Pentir Battery Energy Storage System (BESS)

Noise Impact Assessment for Planning Application

16th April 2024

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Version	Comments	Date	Authored By	Checked By	Project Number
1	Noise Assessment	15/03/2024	Neil Morgan MSc MIOA	Victor Valeron BEng MSc MIOA	24-111
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Contents

Figures

Tables

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 west of Pentir substation, near Bangor.

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 Gwynedd 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 a discrete location representative of the closest noise-sensitive receptors to the Site;
- A 3-dimensional noise modelling exercise, in order to quantify the 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. POLICY CONTEXT

2.1. National Policy

2.1.1. Planning Policy Wales

The Government's planning policies for Wales are contained in Planning Policy Wales (Edition 12, February 2024). 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.

3. Assessment Criteria

3.1.1. BS4142:2014+A1:2019

BS4142:2014[2] 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 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'. A correction to include the consideration of a level of uncertainty in sound measurements, data and calculations can also be applied when necessary.

BS4142:2014 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 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] British Standard 4142: 2014 +A1:2019 Method for rating and assessing commercial sound. BSI

3.1.2. Relative Change in Ambient Noise Level

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 the 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	Not 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 subjective perception of loudness. The difference between the minimum perceptible change and the doubling or halving of the loudness 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.

4. Site Description

4.1. Site and Surrounding Area

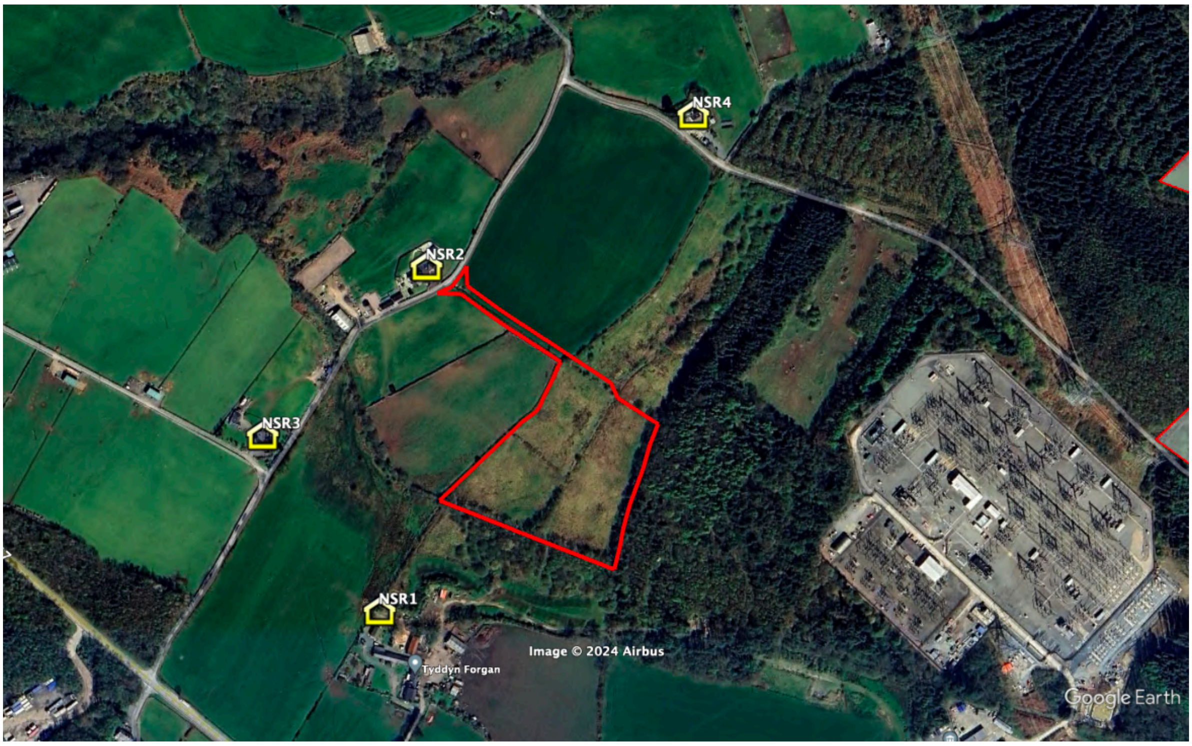
The proposed development is located on land to the north of the B4257, immediately west of the Pentir substation. The area lies due south of the City of Bangor.

The site is situated on disused land approximately 190 metres to the west of the existing Pentir Substation site within a largely rural setting, with isolated residential properties located to the north, west and south.

The ambient sound environment at the area is dominated by road traffic noise and natural sources, such as birdsong and wind-induced vegetation movement. The substation was noted to be audible.

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

Figure 1: Proposed Development Site and Surrounding Area



4.2. 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.

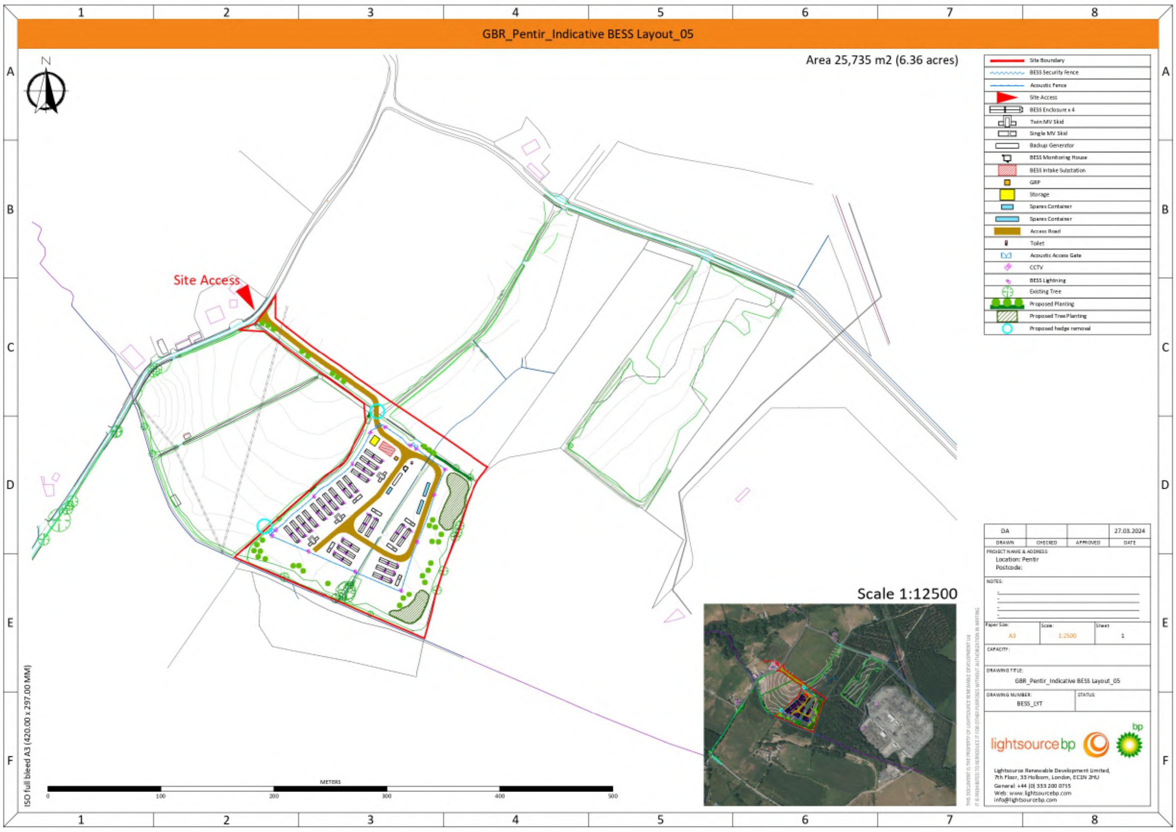
The energy storage process does not inherently have any sound emissions associated with it, however, to ensure the batteries remain at the correct temperature, a series of cooling fans are used. Similarly, the inverter stations used to transform the energy from DC to AC and vice versa are cooled by fans 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, with fans not operating. Therefore, battery storage developments do not operate continuously at full duty during long periods of time. In addition, cooling fans can often to operate at reduced speed during the night-time when the environmental temperature is lower, if provided with variable speed fans.

It is proposed that there will be 96 No. containerised battery units, 12 inverter sets and 9 No. MV transformer stations on Site, plus a BESS intake substation. The units will be served by integrated fan cooling systems. The scheme also incorporates a 4-metre high absorptive acoustic barrier around the north, west and south perimeter of the proposed plant compound, which has been added to the design as an acoustic mitigation measure, following an iterative analysis exercise.

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

FIGURE 2: PROPOSED DEVELOPMENT LAYOUT



5. MEASUREMENT METHODOLOGY

5.1. 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 Wednesday 25th and Tuesday 31st October 2023. The measurements were undertaken by RPS (a part of Tetra Tech).

5.2. 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
MP1	Rion NL-52 Sound Level Meter	164424
MP2	Rion NL-52 Sound Level Meter	164423
MP3	Rion NL-52 Sound Level Meter	943367
All	Rion NC-74 Acoustic Calibrator	35046823

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 meters.

The weather conditions during the survey were conducive to environmental noise measurement; it being dry, with wind speeds typically below 5 ms^{-1}.

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

TABLE 3: MEASUREMENT POSITION DESCRIPTION

Measurement Position	Description
MP1	A largely unattended daytime and night-time measurement of sound at a location representative of the closest noise-sensitive receptor to the west of the site (representative of NSR2). The microphone was located at 1.5 metres above local ground under free-field conditions.

[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.

Measurement Position	Description
	The sound environment at this location was influenced by distant road traffic noise and natural sounds such as birdsong and wind-induced vegetation movement.
MP2	A largely unattended daytime and night-time measurement of sound at a location representative of the closest noise-sensitive receptor to the north of the site (representative of NSR4). The microphone was located at 1.5 metres above local ground under free-field conditions. The sound environment at this location was influenced by distant road traffic noise and natural sounds such as birdsong and wind-induced vegetation movement.
MP3	A largely unattended daytime and night-time measurement of sound at a location representative of the closest noise-sensitive receptor to the south of the site (representative of NSRs 2 and 3). The microphone was located at 1.5 metres above local ground under free-field conditions. The sound environment at this location was influenced by distant road traffic noise and natural sounds such as birdsong and wind-induced vegetation movement.

FIGURE 3: MEASUREMENT POSITIONS

5.3. 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 graphical time histories 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.

5.4. 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	$L_{Aeq,T}$ (dB)	$L_{AF90,T}$ (dB)	L_{AFmax} (dB)
MP1	Day	46	**37**	71
	Night	37	**28**	56
MP2	Day	47	**32**	66
	Night	37	**24**	52
MP3	Day	47	**37**	73
	Night	38	**27**	56

6. Operational Noise Assessment

6.1. Noise Modelling

6.1.1. Source Data

The A-weighted sound source 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)*
Inverter Unit with Standard Acoustic Attenuation Pack	12	88 (Day – 80% Ventilation Duty) 84 (Night – 60% Ventilation Duty)
Battery Cooling System	96	76
Auxiliary Transformer	9	71
BESS Intake Substation	1	78

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

Some plant manufacturers advise that since the weather in the UK is temperate, it is unlikely that the fans would reach a 100% duty cycle, and that at night-time fan duty cycle can be even lower due to less cooling demand. This assessment assumes 80% fan speed during the day and 60% for the night time periods, based on robust information from various manufacturers. Confirmation from the selected plant manufacturers that the above noise levels can be achieved should always be sought prior to plant procurement.

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 demonstrated for the purposes of planning consideration.

6.1.2. 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] *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*

6.1.3. Model Assumptions

Given that the land between proposed development and nearest receptors is largely soft, therefore, the ground factor has been set according 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.

6.1.4. 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 for the daytime and Figure 5 for the night-time.

6.1.5. Specific Sound Level Summary

A summary of the predicted specific sound levels at the closest NSRs, based on the sound maps shown in Figure 4 and Figure 5, can be seen below in Table 6.

TABLE 6: PREDICTED SPECIFIC SOUND LEVEL SUMMARY

NSR	Period	Specific Sound Level (dB)
1	Daytime (07:00-23:00)	34
	Night-time (23:00-07:00)	32
2	Daytime (07:00-23:00)	33
	Night-time (23:00-07:00)	30
3	Daytime (07:00-23:00)	32
	Night-time (23:00-07:00)	30
4	Daytime (07:00-23:00)	29
	Night-time (23:00-07:00)	27

FIGURE 4: SPECIFIC SOUND LEVEL MAP – DAYTIME (80% INVERTER VENTILATION DUTY)

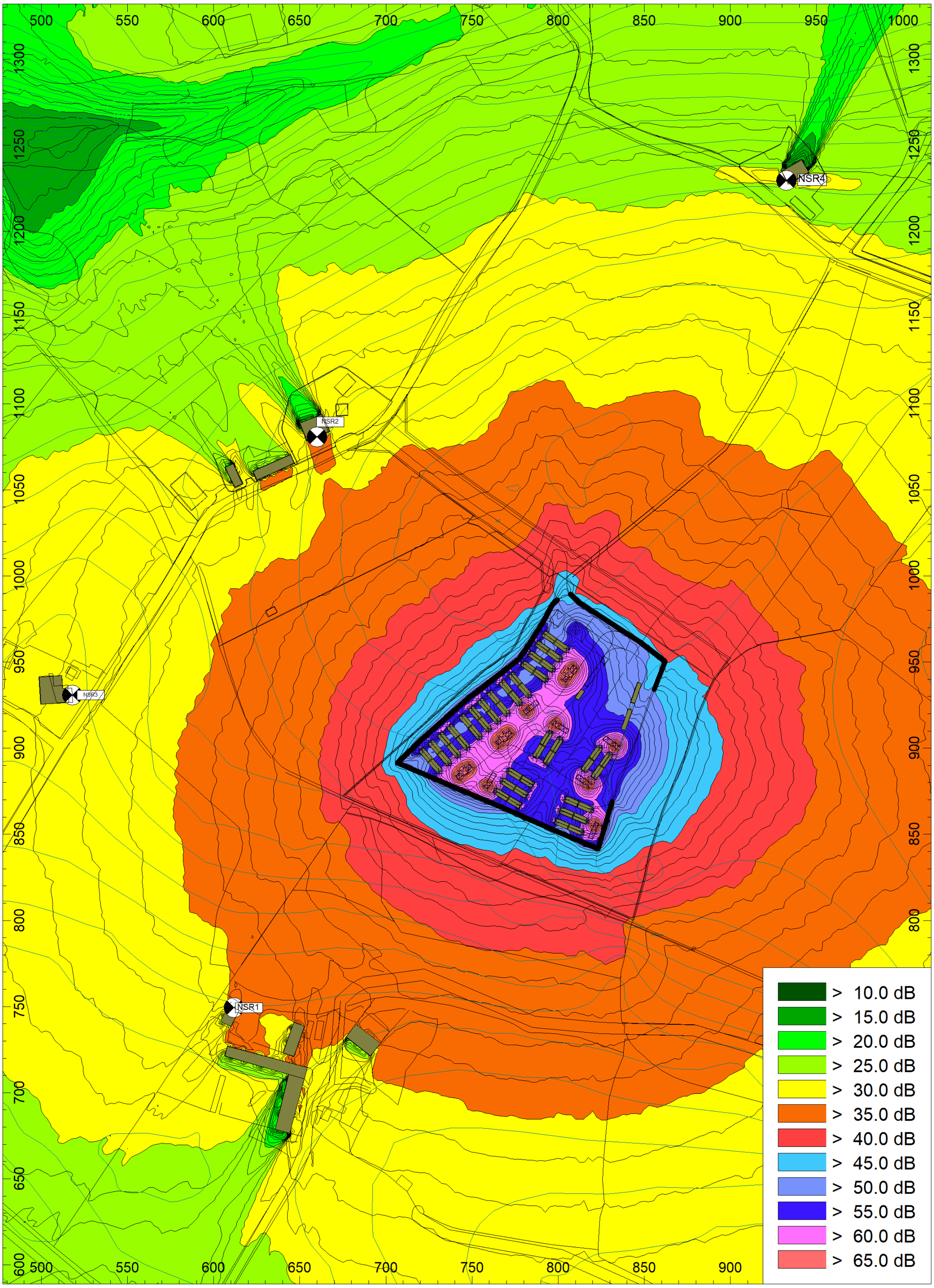
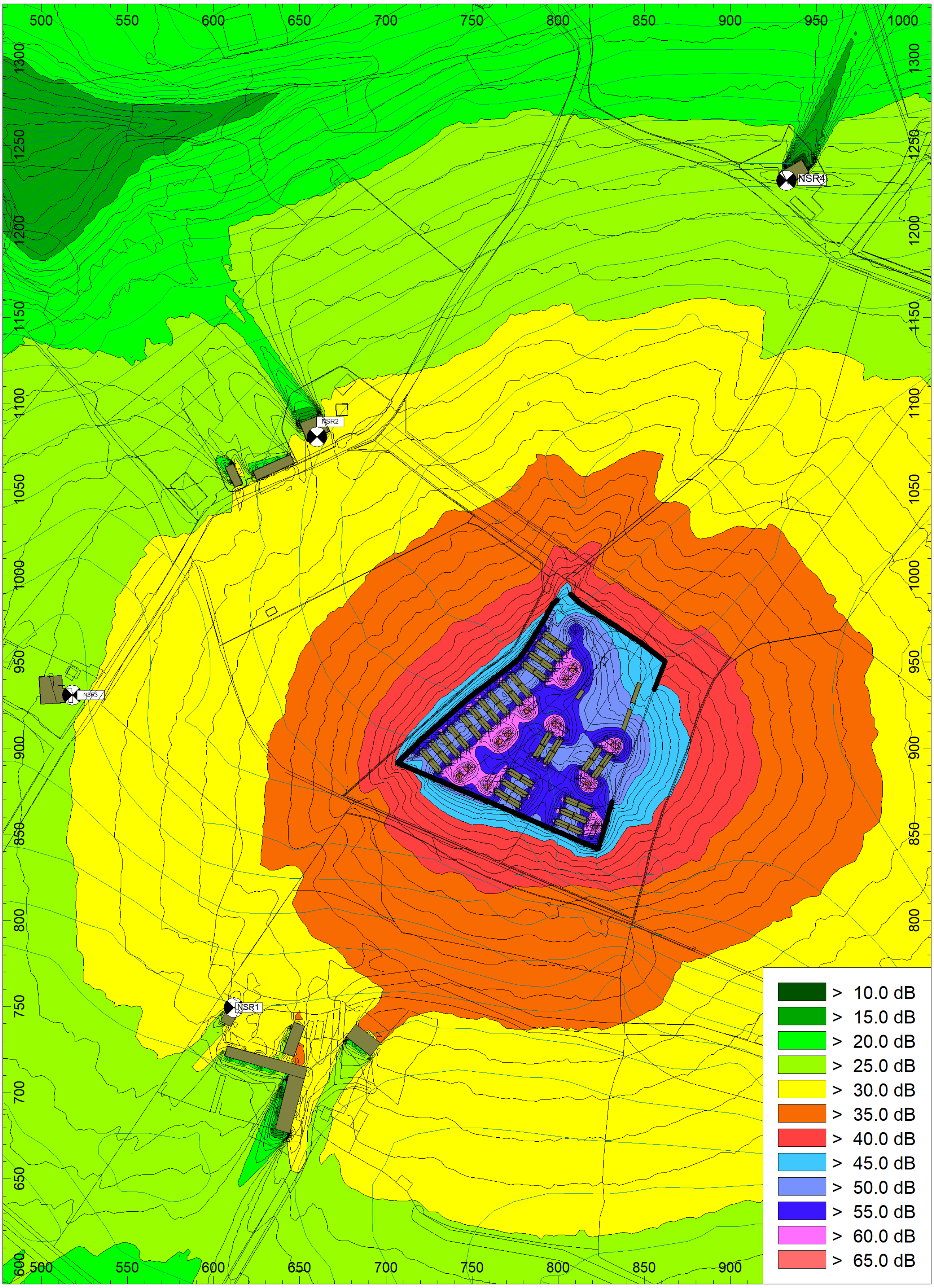


FIGURE 5: SPECIFIC SOUND LEVEL MAP – NIGHT-TIME (60% INVERTER VENTILATION DUTY)



6.2. Assessment

6.2.1. 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."*

6.2.2. Rating Penalty Assessment

Considering the content of Section 6.2.1, 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	ESS 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.

6.2.3. 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 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 multiple days, including midweek and weekend periods.
i)	0 dB	No periods of 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.

6.2.4. 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.

The BS4142:2014+A1:2019 assessment at the NSR's, during the day and night-time periods, can be seen in Table 10.

Table 10: BS4142 Assessment at NSRs

NSR	Period	Rating Sound Level (dB)	Background Sound Level (dB)	Excess of Rating over Background Sound Level (dB)
1	Daytime	34	37	**-3**
	Night-time	32	27	**+5**
2	Daytime	33	37	**-4**
	Night-time	30	28	**+2**
3	Daytime	32	37	**-5**
	Night-time	30	27	**+3**
4	Daytime	29	32	**-3**
	Night-time	27	24	**+3**

It can be seen that the Proposed Development is predicted to give rise to rating sound levels that do not typically exceed the prevailing background sound level during the daytime at the nearest NSRs, which in BS4142:2014+A1:2019 terms represents a 'Low Impact', depending on the context, which is discussed below.

It can also be seen that the Proposed Development is predicted to give rise to rating sound levels that may marginally exceed the prevailing background sound level during the night-time at the nearest NSRs, which in BS4142:2014+A1:2019 terms represents a 'Low to potentially Adverse Impact', depending on the context, which is also discussed below.

6.2.5. Discussion on Context

The results set out in Table 10 identify that the operation of the scheme, as proposed, can occur without affecting the amenity of the closest residential receptors to the site during the day, with a potentially adverse impact during the night, on the basis of a worst-case operational scenario.

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, as has been considered in the assessment. It should also be noted, that peak discharge, where peak levels of noise generation may occur, is typically unlikely to occur at night, as grid demand is lower.

In addition to this, BS4142:2014+A1:2019 states that '*for a given difference between the rating level and the background sound level, the magnitude of the overall impact might be greater for an acoustic environment where the residual sound level is high than for an acoustic environment where the residual sound level is low*'. It follows on to say that '*where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night*'.

In this case, both background sound levels and rating levels are low at the assessment locations. The predicted specific levels presented in Table 6 demonstrate that indoor ambient noise levels would be in the order of 17-22 dB(A) within a bedroom of the most potentially affected receptor at night when considering a 10-15 dB sound reduction for a partially open window for ventilation, well below the BS8233:2014[6] criteria of 30 dB(A).

On the above basis, and despite the fact that this assessment has aimed for the rating sound levels not to exceed the prevailing background sound levels, it is considered that a rating sound level in the order of 5 dB above the prevailing background sound level at night would still ensure that the amenity of the nearest dwellings would not be compromised by noise, and should be acceptable from a policy perspective.

The effect of the Proposed Development on the relative change in ambient noise levels at the nearest residential receptors should also be considered as part of the context.

The differential between the predicted specific sound levels at the closest NSRs as presented in Table 6; being 29-34 dB(A) by day and 27 to 32 dB(A) by night, when compared to the measured ambient $L_{Aeq,T}$ levels in the area as presented in Table 4; being 46-47 dB(A) by day and 37 to 38 dB(A) by night would ensure that no significant increase in the prevailing ambient sound level would occur as a result of the operation of the proposed scheme.

As part of the wider context and benefits of the proposed scheme, it is also important to note the role that these type of energy developments fulfil, in working towards achieving the 'Net Zero Strategy: Build Back Greener' from the Department for Business, Energy & Industrial Strategy, which sets out policies and proposals for decarbonising all sectors of the UK economy to meet the net zero target by 2050.

[6] BS 8233:2014 Guidance on sound insulation and noise reduction for buildings. BSI 2014

7. Conclusion

inacoustic has been commissioned to assess the impact of potential noise arising from a proposed Battery Energy Storage System (BESS) facility on land west of Pentir substation, near Bangor.

This technical noise assessment has been produced to accompany a Planning Application to Gwynedd 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.

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 during the day, thus giving rise to a 'Low Impact'.

The assessment also identifies that the Proposed Development may give rise to rating sound levels that marginally exceed the measured background sound level in the area at night, thus giving rise to a 'Low to potentially Adverse Impact'.

The context within which both of these potential impacts occur has been discussed.

In light of the above, it is considered that the potential noise impacts associated with the Proposed Development can be adequately controlled by appropriate engineering and design and that noise should not be considered a material constraint to the granting of planning permission for the proposals once mitigated as described in this report.

8. Appendices

8.1. 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 (20×10^{-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 11: 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.

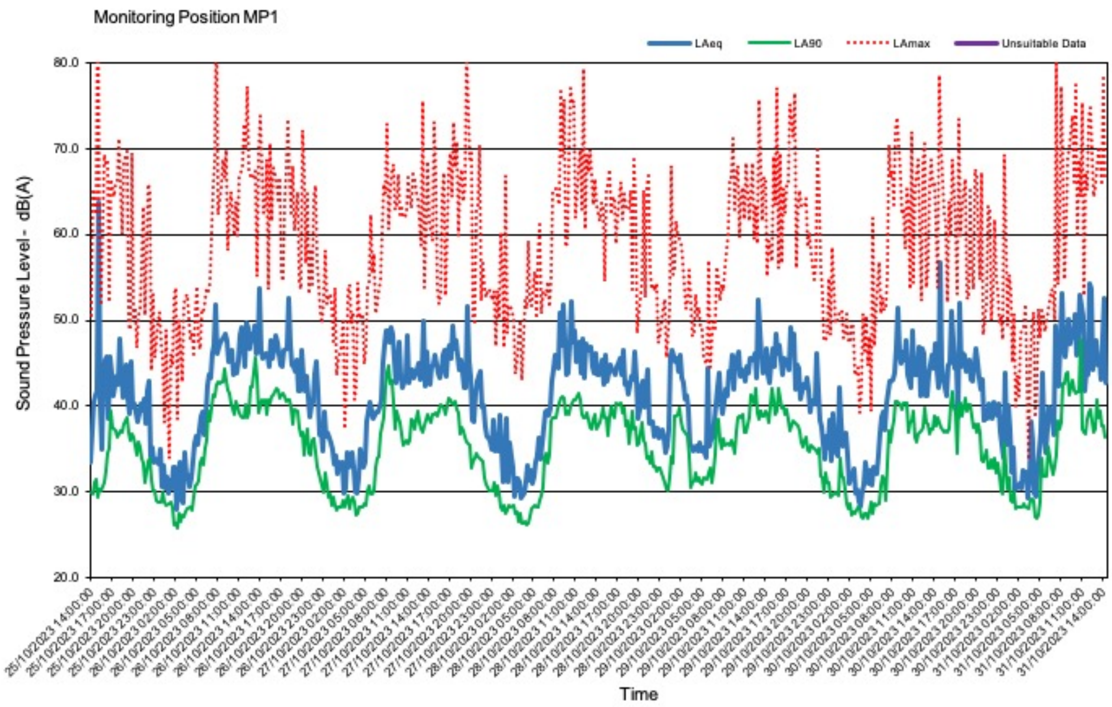
For levels of noise that vary with time, it is necessary to employ a statistical index that allows for this variation. These statistical indices are expressed as the sound level that is exceeded for a percentage of the time period of interest. In the UK, traffic noise is measured as the L_{A10}, the 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}.

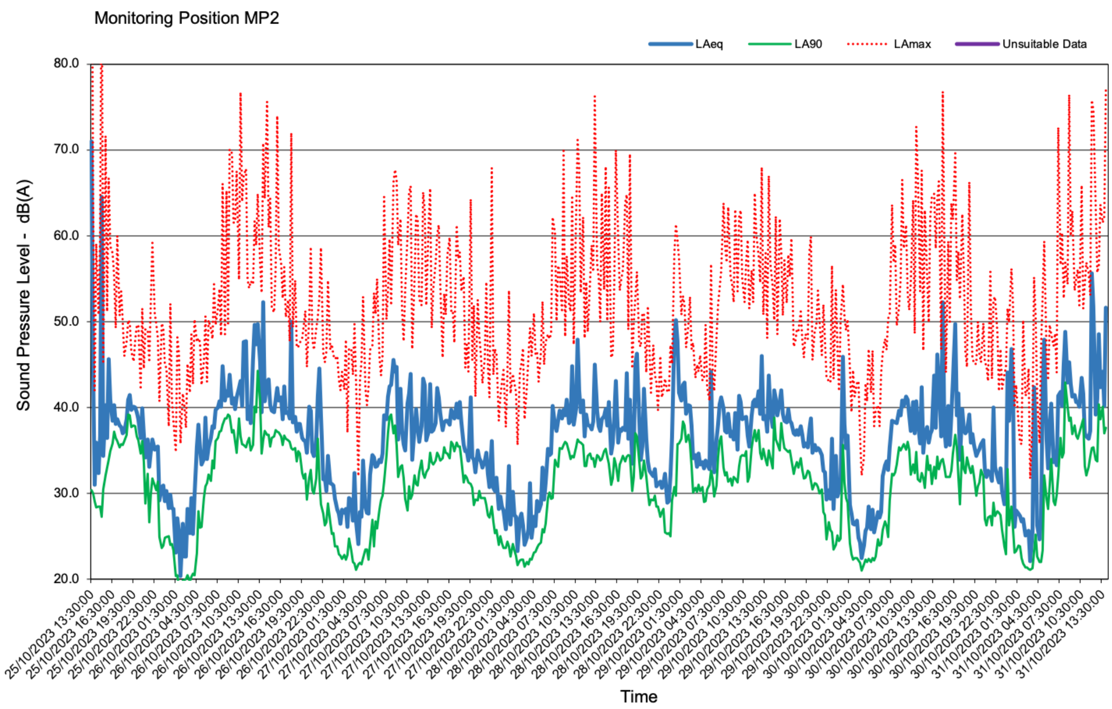
This is a notional steady level that would, over a given period of time, deliver the same sound energy as the actual fluctuating sound.

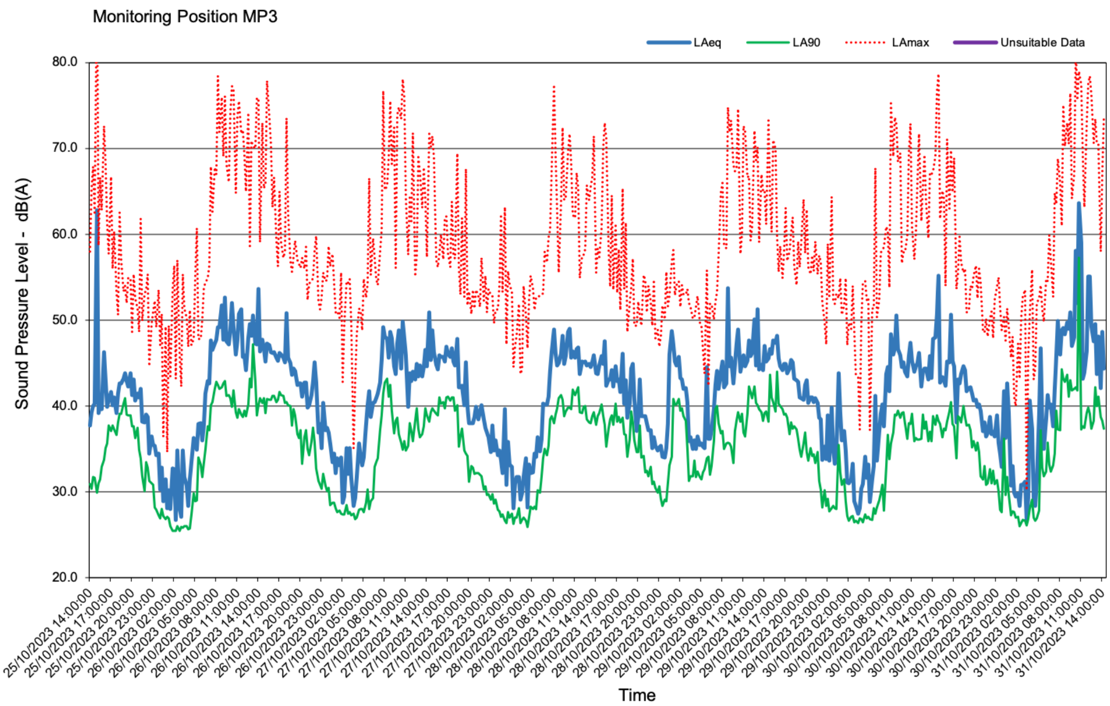
To put these quantities into context, where a receiver is predominantly affected by continuous flows of road traffic, a doubling or halving of the flows would result in a just perceptible change of 3 dB, while an increase of more than 25%, or a decrease of more than 20%, in traffic flows represent changes 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.

8.2. Appendix B – Sound Measurement Results






Monitoring Position MP3
LAeq
LA90
LAmax
Unsuitable Data
Sound Pressure Level - dB(A)
80.0
70.0
60.0
50.0
40.0
30.0
20.0
Time
25/10/2023 14:00:00
25/10/2023 17:00:00
25/10/2023 20:00:00
25/10/2023 23:00:00
26/10/2023 02:00:00
26/10/2023 05:00:00
26/10/2023 08:00:00
26/10/2023 11:00:00
26/10/2023 14:00:00
26/10/2023 17:00:00
26/10/2023 20:00:00
26/10/2023 23:00:00
27/10/2023 02:00:00
27/10/2023 05:00:00
27/10/2023 08:00:00
27/10/2023 11:00:00
27/10/2023 14:00:00
27/10/2023 17:00:00
27/10/2023 20:00:00
27/10/2023 23:00:00
28/10/2023 02:00:00
28/10/2023 05:00:00
28/10/2023 08:00:00
28/10/2023 11:00:00
28/10/2023 14:00:00
28/10/2023 17:00:00
28/10/2023 20:00:00
28/10/2023 23:00:00
29/10/2023 02:00:00
29/10/2023 05:00:00
29/10/2023 08:00:00
29/10/2023 11:00:00
29/10/2023 14:00:00
29/10/2023 17:00:00
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30/10/2023 17:00:00
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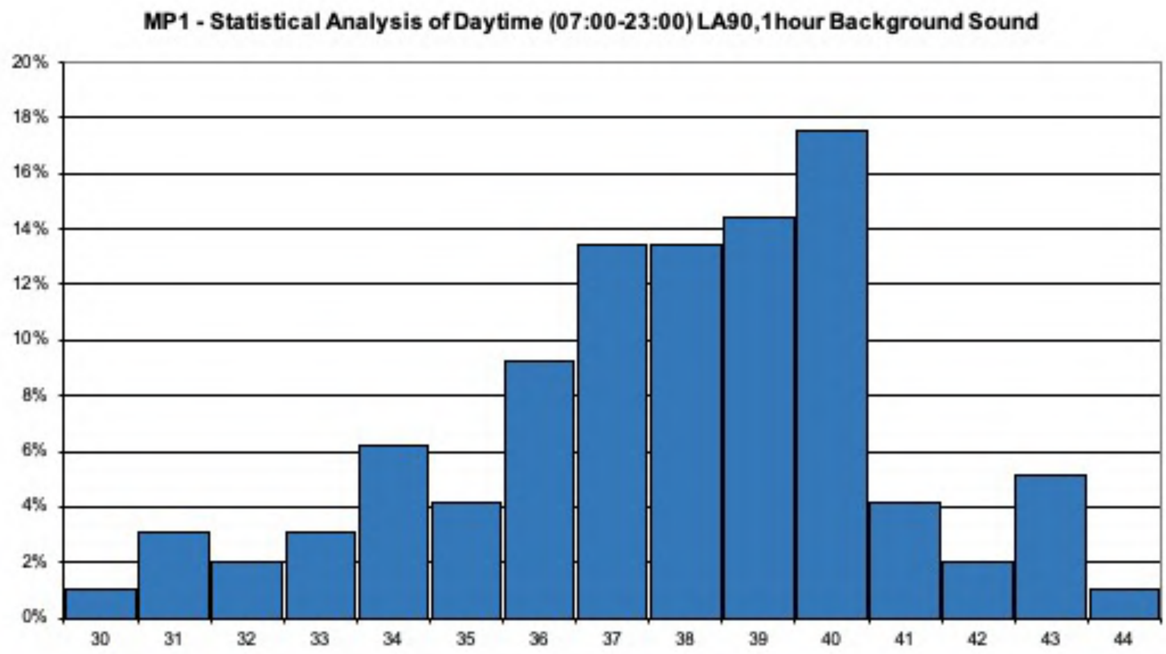
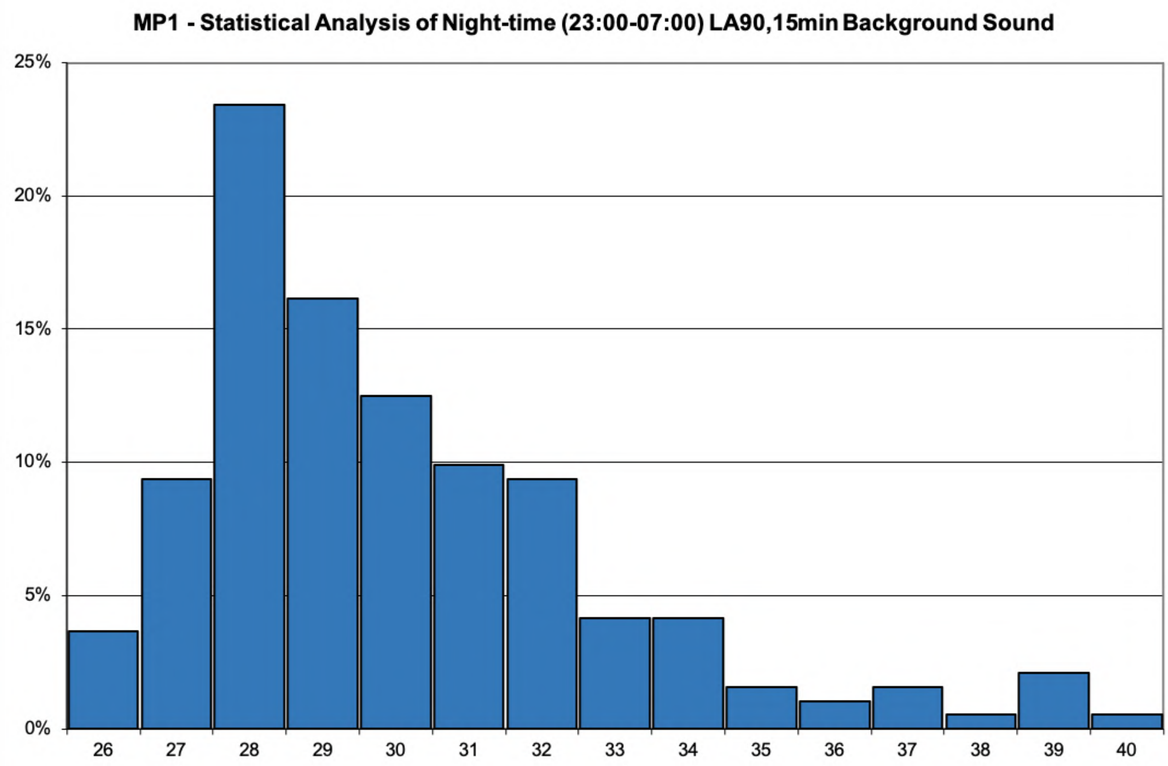
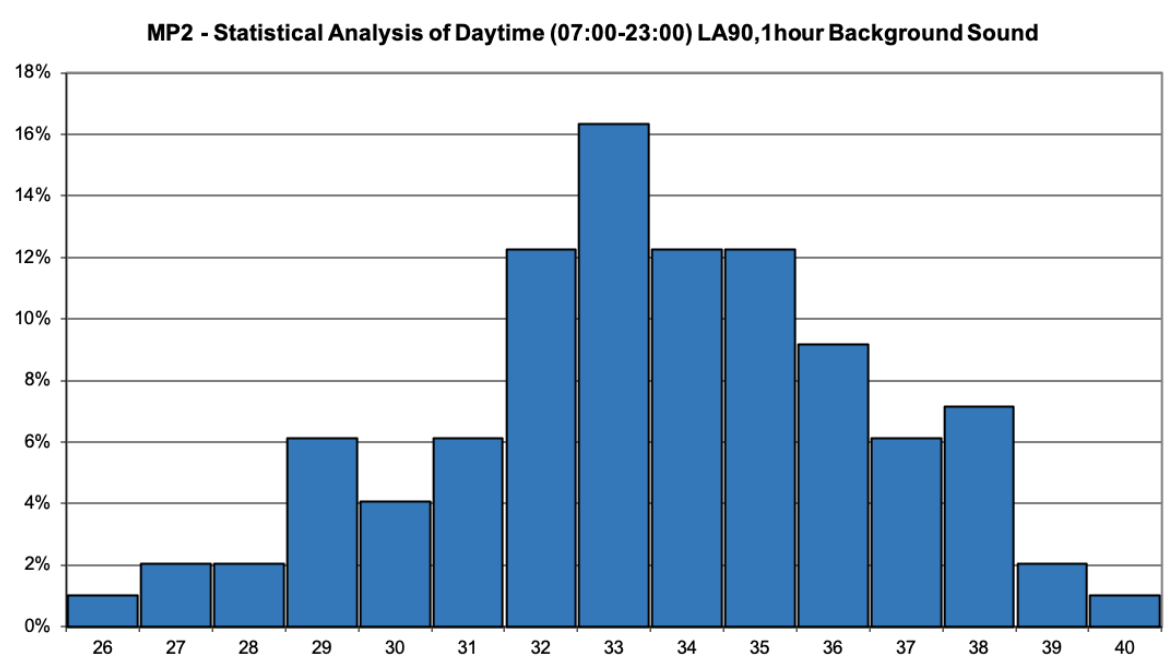
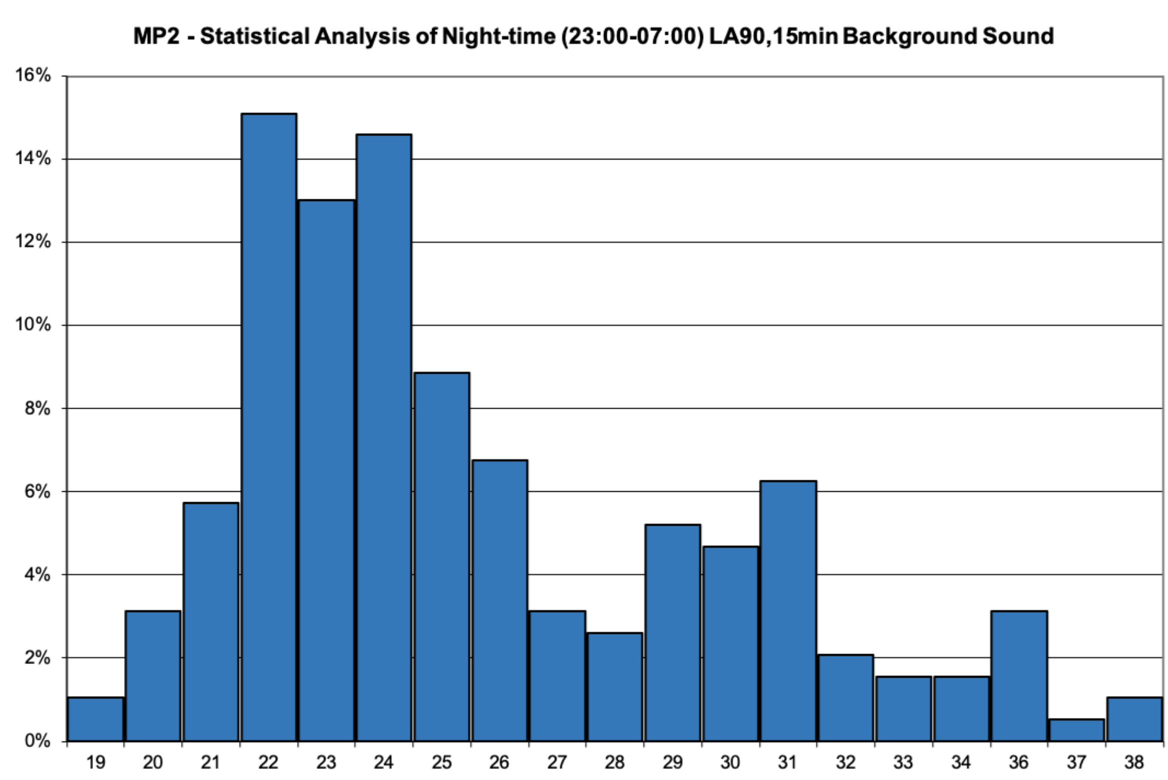
8.3. Appendix C – Statistical Analysis






MP2 - Statistical Analysis of Daytime (07:00-23:00) LA90,1hour Background Sound
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40


MP2 - Statistical Analysis of Night-time (23:00-07:00) LA90,15min Background Sound
16%
14%
12%
10%
8%
6%
4%
2%
0%
19
20
21
22
23
24
25
26
27
28
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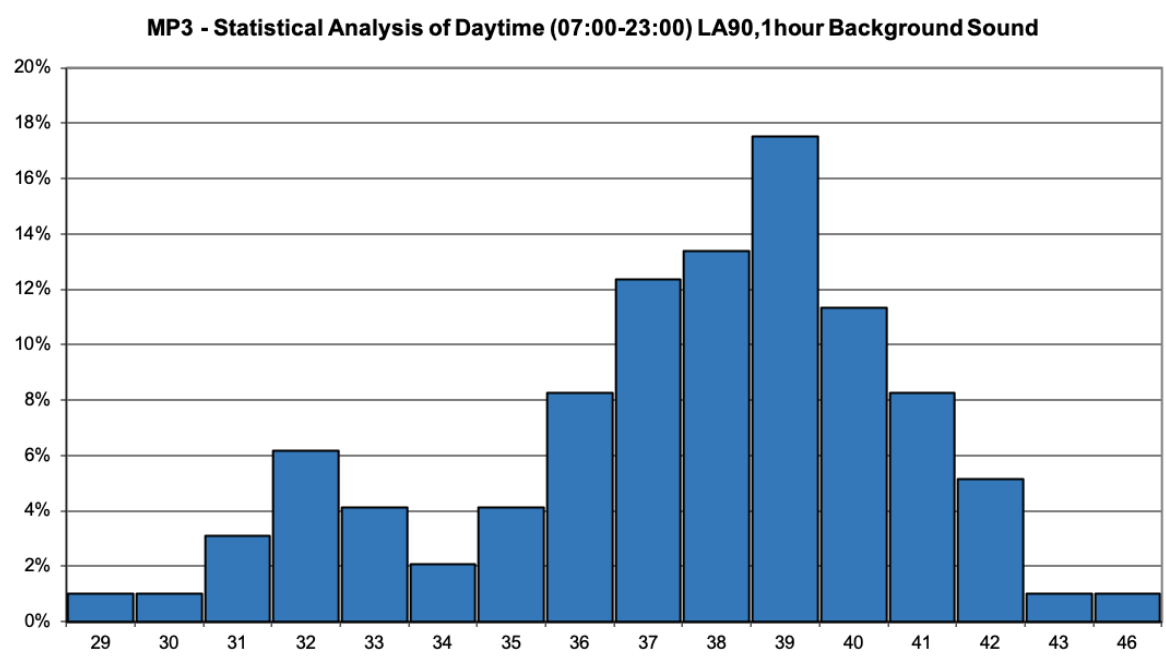
34
36
37
38


MP3 - Statistical Analysis of Daytime (07:00-23:00) LA90,1hour Background Sound
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
29
30
31
32
33
34
35
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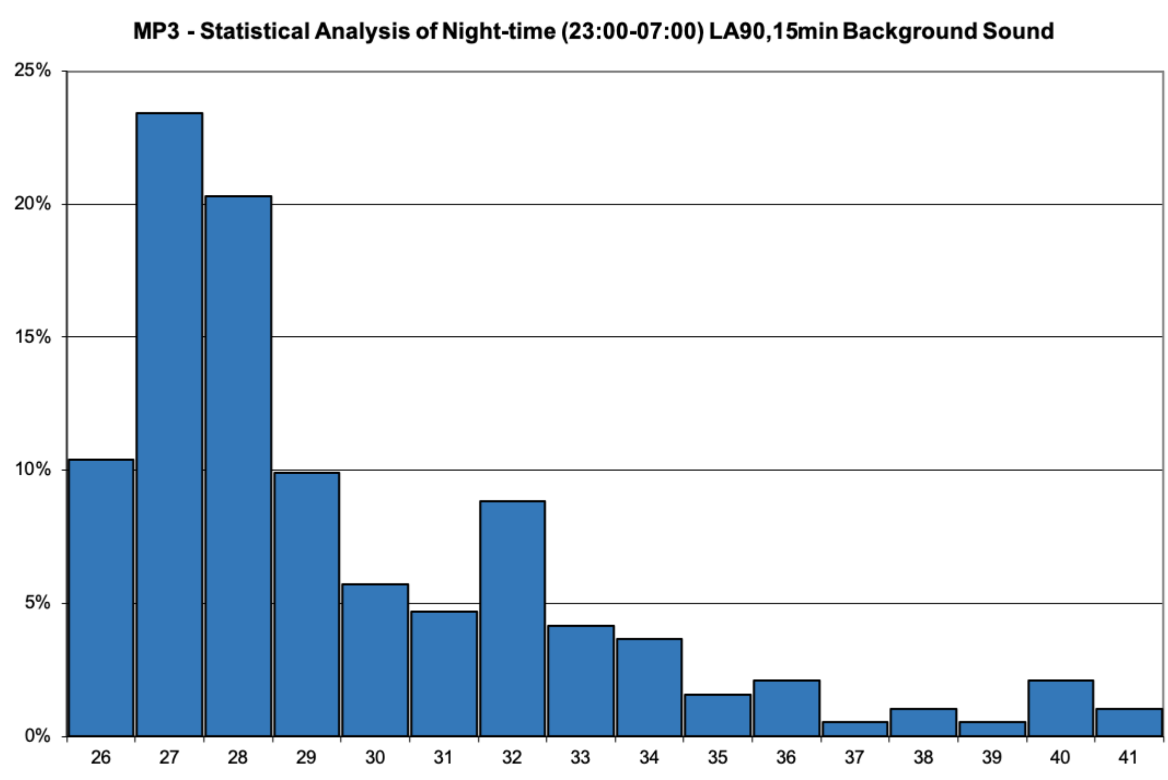
42
43
46


MP3 - Statistical Analysis of Night-time (23:00-07:00) LA90,15min Background Sound
25%
20%
15%
10%
5%
0%
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41

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