NOISE IMPACT ASSESSMENT

GOLDBOROUGH ROAD BATTERY ENERGY STORAGE SYSTEM
LAND SOUTH OF GOLDBOROUGH ROAD, HUNDLETON, PRMBROKE, NEAR SA71 5SH
P16-01-NIA JANUARY 2024

Version	Comments	Date	Authored By	Checked By	Project Number
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1. Introduction

1.1. Overview

inacoustic has been commissioned to assess the impact of potential noise arising from a proposed Battery Energy Storage System (BESS) facility on Land south of Goldborough Road, Pembroke, SA71 5SH.

This report details the existing background sound climate at the nearest noise-sensitive receptors, as well as the potential sound emissions associated with the Proposed Development.

The assessment considers the potential noise generation from the plant associated with the Proposed Development, with respect to existing sound levels in the area. The assessment methodology contained in British Standard 4142:2014+A1:2019 *Method for rating and assessing industrial and commercial sound* has been used.

Accordingly, the following technical noise assessment has been produced to accompany the Planning Application to Pembrokeshire Council and is based upon environmental noise measurements undertaken at the site and a subsequent 3-dimensional noise modelling exercise.

This noise assessment is necessarily technical in nature; therefore a glossary of terms is included in Appendix A to assist the reader.

1.2. Scope and Objectives

The scope of the noise assessment can be summarised as follows:

- A sound monitoring survey was undertaken at discrete locations representative of the closest noise-sensitive receptors to the Site;
- A 3-dimensional noise modelling exercise, in order to quantify the potential noise generation of the proposed site uses;
- An assessment of potential noise impacts with respect to the prevailing acoustic conditions at existing off-site receptors; and
- Recommendation of mitigation measures, where necessary, to comply with the requirements of BS4142:2014+A1:2019[1].

[1] British Standard 4142: 2014+A1:2019 *Method for rating and assessing commercial sound*. BSI

2. Legislation and Policy Framework

The development proposals for the Site are guided by the following policy directives and guidance:

2.1. National Policy

2.1.1. Planning Policy Wales

The Government's planning policies for Wales are contained in Planning Policy Wales (Edition 11, February 2021). The policy provides overarching requirements for developments to adequately control noise pollution, to provide appropriate soundscapes and to incorporate good acoustic design.

The policy is supplemented by the Noise and Soundscape Action Plan 2018-2023, which provides more detailed guidance on planning for a new development, but does not set out specific assessment methods or criteria. The guidance in this document has been used to inform a qualitative assessment of the effect the proposed development could have on the local soundscape.

2.1.2. Technical Advice Note (Wales) 11

This note provides advice on how the planning system in Wales can be used to minimise the adverse impact of noise without placing unreasonable restrictions on development or adding unduly to the costs and administrative burdens of business.

It outlines some of the main considerations which local planning authorities should take into account in drawing-up development plan policies and when determining planning applications for development which will either generate noise or be exposed to existing noise sources.

2.2. Assessment Criteria

2.2.1. BS4142:2014+A1:2019

BS4142:2014+A1:2019 *Methods for Rating and Assessing Industrial and Commercial Sound* sets out a method to assess the likely effect of sound from factories, industrial premises or fixed installations and sources of an industrial nature in commercial premises, on people who might be inside or outside a dwelling or premises used for residential purposes in the vicinity.

The procedure contained in BS4142:2014+A1:2019 for assessing the effect of sound on residential receptors is to compare the measured or predicted sound level from the source in question, the $L_{Aeq,T}$ *specific sound level*, immediately outside the dwelling with the $L_{A90,T}$ background sound level.

Where the sound contains a tonality, impulsivity, intermittency and other sound characteristics, then a correction depending on the grade of the aforementioned characteristics of the sound is added to the specific sound level to obtain the $L_{Ar,Tr}$ *rating sound level*. The effect of uncertainty in sound measurements, data and calculations should also be considered when necessary.

BS4142:2014+A1:2019 states: *"The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs"*. An estimation of the impact of the specific sound can be obtained by the difference of the rating sound level and the background sound level and considering the following:

- *"Typically, the greater this difference, the greater the magnitude of the 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."*
- *"The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context."*

During the daytime, the assessment is typically carried out over a reference time period of 1-hour, with a reference period of 15-minutes used for the night-time assessment. The periods associated with day or night, for the purposes of the Standard, are considered to be 07.00 to 23.00 and 23.00 to 07.00, respectively.

2.2.2. Relative Change in Ambient Noise Level

The IEMA Guidelines[2] define 'Noise Impact' as the difference in the acoustic environment before and after the implementation of the proposals, also known as the magnitude of change. In circumstances where a noise environment may be altered by addition or removal of a noise source, considered to be largely anonymous or within the prevailing acoustic character of an area, for example, changes to traffic quantum or patterns, it is normal to consider this relative change in ambient noise level. The assessment, therefore, considers this phenomenon to add context.

The impact scale adopted in this assessment is shown in Table 1 below, which relates to established human responses to noise, in line with '*Table 7-12 Effect Descriptors'* of the IEMA Guidelines.

TABLE 1: IMPACT SCALE FOR COMPARISON OF FUTURE NOISE AGAINST EXISTING NOISE

Noise Level Change dB(A)	Subjective Response	Significance
Less than 1.0	No perceptible	Negligible
1.0 – 2.9	Barely perceptible	Minor impact
3.0 – 4.9	Noticeable	Moderate impact
5.0 – 9.9	Up to a doubling or halving of loudness	Substantial impact
10.0 or more	More than a doubling or halving of loudness	Major impact

The criteria above reflect the key benchmarks that relate to human perception of sound. A change of 3 dB(A) is generally considered to be the smallest change in environmental noise that is perceptible to the human ear. A 10 dB(A) change in noise represents a doubling or halving of the perception of loudness. The difference between the minimum perceptible change and the doubling or halving of the perceived noise level is split to provide greater definition to the assessment of changes in noise level.

It is considered that the criteria specified in Table 1 provide a good indication as to the likely significance of changes in noise levels in this case and can be used to inform the context in which the sound occurs in order to assess the impact of noise from the proposed development.

[2] Institute of Environmental Management & Assessment (IEMA), Version 1.2 (November 2014). Guidelines for Environmental Noise Impact Assessment

3. Site Description

3.1. Site and Surrounding Area

The Proposed Development will be located approximately 50m south of Goldborough Road, Pembroke, SA71 5SH.

120m to the west of the site is an unnamed road, and further afield lies Hoplass Solar Farm and Wogaston Solar Farm. Green Hill Reservoir and Pembroke Powerstation are situated to the north of the proposed site location. Agricultural fields lie east and elsewhere in surround the area.

The closest noise-sensitive receptors (NSRs) are residential dwellings to the north-west of the site (NSR1 at approximately 350 meters) residential dwellings to the south-west of the site boundary (NSR4 at approximately 400 metres).

The ambient sound environment in the area is influenced predominantly by road traffic from the surrounding roads and the B4320. Surrounding infrastructure could sometimes be heard in lulls of traffic as well as nature sounds; bird song etc.

The Proposed Development site and the surrounding area can be seen in Figure 1.

Figure 1: Proposed Development Site and Surrounding Area

3.2. Proposed Development Overview

BESS is an emissions-free capacity resource that is fast, highly flexible, and ready to provide power services to the grid. It is different from other energy generators as it uses the electrical power grid as a fuel, and can either deliver or withdraw power from the grid depending on what is needed.

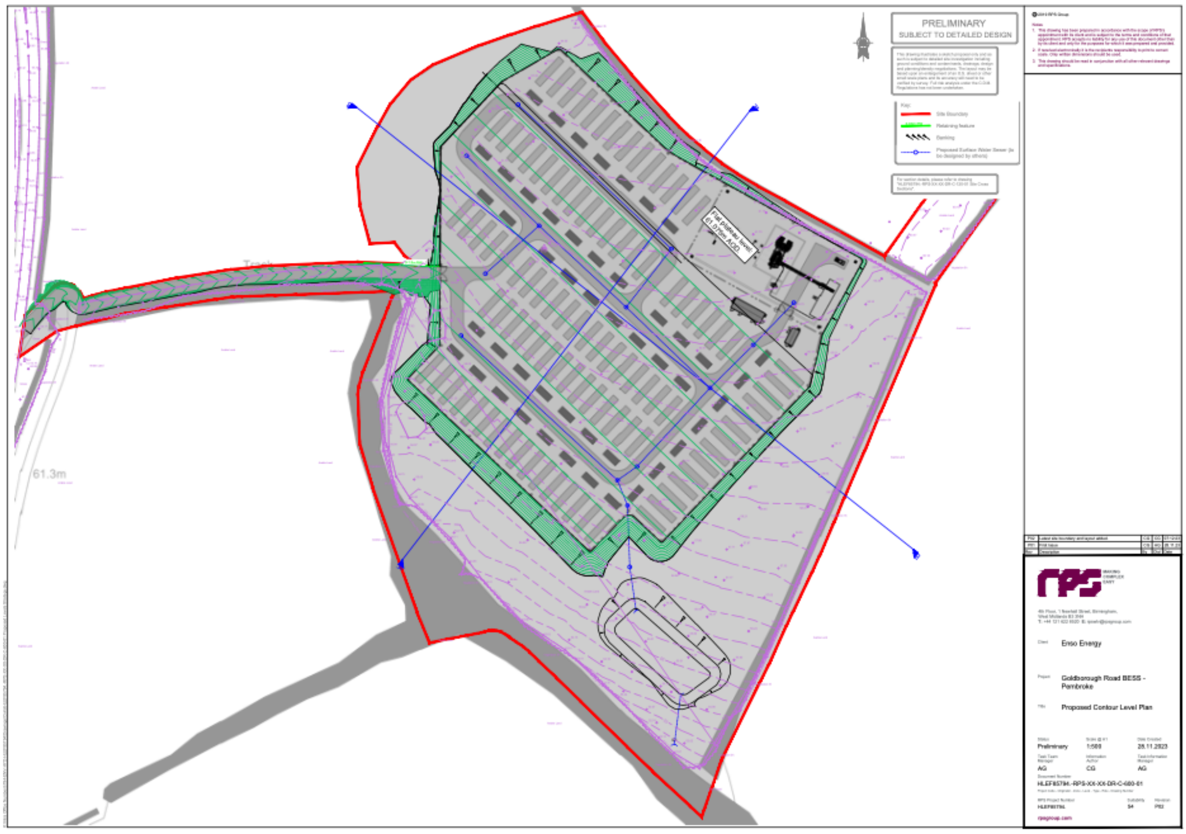
The energy storage process does not inherently have any sound emissions associated with it, however, to ensure the batteries remain at the correct temperature, cooling systems are used. Similarly, the inverter stations used to transform the energy from DC to AC and vice versa are cooled by systems that can generate noise.

Batteries can be charged/discharged over short periods of time with systems operating at full duty. Inversely, they can be charged/discharged over longer periods of time by operating at lower duty. The rest of the time, the systems are on a stand-by mode. Therefore, battery storage developments do not operate continuously at full duty during long periods of time.

Based on the Layout Plan provided, it is understood that the plan for the BESS project is to install 47 no. Inverter + MV Skid stations and 94 no. Battery Containers.

An overview of the proposed site layout can be seen below in Figure 2.

FIGURE 2: PROPOSED DEVELOPMENT LAYOUT



4. Measurement Methodology

4.1. General

The prevailing background sound conditions in the area have been determined by an environmental noise survey conducted during both daytime and night-time periods between 13th and the 16th of October 2023.

4.2. Measurement Details

All noise measurements were undertaken by a consultant certified as competent in environmental noise monitoring, and, in accordance with the principles of BS 7445[3].

All acoustic measurement equipment used during the noise survey conformed to Type 1 specification of British Standard 61672[4]. A full inventory of this equipment is shown in Table 2 below.

Table 2: Inventory of Sound Measurement Equipment

Measurement Position	Make, Model & Description	Serial Number	Certificate Number	Calibration Expiry Date
MP1	Rion NL-52 Sound Level Meter	00764926	1129328	26/06/2024
	Rion NH-25 Preamplifier	76427		
	Rion UC-59 Microphone	12922		
MP2	Rion NL-52 Sound Level Meter	00810575	CONF0322 02	10/03/2024
	Rion NH-25 Preamplifier	11118		
	Rion UC-59 Microphone	19968		
All	Cirrus CR:515	82501	1141302	07/03/2024

The sound measurement equipment used during the survey was field calibrated at the start and end of the measurement period. A calibration laboratory has calibrated the field calibrator used within the twelve months preceding the measurements. A drift of less than 0.2 dB in the field calibration was found to have occurred on the sound level meter.

The weather conditions during the survey were not entirely conducive to noise measurements; with some increased wind speeds, as measured on-site using a rain-tipping gauge and anemometer, respectively. When periods of inclement weather occurred, they have been removed from the dataset used to derive the typical ambient and background sound levels.

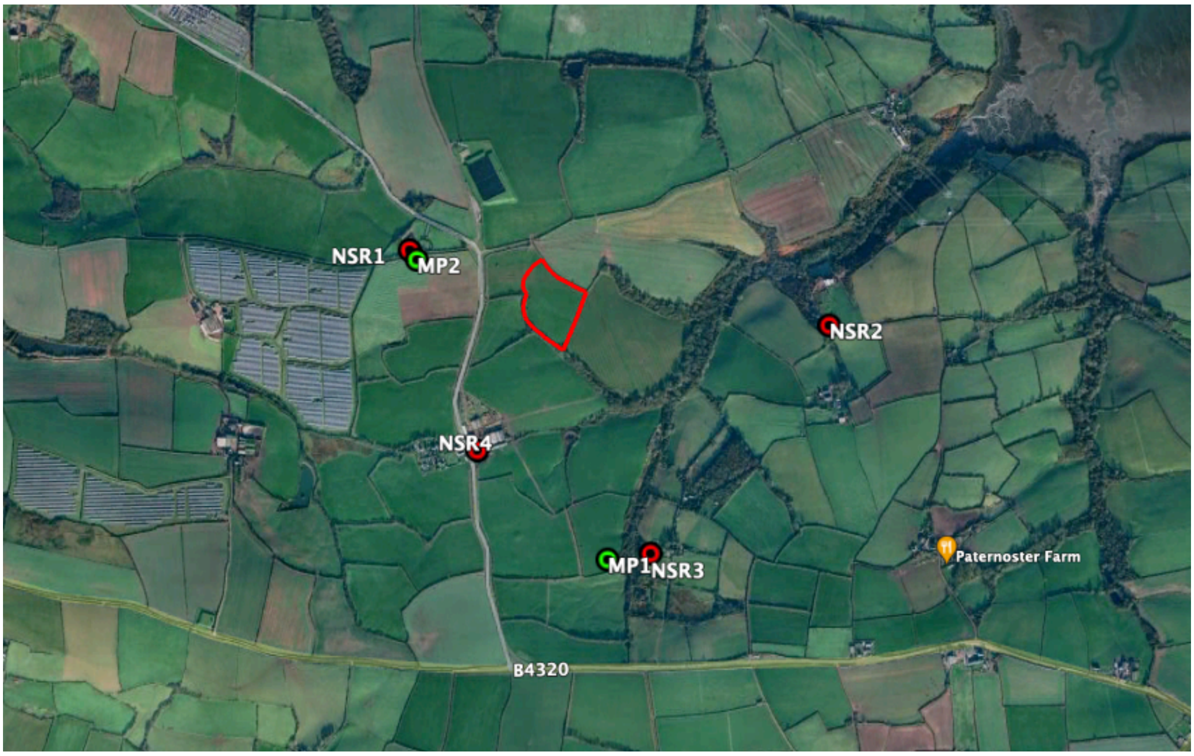
[3] British Standard 7445: 2003: Description and measurement of environmental noise. BSI
[4] British Standard 61672: 2013: Electroacoustics. Sound level meters. Part 1 Specifications. BSI.

The microphones were fitted with protective windshields for the measurements, which are described in Table 3, with an aerial photograph indicating their location shown in Figure 3.

TABLE 3: MEASUREMENT POSITION DESCRIPTIONS

Measurement Position	Description
MP1	Largely unattended daytime and night-time measurement of sound under free-field conditions, at a height of 1.5 metres above local ground level, located approximately 500 meters south east of the Site. The sound environment at this location was dominated by consistent road traffic noise from the north east of the microphone position. Intermittent traffic noise from the B4320 to the south also contributed to the sound environment.
MP2	Largely unattended daytime and night-time measurement of sound under free-field conditions, at a height of 1.5 metres above local ground level, located approximately 250 meters west of the Site boundary. The microphone was located in the vicinity of NSR3 and deemed representative of this receptor. The sound environment at this location was dominated by road traffic noise north and north east of the microphone position. Intermittent traffic noise contributions were attributed to the road immediately north of the microphone adjacent to NSR1 as well as the road due west.

FIGURE 3: MEASUREMENT POSITIONS



4.3. Sound Indices

The parameters reported are the average Equivalent Continuous Sound Level, $L_{Aeq,T}$, the statistical index (typical) Background Sound Level, $L_{A90,T}$, as well as the typical Maximum Sound Pressure Level, L_{AFmax}. An explanation of the sound units presented is given in Appendix A.

The measured L_{Aeq}, L_{AFmax}, and L_{AF90} sound levels are presented as time histories in a graph in Appendix B. Furthermore, the statistical distribution of the measured background sound levels to derive the typical representative $L_{A90,T}$ values are presented in a graphical format in Appendix C.

4.4. Summary Results

The summarised results of the environmental sound measurements, during the day and night-time periods, can be seen below in Table 4. Values have been rounded to the nearest whole number.

TABLE 4: SOUND MEASUREMENT RESULTS

Measurement Position	Period	$L_{AF90,T}$ (dB)	$L_{Aeq,T}$ (dB)	L_{AFmax} (dB)
MP1	Day	46	**29**	71
	Night	41	**28**	59
MP2	Day	41	**30**	68
	Night	37	**27**	54

5. Operational Noise Assessment

5.1. Noise Modelling

5.1.1. Source Data

The A-weighted sound power levels associated with the Proposed Development can be seen below in Table 5. At this stage, these are considered robust candidate source noise levels to be achieved by scheme design.

Table 5: Sound Source Data

Plant	Quantity	Sound Power Level per unit, L_{WA} (dB)*	Indicative Sound Pressure Level at 10m, L_{pA} (dB)*
MV Skid (Inverter Unit & Transformer)	47	75	47
Battery Cooling System	94	76	48
132Kv Substation Transformer	1	88	57

** Some suppliers provide their data in terms of Sound Pressure Level (SPL) at a given distance rather than Sound Power Level (SWL/Lw). However, SPL depends on i) the environment the measurements are taken in, ii) the dimensions and shape of the plant and iii) the distance from the source to the measurement position, etc. SWL is a more objective metric for noise assessments, as it represents the total sound energy radiated by a sound source and can therefore being used in the noise modelling to predict the SPL at any distance, under various environmental conditions. Thus, our noise specifications are provided primarily as derived SWL to enable a transparent and robust comparison between different suppliers. Indicative SPL at 10m distance from the plant are also provided for reference.*

Confirmation from the selected manufacturers that the above noise levels can be achieved should always be sought prior to plant procurement.

It is noted that some cooling systems may perform at lower duty during the night, when ambient temperature is lower, if provided with variable fan speed. However, this assessment assumes nominal fan speed both during the day and during the night, for a reasonable worst-case scenario.

These input parameters are intended as acoustic specifications, to determine the likely sources of noise impact and whether attenuation is likely to be required, such that acoustic feasibility is assessed at early stages.

5.1.2. Calculation Process

Calculations were carried out using Cadna/A, which undertakes its calculations in accordance with guidance given in ISO9613[5], which considers a worst-case downwind propagation to all receptors.

5.1.3. Model Assumptions

Given that the land between proposed development and nearest receptors is largely soft, the ground factor has been set to 0.8, within the calculation software, with 2 orders of reflection. Full octave frequency spectra have been used in the calculations. It has been assumed that all plant will operate simultaneously, representing a worst-case scenario, although this is an unlikely occurrence as all of the units are independent of each other and usually operate as per demand and for a short period of time.

In order to accurately model the land surrounding the development, an AutoCAD DXF drawing was produced, which was based on data provided by the Ordnance Survey, along with associated LIDAR Composite DTM topographic contours sourced from the Defra Data Services Platform.

5.1.4. Mitigation by Design

In order to reduce the potential noise impact of the Proposed Development, an iterative assessment of suitable noise mitigation techniques has been undertaken. The following mitigations have been considered in the noise model and subsequent assessment of residual effects.

Table 5 shows the maximum sound power level required to achieve compliance at the nearest receptors. To achieve this, it is recommended that low-noise inverters are deployed at this site. This might require the inverters to be fitted with a noise reduction kit comprising external acoustic baffles to the air inlets and outlets, or housed within an acoustic enclosure capable of reducing the total sound power level to those presented in Table 5. M&E engineers should make allowances for the necessary pressure loss introduced by the proposed mitigations. Similarly, low noise cooling systems should be employed in the battery containers. The HV Transformer should also be designed for low noise emissions, including any necessary cooling system. It is the responsibility of the contractor/manufacturer to provide test documentation confirming that the plant does not exceed the noise specifications set out in this report.

Where possible, it is recommended to install the plant on a low plinth with gravel underneath, rather than on a concrete slab, to avoid acoustic reflections on the ground.

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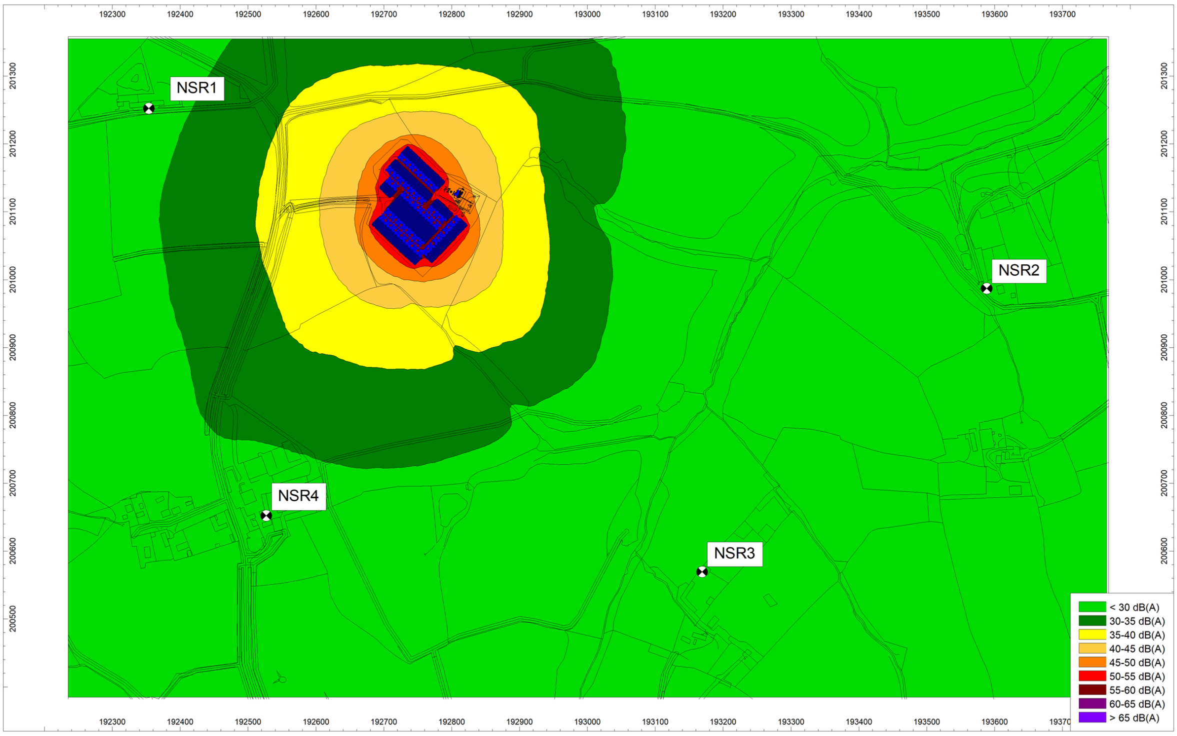
5 *ISO 9613-1:1993 and ISO 9613-2:1996: Acoustics - Attenuation of sound during propagation outdoors. Part 1: Calculation of the absorption of sound by the atmosphere and Part 2: General method of calculation*

5.1.5. Specific Sound Level Map

The sound map at 4m above ground, showing the specific sound level emissions from the Proposed Development can be seen in Figure 4.

FIGURE 4: SPECIFIC SOUND LEVEL MAP



5.1.6. Specific Sound Level Summary

A summary of the predicted specific sound levels at the closest NSRs, based on the sound map shown in Figure 4 can be seen below in Table 6.

TABLE 6: PREDICTED SPECIFIC SOUND LEVEL SUMMARY

NSR	Specific Sound Level (dB)
1	27
2	20
3	25
4	27

5.2. Assessment

5.2.1. Rating Penalty Principle

Section 9 of BS4142:2014+A1:2019 describes how the rating sound level should be derived from the specific sound level, by determining a rating penalty. BS4142:2014+A1:2019 states:

"Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level. Where such features are present at the assessment location, add a character correction to the specific sound level to obtain the rating level. This can be approached in three ways:

a) subjective method;
b) objective method for tonality;
c) reference method."

Given that the Proposed Development is not operational, the subjective method has been adopted to derive the rating sound level from the specific sound level. This is discussed in Section 9.2 of BS4142:2014+A1:2019, which states:

"Where appropriate, establish a rating penalty for sound based on a subjective assessment of its characteristics. This would also be appropriate where a new source cannot be measured because it is only proposed at that time, but the characteristics of similar sources can subjectively be assessed.

Correct the specific sound level if a tone, impulse or other characteristics occurs, or is expected to be present, for new or modified sound sources."

BS4142:2014+A1:2019 defines four characteristics that should be considered when deriving a rating penalty, namely; tonality; impulsivity; intermittency; and other sound characteristics, which are defined as:

Tonality

A rating penalty of +2 dB is applicable for a tone which is *"just perceptible"*, +4 dB where a tone is *"clearly perceptible"*, and +6 dB where a tone is *"highly perceptible"*.

Impulsivity

A rating penalty of +3 dB is applicable for impulsivity which is *"just perceptible"*, +6 dB where it is *"clearly perceptible"*, and +9 dB where it is *"highly perceptible"*.

Intermittency

BS4142:2014+A1:2019 states that when the *"specific sound has identifiable on/off conditions, the specific sound level ought to be representative of the time period of length equal to the reference time interval which contains the greatest total amount of on time … if the intermittency is readily distinctive against the residual acoustic environment, a penalty of +3 dB can be applied."*

Other Sound Characteristics

BS4142:2014+A1:2019 states that where *"the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distinctive against the residual acoustic environment, a penalty of +3 dB can be applied."*

5.2.2. Rating Penalty Assessment

Considering the content of Section 5.2.1, an assessment of the various sound sources associated with the Proposed Development, in terms of whether any rating penalties are applicable, has been detailed in Table 7 below.

TABLE 7: RATING PENALTY ASSESSMENT

Sound Characteristic	Penalty	Discussion
Tonality	0 dB	The primary source of noise generation from energy storage projects is the fans serving the inverters and battery cooling systems, that typically generate aerodynamic broadband sound, which should be achieved by design. As such no rating penalty correction should be applied for Tonality.
Impulsivity	0 dB	Inverters and battery cooling systems operate continuously without the audibility or prominence of sudden sounds. As such, no rating penalty correction should be applied for Impulsivity.
Intermittency	0 dB	Inverters and battery cooling systems operate continuously during the battery charging/discharging process, which takes longer than 100% of the BS4142 reference time interval (1 hour during the day and 15 minutes during the night). The cooling system will then switch off during the cool down period, but gradually and not simultaneously on all units, with no identifiable on/off character. As clarified by the Association of Noise Consultants (ANC) Technical Note on BS 4142:2014+A1:2019, dated March 2020, if a source is considered to be ON for 100% of the reference time interval, an Intermittency correction should not, therefore, be applied.
Other Sound Characteristics	0 dB	BESS systems do not have acoustic features present such as a whine, hiss, screech, non-tonal hum, rattle or rasp that can attract attention. As such, no rating penalty correction should be applied for 'Other Sound Characteristics'.

In summary, no rating penalty has been included in the assessment.

5.2.3. Uncertainty

BS4142:2014+A1:2019 requires that the level of uncertainty in the measured data and associated calculations is considered in the assessment. The Standard recommends that steps should be taken to reduce the level of uncertainty.

Measurement Uncertainty

BS4142:2014+A1:2019 states that measurement uncertainty depends on a number of factors, including the following, which are applicable to the Proposed Development:

" *...*

b) the complexity and level of variability of the residual acoustic environment;
...
d) the location(s) selected for taking the measurements;
...
g) the measurement time intervals;
h) the range of times when the measurements have been taken;
i) the range of suitable weather conditions during which measurements have been taken;
...
k) the level of rounding of each measurement recorded; and
l) the instrumentation used."

Each of the measurement uncertainty factors outlined above have been considered and discussed in Table 8 below.

TABLE 8: MEASUREMENT UNCERTAINTY FACTORS

Measurement Uncertainty Factor Reference	Level of Uncertainty	Discussion
b)	0 dB	Residual acoustic environment is relatively constant, hence no correction for a complex residual acoustic environment.
d)	0 dB	Measuring at positions representative of the closest affected receptors to the site has enabled the determination of robust background sound levels.
g)	0 dB	Measurement time intervals were set in accordance with BS4142:2014+A1:2019, hence no further correction needs to be made.
h)	0 dB	Measurements were undertaken over a continuous 4-day period, including midweek and weekend periods.
i)	0 dB	Measurement periods removed where significant wind or precipitation were noted.
k)	0 dB	Measured values were rounded to 0.1 dB, therefore rounding would not have had a significant impact on the overall typical background sound levels.
l)	0 dB	The acoustic measurement equipment accorded with Type 1 specification of British Standard 61672, and were deployed with appropriate wind shields.

In summary, no uncertainty budget has been considered in the assessment, to account for measurement uncertainty.

Calculation Uncertainty

BS4142:2014+A1:2019 states that calculation uncertainty depends on a number of factors, including the following, which are applicable to the Proposed Development:

" ...

- b) *uncertainty in the operation or sound emission characteristics of the specific sound source and any assumed sound power levels;*
- c) *uncertainty in the calculation method;*
- d) *simplifying the real situation to "fit" the model (user influence on modelling); and*
- e) *error in the calculation process."*

Each of the calculation uncertainty factors outlined above have been considered and discussed in Table 9 below.

TABLE 9: CALCULATION UNCERTAINTY FACTORS

Calculation Uncertainty Factor Reference	Level of Uncertainty	Discussion
b)	0 dB	Sound source levels are based on robust candidate plant data, to be achieved by the design.
c)	0 dB	Calculations were undertaken in accordance with ISO 9613-2, which is considered a *"validated method"* by BS4142:2014+A1:2019.
d)	0 dB	The real situation has not been simplified for the purposes of this assessment.
e)	±1 dB	ISO 9613-2 indicates that there is a ±3 dB accuracy to the prediction method, therefore, an uncertainty factor of ±1 dB is considered appropriate and proportional, given the separation distances involved.

In summary, an uncertainty budget of ±1 dB has been considered in the assessment, to account for calculation uncertainty.

The overall uncertainty is considered to be small enough that it would not affect the conclusions of the assessment. It is also noted that because the assessment considers a worst-case scenario, such as downwind sound propagation (which in reality cannot happen at all NSRs at the same time) the relevance of the uncertainty is further reduced.

5.2.4. BS4142:2014+A1:2019 Assessment

The rating sound level, as calculated from the predicted specific sound level, has been assessed in accordance with BS4142:2014+A1:2019, at the closest NSRs, and can be seen in Table 10 and Table 11 for the daytime and night-time respectively.

TABLE 10: BS4142 ASSESSMENT – DAYTIME (07:00-23:00)

NSR	Specific Sound Level (dB)	Rating Penalty (dB)	Rating Sound Level (dB)	Daytime Background Sound Level (dB)	Excess of Rating over Background Sound Level (dB)
1	27	-	27	30	-3
2	20	-	20	30	-10
3	25	-	25	29	-4
4	27	-	27	29	-2

TABLE 11: BS4142 ASSESSMENT – NIGHT-TIME (23:00-07:00)

NSR	Specific Sound Level (dB)	Rating Penalty (dB)	Rating Sound Level (dB)	Night-time Background Sound Level (dB)	Excess of Rating over Background Sound Level (dB)
1	27	-	27	27	0
2	20	-	20	27	-7
3	25	-	25	28	-3
4	27	-	27	28	-1

It can be seen that the Proposed Development is predicted to have rating sound levels that do not exceed the prevailing background sound level at the nearest NSRs, which in BS4142:2014+A1:2019 terms represent a ‘Low Impact’, depending on the context, which is discussed below.

5.2.5. Discussion on Context

The results set out in Table 10 and Table 11 identify that the operation of the scheme, as proposed, can occur without affecting the amenity of the closest residential receptors to the site.

BS4142:2014+A1:2019, however, recognises the importance of the context in which a sound occurs when assessing impacts.

It is noted that the assessment considers a worst-case scenario, with all batteries charging/discharging at the same time and downwind noise propagation to all receptors. It also considers cooling fans operating at nominal duty during the day and during the night. At night, when cooling demand is lower, inverters and battery unit fans may operate at lower duty if the system is provided with variable fan speed, although this has not been considered in the assessment.

As such, the calculated noise levels from the Proposed Development are likely to be an overprediction based on a worst-case scenario which is unlikely to happen in reality for any prolonged period of time.

The effect of the Proposed Development on the relative change in ambient noise levels at the nearest residential receptors has also been assessed as part of the context, with reference to the IEMA guidelines outlined in Section 2.2.2

TABLE 12: ASSESSMENT OF RELATIVE CHANGE IN SOUND LEVEL

Receptor	Period	Existing L_{Aeq} Ambient Sound Level, dB(A)	Sound from Proposed Development dB(A)	Cumulative Sound Level dB(A)	Change in Sound Level, dB	Significance
NSR1	Daytime	41	27	41.2	0.2	Negligible
	Night-time	37	27	37.4	0.4	Negligible

As can be seen, the operation of the Proposed Development is predicted to have a negligible impact on the prevailing acoustic environment.

6. Conclusion

inacoustic has been commissioned to assess the impact of potential noise arising from a proposed Battery Energy Storage System (BESS) facility on Land south of Goldborough Road, Pembroke, SA71 5SH.

This technical noise assessment has been produced to accompany a Planning Application to Pembrokeshire Council and is based upon environmental noise measurements undertaken at the site and a subsequent 3-dimensional noise modelling exercise.

The assessment considers the potential noise generation from the plant associated with the Proposed Development, with respect to existing sound levels in the area, including mitigation measures presented in Section 5.1.4.

The assessment methodology contained in British Standard 4142: 2014+A1:2019 *Method for rating and assessing industrial and commercial sound* has been used in conjunction with supplementary acoustic guidance.

The assessment identifies that the Proposed Development will give rise to rating sound levels that do not exceed the measured background sound level in the area, thus giving rise to a 'Low Impact'.

The assessment also identifies that no significant change in ambient sound level at the identified receptor locations will be engendered as a result of the Proposed Development in its proposed and assessed form and that the amenity of residential receptors and operational use of the nearest non-residential receptors will not be compromised.

Since the Proposed Development conforms to British Standard and National Planning Policy requirements, it is recommended that noise should not be a considered constraint to the approval of this Planning Application, providing that the plant is constructed and operated in accordance with the acoustic assumptions and recommendations set out within this report.

7. APPENDICES

7.1. Appendix A – Definition of Terms

Sound Pressure	Sound, or sound pressure, is a fluctuation in air pressure over the static ambient pressure.
Sound Pressure Level (Sound Level)	The sound level is the sound pressure relative to a standard reference pressure of 20µPa (20x10^{-6} Pascals) on a decibel scale.
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s1 and s2 is given by 20 log10 (s1 / s2). The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20µPa.
A-weighting, dB(A)	The unit of sound level, weighted according to the A-scale, which takes into account the increased sensitivity of the human ear at some frequencies.
Noise Level Indices	Noise levels usually fluctuate over time, so it is often necessary to consider an average or statistical noise level. This can be done in several ways, so a number of different noise indices have been defined, according to how the averaging or statistics are carried out.
$L_{eq,T}$	A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
$L_{max,T}$	A noise level index defined as the maximum noise level during the period T. L_{max} is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
$L_{90,T}$	A noise level index. The noise level exceeded for 90% of the time over the period T. L_{90} can be considered to be the "average minimum" noise level and is often used to describe the background noise.
$L_{10,T}$	A noise level index. The noise level exceeded for 10% of the time over the period T. L_{10} can be considered to be the "average maximum" noise level. Generally used to describe road traffic noise.
Free-Field	Far from the presence of sound reflecting objects (except the ground), usually taken to mean at least 3.5m
Facade	At a distance of 1m in front of a large sound reflecting object such as a building façade.
Fast Time Weighting	An averaging time used in sound level meters. Defined in BS 5969.

In order to assist the understanding of acoustic terminology and the relative change in noise, the following background information is provided.

The human ear can detect a very wide range of pressure fluctuations, which are perceived as sound. In order to express these fluctuations in a manageable way, a logarithmic scale called the decibel, or dB scale is used. The decibel scale typically ranges from 0 dB (the threshold of hearing) to over 120 dB. An indication of the range of sound levels commonly found in the environment is given in the following table.

TABLE 13: TYPICAL SOUND LEVELS FOUND IN THE ENVIRONMENT

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

The ear is less sensitive to some frequencies than to others. The A-weighting scale is used to approximate the frequency response of the ear. Levels weighted using this scale are commonly identified by the notation dB(A).

In accordance with logarithmic addition, combining two sources with equal noise levels would result in an increase of 3 dB(A) in the noise level from a single source.

A change of 3 dB(A) is generally regarded as the smallest change in broadband continuous noise which the human ear can detect (although in certain controlled circumstances a change of 1 dB(A) is just perceptible). Therefore, a 2 dB(A) increase would not be normally be perceptible. A 10 dB(A) increase in noise represents a subjective doubling of loudness.

A noise impact on a community is deemed to occur when a new noise is introduced that is out of character with the area, or when a significant increase above the pre-existing ambient noise level occurs.

For levels of noise that vary with time, it is necessary to employ a statistical index that allows for this variation. These statistical indices are expressed as the sound level that is exceeded for a percentage of the time period of interest. In the UK, traffic noise is measured as the L_{A10}, the noise level exceeded for 10% of the measurement period. The L_{A90} is the level exceeded for 90% of the time and has been adopted to represent the background noise level in the absence of discrete events. An alternative way of assessing the time varying noise levels is to use the equivalent continuous sound level, L_{Aeq}.

This is a notional steady level that would, over a given period of time, deliver the same sound energy as the actual fluctuating sound.

To put these quantities into context, where a receiver is predominantly affected by continuous flows of road traffic, a doubling or halving of the flows would result in a just perceptible change of 3 dB, while an increase of more than 25%, or a decrease of more than 20%, in traffic flows represent changes of 1 dB in traffic noise levels (assuming no alteration in the mix of traffic or flow speeds).

Note that the time constant and the period of the noise measurement should be specified. For example, BS 4142 specifies background noise measurement periods of 1 hour during the day and 15 minutes during the night. The noise levels are commonly symbolised as $L_{A90,1hour}$ dB and $L_{A90,15mins}$ dB. The noise measurement should be recorded using a 'FAST' time response equivalent to 0.125 ms.

7.2. Appendix B – Sound Measurement Results

FIGURE 5: MEASURED TIME HISTORY – MP1

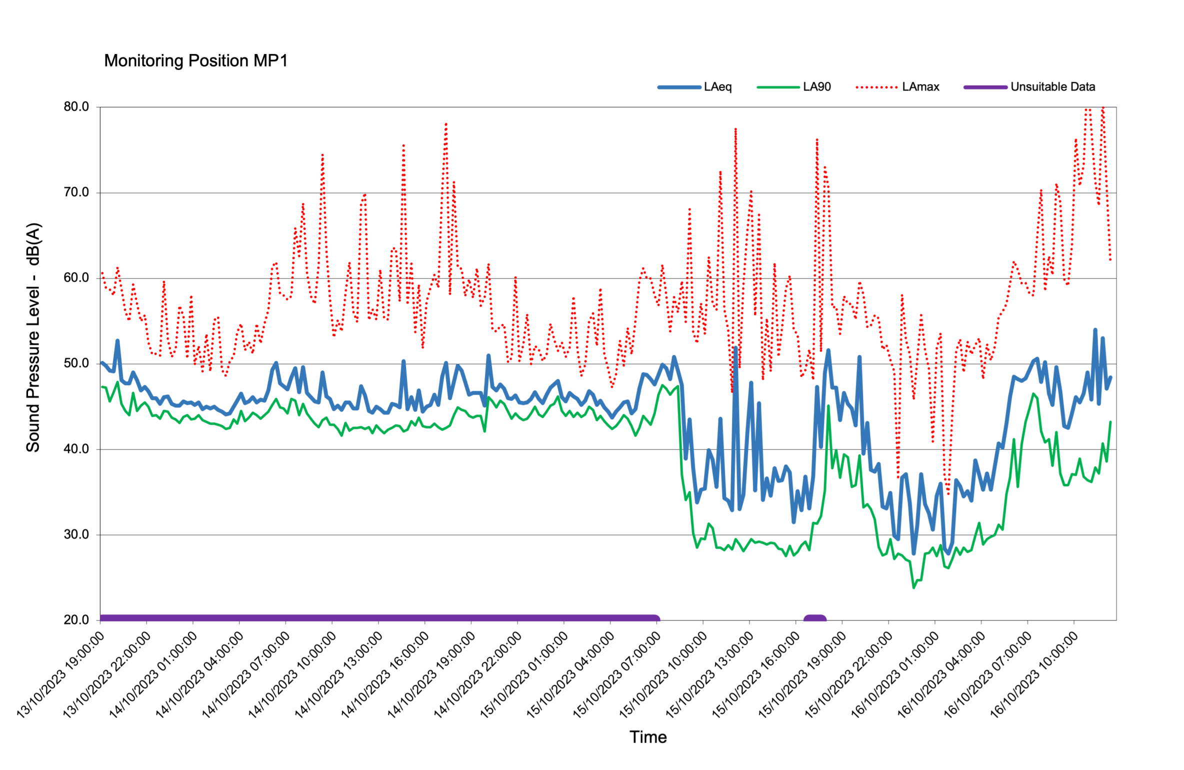
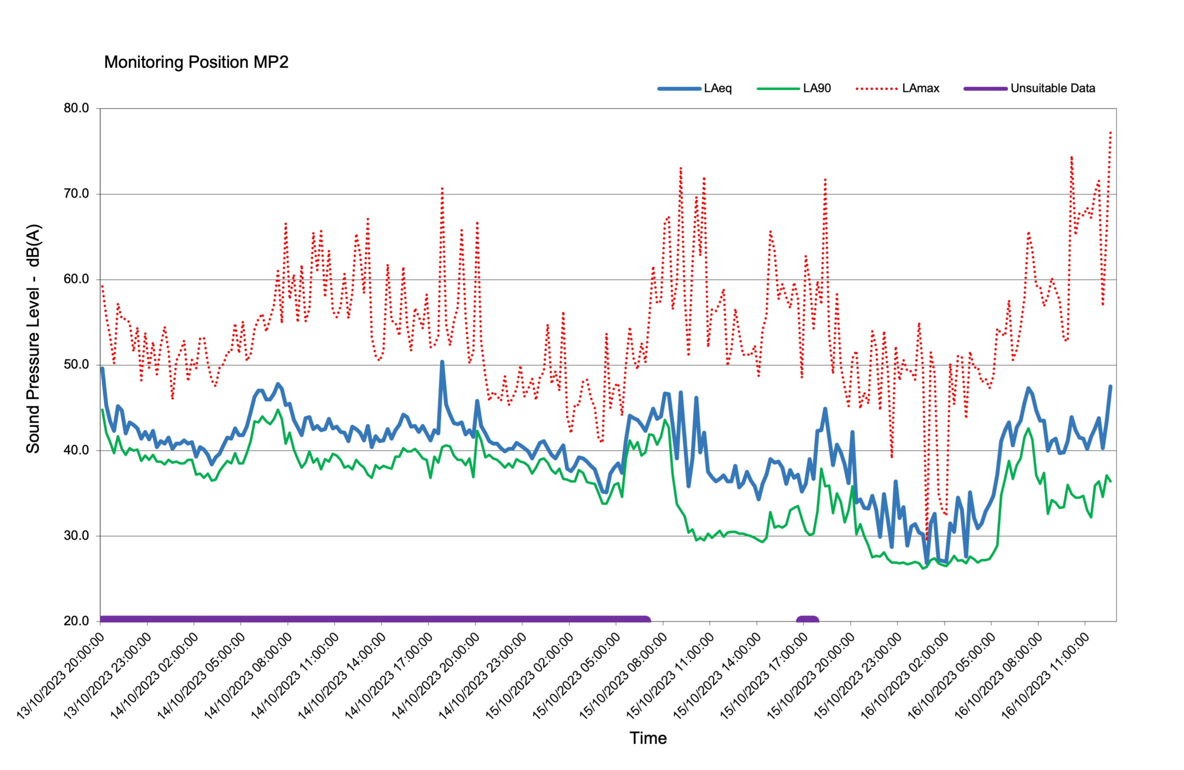


FIGURE 6: MEASURED TIME HISTORY – MP2



7.3. Appendix C – Statistical Analysis

Figure 7: Statistical Analysis of L_{A90} Background – Daytime - MP1

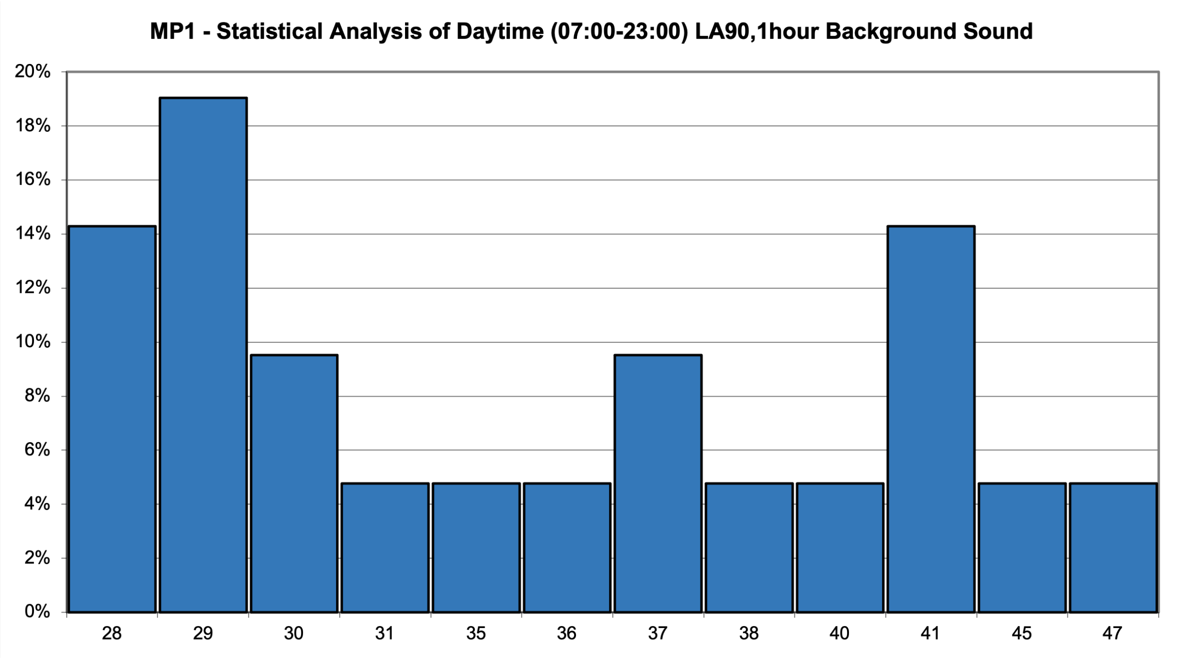


Figure 8: Statistical Analysis of L_{A90} Background – Night-Time – MP1

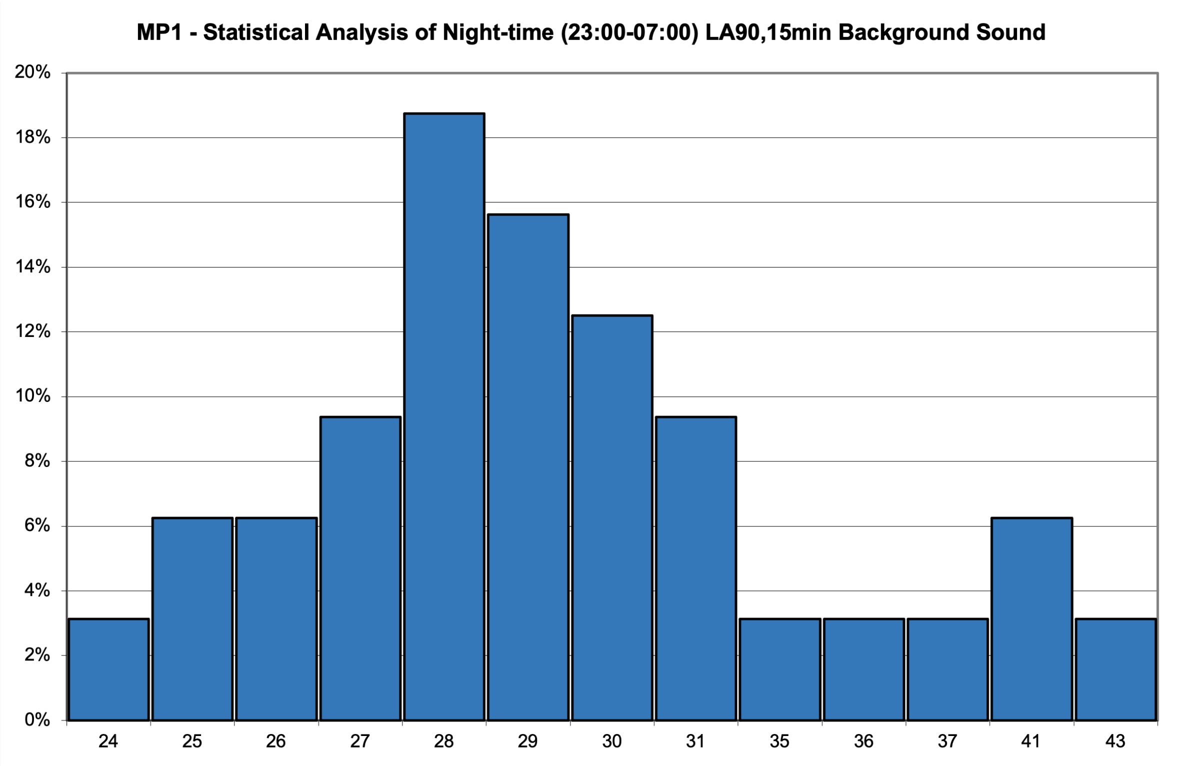


Figure 9: Statistical Analysis of L_{A90} Background – Daytime – MP2

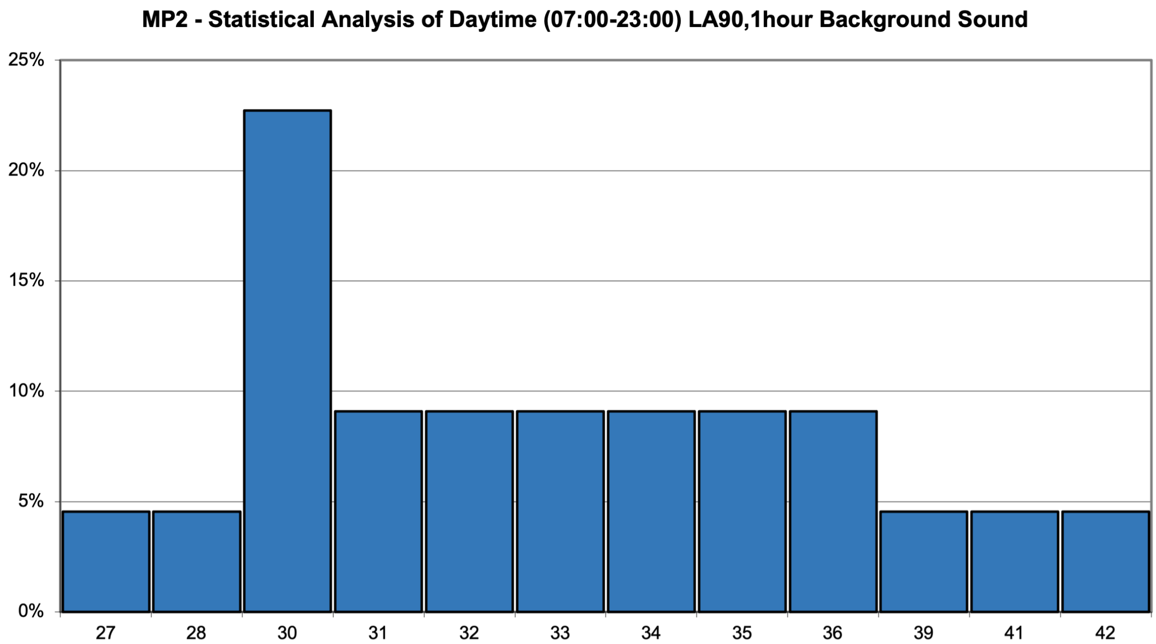


Figure 10: Statistical Analysis of L_{A90} Background – Night-time – MP2