PROFESSIONAL CONSULT

FUTURE ENVIRONMENTS

Noise Impact Assessment

Proposed Energy Centre, Swaffham Prior

Client: **Prospus Energy**

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EXECUTIVE SUMMARY

This Assessment has been undertaken to identify the key sources of noise associated with the development and to quantify the existing background sound climate at the closest residential dwelling. Accordingly, this Assessment has been completed with due regard to the National Planning Policy Framework and its associated National Planning Policy Guidance in addition to appropriate British Standards and guidance documents relevant to the assessment of noise impacts.

This Assessment has shown that the cumulative rated level of noise from all operations associated with the Site will fall below the typical background sound level during daytime hours and during the night-time period, the internal level of noise within bedrooms allowing for a partially open window, comfortably falls below the internal night-time criteria noise level at the closest dwelling. As such, operation of the Site is not expected to give rise to adverse noise impacts at the closest dwelling.

The level of noise generated by the Site and its predicted impact at the closest residential dwelling accords with the 'No Observed Effect Level' as detailed in the PPG and as such noise should not be deemed to be consideration in the granting of planning permission for this scheme.

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1 INTRODUCTION

1.1 Background

1.1.1 Professional Consult Limited was instructed by Prospus Energy to prepare a Noise Impact Assessment ('the Assessment') for a proposed energy centre at Swaffham Prior in Cambridge CB25 to be referred to hereafter as 'the Site'.

1.1.2 Proposals will include for a network of pipes which will run from the renewable Energy Centre to all homes connected. Heat circulates constantly through the network, thermal energy is distributed to each home, and then 'topped up' (reheated) on each return to the energy centre. Thermal energy from the network is transferred to individual homes via a 'Heat Interface Unit' (HIU). The transferred heat then circulates through the radiators and water cylinder. Specifically, the Energy Centre will include for:

- Three heat pumps to be located internally within the building;
- Three air source evaporators, to be located externally;
- Four water vessels, to be located externally; and
- 6x Inverters to be located in the solar field.

1.1.3 The Site is bound by open farmland to the north, east and south and to the west lies a residential dwelling.

1.1.4 This Assessment has been undertaken to identify the key sources of noise associated with the development and to quantify the existing background sound climate at the closest residential dwelling. Accordingly, this Assessment has been completed with due regard to the National Planning Policy Framework and its associated National Planning Policy Guidance in addition to appropriate British Standards and guidance documents relevant to the assessment of noise impacts.

1.1.5 All acronyms used within this report are defined in the Glossary presented in Appendix 2.

1.2 Limitations

1.2.1 The limitations of this report are presented in Appendix 1.

1.3 Confidentiality

1.3.1 Professional Consult has prepared this report solely for the use of the Client. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from Professional Consult; a charge may be levied against such approval.

2 POLICY & GUIDANCE

2.1 National Planning Policy Framework & National Planning Practice Guidance

2.1.1 The Government updated the National Planning Policy Framework (NPPF) on 19th February 2019 and its associated National Planning Practice Guidance (NPPG) on 22nd July 2019. Together, the NPPF and NPPG set out what the Government expects of local authorities. The overall aim is to ensure the planning system allows land to be used for new homes and jobs, while protecting valuable natural and historic environments.

2.1.2 The NPPG adds further context to the NPPF and it is intended that the two documents should be read together.

2.1.3 Noise needs to be considered when new developments may create additional noise and when new developments would be sensitive to the prevailing acoustic environment. When preparing local or neighbourhood plans, or taking decisions about new development, there may also be opportunities to consider improvements to the acoustic environment.

2.1.4 Local planning authorities' plan-making and decision making should take account of the acoustic environment and in doing so 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.

2.1.5 In line with the Explanatory Note of the Noise Policy Statement for England, this would include identifying whether the overall effect of the noise exposure (including the impact during the construction phase wherever applicable) is, or would be, above or below the significant observed adverse effect level and the lowest observed adverse effect level for the given situation.

2.1.6 The Observed Effect Levels are as follows:

- Significant observed adverse effect level: This is the level of noise exposure above which significant adverse effects on health and quality of life occur;
- Lowest observed adverse effect level: this is the level of noise exposure above which adverse effects on health and quality of life can be detected; and
- No observed effect level: this is the level of noise exposure below which no effect at all on health or quality of life can be detected.

2.1.7 Table 1 summarises the noise exposure hierarchy, based on the likely average response.

Table 1. Noise Exposure Hierarchy

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	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 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	Mitigate and reduce to a minimum
Significant Observed 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 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

2.1.8 The subjective nature of noise means that there is not a simple relationship between noise levels and the impact on those affected. This will depend on how various factors combine in any particular situation.

2.1.9 These factors include:

- The source and absolute level of the noise together with the time of day it occurs. Some types and level of noise will cause a greater adverse effect at night than if they occurred during the day - this is because people tend to be more sensitive to noise at night as they are trying to sleep. The adverse effect can also be greater simply because there is less background noise at night;
- For non-continuous sources of noise, the number of noise events, and the frequency and pattern of occurrence of the noise;
- the spectral content of the noise and the general character of the noise. The local topology and topography should also be taken into account along with the existing and, where appropriate, the planned character of the area.

2.1.10 More specific factors to consider when relevant:

- where applicable, the cumulative impacts of more than one source should be taken into account along with the extent to which the source of noise is intermittent and of limited duration;
- Consideration should also be given to whether adverse internal effects can be completely removed by closing windows and, in the case of new residential development, if the proposed mitigation relies on

windows being kept closed most of the time. In both cases a suitable alternative means of ventilation is likely to be necessary. Further information on ventilation can be found in the Building Regulations; and

- If external amenity spaces are an intrinsic part of the overall design, the acoustic environment of those spaces should be considered so that they can be enjoyed as intended.

2.2 BS4142:2014+A1:2019 'Methods for rating and assessing industrial and commercial sound'

2.2.1 This standard describes methods for rating and assessing sound of an industrial or commercial nature which includes:

- Sound from industrial and manufacturing processes;
- Sound from fixed installations which comprise mechanical and electrical plant and equipment;
- Sound from the loading and unloading of goods and materials at industrial and / or commercial premises; and,
- Sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from processes or premises, such as that from forklift trucks, or that from train or ship movements on or around an industrial or commercial Site.

2.2.2 The procedure detailed in the standard compares the measured or predicted noise level 'the specific noise level' from any of the above detailed noise sources with the background sound level at a residential dwelling. The measured background sound level at a receptor should be reliable and should not necessarily ascertain a lowest measured background sound level, but rather to quantify what is 'typical.'

2.2.3 The specific noise level also acknowledges the following reference time intervals depending upon whether the noise source operates during daytime or night-time periods:

- Daytime (07:00 - 23:00): 1 hour; and
- Night-time (23:00 - 07:00): 15 minutes.

2.2.4 There are a number of 'penalties' which can be attributed to the specific sound level, either subjectively or objectively, depending upon the 'acoustic features' of the sound level under investigation as follows. These penalties vary in their weighting depending upon the severity of the acoustic feature, as follows (with regards to the subject method):

<u>Tonality</u>

- +2dB: where the tonality is just perceptible;
- +4dB: where the tonality is clearly perceptible; and
- +6dB: where the tonality is highly perceptible.

<u>Impulsivity</u>

- +3dB: where the impulsivity is just perceptible;
- +6dB: where the impulsivity is clearly perceptible; and
- +9dB: where the impulsivity is highly perceptible.

Intermittency

- +3dB: where the intermittency is readily distinctive against the acoustic environment.

2.2.5 Where the assessment is carried out using the objective method, the tonality penalty is either 0dB or 6dB and the impulsivity penalty can range from 0dB up to 9dB in increments of 1dB, depending on the level of impulsivity identified.

2.2.6 In addition to the above acoustic features, there is a penalty for 'other sound characteristics' of +3dB where a sound exhibits characteristics that are neither tonal nor impulsive, though is readily distinctive against the acoustic environment.

2.2.7 BS4142 goes on to state that the rating level is equal to the specific sound level if there are no such features present or expected to be present.

2.2.8 Assessment of the rating level relative to the background noise level can yield the following commentary:

- Typically, the greater this difference (between the rating level and the background sound level), the greater the magnitude of impact;
- A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context;
- A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context; and
- The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an 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.

2.2.9 Whilst the amended 2019 Standard does make various references to it not being intended to assess noise impacts at indoor locations, section 1.1 does state 'The methods described in this British Standard use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident'. Example 6 in the Standard states 'In addition to the rating/background sound level comparison shown in Table A.6, the primary concern is the potential for disturbance of residents who could be sleeping with open bedroom windows. Other guidance, such as BS 8233, might also be applicable in this instance'.

2.2.10 With the above in mind, and for a clear need to ensure that any potential commercial or industrial noise impacts at the building façade do not give rise to internal noise level which causes sleep disturbance in bedrooms, this Assessment will ensure that the predicted rating level (specific sound level including any character corrections) does not exceed 30dB in bedrooms.

2.3 Local Authority Guidance and Criteria – East Cambridgeshire District Council's Environmental Health Department

2.3.1 Professional Consult contacted East Cambridgeshire District Council in order to outline the proposed noise survey and assessment methodology. The following consultation was provided:

> *'We have been appointed by a developer to complete a Noise Impact Assessment for a proposed energy centre as part of the 'Heating Swaffham Prior' renewable heating network. The proposed energy centre will be located close to an existing residential receptor off Heath Road and so we expect that East*

Cambridgeshire District Council will require a Noise Impact Assessment for the proposal. The energy centre will comprise of boreholes, air pumps and solar power to supply the thermal energy.

We propose to complete a background sound survey over a typical weekday and weekend period at a location considered to be representative of the closest residential receptor to the energy centre. We will the complete a Noise Impact Assessment for all proposed mechanical and electrical plant in line with the guidance and criteria presented in BS4142:2014+A1:2019 whereby we will ensure that the rated level of noise does not exceed the typical background sound level.'

2.3.2 A response was received which stated:

"I have read the EIA Screening and Scoping Report which advises that -

"the air sourced heat collector and energy centre may create a noise profile in their various states of operation. Detailed noise assessments of proposed equipment and assessments during operation at relevant receptor points will be provided."

The report has identified the likely noisy mechanical plant and outlined a methodology to assess them which will follow the principles of BS4142:2014 and I have no issues with this. The scoping report also states that the assessment will ensure that the predicted rating level (specific sound level including any character corrections) does not exceed 30dB in bedrooms. It is not clear if this will be 30dB with a partially open window or with closed windows but the LPA will likely expect these internal levels to be achieved with a partially open window."

3 NOISE SURVEY

3.1.1 Professional Consult has completed a background sound survey at a location considered to be representative of the background sound climate at the closest dwelling to the west of the Site, as follows:

- Measurement Position 1: 14:00, 12th June 2020 – 09:00, 15th June 2020. The microphone of the sound level meter was located in free-field conditions. The sound climate at the microphone location comprised of intermittent vehicles movements along Heath Road, occasional aircraft over-flights and distant low-level noise from the A14.

3.1.2 Table 2 summarises the measured background sound levels at the microphone location.

Table 2. Summary of Measured Background Sound Levels

Measurement Position	Period	Range of Measured Background Sound Levels, $L_{A90,1hr}$ (dB)	Calculated Typical (Median) Background Sound Level, $L_{A90,1hr}$ (dB)
1	Night-time (23:00 – 07:00)	19 - 38	20.4
	Daytime (07:00 – 23:00)	21.3 – 34.1	32.1

3.2 Noise Survey Equipment

3.2.1 The following equipment was used for the Noise Surveys.

Table 3. Noise Measurement Equipment

Measurement Position	Equipment Description	Manufacturer & Type No	Serial No.	Calibration Due Date
NMP1	Sound Level Meter	01dB Fusion	11755	16 July 2020
	Pre-amplifier	01dB PRE22	1707173	
	Microphone	GRAS 40CE	291693	
	Calibrator	01dB CAL-31	84086	13 July 2020

3.2.2 The sound level meters were field calibrated prior to and following the surveys and no significant drift was identified.

3.2.3 During the noise surveys the weather conditions were conducive to the measurement of environmental noise, i.e. wind speeds of no more than 5m/s and dry conditions and Table 4 indicates a summary of the measured weather conditions.

Table 4. Range of Measured Wind Speeds

Period	Range of Measured Wind Speeds (m/s)	Rainfall Recorded?
All periods	0 – 3.2	No

4 NOISE IMPACT ASSESSMENT

4.1 Assessment Information

4.1.1 Professional Consult has been supplied with information detailed in Table 5.

Table 5. Proposed Plant & Equipment

Proposed Plant	Noise Level, $L_{Aeq,T}$ (dB)	Proposed Location
Air Source Evaporator x3	43dB @10m	3x fan beds to be located adjacent to the south east façade of the Energy Centre building
Heat Pump x3	$72L_{WA}$ (Model 170 x1) $77L_{WA}$ (Model 250 x2)	3x Heat Pumps to be located within the Energy Centre building
Inverter x6	65dB @1m	6x inverters to be located in the solar field to east

4.1.2 With regards to the Energy Centre building specification, the following sound reduction indices have been adopted for the various building fabric components:

- Walls: brick/block with a sound reduction index of 45dB R_w; and
- Roof: Cement fibre with a sound reduction index of 25dB R_w.

4.2 Assessment for Residential Dwelling to West

4.2.1 Calculation of the sound pressure level immediately outside the Energy Centre building components by using the following equation:

- SPL outside = SPL inside - R - 6dB

Where: 'R' is the Sound Reduction Index for the building component

4.2.2 Calculation of the sound power level for each building component by using the following equation:

- Lw = SPL + 10 x log S

Where: 'S' is the surface area in square meters of the building component

4.2.3 Calculation of the sound pressure level, from each building component at the receptor, by using the following equation:

- SPL = Lw - 20 x log r - 8

Where: 'r' is the distance in metres from the individual building component to the receptor.

4.2.4 Calculation of the combined sound pressure level from the applicable building components at the receptor, by using the following equation:

- SPLTotal = 10 x log (10^(L1/10) + 10^(L2/10) ……)

4.2.5 Table 6 calculates the sound power level of the various building components.

Table 6. Calculation of Sound Power Levels for Façade & Roof Components

Building		Building Component				
		North Façade	East Façade	South Façade	West Façade	Roof
Energy Centre Building	Direct SPL Internal (dB)	48.7	48.7	48.7	48.7	55.4
	Reverberant SPL Internal (dB)	63.4	63.4	63.4	63.4	63.4
	Total Combined SPL Internal (dB)	63.5	63.5	63.5	63.5	64.0
	SRI (dB)	45	45	45	45	25
	-6 dB	-6	-6	-6	-6	-6
	SPL Immediately Outside (dBA)	12.5	12.5	12.5	12.5	33.0
	Area of Building Component (m^2)	119	126	119	126	306
	Sound Power Level of Component (dBA)	**33.3**	**33.5**	**33.3**	**33.5**	**57.9**

4.2.6 Table 7 calculates the overall sound pressure level at the closest receptor.

Table 7. Calculation of Specific Sound Pressure Level

Building		Building Component				
		North Façade	East Façade	South Façade	West Façade	Roof
Energy Centre Building	Sound Power Level of Component (dB)	33.3	33.5	33.3	33.5	57.9
	Distance to Receptor (m)	28	46	46	30	35
	Calculated Sound Pressure Level at Receptor (dB)	-3.7	-7.7	-8.0	-4.0	19.0
	Total Combined Sound Pressure Level at Receptor (dB)	**19.0**				

4.2.7 In addition to calculating the specific noise level from the Energy Centre building at the dwelling it is also necessary to calculate the noise level from the evaporator beds and the inverters which are all located externally. Table 8 calculates the specific noise level from these plant items.

Table 8. Calculation of Specific Sound Pressure Level

Plant Item	Noise Level, $L_{Aeq,t}$ (dB)	Measurement Distance (m)	Distance to House (m)	Barrier Attenuation (dB)	Calculated Specific Noise Level in Garden (dB)	Cumulative Specific Noise Level at Dwelling (m)
Fan bed 1	43	10	43	-13**	17.3	24.2

Fan bed 2	43	10	45	-12**	17.9	
Fan bed 3	43	10	47	-11**	18.6	
Inverters x6	72.8*	1	504	0***	18.8	

*65dB / inverter unit, 6 items gives 72.8dB
**Barrier attenuation calculated according to each evaporator bed location relative to the Energy Centre building.
***Given the distance of the inverters from the dwelling

4.2.8 Table 9 calculates the cumulative specific noise level at the dwelling.

Table 9. Calculation of Cumulative Specific Noise Level

Component	Calculated Specific Noise Level at Dwelling (dB)
Energy Centre Noise Breakout	19.0
External Plant	24.2
Total	**25.3**

4.2.9 The following has been considered in determining if any acoustic features exist in the predicted noise level at the closest residential receptor:

- Tonality - In determining if any tones exist in the measured noise levels, the methodology set out in BS4142:2014 has been followed using the objective method – either a 0dB penalty is allocated where no tones are present or 6dB penalty is allocated where tonality is present;
- Impulsivity – in determining if any impulsiveness is evident in the measured noise levels, the methodology set out in BS4142:2014 has been followed using the objective method which can result in a penalty from 0dB to 9dB being allocated depending upon the extent of impulsiveness;
- Intermittency – whether or not the measured operations turn on or off during the (1hr) assessment period;
- Other sound characteristics – where no penalties are allocated for the above features, but there will be an audible noise at the closest receptor.

4.2.10 Table 10 allocates appropriate character corrections.

Table 10. Allocation of Character Corrections

Measured Operation	Tonality Correction (dB)	Impulsivity Correction (dB)	Intermittency Correction (dB)	Other Sound Characteristics Correction (dB)	Comments
Building noise breakout and external plant	2	0	3	0	Noise is just audible against the existing noise climate and can be intermittent
Highest Correction for Assessment Period	**2**	**0**	**3**	**0**	**-**

Overall Correction to be added to Specific Noise at Receptor	**+5**

4.2.11 Table 11 calculates the rated level of noise at the façade of the receptor.

Table 11. Calculation of Rated Noise Level & BS4142 Assessment for the Daytime and Night-time Periods

Period	Measured Operation	Calculated Specific Noise Level at Receptor (dB)	Character Correction (dB)	Calculated Rated Level (dB)	Typical Background Sound Level (dB)	Difference +/- (dB)
Daytime (07:00 – 23:00)	All sources	25.3	+5	30.3	32.1	-1.7
Night-time (23:00 – 07:00)					20.4	+10

4.2.12 Table 11 indicates that the rated level of noise does not exceed the background sound level for the daytime period however for the night-time period there is an exceedance of the rated level of noise over the background sound level of 10dB. It should be noted that the night-time exceedance is due to the typical night-time background sound level being very low. The calculated rated level of noise of 30.3dB is also low and it should be borne in mind that it is not reasonably expected that a resident would use their garden area during night-time hours. As such, it is of greater importance to consider the approximate level of noise break-in through a partially open bedroom window and this is displayed in Table 12.

Table 12. Calculation of Rated Noise Level within Bedrooms

Period	Calculated Rated Level (dB)	Approximate Attenuation Afforded by a Partially Open Window (dB)	Calculated Internal Noise Level (dB)	Internal Noise Criteria Level (dB)	Difference +/- (dB)
Night-time (23:00 – 07:00)	30.3	-15	15.3	30	-14.7

4.2.13 Table 12 indicates that the rated level of noise falls below the internal noise criteria level for the night-time period with a partially open window. During cooler months when bedroom windows are closed, the internal noise level due to operation of the plant will be lower.

5 CONCLUSION

5.1.1 Professional Consult Limited was instructed by Prospus Energy to prepare a Noise Impact Assessment for a proposed energy centre at Swaffham Prior in Cambridge CB25.

5.1.2 Proposals will include for a network of pipes which will run from the renewable Energy Centre to all homes connected. Heat circulates constantly through the network, thermal energy is distributed to each home, and then 'topped up' (reheated) on each return to the energy centre. Thermal energy from the network is transferred to individual homes via a 'Heat Interface Unit' (HIU). The transferred heat then circulates through the radiators and water cylinder. Specifically, the Energy Centre will include for:

- Three heat pumps to be located internally within the building;
- Three air source evaporators to be located externally;
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5.1.4 This Assessment has been undertaken to identify the key sources of noise associated with the development and to quantify the existing background sound climate at the closest residential dwelling. Accordingly, this Assessment has been completed with due regard to the National Planning Policy Framework and its associated National Planning Policy Guidance in addition to appropriate British Standards and guidance documents relevant to the assessment of noise impacts.

5.1.5 This Assessment has shown that the cumulative rated level of noise from all operations associated with the Site will fall below the typical background sound level during daytime hours and during the night-time period, the internal level of noise within bedrooms allowing for a partially open window, comfortably falls below the internal night-time criteria noise level at the closest dwelling. As such, operation of the Site is not expected to give rise to adverse noise impacts at the closest dwelling.

5.1.6 The level of noise generated by the Site and its predicted impact at the closest residential dwelling accords with the 'No Observed Effect Level' as detailed in the PPG and as such noise should not be deemed to be consideration in the granting of planning permission for this scheme.

APPENDIX 1: LIMITATIONS

This report and its findings should be considered in relation to the terms of reference and objectives agreed between Professional Consult Limited and the Client.

The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.

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APPENDIX 2: GLOSSARY OF ACOUSTIC TERMINOLOGY

Noise is defined as unwanted sound. Human ears are able to respond to sound in the frequency range 20 Hz (deep bass) to 20,000 Hz (high treble) and over the audible range of 0 dB (the threshold of perception) to 140 dB (the threshold of pain). The ear does not respond equally to different frequencies of the same magnitude, but is more responsive to mid-frequencies than to lower or higher frequencies. To quantify noise in a manner that approximates the response of the human ear, a weighting mechanism is used. This reduces the importance of lower and higher frequencies, in a similar manner to the human ear.

Furthermore, the perception of noise may be determined by a number of other factors, which may not necessarily be acoustic. In general, the impact of noise depends upon its level, the margin by which it exceeds the background level, its character and its variation over a given period of time. In some cases, the time of day and other acoustic features such as tonality or impulsiveness may be important, as may the disposition of the affected individual. Any assessment of noise should give due consideration to all of these factors when assessing the significance of a noise source.

The most widely used weighting mechanism that best corresponds to the response of the human ear is the 'A'-weighting scale. This is widely used for environmental noise measurement, and the levels are denoted as dB(A) or L_{Aeq}, L_{A90} etc., according to the parameter being measured.

The decibel scale is logarithmic rather than linear, and hence a 3 dB increase in sound level represents a doubling of the sound energy present. Judgement of sound is subjective, but as a general guide a 10 dB(A) increase can be taken to represent a doubling of loudness, whilst an increase in the order of 3 dB(A) is generally regarded as the minimum difference needed to perceive a change under normal listening conditions.

An indication of the range of sound levels commonly found in the environment is given in the following table.

Table 1: Typical Sound Pressure Levels

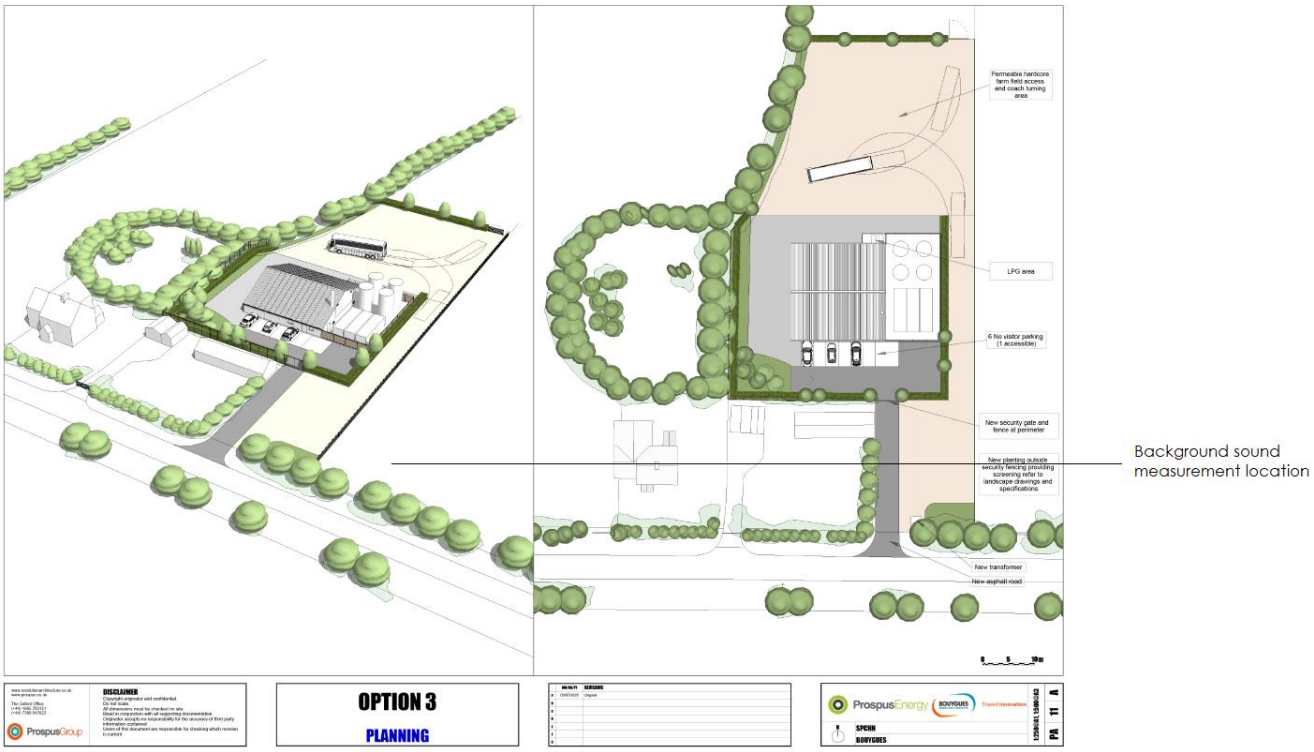
Sound Pressure Level (dB)	Location/Example
0	Threshold of hearing
20 - 30	Quiet bedroom at night
30 - 40	Living room during the day
40 - 50	Typical office
50 - 60	Inside a car
60 - 70	Typical high street
70 - 90	Inside factory
100 - 110	Burglar alarm at 1m away
110 - 130	Jet aircraft on take off
140	Threshold of pain

Table 2: Terminology

Descriptor	Explanation
dB (decibel)	The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and a reference pressure (2x10-5Pa).
dB(A)	A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
$L_{Aeq, T}$	L_{Aeq} is defined as the notional steady sound level which, over a stated period of time (T), would contain the same amount of acoustical energy as the A - weighted fluctuating sound measured over that period.
L_{Amax}	L_{Amax} is the maximum A - weighted sound pressure level recorded over the period stated. L_{Amax} is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the overall Leq noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
L_{10} & L_{90}	If a non-steady noise is to be described it is necessary to know both its level and the degree of fluctuation. The Ln indices are used for this purpose, and the term refers to the level exceeded for n% of the time. Hence L_{10} is the level exceeded for 10% of the time and as such can be regarded as the 'average maximum level'. Similarly, L_{90} is the 'average minimum level' and is often used to describe the background noise. It is common practice to use the L_{10} index to describe traffic noise.
Free-field Level	2A sound field determined at a point away from reflective surfaces other than the ground with no significant contributions due to sound from other reflective surfaces. Generally as measured outside and away from buildings.
Fast	A time weighting used in the root mean square section of a sound level meter with a 125millisecond time constant.
Slow	A time weighting used in the root mean square section of a sound level meter with a 1000millisecond time constant.

APPENDIX 3: SITE LOCATION PLAN & NOISE MEASUREMENT POSITIONS

Figure 1 **Proposed Site Plan & Noise Measurement Location**



APPENDIX 4: MEASURED NOISE LEVEL DATA

Table 1: Measured Background Sound Level Data for NMP1

Date	Time	Measured Noise Level, dB	
		$L_{Aeq,t}$	$L_{A90,t}$
12-Jun	14:00	55.6	47.7
12-Jun	15:00	55.4	45.4
12-Jun	16:00	55.7	43
12-Jun	17:00	54	39.4
12-Jun	18:00	50	39.1
12-Jun	19:00	48.4	40.5
12-Jun	20:00	44.5	37.3
12-Jun	21:00	38.3	34.3
12-Jun	22:00	35.5	33.5
12-Jun	23:00	37	34.5
12-Jun	00:00	41.7	30.2
13-Jun	01:00	32.4	29.4
13-Jun	02:00	40.1	28.8
13-Jun	03:00	39.3	32
13-Jun	04:00	43.2	39.5
13-Jun	05:00	47.3	39.4
13-Jun	06:00	47.8	40.1
13-Jun	07:00	49.4	35.3
13-Jun	08:00	51.8	34.2
13-Jun	09:00	51.4	34
13-Jun	10:00	51.6	36.5
13-Jun	11:00	52.1	36.9
13-Jun	12:00	50.9	36.8
13-Jun	13:00	50.3	38.1
13-Jun	14:00	51	38
13-Jun	15:00	48.7	38.1
13-Jun	16:00	46.4	35.6
13-Jun	17:00	48.5	35.6
13-Jun	18:00	49.3	36.3
13-Jun	19:00	44.1	36.1
13-Jun	20:00	43	32.9
13-Jun	21:00	50.8	36.3
13-Jun	22:00	44.4	32.9
13-Jun	23:00	34.5	32.4
13-Jun	00:00	32.3	29.1
14-Jun	01:00	31.2	25.6
14-Jun	02:00	34.5	31
14-Jun	03:00	36.6	31.9
14-Jun	04:00	41.8	37.6
14-Jun	05:00	51.4	37.2
14-Jun	06:00	41.3	36.8
14-Jun	07:00	41.6	33.6
14-Jun	08:00	42.8	31.6

14-Jun	09:00	46.9	33.8
14-Jun	10:00	47.1	31
14-Jun	11:00	49.3	33.7
14-Jun	12:00	45.4	32
14-Jun	13:00	46.8	31.8
14-Jun	14:00	46.9	32.9
14-Jun	15:00	46.2	31.6
14-Jun	16:00	44.3	31.8
14-Jun	17:00	42	31.5
14-Jun	18:00	43.9	33.8
14-Jun	19:00	42.9	34.1
14-Jun	20:00	38.4	34.1
14-Jun	21:00	45.1	32.1
14-Jun	22:00	33.4	21.3
14-Jun	23:00	31.2	19
14-Jun	00:00	27.9	20.7
15-Jun	01:00	27.1	20
15-Jun	02:00	25.5	19.6
15-Jun	03:00	35.2	20
15-Jun	04:00	43.4	31.8
15-Jun	05:00	42.8	33.8
15-Jun	06:00	56.9	38
15-Jun	07:00	55.7	37.9
15-Jun	08:00	55.6	36
15-Jun	09:00	54.2	33.2
15-Jun	10:00	50.4	31.8