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Project:	J 05472R1
	Plant Noise Assessment:
	Sevenoaks, Hampton, TW12 2SX

Consultants: Sound Planning Ltd
25a Vicarage Hill
Lower Bourne
Farnham
Surrey
GU10 3QS

TEL: 01252 711972

Client: Holland Green Ltd

Prepared by: J. Willmott

Signed:

J. Willmott MSc M.I.O.A
Senior Acoustic Consultant

Dated: Tuesday 10th September 2024

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1. BACKGROUND

1.1. The application concerns the installation of Air Source Heat Pumps as part of the development of the site at Sevenoaks, Hampton, TW12 2SX

See APPENDIX 2 - Site Location/Plans.

1.2. Sound Planning understands that the following equipment/activities will contribute to the noise emissions from the proposed new activity areas:

- Air Source Heat Pumps (ASHPs) in the external areas on the north façade of the proposed property.

1.3. Sound Planning has been retained to evaluate potential noise impact on the nearest noise sensitive receiver using appropriate methodologies and assessment criteria, and to design a suitable noise mitigation strategy if required.

1.4. Jake Willmott is a Member of the Institute of Acoustics (M.I.O.A) having attained appropriate qualifications in acoustics and has five years' experience undertaking acoustic assessments including significant experience of BS4142 assessments in the context of planning applications.

Jake has attained the following qualifications within the field of acoustics:

- Institute of Acoustics (IOA) Diploma
- Masters Degree - Applied Acoustics (Solent University)

1.5. Site and Location

1.5.1. The site is in a residential area, behind other residential properties and well screened from nearby noise sources.

1.5.2. The nearest noise sensitive receiver to the proposed plant installation is garden of the property to the north of the site.

See APPENDIX 2 - Site Location/Plans.

1.5.3. Existing noise at the site comprises faint road traffic noise and noise from rustling foliage.

1.6. Proposed Operation Times:

- Monday – Sunday: up to 24-hours per day as required by residents

2. ASSESSMENT CRITERIA

2.1. The plant noise assessment should be carried out in accordance with relevant standards and guidelines in conjunction with National Planning Policy (from the National Planning Policy Framework and the Noise Policy Statement for England), and the London Borough of Richmond upon Thames Development Control for Noise Generating and Noise Sensitive Development Supplementary Planning Document (SPD).

2.2. National Planning Policy Framework

2.2.1. The National Planning Policy Framework (NPPF) was released in March 2012 and last updated in December 2023.

2.2.2. Paragraph 174 of the NPPF states: *'Planning policies and decisions should contribute to and enhance the natural and local environment by… preventing new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by, unacceptable levels of… noise pollution…'.*

2.2.3. Paragraph 185 of the NPPF states that; *'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 (see Explanatory Note to the Noise Policy Statement for England (DEFRA)).*
- *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*
- *limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation.'*

2.2.4. Paragraph 193 of the NPPF states that; *'Planning policies and decisions should ensure that new development4 can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted* *after they were established. Where operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed.'*

2.2.5. Therefore, the NPPF requires that significant impacts are avoided, adverse impacts be mitigated and reduced to a minimum, and places an obligation on developers to not unduly constrain the operation of existing businesses and other noise sources in the area (the *'agent of change'* principle).

2.3. Noise Policy Statement for England (NPSE)

2.3.1. The NPSE requires that developments:

- 'Avoid significant adverse impacts on health and quality of life;
- Mitigate and minimise adverse impacts on health and quality of life; and
- Where possible contribute to the improvement of health and quality of life'

2.4. London Borough of Richmond upon Thames Development Control for Noise Generating and Noise Sensitive Development SPD

2.4.1. The SPD recommends that rating levels for plant installations are likely to be acceptable to the local authority if they are at least 5 dB below the existing background noise level when assessed using the methodology from BS4142:2014.

2.5. Noise Measurement Protocol - British Standard 7445-1: 2003[1]

2.5.1. The methods and procedures described in BS 7445 are intended to be applicable to sounds from all sources, individually and in combination, which contribute to the total noise at a site.

2.5.2. The aim of the BS 7445 series is to provide authorities with material for the description of noise in community environments. Based on the principles

[1] Description and measurement of environmental noise. Part 1 – Guide to quantities and procedures.

described in this standard, acceptable limits of noise can be specified and compliance with these limits can be controlled.

2.5.3. BS 7445 does not specify limits for environmental noise.

2.6. BS 4142: 2014+A1: 2019 – Assessment of Impacts

2.6.1. The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs.

2.6.2. Evaluation of Adverse Impact

- Typically, the greater this difference, the greater the magnitude of the impact.

- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.

- A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the 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 a 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.

2.6.3. Adverse impacts include, but are not limited to, annoyance and sleep disturbance. Not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact.

2.6.4. The specific sound source level is has character corrections applied during the assessment which account for the specific nature of the sound and whether it is more or less likely to be disruptive to the receptor. The available character corrections within the standard are:

Tonality
A correction of up to +6 dB may be applied for a sound which is likely to have discernible tonal elements at the receptor location. Tonality may be assessed via subjective (i.e. perceived on-site) or objective methods, with the subjective method given preference in the standard, where possible. The objective method

may be calculated in either 1/3 octave or octave bands based, with the 1/3rd octave calculation given preference in the standard.

Impulsivity
A correction of up to +9 dB can be applied for sound that is highly impulsive, considering both the rapidity of the change in sound level and the overall change in sound level. Subjectively, this can be converted to a penalty of +3 dB for impulsivity which is just perceptible at the noise receptor, +6 dB where it is clearly perceptible, and +9 dB where it is highly perceptible. A reference method is provided in the standard if a subjective assessment is inconclusive or not possible to undertake.

Intermittency
When the specific sound has identifiable on/off conditions a penalty of +3 dB can be applied.

Other sound characteristics
Where the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distinctive against the residual acoustic environment, a penalty of +3 dB can be applied.

3. NOISE SURVEY METHODOLOGY

3.1. Sound Planning attended the site on Wednesday 21st to Thursday 22nd August 2024, to undertake a background noise survey.

3.2. Background Noise Measurements (21/08/2024 – 22/08/2024)

3.2.1. Sound Monitoring equipment was installed within the site at a reasonably secure location near to the boundary with the NSR.

See APPENDIX 2 – Site Location & APPENDIX 3 – Site Photographs.

3.2.2. The background noise measurements were carried out over a 24-hour period when background levels were thought to be representative of the typical noise environment in the area.

3.2.3. The measurement location was chosen because the noise environment was similar to the site boundary of the nearest sensitive receptors.

3.2.4. The sound level meter was Class 1 – details provided in 3.3. The microphone was positioned 1.5m above ground level and at least 3.5m from any vertical reflective façade.

3.3. Sound Level Measurement Equipment

Equipment	Make	Model	Class	Serial Number	UKAS Calibration
SLM	Norsonic	NOR140	1	1405819	U41230 (11/5/23)
Field Calibrator	Norsonic	NOR1255	1	125525638	U47907 (24/05/2024)

3.4. The Sound Level Meter (SLM) was field calibrated before and after the on-site noise measurements. No deviation was detected (1kHz). UKAS accredited calibration certificates are available on request.

3.5. Other Equipment

Equipment	Make	Model	Class	Serial Number	UKAS Calibration
Environmental Tripod					
Wind/Weather Shield					

3.6. The noise measurements were undertaken in accordance with BS 7445 and BS 4142.

3.7. Full background noise measurements are provided in APPENDIX 4 - Background Noise Levels.

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4. NOISE LEVEL CALCULATION METHODOLOGY

4.1. The noise level at the nearest external noise sensitive receivers (NSR's) will be calculated using the formula (quarter sphere propagation or Q = 4)[2]:

SPL = SWL - 20 log (r) - 5

Where 'SWL' is sound power level

4.2. The resultant (combined) Rating Level (dB L_{Aeq}) will be compared to the existing background noise levels and evaluated against criteria in BS 4142: 2014+A1: 2019

4.3. Screening corrections have been undertaken using the CRTN barrier calculation methodology.

5. NOISE MEASUREMENT RESULTS

5.1. Background Noise Levels – see APPENDIX 2

Noise Sensitive Receiver	Background Noise Level dB $L_{A90, hr}$
NSR	31

6. BS4142:2014 ASSESSMENT

6.1. The make and model of ASHPs to be installed is not yet known, therefore the maximum combined sound power level (L_{wA}) has been calculated to aid with specification of the units:

Equipment / Activity	Maximum Combined Sound Power of ASHPs	Distance to NSR	Screening Attenuation	Background Level	Excess
	(dB L_{wA})	(m)	(dB)	dB L_{A90}	(dB)
ASHPs	65	11	-13	31	-5

[2] See APPENDIX 1 – Glossary of Terms for further detail.

7. NOISE MITIGATION MEASURES

7.1. If the combined sound power level of the ASHP units installed is higher than 65 dB L_{wA} then the following mitigation measures may be required.

7.1.1. Installation of the units with a set-back mode to reduce noise output. Usually set-back modes will reduce the capacity of the ASHP units.

7.1.2. Installation of an acoustic enclosure around the units to attenuate noise.

8. CONCLUSIONS

8.1. Sound Planning has carried out a plant noise assessment in accordance with the requirements of BS 4142: 2014+A1: 2019 and BS 7445: 2003.

8.2. The make and model of ASHPs to be installed at the site is not yet known, therefore a maximum noise level has been provided to aid with specification of the units.

8.3. A detailed assessment of plant noise at the site should be undertaken once the make and model of the ASHPs is known.

8.4. Subject to installation of units below the identified combined sound power level, the installation is likely to comply with the requirement of the local authority and national planning policy and avoid significant impacts on nearby residents.

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APPENDIX 1

Glossary of Acoustic Terms

The Decibel, dB

The unit used to describe the magnitude of sound is the decibel (dB) and the quantity measured is the sound pressure level. The decibel scale is logarithmic and it ascribes equal values to proportional changes in sound pressure, which is a characteristic of the ear. Use of a logarithmic scale has the added advantage that it compresses the very wide range of sound pressures to which the ear may typically be exposed to a more manageable range of numbers. The threshold of hearing occurs at approximately 0 dB (which corresponds to a reference sound pressure of 2 x 10^{-5} pascals) and the threshold of pain is around 120 dB. The sound energy radiated by a source can also be expressed in decibels. The sound power is a measure of the total sound energy radiated by a source per second, in watts. The sound power level, L_w is expressed in decibels, referenced to 10^{-12} watts.

Frequency, Hz

Frequency is analogous to musical pitch. It depends upon the rate of vibration of the air molecules that transmit the sound and is measure as the number of cycles per second or Hertz (Hz). The human ear is sensitive to sound in the range 20 Hz to 20,000 Hz (20 kHz). For acoustic engineering purposes, the frequency range is normally divided up into discrete bands. The most commonly used bands are octave bands, in which the upper limiting frequency for any band is twice the lower limiting frequency, and one-third octave bands, in which each octave band is divided into three. The bands are described by their centre frequency value and the ranges which are typically used for building acoustics purposes are 63 Hz to 4 kHz (octave bands) and 100 Hz to 3150 Hz (one-third octave bands).

Noise Rating

The Noise Rating (NR) system is a set of octave band sound pressure level curves used for specifying limiting values for building services noise. The Noise Criteria (NC) and Preferred Noise Criteria (PNC) systems are similar.

A-weighting

The sensitivity of the ear is frequency dependent. Sound level meters are fitted with a weighting network which approximates to this response and allows sound levels to be expressed as an overall single figure value, in dB(A).

Noise Descriptors

Where noise levels vary with time, it is necessary to express the results of a measurement over a period of time in statistical terms. Some commonly used descriptors follow.

$L_{Aeq, T}$ *The most widely applicable unit is the equivalent continuous A-weighted sound pressure level ($L_{Aeq, T}$). It is an energy average and is defined as the level of a notional sound which (over a defined period of time, T) would deliver the same A-weighted sound energy as the actual fluctuating sound.*

L_{AE} *Where the overall noise level over a given period is made up of individual noise events, the $L_{Aeq, T}$ can be predicted by measuring the noise of the individual noise events using the sound exposure level, L_{AE} (or SEL or L_{AX}). It is defined as the level that, if maintained constant for a period of one second, would deliver the same A-weighted sound energy as the actual noise event.*

L_{A1} *The level exceeded for 1% of the time is sometimes used to represent typical noise maxima.*

L_{A10} *The level exceeded for 10% of the time is often used to describe road traffic noise.*

L_{A90} *The level exceeded for 90% of the time is normally used to describe background noise.*

Sound Transmission Descriptors

D_{nT} Standardised level difference

$D_{nT, w}$ Weighted standardised level difference

L_1 The average sound pressure level in the source room

L_2 The average sound pressure level in the receiving room

T Reverberation time (receiving room)

T_0 Reference reverberation time = 0.5s

C_{tr} Adaption spectrum which takes account for low to medium speed road/rail/air traffic; disco music; and factory noise (medium to low frequency noise).

C Adaptation spectrum which takes account of domestic activities including speech, music, radio and television.

Frequency Analysis

Octave Band	*A band of frequencies the upper limit of which is twice the lower limit. They are known by their centre frequency, e.g., 63, 125, 250, 500, 1000, 2000 Hz…*
One Third Octave	*The logarithmic frequency interval between a lower frequency f_2, when f_2/f_1 equals $2^{1/3}$ apart. Frequencies include: 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1000Hz.*

Sound Transmission in the Open Air

Most sources of sound can be characterised as a single point in space. The sound energy radiated is proportional to the surface area of a sphere centred on the point. The area of a sphere is proportional to the square of the radius, so the sound energy is inversely proportional to the square of the radius. This is the inverse square law.

In decibel terms, every time the distance from a point source is doubled, the sound pressure level is reduced by 6 dB. Road traffic noise is a notable exception to this rule, as it approximates to a line source, which is represented by the line of the road. The sound energy radiated is inversely proportional to the area of a cylinder centred on the line. In decibel terms, every time the distance from a line source is doubled, the sound pressure level is reduced by 3 dB.

Factors Affecting Sound Transmission in the Open Air

Reflection

When sound waves encounter a hard surface, such as concrete, brickwork, glass, timber or plasterboard, it is reflected from it. As a result, the sound pressure level measured immediately in front of a building façade is approximately 3 dB higher than it would be in the absence of the façade.

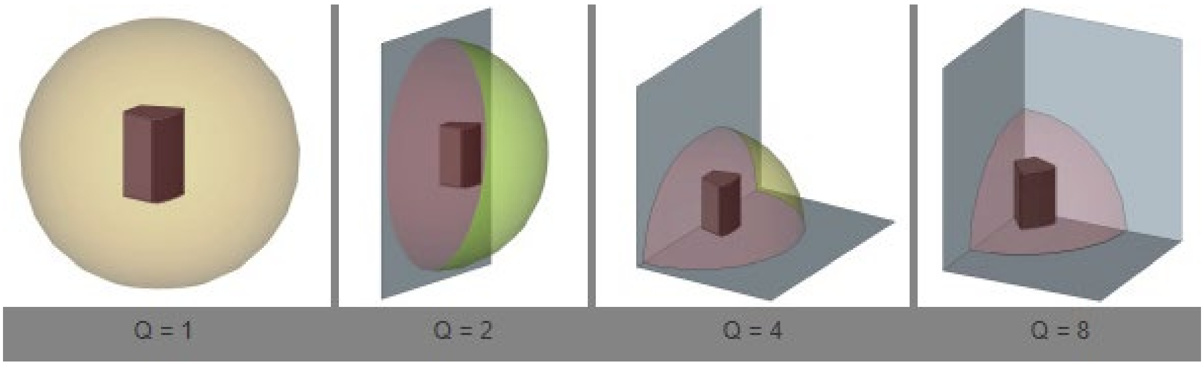
Screening and Diffraction

If a solid screen is introduced between a source and receiver, interrupting the sound path, a reduction in sound level is experienced. This reduction is limited, however, by diffraction of the sound energy at the edges of the screen. Screens can provide valuable noise attenuation however. For example, a timber boarded fence built next to a motorway can reduce noise levels on the land beyond, typically by around 10 dB(A). The best results are obtained when a screen is situated close to the source or close to the receiver.

Meteorological Effects

Temperature and wind gradients affect noise transmission, especially over large distances. The wind effects range from increasing the level by typically 2 dB downwind, to reducing it by typically 10 dB upwind – or even more in extreme conditions. Temperature and wind gradient are variable and difficult to predict.

Directivity Index



APPENDIX 2

Site Location/Plans

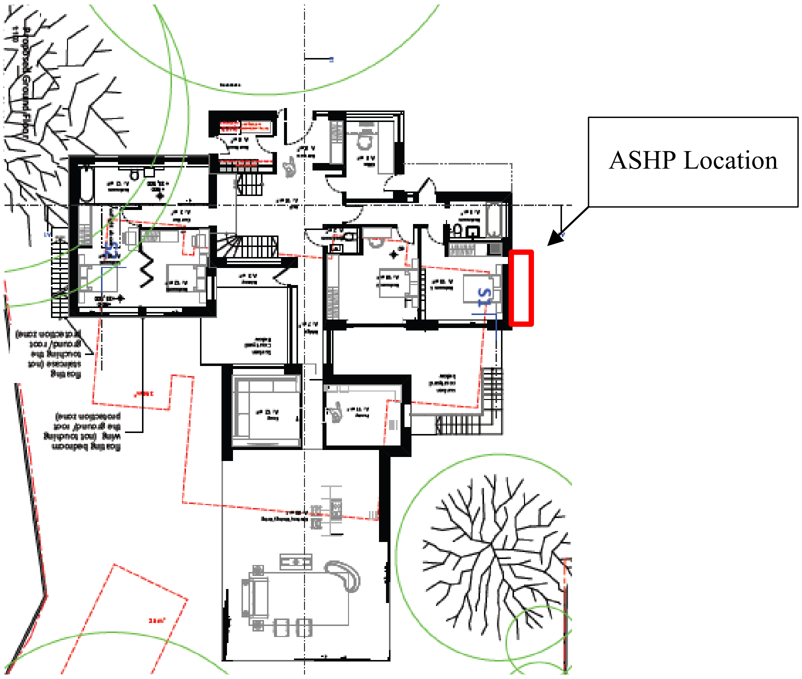
Google Earth

Key:

- NSR 1 – Residential Property
- ASHP location
- Site Boundary
- Noise Monitoring Position (MP1)

Site Location/Plans

Site Layout with ASHP Location



NSR 1 Distance

APPENDIX 3

Site Photographs

Background Noise Measurement Position

APPENDIX 4

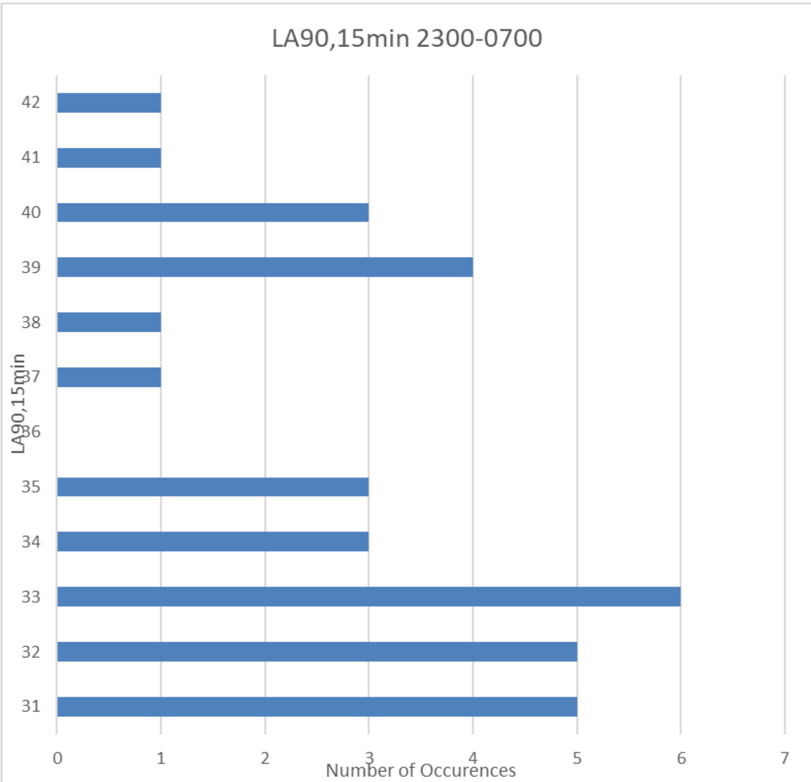
Noise Measurement Data

Background Noise Levels – MP1

Date	Time	L_{Aeq}	L_{AFmax}	L_{AF10}	L_{AF90}
(d/m/y)	(hrs:mins)	(dB)	(dB)	(dB)	(dB)
21/08/2024	12:00	47.1	74.4	41.4	39.3
21/08/2024	13:00	41.9	59.3	43	38.1
21/08/2024	14:00	47.5	72.4	45.1	38.1
21/08/2024	15:00	40.8	58.5	41.9	37.6
21/08/2024	16:00	42.6	62.8	42.9	38.4
21/08/2024	17:00	48.2	73.8	44.8	38.7
21/08/2024	18:00	46.8	73.5	42.2	38.2
21/08/2024	19:00	44.6	69.2	41.3	37.0
21/08/2024	20:00	44.2	75.9	39.5	35.8
21/08/2024	21:00	40.0	56.5	41.3	36.2
21/08/2024	22:00	39.9	59.7	40.1	34.8
21/08/2024	23:00	37.5	51.6	38.7	33.2
22/08/2024	00:00	35.9	45.2	37.7	32.3
22/08/2024	01:00	35.0	54.0	36.3	31.1
22/08/2024	02:00	35.9	47.3	37.1	32.1
22/08/2024	03:00	39.9	51.7	39.6	34.6
22/08/2024	04:00	42.9	55.6	45.2	37.3
22/08/2024	05:00	44.9	64.3	45.3	39.5
22/08/2024	06:00	46.8	70.2	46.1	41.4
22/08/2024	07:00	50.0	76.4	48.6	43.8
22/08/2024	08:00	48.8	64.5	49.2	43.5

Date	Time	L_{Aeq}	L_{AFmax}	L_{AF10}	L_{AF90}
22/08/2024	09:00	47.2	66.8	48.3	42.3
22/08/2024	10:00	47.9	69.4	49	42.1
22/08/2024	11:00	46.9	66.9	47.8	41.4
22/08/2024	12:00	44.5	58.9	44.6	41.1
22/08/2024	13:00	46.9	68.6	47.4	41.7

Background Noise Level Analysis – Night-time



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APPENDIX 5

Levels of Uncertainty

Category	Notes
Complexity of Sound Source	Unknown number of ASHP units installed externally
Complexity of Acoustic Environment (Residual)	Residual environment is shielded from nearby noise sources and controlled by distant traffic and nature noise
Level of Residual Sound (including Specific)	Level of residual sound is low compared to specific sound levels
Measurement Location	Representative of closest receptor
Distance Between Sound Source & Measurement Position	11m – measured from satellite and scaled drawings
Number of Measurements Taken	24-hours
Measurement Time Intervals	15-minute measurements
Range of Times	Includes quietest likely times of proposed operation
Range of Suitable Weather Conditions	1 measurement period – Suitable weather conditions
Measurement Method/Practitioners	1 measurement period (Jake Willmott) measurements taken in line with BS7445
Level of Rounding	Rounded to nearest DP; 0.5 rounded up
Instrumentation	Class 1 SLM (suitable)

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APPENDIX 6

Barrier Calculation

Based on CRTN Barrier Calculation procedure			
Source-receiver distance, m	11.0	S-R angle	0.090659887
Source-barrier distance, m	2	Height to S-R line	0.681818182
Source height, m	0.5	Diffracted path length	11.51387819
Receiver height, m	1.5	Direct path length	11.04536102
Barrier height, m	2		
Path length difference, m	0.469	Log pld	-0.329274487
	Shadow zone	Shadow zone attenuation	-12.95547314
Attenuation, dB	**-13.0**	Illuminated zone attenuation	-0.137664435