Frequency (Hz)	63	125	250	500	1k	2k	4k	8k
Living Rooms	22	24	31	30	42	41	45	48
Bedrooms	26	31	34	32	35	45	48	56

The calculations involved in obtaining the 'Overall Loss' are lengthy, so the workings are omitted from this report for conciseness and readability.

The overall loss predictions of the building envelope are applied to the measured frequency spectra in each 15 minute measurement period.

The distance decay and barrier effects to different elevations of the care home building are shown below.

The predicted overall dBA values and linear frequency spectra inside rooms are shown in the table overleaf.

Internal Sound Level Predictions, dB(A)

Units 1 & 2 overlooking Barnsley Road

Date	Time	Bedroom			Living Room
		Day L _{eq}	Night L _{eq}	Night L _{max}	Daytime L _{eq}
04/08/2022	11:30	22.3			30.3
04/08/2022	11:45	23.3			30.6
04/08/2022	12:00	24.6			32.7
04/08/2022	12:15	23.4			30.7
04/08/2022	12:30	22.3			30.1
04/08/2022	12:45	22.0			29.6
04/08/2022	13:00	23.0			30.6
04/08/2022	13:15	22.8			30.4
04/08/2022	13:30	22.5			30.2
04/08/2022	13:45	24.0			31.7
04/08/2022	14:00	22.5			30.2
04/08/2022	14:15	24.1			31.7
04/08/2022	14:30	24.6			32.2
04/08/2022	14:45	23.0			30.8
04/08/2022	15:00	25.5			32.5
04/08/2022	15:15	23.7			31.4
04/08/2022	15:30	23.7			31.1
04/08/2022	15:45	25.0			32.1
04/08/2022	16:00	24.0			31.7
04/08/2022	16:15	29.6			37.3
04/08/2022	16:30	23.7			31.1
04/08/2022	16:45	24.5			31.7
04/08/2022	17:00	24.7			32.0
04/08/2022	17:15	24.1			31.4
04/08/2022	17:30	23.9			31.3
04/08/2022	17:45	23.3			31.0
04/08/2022	18:00	24.7			31.7
04/08/2022	18:15	24.8			33.1
04/08/2022	18:30	24.4			32.0
04/08/2022	18:45	24.2			31.2
04/08/2022	19:00	21.7			29.5
04/08/2022	19:15	23.0			30.2
04/08/2022	19:30	24.4			31.6
04/08/2022	19:45	28.7			37.0
04/08/2022	20:00	19.9			28.1
04/08/2022	20:15	19.0			27.1
04/08/2022	20:30	19.8			28.0

Date	Time	Bedroom			Living Room
		Day L _{eq}	Night L _{eq}	Night L _{max}	Daytime L _{eq}
04/08/2022	20:45	24.8			32.2
04/08/2022	21:00	22.6			29.8
04/08/2022	21:15	17.6			25.6
04/08/2022	21:30	22.2			29.1
04/08/2022	21:45	19.5			27.3
04/08/2022	22:00	17.3			25.5
04/08/2022	22:15	18.7			26.2
04/08/2022	22:30	20.9			27.8
04/08/2022	22:45	15.9			24.1
04/08/2022	23:00		16.1	40.4	
04/08/2022	23:15		15.0	37.0	
04/08/2022	23:30		15.4	41.0	
04/08/2022	23:45		18.3	45.4	
05/08/2022	00:00		15.5	40.8	
05/08/2022	00:15		11.6	34.5	
05/08/2022	00:30		14.6	40.3	
05/08/2022	00:45		13.7	40.5	
05/08/2022	01:00		12.8	37.9	
05/08/2022	01:15		14.2	41.8	
05/08/2022	01:30		12.6	40.2	
05/08/2022	01:45		15.6	41.5	
05/08/2022	02:00		12.6	39.1	
05/08/2022	02:15		13.7	41.3	
05/08/2022	02:30		8.8	33.1	
05/08/2022	02:45		10.9	35.6	
05/08/2022	03:00		14.3	41.0	
05/08/2022	03:15		11.0	37.0	
05/08/2022	03:30		9.7	36.4	
05/08/2022	03:45		11.6	35.5	
05/08/2022	04:00		15.0	41.5	
05/08/2022	04:15		10.5	34.3	
05/08/2022	04:30		12.7	36.1	
05/08/2022	04:45		12.7	37.1	
05/08/2022	05:00		16.6	40.7	
05/08/2022	05:15		17.2	42.2	
05/08/2022	05:30		18.4	44.5	
05/08/2022	05:45		19.3	44.0	
05/08/2022	06:00		20.9	43.3	
05/08/2022	06:15		20.3	41.7	
05/08/2022	06:30		23.3	45.2	
05/08/2022	06:45		23.5	44.6	
05/08/2022	07:00	24.2			32.2
05/08/2022	07:15	24.6			32.6

Date	Time	Bedroom			Living Room
		Day L _{eq}	Night L _{eq}	Night L _{max}	Daytime L _{eq}
05/08/2022	07:30	24.1			32.2
05/08/2022	07:45	23.3			31.2
05/08/2022	08:00	24.8			32.6
05/08/2022	08:15	23.7			31.7
05/08/2022	08:30	22.5			30.4
05/08/2022	08:45	24.1			31.7
05/08/2022	09:00	22.9			30.6
05/08/2022	09:15	22.9			30.3
05/08/2022	09:30	22.6			30.9
05/08/2022	09:45	23.5			31.4
05/08/2022	10:00	23.0			30.7
05/08/2022	10:15	24.5			32.2
05/08/2022	10:30	23.0			30.9
05/08/2022	10:45	27.0			33.8
05/08/2022	11:00	22.6			30.4
05/08/2022	11:15	23.8			31.6
05/08/2022	11:30				

		Bedroom			Living Room
Date	Time	Day Leq	Night Leq	Night L _{max}	Daytime Leq
09/08/2022	15:30	25.1			26.2
09/08/2022	15:45	24.2			25.1
09/08/2022	16:00	23.0			23.9
09/08/2022	16:15	24.9			25.8
09/08/2022	16:30	26.9			27.7
09/08/2022	16:45	24.1			25.0
09/08/2022	17:00	23.3			24.2
09/08/2022	17:15	23.3			24.1
09/08/2022	17:30	23.9			24.8
09/08/2022	17:45	24.0			25.0
09/08/2022	18:00	24.8			25.7
09/08/2022	18:15	23.0			23.8
09/08/2022	18:30	22.6			23.4
09/08/2022	18:45	22.1			22.9
09/08/2022	19:00	24.3			25.3
09/08/2022	19:15	22.3			23.2
09/08/2022	19:30	22.3			23.2
09/08/2022	19:45	22.3			23.2
09/08/2022	20:00	19.7			20.5
09/08/2022	20:15	20.5			21.3
09/08/2022	20:30	22.4			23.5
09/08/2022	20:45	18.9			19.6
09/08/2022	21:00	19.3			20.2
09/08/2022	21:15	19.5			20.5
09/08/2022	21:30	18.9			19.6
09/08/2022	21:45	18.3			19.2
09/08/2022	22:00	19.1			19.9
09/08/2022	22:15	19.9			20.7
09/08/2022	22:30	20.1			21.1
09/08/2022	22:45	19.9			20.9
09/08/2022	23:00		17.7	38.6	
09/08/2022	23:15		17.2	40.0	
09/08/2022	23:30		18.1	42.5	
09/08/2022	23:45		16.0	38.4	
10/08/2022	00:00		13.9	37.9	
10/08/2022	00:15		18.6	43.4	
10/08/2022	00:30		16.2	39.9	
10/08/2022	00:45		11.2	33.6	
10/08/2022	01:00		13.7	38.6	
10/08/2022	01:15		17.3	44.1	
10/08/2022	01:30		13.3	37.4	
10/08/2022	01:45		13.0	35.2	
10/08/2022	02:00		14.0	39.9	
10/08/2022	02:15		8.2	31.8	

		Bedroom			Living Room
Date	Time	Day Leq	Night Leq	Night L _{max}	Daytime Leq
10/08/2022	02:30		12.5	38.3	
10/08/2022	02:45		10.1	34.8	
10/08/2022	03:00		14.1	41.2	
10/08/2022	03:15		10.9	34.2	
10/08/2022	03:30		16.6	42.5	
10/08/2022	03:45		13.4	36.9	
10/08/2022	04:00		14.7	40.5	
10/08/2022	04:15		17.9	44.9	
10/08/2022	04:30		17.1	43.7	
10/08/2022	04:45		16.5	36.6	
10/08/2022	05:00		17.7	39.3	
10/08/2022	05:15		18.3	39.5	
10/08/2022	05:30		20.9	42.6	
10/08/2022	05:45		19.2	39.2	
10/08/2022	06:00		20.8	40.2	
10/08/2022	06:15		21.8	40.1	
10/08/2022	06:30		25.1	48.0	
10/08/2022	06:45		23.7	40.2	
10/08/2022	07:00	23.2			24.0
10/08/2022	07:15	24.9			25.7
10/08/2022	07:30	25.2			26.0
10/08/2022	07:45	24.8			25.6
10/08/2022	08:00	24.2			25.0
10/08/2022	08:15	24.2			25.0
10/08/2022	08:30	23.6			24.4
10/08/2022	08:45	20.9			21.7
10/08/2022	09:00	22.2			23.1

		Outdoor dBA				
Date	Time	<i>dB LA_{eq}</i>	<i>dB LA_{max}</i>	<i>dB LA_{min}</i>	<i>dB LA₁₀</i>	<i>dB LA₉₀</i>
10/08/2022	01:15	55.9	78.3	21.5	51.7	22.6
10/08/2022	01:30	56.0	77.6	22.3	55.8	25.7
10/08/2022	01:45	55.9	79.8	21.3	49.7	22.7
10/08/2022	02:00	51.2	74.0	21.2	47.8	22.2
10/08/2022	02:15	54.1	76.2	21.4	50.7	22.5
10/08/2022	02:30	53.1	77.5	21.2	46.2	22.3
10/08/2022	02:45	56.7	82.4	20.8	52.3	21.4
10/08/2022	03:00	53.9	76.7	21.1	51.5	22.2
10/08/2022	03:15	59.1	84.1	21.4	56.0	22.9
10/08/2022	03:30	56.7	80.1	22.9	54.7	25.5
10/08/2022	03:45	56.8	80.2	21.9	54.0	24.0
10/08/2022	04:00	60.4	86.2	22.6	59.3	26.7
10/08/2022	04:15	60.3	88.0	24.2	59.5	28.5
10/08/2022	04:30	59.7	78.4	22.9	61.8	28.1
10/08/2022	04:45	60.6	79.1	25.1	63.2	29.0
10/08/2022	05:00	60.9	80.0	29.2	64.1	36.5
10/08/2022	05:15	63.0	80.1	32.6	66.7	38.5
10/08/2022	05:30	62.1	77.7	33.0	66.4	39.6
10/08/2022	05:45	63.5	78.6	35.9	67.7	44.8
10/08/2022	06:00	64.8	81.3	36.1	68.8	46.8
10/08/2022	06:15	67.3	86.9	41.8	71.3	51.2
10/08/2022	06:30	66.3	78.8	37.3	70.4	49.9
10/08/2022	06:45	65.8	80.4	39.0	69.8	51.0
10/08/2022	07:00	67.6	86.2	37.9	71.3	57.7
10/08/2022	07:15	67.3	85.5	36.1	71.0	56.0
10/08/2022	07:30	66.9	90.6	46.8	69.1	58.9
10/08/2022	07:45	66.4	83.8	46.2	69.9	56.8
10/08/2022	08:00	66.4	84.2	36.6	70.1	53.2
10/08/2022	08:15	65.8	79.8	38.7	69.3	55.1
10/08/2022	08:30	63.2	84.3	44.2	66.5	52.7
10/08/2022	08:45	64.4	78.9	41.5	67.8	51.0
10/08/2022	09:00	65.0	80.5	41.3	69.1	49.6

