Bishops Dal Energy Storage Project

Acoustic Impact Assessment

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Contents

Revision History

Issue	Date	Name	Latest Changes	File References
01	04/11/2024	Stuart Hill	First Draft	05389-7788890

1 Introduction

This report contains an assessment of the acoustic impact of the proposed Bishops Dal Battery Energy Storage System (the 'Proposed Development') in terms of potential operational and construction impacts. Three Members of the Institute of Acoustics have been involved in its production. Details of their experience and qualifications can be found in Appendix A.

An assessment of the sound generated by the equipment to be installed has been undertaken in accordance with Noise Rating (NR) curves to determine the external noise levels at residential properties, as per the noise condition specified by Scottish Borders Council (SBC).

2 Planning Policy, Guidance & Standards

2.1 Planning Advice Note 1/2011: Planning and Noise

Within Scotland, the treatment of noise is defined in the planning context by 'Planning Advice Note (PAN) 1/2011: Planning and Noise' [1]. This document details the Government's planning policies and how these are expected to be applied. The PAN provides advice on the role of the planning system in helping to prevent and limit the 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.

2.2 Technical Advice Note: Assessment of Noise

The online documentation 'Technical Advice Note (TAN): Assessment of Noise' [2] provides guidance to assist in the technical evaluation of noise assessments and aims to assist in assessing the significance of impacts associated with various development. The guidance refers to a since superseded version of BS 4142 in terms of assessing the impact of new sound generating development on neighbouring residences (the latest and previous version of which are discussed herein) and provides various matrices as to the significance and sensitivity of residences resulting from the introduction of certain facilities. The document states, at Paragraph 3.20, that '… the Scottish Government consider impacts are normally not significant (in a quantitative sense only) [if] the difference between the Rating and background noise levels is less than 5 dB(A), and that usually the threshold of minor significant impacts is when the difference between the Rating and background noise levels is at least 5 dB(A); and commonly do not become sufficiently significant to warrant mitigation until the difference between the Rating and background noise levels is more than 10 dB(A)'. The documentation also refers to publications released by the World Health Organisation (WHO) in terms of general internal and external absolute noise criteria for the protection of health, amenity, and sleep disturbance.

2.3 BS 8233 Guidance on Sound Insulation and Noise Reduction for Buildings

British Standard BS 8233:2014 [3] provides information on the design of buildings to ensure they have internal acoustic environments appropriate to their functions. The standard specifies guideline indoor ambient sound levels for buildings for different activities, locations and times of day and states that it is desirable that these guideline values are not exceeded. Therefore, in practice the guidelines specify absolute limits for sound levels in specific environments. The most conservative applicable values specified are those conducive to sleeping or daytime resting in a house bedroom where the internal sound level should not exceed 30 dB $L_{Aeq,\ 8\ hour}$ at night. If a 15 dB reduction is assumed for attenuation through an open window, then a maximum outdoor sound level of 45 dB $L_{Aeq,\ 8\ hour}$ is applicable. The criteria for residential properties are shown in **Table 1**.

Table 1 – Indoor Ambient Noise Levels for Residential Properties

Criterion	Typical Situation	07:00 – 23:00	23:00 – 07:00
Resting	Living Room	35 dB $L_{Aeq,16h}$	-
Dining	Dining Room	40 dB $L_{Aeq,16h}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16h}$	30 dB $L_{Aeq,8h}$

BS 8233:2014 provides guidance on acceptable levels within external areas such as gardens and patios. BS 8233 states that "*it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments*".

BS 8233:2014 also includes a methodology for assessment to noise rating (NR) values. This is a method for assigning a single-number rating to a noise spectrum. It can be used to specify the maximum acceptable level in each octave band of a frequency spectrum.

2.4 WHO Guidelines

The '*Guidelines for Community Noise*' document (WHO, 1999) [4] recommend guideline noise levels regardless of the current noise environment. The WHO suggests suitable noise levels for both indoor and outdoor living areas during daytime and night-time periods, and these levels are set regardless of the noise type or noise source, i.e. '*benchmark*' levels. It advises on the minimum levels of noise before critical health effects, including annoyance, occur.

In this regard, the WHO guidelines state:

- *"In dwellings, the critical effects of noise are on sleep, annoyance, and speech interference. To avoid sleep disturbance, indoor guideline values for bedrooms are 30dB $L_{Aeq,8h}$ for continuous noise and 45dB L_{Amax} for single sound events;*
- *To protect the majority of people from being seriously annoyed during the daytime, the sound pressure level on balconies, terraces and outdoor living areas should not exceed 55dB $L_{Aeq,16h}$ for a steady, continuous noise; and*

- *To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound pressure level should not exceed 50dB $L_{Aeq,16h}$."*

It must be noted that if the lower external noise limit of 50dB L_{Aeq} is achieved, it would equate to an internal noise level of 35dB L_{Aeq}, when accounting for the attenuation provided by an open window. An internal noise level of 35dB L_{Aeq} is the daytime noise limit for resting within living rooms as per BS 8233:2014.

For night-time, and to achieve an internal noise limit of 30dB L_{Aeq}, the external noise limit would be 45dB L_{Aeq} (when accounting for an open window).

2.5 Noise Rating Curves

The Noise Rating curves were developed by the International Organization for Standardization (ISO) to determine the acceptable indoor environment for hearing preservation, speech communication and annoyance. The curves determine the acceptable sound pressure levels at different frequencies for a variety of internal environments.

2.6 BS 5228 Code of Practice for Noise and Vibration Control on Construction and Open Sites

BS 5228-1:2009 'Code of practice for noise and vibration control on construction and open sites - Part 1: Noise' [5] has been identified as being the appropriate source of guidance on appropriate methods for minimising sound from construction activities and is adopted herein. The document provides guidance on construction limits, modelling techniques and best practicable measures for the reduction of sound generated during construction activities.

Annex E of BS 5228-1:2009 provides guidance on setting environmental sound targets for construction activities. Several methods of assessing the significance of the expected sound levels are presented with the most applicable being the ABC method. This method sets threshold levels for construction activities for specific time periods based on the pre-existing ambient sound levels, subject to average lower Category A limiting values of 65, 55 and 45 dB L_{Aeq} for daytime (07:00 - 19:00 weekdays and Saturdays 07:00 – 13:00), evenings and weekends (19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays and 07:00 – 23:00 Sundays) and night-time (23:00 – 07:00) periods respectively in instances where existing ambient sound levels are low in relation to these values, which is the case here.

BS 5228-2:2009 'Code of practice for noise and vibration control on construction and open sites - Part 2: Vibration' [6], provides a method for predicting levels of vibration. The document provides guidance on construction vibration limits, vibration modelling techniques and best practicable measures for the reduction of vibration generated during construction activities.

The generally accepted maximum satisfactory magnitude of vibration due to construction activities, at residential premises during daytime periods (08:00 – 18:00 Monday to Friday and 08:00 – 13:00 on Saturdays), is a peak particle velocity (ppv) of 6 to 10 $mm.s^{-1}$. In practice, the lower satisfactory magnitude is typically used with the higher magnitude being justified on a case-by-case basis.

2.7 Consultation with Scottish Borders Council

SBC have been consulted to ensure that this acoustic assessment meets their requirements. RES and SBC agreed the following:

- Following analysis of a number of acoustic impact assessments submitted in support of 3rd party planned sites adjacent to the proposed Bishops Dal site, it is apparent that measured night-time background sound levels are particularly low and as such it may not be appropriate to rely on BS 4142:2014+A1:2019 [7] as an assessment method. The previous version of BS 4142:1997 [8] stated that the standard is not appropriate for use in instances where background and rating noise 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*'. Therefore, it was proposed and agreed with SBC that there would be no requirement for a baseline sound survey.

- It was proposed that an assessment of the Proposed Development in isolation would be undertaken in accordance with Noise Rating Curves which have been developed by the International Organization for Standardization (ISO). The proposed limit criteria for the noise sensitive receptors within the area would be evaluated against the following noise rating (NR) curves:

    - NR20 indoors in the night-time; and
    - NR30 indoors in the daytime.

- This will be based on the assumption of a partially open window for ventilation providing a minimum of 10 dB reduction between the external and internal predicted sound levels.

- This approach would be consistent with the methodology adopted for the acoustic impact assessments for the adjacent 3rd party BESS sites which have been submitted in support of their relevant planning applications.

- SBC suggested a proposed noise condition applicable to a planned site adjacent to the proposed Bishops Dal site (Planning Ref: 22/01532/S36) may be applicable in this instance, as detailed below:

    1. *"The free-field Leq(1 hour) noise levels emitted by plant and machinery used on the premises will not exceed the values detailed in **Table 2** when measured externally at the nearest occupied residential Noise Sensitive Receptors, as existing or consented at the time of this consent unless otherwise agreed in writing with the Planning Authority.*

Table 2: Noise Limits

Time	Descriptor	Frequency (Hz), dBZ								
		31.5	63	125	250	500	1000	2000	4000	8000
23:00 - 07:00	Night	79	61	49	41	34	30	27	24	23
07:00 - 23:00	Day	86	69	58	50	44	40	37	35	33

Reason: To protect nearby residents from undue noise and disturbance."

- It was proposed and accepted by SBC that a cumulative assessment would also be undertaken in order to determine the combined noise impact of all the other nearby BESS projects currently in the planning process, to include:
    - Eccles II Battery Energy Storage System Land West of Eccles Sub Station Coldstream Scottish Borders. Application Ref: 23/01038/S36;
    - BESS with ancillary infrastructure on Land West of Eccles Substation Eccles Coldstream Scottish Borders. Application Ref: 22/01988/FUL; and
    - BESS and Associated Infrastructure | Proposed 400MW Battery Storage Facility Coldstream Scottish Borders. Application Ref: 22/01532/S36.
- It was discussed with the EHO at SBC that the cumulative assessment will consider, in addition to the Proposed Development, the predicted noise levels from the three neighbouring sites at the nearest residential receptors. The cumulative noise levels will be calculated as octave band unweighted (dBZ) L_{eq} values, external at the nearest residential receptors.
- The assessment will use the predicted noise levels presented in the Noise Impact Assessments for each of the cumulative sites, rather than considering the operation of the cumulative sites in full use of their planning consent.
- The contribution of the Proposed Development to the overall cumulative noise levels will be analysed and any conclusions will be provided in this report.

3 Baseline Environment

A list of the residential assessment locations considered representative of those located closest to the Proposed Development is provided in **Table 3**, as also shown in **Figure 1, Section 5**.

Table 3 - Assessment Locations

Property Name	Property ID	Co-ordinates (OSGB36)	
		Easting	Northing
Whitrig A	H01	378591	641369
Whitrig B	H02	378670	641490
Woodside	H03	379680	641607
Rossander	H04	379777	641559
Hatchednize	H05	380446	641388
Haigsfield	H06	380523	640123
Fernyrig New Cottage	H07	379065	640416
Fernyrig Farm	H08	378857	640797
Todrig Farm	H09	379574	642120

The current sound environment at properties surrounding the site is considered typical of a rural environment, sources of which include farm stock, the sound of water flowing from streams and burns, localised human and animal activities, birdsong, occasional aircraft passing overhead and traffic passing along local roads.

4 Predictions

4.1 Operation

A model of the proposed battery storage facilities and the surroundings has been developed using CadnaA[1] software. The ISO 9613-2 [9] propagation/prediction methodology has been employed to predict the sound levels resulting from the development at nearby residential properties, incorporating various assumptions and factors which are considered appropriate for use here:

- The plant to be installed as part of the development has been modelled as point sources and these are assumed to be operating at their 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 4.0 m;
- Atmospheric attenuation corresponding to a temperature and relative humidity of 10 °C and 70 % respectively, as defined within ISO 9613-1 [10], which represents relatively low levels of sound absorption in the atmosphere;
- A 3 m high barrier of suitable mass and density, surrounding the battery storage facilities; and,
- The topography of the site and surroundings has been included within the model.

Furthermore, 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 resultant 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 48 inverters (INV) , 24 transformers (TRA) and 96 battery storage containers (BESS) and 2 substation transformers (Sub_Tx).

The assumed sound power data in octave bands for the equipment to be installed as part of the Proposed Development are provided in **Table 4**. The overall levels correspond to the maximum anticipated sound output for each of the respective plant, as advised by a candidate manufacturer and from RES's experience

[1] https://www.datakustik.com/

of typical equipment. The propagation modelling therefore represents a relatively conservative scenario and actual sound levels would be expected to be less when the site is not operating at maximum capacity.

Table 4 - Octave Band Sound Power Levels, dB L_{WA}

ID	Overall, dB L_{WA}	Octave Band Centre Frequency, Hz								
		31.5	63	125	250	500	1k	2k	4k	8k
BESS	68	22	56	60	61	61	63	58	48	41
INV	80	36	55	65	75	73	73	72	69	63
TRA	76	38	41	62	70	74	64	57	51	49
Sub_Tx	94	57	59	81	89	92	82	74	69	67

The combination of assumptions detailed above are considered to provide a conservative prediction/modelling basis overall. The results of the predictions at the various residences surrounding the Proposed Development are shown in **Section 5**.

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

5 Assessment

5.1 Predicted Sound Levels

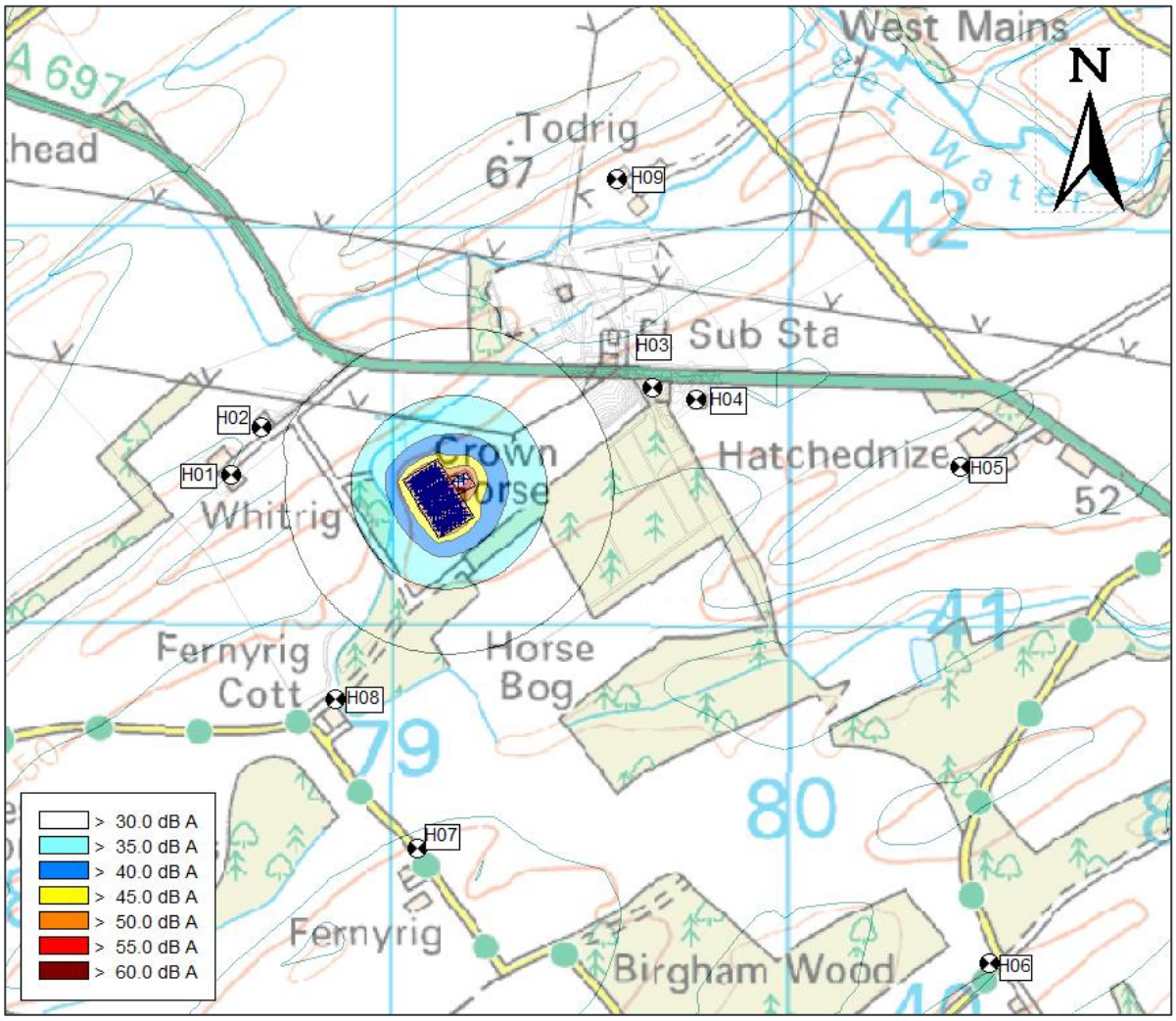
The predicted specific sound levels (L_{Aeq}) due to the Proposed Development at the nearest residential receptor locations are shown in **Table 5** below. The sound levels have been predicted at 4 m above local ground level for both daytime and night-time, the approximate height of a first-floor window, and the site is assumed to be operating at all times so the predicted sound levels for day and night-time are the same.

Table 5 - Predicted Specific Sound Levels Freefield External to Properties

Property ID	Predicted Specific Sound Level, $L_{Aeq,T}$
H01	28
H02	29
H03	26
H04	25
H05	18
H06	14
H07	22
H08	26
H09	22

An illustrative sound footprint for the proposed development showing the predicted specific sound level (dB L_{Aeq}) is provided in **Figure 1**.

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



5.2 Assessment of Proposed Development

The predicted sound levels as octave band unweighted (dBZ) L_{eq} values, external at the nearest residential receptor locations to the Proposed Development are shown in **Table 6** for daytime and night-time periods.

Table 6 - Predicted Sound Levels Freefield External to Properties

Property ID	Sound Levels (L_{eq}) dBZ for Octave Frequency Bands								
	31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
	Daytime								
H01	35	41	32	29	28	21	15	2	-31
H02	36	42	33	30	29	22	17	4	-26
H03	34	37	31	28	28	18	11	-4	-42
H04	33	36	30	27	27	17	9	-6	-48

Property ID	Sound Levels (L_{eq}) dBZ for Octave Frequency Bands								
	31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
H05	28	31	22	20	20	9	-1	-26	-80
H06	25	28	19	17	16	5	-8	-39	-80
H07	30	34	25	24	23	14	6	-13	-64
H08	34	38	31	28	27	19	12	-2	-37
H09	31	34	26	24	24	14	5	-14	-67
Night-time									
H01	35	41	32	29	28	21	15	2	-31
H02	36	42	33	30	29	22	17	4	-26
H03	34	37	31	28	28	18	11	-4	-42
H04	33	36	30	27	27	17	9	-6	-48
H05	28	31	22	20	20	9	-1	-26	-80
H06	25	28	19	17	16	5	-8	-39	-80
H07	30	34	25	24	23	14	6	-13	-64
H08	34	38	31	28	27	19	12	-2	-37
H09	31	34	26	24	24	14	5	-14	-67

Table 7 shows the daytime and night-time margins by which the predicted operational sound levels resulting from the operation of the Proposed Development in **Table 6** meets the noise limits set out in **Table 2** in **Section 2.7** for daytime and night-time, respectively. A negative number shows that predicted levels are below the relevant noise limits at each residence.

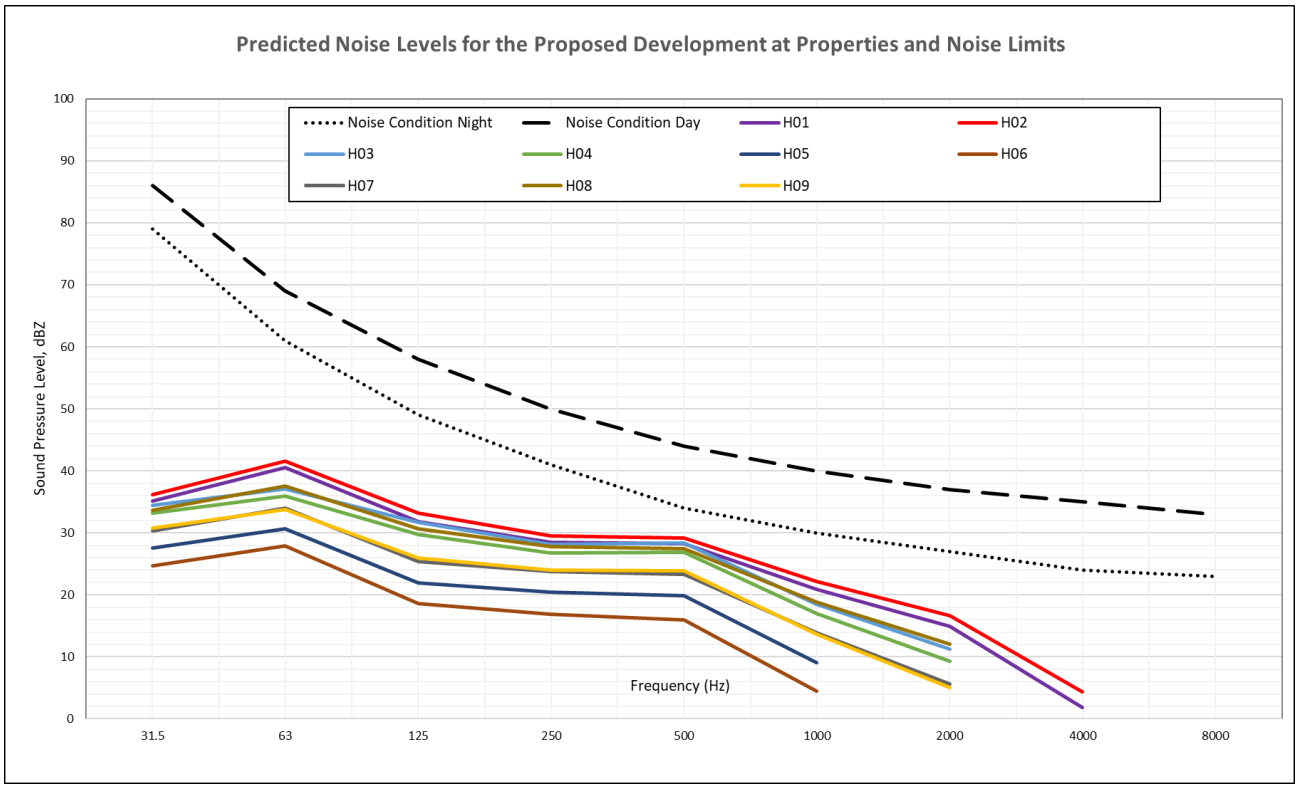
Figure 2 shows the predicted noise levels at each of the assessed properties as octave band unweighted (dBZ) L_{eq} values and the daytime and night-time noise limits.

Table 7 - Predicted Margin of Compliance

Property ID	Sound Levels (L_{eq}) dBZ for Octave Frequency Bands								
	31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Daytime									
H01	-51	-29	-26	-22	-16	-19	-22	-33	-64
H02	-50	-27	-25	-21	-15	-18	-20	-31	-59
H03	-52	-32	-27	-22	-16	-22	-26	-39	-75
H04	-53	-33	-28	-23	-17	-23	-28	-41	-81
H05	-58	-38	-36	-30	-24	-31	-38	-61	-113
H06	-61	-41	-39	-33	-28	-36	-45	-74	-113
H07	-56	-35	-33	-26	-21	-26	-31	-48	-97
H08	-52	-31	-27	-22	-17	-21	-25	-37	-70
H09	-55	-35	-32	-26	-20	-26	-32	-49	-100

Property ID	Sound Levels (L_{eq}) dBZ for Octave Frequency Bands								
	31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
	Night-time								
H01	-44	-21	-17	-13	-6	-9	-12	-22	-54
H02	-43	-19	-16	-12	-5	-8	-10	-20	-49
H03	-45	-24	-18	-13	-6	-12	-16	-28	-65
H04	-46	-25	-19	-14	-7	-13	-18	-30	-71
H05	-51	-30	-27	-21	-14	-21	-28	-50	-103
H06	-54	-33	-30	-24	-18	-26	-35	-63	-103
H07	-49	-27	-24	-17	-11	-16	-21	-37	-87
H08	-45	-23	-18	-13	-7	-11	-15	-26	-60
H09	-48	-27	-23	-17	-10	-16	-22	-38	-90

Figure 2 - Predicted Noise Levels & Noise Limits, L_{eq} dBZ



The assessment indicates that the predicted external noise levels resulting from the introduction of the Proposed Development, at the nearest neighbouring properties, remain below the derived daytime and night-time noise level limits for all receptors.

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

5.3 Cumulative Sound Levels

5.3.1 Cumulative Sites Considered

Planning applications have been submitted for the construction and operation of three other battery energy storage systems located in the proximity of the Proposed Development.

- Site A - Eccles II Battery Energy Storage System Land West of Eccles Sub Station Coldstream Scottish Borders. Application Ref: 23/01038/S36. Located approximately 300m to the north of the Proposed development;
- Site B - BESS with ancillary infrastructure on Land East of Eccles Substation Eccles Coldstream Scottish Borders. Application Ref: 22/01988/FUL. Located approximately 700m to the northeast of the Proposed development; and
- Site C - BESS and Associated Infrastructure | Proposed 400MW Battery Storage Facility Coldstream Scottish Borders. Application Ref: 22/01532/S36. Located approximately 100m to the east of the Proposed development;

Noise impact assessment reports for each of the developments have been submitted as part of the planning application for the developments. The corresponding reports are referenced as: Site A [11]; Site B [12]; and Site C [13] & [14]. The predicted noise levels produced in each of these reports have been used to inform the cumulative assessment.

5.3.2 Predicted Broadband Cumulative Sound Levels

For each of the cumulative sites considered, the predicted specific sound levels, L_{Aeq}, taken from each of the associated noise impact assessments are given in **Table 8**. The predicted sound levels stated are for each of the cumulative sites in isolation at the identified receptor locations in the corresponding reports. Each of the assessments for the cumulative sites consider different numbers of receptors, as shown in **Table 8**. As a conservative measure the maximum predicted sound levels for each site are considered in the cumulative assessment, i.e. sound levels predicted at night-time for 4m above ground level for the Proposed Development, Site A and Site B and 1.5m for Site C.

Table 8 - Predicted Sound Levels for each Site in Isolation and Cumulative Levels

Property ID	Predicted Sound Level, dB $L_{Aeq, T}$				
	Proposed Development	Site A	Site B	Site C	Cumulative
H01	28	-	-	30	32
H02	29	41	-	30	42
H03	26	34	28	33	37
H04	25		29	32	34
H05	18	-	-	25	26
H06	14	-	-	22	23
H07	22	-	-	31	32

Property ID	Predicted Sound Level, dB $L_{Aeq, T}$				
	Proposed Development	Site A	Site B	Site C	Cumulative
H08	26	-	-	34	35
H09	22	39	19	-	39

The maximum predicted cumulative sound level is 42 dB(A) at receptor H02. It should be noted that the predicted sound levels associated with the operation of the Proposed Development at H02 will be 29 dB(A), which is greater than 10 dB lower than the predicted cumulative sound level and can be considered insignificant as a result.

5.3.3 Cumulative Predicted Sound Levels as Octave Band (dBZ) L_{eq} values

The maximum cumulative predicted sound levels as octave band unweighted (dBZ) L_{eq} values, external at the nearest residential receptor locations to the Proposed Development and the three specified nearby sites are detailed in **Table 9**. For Site B +10 dB has been applied to the value given in the report in order to convert from internal results to external. The isolative and cumulative predicted sound levels are shown for each receptor location.

Table 9 - Isolative & Cumulative - Predicted Sound Levels Freefield External to Properties

Property ID	Site	Sound Levels (L_{eq}) dBZ for Octave Frequency Bands								
		31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
H01	Proposed Development	35	41	32	29	28	21	15	2	-31
	Site A	-	-	-	-	-	-	-	-	-
	Site B	-	-	-	-	-	-	-	-	-
	Site C	0	33	34	33	28	23	15	0	0
	Cumulative	**35**	**41**	**36**	**34**	**31**	**25**	**18**	**4**	**0**
H02	Proposed Development	36	42	33	30	29	22	17	4	-26
	Site A	48	50	48	42	41	35	29	15	-22
	Site B	-	-	-	-	-	-	-	-	-
	Site C	0	34	35	33	28	24	15	0	0
	Cumulative	**49**	**50**	**48**	**42**	**41**	**36**	**30**	**15**	**-21**
H03	Proposed Development	34	37	31	28	28	18	11	-4	-41
	Site A	45	46	43	35	33	27	22	3	-51
	Site B	-2	7	19	20	21	23	18	18	-7
	Site C	0	36	37	36	31	26	19	0	0
	Cumulative	**45**	**47**	**44**	**39**	**36**	**31**	**25**	**18**	**1**
H04	Proposed Development	33	36	30	27	27	17	9	-6	-48
	Site A	-	-	-	-	-	-	-	-	-
	Site B	0	8	21	21	23	23	19	15	-7
	Site C	0	37	37	35	30	26	18	0	0

Property ID	Site	Sound Levels (L_{eq}) dBZ for Octave Frequency Bands								
		31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
	Cumulative	**33**	**40**	**38**	**36**	**33**	**28**	**22**	**16**	**1**
H05	Proposed Development	28	31	22	20	20	9	-1	-26	-80
	Site A	-	-	-	-	-	-	-	-	-
	Site B	-	-	-	-	-	-	-	-	-
	Site C	0	25	30	29	24	19	0	0	0
	Cumulative	**28**	**32**	**31**	**29**	**26**	**19**	**2**	**0**	**0**
H06	Proposed Development	25	28	19	17	16	5	-8	-39	-80
	Site A	-	-	-	-	-	-	-	-	-
	Site B	-	-	-	-	-	-	-	-	-
	Site C	0	24	28	26	21	15	0	0	0
	Cumulative	**25**	**29**	**28**	**26**	**22**	**16**	**1**	**0**	**0**
H07	Proposed Development	30	34	25	24	23	14	6	-13	-64
	Site A	-	-	-	-	-	-	-	-	-
	Site B	-	-	-	-	-	-	-	-	-
	Site C	0	34	35	34	29	25	17	0	0
	Cumulative	**30**	**37**	**35**	**34**	**30**	**25**	**17**	**0**	**0**
H08	Proposed Development	34	38	31	28	27	19	12	-2	-37
	Site A	-	-	-	-	-	-	-	-	-
	Site B	-	-	-	-	-	-	-	-	-
	Site C	0	38	38	37	32	28	21	0	0
	Cumulative	**34**	**41**	**39**	**37**	**33**	**28**	**21**	**2**	**0**
H09	Proposed Development	31	34	26	24	24	14	5	-14	-67
	Site A	47	48	46	40	38	31	23	5	-54
	Site B	-8	-1	10	12	12	13	7	-2	-45
	Site C	-	-	-	-	-	-	-	-	-
	Cumulative	**47**	**48**	**46**	**40**	**38**	**31**	**23**	**3**	**-51**

- Indicates no data available

In order to visualise the predicted sound levels for the proposed sites in isolation and cumulatively at the receptor locations, graphs have been generated for the three residential receptors with the highest predicted sound levels (H02, H03 and H09). **Figures 3, 4 & 5** show the predicted sound levels associated with the operation of the Proposed Development, the cumulative sites considered and the combined total at H02, H03 & H09 respectively.

Figure 3 - Predicted Sound Levels at property H02, L_{eq} dBZ

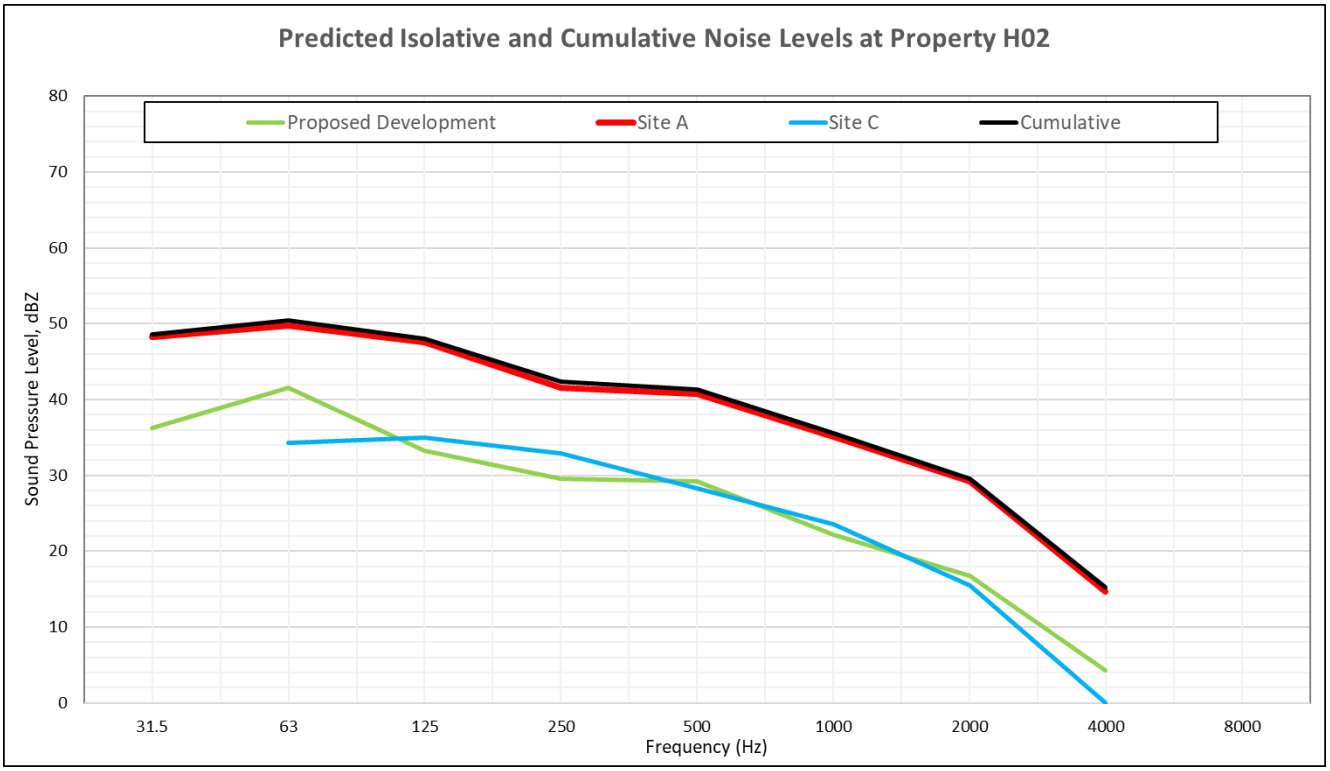


Figure 4 - Predicted Sound Levels at property H03, L_{eq} dBZ

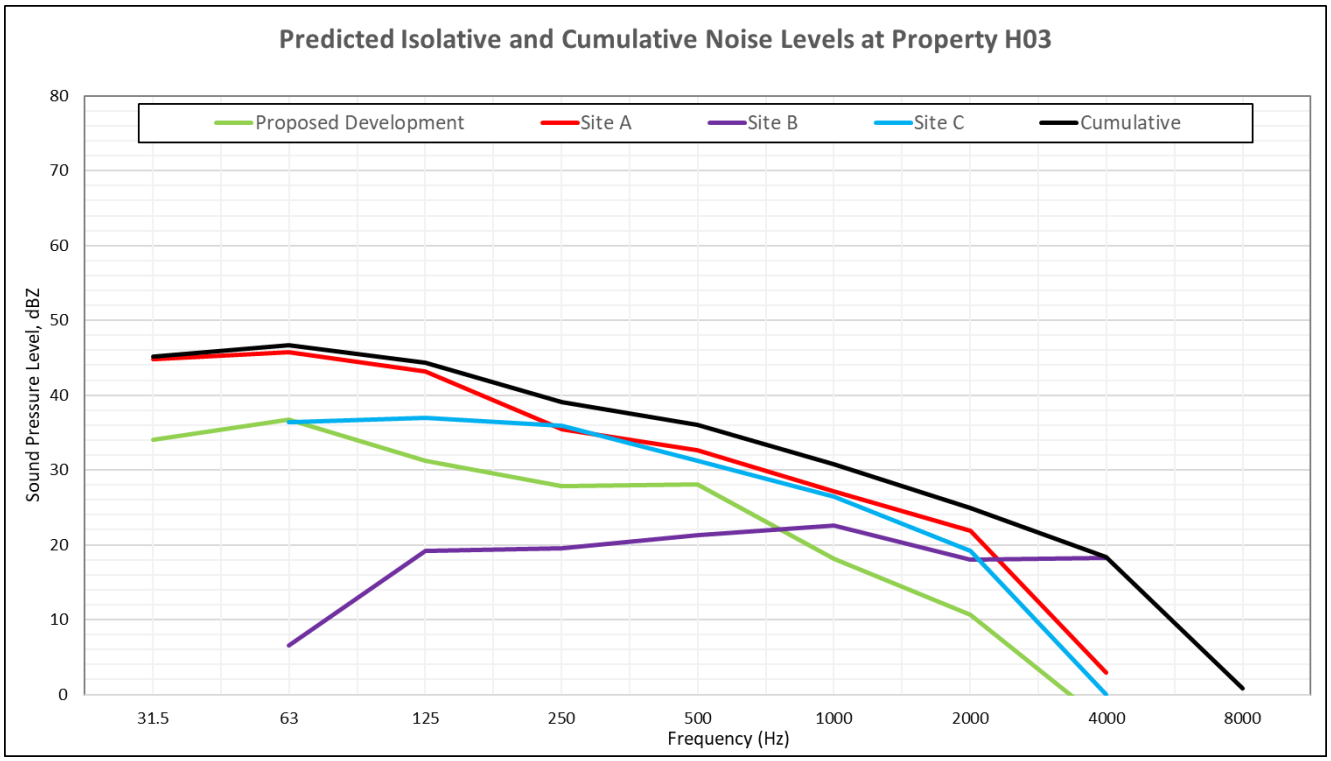
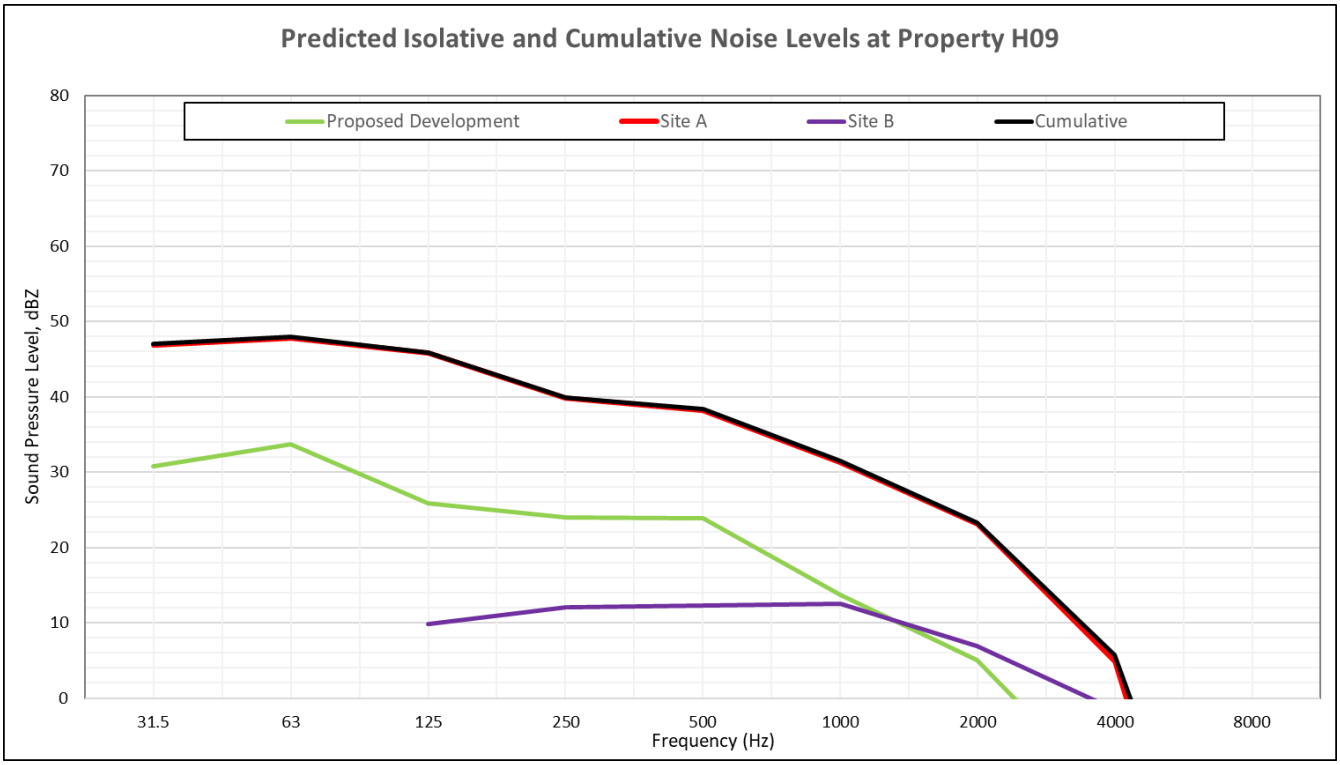


Figure 5 - Predicted Sound Levels at property H09, L_{eq} dBZ



For each of the three considered properties in the figures above it can be seen that the Proposed Development's predicted sound levels are well below the predicted cumulative sound levels. For the majority of the octave frequency bands the predicted levels for the Proposed Development are more than 10 dB below the cumulative levels which would mean that the Proposed Development could be considered insignificant as a result.

From analysis of the result it can be concluded that the proposed development is not a significant contributor to the predicted cumulative levels.

5.3.4 Assumptions

There are a number of conservative assumptions which have been made that are likely to overestimate the predicted noise levels from the Proposed Development. The noise model assumes that the overall levels correspond to the maximum anticipated sound output for each of the respective plant and that all plant operates at full capacity at all times. In reality the Proposed Development will not always operate at full capacity and is unlikely to generate the maximum predicted sound levels stated. Additionally, the model of the Proposed Development is calculated according to ISO 9613-2, which 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 resultant levels would be expected to be less, and the downwind predictions presented as part of this report would be regarded as conservative.

5.4 Construction

Construction sound is discussed with reference to the 'ABC Method' daytime, evening/weekend and night-time limits of 65, 55 and 45 dB L_{Aeq} respectively, for instances where existing ambient levels are relatively

low, which is the case here, and vibration is discussed in terms of the typical peak particle velocity (ppv) limits of 6 to 10 mms^{-1} (see **Section 2.6**).

The construction of battery storage facilities is typically undertaken in phases starting with the formation of access tracks such that the main site construction activities can begin, following with the installation of security fencing; the introduction of a concrete base and the subsequent construction of the battery storage and ancillary equipment; installation of transmission connection and installation of any necessary ecological and landscape mitigation measures.

The main activities which have the potential to generate sound and vibration are the formation of the access tracks, concrete works and landscaping when occurring relatively close to neighbouring residences. The other activities either occur at distances which are very unlikely to result in levels that would breach typical construction limits or involve relatively light construction methods/techniques that would equally result in comparably low temporary levels of sound and vibration.

Additional traffic movements generated during the construction process, along existing local roads, and access tracks, also have the potential to sporadically increase sound and vibration levels at residences adjacent to these. However, this essentially only tends to result in a minor increase in the average sound levels from existing roads, with the most noticeable sound and perceptible vibration effects resulting from the sporadic and increased number of HGV pass-bys at residences along the access routes, with resulting levels for individual events being similar to that created by existing HGV movements. In the case of the use of the introduced access tracks, overall levels are highly unlikely to breach typical construction limits.

Where relatively intense construction activities are to be undertaken near neighbouring residences, particularly during the construction of the site access routes, piling and trenching, specific attention to potential for enhanced mitigation measures to reduce the level of sound and vibration from these activities will be considered.

For all activities, measures will be taken to reduce sound levels with due regard to practicality and cost as per the concept of 'best practicable means' as defined for example in Section 72 of the Control of Pollution Act 1974 [15], which BS 5228-1 makes refence to. BS 5228-1 states that community relations are important in minimising the likelihood of complaints and therefore liaison with the local authority and members of the public will take place to ensure that residents are informed of the intended activities. Non-acoustic factors which influence the overall level of complaints, such as mud on roads and dust generation, shall also be controlled.

Activities that have the potential to generate significant sound and vibration will occur during normal working hours (07:00 - 19:00 weekdays and Saturdays 07:00 – 13:00) with less intensive activities potentially occurring outside these hours depending on the location and sensitivity of the works.

The following construction sound and vibration mitigation measures will be implemented where appropriate and proportionate:

- Consideration shall be given to sound and vibration emissions when selecting or modifying the plant and equipment to be used on site, with quieter variants given preference;

- All plant and equipment should be used in accordance with manufacturers' instructions, maintained in good working order and fitted with the appropriate silencers, mufflers, or acoustic covers where applicable;
- Where sound generated from a specific activity is expected to be directional, steps should be taken to orientate the equipment such that sound is directed away from any sensitive areas;
- Stationary sound sources shall be sited as far away as reasonably possible from residential properties and consideration given as to whether it is necessary to install acoustic barriers to provide screening;
- The movement of vehicles to and from the site shall be controlled and employees instructed to ensure compliance with the sound control measures adopted;
- Reducing the number of construction activities occurring simultaneously;
- Restricting activities being performed within a certain distance of sensitive locations; and,
- Reducing construction traffic.

Any strategy that would reasonably be expected to reduce the level of construction sound and vibration by the desired amount will be considered.

6 Conclusions

An acoustic impact assessment of the proposed Bishops Dal Energy Storage Project has been undertaken in accordance with Noise Rating (NR) curves to determine the external noise levels at residential properties, as per the noise condition specified by SBC. The results of the assessment show that the predicted external noise levels resulting from the introduction of the Proposed Development, at the nearest neighbouring properties, remain below the derived noise level limits for all receptors and can be considered acceptable in terms of the condition provided by SBC.

A cumulative assessment considered the cumulative predicted noise levels from the Proposed Development and the three neighbouring sites as octave band unweighted (dBZ) L_{eq} values, external at the nearest residential receptors.

For the three properties with the highest predicted cumulative sound levels, the Proposed Development's predicted sound levels are well below the predicted cumulative levels. For the majority of the octave frequency bands the predicted levels for the Proposed Development are more than 10 dB below the cumulative levels which would mean that the Proposed Development could be considered insignificant in terms of its cumulative contribution. It can be concluded that the proposed development is not a significant contributor to the predicted cumulative levels.

Additionally, there are a number of conservative assumptions which have been made within the assessment which are likely to overestimate the predicted noise levels from the Proposed Development. As discussed, the noise model assumes that the overall levels correspond to the maximum anticipated sound output for each of the respective plant and that all plant operates at full capacity at all times. In reality the Proposed Development will not always operate simultaneously at full capacity and is unlikely to generate the maximum predicted sound levels stated.

Sound and vibration resulting from the construction of the site are unlikely to breach typical limits at neighbouring dwellings. However, appropriate sound reduction measures via the use of ‘best practicable means’ will be implemented to mitigate levels in any case.

7 References

[1] Scottish Government (March 2011) Planning Advice Notice 1/2011: Planning and Noise

[2] Scottish Government (March 2011) Assessment of Noise: Technical Advice Note

[3] British Standards Institution (2014) BS 8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings

[4] Guidelines for Community Noise, World Health Organization (1999), WHO Reference Number: a68672, Berglund, B., Lindvall, T., & Schwela, D. H. (Eds.)

[5] British Standards Institution (2014) BS 5228-1:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites - Part 1: Noise

[6] British Standards Institution (2014) BS 5228-1:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites - Part 2: Vibration

[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] International Organisation for Standardisation (1996) ISO 9613-2:1996 Acoustics - Attenuation of Sound During Propagation Outdoors - Part 2: General Method of Calculation

[10] International Organisation for Standardisation (1993) ISO 9613-1:1993 Acoustics - Attenuation of sound during propagation outdoors - Part 1: Calculation of the Absorption of Sound by the Atmosphere

[11] Eccles Battery Energy Storage System (500MW), Noise Impact Assessment, Prepared for: Eccles Energy Centre Limited by AECOM (April 2023). Submitted to SBC as part of planning application 23/01038/S36.

[12] Eccles Battery Energy Storage Scheme, Noise Impact Assessment, Prepared for: Eccles Grid Stability Limited, SLR Ref: 428.012983.00001, (December 2022). Submitted to SBC as part of planning application 22/01988/FUL.

[13] Environmental Noise Impact Assessment, Eccles Battery Energy Storage System, Prepared for: Zenobe Ltd, Ref: 15063-024-R0, (August 2022) by TNEI. Submitted to SBC as part of planning application 22/01532/S36.

[14] Addendum to Environmental Noise Impact Assessment, Eccles Battery Energy Storage System, Prepared for: Zenobe Energy Ltd, Ref: 15063-026-R0, (January 2023) by TNEI. Submitted to SBC as part of planning application 22/01532/S36.

[15] Her Majesty's Stationery Office (July 1974) The Control of Pollution Act (CoPA)

Appendix A – Experience & Qualifications

Table A.1 - Author

Name	Stuart Hill
Experience	Senior Acoustic Specialist, RES, 2024-Present Senior Acoustic Consultant, Mabbett, 2022-2024 Senior Environmentalist (Acoustics), Amey, 2021-2022 Associate Consultant – Acoustics, Noise & Vibration, SLR Consulting, 2017-2020 Technical Analyst/Senior Acoustic Analyst, RES, 2013-2017
Qualifications	AMIOA, Associate Member of the Institute of Acoustics MInstP, Member of the Institute of Physics MSc Principles and Applications of Radiation in Industry, the Environment and Medicine, University of St Andrews BEng Electronics Engineering, University of Aberdeen

Table A.2 - Checker

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

Table A.3 - Approver

Name	Dr Jeremy Bass
Experience	Head of Specialist Services/Senior Technical Manager, RES, 2000-Present Technical Analyst/Senior Technical Analyst, RES, 1990-2000 Foreign Exchange Researcher, Mechanical Engineering Laboratory, Tsukuba, Japan, 1989-1990 Research Associate, Energy Research Unit, Rutherford Appleton Laboratory, 1986-1989
Qualifications	MIOA, Member of the Institute of Acoustics MInstP, Member of the Institute of Physics 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 BSc Physics, University of Durham

Appendix B – Suggested Planning Condition Wording

The energy storage facility shall be designed and operated to ensure that the noise limits, as shown below, as stipulated by SBC will be met for daytime and night-time.

1. *"The free-field Leq(1 hour) noise levels emitted by plant and machinery used on the premises will not exceed the values detailed in Table (1) when measured externally at the nearest occupied residential Noise Sensitive Receptors, as existing or consented at the time of this consent unless otherwise agreed in writing with the Planning Authority.*

Table (1): Noise Limits

Time	Descriptor	Frequency (Hz), dBZ								
		31.5	63	125	250	500	1000	2000	4000	8000
23:00 – 07:00	Night	79	61	49	41	34	30	27	24	23
07:00 – 23:00	Day	86	69	58	50	44	40	37	35	33

Reason: To protect nearby residents from undue noise and disturbance."