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NCC FUTURE READY PROPERTY ENHANCEMENT INITIATIVE

34 RIGHTUP LANE, WYMONDHAM – PLANT NOISE ASSESSMENT

AJA Report no. 14065/1A

Aconex ref. AL0633-ADR-ZZ-ZZ-RP-O-00002

Adrian James Acoustics Document Control Sheet

Client	Mace 155 Moorgate London EC2M 6XB
Filename	14065 Report 1A - 34 Rightup Lane.docx

QA Control

Rev	Date	Author	Checked by	Approved by
P01	24 May 2024	[redacted]	[redacted]	[redacted]
P02	30 May 2024	[redacted]	[redacted]	[redacted]

Revision History

Rev	Details
P01	First issue
P02	Heat pump position updated

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1 INTRODUCTION

1.1 Background

We have been appointed by Mace to assess noise from an air source heat pump (ASHP) proposed to be installed at 34 Rightup Lane, Wymondham, as part of Tranche 1 of the Norfolk County Council Future Ready Property Enhancement Initiative.

This report details the results of our assessment.

1.2 Statement of technical competency

The survey and assessment described in this report were carried out by Ian Rees, a full member of the UK Institute of Acoustics (MIOA).

Ian is an Associate Acoustics Consultant with Adrian James Acoustics Ltd. He has worked as an acoustics consultant with Adrian James Acoustics since 2005. Ian has a BSc (Hons) degree and was awarded the IoA Diploma in Acoustics and Noise Control in 2004.

Ian has experience of undertaking environmental noise assessments for a variety of premises including industrial and healthcare.

Adrian James Acoustics Ltd is a full member and registered test organisation for the ANC (the Association of Noise Consultants) and the company is therefore qualified to undertake noise measurements and assessments.

1.3 Source information

The report is based on design information provided to us by Hudson Architects and Hoare Lea, including the following drawings:

Drawing no.	Revision	Title
AL0633-HUD-XX-XX-DR-A-45003	P01	Proposed site plan
AL0633-HUD-XX-XX-DR-A-45002	P01	Proposed block plan

2 PLANNING POLICY, TECHNICAL STANDARDS AND GUIDANCE

2.1 National planning policy

Details of national planning policies and associated guidance relevant to this assessment are provided in Appendix B. This includes:

- National Planning Policy Framework (NPPF)
- Noise Policy Statement for England (NPSE)
- National Planning Practice Guidance (NPPG)

In combination, these documents set out national planning policies relating to noise, and the current guidance on appropriate terminology and methodology for noise assessment.

2.2 BS 4142:2014+A1:2019

British Standard 4142:2014+A1:2019 *'Methods for rating and assessing industrial and commercial sound'* (BS 4142) describes a method for the rating and assessment of sound of an industrial and/or commercial nature. Details of the standard are provided in Appendix C.

In summary, the BS 4142 assessment methodology can be summarised as follows:

1. Determine the background sound level (dB $L_{A90,T}$) at the noise sensitive receptor(s).
2. Determine the specific sound level of the source under assessment (dB $L_{Aeq,T}$) at the receptor location(s).
3. Apply corrections to the rating level if the sound has tonal, impulsive, intermittent, or other characteristics which attract attention (see Table 8 of Appendix C for details).
4. Compare the rating level (dB $L_{Ar,Tr}$) with the background sound level.

According to BS 4142:

- If the rating level is 5 dB or more above the background sound level this indicates an adverse impact, depending on context.
- If the rating level is 10 dB or more above the background sound level this indicates a significant adverse impact, depending on context.
- Where the rating level does not exceed the background sound level this indicates a low impact, depending on context.

BS 4142 places a strong emphasis on context when considering any assessment outcome.

The BS 4142 methodology also requires that any areas of uncertainty are reported and that, where necessary, reasonable, practicable steps should be taken to reduce the uncertainty.

3 DESCRIPTION OF SITE AND PROPOSALS

3.1 Description of site and proposals

34 Rightup Lane is located in a quiet suburban area of Wymondham, Norfolk. Surrounding areas primarily comprise residential dwellings and grasslands. The railway line serving Wymondham is located approximately 200 m to the north-west, and the A11 dual carriage way is approximately 750 m to the south-east. The nearest noise-sensitive receptors are the neighbouring residential dwellings on Rightup Lane and adjoining roads.

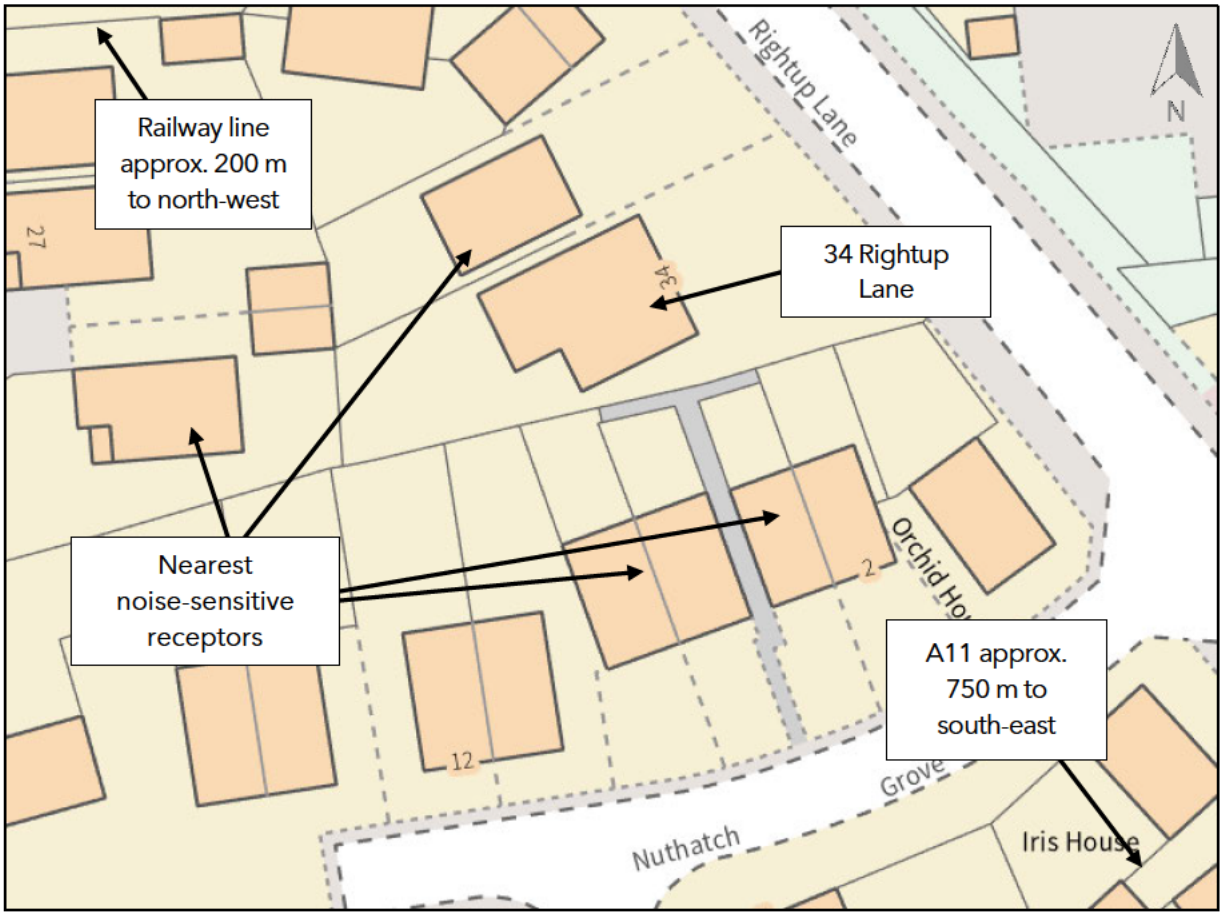

Figure 1 – Annotated aerial plan of site and surroundings

The development includes the installation of an air source heat pump (ASHP), with proposed location shown in Figure 2.

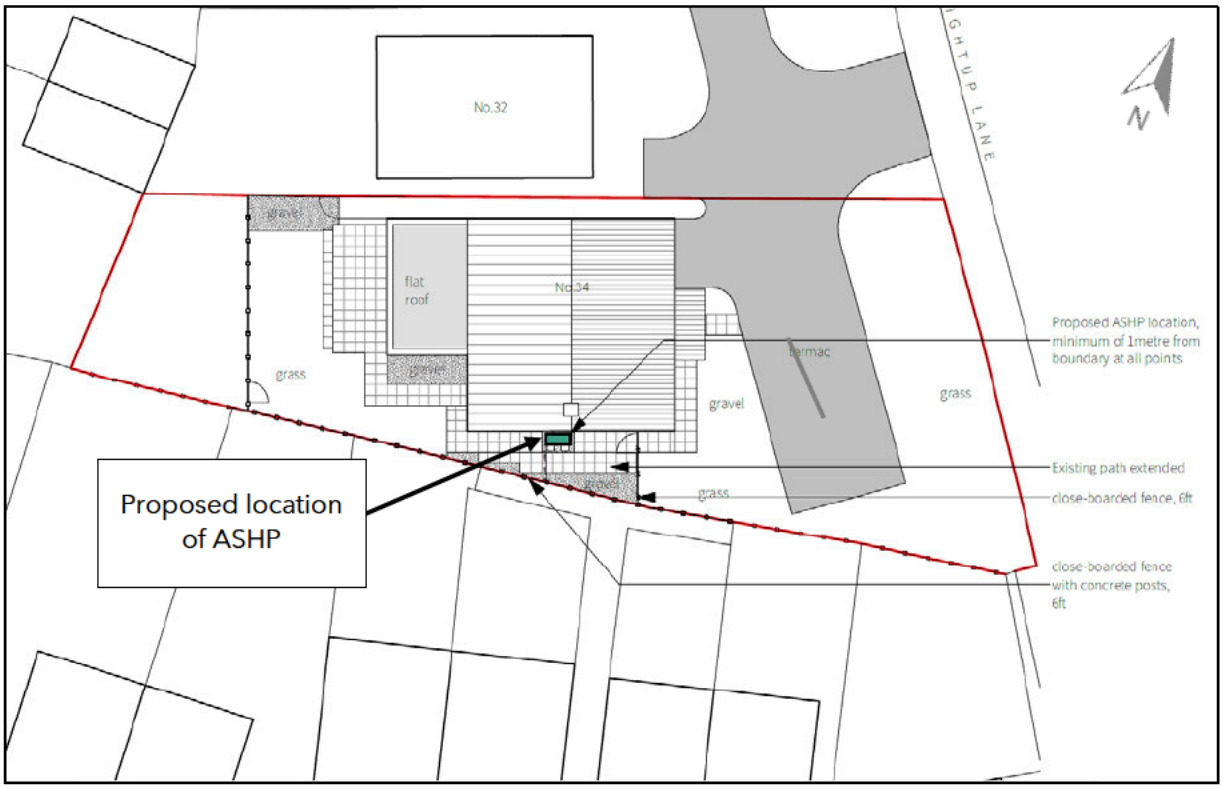

Figure 2 – Proposed location of ASHP

3.2 Description of sound source(s)

3.2.1 Overview of plant

Details of the proposed plant are shown in Table 1.

Plant Type	Make / Model	Quantity
Air Source Heat Pump (ASHP)	Mitsubishi PUZ-WM112VAA(-BS)	1

Table 1 – Details of proposed plant

We understand that the proposed plant may operate during day and night-time periods and have therefore assessed noise levels on this basis.

3.2.2 Plant noise data

The octave-band sound pressure levels of the ASHP type PUZ-WM112VAA provided by the manufacturer Mitsubishi are shown in Table 2.

Frequency, Hz	63	125	250	500	1000	2000	4000	8000	dB(A)
Sound pressure level, dB	54.5	56.5	45.5	43.5	41.5	34.5	32.0	27.0	**47**

Note: The stated sound pressure levels are measured at a distance of 1 m from the unit, under hemi-spherical conditions.

Table 2 – Sound pressure levels of proposed ASHP

4 SOUND MEASUREMENTS

4.1 Introduction

We undertook a survey from 19 April 2024 to 22 April 2024 to establish typical background sound levels at the site, using an unattended logging sound level meter. Values for L_{AF90} were measured at 1-hour intervals for daytime and 15-minute intervals for night-time, in line with the BS 4142 day and night-time reference time intervals. The instrument also recorded audio for the complete survey duration, so that extraneous noises could be identified and omitted from the calculations. The microphone was mounted on a pole at a height of 1.5 m in free-field conditions.

4.2 Survey methodology

4.2.1 Measurement locations

Measurements were taken in the front garden of 34 Rightup Lane at a distance of approximately 14 m to the road. Individual car passes on Rightup Lane were infrequent, and background sound levels were dominated by distant traffic on the A11 dual carriageway. We therefore expect this measurement position to be representative of background sound levels experienced at the nearest noise-sensitive receptors.

Figure 3 – Annotated aerial photo of measurement positions © Google 2024

4.2.2 Instrumentation

Details of the sound measurement systems used are presented in Appendix E.

The measurement systems were calibrated before and after use using the reference calibrator described in Appendix E. The results of the test are presented in Table 3.

Instrument	Calibrator reference level (dB)	Level before (dB)	Level after (dB)	Calibration drift (± dB)
NTi XL2	93.8	93.8	93.8	0.0

Table 3 – Details of operational calibration test

4.2.3 Weather conditions

Meteorological information for the survey period was taken from regional weather data.

Weather conditions were generally considered suitable for acoustic measurement with average temperatures typically ranging between 2°C and 11°C and negligible rainfall.

Average wind speeds did not exceed 5–6 m/s during the survey, apart from the evening of Friday 19 April. This period has been excluded from our analysis. Stronger gusts of wind at other times during the survey period did not significantly impact the measured levels.

4.3 Survey results

4.3.1 Subjective impressions

As discussed in Section 4.2.1, whilst traffic was observed on Rightup Lane, individual car passes were infrequent. Background sound levels were instead dominated by distant traffic on the A11 dual carriageway. Other notable sources include birdsong and wind noise.

4.3.2 Background sound levels

Figure 4 presents the measured daytime background sound levels in a histogram (showing the frequency of occurrence for the full range of background sound levels).

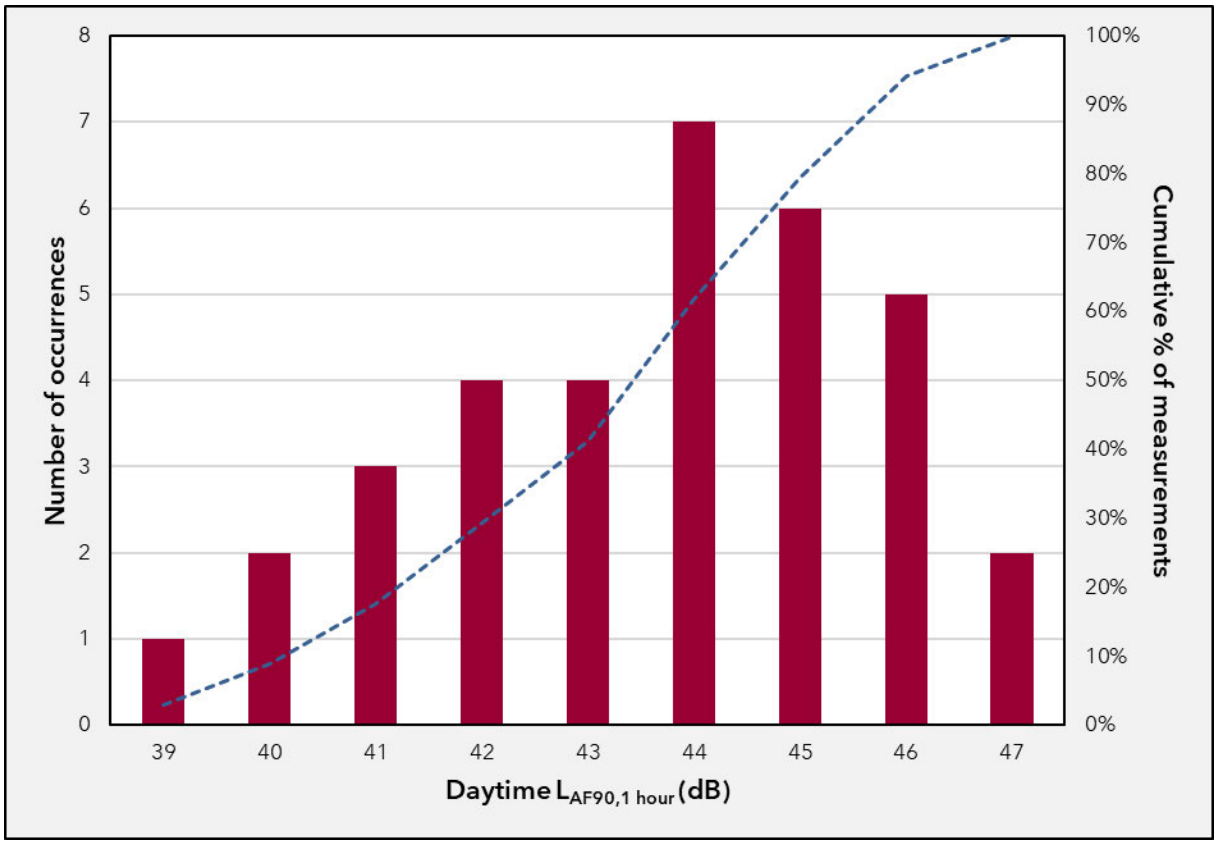

Figure 4 – Histogram of measured daytime background sound levels

Figure 5 presents the measured night-time background sound levels in a histogram.

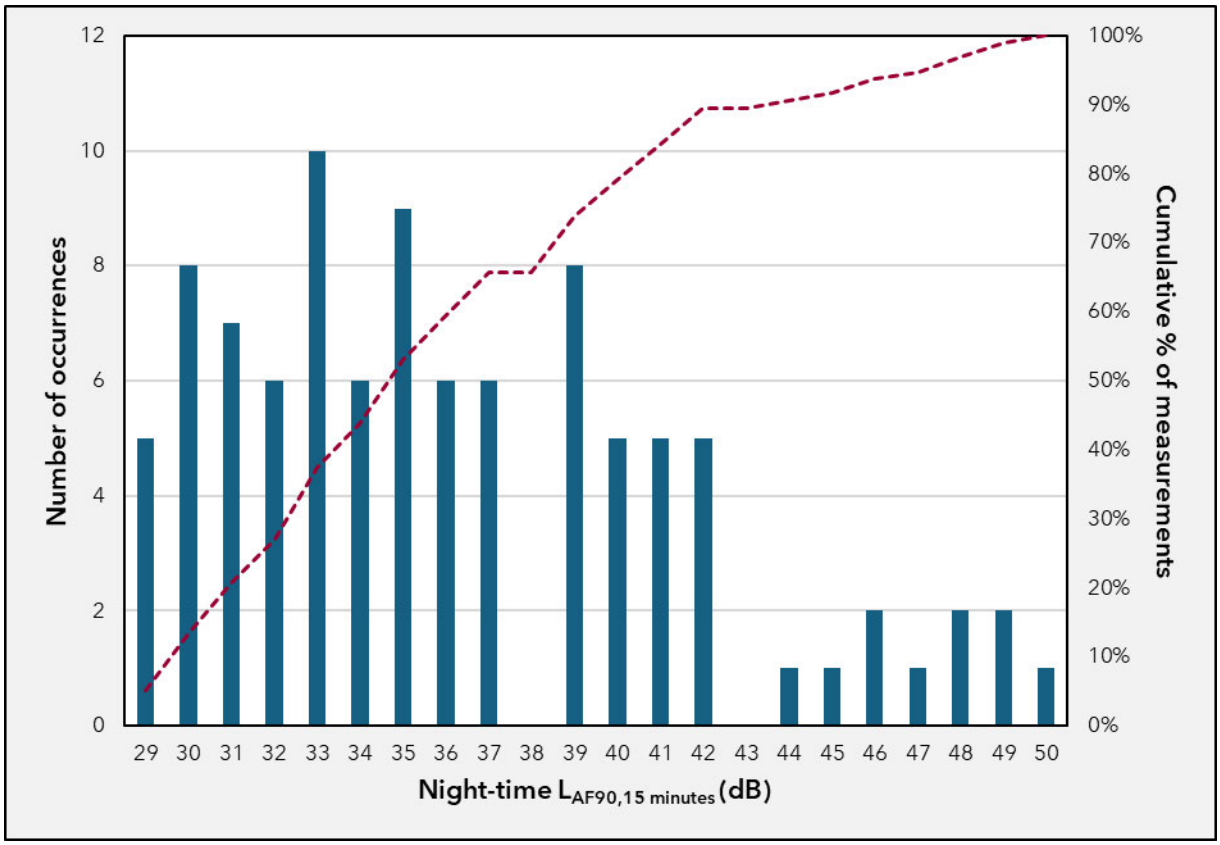

Figure 5 – Histogram of measured night-time background sound levels

5 BS 4142 ASSESSMENT

5.1 Background sound level

In practice, there is no single background sound level as this is a fluctuating parameter and the background sound level used should be representative of the period being assessed.

Both BS 4142 and the accompanying Association of Noise Consultants (ANC) technical note state that the representative background sound level used ought to account for the range of background sound levels and should not necessarily be the lowest and/or mode value.

Based on this, and in consideration of the histograms presented in Section 4.3.2, we have selected a typical free-field background sound level of 42 dB during daytime periods and 32 dB during night-time periods. This is presented in Table 4.

Measurement period	Free-field background sound level, dB $L_{AF90,T}$
Daytime (07:00–23:00 hrs, T=1 hour)	42
Night-time (23:00–07:00 hrs, T=15 minutes)	32

Table 4 – Typical free-field background sound levels

5.2 Specific sound level

We created a 3D noise model using CadnaA software to calculate sound propagation from the source subject to assessment.

The calculation methodology from ISO 9613-2 *'Attenuation of sound during propagation outdoors'* (ISO 9613-2) was adopted (full details of ISO 9613-2 are provided in Appendix D).

Table 5 below sets out the main configuration settings from our CadnaA model which define the correction factors applied according to the ISO 9613-2 calculation method. ISO 9613-2 has a calculation tolerance of ±3 dB.

Atmospheric absorption	Ambient temperature	10°C
	Relative humidity	70%
Ground effect	Default ground absorption	0.50 (medium-soft ground)
	Roads, driveways	0.00 (hard ground)
Surface reflection and absorption	Freestanding barriers	Absorption coefficient: 0.10
	Buildings	Absorption coefficient: 0.10
	Number of reflections calculated	5

Table 5 – ISO 9613-2 correction configurations applied in the CadnaA model

The A-weighted sound level propagation map with the ASHP operating is shown in Figure 6. The map height was set to 1.5 m to align to indicate propagation through gardens and external amenity areas.

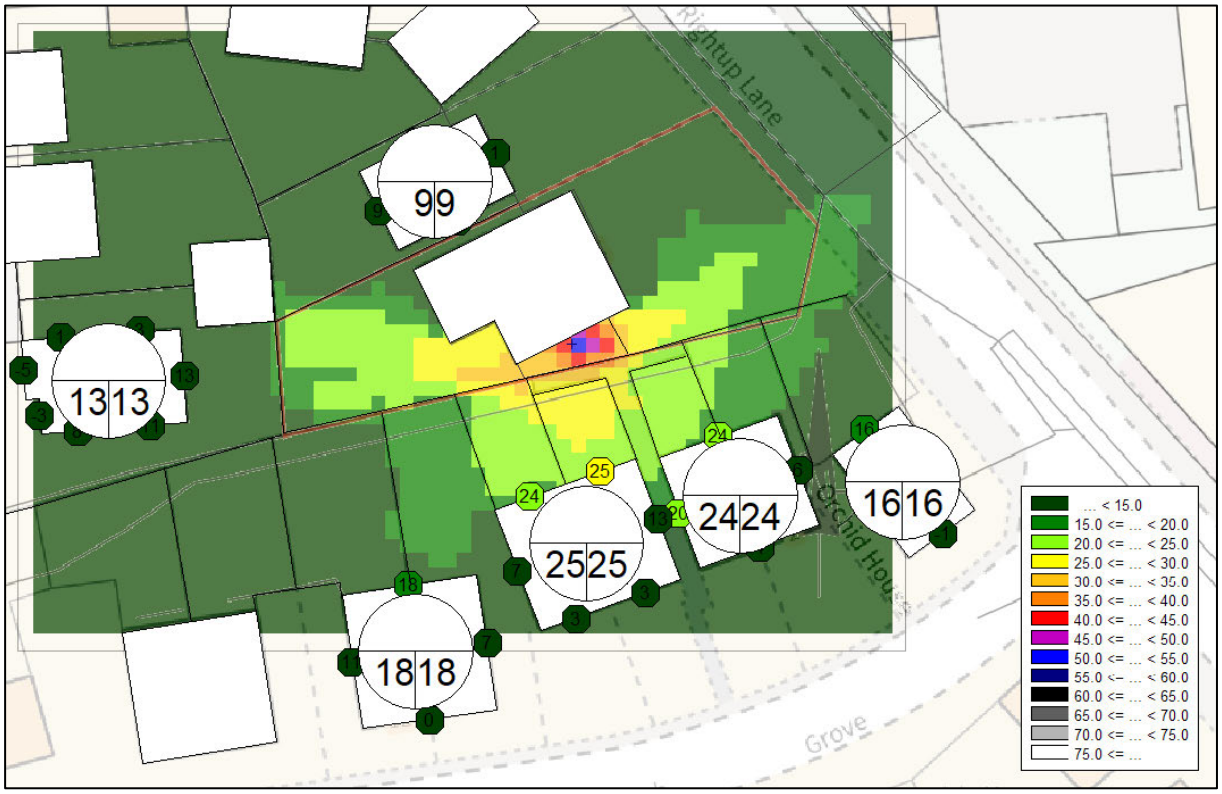

Figure 6 – CadnaA noise prediction map

5.3 Rating level

During the daytime, we have taken the highest specific sound level in the neighbouring gardens to the south to be 30 dB $L_{Aeq,1hr}$.

During the night-time, we have considered equivalent free-field levels at the nearest residential windows. The highest specific sound level at night is 25 dB $L_{Aeq,15min}$ at the first-floor window of a neighbouring dwelling to the south.

Where the specific sound source(s) under assessment contains acoustic features which are likely to make it more distinctive at the location of noise-sensitive receptors, BS 4142 states that corrections should be applied to the specific sound level to obtain the rating level.

We have assessed this as follows:

- **Impulsivity:** Modern fan systems should not inherently exhibit any identifiable impulsive characteristics if they are appropriately specified and are regularly and appropriately maintained. As a result, we do not expect the proposed plant to exhibit any distinctive impulsive components.

- **Tonality:** Modern fan systems should not inherently exhibit any identifiable tonality if they are appropriately specified and are regularly and appropriately maintained. As a result, we do not expect the proposed plant to exhibit any distinctive tonal components.
- **Intermittency:** The proposed ASHP is likely to operate continuously, but may be intermittent during particular modes of operation, for example during frost protection cycles. We have therefore applied a correction of 3 dB in respect of this.

5.4 Assessment of impacts

The impact of the specific sound source can initially be estimated by subtracting the representative background sound level from the rating level. Typically, the greater this difference, the greater the magnitude of impact (depending on context).

The results of the BS 4142 assessment are presented in Table 6.

Assessment Period	Specific sound level dB $L_{Aeq,T}$	Combined feature corrections dB	Rating level dB $L_{Ar,Tr}$	Background sound level dB $L_{A90,T}$	Difference (± dB)
Daytime 07:00–23:00 hrs	30	+3	33	42	-9
Night-time 23:00–07:00 hrs	25	+3	28	32	-4

Table 6 – Summary of BS 4142 assessment results

The predicted rating level is below the typical background level during both the day and night. In accordance with BS 4142, the above assessment indicates that a low impact is likely. The predicted rating levels are very low in absolute terms and therefore we consider the risk of adverse impact to be very unlikely.

5.5 Uncertainty

Certain aspects of the field measurement method in this case introduce uncertainty. BS 4142 recommends that any significant uncertainties are reported, potential effects highlighted and, where practicable, reasonable steps taken to reduce the effects.

5.5.1 Uncertainty of measured values

- Measurement position:
  - The measurement position was in the front garden of 34 Rightup Lane. It is possible that the noise levels experienced at the nearest noise-sensitive receptors may be slightly different, but we expect any differences to be minimal.

- Weather conditions:
    - Unfavourable weather conditions such as rain and high winds can cause inaccuracies in measured data. Where unfavourable weather conditions occurred, we have identified and omitted the data from our analysis.

5.5.2 Uncertainty in calculations

- Plant noise data:
    - Plant noise data was obtained directly from the plant manufacturers, and as such we are reliant on the accuracy of this data.
- Computer model:
    - Our noise model was created in CadnaA software and used the calculation methodology from ISO 9613-2 to predict outdoor sound propagation of the plant noise. ISO 9613-2 has a calculation uncertainty of ±3 dB. Due to the relatively low plant noise levels, a difference of ±3 dB would not significantly affect the outcome of the assessment.

6 CONCLUSIONS

- We have assessed noise from proposed plant at 34 Rightup Lane, Wymondham.
- We understand that the proposed plant may operate during day and night-time periods and have therefore undertaken our assessment on this basis.
- We took day and night-time measurements to ascertain the representative (lowest typical) background sound levels at the nearest noise-sensitive receptors. The representative daytime background sound level was found to be 42 dB $L_{AF90,1hr}$. The representative night-time background sound level was found to be 32 dB $L_{AF90,15min}$.
- We used manufacturer's data and a computer model to calculate plant noise levels at the façades of the nearest noise-sensitive receptors. We have applied a 3 dB character correction for intermittency, although this is only likely to occur during very specific scenarios. We predicted a daytime rating level of 33 dB $L_{Ar,Tr}$ in the nearest neighbouring garden and a night-time rating of 28 dB $L_{Ar,Tr}$ at the façade of the nearest noise-sensitive receptor.
- The calculated rating levels are 9 dB below the daytime background sound level, and 4 dB below the night-time background sound level.
- In accordance with BS 4142, our assessment indicates that an adverse impact is unlikely at all noise-sensitive receptors.
- Based on the outcome of this assessment, we expect that no additional mitigation measures are required to control noise levels from the proposed plant.

APPENDIX A
TECHNICAL TERMS AND UNITS RELEVANT TO THIS REPORT

A1 General acoustic terminology

Decibel (dB) – This is the unit used to measure sound level. The range of human hearing from the quietest detectable sound to the threshold of pain is very large. If a normal linear scale of measurement were used, it would have to range from 20 µPa to 200,000,000 µPa. Using such large figures would be unmanageable and for this reason sound pressure levels are expressed on a logarithmic scale, which corresponds to the almost logarithmic response of the ear and which compresses the range to a manageable 0 dB to140 dB.

Sound Pressure Level (L_p or SPL) – This is a function of the source and its surroundings and is a measure in decibels of the total instantaneous sound pressure at a point in space. The SPL can vary both in time and in frequency. Different measurement parameters are therefore required to describe the time variation and frequency content of a given sound.

Frequency – This refers to the number of complete pressure fluctuations or cycles that occur in one second. Frequency is measured in Hertz (Hz). The rumble of thunder has a low frequency, while a whistle has a high frequency. The sensitivity of the ear varies over the frequency range and is most sensitive between 1 kHz and 5 kHz.

Octave and One-Third Octave Bands – The human ear is sensitive to sound over a frequency range of approximately 20 Hz to 20,000 Hz and is more sensitive to medium and high frequencies than to low frequencies. To define the frequency content of a sound, the spectrum is divided into frequency bands, the most common of which are octave bands. Each band is referred to by its centre frequency, and the centre frequency of each band is twice that of the band below it. Where it is necessary for a more detailed analysis octave bands may be divided into one-third octave bands.

'A' Weighting – A number of frequency weightings have been developed to imitate the ear's varying sensitivity to sound of different frequencies. The most commonly used is the 'A' weighting. The A-weighted SPL can be measured directly or derived from octave or one-third octave band SPLs. The result is a single-figure index which gives some idea of the subjective loudness of the sound, but which contains no information as to its frequency content. The addition of the subscript 'A' to any of the indices described above indicates that these have been measured using the A-weighting (*e.g.* $L_{Aeq,T}$ or L_{Amax}).

Statistical Analysis – These figures are normally expressed as L_N, where L is the sound pressure level in dB and N is the percentage of the measurement period. The L_N figure represents the sound level that is exceeded for that percentage of the measurement period. L_{90} is commonly used to give an indication of the background level or the lowest level during the measurement period. L_{10} may be used to measure road traffic noise.

A2 BS 4142-specific terminology

Acoustic environment - Sound from all sources as modified by the environment.

Ambient sound level, LA = $L_{Aeq,T}$ – Totally encompassing sound, usually composed of many sources. Comprises the residual sound and specific sound when present.

Background sound level, $L_{A90,T}$ – A weighted SPL exceeded by the residual sound for 90% of the a given time interval, T and rounded to the nearest whole dB.

Measurement time interval, T_m – Total time over which measurements are taken. May be the sum of multiple non-contiguous, short-term intervals.

Rating level, $L_{Ar,Tr}$ – Specific sound level plus adjustment for characteristic features

Reference time interval, T_r – Specified interval over which the specific sound level is determined, *i.e.* 1 hour during the day (07:00–23:00 hrs) and 15 minutes at night (23:00–07:00 hrs).

Residual sound level, $L_r = L_{Aeq,T}$ – Ambient sound remaining when specific sound source does not contribute

Specific sound level, $L_S = L_{Aeq,Tr}$ – Level produced by specific sound source over reference time interval, Tr. Can also be calculated and/or predicted.

APPENDIX B
NATIONAL PLANNING POLICY AND GUIDANCE

B1 National Planning Policy Framework

The latest version of the National Planning Policy Framework (NPPF) was released in February 2019 and was last updated in December 2023.

The NPPF does not set out quantitative criteria for assessing noise affecting proposed developments, but in paragraph 180 states that planning policies and decisions should actively contribute to the enhancement of 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."*

According to paragraph 191, planning policies and decisions should also ensure new development is appropriate for its location, particularly considering the likely effects on health and living conditions. Planning policy and decision makers should aim to:

> *"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".*

The 'agent of change principle' has been part of the NPPF since the July 2018 revision. This principle means that a person or business (i.e. the agent) introducing a new land use is responsible for managing the impact of that change. Paragraph 193 states:

> *"Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the 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."*

B2 Noise Policy Statement for England

The Noise Policy Statement for England (NPSE) published by DEFRA in March 2010 sets out the Government's policy on noise, which is:

> *"to promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development."*

The NPSE also introduces concepts from toxicology currently being applied to noise impacts by the World Health Organisation. These are:

- NOEL – No Observed Effect Level: This is the level below which no effect can be detected.
- LOAEL – Lowest Observed Adverse Effect Level: This the level above which adverse effects on health and quality of life can be detected.
- SOAEL – Significant Observed Adverse Effect Level: This is the level above which significant adverse effects on health and quality of life occur.

The three aims of the NPSE are in alignment with the categories described above.

These aims are:

1. *"Avoid significant adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.*
2. *Mitigate and minimise adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.*
3. *Where possible, contribute to the improvement of health and quality of life through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development."*

B3 National Planning Practice Guidance

Guidance on interpretation of the policy aims of the NPPF and NPSE is provided in the online National Planning Practice Guidance (NPPG) published in March 2014.

It reiterates the guidance within the NPPF, stating that:

> *"Noise needs to be considered when new developments may create additional noise and when new developments would be sensitive to the prevailing acoustic environment."*

The NPPG provides advice regarding how to determine the impact of noise, including whether or not a significant adverse effect or adverse effect is occurring or likely to occur and whether or not a good standard of amenity can be achieved.

The NPPG proposes a noise exposure hierarchy based on likely average response. The guidance contained in the NPPG is summarised in Table 7.

Perception	Examples of Outcomes	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 Lowest Observed Adverse Effect Level	No specific measures required
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 reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect Significant Observed Adverse Effect Level	Mitigate and reduce to a minimum
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

Table 7 – Noise exposure hierarchy from the NPPG

APPENDIX C
TECHNICAL STANDARDS AND GUIDANCE

C1 BS 4142:2014+A1:2019

C1.1 Introduction

British Standard 4142:2014+A1:2019 *'Methods for rating and assessing industrial and commercial sound'* (BS 4142) describes appropriate technical methodology for the rating and assessment of sound of an industrial and/or commercial nature.

Sound of an industrial and/or commercial nature includes industrial and manufacturing processes, fixed mechanical and electrical plant installations, the unloading of goods and materials at industrial and/or commercial premises and sound from mobile plant that is an inherent part of the overall sound from industrial and/or commercial premises.

BS 4142 is applicable for the purposes of:

- Investigating complaints;
- Assessing sound from proposed, new, modified, or additional source(s) of sound from an industrial and/or commercial nature; and
- Assessing sound at proposed new dwellings or premises used for residential purposes.

BS 4142 is not intended to be applied to the rating and/or assessment of sound from recreational activities (including motorsport), music and other forms of entertainment, shooting grounds, construction/demolition, domestic animals, people, public address systems and any other sources falling within the scope of other standards/guidance.

C1.2 Summary of BS 4142 assessment methodology

The BS 4142 assessment methodology can be summarised as follows:

1. Determine the background sound level (dB $L_{A90,T}$) at the nearest noise sensitive receptor(s) of interest.
2. Determine the specific sound level of the source under assessment (dB $L_{Aeq,T}$) (T=1 hour during the day or 15 minutes at night) at the receptor location(s).
3. Apply a rating level acoustic feature correction if the sound source has tonal, impulsive, intermittent, or other characteristics which attract attention.
4. Compare the rating level (dB $L_{Ar,Tr}$) with the background sound level; typically, the greater this difference, the greater the magnitude of impact.

Differences of around +10 dB are likely to be an indication of significant adverse impact, depending upon the context; a difference of +5 dB is likely to be an indication of adverse impact, depending upon the context. Where the rating level (dB $L_{Ar,Tr}$) does not exceed the background sound level ($L_{A90,T}$) at the nearest receptor of interest, the indication is that the specific sound source will have a low impact, depending upon the context.

Note: Adverse impacts include but are not limited to sleep disturbance. Not all adverse impacts will lead to complaints and not all complaints are proof of an adverse impact.

C1.3 Acoustic features

Certain acoustic features (which include tonality impulsivity and/or intermittence) can also increase the significance of impact. Where such features are present a *"character correction"* should be added to the specific sound level to obtain the rating level.

The recommended BS 4142 character corrections are presented in Table 8.

Characteristic	Perceptibility		
	Just Perceptible	Clearly Perceptible	Highly Perceptible
Tonality	+2 dB	+4 dB	+6 dB
Impulsivity	+3 dB	+6 dB	+9 dB
Intermittency	0 dB	+3 dB	+3 dB
Other	0 dB	+3 dB	+3 dB

Table 8 – Summary of BS 4142:2014 character corrections

BS 4142:2014 describes suitable subjective methods for assessing character features, plus additional objective (one-third octave and reference) methods for tonality.

C1.4 Context

BS 4142 places emphasis on context. Section 11 of the standard states that:

> *"An effective assessment cannot be conducted without an understanding of the reason(s) for the assessment and the context in which the sound occurs/will occur. When making assessments and arriving at decisions, therefore, it is essential to place the sound in context."*

Contextual factors to be considered include:

- The absolute level of sound.
- The character and level of the residual sound compared to the character and level of the specific sound.
- The sensitivity of the receptor and whether sensitive premises will already incorporate design measures that secure good internal and/or outdoor acoustic conditions, such as glazing/ventilation/screening etc.

C1.5 Low sound levels

Where background sound and rating levels are low, Section 11 of BS 4142 states that:

> *"absolute sound levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night."*

The ANC Technical Note on BS 4142 (March 2020) states that:

> *"BS 4142 does not define 'low' in the context of background sound levels nor rating levels. The note to the Scope of the 1997 version of BS 4142 defined very low background sound levels as being less than about 30 dB L_{A90}, and low rating levels as being less than about 35 dB $L_{Ar,Tr}$."*

C1.6 Uncertainty

The BS 4142 methodology also requires that the level of uncertainty in the technical data and/or calculations is reported. Where uncertainty could affect the conclusion, reasonable, practicable steps should be taken to reduce uncertainty. If appropriate, the level and potential effects of any identified uncertainty should also be reported.

APPENDIX D
ISO 9613-2 *'ATTENUATION OF SOUND DURING PROPAGATION OUTDOORS'*

ISO 9613-2 *'Attenuation of sound during propagation outdoors'* sets out an engineering method for calculating the attenuation of sound during propagation outdoors in order to predict downwind environmental noise levels at distance from a variety of sources.

As well as accounting for the distance between each source and receiver, the ISO 9613-2 method also includes the following factors:

- **Geometrical divergence, A_{div}**

  Accounts for spherical spreading in the free field from a point sound source.

- **Atmospheric absorption, A_{atm}**

  Depends primarily on the frequency of the sound, the ambient temperature and relative humidity of the air.

- **Ground effect, A_{gr}**

  Mainly the result of sound reflected by the ground surface interfering with the sound propagating directly from source to receiver.

- **Screening by obstacles, A_{bar}**

  Screening obstacles (often called barriers) must have a closed surface (without large cracks or gaps) and have a surface density of at least 10 kg/m².

- **Reflections**

  Reflections off horizontal or vertical surfaces (such as the facades of buildings) which can increase the sound pressure levels at the receiver.

- **Meteorological correction, C_{met}**

  Only applied where local meteorological conditions vary from those which are favourable to propagation for several months or a year. This is rarely applied.

ISO 9613-2 has a calculation tolerance of ±3 dB.

APPENDIX E
MEASUREMENT SYSTEMS AND CALIBRATION

Job reference and title:	14065 NCC Future Ready PEI
Measurement location:	See Section 4.2.1 of this report
Measurement date(s):	19–22 April 2024

Equipment used on survey:

Equipment description / serial number	Type number	Manufacturer	Date of calibration expiration	Calibration certificate number
Precision sound level meter serial no. A2A-04410-D2	XL2	NTi Audio	23/10/2025	45703
Microphone serial no. A16324	MC230	NTi Audio	23/10/2025	45704
Microphone pre-amplifier serial no. 5309	MA220	Neutrik	23/10/2025	45703
Microphone calibrator serial no. 01120250	CAL21	01dB-Stell	23/10/2025	45702

On-site calibration (all levels in dB, reference level at 1 kHz):

Reference level	Level before	Level after	Calibration drift
93.8	93.8	93.8	0.0

Other information:

Person in charge of measurements:	[redacted]
Measurement parameters	Octave-band and A-weighted $L_{eq,T}$ Octave-band and A-weighted $L_{F90,T}$ Octave-band and A-weighted $L_{F,max}$

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