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SKYWAVES HOUSE, IVY ARCH ROAD, WORTHING

ASSESSMENT OF NOISE FROM EXTERNAL PLANT

On behalf of:

Hampshire Homes Limited

Report No: P24-329-R01v2
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1.0 INTRODUCTION

1.1 Hepworth Acoustics Ltd was commissioned by Hampshire Homes Limited to carry out an assessment of noise impact from externally mounted plant as part of the new residential building at Skywaves House, Ivy Arch Road, Worthing.

1.2 This plant noise assessment is required in connection with **Planning Condition 17** of application ref: **AWDM/0207/22** as follows:

> "*External Air Moving Equipment*
> *No external fixed plant, or mechanical vent or duct shall be installed until a scheme has first been submitted to and approved in writing by the Local Planning Authority including details of acoustic performance and any required measures to minimise vibration. All plant shall be maintained in accordance with manufacturer's guidance to ensure the levels contained in the aforementioned acoustic performance are not exceeded and any future plant shall also meet the specified levels within the approved scheme.*"

1.3 The development will be a residential block with assistance facilities, the location of which is shown in **Figure 1**. The nearest existing dwellings are positioned to the north of the development site, off King Edward Avenue.

1.4 The proposals are to install three items of external plant – one condenser and two air source heat pumps (ASHPs) – at ground level as shown in the layout drawing in **Figure 2**. **Figure 3** also shows an elevation drawing with the plant position highlighted.

1.5 This noise assessment has included the following:

- A background noise survey at a location representative of the nearest dwellings.
- Determination of plant noise design limits.
- Initial noise impact assessment.
- Recommendations.

1.6 The various noise units and indices referred to in this report are described in **Appendix I**. All noise levels mentioned in the text have been rounded to the nearest decibel, as fractions of decibels are imperceptible. The recommendations given in this report have been provided with respect to acoustic only. All other considerations and compliances (such as fire, structural, ventilation, overheating etc.) should be reviewed and confirmed by others.

2.0 POLICY & GUIDANCE

National Planning Policy Framework (NPPF) December 2023

2.1 The National Planning Policy Framework (NPPF) December 2023 includes the following relevant paragraphs with respect to noise and planning:

Paragraph 180

> "*Planning policies and decisions should contribute to and enhance the natural and local environment by:*
> *… e) 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. …*"

Paragraph 191

> "*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;"*

British Standard 4142:2014+A1:2019

2.2 British Standard 4142:2014+A1:2019, '*Methods for rating and assessing industrial and commercial sound*" (referred to as Bs 4142 hereafter), is appropriate guidance for assessing the potential noise impact from proposed new industrial/commercial noise sources, including mechanical/electrical plant.

2.3 BS 4142 requires a Rating Level ($L_{Ar,Tr}$), calculated from the operation of the noise source, to be compared with the Background Sound Level ($L_{A90,T}$) which is measured in the absence of the noise source, evaluated over a 1-hour period for daytime operations (07:00-23:00) and 15-minute period for night-time operations (23:00-07:00).

2.4 The Rating Level ($L_{Ar,Tr}$) is based on the Specific Sound Level ($L_{Aeq,T}$) attributed to the operating noise source, with 'character corrections' added for sound sources where 'certain acoustic features can increase the significance of impact'.

2.5 The character correction applied to the Specific Sound Level in order to obtain the Rating Level can take into account tonality, intermittency, impulsivity and characteristics otherwise distinctive against the prevailing noise climate in the area. The applicable character corrections apply depending on how perceptible the characteristics are anticipated to be at the assessment location.

2.6 An initial estimate of the potential noise impact from the operating noise source is determined by comparing the difference between the Rating Level and the Background Sound Level.

2.7 Regarding the outcome of the initial estimate, BS 4142 states that:

- Typically, the greater this difference, the greater the magnitude of impact;
- A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context;
- A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context; and,
- The lower the Rating Level is relative to the measured background level, the less likely it is that the operation will have an adverse impact or a significant adverse impact. Where the Rating Level is does not exceed the Background Sound Level, this is an indication of the specific sound source having low impact, depending on the context.

2.8 BS 4142 states that all pertinent factors must be taken into account regarding the context in which the noise occurs, including:

- The absolute level of sound.
- The character and level of the residual sound compared to the specific sound; and,
- The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that ensure good internal and/or outdoor acoustic conditions such as acoustic screening.

2.9 The initial numerical assessment, as well as applicable contextual factors, are then taken into account when determining the potential noise impact. For new plant, where reasonably possible, it is generally considered suitable to control the Rating Level to a value not exceeding the Background Sound Level or below.

3.0 NOISE ASSESSMENT

Background Noise Survey

3.1 Automated noise monitoring was carried out at **Location X** representative of the nearest dwellings as shown in **Figure 1**.

3.2 The noise monitoring was carried out between 15:15 on Wednesday 11 September 2024 and 10:15 on Thursday 12 September 2024, covering the daytime and night-time periods.

3.3 The noise survey measurements were carried out in consecutive 15-minute periods at a microphone height of 1.4m above the ground, in semi 'free-field' conditions (i.e. within 1m of a reflective garden wall, but otherwise 'free-field') with a windshield fitted to the microphone. Given that the background sound levels [dB $L_{A90,T}$] are the metric of interest and the garden wall was not in a position to produce specular reflections from the predominant road traffic noise on the A24, there is not considered to be any significant effect on the results from the microphone being close to a garden wall. Calibration checks were carried out both before and after the noise survey, with no deviation in calibration level.

3.4 Weather conditions during the noise survey were suitable for sound pressure levels measurements. Full details of the equipment used for the noise survey, the weather conditions and the full noise survey results, are shown in **Appendix II**.

3.5 The existing noise climate in the area is generally moderate in level and largely made up of contributions from road traffic noise. Works are underway on site, therefore contributions from construction activity noise have been excluded from the summarised results, but these only occurred during daytime periods.

3.6 A summary showing the range and average of the noise survey results is shown in **Table 1**. The average values shown in brackets are the arithmetic mean for the $L_{A90,T}$ values and the logarithmic mean for the $L_{Aeq,T}$ values.

Table 1: Summary of Background Noise Survey Results [dB]

Period	$L_{A90,T}$ 'Background'	$L_{Aeq,T}$ 'Residual'
Daytime (07:00-23:00)	41-59 (53)	55-63 (60)
Night-time (23:00-07:00)	29-50 (34)	43-59 (52)

3.7 The existing background noise levels in **Table 1** in absolute terms are moderate during the daytime and low during the night-time. These noise survey results been used as the basis for the plant noise design limits.

Plant Noise Design Limits

3.8 We have determined suitable plant noise design limits based on the existing background noise levels shown in **Table 1** in line with BS 4142 guidance. We recommend limiting plant noise levels to not exceed the existing representative Background Sound Levels.

3.9 We have been informed that the plant will operate as needed 24-hours a day, thus there are not time restriction on the operation.

3.10 The modal values of the background noise survey data have been adopted as the representative Background Sound Levels, which form the plant noise design limits at the nearest existing dwelling as shown in **Table 2**.

Table 2: Planning Plant Noise Design Limits at Nearest Existing Dwellings

Daytime (07:00-23:00)	Night-time (23:00-07:00)
54 dB $L_{Ar,Tr}$	30 dB $L_{Ar,Tr}$

3.11 It should be noted that the plant noise design limits in **Table 2** apply at the nearest dwellings.

3.12 The plant noise design limits in **Table 2** apply to the Rating Level of the sound generated by the plant. As discussed in **Section 2** of this report, the Rating Level is the Specific Sound Level (plant noise level at the nearest dwellings) plus corrections for the perceptibility of different acoustic characteristics at the assessment location.

3.13 However, newly installed condensers and ASHPs should not contain any tonal nor impulsive characteristics if well maintained. Given how high the 'residual' noise levels are above the 'background' levels, any plant operating within 30 dB $L_{Aeq,T}$ at the nearest dwellings (i.e. the night-time plant noise design limit), would not have readily distinguishable intermittent characteristics.

Plant Noise Emission Recommendations

3.14 No specific plant model selections are currently available for review but given the lower night-time plant noise design limit of 30 dB $L_{Aeq,T}$ and the distance to the nearest dwellings to the north, the total sound power level emissions limit for all external plant combined is 60 dB L_{wA}.

3.15 Given that there are three items of external plant, the overall sound power level limit can be met if each plant item is limited to a sound power level output of 55 dB L_{wA}. The recommended plant noise emission limits are provided in **Table 3**.

Table 3: Recommended Plant Noise Emission Design Limits

Description	dB L_{wA}	dB L_{pA} at 1m*	dB L_{pA} at 3m*
Multi-split external condenser unit	55	47	37
Hi-temp ASHP condenser unit	55	47	37
Lo-temp ASHP condenser unit	55	47	37
Combined Emissions Limit	**60**	**52**	**42**

*Assuming hemispherical propagation, i.e. directivity factor Q = 2.

3.16 The recommendations in **Table 3** can be used to select suitable plant models. The recommended noise emission limits are on the lower end of the scale but should not be prohibitively low.

Building Envelope Sound Insulation Recommendations

3.17 If plant models are selected to operate within the noise emission limits recommended in **Table 3**, then the plant noise design limits in **Table 2** will be met at the nearest dwellings to the north.

3.18 Nevertheless, noise levels outside the nearest window (approximately 3m away from the plant) of the new residential development itself would still be exposed to noise levels of 48 dB $L_{Aeq,T}$.

3.19 Given that the plant is part of the development, then the sensitivity to noise at the assessment location can be reduced by incorporating suitable building envelope sound insulation measures into the design.

3.20 For all windows to habitable rooms on the elevations shown in **Figure 4**, we recommend installing glazing and ventilation in line with the specifications provided in **Table 4.**

Table 4: Recommended Sound Insulation Measures

Description	Minimum Performance
Upgraded Double Glazing	30 dB $R_w + C_{tr}$
Acoustic Ventilation	35 dB $D_{n,e,w} + C_{tr}$

3.21 The sound insulation performance values in **Table 4** should ensure that any plant noise ingress to habitable rooms is controlled to within 20 dBA inside, which is suitably lower than standard BS 8233 design guidance for indoor ambient noise levels in new dwellings, to account for the fact that the plant noise is not a 'source without a specific character'.

Alternative Noise Mitigation Option: Louvred Acoustic Enclosure

3.22 Depending on other non-acoustic factors such as fire, air flow etc. an alternative to the upgraded building envelope sound insulation recommendations above would be to install the plant within a louvred acoustic enclosure. The exact acoustic specifications of the louvred acoustic enclosure would depend on the sound power output of the final plant model selections.

3.23 Nevertheless, the plant models and louvred acoustic enclosure, considered together, would need to be designed to ensure that the plant noise design limits in **Table 2,** that apply at the nearest existing dwellings, are achieved. Also, taking into account the performance of standard double glazing and standard trickle vents, they will need to be designed to ensure that the sound pressure level outside the nearest window of the residential development itself does not exceed 45 dB L_{pA}. Any distance attenuation calculations used should use a directivity factory Q = 8, to account for the placement of plant at the intersection of three reflecting surfaces in the proposals.

Recommendations for Vibration Isolation

3.24 Where any physical connections to the plant are made directly to the new residential building itself or to a rigidly connected structure, the plant will need to be installed on proprietary vibration isolating mounts that provide a minimum of 95% isolation efficiency. Manufacturers will often have specific isolation kits for a particular item of plant, alternatively a specialist vibration isolator manufacturer can be used to provide the design solution.

4.0 SUMMARY & CONCLUSION

4.1 Hepworth Acoustics Ltd was commissioned by Hampshire Homes Limited to carry out an assessment of noise impact from externally mounted plant as part of the new residential building at Skywaves House, Ivy Arch Road, Worthing.

4.2 A background noise survey has been carried out to quantify the prevailing existing noise climate at a location representative of the nearest dwellings.

4.3 Suitable plant noise design limits have been determined based on the results of the background noise survey and BS 4142 guidance.

4.4 Recommendations have been provided for plant noise emission limits to aid in the selection of suitable plant models.

4.5 Recommendations have been provided for upgraded glazing, acoustic ventilation and vibration isolators, to ensure that the plant does not result in an adverse impact upon the future residents of the new development itself.

Do not scale from this figure
Key:
Illustrative site location
Noise survey location
Nearest dwellings
N
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Title: Figure 1: Aerial View & Noise Survey Location
Project: P24-329
King Edward Avenue
Businesses Premises
Ivy Arch Road
Gardner & Scardifield Builders Merchants
Broadwater road (A24)
Google Earth

Do not scale from this figure

Key:

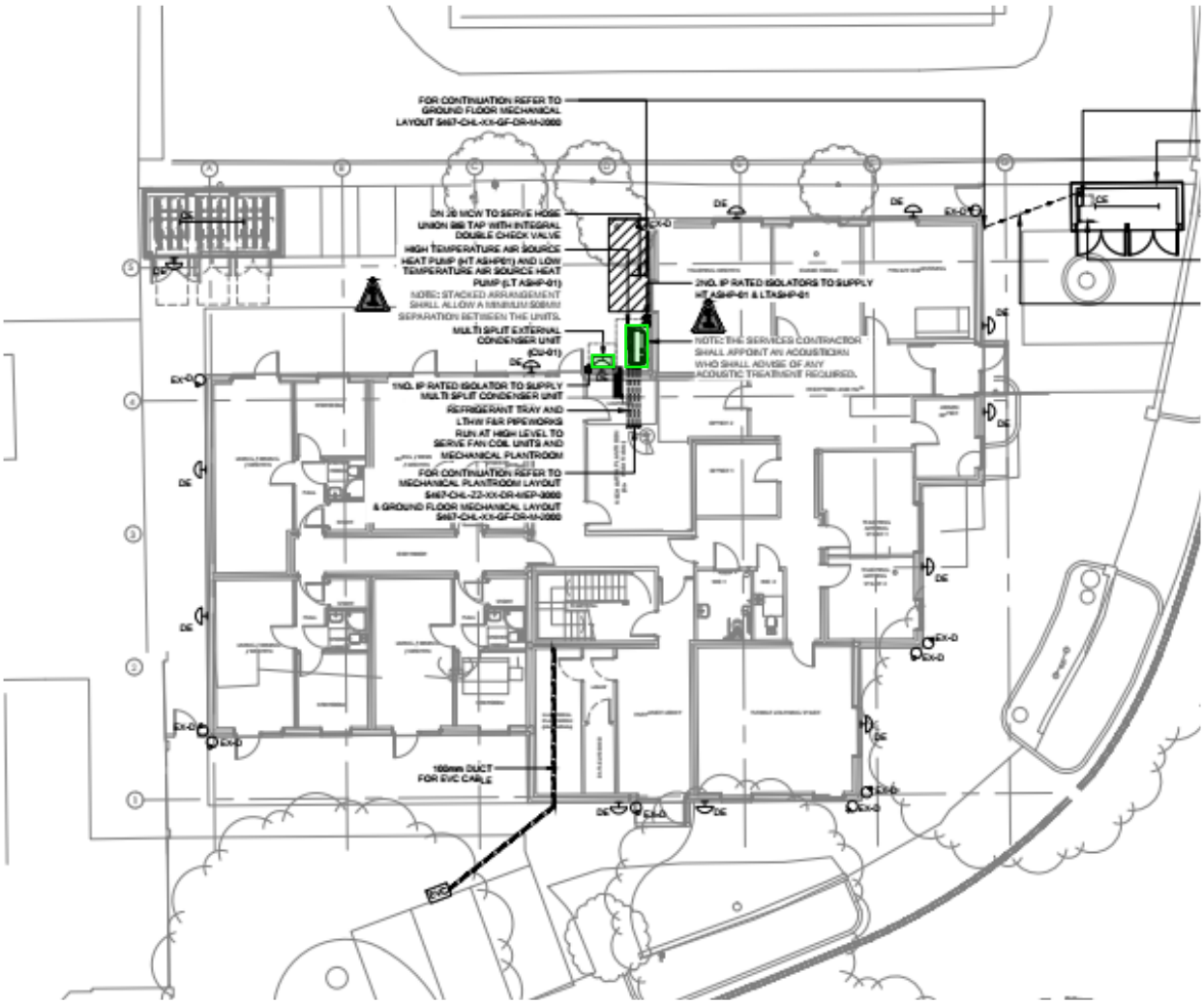
Location of proposed external plant

N

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Title: Figure 2: Proposed Plant Locations

Project: P24-329



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Title: Figure 3: Proposed East Elevation

Project: P24-329

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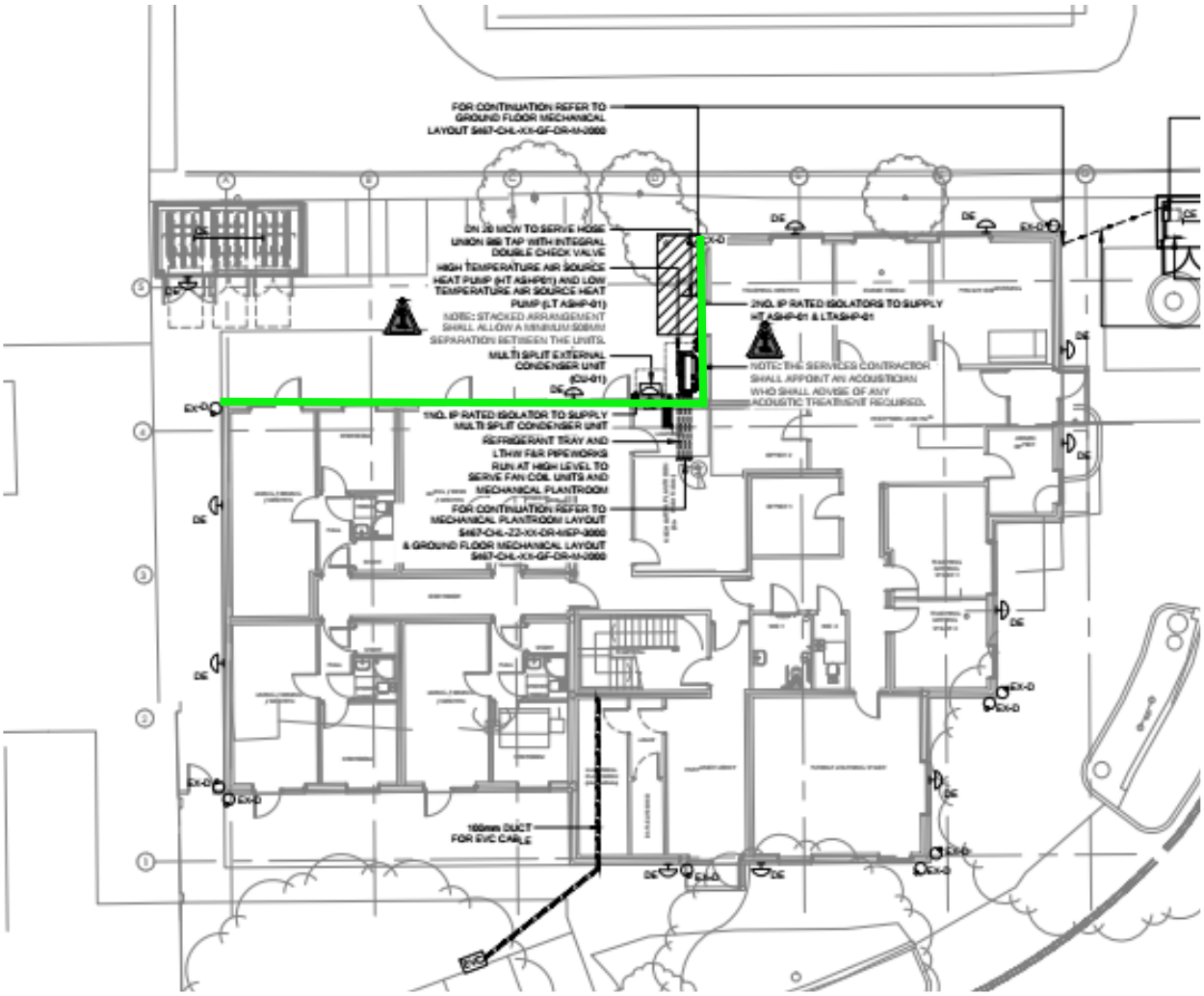
Noise mitigation scheme

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Title: Figure 4: Recommendations

Project: P24-329



Appendix I: Noise Units & Indices

Sound and the Decibel

A sound wave is a small fluctuation of atmospheric pressure. The human ear responds to these variations in pressure, producing the sensation of hearing. The ear can detect a very wide range of pressure variations. In order to cope with this wide range of pressure variations, a logarithmic scale is used to convert the pressure values into manageable numbers. Although it might seem unusual to use a logarithmic scale to measure a physical phenomenon, it has been found that the human response to sound most closely follows a logarithmic relationship. The dB (decibel) is the logarithmic unit used to describe sound (or noise) levels. The usual range of sound pressure levels is from 0 dB (at the threshold of hearing) to 120 dB (at the threshold of pain).

Due to the logarithmic nature of decibels, when two sounds of the same level are combined together, the total sound level is (under normal circumstances) 3 dB higher than each of the individual sound levels e.g. 60 dB plus 60 dB = 63 dB. In terms of perceived 'loudness', a 3 dB(A) variation in sound level is a relatively small (but nevertheless just noticeable) change. An increase in sound level of 10 dB(A) generally corresponds to a doubling of perceived loudness. Likewise, a reduction in sound level of 10 dB(A) generally corresponds to a halving of perceived loudness.

The ear is not equally sensitive to sound at all frequencies. It is less sensitive to sound at low and very high frequencies, compared with the frequencies in between. Therefore, when measuring a sound made up of different frequencies, it is often useful to 'weight' the frequency spectrum appropriately, so that the measurement correlates better with what a person would actually hear. This is usually achieved by using a mathematical filter called the 'A' weighting, which is built into sound level meters. Sound levels measured using the 'A' weighting are denoted dB(A) or dBA.

Frequency and Hertz [Hz]

As well as the loudness of a sound, the frequency content of a sound is also very important. Frequency is a measure of the rate of fluctuation of a sound wave. The unit used is cycles per second, or Hertz [Hz]. Sometimes large frequency values are written as kiloHertz [kHz], where 1 kHz = 1000 Hz.

Young people with normal hearing can hear frequencies in the range 20 Hz to 20 kHz. However, the upper frequency limit gradually reduces as a person gets older.

Glossary of Terms

When a noise level is constant and does not fluctuate, it can be described adequately by measuring the dB(A) level. However, when the noise level varies with time, the measured dB(A) level will vary as well. In this case, it is therefore not possible to represent the noise with a simple dB(A) value. In order to describe noise where the level is continuously varying, a number of other indices can be used. The various indices used in this report, along with other relevant terms are described below.

L_p **Sound Pressure Level:** A logarithmic ratio between a squared sound pressure quantity and the square of the human threshold of hearing ($2x10^{-5}$ Pa).

L_{pA} **A-weighted Sound Pressure Level:** The Sound Pressure Level (L_p) with the frequency spectrum adjusted to account for the average human hearing response at difference frequencies for a moderate sound pressure range.

L_w **Sound Power Level:** A logarithmic ratio between a sound power quantity and the human threshold of hearing (10^{-12} W).

L_{wA} **A-weighted Sound Power Level:** The Sound Power Level (L_w) adjusted to account for the average human hearing response at difference frequencies for a moderate sound power range.

$L_{Aeq,T}$ **A-weighted Equivalent Continuous Sound Level:** An average of the total sound pressure measured over a specified time period (T). In other words, $L_{Aeq,T}$ is the level of a steady sound which has the same total A-weighted sound pressure as the real fluctuating noise, measured over the same time period. It is increasingly being used as the preferred parameter for most forms of environmental noise.

L_{Amax} **Maximum A-weighted Sound Level with Fast Time-weighting:** The maximum A-weighted sound pressure level during the measurement period, using the Fast time-weighting of 125ms. L_{Amax} used in this report refers throughout to L_{AFmax} with the Fast time weighting, denoted L_{AFmax} or $L_{Amax,f}$ in other documents but L_{Amax} in BS 8233:2014 standard notation.

$L_{A90,T}$ **A-weighted 90 Percentile Level:** The A-weighted sound level exceeded for 90% of a measurement time period (T). $L_{A90,T}$ is generally used as a measure of Background Sound Level.

$L_{Ar,Tr}$ **Rating Level:** An A-weighted value most commonly used in BS 4142 assessments, which is the sound level of the noise source under assessment, at the assessment location, evaluated over the reference assessment period (T_r) and includes numerical adjustments for the characteristic features of the sound.

Appendix II: Background Noise Survey Results

Date	Wednesday 11 to Thursday 12 September 2024
Equipment	NTi Audio XL2-TA 'Class 1' sound analyser (SN: A2A-20259-E0) NTi Audio CAL200 'Class 1' sound calibrator (SN: 19360) Kestrel 2500 portable weather meter (SN: 2556870) Associated environmental outdoor monitoring kit and tripod
Weather	Wednesday daytime: Dry, ~15°C with low NW winds <5 $m.s^{-1}$ and moderate cloud coverage Wednesday night: Dry, ~9°C with low NW winds <4 $m.s^{-1}$ and low cloud coverage Thursday daytime: Dry, ~14°C with low NW winds <4 $m.s^{-1}$ and moderate cloud coverage

