



Noise Survey of a Residential Development

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Executive summary

An environmental noise survey and noise impact assessment has been undertaken at the proposed residential development at the land of Thorncliffe Lane, Blackshaw Moor, Leek, Staffordshire, ST13 8TL to assess the suitability of the site. The measured ambient sound levels have allowed BS8233:2014, ProPG and CIEH noise assessments to be carried out.

The ProPG assessment shows that the site is considered 'Low Risk'. This indicates that if good acoustic design can be implemented then the amenity of the future occupants can be fully protected. Due to the number of residential properties located in similar proximity to the shooting range, it is thought that the acoustic environment of the area is appropriate for further residential development.

Specifications for the necessary sound reduction of the facades including ventilation and glazing have been included in section 4.0. These recommendations have been calculated using criteria that are considerably stricter than the criteria stated in BS8233:2014, and it is thought that this will ensure future residents are fully protected against any annoyance caused by the noise of gunshots whilst indoors.

The average external noise levels are within BS8233:2014 criteria, however, when the noise emissions from single gunshots are assessed in line with CIEH guidelines, the criterion is marginally exceeded. It is important to state that this exceedance is below the level at which the CIEH document states that annoyance is likely to occur and considering the frequency of shooting events, and the fact that the residents are aware of the noise emissions from the shooting centre, this impact is expected to be reduced even further.

An overview of the recommendations can be found below:

Recommendations and Mitigation Overview

- An octave band assessment has been completed and the specified glazing must adhere to the necessary SRI in all frequency bands.
- All bedrooms on all façades require a minimum sound reduction of **29.0** dB $R_w + c_{tr}$ and **33.0** dB R_w .
- All Living Rooms on all façades require a minimum sound reduction of **29.0** dB $R_w + c_{tr}$ and **29.0** dB R_w .
- Suitable models of double glazing and secondary glazing are included in section 4.0.
- All ventilation within the development requires a minimum sound reduction of **33.0** dB $D_{n,e,w}$ when open.
- Further mitigation measures can be found in the body of the report.

The findings of this report will require written approval from the Local Authority prior to work commencing.

1. Introduction

1.1 Overview

NOVA Acoustics Ltd has been commissioned to prepare a noise assessment for a residential development ('the Proposed Development') at the land of Thorncliffe Lane, Blackshaw Moor, Leek, Staffordshire, ST13 8TL ('the Site').

The Applicant has submitted a full planning application reference number SMD/2018/0775 ('the Application') to the Staffordshire Moorlands District Council.

Accordingly, the following technical noise assessment has been produced to accompany the Application to the Staffordshire Moorlands District Council.

This noise assessment is necessarily technical in nature; therefore, a glossary of terms is included in Appendix A to assist the reader.

1.2 Scope & Objectives

The scope of the noise assessment can be summarized as follows:

- Ambient sound monitoring survey to evaluate the prevailing sound levels incident on the Site;
- Detailed sound modelling, acoustic calculation and analysis in accordance with ISO9613 – 1 prediction methodology to predict sound levels incident on the Site;
- A detailed assessment of the suitability of the Site, in accordance with relevant standards in respect of sound from the surrounding noise sources; and
- Recommendation of mitigation measures, where necessary, to comply with the requirements of the National Planning Practice Guidance in England and Wales, BS8233:2014, World Health Organisation Guidelines and other relevant standards.

1.3 Legislation, Policy and Guidance

This report is to be primarily based on the following legislation, policy and guidance.

- National Planning Policy Framework (2018)
- Noise Policy Statement for England
- ProPG: Planning & Noise
- BS8233:2014 'Guidance on sound insulation and noise reduction for buildings'
- CIEH Clay Pidgeon Shooting Noise Control Guidance
- ISO 9613-2 Attenuation of sound during propagation outdoors
- BS EN 12354-4 Building Acoustics

1.4 Local Policy Guidance & Discussions with the Local Authority

The scope of the noise assessment has been agreed with Denis Colgan of the Staffordshire Moorlands District Council Environmental Health Department. He has requested that alongside the ProPG and BS8233:2014 assessments an assessment is also carried out considering elements of CIEH 'Clay Pidgeon Shooting' guidance although this guidance is not strictly applicable. This involves measuring

the noise levels of specific gunshots and predicting the potential annoyance caused both inside the residences, and in the external amenity areas.

2. Site Description & Background Information

2.1 Site & Surroundings

The Proposed Development is located on land adjacent to Thorncliffe Road. The site was previously the location of Anzio Camp 3, an army barracks operational in World War 2. The area is primarily rural farmland with some residential dwellings. The acoustic environment surrounding the site is low. Approximately 230m to the north of the site is 'Leek Shooting Centre' which is the primary noise concern in the immediate area. To the east of the site is Thorncliffe Road, which facilitates low levels of traffic flow and approximately 570m to the west of the site is the A53. To the east of the Site is Anzio Camp 1, which received approved planning permission for residential holiday and higher care housing.

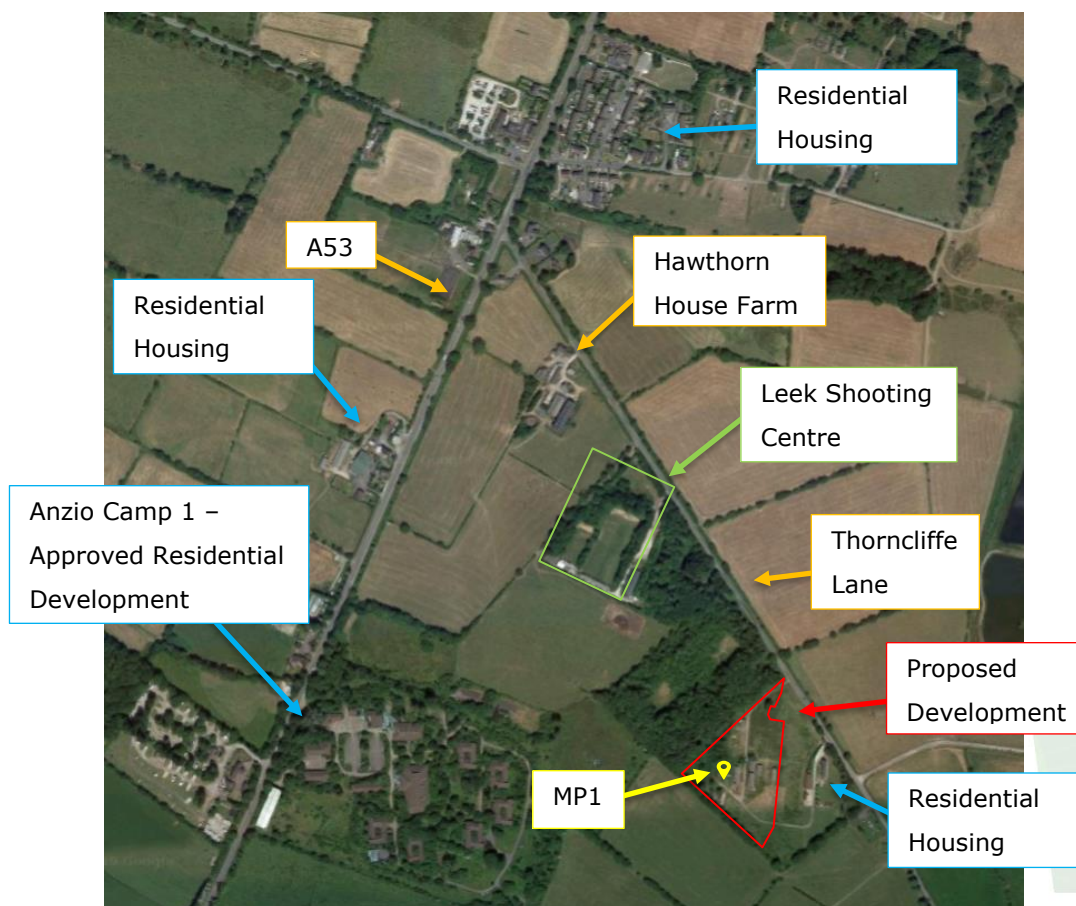


Figure 1.0 – Site and Surroundings

2.2 Background

The site is to be used for a cohousing development comprising of 5 new low impact dwellings, the conversion and extension of existing buildings to provide further 2 low impact dwellings and cohousing facilities, shared car parking area and associated landscaping. Multiple comments have been made against the planning application, a large portion of which relate to Leek Shooting Centre.

The primary noise concern relates to protecting the Shooting Centre against noise complaints arising from the future occupants of the Proposed Development.

It is shown on Leek Shooting Centre's calendar that they host approximately one event per month, and though it is thought that shooting sessions occur frequently, it is not thought that they will be as intensive as the planned events.

Location and site plans are included in Appendices C and D respectively.



3. Environmental Noise Survey

In order to characterise the sound profile of the area of the proposed development, a long-term 71-hour environmental sound survey was carried out from the 8th March 2019 to 11th March 2019 during a planned shooting event.

3.1 Measurement Methodology

For the long-term sound monitoring, the sound level meter was placed at ground floor level, approximately 1.7m from the floor and at least 3m from any other reflective surface. The monitoring position was chosen in order to collect representative sound levels of the area during the week and weekend day time and night time periods. The measurement position can be found in Figure 1.0.

3.2 Measurement Equipment

Piece of Equipment	Serial No	Calibration Deviation
CESVA SC420 Class 1 Sound level meter	T246458	≤0.5
CESVA CB006 Class 1 Calibrator	901927	

Table 1.0 – Measurement Equipment

All equipment used during the survey was field calibrated at the start and end of the measurement period with a negligible deviation of ≤0.5 dB. All sound level meters are calibrated every 24 months and all calibrators are calibrated every 12 months, by a third-party calibration laboratory. All microphones were fitted with a protective windshield for the entire measurements period. Calibration certificates can be provided upon request.

3.3 Weather Summary

As the environmental noise survey was carried out over a long un-manned 71-hour period no records of weather conditions were taken, however, during the setup and collection of the monitoring equipment, the weather was calm with wind speeds of less than 5m/s and no precipitation. All measurements have been compared with met office weather data of the area and periods of elevated weather conditions have been excluded from the subsequent calculations. The weather conditions were suitable for the measurement of environmental noise in accordance with BS7445 Description and Measurement of Environmental Noise.

3.4 Results

3.4.1 Summary Results

The following table shows a summary of the sound survey results; L_{Aeq} , L_{Amax} , L_{A90} and the L_{A10} for the measurement period.

Measurement Position MP1				
Measurement Time Period ('t')	L _{Aeq,t}	L _{Amax,t}	L _{A90,t}	L _{A10,t}
Day 1 - 08/03/19 - 10:20 - 23:00	44.0	74.0	41.0	46.0
Night 1 - 08/03/19 - 23:00 - 07:00	44.0	76.0	33.0	46.0
Day 2 - 09/03/19 - 07:00 - 23:00	53.0	87.0	38.0	57.0
Night 2 - 09/03/19 - 23:00 - 07:00	45.0	75.0	30.0	50.0
Day 3 - 10/03/19 - 07:00 - 23:00	53.0	93.0	41.0	57.0
Night 3 - 10/03/19 - 23:00 - 07:00	48.0	78.0	43.0	52.0
Day 4 - 11/03/19 - 07:00 - 09:55	50.0	89.0	47.0	53.0

Table 2.0 – Sound Survey Results Summary

The following table shows a summary of the maximum sound level results during the measurement period.

Measurement Position MP1			
Measurement Period ('t')	L _{AFMax,01,15min}	Statistically most Repeated L _{AFMax,01,15min}	No. of exceedances of 77 dB L _{AFMax,01,15min}
Night 1 - 08/03/19 - 23:00 - 07:00	76.0	76.0	0
Night 2 - 09/03/19 - 23:00 - 07:00	75.0	75.0	0
Night 3 - 10/03/19 - 23:00 - 07:00	78.0	76.0	4

Table 3.0 – Maximum Sound Level Summary Results

The following tables show the maximum octave band 15-minute results for the day time and night time periods.

Frequency Analysis	Z-weighted Octave Band Sound Pressure Level, Hz (dB)						
	63	125	250	500	1K	2K	4K
Highest L _{eq,15mins} During the Night	63.0	58.0	55.0	51.0	48.0	44.0	52.0

Table 4.0 – Octave Band Noise Levels – Night Time

Frequency Analysis	Z-weighted Octave Band Sound Pressure Level, Hz (dB)						
	63	125	250	500	1K	2K	4K
Highest L _{eq,15mins} During the Day	73.0	68.0	61.0	62.0	62.0	56.0	55.0

Table 5.0 – Octave Band Noise Levels – Day Time

The following table shows noise levels recorded for individual gunshots taken on the 10th of March 2019. The sound level meter used to undertake the measurements were also equip with an audio

recording function. Thus the gunshots have been identified from the audio recordings and the resulting sound levels measured during the gunshots are presented below.

Measurement Position MP1		
Measurement Time Period ('t')	L _{Aeq,t}	L _{Amax,t}
10:52:42	62.0	68.0
10:52:49	57.0	61.0
10:54:18	62.0	69.0
11:04:55	64.0	73.0
11:38:40	63.0	68.0
11:40:20	60.0	66.0
11:57:04	58.0	63.0
12:40:43	74.0	79.0
12:42:30	62.0	68.0
13:11:11	64.0	71.0
13:12:45	63.0	68.0
13:15:08	63.0	70.0
13:48:03	62.0	69.0
14:32:08	63.0	68.0
14:32:12	62.0	68.0
14:34:20	58.0	65.0
14:48:07	61.0	67.0
15:09:36	64.0	70.0
15:24:55	59.0	64.0
Shooting Noise Level (SNL)	64.0	70.0

Table 6.0 – Measured Gun Shots

3.5 Subjective impression & Context

Whilst on site it was found that the acoustic environment of the area was of a low level, typical of this type of rural location. The noise emissions from gunshots were clearly audible on site, and the dominant source of noise during a typical day would be the occasional pass-by of a vehicle on Thorncliffe Road.

4. Noise Assessment

4.1 ProPG Stage 1 Initial Noise Risk Assessment

Considering the noise levels measured across the entire measurement period, the development site falls into Noise Risk Category (NRC) 1. As shown in the following table.

Noise Risk Category	Potential Effect if unmitigated	Pre-Planning Application Guidance
1 - Low $L_{Aeq, 16hour} < 50 - 60dB$ $L_{Aeq, 8hour} < 40 - 50dB$	Adverse effect on health and quality of life	At low noise levels, the site is likely to be acceptable from a noise perspective provided that a good acoustic design process is followed and is demonstrated in an ADS which confirms how the adverse impacts of noise will be mitigated and the minimized in the finished development.

Table 7.0 – Noise Risk Category for Site

Discussion

As can be seen in the table above, the Proposed Development falls into noise risk category (NRC) 1. This is a positive indication that average day time and night time noise levels will not adversely impact on the amenity of future occupants.

4.2 BS8233:2014 Noise Assessment

The following section analyses the ambient sound levels incident on the development compared with the internal noise level criteria presented within BS8233:2014. To ensure a robust analysis, and to protect the amenity of future occupants from the effects of the shooting centre, a more stringent set of criteria than that which are stated in BS8233:2014 have been used.

4.2.1 LA_{max} Assessment Criteria

BS8233:2014 does not provide any criteria for internal maximum noise levels during the daytime, the standard does, however, provide internal maximum noise levels during the night time of 45dB L_{AFMax} , with further consideration being taken for the frequency of maximum events. This criterion is implemented to minimise sleep disturbance and provide an adequate environment for sleep and rest for a typical person. Therefore, it is not deemed to be appropriate to apply this objective criterion to day time maximum noise events. It is however noted that there are no specific objective criteria that we are aware of, to assess the suitability of maximum internal noise events during the day. Therefore, any decision would have to be solely based on the subjective impression of the effect level. We, therefore, present the following objective criteria considering the internal sound levels presented in BS8233:2014. The night-time maximum noise level criteria is 45dB $L_{AFMax, 8hour}$ and the average noise level criteria is 35 dB $L_{Aeq, 16hour}$ during the day, and 30dB $L_{Aeq, 8hour}$ at night. If the difference between average noise criteria is applied to the maximum noise criteria the resultant maximum would be 50 dB $L_{AFMax, DAY}$. This would provide an internal noise criteria of 50 dB $L_{AFMax, DAY}$, dependent on the frequency of events.

4.2.1 Internal Noise Level Assessment

The following analysis has been completed using the following criteria.

- The highest of either the $L_{Aeq,15mins}$ during the day or the average gunshot noise level (SNL)
- The highest $L_{Aeq,15mins}$ during the night
- The $L_{AFmax,15min}$ during the night
- The highest $L_{eq,15mins}$ octave band noise levels during the day and night
- The maximum recorded noise level from gunshots during the day

The following table analyses the required composite SRI required of the dwelling to achieve appropriate internal noise levels.

Measurement position	Location	Time Period	Façade Noise Level	BS8233 Criteria	Min. SRI Required (dB)
MP1	Bedroom / Living Room	Day time	64.0 $L_{Aeq,Gunshot(SNL)}$	35 dB $L_{Aeq,16hour}$	29.0 $R_w + C_{tr}$
			79.0 $L_{Amax,Gunshot}$	50 dB $L_{Amax,Day}$	29.0 R_w^{**}
	Bedroom	Night time	54.0 $L_{Aeq,15mins}$	30 dB $L_{Aeq,8hour}$	24.0 $R_w + C_{tr}$
			78.0 $L_{Amax,8hour}$	45 dB $L_{Amax,8hour}$	33.0 R_w^{**}

Table 8.0 – BS8233 Internal Noise Level Analysis

The following table analyses the required composite octave band SRI required of the dwelling to achieve appropriate internal noise levels during the night time period.

Frequency Analysis	Z-weighted Octave Band Sound Pressure Level, Hz (dB)						
	63	125	250	500	1K	2K	4K
Highest $L_{eq,15mins}$ During the Night	63.0	58.0	55.0	51.0	48.0	44.0	52.0
NR25 Curve (dB)	55.2	43.7	35.2	29.2	25.0	21.9	19.5
Required Octave Band SRI (R_w)	8.0	14.0	20.0	22.0	23.0	23.0	33.0

Table 9.0 – Octave Band Internal Noise Level Analysis – Night Time

Frequency Analysis	Z-weighted Octave Band Sound Pressure Level, Hz (dB)						
	63	125	250	500	1K	2K	4K
Highest $L_{eq,15mins}$ During the Day	73.0	68.0	61.0	62.0	62.0	56.0	55.0
NR30 Curve (dB)	59.2	48.1	39.9	34.0	30.0	26.9	24.7
Required Octave Band SRI (R_w)	14.0	20.0	21.0	28.0	32.0	30.0	31.0

Table 10.0 – Octave Band Internal Noise Level Analysis – Day Time

4.3 CIEH Guideline External Noise Level Assessment

In paragraph 6.1 of the CIEH Clay Pidgeon Shooting Guidance it is stated,

'... there is no fixed shooting noise level at which annoyance starts to occur. Annoyance is less likely to occur at a mean shooting noise level (mean SNL) below 55 dB(A), and highly likely to occur at a mean shooting noise level (mean SNL) above 65dB(A).'

As the Proposed Development is to be located near to a shooting range, and the future residents are aware of this, it is anticipated that the tolerance of gunshot noise before it causes annoyance will be higher than if the situation was reversed. For this reason, it is recommended that the average noise level from specific gunshots (SNL) does not exceed 60 dBA in the external amenity areas.

The sound map below shows the predicted noise level from a single gunshot. The sound levels have been calculated using SoundPlan 8.0, which undertakes its calculations in accordance with the guidance given in ISO9613 – 1:1993 and ISO9613 – 2:1996.

The following assumptions have been made within the calculation software:

- To accurately model the land surrounding the development the topographical data has been taken from Google Maps, it is assumed this has an accuracy within the last 3 years.
- The ground between the source and receiver is considered 'soft'.
- The SNL calculated above has been used to calibrate the sound map.

The sound map showing the specific sound level emissions incident on the Proposed Development due to gunshots can be seen below in Figure 2.0.

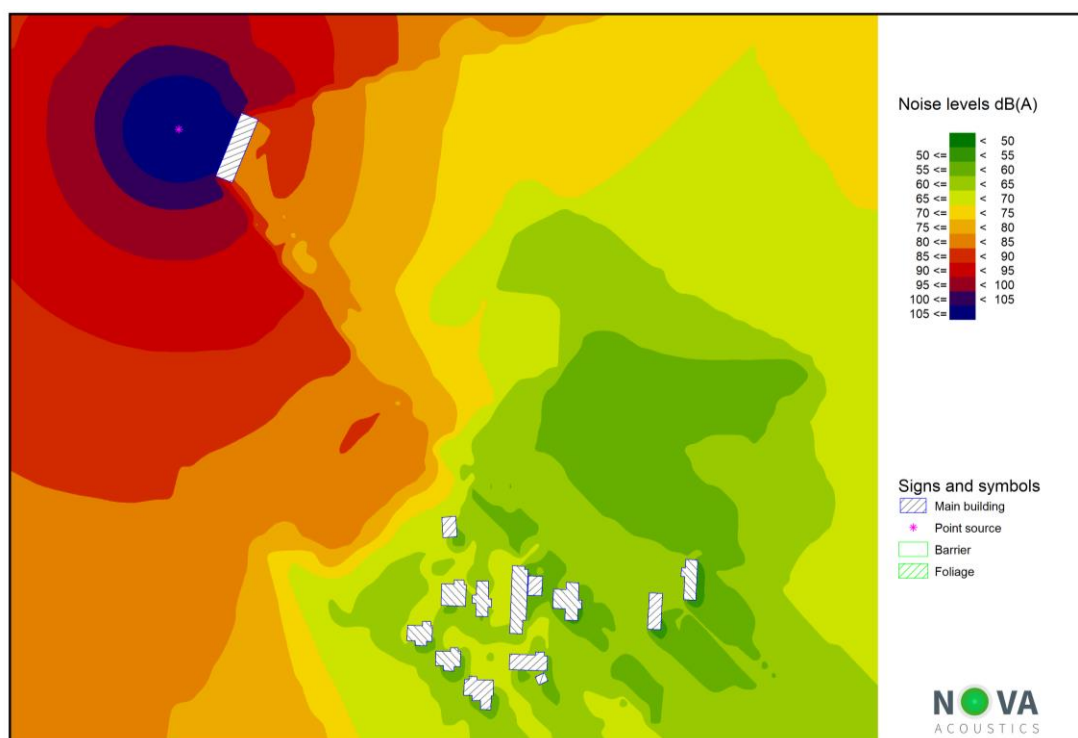


Figure 2.0 – Sound Level Map – Predicted Gun Shot noise

The table below shows the noise levels in the garden areas to the rear of the residential plots due to a single gunshot.

Location	Time Period	Garden Noise Level (dB)	Proposed CIEH Criteria	Min. Attenuation Required (dB)
Rear Gardens of Plots 1 - 7	Day time	58.0 – 62.0	60 dB $L_{Aeq, Gunshot(SNL)}$	0.0 – 2.0

Table 11.0 – CIEH Guideline External Noise Level Analysis

Discussion

As can be seen in the assessment above the noise levels in the rear garden areas of plots 1-7 fall a maximum of 2 dB above and a minimum of 2 dB below the criteria.

Multiple earth bunding and fencing scenarios were modelled in order to try and reduce the external noise levels. However, due to the topography of the land, an earth bund at the north-western perimeter of the site, or fences around the garden areas, would be ineffective in reducing the specific sound level of the gunshots. This is because there is currently no clear line of sight between the shooting centre and the Proposed Development, and the land to the north-west of the site is already raised significantly effectively creating a natural earth bund. For an earth bund to be effective it would have to be raised above this section of land which is not feasible. However, it is important to note that the exceedance is only marginally above the criteria and is below the level at which the CIEH document states that annoyance is likely to occur. Considering the frequency of shooting events, and the fact that the residents are aware of the noise emissions from the shooting centre which leads to a higher tolerance, this impact is expected to be reduced even further. Thus, the site is deemed suitable for residential development.

4.3.1 BS8233:2014 External Noise Level Assessment

The following table analyses the expected external noise levels within the external amenity areas of the Proposed Development, such as the gardens. The noise level is taken from the highest day time $L_{Aeq, 16hr}$ during the measurement period.

Measurement position	Location	Time Period	Garden Noise Level	BS8233 Criteria	Min. Attenuation Required (dB)
MP1	Garden	Day time	53 dB	50 - 55 dB $L_{Aeq, 16hour}$	0.0 dB

Table 12.0 – BS8233 External Noise Level Analysis

Discussion

As can be seen in the assessment above, the average noise levels in the external amenity areas are predicted to be within BS8233:2014 guideline levels.

4.3.2 Recommendations & Mitigation

Building Envelope

The noise levels within the proposed dwellings will be dictated by the configuration, materials and elements of the façade. The non-glazed elements of the facade will contribute significantly to the

reduction of ambient noise levels in combination with a superior quality appropriate acoustic glazing specification.

a) Facades

The prediction of the performance of the facade is based upon a construction of 200mm brick and is calculated within INSUL software, the expected performance is shown in the following table.

Frequency (Hz)	63	125	250	500	1K	2K	4K	R _w
Façade SRI	41	44	42	47	55	63	68	53

Table 13.0 – Façade SRI

Any other configuration of external walls that would achieve at least these insulation figures will be suitable for the development.

b) Roofs

If the dwelling has rooms within the roof space the roof system will require additional sound insulation to achieve appropriate internal noise levels. If the roof, is being utilized as a voided loft space with thermal insulation the following detailing is not required. The ceilings in the roof space should consist of 100mm 45kg/m³ fitted tightly between the 200mm roof joists and 2no. 15mm SoundBloc plasterboard fixed to resilient bars to achieve a uniform sound reduction. The expected performance as predicted within INSUL software is shown in the following table.

Frequency (Hz)	63	125	250	500	1K	2K	4K	R _w
Roof SRI	33	45	52	57	60	57	61	58

Table 14.0 – Roof SRI

Any other configuration of roof that would achieve at least these insulation figures will be suitable for the development.

c) Glazing

Windows can be considered the weakest point of a façade in terms of noise reduction from external noise. To provide a robust assessment the composite SRI required for the entire building envelope will be used to provide the glazing specification.

Glazed elements installed in all the living rooms and bedrooms require a minimum sound reduction index value as shown in Table 8.0. The glazing units shown in the following table would provide a suitable sound reduction, any other window capable of providing this attenuation will be suitable. The performance is specified for the whole window unit, including frame and other design features.

Location	Glazing Configuration	Attenuation (dB)
All Rooms	<i>Double Glazing</i>	33 R _w **
	8 mm Glass / (6 - 16 mm Air Cavity) / 4 mm Glass	29 R _w + C _{tr}

Table 15.0 – Glazing SRI

The glazing system above will protect the amenity of the occupants of the dwellings against the extraneous noise. The glazing specifications have been taken from the BS6262 – 2 and Pilkington's Optiphon range however any glazing providing the same attenuation can be used.

d) Ventilation

BS8233 States;

"If relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level."

and

"The Building Regulations' supporting documents on ventilation [48, 49, 50] 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. Alternatively, acoustic ventilation units are available for insertion in external walls. These can provide sound reduction comparable with double glazed windows. However, ducted systems with intakes on the quiet side of the building might be required in very noisy situations, or where appearance rules out through-the-wall fans."

It is recommended that an alternative ventilation system is installed to fully protect the amenity of future inhabitants. As stated in BS8233:2014 section 5.4.4, having complete enclosure of the noise source or receiver is the most effective barrier of sound. An alternative ventilation strategy allows for maximum sound insulation from the noise source whilst still maintaining a sufficient level of ventilation. It is recommended that the alternative ventilation should provide the same resistance to sound as the glazed elements. The following table provides ventilation systems that meets the above recommendations.

Model	Attenuation (dB)
Titon Sonair F+	55dB $D_{n,e,w}$
Simon Acoustic Trickle Ventilation	38dB Open / 41dB Closed $D_{n,e,w}$

Table 16.0 – Ventilation Specification

If the above ventilation systems are not deemed suitable for the development then a mechanical heat-recovery ventilation (MHRV) system should be employed. It should be noted that if a MHRV system is used, the self-generating noise from the system will need to conform to the internal noise levels outlined in BS8233:2014.

Appendix A – Acoustic Terminology

Sound Pressure	Sound, or sound pressure, is a fluctuation in air pressure over the static ambient pressure.
Sound Pressure Level (Sound Level)	The sound level is the sound pressure relative to a standard reference pressure of 20µPa (20x10 ⁻⁶ Pascals) on a decibel scale.
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s_1 and s_2 is given by $20 \log_{10} (s_1 / s_2)$. The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20µPa.
A-weighting, dB(A)	The unit of sound level, weighted according to the A-scale, which takes into account the increased sensitivity of the human ear at some frequencies.
Noise Level Indices	Noise levels usually fluctuate over time, so it is often necessary to consider an average or statistical noise level. This can be done in several ways, so a number of different noise indices have been defined, according to how the averaging or statistics are carried out.
$L_{eq,T}$	A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
$L_{max,T}$	A noise level index defined as the maximum noise level during the period T. L_{max} is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
$L_{90,T}$	A noise level index. The noise level exceeded for 90% of the time over the period T. L_{90} can be considered to be the "average minimum" noise level and is often used to describe the background noise.
$L_{10,T}$	A noise level index. The noise level exceeded for 10% of the time over the period T. L_{10} can be considered to be the "average maximum" noise level. Generally used to describe road traffic noise.
Free-Field	Far from the presence of sound reflecting objects (except the ground), usually taken to mean at least 3.5m
Facade	At a distance of 1m in front of a large sound reflecting object such as a building façade.
Fast Time Weighting	An averaging time used in sound level meters. Defined in BS 5969.

A

In order to assist the understanding of acoustic terminology and the relative change in noise, the following background information is provided. The human ear can detect a very wide range of pressure fluctuations, which are perceived as sound. In order to express these fluctuations in a manageable way, a logarithmic scale called the decibel, or dB scale is used. The decibel scale typically ranges from 0 dB (the threshold of hearing) to over 120 dB. An indication of the range of sound levels commonly found in the environment is given in the following table.

Sound Level	Location
0dB(A)	Threshold of hearing
20 to 30dB(A)	Quiet bedroom at night
30 to 40dB(A)	Living room during the day
40 to 50dB(A)	Typical office
50 to 60dB(A)	Inside a car
60 to 70dB(A)	Typical high street
70 to 90dB(A)	Inside factory
100 to 110dB(A)	Burglar alarm at 1m away
110 to 130dB(A)	Jet aircraft on take off
140dB(A)	Threshold of Pain

The ear is less sensitive to some frequencies than to others. The A-weighting scale is used to approximate the frequency response of the ear. Levels weighted using this scale are commonly identified by the notation dB(A).

In accordance with logarithmic addition, combining two sources with equal noise levels would result in an increase of 3 dB(A) in the noise level from a single source. A change of 3 dB(A) is generally regarded as the smallest change in broadband continuous noise which the human ear can detect (although in certain controlled circumstances a change of 1 dB(A) is just perceptible). Therefore, a 2 dB(A) increase would not be normally be perceptible. A 10 dB(A) increase in noise represents a subjective doubling of loudness.

A noise impact on a community is deemed to occur when a new noise is introduced that is out of character with the area, or when a significant increase above the pre-existing ambient noise level occurs.

For levels of noise that vary with time, it is necessary to employ a statistical index that allows for this variation. These statistical indices are expressed as the sound level that is exceeded for a percentage of the time period of interest. In the UK, traffic noise is measured as the L_{A10} , the noise level exceeded for 10% of the measurement period. The L_{A90} is the level exceeded for 90% of the

time and has been adopted to represent the background noise level in the absence of discrete events. An alternative way of assessing the time varying noise levels is to use the equivalent continuous sound level, L_{Aeq} .

This is a notional steady level that would, over a given period of time, deliver the same sound energy as the actual fluctuating sound. To put these quantities into context, where a receiver is predominantly affected by continuous flows of road traffic, a doubling or halving of the flows would result in a just perceptible change of 3 dB, while an increase of more than 25%, or a decrease of more than 20%, in traffic flows represent changes of 1 dB in traffic noise levels (assuming no alteration in the mix of traffic or flow speeds).

Note that the time constant and the period of the noise measurement should be specified. For example, BS4142:2014 specifies background noise measurement periods of 1 hour during the day and 15 minutes during the night. The noise levels are commonly symbolised as $L_{A90,1\text{hour}}$ dB and $L_{A90,15\text{mins}}$ dB. The noise measurement should be recorded using a 'FAST' time response equivalent to 0.125ms.



Appendix B – Legislation, Policy and Guidance

This report is to be primarily based on the following legislation, policy and guidance.

National Planning Policy Framework (2018)

Government policy on noise is set out in the National Planning Policy Framework (NPPF), published in 2018. This replaced all earlier guidance on noise and places an emphasis on sustainability. In section 15, Conserving and enhancing the natural and local environment, paragraph 170e, it states:

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. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans;

Paragraph 180 states:

Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

- a) Mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;*
- b) Identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and*
- c) Limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation.*

Noise Policy Statement for England

Paragraph 123 of the NPPF also refers to advice on adverse effects of noise given in the Noise Policy Statement for England (NPSE). This document sets out a policy 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.

To achieve this vision the Statement identifies the following three aims:

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;*
- Where possible, contribute to the improvement of health and quality of life.*

In achieving these aims the document introduces significance criteria as follows:

SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur. It is stated that “significant adverse effects on health and quality of life should be avoided while also considering the guiding principles of sustainable development”.

LOAEL – Lowest Observed Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected. It is stated that the second aim above lies somewhere between LOAEL and SOAEL and requires that: “all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also considering the guiding principles of sustainable development. This does not mean that such adverse effects cannot occur.”

NOEL – No Observed Effect Level

This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise. This can be related to the third aim above, which seeks: “where possible, positively to improve health and quality of life through the pro-active management of noise while also considering the guiding principles of sustainable development, recognising that there will be opportunities for such measures to be taken and that they will deliver potential benefits to society. The protection of quiet places and quiet times as well as the enhancement of the acoustic environment will assist with delivering this aim.”

The NPSE recognises that it is not possible to have a single objective noise-based measure that is mandatory and applicable to all sources of noise in all situations and provides no guidance as to how these criteria should be interpreted. It is clear, however, that there is no requirement to achieve noise levels where there are no observable adverse impacts but that reasonable and practicable steps to reduce adverse noise impacts should be taken in the context of sustainable development and ensure a balance between noise sensitive and the need for noise generating developments.

Any scheme of noise mitigation outlined in this report will, therefore, aim to abide by the above principles of the NPPF and NPSE whilst recognizing the constraints of the site.

ProPG: Planning & Noise

The Professional Practice Guidance on Planning and Noise (ProPG) has been produced to provide practitioners with guidance on the management of noise within the planning system in England.

Noise can have a significant effect on the environment and on the quality of life enjoyed by individuals and communities. For these reasons, noise is a material consideration in the planning process and a key aspect of sustainable development. Noise must therefore be considered and given serious attention when new developments might create additional noise and when new developments would be sensitive to the prevailing acoustic conditions.

It aims to:

- Advocate full consideration of the acoustic environment from the earliest possible stage of the development control process;
- Encourage the process of good acoustic design in and around new residential developments;

- Outline what should be taken into account in deciding planning applications for new noise-sensitive developments.
- Promote appropriate noise exposure standards; and
- Assist the delivery of sustainable development.

This document describes an acoustic design process which is multi-faceted and that seeks to deliver the best acoustic outcome for a particular site. The advice and procedures contained in the ProPG are restricted to the consideration of new residential development that will be exposed predominantly to airborne noise from existing transport sources. New housing is the most common type of new residential development, however the ProPG can also be applied to other types of residential developments such as residential institutions, care homes etc.

The document a Stage 1 Initial Site Risk Assessment, as follows:

Noise Risk Category	Potential Effect if unmitigated	Pre-Planning Application Guidance
0 – Negligible $L_{Aeq, 16hour} < 50dB$ $L_{Aeq, 8hour} < 40dB$	No adverse effect	These noise levels indicate that the development site is likely to be acceptable from a noise perspective, and the application need not normally be delayed on noise grounds.
1 - Low $L_{Aeq, 16hour} < 50 - 60dB$ $L_{Aeq, 8hour} < 40 - 50dB$	Adverse effect on health and quality of life	At low noise levels, the site is likely to be acceptable from a noise perspective provided that a good acoustic design process is followed and is demonstrated in an ADS which confirms how the adverse impacts of noise will be mitigated and the minimized in the finished development.
2 - Medium $L_{Aeq, 16hour} < 60 - 70dB$ $L_{Aeq, 8hour} < 50 - 60dB$	Significant adverse effect on health and quality of life	As noise levels increase, the site is likely to be less suitable from a noise perspective and any subsequent application may be refused unless good acoustic design process is followed and is demonstrated in an ADS which confirms how the adverse impacts of noise will be mitigated and minimize, and which clearly demonstrated that a significant adverse noise impact will be avoided in the finished development.
3 - High $L_{Aeq, 16hour} > 70dB$ $L_{Aeq, 8hour} > 60dB$	Unacceptable adverse effect on health and quality of life	High noise levels indicate that there is an increased risk that development may be refused on noise grounds. The risk may be reduced by following a good acoustic design process that is demonstrated in a detailed ADS. Applicants are strongly advised to seek expert advice.

Table 17.0 – ProPG Stage 1 Initial Risk Assessment Criteria

The British Standard BS 8233: 2014, Guidance on Sound insulation and noise reduction for buildings provides additional guidance on noise levels from sources without specific character in the built environment, based on the recommendations of the World Health Organization; specifically, WHO Guidelines on Community Noise, 1999. The criteria desirable levels of steady state, “anonymous” noise in unoccupied spaces within dwellings, from sources such as road traffic, mechanical services and other continuously running plant, are tabulated below:

Activity	Location	07:00 – 23:00	23:00 – 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 $L_{Aeq,8hour}$

Table 18.0 - BS8233 criteria for internal noise levels in dwellings

It is noted, however that where development is considered necessary or desirable, despite external noise level above WHO guidelines, the above target levels may be relaxed by up to 5 dB.

The standard also recommends that for traditional external amenity areas, such as gardens, it is desirable that external noise levels do not exceed 50 dB $L_{Aeq,T}$, and that 55 dB $L_{Aeq,T}$ would be acceptable in noisier environments. However, it is recognised that these values may not be achievable in all areas where development is desirable and in such locations, development should be designed to achieve the lowest practicable levels.

General recommendations for mitigation to enable these targets to be achieved are provided, including the use of bunds and barriers to reduce external noise and space planning and sound insulation for the control of internal noise levels.

For this assessment, the above criteria are considered to be the LOAEL as defined in the NPSE above.

ISO 9613-2 Attenuation of sound during propagation outdoors

The ISO 1996 series of standards specifies methods for the description of noise outdoors in community environments. Part 2 of ISO 9613 is intended to enable noise levels in the community to be predicted from sources of known sound emission. The method is general in the sense that it may be applied to a wide variety of noise sources, and cover most of the major mechanisms of attenuation.

This standard provides guidance on the outdoor propagation of sound. It is widely used to establish the different attenuations that occur during the transmission of the sound from the sources to the receivers. The total attenuation is the sum of the following: geometrical divergence, atmospheric absorption, ground effect, barriers, and miscellaneous other effects.

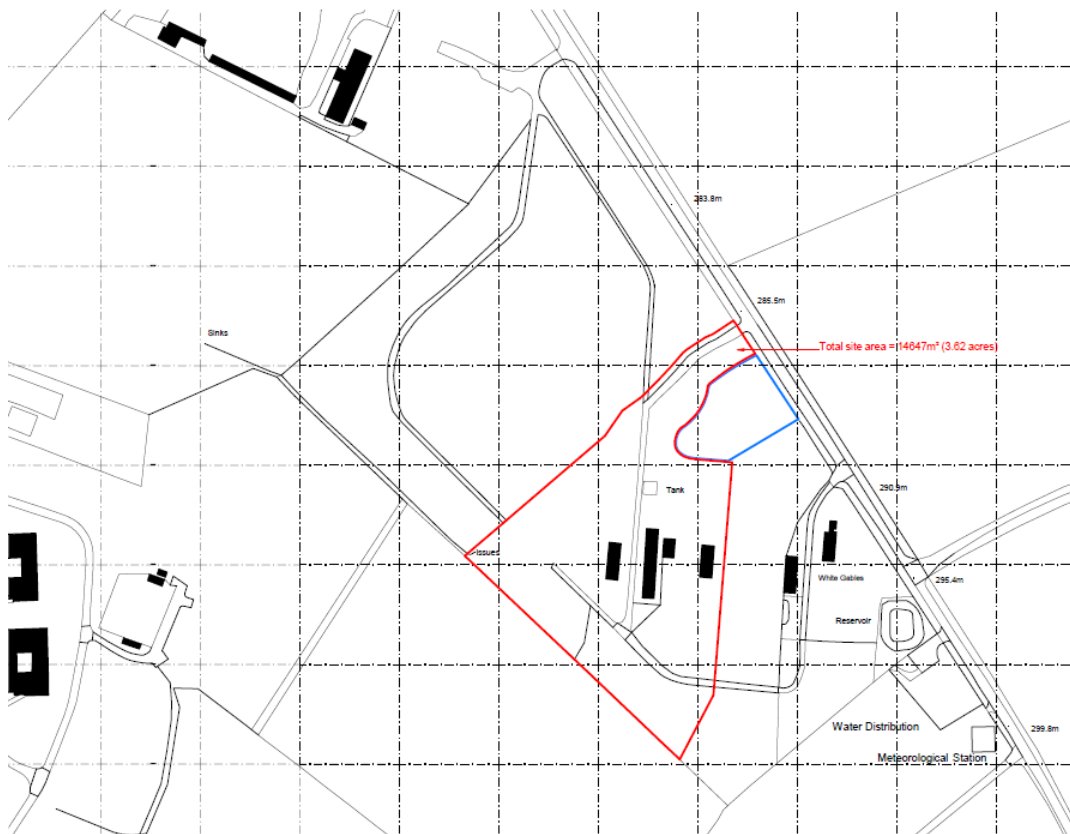
BS EN 12354-4 Building Acoustics

Estimation of acoustic performance of buildings from the performance of elements – Transmission of indoor sound to the outside

This European Standard describes a calculation model for the sound power level radiated by the envelope of a building due to airborne sound inside that building, primarily by means of measured sound pressure levels inside the building and measured data which characterize the sound transmission by the relevant elements and openings in the building envelope. These sound power levels, together with those of other sound sources in or in front of the building envelope, form the basis for the calculation of the sound pressure level at a chosen distance from a building as a measure for the acoustic performance of buildings.



Appendix C - Location Plan



Appendix D – Site Plans



Appendix E – Environmental Sound Survey