



Legacy - Battery Energy Storage System (BESS)

Noise Impact Assessment for Revised Site Layout

3rd March 2023

Version	Comments	Date	Authored By	Checked By	Project Number
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CONTENTS

1.	INTRODUCTION	5
1.1.	OVERVIEW	5
1.2.	SCOPE AND OBJECTIVES	5
2.	LEGISLATION AND POLICY FRAMEWORK	6
2.2.	ASSESSMENT CRITERIA	7
3.	SITE DESCRIPTION	8
3.1.	SITE AND SURROUNDING AREA	8
3.2.	AMENDED LAYOUT PROPOSAL	9
4.	BACKGROUND SOUND DATA	10
5.	OPERATIONAL NOISE ASSESSMENT	11
5.1.	NOISE MODELLING	11
5.2.	ASSESSMENT	14
6.	CONCLUSION	19
7.	APPENDICES	20
7.1.	APPENDIX A - DEFINITION OF TERMS	21
8.	APPENDIX B - MEASUREMENT RESULTS	24

FIGURES

FIGURE 1: DEVELOPMENT SITE AND SURROUNDING AREA	8
FIGURE 2: PROPOSED DEVELOPMENT LAYOUT	9
FIGURE 3: MEASUREMENT LOCATIONS, RECEPTOR POSITIONS AND SITE LOCATION	10
FIGURE 4: SPECIFIC SOUND LEVEL MAP - DAYTIME	12

TABLES

TABLE 2: MEASURED BACKGROUND SOUND LEVELS	11
TABLE 3: SOUND SOURCE DATA	11
TABLE 4: PREDICTED SPECIFIC SOUND LEVEL SUMMARY – DAYTIME AND NIGHT TIME	13
TABLE 5: RATING PENALTY ASSESSMENT	15
TABLE 6: CALCULATION UNCERTAINTY FACTORS	16
TABLE 7: BS4142 ASSESSMENT AT NSR's – DAYTIME	17
TABLE 8: BS4142 ASSESSMENT AT NSR's – NIGHT-TIME	17
TABLE 9: TYPICAL SOUND LEVELS FOUND IN THE ENVIRONMENT	22

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 at the National Grid Legacy site off Bronwylfa Road in Talwrn, Wrexham. The proposed BESS represents a revised scheme to an extant permission on the same site for a BESS facility (under planning permission reference P/2021/0441). Condition 4 of this permission has set a precedent of the acceptable noise levels at the site.

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

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 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 anticipated 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.

2. LEGISLATION AND POLICY FRAMEWORK

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

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. The guidance in BS4142:2014+A1:2019 will therefore be used to assess noise from the proposed scheme.

2.2. Planning Condition

Planning Condition 4 associated with the original application referenced 'P/2021/0441' can be seen below:

'The rating level of any noise generated by reason of this development shall not exceed the pre-existing background level at any time. The noise levels shall be determined at nearby noise sensitive premises, and measurements and assessment shall be made in accordance with BS4142:2014 Method for rating and assessing industrial and commercial sound.'

2.3. Assessment Criteria

2.3.1. 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.

3. SITE DESCRIPTION

3.1. Site and Surrounding Area

The Development is located within the National Grid Legacy site off Bronwylfa Road in Talwrn, Wrexham.

The Development site in relation to the nearest noise sensitive receivers (NSR) can be seen in Figure 1.

FIGURE 1: DEVELOPMENT SITE AND SURROUNDING AREA



3.2. Amended Layout Proposal

BESS is an emissions-free capacity resource that is fast, highly flexible, and always on 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.

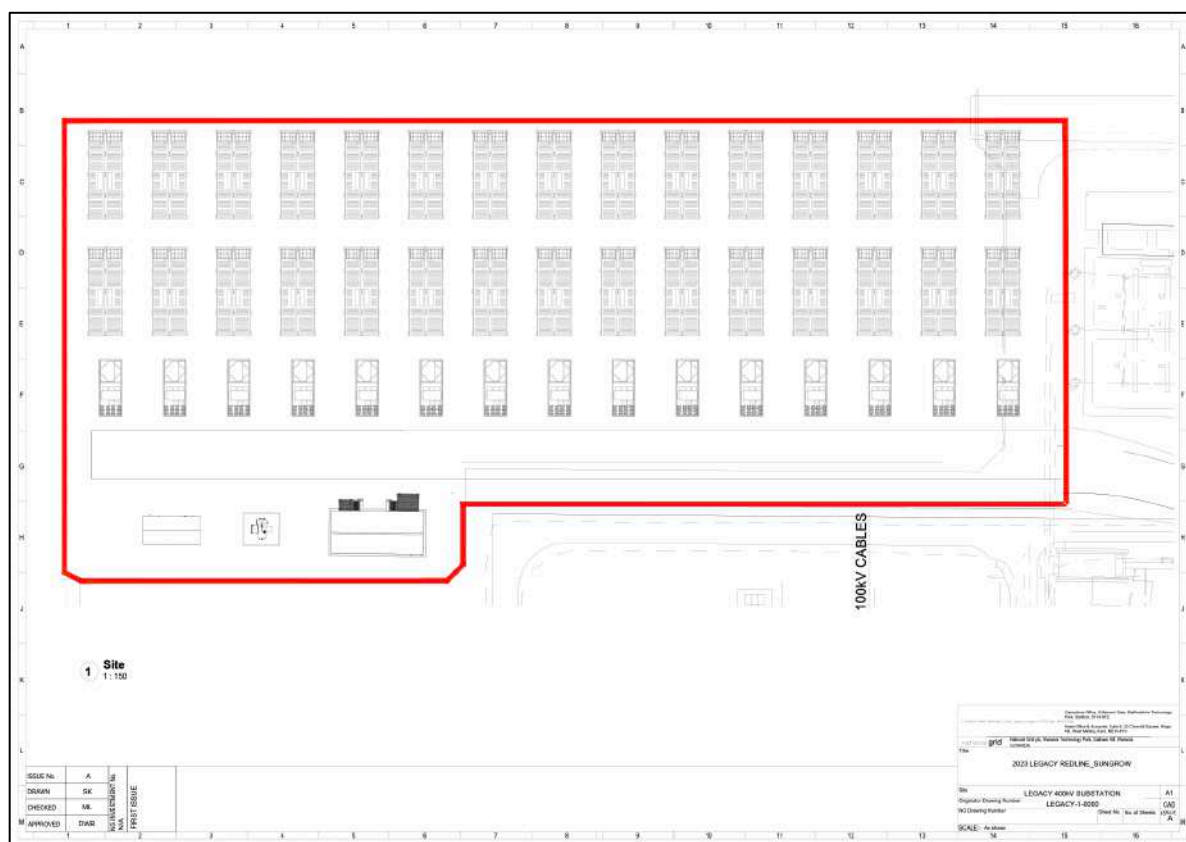
The energy storage process does not inherently have any sound emissions associated with it, however, to ensure the batteries remain at the correct temperature, a series of cooling fans are used. Similarly, the inverter stations used to transform the energy from DC to AC and vice versa are cooled by fans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

As described previously, this assessment is for a revised layout to the consented BESS facility at the Site (under reference P/2021/0441). The revised layout is made up of 30 battery banks (comprised of 60 containerised battery units) and 15 No. inverter/transformer stations on Site. It is assumed that battery units will be served by an integrated cooling system on each side of the container.

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

FIGURE 2: PROPOSED DEVELOPMENT LAYOUT



4. BACKGROUND SOUND DATA

Background sound levels have been previously measured at locations representative of the nearest noise-sensitive receptors. Measurements were undertaken by Noise Vibration Consultants Ltd to support the now consented BESS scheme at the site. The noise assessment report reference associated with the original planning application was R21.0501/DRK.

Measurements were taken between Wednesday 26th to Thursday 27th February 2020, inclusive of a daytime and night-time period. The measurement methodology was in accordance with BS4142:2014+A1:2019. Details of the weather, meteorology and instrument details are referenced in the report.

Locations of the measurements can be seen below in Figure 3.

FIGURE 3: MEASUREMENT LOCATIONS, RECEPTOR POSITIONS AND SITE LOCATION



The measured background sound level data can be seen below in Table 1.

TABLE 1: MEASURED BACKGROUND SOUND LEVELS

Location	Time Period	Typical L _{A90} Background Sound Levels
A	Daytime 07:00-23:00	42
	Night-time 23:00-07:00	41
B	Daytime 07:00-23:00	42
	Night-time 23:00-07:00	35
C	Daytime 07:00-23:00	50
	Night-time 23:00-07:00	44

5. OPERATIONAL NOISE ASSESSMENT

5.1. Noise Modelling

5.1.1. Source Data

The A-weighted sound pressure levels provided by the manufacturer can be seen below in Table 2.

TABLE 2: SOUND SOURCE DATA

Plant	Quantity	Sound Pressure Level Per Unit (dBA) at 1m
Sungrow Inverter Unit	15	79
Sungrow Inverter Unit (Transformer End)	15	68
Sungrow Battery Cooling System	30	73
Switchgear	1	65
Auxillary Transformer	1	63

5.1.2. Calculation Process

Calculations were carried out using Cadna/A, which undertakes its calculations in accordance with guidance given in ISO9613¹, which considers a worst-case downwind propagation to all receptors.

5.1.3. Model Assumptions

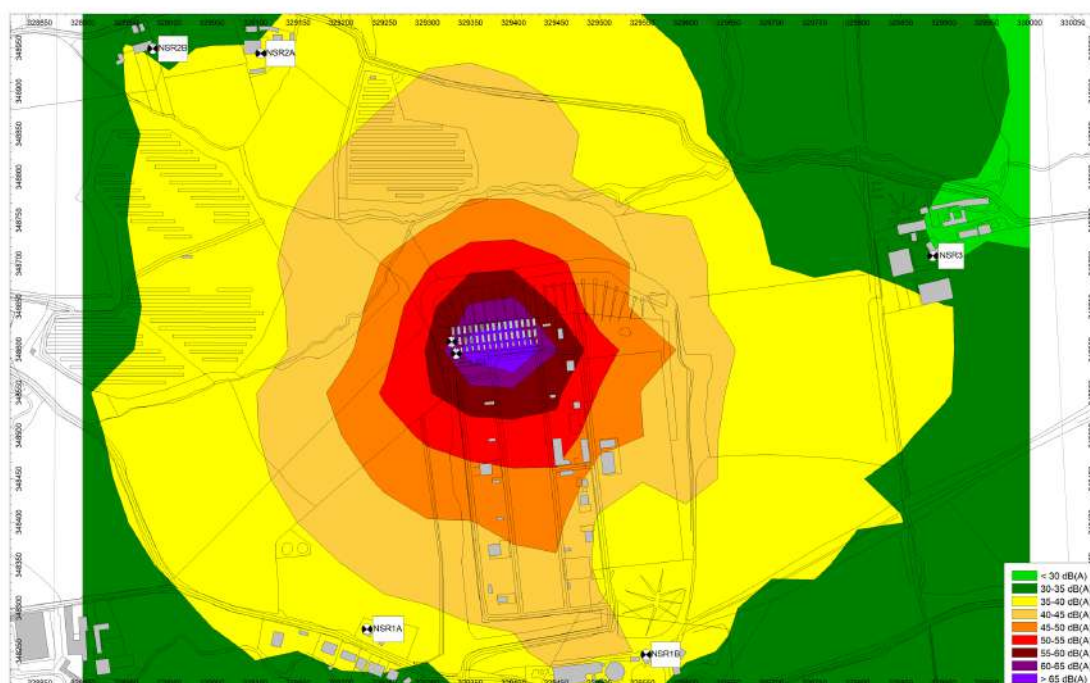
Given that the land between the development and nearest receptors is largely soft, the ground factor has been set to 0.8, with 2 orders of reflection. Full octave frequency spectra have been used in the calculations. It has been assumed that all processes will occur simultaneously, representing a worst-case scenario. However, this is a highly 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 Defra.

5.1.4. Specific Sound Level Map

The sound map showing the specific sound level emissions from the Development can be seen in Figure 4 for both daytime and night-time periods.

FIGURE 4: SPECIFIC SOUND LEVEL MAP - DAYTIME



¹ 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 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 3.

TABLE 3: PREDICTED SPECIFIC SOUND LEVEL SUMMARY – DAYTIME AND NIGHT TIME

NSR	Period	Specific Sound Level (dB)
NSR1A	Daytime and Night Time	38
NSR1B		37
NSR2A		36
NSR2B		34
NSR3		29

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 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 distance 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 Consented Development, in terms of whether any rating penalties are applicable, has been detailed in Table 4 below.

TABLE 4: RATING PENALTY ASSESSMENT

Source	Tonality	Impulsivity	Intermittency	Other Sound Characteristics	Discussion
Battery Energy Storage Plant	0 dB	0 dB	0 dB	0 dB	The cooling systems do normally operate continuously during the majority of the charging/discharging periods. They might switch on/off, but not simultaneously, during cool down periods when they are less noisy, and therefore the intermittency is not expected to be readily noticeable at the receptors location. A potential mid-low frequency bias might exist at source, but due to distance to receptors, the residual acoustic environment will mask any significant tones or low frequency 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 (does not apply to this assessment) and associated calculations is considered in the assessment. The Standard recommends that steps should be taken to reduce the level of 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 Consented 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 5 below.

TABLE 5: CALCULATION UNCERTAINTY FACTORS

Calculation Uncertainty Factor Reference	Level of Uncertainty	Discussion
b)	0 dB	Sound source levels provided by manufacturer.
c)	0 dB	Calculations were undertaken in accordance with ISO 9613-2, which is considered a “ <i>validated method</i> ” 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.

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.

The BS4142:2014+A1:2019 assessment at NSR's, during the daytime periods, can be seen in Table 6.

TABLE 6: BS4142 ASSESSMENT AT NSR's – DAYTIME

NSR	Period	Rating Sound Level (dB)	Background Sound Level L _{A90} dB	Excess of Rating Level Over Background Sound Level (dB)
NSR1A	Daytime	38	44	-6
NSR1B		37	44	-7
NSR2A		36	43	-7
NSR2B		34	43	-9
NSR3		29	50	-21

The BS4142:2014+A1:2019 assessment at NSR's, during the night-time periods, can be seen in Table 7.

TABLE 7: BS4142 ASSESSMENT AT NSR's – NIGHT-TIME

NSR	Period	Rating Sound Level (dB)	Background Sound Level L _{A90} dB	Excess of Rating Level Over Background Sound Level (dB)
NSR1A	Night-time	38	42	-4
NSR1B		37	42	-5
NSR2A		36	38	-2
NSR2B		34	38	-4
NSR3		29	44	-15

It can be seen that the rating level at the nearest noise sensitive receptors does not exceed the background sound level, resulting in a low impact in BS4142 terms.

5.2.5. Discussion on Context

The results set out in Table 6 and Table 7 identify that the operation of the scheme can occur without affecting the amenity of the closest residential receptors to the site.

The assessment considers a worst-case scenario, such as all plant operating simultaneously, where the batteries are working at their maximum output and inverters and battery cooling fans operate at full duty. In reality, this typically occurs during limited periods of the day only and is highly unlikely to happen during the night time, when batteries are trickle charging, with any cooling fans operating at a much lower duty due to cooler temperatures and a lower demand on the system.

Long-term source noise measurements undertaken at a comparable operational development has confirmed that noise levels associated with plant operating at full duty tends to occur during short periods of the daytime only, with the majority of the daytime and night-time periods presenting significantly lower noise emission levels.

Therefore, it is highly likely that the rating sound levels at the noise sensitive receptors will be significantly less than is outlined in this assessment, which demonstrates an absolute worst-case scenario.

6. CONCLUSION

inacoustic has been commissioned to assess the impact of potential noise arising from a proposed Battery Energy Storage System (BESS) facility at the National Grid Legacy site off Bronwylfa Road in Talwrn, Wrexham. The proposed BESS represents a revised scheme to an extant permission on the same site for a BESS facility (under planning permission reference P/2021/0441). Condition 4 of this permission has set a precedent of the acceptable noise levels at the site.

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

The assessment identifies that the Proposed Development is predicted to generate rating sound levels that do not exceed the measured background sound level in the area, thus giving rise to a 'Low Impact' in BS4142 terms.

Since the amended layout conforms to British Standards 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 20 μ Pa (20 $\times 10^{-6}$ 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 s_1 and s_2 is given by $20 \log_{10} (s_1 / s_2)$. 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 20 μ Pa.
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 8: 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.

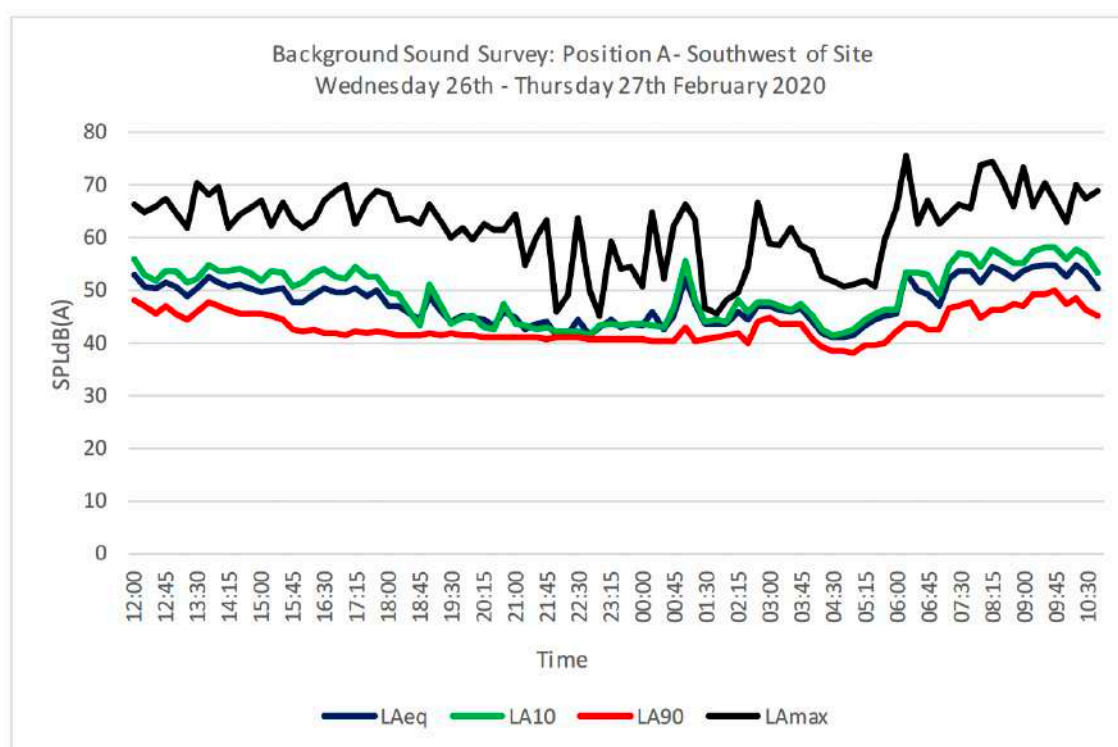
For levels of noise that vary with time, it is necessary to employ a statistical index that allows for this variation. These statistical indices are expressed as the sound level that is exceeded for a percentage of the time period of interest. In the UK, traffic noise is measured as the L_{A10} , the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

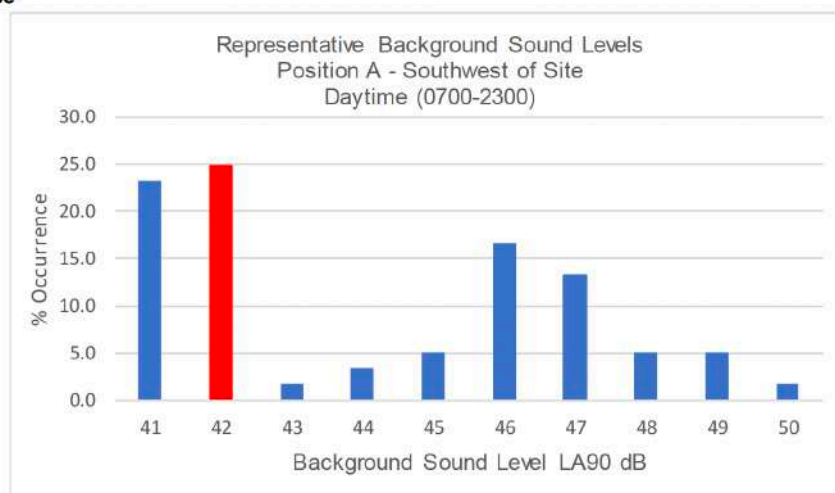
Note that the time constant and the period of the noise measurement should be specified. For example, BS 4142 specifies background noise measurement periods of 1 hour during the day and 15 minutes during the night. The noise levels are commonly symbolised as $L_{A90,1\text{hour}}$ dB and $L_{A90,15\text{mins}}$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

8. APPENDIX B – MEASUREMENT RESULTS

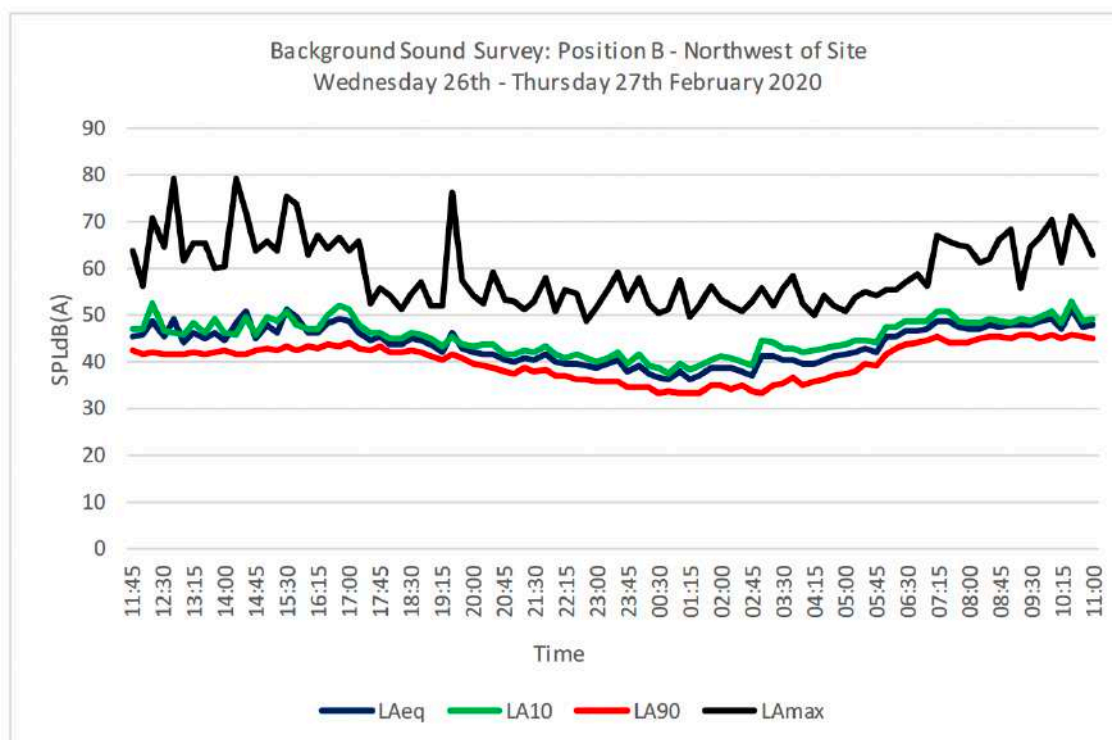
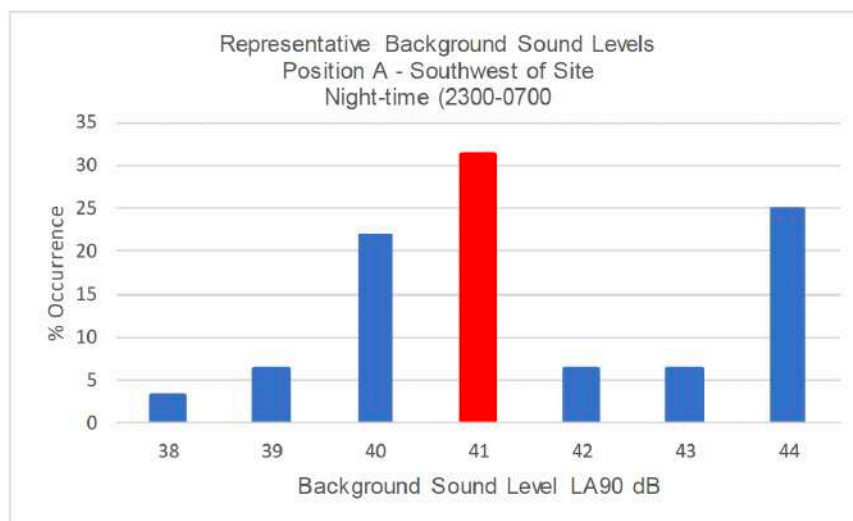


LA90 % Occurrence

41	23.3
42	25.0
43	1.7
44	3.3
45	5.0
46	16.7
47	13.3
48	5.0
49	5.0
50	1.7

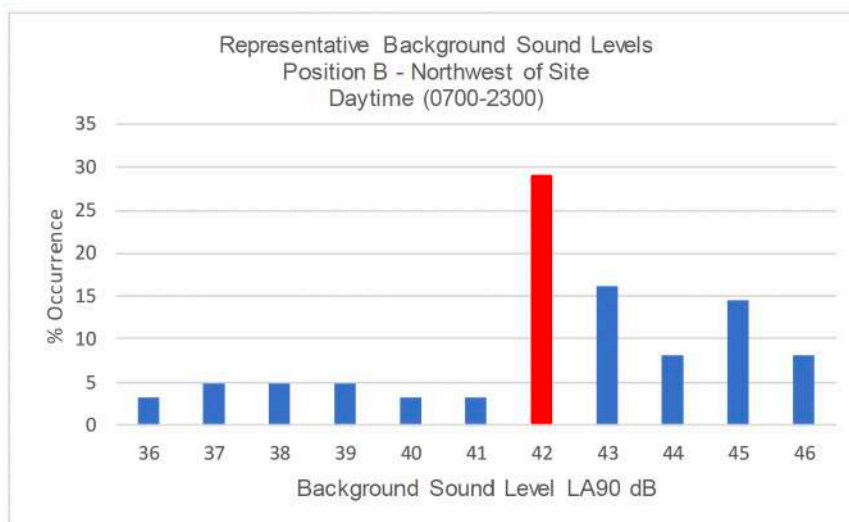


LA90	% Occurrence
38	3.1
39	6.3
40	21.9
41	31.3
42	6.3
43	6.3
44	25



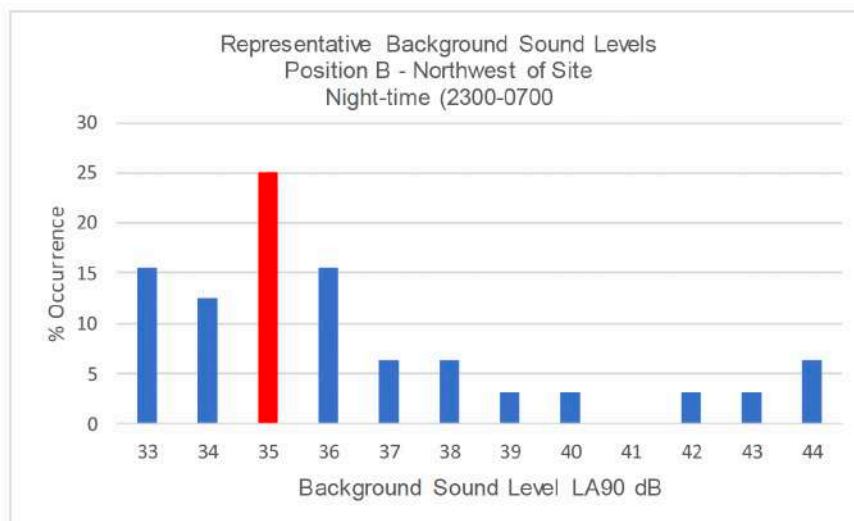
LA90 % Occurrence

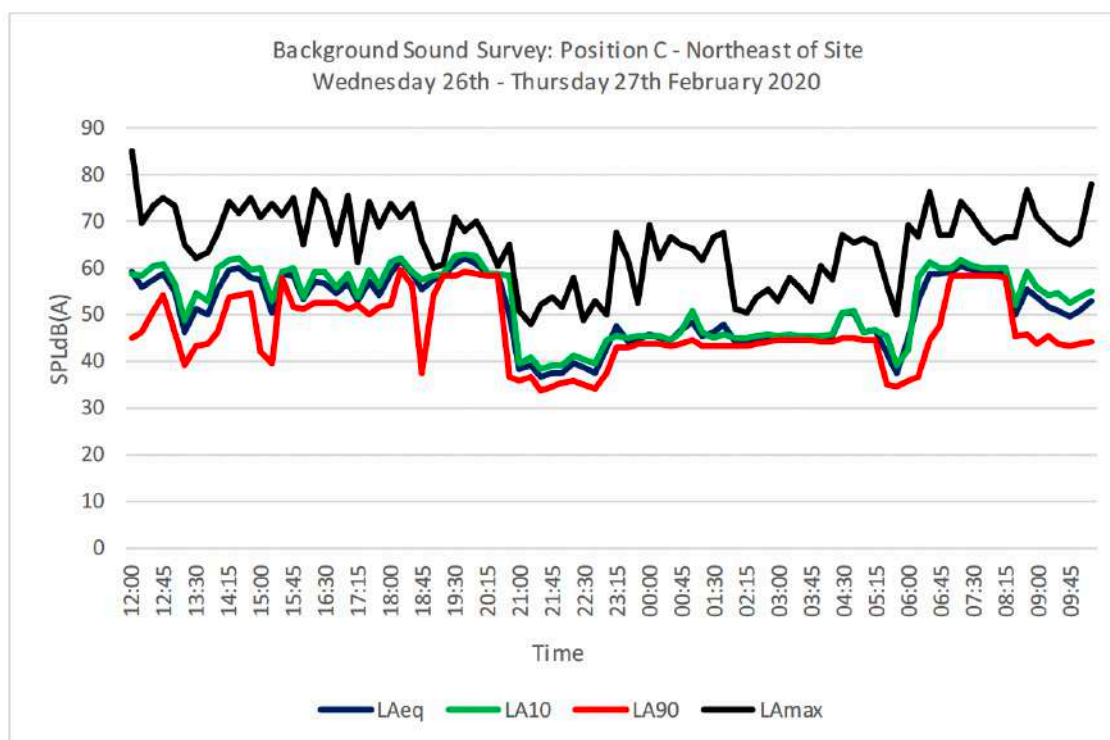
36	3.2
37	4.8
38	4.8
39	4.8
40	3.2
41	3.2
42	29
43	16.1
44	8.1
45	14.5
46	8.1



LA90 % Occurrence

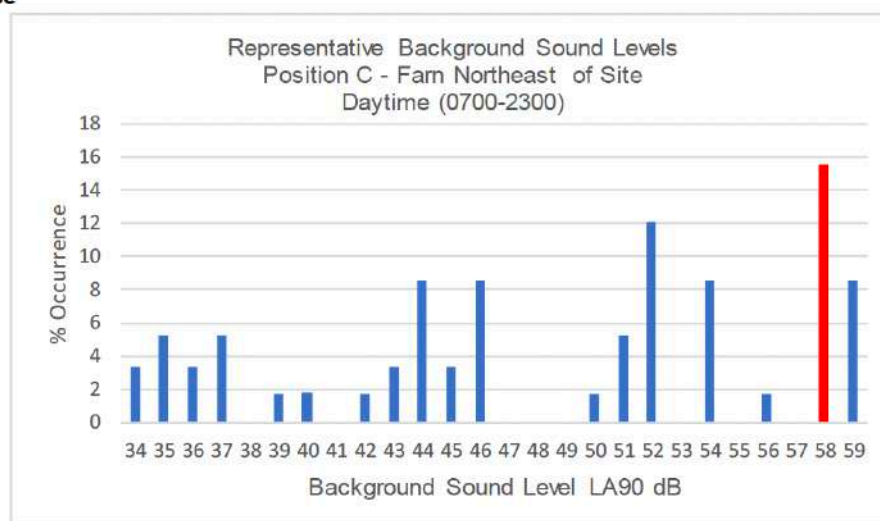
33	15.6
34	12.5
35	25
36	15.6
37	6.3
38	6.3
39	3.1
40	3.1
41	0
42	3.1
43	3.1
44	6.3



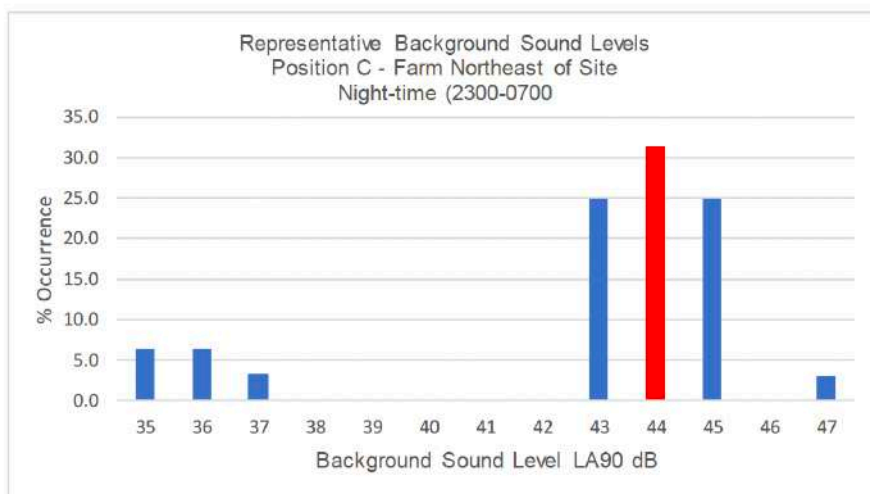


LA90 % Occurrence

34	3.4
35	5.2
36	3.4
37	5.2
38	0
39	1.7
40	1.7
41	0
42	1.7
43	3.4
44	8.6
45	3.4
46	8.6
47	0
48	0
49	0
50	1.7
51	5.2
52	12.1
53	0
54	8.6
55	0
56	1.7
57	0
58	15.5
59	8.6



LA90	% Occurrence
35	6.3
36	6.3
37	3.1
38	0.0
39	0.0
40	0.0
41	0.0
42	0.0
43	25.0
44	31.3
45	25.0
46	0.0
47	3.1



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