auricl
acoustic consulting

Haven Banks
Exeter

Noise Assessment Report

18 July 2022

For

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Contents

SUMMARY

A new development is proposed on land adjacent to Haven Road in Exeter, involving predominantly residential units and several café/retail units

auricl has undertaken an environmental noise survey to assess noise levels affecting the site and its surroundings.

Based on the noise survey results, calculations have been undertaken to determine the acoustic requirements of the new façades, so as to achieve internal noise levels within the residential properties that are commensurate with the standards.

Our calculations indicate that the internal noise standards should be achievable using suitable glazing and ventilation configurations throughout the development and preliminary recommendations have been made.

In addition, external noise levels affecting future occupants have been assessed in relation to the Association of Noise Consultants (ANC) guidance document "*Acoustics, Ventilation and Overheating Residential Design Guide*".

The assessment concluded that some site boundaries façades are in the medium noise risk category during both daytime and night-time periods, and as such some behavioural changes may occur in the completed apartments when windows are opened.

The south-western site boundary was found to be in the high noise risk category during the night-time and as such open windows may not be acoustically acceptable means of mitigating overheating during night-time periods for residential façades at this boundary.

For other façades, noise levels are within the low noise risk categories during the daytime and night-time periods. According to the guidance, for these façades *"use of opening windows as a primary means of mitigating overheating is not likely to result in adverse effect"*.

Limits for building services noise associated with the development have been proposed, based on the measured background noise levels and BS 4142. Preliminary noise and vibration control measures that would be expected to be implemented have been discussed.

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1.0 Introduction

A new development is proposed on land adjacent to Haven Road in Exeter, involving predominantly residential units and several café/retail units.

auricl has undertaken an environmental noise survey to assess noise levels affecting the site and its surroundings.

The following report presents the methodology and results of the environmental noise survey carried out at the site, and preliminary assessments of the findings in relation to external noise intrusion and building services noise emissions.

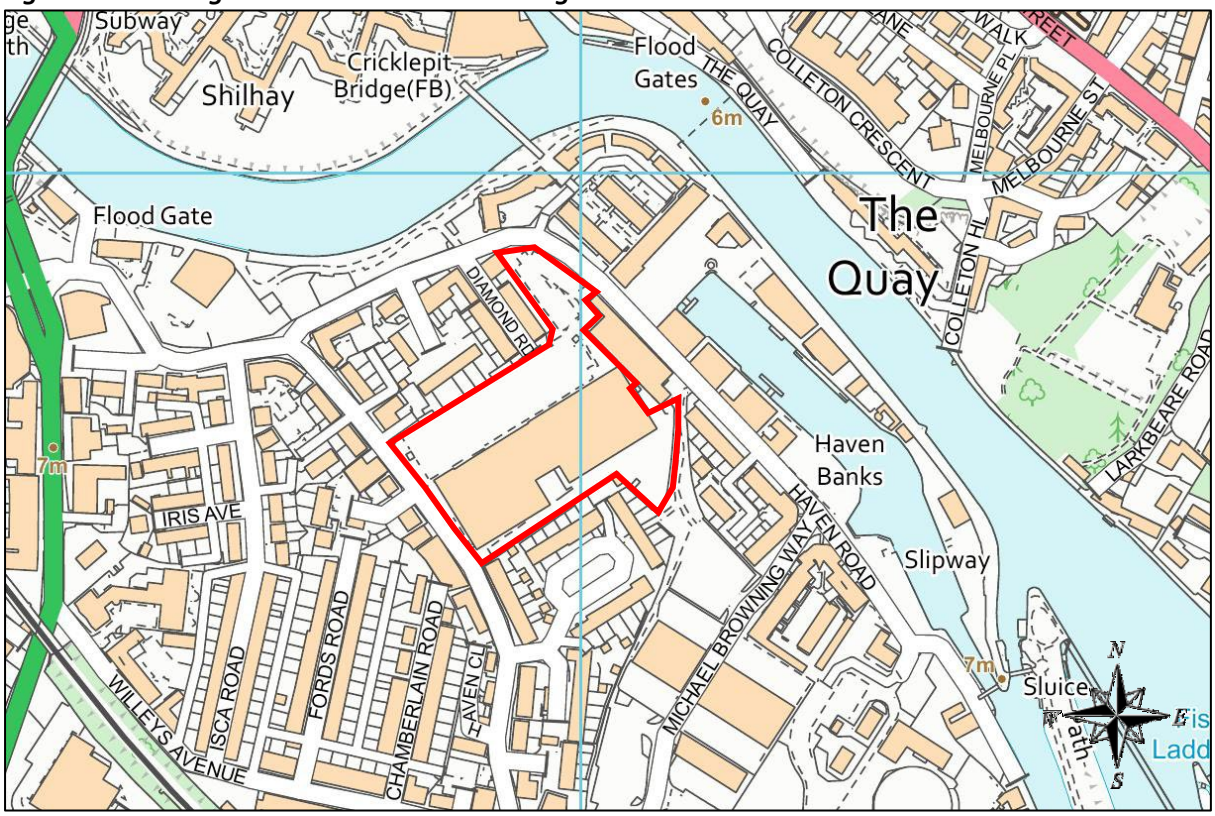
2.0 Description of Site and Proposals

The site is located on the south-western side of Haven Road in Exeter and is currently occupied by several commercial units and associated open air car parking.

Water Lane runs along the south-western site boundary, along which are located various commercial uses. Haven Road runs along the north-eastern site boundary and an indoor climbing centre is also located on this boundary. Residential properties bound the remainder of the site to the south-east and north-west.

Figure 2.1 shows the approximate existing site extent in **red** in relation to the surrounding area.

Figure 2.1 Existing Site Extent and Surroundings



It is proposed to demolish the existing building on the site and create approximately 436 residential dwellings and flexible commercial space located at ground floor level.

3.0 Noise & Vibration Standards

3.1 BS 8233: 2014 and WHO Guidelines

British Standard 8233: 2014 "*Guidance on sound insulation and noise reduction for buildings*", which is the current industry standard document for assessing external noise levels affecting residential dwellings, presents 'desirable' internal noise levels as shown in Table 3.1.

Table 3.1 BS 8233 Recommended Internal Noise Levels

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

In addition, the World Health Organisation (WHO) document "*Guidelines for Community Noise*" (1999) advises the following:

"For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45dB L_{Amax} more than 10-15 times per night (Vallet & Vernet 1991)."

3.2 Overheating and Open Windows

Whilst there is no legislation covering the scenario when windows are open to control overheating and little technical guidance is currently available, it is prudent to consider this condition when assessing external noise intrusion.

The Association of Noise Consultants (ANC) has produced a guidance document entitled "*Acoustics, Ventilation and Overheating Residential Design Guide*", published in January 2020, which states that "*it is considered reasonable to allow higher levels of internal ambient noise for transport sources when higher rates of ventilation are required in relation to the overheating condition*".

A two-stage noise risk assessment is then proposed, based upon the levels of external noise affecting the site as shown in Figure 3.1 and the subsequent internal noise levels shown Figure 3.2.

Figure 3.1 Level 1 Noise Risk Assessment – External Noise Levels

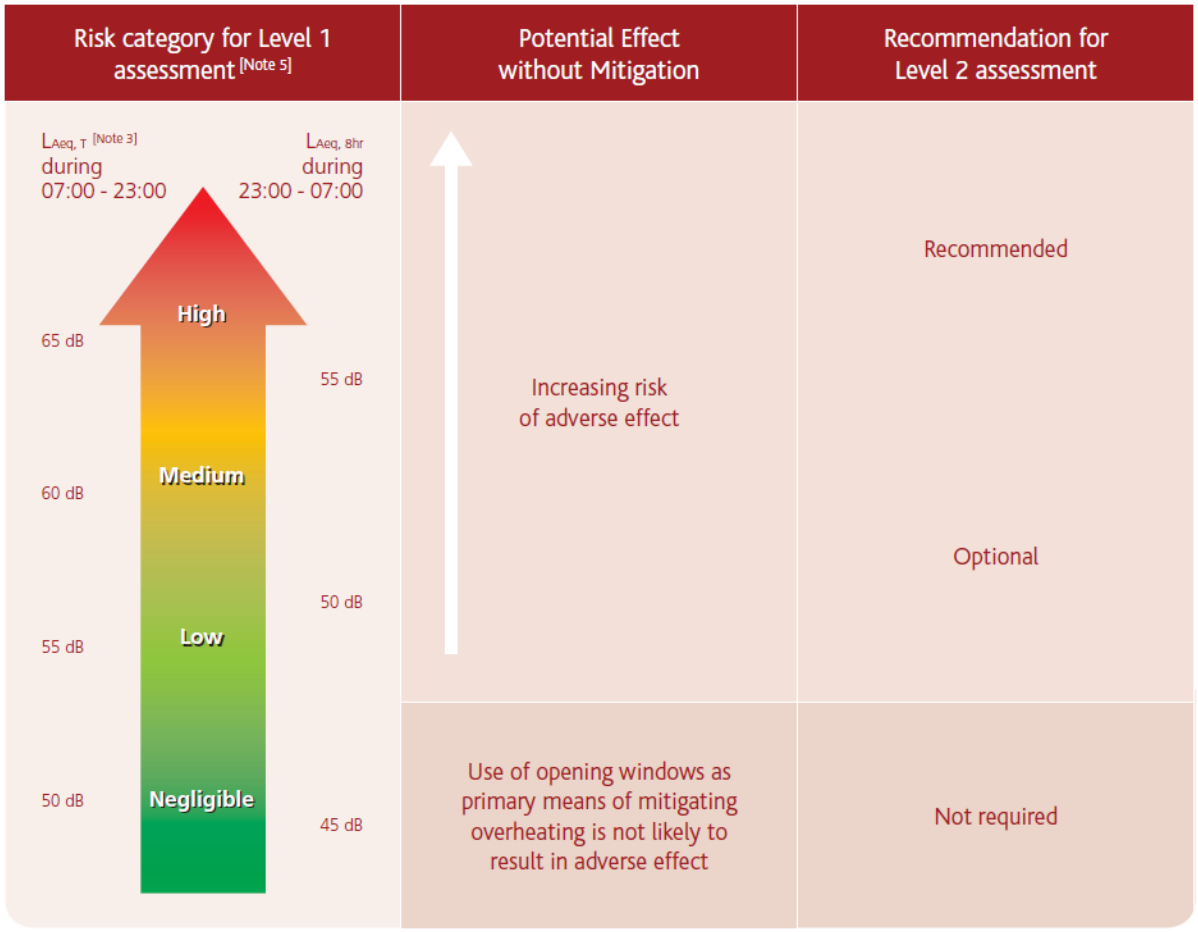


Figure 3.2 Level 2 Noise Risk Assessment – Internal Noise Levels

Internal ambient noise level [Note 2]			Examples of Outcomes [Note 5]	
$L_{Aeq,T}$ [Note 3] during 07:00 – 23:00 [Note 6]	$L_{Aeq,8h}$ during 23:00 – 07:00	Individual noise events during 23:00 – 07:00 [Note 4]		
> 50 dB	> 42 dB	Normally exceeds 65 dB $L_{AF,max}$	Noise causes a material change in behaviour e.g. having to keep windows closed most of the time	Avoiding certain activities during periods of intrusion. Having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.
			Increasing likelihood of impact on reliable speech communication during the day or sleep disturbance at night	At higher noise levels, more significant behavioural change is expected and may only be considered suitable if occurring for limited periods. As noise levels increase, small behaviour changes are expected e.g. turning up the volume on the television; speaking a little more loudly; having to close windows for certain activities, for example ones which require a high level of concentration. Potential for some reported sleep disturbance. Affects the acoustic environment inside the dwelling such that there is a perceived change in quality of life. At lower noise levels, limited behavioural change is expected unless conditions are prevalent for most of the time. [Note 8]
≤ 35 dB	≤ 30 dB	Do not normally exceed $L_{AF,max}$ 45 dB more than 10 times a night	Noise can be heard, but does not cause any change in behaviour	Noise can be heard, but does not cause any change in behaviour, attitude, or other physiological response[Note 9]. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.

Figures 3.1 and 3.2 are related by the 13 dB attenuation typically provided by an open window.

For noisier sites, the risk of an adverse effect increases with increasing noise level and further consideration may be required.

3.3 BS 4142: 2014+A1: 2019

British Standard 4142: 2014+A1: 2019 (referred to hereafter as BS 4142) provides a procedure for the measurement and rating of noise levels form industrial and commercial noise sources. A methodology for predicting the likelihood of adverse impact is provided in the document.

The rating level ($L_{Ar,Tr}$) is defined in BS 4142 and is used to rate the industrial source (known as the specific noise source) at the assessment location. This level is obtained by adding a correction of between 0 and 6 dB, for tonal noise sources, and a correction of between 0 and 9 dB for impulsive sources. Additionally, corrections of 3 dB can be made for other sound characteristics and intermittency of the noise source.

The method for predicting the likelihood of complaints is based on differences between the rating level and the background $L_{A90,T}$ noise level. The standard states that:

a) "Typically, the greater this difference, the greater the magnitude of the impact.
b) A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context.
c) A difference of around +5 dB is likely to be an indication of an adverse impact, depending on context.

The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact depending on the context."

4.0 Noise Survey

4.1 Noise Survey Methodology

An environmental noise survey was undertaken between Monday 14 March 2022 and Tuesday 15 March 2022.

The noise survey period was selected to determine typical noise levels during the daytime and night-time, when the residential elements will be occupied and the commercial units operational.

The approximate measurement positions are shown in **purple** on Figure 4.1 and described in Table 4.1.

Figure 4.1 Noise Measurement Positions in Relation to Site Extent and Surroundings

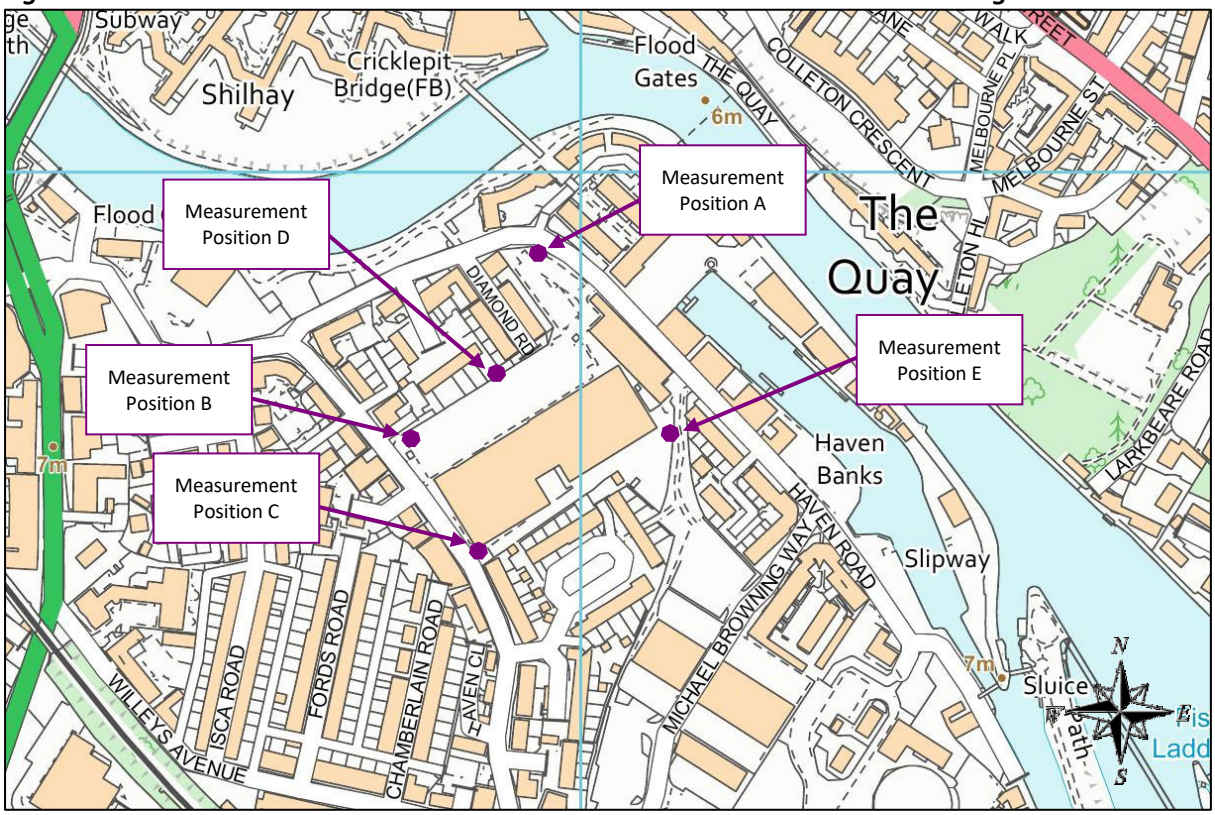


Table 4.1 Description of Measurement Positions

Measurement Position	Description
A	Measurement microphone attached to a pole approximately 2.5m above ground level in free-field at the northern corner of the site, approximately 2m from the site boundary.
B	Measurement microphone attached to a pole approximately 2.5m above ground level in free-field at the north-western corner of the site, approximately 8m from the site boundary.
C	Measurement microphone attached to a pole approximately 1.7m above ground level in free-field at the southern corner of the site, approximately 8m from the site boundary.
D	Measurement microphone attached to a pole approximately 2.5m above ground level in free-field on the north-western site boundary.
E	Measurement microphone attached to a pole approximately 2.5m above ground level in free-field at the eastern corner of the site.

Measurement positions A, B, C and E were selected as being representative of environmental noise levels affecting the site boundaries.

All of the measurement positions were selected as being representative of background noise levels at the nearest noise sensitive properties to the site boundaries.

The equipment used for the noise survey is summarised in Table 4.2.

Table 4.2 Description of Equipment used for Noise Survey

Measurement Position	Item	Make & Model	Serial Number
A, B, C	Type 1 automated logging sound level meter	Norsonic 140	1405948
	Type 1 ½" microphone	Norsonic 1225	212903
D	Type 1 automated logging sound level meter	Norsonic 140	1405947
	Type 1 ½" microphone	GRAS 40AF	355507
E	Type 1 automated logging sound level meter	Norsonic 140	1403413
	Type 1 ½" microphone	Norsonic 1225	207390
All	Calibrator	Brüel and Kjær 4231	1839133

L_{Amax}, L_{Aeq} and L_{A90} sound pressure levels were measured throughout the noise survey at each measurement position.

Due to the nature of the noise survey, i.e. unmanned, we are unable to comment on the weather conditions throughout the entire noise survey period. However, at the beginning and end of the survey period, there was a clear sky, low wind speeds and dry conditions. These conditions are considered appropriate for undertaking environmental noise measurements.

The noise monitoring equipment was calibrated before and after the noise survey period. No significant change was found. Laboratory equipment calibration certificates can be provided upon request.

4.2 Noise Survey Results & Observations

The measured ambient ($L_{Aeq, T}$) and maximum (L_{Amax}) noise levels at each position are summarised in Table 4.3.

Table 4.3 Summary of Noise Survey Results

Measurement Position	Daytime $L_{Aeq,T}$ (dB)	Night-time $L_{Aeq,T}$ (dB)	Night-time $L_{Amax\ (typical)}$ (dB)
A	57	54	74
B	59	56	75
D	56	46	65
E	54	49	67

The lowest L_{A90} background noise levels at each measurement position during daytime and night-time periods are presented in Table 4.4.

Table 4.4 Lowest Measured Background Noise Levels

Measurement Position	Lowest Measured L_{A90} Background Noise Level (dB)	
	Daytime (07:00 – 23:00 hours)	Night-time (23:00 – 07:00 hours)
A	45	38
B	45	38
D	35	32
E	40	34

We would consider the levels measured to be reasonable, taking into account the location of the measurement positions and the dominant nearby noise sources.

At all of measurement positions, the noise climate was noted to be dominated by road traffic using surrounding roads. Commercial activities along Water Lane were also noted at position C.

4.3 Commercial Noise along Water Lane

Specific measurements and observations were made at position C to assess the effect of commercial activities along Water Lane on the noise climate along the south-western site boundary. These activities include a car garage (Steve Clarke Garages), car jet wash (The Magic Hand Car Wash) and gym (Lloyds Gym with doors that were generally left open).

Noise emissions associated with the car garage were noted to be inaudible at the site boundary in comparison to the wider noise climate, which was dominated by road traffic noise using Water Lane and other roads.

Measurements of the jet wash and gym were undertaken and we have assessed the noise impact of these sources in accordance with the BS 4142 methodology, based on a reference period of 1-hour, which is appropriate for these daytime-only activities.

Our assessment is presented in Table 4.5.

Table 4.5 Commercial Activities – BS 4142 Noise Impact Assessment

Element	Measured $L_{Aeq, T}$ (dB)	Measurement Duration, T (seconds)	Equivalent $L_{Aeq\ (1\ hour)}$ (dB) Specific Noise Level	BS 4142 Character Correction – Tonality (dB)	BS 4142 Character Correction – Intermittency (dB)	Rating Noise Level (dB)
Car hoovering and jet wash	60	90	44	+2	+3	49
	64	39	44	+2	+3	49
	61	33	40	+2	+3	45
	58	16	35	+2	+3	40
	59	62	41	+2	+3	46
Music/ radio/ closing shutters	57	171	44	+2	+3	49
Gym Activities	55	7	28	0	+3	34
	55	15	31	0	+3	34
	57	8	30	0	+3	33
Total Rating Noise Level for All Activities Combined						**55**
Typical Background Noise Level (measured in the absence of commercial noise)						**55**
Difference						**0**

By comparison with the BS 4142 guidance, it can be seen that this correlates with a "*low noise impact*".

5.0 External Noise Intrusion

5.1 Preliminary External Façade Recommendations

Based on the measured external noise levels, we have undertaken calculations to predict the internal noise levels in the proposed dwellings. Results of the calculations show that the standards described in Section 3.3 could be achieved by using suitable external façade constructions.

Table 5.1 presents the recommended specifications for the glazing and the ventilation strategy for habitable rooms to achieve the internal noise standards.

Table 5.1 Recommended Glazing and Ventilation Specifications

Façade	Room	Glazing	Ventilation
Facing Water Lane Facing Haven Road	Living Rooms	R_w 34 dB e.g. 6mm glass / 16mm cavity / 6mm glass	$D_{ne,w}$ 37 dB Standard trickle ventilator
	Bedrooms	R_w 38 dB e.g. 10mm glass / 12mm cavity / 6.4mm laminated glass	$D_{ne,w}$ 41 dB Acoustic trickle ventilator
Remainder of Site	Living Rooms	R_w 34 dB e.g. 6mm glass / 16mm cavity / 6mm glass	$D_{ne,w}$ 37 dB Standard trickle ventilator
	Bedrooms	R_w 34 dB e.g. 6mm glass / 16mm cavity / 6mm glass	$D_{ne,w}$ 37 dB Standard trickle ventilator

Our calculations have assumed that the non-glazed areas will provide a sound insulation performance of at least R_w 52 dB (i.e. standard brick/block cavity wall or suitable lightweight external wall construction).

Our calculations are based on typical room and window dimensions (i.e. bedrooms 30m^3 with a 25% glazed façade area, and living rooms 40m^3 with a 50% glazed façade area).

The specifications above are to demonstrate viability for planning guidance only. Further consideration should be undertaken during the detailed project design stage to determine detailed glazing and ventilator acoustic specifications to ensure it meets minimum criteria.

5.2 Open Windows and Overheating

Comparing the measured external noise levels with the ANC criteria in Section 3.4 gives the daytime and night-time noise risk categories shown in Table 5.2.

Table 5.2 Noise Risk Categories

Boundary	Measured External Noise Level at Façade	Noise Risk Category	Internal Noise Level with Windows Open
North-East	54-57 dB $L_{Aeq\ (16\ hour)}$ Daytime	**Low**	41-44 dB $L_{Aeq\ (16\ hour)}$ Daytime
	49-54 dB $L_{Aeq\ (8\ hour)}$ Night-time	**Low/Medium**	36-41 dB $L_{Aeq\ (8\ hour)}$ Night-time
South-West	59 dB $L_{Aeq\ (16\ hour)}$	**Low/Medium**	46 dB $L_{Aeq\ (16\ hour)}$ Daytime
	56 dB $L_{Aeq\ (8\ hour)}$	**High**	46 dB $L_{Aeq\ (8\ hour)}$ Night-time
North-West / South-East	56 dB $L_{Aeq\ (16\ hour)}$ Daytime	**Low**	43 dB $L_{Aeq\ (16\ hour)}$ Daytime
	46 dB $L_{Aeq\ (8\ hour)}$ Night-time	**Negligible**	33 dB $L_{Aeq\ (8\ hour)}$ Night-time

The assessment shows that some site boundaries façades are in the medium noise risk category during both daytime and night-time periods, and as such some behavioural changes may occur in the completed apartments when windows are opened.

The south-western site boundary was found to be in the high noise risk category during the night-time and as such open windows may not be acoustically acceptable means of mitigating overheating during night-time periods for residential façades at this boundary.

For other façades, noise levels are within the low noise risk categories during the daytime and night-time periods. According to the guidance, for these façades *"use of opening windows as a primary means of mitigating overheating is not likely to result in adverse effect"*.

6.0 Building Services Plant Noise Emissions

6.1 Noise Limits

Based on the standards described in Section 3.0 and the measured background noise levels, Table 6.1 presents the overall development noise limits to be achieved at the nearest existing and proposed noise sensitive properties during daytime and night-time periods, correlating with a "*low noise impact*" in accordance with BS 4142.

Table 6.1 External Plant Noise Limits

Noise Sensitive Receptor	External L_{Aeq} Rating Noise Limit during Plant Operating Period (dB)	
	Daytime (07:00 – 23:00 hours)	Night-time (23:00 – 07:00 hours)
North-East	45	38
South-West	45	38
North-West / South-East	35	32
Proposed within Site	35	32

If any BS 4142: 2014 feature corrections are relevant (e.g. for intermittency, tonality, etc.), the resultant rating level shall not exceed the Table 6.1 levels.

The noise limits are to be achieved at a distance of 1m external to the nearest noise sensitive property and apply to the total cumulative noise level with all relevant plant operating simultaneously.

6.2 Noise Control Measures

At this early stage, the building services plant design should be sufficiently flexible to ensure that suitably quiet, non-tonal plant can be procured and where necessary mitigation options can be included to ensure the noise limits are not exceeded.

Noise mitigation measures that could be expected to be implemented as part of the design are as follows:

- Housing of certain items of building services plant within internal plantrooms, to contain radiated noise within the building envelope
- Selection of low-noise fans and condenser units, including night set-back modes
- Considerate location of external plant, so as to maximise distance and screening from noise sensitive façades
- Appropriate casings on external fans and air handling units, so as to limit noise break-out
- Use of appropriate atmospheric duct-mounted attenuators on fans and air handling units
- Use of acoustic mitigation such as plant enclosures and screening where necessary

Appendix A – Acoustic Terminology

Parameter	Description
Decibel (dB)	A logarithmic scale representing the sound pressure or power level relative to the threshold of hearing ($20x10^{-6}$ Pascals).
Sound Pressure Level (L_p)	The sound pressure level is the sound pressure fluctuation caused by vibrating objects relative to the threshold of hearing.
A-weighting (L_A or dBA)	The sound level in dB with a filter applied to increase certain frequencies and decrease others to correspond with the average human response to sound.
L_{Amax}	The A-weighted maximum noise level measured during the measurement period.
$L_{Aeq,T}$	The A-weighted equivalent continuous noise level over the time period T (typically T= 16 hours for daytime periods, T = 8 hours for night-time periods). This is the sound level that is equivalent to the average energy of noise recorded over a given period.
$L_{A90\ (15\ min)}$	The noise level exceeded for 90% of the time (also referred to as the background noise level), measured over a 15-minute period
R_w	The weighted (w) sound reduction index (R), a single figure rating of the laboratory airborne sound insulation performance of a construction, usually measured across the frequency range 100-3150Hz. The higher the value, the greater the sound insulation, and the more onerous the requirement.
$D_{n,e,w}$	The weighted (w) element (e) normalised (n) level difference (D), a single figure indicator of the ability of a small building element (such as a trickle ventilator) to reduce sound. The higher the value, the greater the sound reduction, and vice versa.