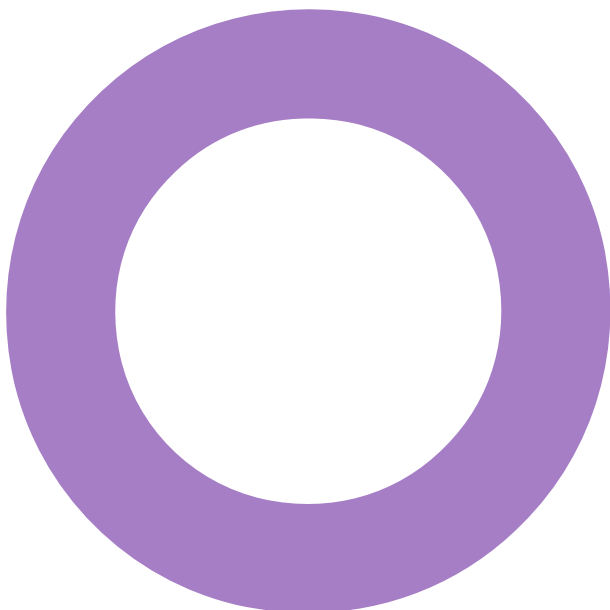


# Mansion House decarbonisation. Wakehurst. Royal Botanical Gardens.

**ACOUSTICS**  
NOISE IMPACT ASSESSMENT

REVISION 0 – 10 SEPTEMBER 2024



## Audit sheet.

| Rev. | Date       | Description of change / purpose of issue | Prepared | Reviewed | Authorised |
|------|------------|------------------------------------------|----------|----------|------------|
| 0    | 10/09/2024 | Noise impact assessment report           | MW       | PM       | PM         |
|      |            |                                          |          |          |            |
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|      |            |                                          |          |          |            |

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Project number: 1015656

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## Contents.

|                                                        |    |
|--------------------------------------------------------|----|
| Audit sheet.                                           | 2  |
| 1. Introduction.                                       | 4  |
| 2. Site Description.                                   | 5  |
| 3. Proposals.                                          | 6  |
| 3.1 Noise egress.                                      | 6  |
| 4. Basis of assessment.                                | 7  |
| 4.1 National Planning Policy Framework.                | 7  |
| 4.2 Planning Practice Guidance (PPG)- Noise.           | 8  |
| 4.3 BS 4142: 2014.                                     | 9  |
| 4.4 Mid Sussex District Council.                       | 9  |
| 5. Measurements.                                       | 10 |
| 5.1 Survey results.                                    | 10 |
| 6. Plant noise egress criteria.                        | 12 |
| 6.1 Plant noise limit criteria.                        | 12 |
| 7. Conclusions.                                        | 12 |
| Appendix A – Glossary of acoustic terminology.         | 13 |
| Appendix B – Histogram of logging survey measurements. | 16 |
| Appendix C – Survey and equipment details.             | 18 |

## 1. Introduction.

Hoare Lea Acoustics (HLA) have been appointed to assess the noise impacts from the proposed introduction of new decarbonisation plant associated with the Mansion House at Wakehurst, Haywards Heath.

The proposals include the introduction of new Air Source Heat Pumps adjacent to the Wakehurst Place stables.

The closest residential premises with windows from habitable rooms looking towards the proposed development site have been identified as:

- Wakehurst Farmhouse, approximately 100m to the west of the plant location, there are walled gardens and temporary container offices that break the line of sight to the upstairs windows of the farmhouse.

It is noted that staff accommodation associated with Wakehurst Place Stables is located some 8m from the proposed plant location, and although consideration of this for planning may not be required, it is recommended that noise ingress to this area be considered if this accommodation is to remain in use following the new plant installation.

HLA have visited site, conducted sample and continuous noise monitoring, and considered the potential noise impact at the nearest dwellings in accordance with BS4142 and local planning guidance.

This report sets out the site observations, the results of the continuous monitoring survey measurements, defines limit criteria for plant noise egress in order to be capable of achieving the Mid Sussex District Council limit criteria when assessed in terms of BS4142:2014.

As plant selections have yet to be confirmed, the selections and noise control measures will need to be introduced in order to not exceed a Rating Level of 30dB at 1m from the Wakehurst Farmhouse façade.

## 2. Site Description.

The proposed development site is located to the west of the existing Wakehurst Place Stables building within the grounds of the Royal Botanical Gardens Wakehurst Place seedbank and gardens.

It is set in a rural location and generally enjoys low sound levels; when visitors leave site and site activities end for the day ambient and background sound levels fall to very low levels. The exception to this is those locations where continuous plant items are in operation.

The closest existing residential premises is Wakehurst Farmhouse approximately 100m to the west of the proposed plant location. The residence is adjacent to the Wakehurst site office and car parking. During the daytime activities associated with the operation of Wakehurst site maintenance teams and voices of visiting children playing in the nearby 'mud kitchen' can be heard. In between these sound events the sound of insects, birdsong and distant overhead aircraft associated with Gatwick airport some 11km to the north west were noted.

The location of the proposed new plant items also lies about 8m to the west of existing Wakehurst Place Stables staff accommodation. The daytime noise climate here was dominated from activities associated with the adjacent Wakehurst Place Stables Restaurant (open 10am-5pm daily) with extract plant and the sound of clattering crockery from the kitchen being clearly audible. In between sound events, the hum from two large external 'Williams' refrigerators were audible in the background. These are located approximately 20m to the south west of the new plant location.

During the survey intermittent noise associated with the ongoing restoration works at the nearby Mansion House were also audible.

An aerial view of the site including measurement locations can be seen in Figure 1.

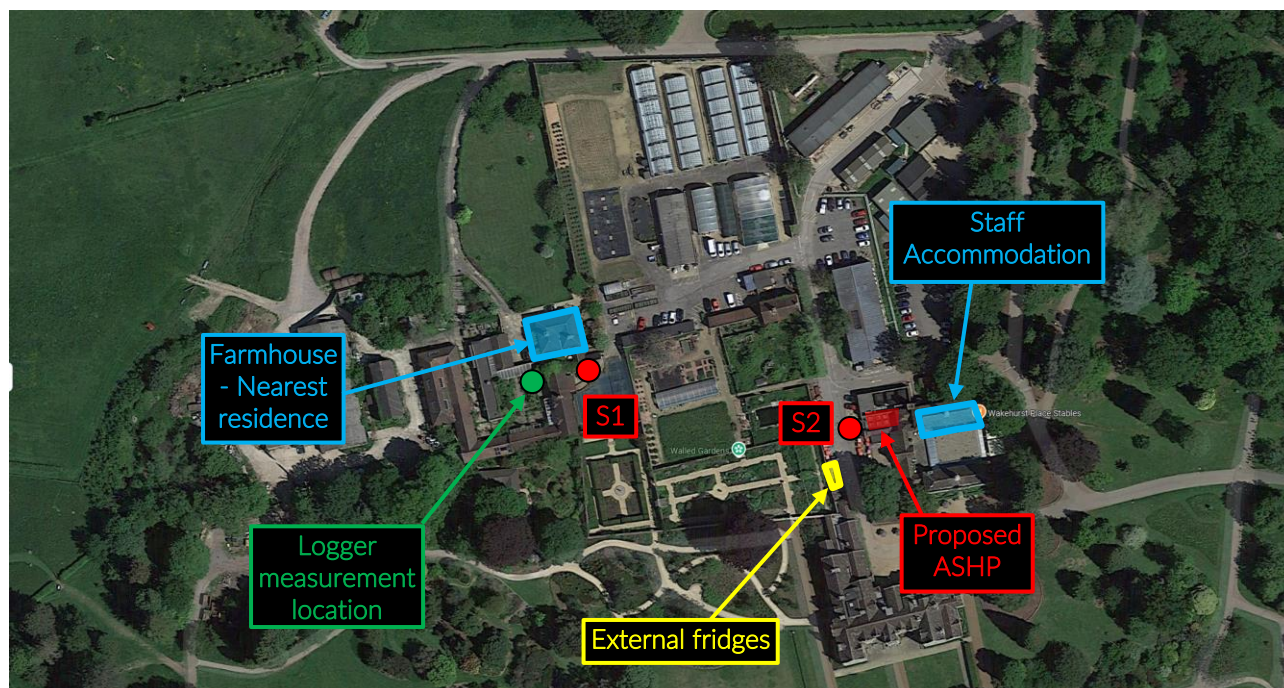


Figure 1 - Aerial view of site and measurement locations (image courtesy of Google Earth)

### 3. Proposals.

#### 3.1 Noise egress.

External noise levels from new plant items will need to be controlled to minimise the potential for disturbance at the nearest noise sensitive premises in accordance with local planning requirements.

The precise nature of the new plant items is still under development, but it is anticipated that some form of enclosure housing Air Source Heat Pumps (ASHP) with acoustic packs fitted is proposed.

Noise control measures are recommended to not only control plant noise egress to the nearest existing residential dwelling of the Farmhouse but also to the staff accommodation in the nearby Stable block.

The nearest existing residential premises to the site are approximately 100m to the west of the proposed plant location and the Wakehurst Staff accommodation is approximately 8m to the east of the proposed plant location.

## 4. Basis of assessment.

### 4.1 National Planning Policy Framework.

The National Planning Policy Framework (NPPF): Dec 2023 sets out the Government's planning policies for England and how these are expected to be applied. The document seeks to encourage sustainable development subject to all relevant factors.

Section 11: 'Making effective use of land' advises that planning policy and decisions should promote effective use of land making as much use as is possible of brownfield sites.

Section 15: 'Conserving and enhancing the natural environment', paragraph 174, states the following:

*'Planning policies and decisions should contribute to and enhance the natural and local environment by:*

- *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'.*

Furthermore, paragraph 185 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:*

- *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;*
- *identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason'*

Paragraph 188, additionally, states *'The focus of planning policies and decisions should be on whether proposed development is acceptable use of land, rather than the control of processes or emissions (where these are subject to separate pollution control regimes)'.*

NPPF also makes reference to the DEFRA Noise Policy Statement for England (NPSfE) 2010. This latter document is intended to apply to all forms of noise other than that which occurs in the workplace. It includes environmental noise and neighbourhood noise in all forms.

NPSfE advises that the impact of noise should be assessed on the basis of adverse and significant adverse effect but does not provide any specific guidance on assessment methods or limit sound levels. Moreover, the document advises that it is not possible to have *'a single objective noise-based measure...that is applicable to all sources of noise in all situations'.* It further advises that the sound level at which an adverse effect occurs is *'likely to be different for different noise sources, for different receptors and at different times'.*

It is noted that NPSfE also advises that the general principle that increases in ambient noise should be 'minimised', needs to be considered in context for each site and, in this regard, states:

*'Of course, taken in isolation and to a literal extreme, noise minimisation would mean no noise at all. In reality, although it has not always been stated, the aim has tended to be to minimise noise as far as is reasonably practical... the application of the NPSfE should enable noise to be considered alongside other relevant issues and not to be considered in isolation. In the past, the wider benefits of a particular...development or other activity may not have been given adequate weight when assessing the noise implications'.*

In the absence of specific guidance for assessment of environmental noise within NPPF and NPSfE it is considered appropriate to base this assessment on current British Standards and appropriate local or national guidance.

## 4.2 Planning Practice Guidance (PPG)- Noise.

More targeted advice concerning noise is presented in the Noise section of the PPG in which the relevance of noise in the context of development is discussed. The PPG advises that local planning authorities should take account of the acoustic environment and in so doing should consider:

- whether or not a significant adverse effect is occurring or likely to occur;
- whether or not an adverse effect is occurring or likely to occur; and
- whether or not a good standard of amenity can be achieved.

In line with the NPSfE, this would include identifying where the noise exposure is, or would be, relative to the various effect levels for the given situation.

Table 1 presents the summary given in the PPG of the noise exposure hierarchy, based on the likely response.

Table 1 - Noise exposure hierarchy (PPG -Noise)

| Perception                     | Examples of Outcome                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Increasing Effect Level              | Action                            |
|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|-----------------------------------|
| Not noticeable                 | No effect                                                                                                                                                                                                                                                                                                                                                                                                                                                              | No Observed Effect                   | No specific measures required     |
| Noticeable and not intrusive   | Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.                                                                                                                                                                                                                                                               | No Observed Adverse Effect           | No specific measures required     |
|                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Lowest Observed Adverse Effect Level |                                   |
| Noticeable and intrusive       | Noise can be heard and causes small changes in behaviour and / or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.                                                                   | Observed Adverse Effect              | Mitigate and reduce to a minimum. |
|                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Significant Adverse Effect Level     |                                   |
| Noticeable and disruptive      | The noise causes a material change in behaviour and / or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, 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. | Significant Observed Adverse Effect  | Avoid                             |
| Noticeable and very disruptive | Extensive and regular changes in behaviour and / or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation / awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory.                                                                                                                                                                            | Unacceptable Adverse Effect          | Prevent                           |

#### 4.3 BS 4142: 2014.

BS 4142:2014 'Methods for rating and assessing industrial and commercial sound' is the current British Standard providing guidance for assessment of noise impact from industrial and commercial sites. In general, the likelihood of adverse impact for a particular noise source is dependent upon factors including the margin by which it exceeds the background noise level, the character of the noise and its occurrence. The Standard recommends the determination of the Rating Level of the specific source and advises a correction factor of between +3dB and +9dB if the sound has a tonal quality, is intermittent or impulsive or has any other distinct characteristics which would make it more noticeable.

The determination of these noise characteristic penalties is to be considered at the noise sensitive receptor location in the presence of typical prevailing ambient and background noise sources and not at the sound source location.

The degree of impact is assessed by comparing the measured background level with the Rating Level. Where the Rating Level exceeds the background, the level of impact increases as shown in the following table.

| Comparison with background                | Assessment                 |
|-------------------------------------------|----------------------------|
| +0 dB or below measured background        | Low impact                 |
| + 5 dB                                    | Adverse impact             |
| + 10 dB or more above measured background | Significant adverse impact |

It should be noted that the assessment method applies to free field external sound levels.

#### 4.4 Mid Sussex District Council.

Noise egress from the new plant items will need to consider the requirements set out in within Policy DP26 of the Mid Sussex District Council District Plan.

It is understood that typically the Rating Level (as determined by the guidance in BS4142:2014) of the cumulative noise associated with new plant items should not be more than 5dB below the prevailing  $L_{A90}$  background sound level at 1m from the nearest noise sensitive premises – in this case the Farmhouse.

Where background sound levels are below  $L_{A90}$  30dB, a limit Rating Level of not more than 30dB is understood to be required to be met.

## 5. Measurements.

### 5.1 Survey results.

Measurements have been made at the Wakehurst Farmhouse to establish the existing ambient noise climate at site and background noise climate representative of the nearest residential façades. These have been used to set plant noise limits in accordance with BS4142 to ensure that noise from new plant items falls into the 'low impact' category and also complies with the Mid Sussex District Council Planning requirements.

Continuous logging measurements were undertaken over a 3-day period from 13:00 Friday 2<sup>nd</sup> August 2024 to 13:00 on Monday 5<sup>th</sup> August 2024.

The most suitable secure location for the logger was judged to be in the courtyard area behind the staff offices so that it would not be disturbed. It was noted that this location was slightly more screened from noise than the upstairs window of the Farmhouse and so synchronised sample measurements were undertaken at location **S1** (see Figure 1) with the mean relative difference between the **sample** and **logger** measurements for ambient and background sound levels noted and used to apply a correction to the logger measurements.

The synchronised logger and sample measurement were as below:

Table 2 – Difference between synchronised logger and sample measurement at residential facade

| Date /time                | Metric           | Logger | Sample | Difference |
|---------------------------|------------------|--------|--------|------------|
| 2 <sup>nd</sup> Aug 13:40 | L <sub>Aeq</sub> | 32     | 37     | +5         |
|                           | L <sub>A90</sub> | 28     | 34     | +6         |
| 2 <sup>nd</sup> Aug 14:10 | L <sub>Aeq</sub> | 31     | 36     | +5         |
|                           | L <sub>A90</sub> | 26     | 32     | +6         |

Based on the above the logger ambient L<sub>Aeq</sub> level have been corrected by 5dB and the background L<sub>A90</sub> by 6dB.

Weather conditions were dry and warm throughout the measurement survey period, with generally light to moderate wind speeds of up to 19km/h. Temperatures ranged between 13 to 27 degrees Celsius.

Levels were recorded continuously in 5-minute samples to determine the equivalent continuous sound level, L<sub>Aeq</sub>, and the percentile L<sub>A90</sub>.

It is considered that the logger measurement data obtained is a true and accurate representation of the overall ambient and background noise climate at site.

It was noted that on the morning of Monday 5<sup>th</sup> from 11:30am grass cutting works were undertaken, these have artificially elevated the data set and so have been removed.

A histogram of the measurements can be found in Appendix B.

All measurements were made with calibrated, precision grade sound level meters in accordance with BS EN 60651 and BS 7445:1993. The equipment was calibration checked before and after measurements with no significant observed calibration drift.

Details of the equipment used are provided in Appendix C.

The mean equivalent L<sub>Aeq,16 hour</sub> daytime, L<sub>Aeq,8 hour</sub> night time and typical background L<sub>A90</sub> daytime and night time measured levels are provided in the following table.

Table 3 – Typical measured ambient and background noise levels at site

| Daytime<br>L <sub>Aeq, 16 hours</sub> (dB) | Night time<br>L <sub>Aeq, 8 hours</sub> (dB) | Typical daytime<br>L <sub>A90</sub> (dB) | Typical night time<br>L <sub>A90</sub> (dB) |
|--------------------------------------------|----------------------------------------------|------------------------------------------|---------------------------------------------|
| 39                                         | 31                                           | 27                                       | 21                                          |

The corrected levels to allow for the screening of the logger position (as set out in Table 2), are set out below.

Table 4 – Typical ambient and background noise levels at nearest residential façade

| Daytime<br>$L_{Aeq, 16 \text{ hours}}$ (dB) | Night time<br>$L_{Aeq, 8 \text{ hours}}$ (dB) | Typical daytime<br>$L_{A90, (dB)}$ | Typical night time<br>$L_{A90, (dB)}$ |
|---------------------------------------------|-----------------------------------------------|------------------------------------|---------------------------------------|
| 44                                          | 36                                            | 33                                 | 27                                    |

## 6. Plant noise egress criteria.

### 6.1 Plant noise limit criteria.

In accordance with the continuous background noise measurements made at site, corrected for screening to the residential facades of the Farmhouse. The plant noise limit criteria at 1m from the Farmhouse façade to meet Mid Sussex District Council Planning requirements, as determined using BS4142 guidance, should be no more than those given below.

Table 5 - External plant noise limit BS4142 Rating Level noise criteria.

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

Plant selections are currently under development but will need to be made and provision for noise control strategies implemented to ensure the above criteria are met whenever the plant is in operation.

Appropriate noise control measures may include, but shall not be limited to the following:

- Selection of low noise plant items
- The introduction of atmosphere side attenuators
- The installation of plant enclosures
- The installation of barrier screens

It is further recommended that if the nearby Wakehurst Place Stable staff accommodation is to be used, that plant noise limits from new items be controlled to be not more than  $L_{Aeq}$  40dB outside the closest bedroom window during the night time. This should enable internal levels of less than  $L_{Aeq}$  30dB be achieved with windows open for background ventilation.

It is noted that if this sound level at the closest staff bedroom window is achieved then the noise limit criteria at the closest existing external residential window of the Farmhouse will be met by default due to the increased distance to the Farmhouse façade.

## 7. Conclusions.

Noise monitoring has been conducted at site to establish the prevailing ambient sound levels at site and the typical background sound levels representative of the nearest residential dwelling facade of Wakehurst Farmhouse.

Limit plant noise egress criteria at the nearest noise sensitive premises have been set in order to be capable of achieving the Mid Sussex District Council criteria when assessed in accordance with BS4142:2014. The total cumulative noise egress associated with all final plant selections will need appropriate noise control measures to ensure compliance with these limit criteria of  $L_{Ar, Tr}$  30dB.

## Appendix A – Glossary of acoustic terminology.

### Sound.

Sound is produced by mechanical vibration of a surface, which sets up rapid pressure fluctuations in the surrounding air.

### The Sound Pressure.

The Sound Pressure is the force (N) of sound on a surface area (m<sup>2</sup>) perpendicular to the direction of the sound. The SI-units for the Sound Pressure are Nm<sup>-2</sup> or Pa (Pascal).

Sound is measured with microphones responding proportionally to the sound pressure – p. The power is proportional to the square of the sound pressure.

### The Sound Pressure Level.

The human ear has an approximately logarithmic response to sound pressure over a very large dynamic range. The lowest audible sound pressure approximately  $2 \times 10^{-5}$ Pa (2 ten billionths of an atmosphere) and the highest is approximately 100Pa.

It is therefore convenient to express the sound pressure as a logarithmic decibel scale related to this lowest human audible sound, where:

$$L_p = 10 \log \left( \frac{p^2}{p_{ref}^2} \right) = 10 \log \left( \frac{p}{p_{ref}} \right)^2 = 20 \log \left( \frac{p}{p_{ref}} \right)$$

Where:

$L_p$  = sound pressure level (dB)

$p$  = sound pressure (Pa)

$p_{ref} = 2 \times 10^{-5}$  – reference sound pressure (Pa)

In accordance with the logarithmic scale, doubling the sound pressure level gives an increase of 6dB.

### Decibel (dB).

The decibel is the unit used to quantify sound pressure levels as well as sound intensity and power levels.

In accordance with the logarithmic scale, an increase of 10dB in sound pressure level is equivalent to an increase by a factor of 10 in the sound pressure level (measured in Pa). Subjectively, this increase would correspond to a doubling of the perceived loudness of the sound.

### Frequency.

The rate at which the pressure fluctuations occur determines the pitch or frequency of the sound. The frequency is expressed in Hertz (Hz) or cycles per second.

### Octave and Third Octave Bands.

An octave is the interval between two points where the frequency at the second point is twice the frequency of the first.

There are many methods of describing the frequency content of a noise. The most common methods split the frequency range into defined bands, in which the mid-frequency is used as the band descriptor and in the case of octave bands is double that of the band lower. For example, two adjacent octave bands are 250Hz and 500Hz.

Third octave bands provided a fine resolution by dividing each octave band into three bands. For examples, third octave bands would be 160Hz, 250Hz and 315Hz for the same 250Hz octave band.

### A-Weighting.

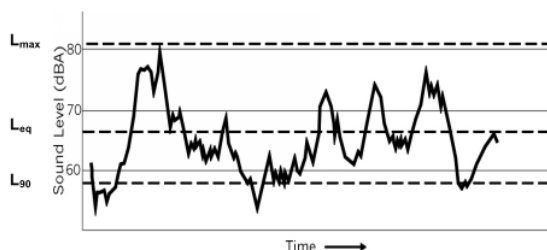
The A-weighting is a correction term applied to the frequency range in order to mimic the sensitivity of the human ear to noise. It is generally used to obtain an overall noise level from octave or third octave band frequencies.

An A weighted value would be written as dB(A) or including A within the parameter term.

### Noise Units.

In order to assess environmental noise, measurements are carried out by sampling over specific periods of time, such as five minutes, the statistically determined results being used to quantify various aspects of the noise.

The figure below shows an example of sound level varying with time. Because of this time variation the same period of noise can be described by several different levels. The most common of these are described below.



#### $L_{eq,T}$

The  $L_{eq,T}$  is a parameter defined as the equivalent continuous sound pressure level over a defined time period 'T'. It is the sound pressure level equivalent to the acoustic energy of the fluctuating sound signal.

The  $L_{eq,T}$  can be thought of as an 'average' sound pressure level over a given time period (although it is not an arithmetic average). Typically, the  $L_{eq,T}$  will be an A-weighted noise level in dB(A) and is commonly used to describe all types of environmental noise sources.

#### $L_{01,T}$

The  $L_{01,T}$  is a parameter defined as the sound pressure level exceeded for 1% of the measurement period 'T'. It is a statistical parameter and cannot be directly combined to another acoustic parameter.

#### $L_{10,T}$

The  $L_{10,T}$  is a parameter defined as the sound pressure level exceeded for 10% of the measurement period 'T'. It is a statistical parameter and cannot be directly combined to other acoustic parameter and is generally used to describe road traffic noise.

#### $L_{90,T}$

The  $L_{90,T}$  is a parameter defined as the sound pressure level exceeded for 90% of the measurement period 'T'. It is a statistical parameter and cannot be directly combined to other acoustic parameter and is generally used to describe the prevailing background noise level.

#### $L_{max,T}$

The  $L_{max,T}$  is a parameter defined as the maximum noise level measured during the specified period 'T'. Fast and slow time constant are usually employed for airborne and structure-borne noise, respectively.

### Specific Noise Level, $L_{Aeq,Tr}$

This is the equivalent continuous A-weighted sound pressure level at the assessment position due to a specific noise source operating over a given time interval.

### **Free Field**

A measurement taken in the free field is at least 3.5m from reflecting vertical surfaces and 1.2m from the ground.

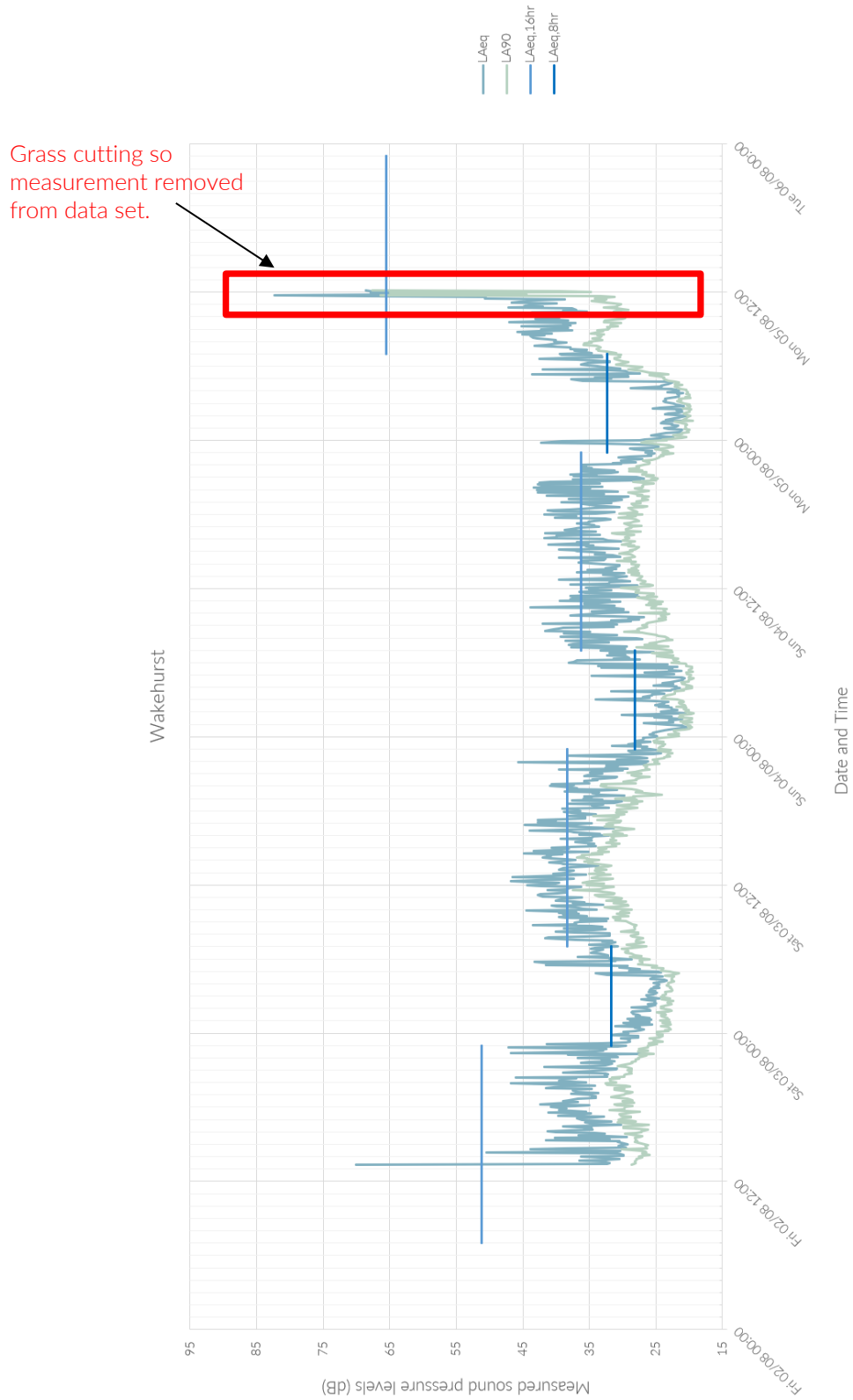
### **Façade**

A measurement is influenced by the reflection of sound from the façade of a building within 3.5m. A façade measurement is made 1m in front of the vertical building surface.

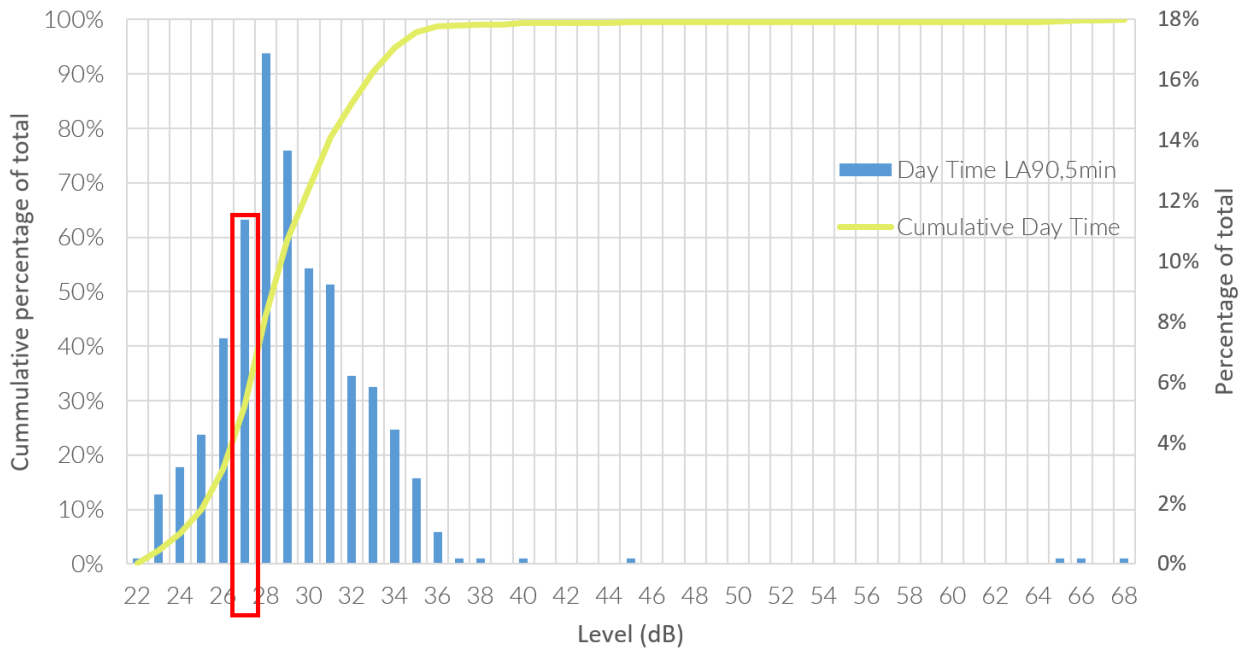
### **R<sub>w</sub>**

A single-number quantity which characterizes the airborne sound insulation of a material or building element in the laboratory. See BS EN ISO 717-1: 1997.

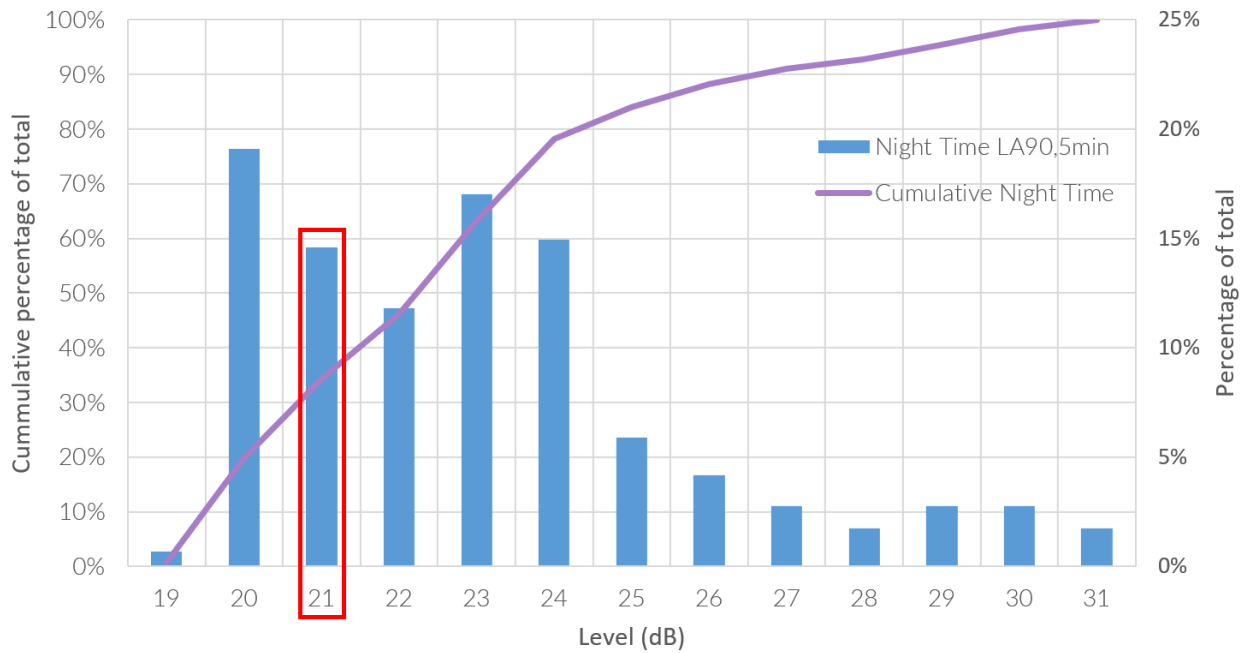
## Appendix B – Histogram of logging survey measurements.



Day (16hr) LA90,5min at Wakehurst



Night LA90,5min at Wakehurst



## Appendix C – Survey and equipment details.

### Equipment details

The details of the equipment used during the environmental noise survey.

All equipment used was within dates of calibration and calibration certificates are available on request. All sound level meters and microphones were calibrated before and after the measurements and no significant calibration drift was observed.

Table 6 - Equipment used during environmental noise survey

| Description                     | Serial Number | Calibration Date |
|---------------------------------|---------------|------------------|
| Rion - Sound Level Meter: NL-52 | 00710261      | 18/08/2023       |
| Rion - Microphone: UC-59        | 18984         |                  |
| Rion - Pre-amplifier: NH-25     | 10255         |                  |

### Weather information

Weather conditions were dry and warm throughout the measurement survey period, with generally light to moderate wind speeds of up to 19km/h. Temperatures ranged between 13 to 27 degrees Celsius.

It was noted that on the morning of Monday 5<sup>th</sup> from 11:30am grass cutting works were undertaken, these have artificially elevated the data set and so have been removed.

The measured data is considered suitable as being representative of typical conditions.



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