



Winking Hill Energy Storage Project

Acoustic Impact Assessment

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Date	8 th October 2024
Ref	04875-7296858

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Revision History

Issue	Date	Name	Latest Changes	File References
01	08/10/2024	Mike Craven	Finalised	04875-6971324 04875-6971326

1 Introduction

This report provides an acoustic assessment of the proposed Winking Hill Energy Storage Project, referred to as ‘the Proposed Development’ herein, in terms of operational impacts in isolative terms and cumulatively with a neighbouring proposed battery storage facility. Two Members of the Institute of Acoustics have been involved in its production and details of their experience and qualifications can be found in **Appendix A**.

An assessment of the noise generated by the equipment to be installed as part of the Proposed Development has been undertaken in accordance with BS 4142:2014+A1:2019 ‘Methods for Rating and Assessing Industrial & Commercial Sound’.

2 Planning Policy, Guidance & Standards

2.1 National Planning Policy Framework (NPPF)

The treatment of noise is defined in the context of planning by the National Planning Policy Framework (NPPF) [1] which details the Government’s planning policies and how these are expected to be applied. The NPPF provides advice on the role of the planning system in helping to prevent and limit potential adverse effects of noise, stating that planning policies and decisions should aim to avoid noise giving rise to significant adverse impacts, whilst at the same time mitigating and reducing other adverse impacts on health and quality of life to a minimum. The NPPF refers to the Noise Policy Statement for England (NPSE) which provides guidance on the categorisation of impact levels.

2.2 Noise Policy Statement for England (NPSE)

The Noise Policy Statement for England (NPSE) [2] sets out the long-term vision of Government noise policy which is to ‘... promote good health and quality of life through effective noise management within the context of sustainable development’. In order to weigh noise impacts against the economic and social benefits of the activity under consideration, the NPSE defines three categories of effect levels:

- No Observed Effect Level (NOEL) - noise levels below this have no detectable effect on health and quality of life;
- Lowest Observed Adverse Effect Level (LOAEL) - the level above which adverse effects on health and quality of life can be detected; and,
- Significant Observed Adverse Effect Level (SOAEL) - the level above which effects on health and quality of life become significant.

2.3 National Planning Practice Guidance (NPPG): Noise

National Planning Practice Guidance (NPPG) [3] on noise puts the effect levels defined by the NPSE into greater context by explaining how such noise levels might be perceived, providing examples of outcomes based on likely average response, and advising on appropriate actions. These are reproduced at **Table 1**.

Table 1 - Noise Exposure Hierarchy

Response	Examples of Outcomes	Increasing Effect Level	Action
Not present	No Effect	No Observed Effect	No specific measures required
No Observed Effect Level (NOEL)			
Present and not intrusive	Noise can be heard, but does not cause any change in behaviour, attitude or other physiological response. Can slightly affect the acoustic character of the area but not such that there is a change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level (LOAEL)			
Present and intrusive	Noise can be heard and causes small changes in behaviour, attitude or other physiological response, 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 small actual or perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level (SOAEL)			
Present and disruptive	The noise causes a material change in behaviour, attitude or other physiological response, 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
Present and very disruptive	Extensive and regular changes in behaviour, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory.	Unacceptable Adverse Effect	Prevent

In addition to this guidance, which is applicable to all forms of environmental noise, specific guidance relating to nationally significant energy infrastructure has been published by the Department for Energy Security & Net Zero (DESNZ). Whilst the proposed development is not of a scale that would be deemed nationally significant, the relevant National Policy Statements (NPS) are informative in that they suggest an assessment methodology that would be considered appropriate for the type of development being proposed.

2.4 The Overarching National Policy Statement for Energy (EN-1)

The Overarching National Policy Statement for Energy (EN-1) [4] outlines the need for new electricity capacity from renewable sources as the country transitions to a low carbon electricity system. However, when referring to the NPSE, EN-1 recognises the potential for energy infrastructure to impact on health and quality of life if it results in excessive noise and goes on to state that where noise impacts are likely to arise, they should be assessed according to the principles of the relevant British Standards. Of the examples provided, the standards BS 4142 and BS 8233 (discussed below) relate to operational sound/noise.

2.5 National Policy Statement for Renewable Energy Infrastructure (EN-3)

The National Policy Statement for Renewable Energy Infrastructure (EN-3) [5] refers back to EN-1 for the purposes of addressing noise impacts from renewable energy development on sensitive locations and provides general advice as to potential mitigation measures in specific instances.

2.6 The National Policy Statement for Electricity Networks Infrastructure (EN-5)

The National Policy Statement for Electricity Networks Infrastructure (EN-5) [6], relevant to the transmission and distribution parts of the electricity network along with any associated infrastructure, such as substations and converter stations, again points to the appropriateness of BS 4142 (discussed at **Section 2.7**) in assessing the operational acoustic impact of such projects.

2.7 BS 4142 Methods for Rating and Assessing Industrial & Commercial Sound

BS 4142 [7] describes methods for rating and assessing sound of an industrial or commercial nature. Outdoor sound levels are used to assess the likely effects on people who might be inside or outside a residential property via the comparison of the pre-existing background sound levels with the predicted/modelled sound associated with the introduction of a particular development, known as the ‘rating’ level, which also accounts for any distinguishing characteristics of the emitted sound.

To determine a value for the background sound level at a specific assessment point, a series of measurements are made at a location at, or representative of, a dwelling or receptor of interest. The standard requires that the background sound measurements ($\text{dB } L_{A90, T}$ - the sound level exceeded for 90% of the time, or the lowest 10 % of sound, for the reference time period, T) should be measured during times when the sound source in question could or will be operating and that the individual measurement intervals should not normally be less than 15-minutes in length. The objective is then to determine a justifiable representative background sound level for time periods of interest via statistical analysis and/or observations of the data set collected. The standard states that the representative background sound level ‘... should not automatically be assumed to be either the minimum or modal value’.

The ‘rating’ level is defined as the ‘specific’ sound level (dB L_{Aeq} - the average sound level) plus any adjustment for the characteristic features of the sound generated by the source in question. In instances where the source is unlikely to have a specific character at the assessment location then the ‘rating’ level can be assumed to equal to the ‘specific’ sound level. Where tones are present a correction of 2 to 6 dB can be added to the ‘specific’ sound level to determine the ‘rating’ level and further adjustments may be added where the source has other applicable characteristics.

The defined representative background sound level(s) and rating level(s) are then compared to determine the possible impact but with consideration of the context in which the industrial or commercial sound source to be introduced presents itself in respect of other sound sources and the existing character of the area. Table 2 provides a summary of expected impacts when comparing background and rating levels.

Table 2 - BS 4142 Assessment Criteria

Rating Level	BS 4142 Assessment Criteria
Equal to or below background	‘...an indication of the specific sound source having a low impact, depending on the context’.
Approximately +5 dB greater than the background sound level	‘...an indication of an adverse impact, depending on the context’.
Approximately +10 dB or more greater than the background sound level	‘...an indication of a significant adverse impact, depending on the context’.

Further to the above, it may not be appropriate or proportionate to undertake a full assessment in accordance with the BS 4142 standard, particularly when the sound level associated with the new source is particularly low at neighbouring receptors and/or is expected to be much lower than the existing background sound levels. The previous version of BS 4142 [8] stated that this version of the standard is not appropriate for use in instances where background and rating levels are very low and that ‘... background noise levels below about 30 dB and rating levels below about 35 dB are considered to be very low’.

3 Baseline Environment

3.1 Existing Sources of Sound

The current sound environment at properties surrounding the site is typically dominated by sound from the high volumes of traffic along the A453 and, to a far lesser extent, plant noise from the existing Ratcliffe-on-Soar Power Station. Other sources relate to the surrounding commercial facilities, aircraft overhead, sporadic vehicle movements along other local roads plus localised human and animal activities.

The neighbouring Ratcliffe-on-Soar site has a generalised application for redevelopment that was recently granted planning consent. The removal of the existing site will reduce the current levels of sound generated by the site. However, the sound generated by the A453 is expected to remain by far the most dominant source of pre-existing sound in the area. As a result, the findings of sound surveys undertaken as part of information supporting various other planning applications in the area, undertaken prior to the demolition of the existing Ratcliffe-on-Soar site and specifically at Winking Hill Farm (H1), have been used to inform

the assessment provided herein. This approach has been accepted by Rushcliffe Borough Council (RBC) when considering another proposed battery storage facility in the area.

3.2 Sensitive Receptors

There is one dwelling located relatively close to the Proposed Development, known as Winking Hill Farm (H1). A few other residences are located at substantial distances away. A list of locations considered representative of those potentially sensitive to noise from the Proposed Development is provided in **Table 3** as also shown in **Figure 1, Section 5**.

Table 3 - Sensitive Receptors / Assessment Locations

House Name	ID	Co-ordinates	
		Easting	Northing
Winking Hill Farm	H1	450961	329743
Oaks Farm	H2	451198	328667
Stonepit Farm	H3	452107	329688
Hillside Cottage	H4	451861	330664
Morley's Barn Farm	H5	452414	330192

3.3 Existing Sound Levels

A survey of the existing ambient (dB L_{Aeq}) and background (dB L_{A90}) sound levels at Winking Hill Farm was undertaken in support of a planning application for a neighbouring battery storage facility on land to the northeast of the Proposed Development (Planning Reference 23/01285/FUL). The results of the survey and a noise impact assessment of the site are provided within a report attached to the application [9].

The consultation responses to the neighbouring application, as provided by representatives of Rushcliffe Borough Council (RBC), demonstrate that the results have been accepted and therefore are also considered appropriate for use in informing the assessment provided herein.

The adopted background and ambient sound levels, as taken from information supporting the neighbouring battery storage scheme, are shown in **Table 4** below.

Table 4 - Adopted Background & Ambient Sound Levels

Name	ID	Background Sound Level, dB L _{A90}		Ambient Sound Level, dB L _{Aeq}	
		Daytime	Night-time	Daytime	Night-time
Winking Hill Farm	H1	52	44	58	54

4 Predictions

A model of the battery storage facilities and the surroundings has been developed using CadnaA¹ sound modelling software. The ISO 9613-2 [10] sound propagation/prediction methodology has been employed to predict the specific sound levels resulting from the development at nearby residential properties, incorporating various assumptions and factors which are considered appropriate for use here:

- The various plant to be installed as part of the development has been modelled as point sources with a height of 2 m and these sources are assumed to be operating at their near maximum potential output for all time periods as a conservative basis of assessment;
- Soft ground conditions have been assumed (i.e. $G=1$) as representative of the farmland surrounding the Proposed Development. The ISO 9613-2 standard allows for a range of ground conditions to be applied, from porous ground conditions ($G=1$), which includes surfaces suitable for the growth of vegetation (i.e. farmland), to hard ground ($G=0$), such as paving, water and concrete;
- The receptors have been assigned a height of 1.5 m;
- Atmospheric attenuation corresponding to a temperature and relative humidity of 10 °C and 70 % respectively, as defined within ISO 9613-1 [11], which represents relatively low levels of sound absorption in the atmosphere;
- The topography of the site and surroundings has also been included within the sound model; and,
- A 4 m high barrier of suitable mass and density located on the western boundary of the battery storage facility.

The barrier referred to in the last point is placed to minimise the combined impact of the Proposed Development operating at the same time as the neighbouring battery storage facility, for which planning permission is also being sought. Should the neighbouring site be refused planning permission then it may not be necessary to incorporate this into the design of the Proposed Development.

ISO 9613-2 is a downwind propagation model. Where conditions less favourable to sound propagation occur, such as when the assessment locations are upwind of the Proposed Development, the sound levels would be expected to be less and the downwind predictions presented as part of this report would be regarded as conservative, i.e. greater than those likely to be experienced in practice.

The predominant sources of sound to be introduced as part of the Proposed Development are the inverters (PCS units), battery storage containers and substation transformer.

The site has been designed on an iterative basis with a view to minimising, as far as practicably possible, the projected operational noise levels with due regard to the relative sensitivity of neighbouring premises and all other site constraints.

¹ <https://www.datakustik.com/>

The assumed sound power data for the equipment to be installed as part of the Proposed Development are provided at **Table 5**. The overall levels correspond to the maximum expected sound output for each of the respective plant that will be available at the time of potential procurement/installation, should the site be granted planning consent, and as advised by candidate manufacturers.

Table 5 - Overall Sound Power Levels, dB L_{WA}

Equipment & ID	Sound Power Level, dB L _{WA}
Battery Energy Storage System (BESS)	83
Power Conversion System (PCS)	80
Substation (SUB)	96

The sound emitted by the various equipment to be introduced as part of the Proposed Development can have a tonal character that is just perceptible (i.e. a whine, whistle or hum). Under the subjective method described in BS 4142, a correction of 2 dB has been applied to account for this feature. However, the assessed specific and rating levels detailed in **Section 5** are particularly low and potential tonal noise in the sound emitted from the various plant may well be masked by existing sources of sound in the area.

The results of the predictions at the various residences surrounding the Proposed Development are shown at **Section 5**.

5 Assessment

The predicted specific sound and corresponding rating levels (i.e. including for a 2 dB penalty for tonal noise) at the potentially sensitive property located nearest to the Proposed Development, for daytime and night-time periods respectively, are shown in **Table 6**. The rating level is compared to the background sound levels detailed in **Section 3.3** to provide the associated impact.

The resultant impact is described as ‘negligible’ if the rating level is more than 10 dB below the background sound level; ‘low’ if the rating level is less than or equal to the background sound level; ‘minor’ if not more than 5 dB above; ‘moderate’ if not more than 10 dB above and major if more than 10 dB above. These criteria compare to the categories defined by the NPSE, with rating levels less than or equal to background sound level representing the NOEL, 5 dB above background representing the LOAEL and 10 dB above background the SOAEL.

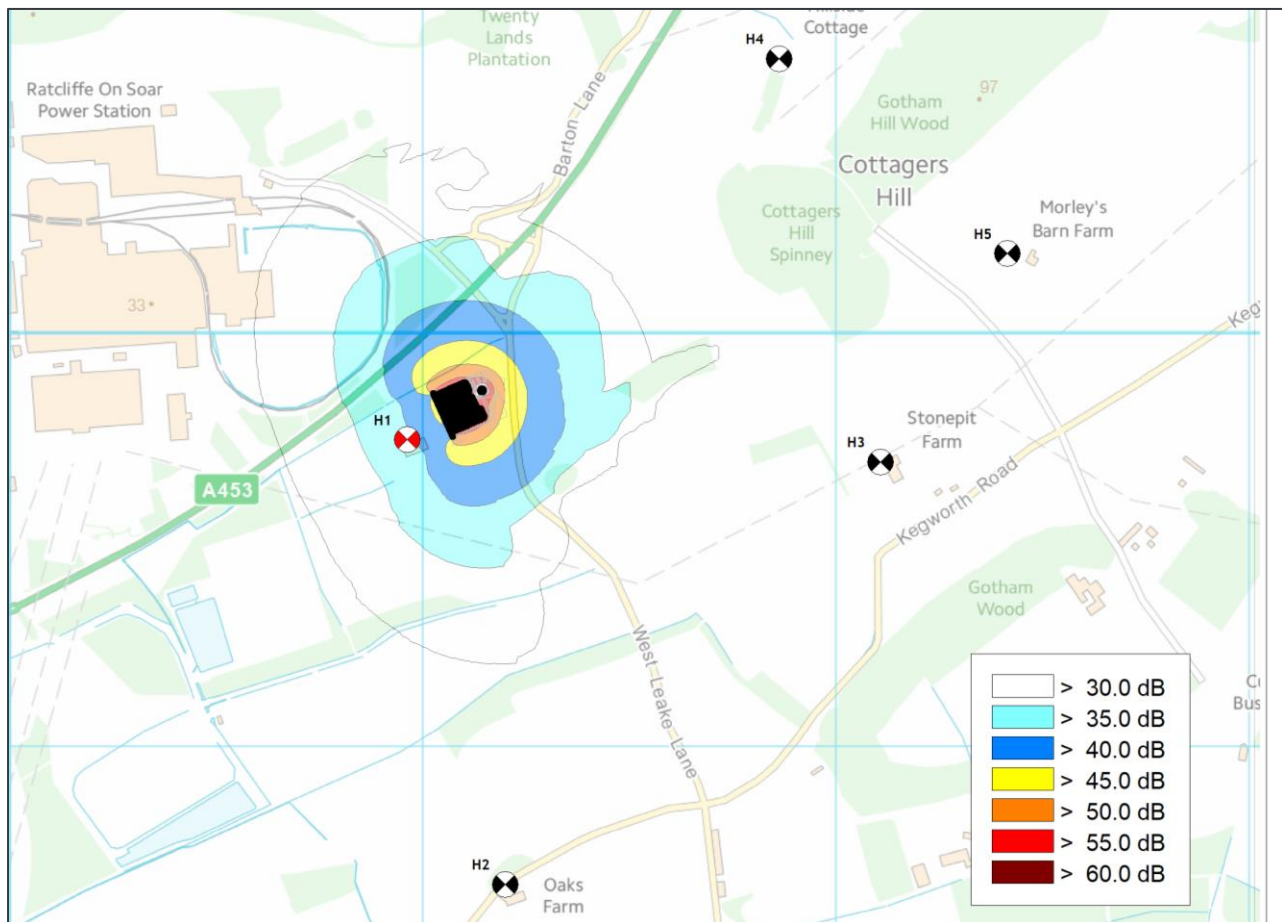
Table 6 - BS 4142 Assessment

House ID	Specific Level, dB L _{Aeq}	Rating Level, dB L _{Ar}	Background Level, dB L _{A90}	L _{Ar} - L _{A90} , dB	Potential Impact
Daytime					
H1	39	41	52	-11	Negligible
Night-time					
H1	39	41	44	-3	Low

The assessment indicates that the predicted noise impact from the Proposed Development at the nearest neighbouring property (H1) is negligible for daytime and low for night-time periods. Existing adopted ambient (dB L_{Aeq}) sound levels at Winking Hill Farm (see **Section 3.3**) are also well above the predicted rating levels associated with the operation of the Proposed Development which will serve to provide substantial masking of operational noise should the site become operational.

An illustrative sound footprint for the proposed development showing the predicted specific sound level (dB L_{Aeq}) is provided in **Figure 1**. The background sound survey location referred to above is marked in red.

Figure 1 - Specific Sound Level Contour Plot, dB L_{Aeq}



The other surrounding properties (see **Section 3.2**) will have rating levels well below 35 dB which is considered lower than the threshold at which any discernible impacts will occur, particularly given the general pre-existing sound environment in the area (see **Section 3.1**).

Overall, in this context and based on the sound modelling assumptions and assessment results presented, the sound emitted by the Proposed Development can be considered ‘present and not intrusive’ in terms of government policy and guidance provided within the NPSE & NPPG (see **Sections 2.2 & 2.3** respectively). This corresponds to the ‘No Observed Effect Level’ (NOEL) and no further specific action, over and above that already considered, is required to further mitigate operational noise associated with the introduction of the site.

A further assessment has been undertaken to address the potential for cumulative operational noise impacts, should the Proposed Development and neighbouring West Leake Lane development both be granted planning consent and become operational, as provided in **Table 7**. The impact assessment for the West Leake Lane development [9] details a predicted specific sound level of 45 dB L_{Aeq} at Winking Hill Farm (H1), the only property relevant to the cumulative assessment provided here. This value is added to the predicted level from the Proposed Development and corrected to give the rating level (dB L_{Ar}) assuming an overall tonal noise penalty of 2 dB, as applied for the isolative assessment above and for the West Leake Lane assessment.

Table 7 - Cumulative BS 4142 Assessment

House ID	Specific Level, dB L_{Aeq}	Rating Level, dB L_{Ar}	Background Level, dB L_{A90}	$L_{Ar} - L_{A90}$, dB	Potential Impact
Daytime					
H1	46	48	52	-4	Low
Night-time					
H1	46	48	44	4	Minor

The assessment indicates that the combined noise impact is low at H1 for daytime periods and minor for night-time periods. Similarly to the isolative assessment, existing adopted ambient (dB L_{Aeq}) sound levels at Winking Hill Farm (see **Section 3.3**) are well above the predicted sound levels associated with the operation of the Proposed Development which will serve to provide some masking of the generated noise should both sites become operational. In conclusion, the cumulative/combined noise levels associated with the operation of the Proposed Development at the same time as the West Leake Lane site can be considered ‘present and not intrusive’ in terms of government policy which corresponds to the ‘No Observed Effect Level’ (NOEL).

As discussed in **Section 4**, the acoustic barrier specified as part of the design of the Proposed Development would not be necessary should planning permission for the West Leake Lane proposals be refused.

The wording for a suggested planning condition, that would restrict noise associated with the introduction of the Proposed Development should the site gain planning consent, is provided in **Appendix B**.

6 Conclusions

An acoustic impact assessment of the proposed Winking Hill Energy Storage Project has been undertaken. The results show that noise levels resulting from the operation of the site in isolation and cumulatively with a neighbouring battery storage project will be low in the context of relevant assessment criteria (i.e. BS 4142) and can be considered ‘present and not intrusive’ in terms of government policy and guidance provided within the NPSE & NPPG.

7 References

- [1] Department for Levelling Up, Housing and Communities (September 2023) National Planning Policy Framework
- [2] Department for Environment, Food and Rural Affairs (March 2010) Noise Policy Statement for England
- [3] Department for Levelling Up, Housing and Communities and Ministry of Housing, Communities & Local Government (July 2019) National Planning Practice Guidance: Noise
- [4] Department for Energy Security & Net Zero (November 2023) Overarching National Policy Statement for Energy (EN-1)
- [5] Department for Energy Security & Net Zero (November 2023) National Policy Statement for Renewable Energy Infrastructure (EN-3)
- [6] Department for Energy Security & Net Zero (November 2023) National Policy Statement for Electricity Networks Infrastructure (EN-5)
- [7] British Standards Institution (2019) BS 4142:2014+A1:2019 Methods for Rating and Assessing Industrial and Commercial Sound
- [8] British Standards Institution (1997) BS 4142:1997 Rating Industrial Noise Affecting Mixed Residential and Industrial Areas
- [9] E3P (September 2023) Noise Impact Assessment - Land at West Leake Lane, 50-923-R1-2
- [10] International Organisation for Standardisation (December 1996) ISO 9613-2:1996 Acoustics - Attenuation of Sound During Propagation Outdoors - Part 2: General Method of Calculation
- [11] International Organisation for Standardisation (June 1993) ISO 9613-1:1993 Acoustics - Attenuation of Sound During Propagation Outdoors - Part 1: Calculation of the Absorption of Sound by the Atmosphere

Appendix A - Experience & Qualifications

Table A.1 - Author

Name	Mike Craven
Experience	<p>Senior Acoustic Specialist, Renewable Energy Systems (RES), 2023-Present</p> <p>Principal Acoustic Consultant, Hayes McKenzie Partnership Limited (HMPL), 2019-2022</p> <p>Senior Acoustic Consultant, HMPL, 2013-2019</p> <p>Acoustic Consultant, HMPL, 2011-2013</p> <p>Acoustic Consultant, URS/Scott Wilson, 2008-2011</p> <p>Acoustic Consultant, HMPL, 2004-2008</p>
Qualifications	<p>MIOA, Member of the Institute of Acoustics</p> <p>BSc Audio Technology, University of Salford</p>

Table A.2 - Checker

Name	Peter Brooks
Experience	<p>Acoustic Lead, RES, 2023-Present</p> <p>Senior Acoustic Analyst, RES, 2022-2023</p> <p>Acoustic Consultant, Arcus Consultancy Services, 2021-2022</p> <p>Director, 343 Acoustics, 2019-2021</p> <p>Lead Acoustic Engineer, Tymphany, 2017-2019</p> <p>Research and Development Engineer, SEAS Fabrikker, 2014-2017</p> <p>Acoustic Engineer, Premium Sound Solutions, 2011-2013</p>
Qualifications	<p>MIOA, Member of the Institute of Acoustics</p> <p>PGCert Environmental Acoustics, University of Salford</p> <p>BSc (Hons) Audio Technology, University of Salford</p>

Table A.3 - Approver

Name	Dr Jeremy Bass
Experience	<p>Head of Specialist Services/Senior Technical Manager, RES, 2000-Present</p> <p>Technical Analyst/Senior Technical Analyst, RES, 1990-2000</p> <p>Foreign Exchange Researcher, Mechanical Engineering Laboratory, Tsukuba, Japan, 1989-1990</p> <p>Research Associate, Energy Research Unit, Rutherford Appleton Laboratory, 1986-1989</p>
Qualifications	<p>MIOA, Member of the Institute of Acoustics</p> <p>MInstP, Member of the Institute of Physics</p> <p>PhD, The Potential of Combined Heat & Power, Wind Power & Load Management for Cost Reduction in Small Electricity Supply Systems, Department of Applied Physics, University of Strathclyde</p> <p>BSc Physics, University of Durham</p>

Appendix B - Suggested Planning Condition Wording

The energy storage project shall be designed and operated to ensure that the rating level, determined using the BS 4142:2014+A1:2019 methodology and external to the property located closest to the development (H1), shall not exceed the pre-existing background sound level plus 5 dB during both daytime and night-time periods (as identified in RES report 04875-7296858 dated 20/2/2024).

At all other properties (as identified in RES report 04875-7296858 dated 20/2/2024), existent at the time the planning application was granted planning consent, the rating level shall not exceed 35 dB L_{Ar} or the background sound level plus 5 dB, whichever is the greater.