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**Noise Impact Assessment
For Battery Storage Facility (BSF)**

At

**Legacy
Wrexham**

For

Pelagic Energy

Report No.: R21.0501/DRK

Noise & Vibration Consultants Ltd

**Member of Institute of Acoustics
Member of Association of Noise Consultants
Member of Academy of Experts**

**Report prepared by:
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A handwritten signature in black ink, appearing to read 'DR Kettlewell', is written over a light grey rectangular background.

Date: 5th May 2021

Summary

1. Pelagic Energy Ltd ("the Applicant") is proposing to submit a planning application to construct and operate a Battery Storage Facility ("BSF") facility ("the Proposed Development") on land at the Legacy National Grid site off Bronwylfa Road in Talwrn, Wrexham ("the Site").
2. At the request of Axis acting on behalf of the Applicant, Noise & Vibration Consultants Ltd ("NVC") were commissioned to undertake a noise impact assessment to assess the impact and advise (where appropriate) on any noise mitigation measures to meet planning guidance and noise standards.
3. Following a study of the local area to the Site, the nearest sensitive residential receptors were determined. Noise monitoring was carried out over a daytime and night-time period to determine the representative background sound levels.
4. Site operational noise has been calculated using noise data for the BSF plant. The assessment has used ISO9613-2 prediction methodology and CadnaA noise modelling software for producing noise contours of the highest likely generated noise with all plant operating.
5. An assessment of the resultant impacts has been undertaken by applying noise limits determined by appropriate standards for noise (i.e. BS4142:2014+A1;2019, WHO guidance and BS8233: 2014).

Conclusions

6. Following analysis of noise survey results our conclusions are as follows:
 - (i) The results of baseline noise monitoring over a weekend monitoring period at three locations (in areas providing a representative assessment of background sound level) in the vicinity of sensitive receptors indicate that representative background sound levels between 0700-2300 hours at the monitoring position was shown to vary between 42dB and 50dB LA90. During night-time periods the background levels were established as 35dB to 42dB LA90.
 - (ii) The predicted noise contribution from the application site using ISO9613-2 methodology and CadnaA noise modelling software with assumed noise mitigation measures show rating noise levels from Site to range between 30dB and 38dB LAeq during maximum site operations.
 - (iii) The BS4142 assessment shows that with appropriate mitigation the Proposed Development can be designed to comply with relevant noise guidance and standards. The impact at other receptor positions would be lower than that predicted for the chosen receptors.

- (iv) In terms of absolute levels, the predicted highest noise contributions from the proposed site operations are shown to be well below residual sound levels and therefore in context noise levels would not be significant.
 - (v) Absolute levels are below WHO guidelines for general daytime amenity levels, night-time levels for sleep disturbance and internal room design criteria according to BS8233: 2014 assuming windows open.
 - (vi) The predicted residual noise levels from the site have been calculated based on an example of noise mitigation measures designed to achieve a specific design level. This design limit would form part of the purchasing specification when the plant supplier is defined.
 - (vii) Noise from construction activities would not be significant and best practice would be applied according to BS5228-1:2009+A1:2014 to minimise noise.
7. The assessment concludes that the Proposed Development can be designed to operate such that it complies with all appropriate and relevant noise standards and guidance.

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1.0 INTRODUCTION

- 1.1 Pelagic Energy ('the Applicant') are proposing to submit a planning application to construct and operate a Battery Storage Facility ("BSF") ('the Proposed Development') on land at the National Grid Legacy site off Bronwylfa Road in Talwrn, Wrexham ('the Site'). The Proposed Development will include the use of containerised batteries that will provide ancillary services to support the National Grid. BSFs help provide balancing and reserve services to the National Grid system.
- 1.2 BSFs are a contracted balancing service, whereby the service provider is required to make the generating plant available to provide power at specific times during certain periods in the week.
- 1.3 The facility will accommodate 52 individual battery storage containers and supporting plant and infrastructure.
- 1.4 At the request of Axis acting on behalf of the Applicant, Noise & Vibration Consultants Ltd ("NVC") were commissioned to undertake a noise impact assessment to assess noise from the Proposed Development at nearest sensitive receptors and advise (where appropriate) on any additional noise mitigation measures to meet planning guidance and noise standards.
- 1.5 Following examination of the Site location, the nearest sensitive residential receptors were determined, and an appropriate methodology adopted.
- 1.6 The study benefits from a baseline noise survey carried out during a daytime and night-time period to determine the representative background sound levels in the vicinity of nearest sensitive receptors to the Proposed Development.

Sources of Information

- 1.7 Information used in this assessment has been obtained from the following sources:
 - Ordnance Survey maps of the local area;
 - Information relating to the site layout was provided by the Axis;
 - BS 7445: 2003 Description and measurement of environmental noise;
 - BS4142:2014+A1:2019 'Methods for rating and assessing industrial and commercial sound';
 - Guidelines for Community Noise – World Health Organisation: April 1999;
 - BS8233: 2014 'Guidance on sound insulation and noise reduction for buildings';
 - Noise Policy Statement for England (NPSE) – March 2010: Department for Communities and Local Government: National Planning Policy Framework: February 2019; and
 - National Planning Practice Guidance ("NPPG") – July 2019.

Assessment Methodology

- 1.8 The aim of the survey was to provide information and advice on the following:
 - Provide information on typical operating noise levels from the battery unit HVAC systems, inverters and transformers, switchgear equipment, control room and auxiliary transformer;

- provide information on background and residual sound levels at the nearest sensitive receptors during the most sensitive periods of proposed operation; and
- advise on any operations that are shown to exceed appropriate and relevant noise criteria and where appropriate provide recommendations for further mitigation.

1.9 Appendix 1 provides details of technical terms within the report, for ease of reference. There is also a chart showing typical everyday noise levels to assist in understanding the subjective level of noise in terms of decibels.

1.10 The Proposed Development is defined in section 3.0 of the Planning Statement.

2.0 SITE DESCRIPTION

2.1 Location

- 2.1.1 The Proposed Development is located on land off Bronwylfa Road in the catchment area of Rhostyllen within the National Grid Site known as Legacy. The Site is located west of the village of Rhostyllen, near Wrexham with the location characterised by a large electricity sub-station.
- 2.1.2 The Site is located within a rural area, at the north western corner of the Legacy substation development with surrounding land use being farmland and solar farm development, which is situated to the north and west of the Proposed Development.
- 2.1.3 Access to the Site is via the B5426 Bronwylfa Road to the south of the Legacy development.

2.2 Site Noise Sources

- 2.2.2 In terms of noise generated by this type of development, the assessment has considered the following activities:
- Noise during the construction period, which would take approximately six to twelve months to complete.
 - Noise from the operation of the battery storage container cooling/heating systems, inverters, transformers and switchgear equipment.

2.3 Site Operations

- 2.3.1 At times of low demand for electricity, where generation exceeds demand (typically during the night-time), the battery storage facility would capture this excess energy from the grid and store it in the battery cells. This energy would then be rapidly (within a matter of milliseconds) released back into the grid, at times when energy demand outweighs supply. Accordingly, the proposed facility assists in stabilising the capacity of the grid, and supports a reliant and resilient energy supply system.
- 2.3.2 The system of communication between the grid and the battery storage system is fully automated. The facility is able to respond automatically to any dip in grid frequency by exporting/ importing the required energy to stabilise the grid. As operations at the Site would be fully automated (following the completion of construction), infrequent visits by site personnel and engineers in a light goods vehicle are only anticipated to occur on average at monthly intervals.

2.4 Nearest Receptors

- 2.4.1 Following a detailed study of the site and surrounding area, the nearest sensitive receptors identified are detailed below:
- 2.4.2 The nearest residential areas relative to the Site are located to the southwest of the Proposed Development off Bronwylfa Road at a distance of circa 300m to 350m (refer to Figure 1). Additional isolated residential receptors are located southeast off Bronwylfa Road at a distance of 350m to 430m and to the northwest and northeast directions at distances of approximately 430m to 540m respectively.

- 2.4.3 Other residential areas are located at greater distance to the southwest and north west.
- 2.4.4 The noise monitoring position chosen for establishing baseline noise data is indicated on Figure 1. This survey provides broadband noise data of the baseline noise climate around the Site at the nearest residential properties.
- 2.4.5 The noise monitoring exercise was carried out over a 24-hour period to establish representative background and residual sound levels. Details of the instrumentation and methodology used for the survey are provided in Appendix 2.
- 2.4.6 The main source of existing noise affecting nearest property positions relates to the movement of traffic along the local road network, Legacy site and farming activities.
- 2.4.7 There are other receptors located at greater distance than the above in similar directions, which are shown on the noise map but as the impact would be lower are not included in the assessment. The nearest sensitive receptor positions are indicated on Figure 1 together with the Site position.

3.0 NOISE CRITERIA

3.1 Introduction

- 3.1.1 Noise has been defined as sound that is unwanted by the recipient. The effects of noise on the neighbourhood are varied and complicated, including such things as interference with speech communication, disturbance of work, leisure or sleep. A further complicating factor is that in any one neighbourhood some individuals will be more sensitive to noise than others.

General Planning Guidance

National Planning Policy Framework - February 2019 (NPPF)

- 3.1.2 Chapter 15 of the National Planning Policy Framework (NPPF) relates to 'Conserving and enhancing the natural environment'.
- 3.1.3 Paragraph 170 e) refers directly to noise and states that: *"e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans;"*
- 3.1.4 Paragraph 180 also states: *"180. Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:*
- a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;*
 - b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and*
 - c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation."*
- 3.1.5 The Noise Policy Statement for England (NPSE) was published in March 2010. It specifies the following long-term vision in policy aims: *"Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:*
- Avoid significant adverse impacts on health and quality of life;*
 - Mitigate and minimise adverse impacts on health and quality of life; and*
 - Where possible, contribute to the improvement of health and quality of life."*

- 3.1.6 The NPSE introduced three concepts to the assessment of noise, which includes:

NOEL – No Observed Effect Level

This is the level below which no effect can be detected and below which there is no detectable effect on health and quality of life due to noise.

LOAEL – Lowest Observable Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected.

SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur.

- 3.1.7 The above categories are however, undefined in terms of noise levels and for the SOAEL the NPSE indicates that the noise level will vary depending upon the noise source, the receptor and the time of day/day of the week, etc. The need for more research is therefore required to establish what may represent an SOAEL. It is acknowledged in the NPSE that not stating specific SOAEL levels provides policy flexibility until there is further evidence and guidance.

- 3.1.8 The NPSE indicates how the LOAEL and SOAEL relate to the three aims listed above. The first aim of NPSE requires that:

"significant adverse effects on health and quality of life should be avoided while also taking into account the guiding principles of sustainable development."

- 3.1.9 The second aim of the NPSE (mitigating and minimising adverse impacts on health and quality of life) refers to the situation where the impact lies somewhere between LOAEL and SOAEL. It requires that all reasonable steps should be taken to mitigate adverse effects on health and quality of life whilst also taking into account the guiding principles of sustainable development. This does not mean that such adverse effects cannot occur.

- 3.1.10 The third aim envisages pro-active management of noise to improve health and quality of life, again taking into account the guiding principles of sustainable development.

Planning Practice Guidance

- 3.1.11 On March 6th, 2014, the Government published the National Planning Practice Guidance ("NPPG") on noise, which provides further information in respect of new developments which may be sensitive to the prevailing noise environment. This was updated in July 2019.

- 3.1.12 The NPPG refers to the NPSE documents and under the heading 'How can noise impacts be determined?' it states:

"Plan-making and decision taking need to take account of the acoustic environment and in doing so consider:

- *whether or not a significant adverse effect is occurring or likely to occur;*
- *whether or not an adverse effect is occurring or likely to occur; and*
- *whether or not a good standard of amenity can be achieved."*

3.1.13 At paragraph 004 the NPPG includes a table summarising the noise exposure hierarchy, based on the likely response. Under the heading of 'example of outcome' the '*present and not intrusive*' assessment of noise is defined as '*noise can be heard, but does not cause any change in behaviour, attitude or physiological response. Can slight affect the acoustic character of the area but not such that there is a change in the quality of life*'. The increasing effect level under these conditions is deemed to be '*no observed adverse effect*' and '*no specific measures are required*'.

3.1.14 The NPPG explains this by stating:

"At the lowest extreme, when noise is not perceived to be present, there is by definition no effect. As the noise exposure increases, it will cross the 'no observed effect' level. However, the noise has no adverse effect so long as the exposure does not cause any change in behaviour, attitude or other physiological responses of those affected by it. The noise may slightly affect the acoustic character of an area but not to the extent there is a change in quality of life. If the noise exposure is at this level no specific measures are required to manage the acoustic environment.

As the exposure increases further, it crosses the 'lowest observed adverse effect' level boundary above which the noise starts to cause small changes in behaviour and attitude, for example, having to turn up the volume on the television or needing to speak more loudly to be heard. The noise therefore starts to have an adverse effect and consideration needs to be given to mitigating and minimising those effects (taking account of the economic and social benefits being derived from the activity causing the noise).

Increasing noise exposure will at some point cause the 'significant observed adverse effect' level boundary to be crossed. Above this level the noise causes a material change in behaviour such as keeping windows closed for most of the time or avoiding certain activities during periods when the noise is present. If the exposure is predicted to be above this level the planning process should be used to avoid this effect occurring, for example through the choice of sites at the plan-making stage, or by use of appropriate mitigation such as by altering the design and layout. While such decisions must be made taking account of the economic and social benefit of the activity causing or affected by the noise, it is undesirable for such exposure to be caused.

At the highest extreme, noise exposure would cause extensive and sustained adverse changes in behaviour and / or health without an ability to mitigate the effect of the noise. The impacts on health and quality of life are such that regardless of the benefits of the activity causing the noise, this situation should be avoided."

3.1.15 The NPPG includes a table summarising the noise exposure hierarchy, based on the likely average response. Table 3.1 below provides the perception, example of outcome, effect and action required relative to noise.

Table 3.1: Noise Exposure Hierarchy

Response	Examples of Outcomes	Increasing Effect Level	Action
Not present	No Effect	No Observed Effect (NOEL)	No Specific Measures Required
Present and not intrusive	Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect (NOAEL)	No Specific Measures Required
Lowest Observed Adverse Effect Level (LOAEL)			
Present and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; closing windows for some of the time because of the noise. Potential for non-awakening sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level (SOAEL)			
Present and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. having to keep windows closed most of the time, avoiding certain activities during periods of intrusion. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Present and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Observed Adverse Effect	Prevent

3.2 Relevant Guidance & Standards – Industrial Noise

BS 4142:2014+A1:2019 'Methods for rating and assessing industrial and commercial sound'

3.2.1 BS 4142: 2014 'Methods for rating and assessing industrial and commercial sound' is based on the measurement of background sound using L_{A90} noise measurements, compared to source noise levels measured in L_{Aeq} units. The differential between the two measurements; once any corrections have been applied for source noise tonality, distinct impulses etc. (i.e. the 'rating' level); determines the likelihood of complaints.

- Typically, the greater this difference, the greater the magnitude of the impact.
- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
- A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.

- d) 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.

3.2.2 In order to establish the rating level, corrections for the noise character need to be taken into consideration. The Standard states that when considering the perceptibility:

"Consider the subjective prominence of the character of the specific sound at the noise-sensitive locations and the extent to which such acoustically distinguishing characteristics will attract attention."

3.2.3 The subjective method adopted includes the following character corrections:

Table 3.2: BS4142: 2014 Character Corrections

Level of Perceptibility	Correction for Tonal Character dB	Correction for Impulsivity dB	Correction for Intermittency dB	Correction for 'Other Character' dB
Not perceptible	0	0	0	0
Just perceptible	+2	+3	0	0
Clearly perceptible	+4	+6	+3*	+3*
Highly perceptible	+6	+9	+3*	+3*

*Standard defines this should be readily distinctive against the residual acoustic environment, it is interpreted therefore to be either clearly or highly perceptible as a character.

3.2.4 The assessment of noise from the fixed plant at the nearest receptors is considered and our expert opinion is provided below:

3.2.5 In terms of tonality, the proposed mitigation measures that will be required to control noise from the heating and cooling systems associated with the containerised plant and given the existing residual levels relative to background we would not expect any tonal characteristics to be perceptible at the nearest receptor and we would therefore not apply a correction. Noise from the transformers would be so low that they would not be perceptible.

3.2.6 In terms of impulsivity this is unlikely to be a characteristic of battery heating/cooling systems or transformers installations and is therefore not deemed to be applicable.

3.2.7 In terms of intermittency whilst the plant would operate intermittently once operational would normally remain on and unlikely to operate during sensitive hours. Taking into account the level of attenuation required to comply with appropriate and relevant standards for noise, the intermittency is unlikely to be distinctive (due to residual sound levels compared with plant noise contribution).

3.2.8 In conclusion, in view of the noise contribution from the Proposed Development and mitigation measures proposed, we would advise that a noise character penalty is unlikely to be appropriate.

BS8233:2014 'Guidance on sound insulation and noise reduction for buildings'

3.2.9 The British Standard BS8233 provides additional guidance on noise levels within buildings. These are based on the WHO recommendations and the criteria given in BS8233 for unoccupied spaces within residential properties.

3.2.10 The guidance provided in section 7.7 of BS8233 provides recommended internal ambient noise levels for resting, dining and sleeping within residential dwellings. Table 3.2 provides detail of the levels given in the standard.

Table 3.2: BS8233: 2014 Indoor ambient noise levels for dwellings

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living Room	35dB LAeq	
Dining	Dining Room/area	40dB LAeq	
Sleeping (daytime resting)	Bedroom	35dB LAeq	30dB LAeq
Study and work requiring concentration	Staff/Meeting Room	35-45dB LAeq	
	Training Room/ Executive Office	35-45dB LAeq	

3.2.11 This standard would be appropriate to apply to existing residential developments. The Site noise contribution should be within the proposed internal noise levels, which would include the following noise limits:

- Living room areas: $\leq 35\text{dB LAeq,16hours}$ (0700-2300 hours) [equivalent to an external level of approximately 65dB LAeq,16hours based on typical standard double-glazed units in the closed position and approximately 50dB LAeq,16hours in the open position].
- Bedrooms: $\leq 30\text{dB LAeq,8 hours}$ (2300-0700 hours) [equivalent to an external level of approximately 60dB LAeq,8hours based on typical standard double-glazed units in the closed position and approximately 45dB LAeq,8hours in the open position].
- Offices: $35\text{dB to } 45\text{dB LAeq, 8hours}$ [equivalent to an external level of approximately $65\text{dB to } 75\text{dB LAeq, 8hours}$ based on typical standard double-glazed units in the closed position].

World Health Organisation (WHO) Guidelines for Community Noise: April 1999

3.2.9 This document provides further updated information on noise and its effects on the community. The document for noise 'In Dwellings' states "*The effects of noise in dwellings, typically, are sleep disturbance, annoyance and speech interference. For bedrooms the critical effect is sleep disturbance. Indoor guideline values for bedrooms are 30dB LAeq for continuous noise and 45dB LAmax for single sound events. Lower noise levels may be disturbing depending upon the nature of the noise source.*"

3.2.10 The WHO document also states "*To enable casual conversation indoors during daytime, the sound level of interfering noise should not exceed 35dB LAeq. To protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 55dB LAeq on balconies, terraces and in outdoor living areas. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound level should not exceed 50dB LAeq. Where it is practical and feasible, the lower outdoor sound level should be considered the maximum desirable sound level for new development.*"

3.2.11 In 2009, the WHO published: 'Night Noise Guidelines for Europe', which it describes as an extension to the WHO 'Guidelines for Community Noise' (1999). It concludes that: *"Considering the scientific evidence on the thresholds of night noise exposure indicated by $L_{night, outside}$ as defined in the Environmental Noise Directive (2002/48/EC), an $L_{night, outside}$ of 40dB should be the target of the night noise guideline (NNG) to protect the public, including the most vulnerable groups such as children, the chronically ill and the elderly. $L_{night, outside}$ value of 55dB is recommended as an interim target for those countries where the NNG cannot be achieved in the short term for various reasons, and where policy-makers choose to adopt a stepwise approach."*

3.3 Survey Techniques

3.3.1 The background sound survey has been carried out in accordance with BS4142: 2014+A1:2019.

3.4 Establishing Baseline Sound Level

3.4.1 According to BS4142: 2014+A1:2019 in terms of what is defined as the background sound, the standard states the following:

8.1.3 "Ensure that the measurement time interval is sufficient to obtain a representative value of the background sound level for the period of interest. This should comprise continuous measurements of normally not less than 15 min intervals, which can be contiguous or disaggregated."

8.1.4 The monitoring duration should reflect the range of background sound levels for the period being assessed. In practice, there is no "single" background sound level as this is a fluctuating parameter. However, the background sound level used for the assessment should be representative of the period being assessed."

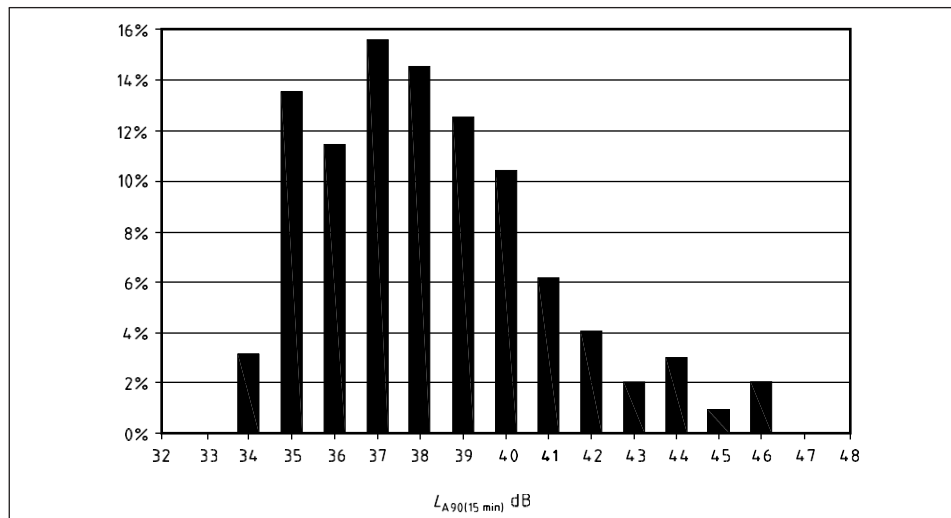
NOTE 1 To obtain a representative background sound level a series of either sequential or disaggregated measurements ought to be carried out for the period(s) of interest, possibly on more than one occasion. A representative level ought to account for the range of background sound levels and ought not automatically to be assumed to be either the minimum or modal value."

NOTE 2 The mean average of a series of measured background sound levels is not numerically equal to the overall period background sound level that would otherwise be obtained by a single measurement spanning individual measurement periods."

NOTE 3 Background sound can be significantly affected by meteorological conditions, particularly where the main sources of residual sound are remote from the assessment location(s)."

NOTE 4 Figure 4 shows an example of a statistical analysis of the results of all the measurement periods in order to determine a background sound level. For this distribution of the data an $L_{A90(15 \text{ min})}$ of 37 dB was considered to be representative and in this instance was also the most commonly occurring value."

Figure 4: Example of a statistical analysis to determine the background sound level



3.4.2 The above guidance indicates that to establish the background sound level requires the determination of a representative value which is not deemed to be the lowest but under statistical analysis the most common place when measured over a representative time period.

4.0 SOUND SURVEY METHODOLOGY & RESULTS

4.1 Baseline Sound Monitoring (See Appendix 2 & Figure 1)

Instrumentation and Fieldwork Details

- 4.1.1 A detailed environmental baseline sound survey was carried out in the vicinity of the nearest sensitive receptors to determine details of the sound climate to provide representative background sound data. The location chosen to establish background sound is as follows:

Position A: Southwest of Site (off Bronwylfa Road)

Position B: Northwest of Site

Position C: Northeast of Site (Cadwgan Hall Farm)

- 4.1.2 The sound survey and site inspection were carried out on Wednesday 26th to Thursday 27th February 2020. Static noise measurements were undertaken in the area adjacent to the nearest residential properties to establish representative data on the existing sound climate.
- 4.1.3 The main source of existing sound affecting nearest receptor properties generally relates to local road traffic, birdsong and occasional farming activities.
- 4.1.4 For noise measurements at the nearest sensitive receptor positions the following noise meter was used:

Manufacturer	Description	Type	Calibration Due date	Serial No.
Cirrus	Real Time Sound Analyser	1710A	May 2020	G066350
Norsonic	Integrating Sound Level Meter	116	July 2020	27342
Cirrus	Real Time Sound Analyser	171B	February 2021	G056142
Norsonic	Real Time Sound Analyser	118	August 2020	31992
Cirrus	Electronic Calibrator	CR: 513A	August 2020	031523

- 4.1.5 The following set-up parameters were used on the sound level meter during measurements:

Static Sound Monitoring:

Time Weighting: Fast
 Frequency Weighting: 'A'
 Measurement Period: 15 minutes

Monitoring Period and Test Details

- 4.1.6 Measurements were recorded over a period of approximately 24 hours. Data logging of L_{Aeq} , L_{A10} , L_{A90} and L_{Amax} were recorded at 15-minute intervals for information on the variation of sound levels (see Appendix 2 for details).
- 4.1.7 The noise meter was mounted on a tripod at a height of between 1.2 to 1.5 metres above ground level and fitted with a wind and rain shield.

Calibration

Calibration setting: 94dB

- 4.1.8 The noise meter was calibrated with the electronic calibrator prior to commencement and on completion of the survey. No significant drift in calibration was observed.

Survey Dates and Personnel

- 4.1.9 Static sound measurement positions (shown on Figure 1) were chosen to establish typical and representative background and ambient sound data at nearest sensitive receptors (see Appendix 2 for detailed information). Mr D R Kettlewell of Noise & Vibration Consultants Limited set up the sound monitoring on Wednesday 26th February at 1200 hours and removed the equipment on Friday 27th February 2020 at circa 1100 hours.

Meteorological Conditions

- 4.1.10 Weather details established from local weather stations by the NVC consultant during the period of the surveys, and appear below:

Wednesday 26th February 2020

- 4.1.11 Dry, variable cloud cover, light westerly to southerly winds (2-3m/s), temperature 4-7degC. Overnight it remained dry, variable cloud cover, light south westerly to variable wind direction, temperature 2deg to 5degC.

Thursday 27th February 2020

- 4.1.12 Overcast, occasional light drizzle, light north westerly wind (1-3m/s), temperature 5-7degC.

- 4.1.13 The above climatic conditions were suitable for monitoring environmental noise levels in accordance with advice given in BS4142:2014+A1:2019.

4.2 Results

Background Sound

- 4.2.1 Background sound measurements taken in the vicinity of the nearest residential sensitive receptors. The results of measurements taken at the fixed monitoring positions at site are presented below in Table 4.1 with detailed measurements in Appendix 2.

Table 4.1: Average Sound Levels during Daytime and Night-time periods

Location	Time Period	LAeq dB	LA10 dB	LA90 dB	Representative LA90 dB	LAmix dB
A. Southwest of Site	0700-2300	49	52	44	42	46-74
A. Southwest of Site	2300-0700	45	47	42	41	42-76
B. Northwest of Site	0700-2300	47	48	43	42	49-79
B. Northwest of Site	2300-0700	41	43	38	35	50-76
C. Northeast of Site	0700-2300	54	55	50	50	44-85
C. Northeast of Site	2300-0700	49	51	44	44	50-76

Note: The representative background sound level taken as either the average or 'most common place', whichever is lowest.

- 4.2.2 The methodology detailed in the latest version of BS4142: 2014+A1:2019 provides an example of statistical analysis to determine the background sound level (i.e. most common place). Further detail of the measured background sound levels and analysis of representative background sound levels is provided in Appendix 2.
- 4.2.3 The above table show that the most common place or average value (whichever is lowest) for determining background sound levels. The results show that between 0700-2300 hours at the monitoring positions, the representative LA90 level varies between 42dB to 50dB. During night-time periods the representative background level varies between 35dB to 42dB LA90.
- 4.2.4 For night-time periods the most appropriate absolute criteria would relate to sleep disturbance which would be found within the WHO 'Night Noise Guidelines for Europe', which concludes that: *"Considering the scientific evidence on the thresholds of night noise exposure indicated by $L_{night,outside}$ as defined in the Environmental Noise Directive (2002/48/EC), an $L_{night,outside}$ of 40dB should be the target of the night noise guideline (NNG) to protect the public, including the most vulnerable groups such as children, the chronically ill and the elderly, $L_{night,outside}$.*

4.3 Source Noise Levels

- 4.3.1 Section 5.2.3 below details noise levels for the battery heating/cooling plant, inverters, transformers and switchgear assumed for the noise prediction calculations.

5.0 NOISE LEVEL PREDICTIONS

5.1 Introduction

- 5.1.1 Noise has been defined as sound which is undesired by the recipient. The effects of noise on the neighbourhood are varied and complicated, including such things as interference with speech communication, disturbance of work, leisure or sleep. A further complicating factor is that in any one neighbourhood some individuals will be more sensitive to noise than others.
- 5.1.2 A measure that is in general use and is recommended internationally for the description of environmental noise is the equivalent continuous noise level or L_{Aeq} parameter.
- 5.1.3 In general, the level of noise in the local environs that arises from a development site will depend on a number of factors. The more significant of which are:-
- (a) The sound power levels (SWL's) of the plant or equipment used on site.
 - (b) The periods of operation of the plant on site.
 - (c) The distance between the source noise and the receiving position.
 - (d) The presence or absence of screening effects due to barriers, or ground absorption.
 - (e) Any reflection effects due to the facades of buildings etc.
- 5.1.4 The empirical noise levels have been used provided by manufacturers of the plant equipment to assist in determining the likely noise contribution at nearest sensitive receptors for comparison with the requirements of BS4142: 2014+A1:2019.

5.2 Prediction Methodology

Operational Noise

- 5.2.1 For site operational noise the assessment used ISO9613-2 prediction modelling and CadnaA software for producing a noise map of the highest likely generated noise during peak noise operations. The Input settings for the noise model include:

Ground factor (G) = 0.5 (mixed ground absorption)

Temperature = 10degC

Relative humidity = 70%

Receptor height = Assumed to be 4m above ground for operations.

- 5.2.2 The methodology takes into account source position and distance to the nearest sensitive receptors. The noise modelling assumes that all transformers, inverters and HVAC systems are in operation and therefore the noise predictions provide an indication of the highest likely noise level (and therefore a worst-case scenario).

Source Noise Levels

- 5.2.3 The plant associated with the proposal is based on the noise levels given below, which are based on manufacturer's or library noise data.

- a) Transformers (step-up and auxiliary) design noise level 65dB(A) at 1m.
- b) Lower Battery Storage containers (including cooling/heating system) designed to a noise level not exceeding 75dB(A) @ 1m (external to container).
- c) Battery Storage containers at upper mezzanine level (including cooling/heating system) designed to a noise level not exceeding of 70dB(A) @ 1m (external to container).
- d) Inverter plant mounted within an open sided container designed to a noise level not exceeding 75dB(A) @ 1m.
- e) Coolers for the switchgear rooms or any other cooling system noise levels 70dB(A) @ 1m.

5.2.4 The results of the CadnaA software prediction modelling noise contours for site operations are provided in Appendix 3.

5.3 Results of Noise

Predictions Site Plant

Noise Assessment:

5.3.1 Noise levels from fixed plant operating at the Site has been assessed against BS4142: 2014+A1:2019.

Noise Contribution Levels from Battery Storage Containers, HVAC systems, Transformers, Inverters and Switchgear Containers

Table 5.1: Predicted Noise from Plant Operations (with mitigation measures)

Receptor Position (Refer to Figure 1)	Period	Predicted highest rating noise level LAeq(dB)	Representative background sound level LA90 [LAeq] dB	Rating Noise Limit LAeq dB	Excess over limits LAeq dB
R1: Southwest/South of Site (off Bronwylfa Road)	Daytime	36-38	42 [49]	<=42	-6 to -4
	Night-time	36-38	41 [45]	<=41	-5 to -3
R2: Northwest of Site	Daytime	30-33	42 [47]	<=42	-12 to -9
	Night-time	30-33	35 [41]	<=35	-5 to -2
R3: Northeast of Site (Cadwgan Hall Farm)	Daytime	34	50 [54]	<=50	-16
	Night-time	34	44 [49]	<=44	-10

5.3.2 The results show that the noise contribution from maximum site operations with chosen mitigation measures would not exceed the representative background sound level during the daytime and night-time periods. According to BS4142: 2014+A1:2019, the resultant assessment would conclude that noise from the site would result in a **low impact** (see Tables 5.2 and 5.3 below for more detailed assessment in accordance with BS4142: 2014+A1:2019).

5.3.3 Additionally, the noise contribution from maximum operations would be within sleep disturbance criteria according to BS8233: 2014 (i.e. inside bedroom levels not exceeding 30dB LAeq_{8hrs}, which is circa 40-45dB LAeq external to a window assuming an open window scenario). The noise levels also comply with the Night Noise Guidelines for Europe, which has an aim of 40dB LAeq_{8hrs} external to dwellings.

Table 5.2: BS4142 Assessment of mitigated noise at Position R1 (all plant running i.e. highest impact) at Night-time

Results		Relevant	Commentary
Calculated Specific sound level	$L_{Aeq}(15mins) = 38dB$	7.3.6	Specific sound source calculated using ISO9613-2
Background sound level	$L_{A90} = 41dB$	8.1.3 8.2	Measured over night-time period deemed to be representative of the background sound level.
Assessment during daytime, reference time interval is 15mins		7.2	
Acoustic feature correction	0dB	9.2	No acoustic feature expected due to site noise contribution and much higher residual sound levels.
Rating level	$(38 + 0) dB = 38dB$	9.2	No significant perceptible noise character predicted
Background sound level	$L_{A90} = 41dB$	8	Most common place or average (whichever is lowest) value determined using measured background level (2300-0700) providing a robust assessment
Excess of rating over background sound level	$(38 - 41) dB = -3dB$	11	
Assessment indicates low impact		11	
Uncertainty	Not significant	10	The excess of the rating level over the background sound level is negative and residual levels are higher (i.e. 45dB LAeq) and the uncertainty of the measurement does not have any significance to the outcome of the assessment. Appropriate standards used for the calculation. All instruments used Type 1, calibrated and in calibration limits for baseline.

**Table 5.3: BS4142 Assessment of mitigated noise at Position R2
 (all plant running i.e. highest impact) at Night-time**

Results		Relevant	Commentary
Calculated Specific sound level	$L_{Aeq}(15mins) = 33dB$	7.3.6	Specific sound source calculated using ISO9613-2
Background sound level	$L_{A90} = 35dB$	8.1.3 8.2	Measured over night-time period deemed to be representative of the background sound level.
Assessment during daytime, reference time interval is 15mins		7.2	
Acoustic feature correction	0dB	9.2	No acoustic feature expected due to site noise contribution and much higher residual sound levels.
Rating level	$(33 + 0) dB = 33dB$	9.2	No significant perceptible noise character predicted
Background sound level	$L_{A90} = 35dB$	8	Most common place or average (whichever is lowest) value determined using measured background level (2300-0700) providing a robust assessment
Excess of rating over background sound level	$(33 - 35) dB = -2dB$	11	
Assessment indicates low impact		11	
Uncertainty	Not significant	10	The excess of the rating level over the background sound level is negative and residual levels are higher (i.e. 41dB L_{Aeq}) and the uncertainty of the measurement does not have any significance to the outcome of the assessment. Appropriate standards used for the calculation. All instruments used Type 1, calibrated and in calibration limits for baseline.

6.0 CONSTRUCTION NOISE

- 6.1 In general, the level of noise in the local environs arising from the construction of a development site will depend on a number of factors.

The most significant of which are as follows:

- The sound power levels (SWL's) or sound pressure levels (SPL's) of the plant or equipment used on site;
- The periods of operation of the plant on site;
- The distance between the source noise and the receiving position;
- The presence or absence of screening effects due to barriers, or ground absorption; and,
- Any reflection effects due to the facades of buildings etc.

Calculation Methodology

- 6.2 The calculation method used in this study for construction noise is based upon theoretical noise propagation theory, which takes into account source position, distance, direction and frequency content in relation to the nearest residential property boundary positions. British Standard BS5228 methodology has been used to estimate construction noise levels at the nearest existing dwellings including source noise levels for construction plant.
- 6.3 Noise levels emanating from the Site due to construction works associated with the Proposed Development will vary from day to day. In order to give an indication of the probable noise levels generated by the works, a worst-case scenario has been considered for several construction activities, namely soil movement and road construction. See Appendix 5 for further information.

Predicted Noise Levels: Construction

- 6.4 The highest likely noise levels for the Proposed Development in terms of construction noise are provided below. This is based on calculations for soil movement work, infrastructure, plant installation and general site activities at the closest approach to existing dwellings.
- 6.5 The results of calculations (excluding mitigation measures) are shown below in Table 6.1 which applies the ABC method for noise criteria proposed threshold limits as advised in the Standard (Annex E).

Table 6.1: Noise Predictions for Highest Likely Construction Noise at Nearest Receptors

Receptor Position	Distance to receptor (m)	Activity	Noise Level, dB LAeq1hr	Typical Residual Noise LAeq1hr dB	Total noise (residual + construction) LAeq1hr dB	BS5228 Threshold Value LAeq dB (daytime)
R1: Southwest of Site (off Bronwylfa Road)	340-400	Piling	51-55	49	53-56	65
	340-400	Site Preparation	39-40	49	49-50	65
	340-400	General site activities	45-46	49	50-52	65
	340-400	Infrastructure	37-44	49	49-50	65
	340-400	Plant installation	49-50	49	52-53	65
R2: Northwest of Site	370-700	Piling	45-51	47	49-52	65
	370-700	Site Preparation	34-40	47	47-48	65
	370-700	General site activities	40-45	47	48-49	65
	370-700	Infrastructure	32-44	47	47-49	65
	370-700	Plant installation	44-50	47	49-52	65
R3: Northeast of Site (Cadwgan Hall Farm)	490-560	Piling	47-48	54	55	65
	490-560	Site Preparation	41-43	54	54	65
	490-560	General site activities	42-43	54	54	65
	490-560	Infrastructure	34-41	54	54	65
	490-560	Plant installation	43-47	54	54-55	65

Note: Construction noise prediction levels given above do not allow for any site screening or proposed amelioration measures and highest levels predicted assumes that the plant equipment is at its closest approach.

- 6.6 The highest construction noise levels are likely to be created during any initial soil movement and the installation of plant and infrastructure. The results show that during the construction period noise levels at residential receptors would be well within threshold levels. The implementation of best practice measures would assist in reducing and minimising noise radiating towards receptors and the threshold proposed by BS5228 would not be exceeded and within acceptable limits for this type of temporary activity.

Mitigation of Construction Period Effects

- 6.7 In accordance with BS 5228:2009+A1:2014 Parts 1 & 2, best practical means would be employed to control the noise and vibration generation.
- 6.8 In consideration of the likely highest levels of construction noise, the following approach would be adopted:
- Restriction of construction hours to non-sensitive times of day would normally form part of the planning consent conditions.
 - Community Relations – where noise levels are likely to impact on existing residual sound levels at receptor positions, this is one of the most important aspects of mitigation, as providing the nearest sensitive receptors with clear information about the activities that would be taking place and the length of time that any peak noise levels may occur will assist in allaying people's fears. BS 5228 states *"It is suggested that good relations can be developed by keeping people informed of progress and by treating complaints fairly and expeditiously. The person, company or organisation carrying out the work on site should appoint a responsible person to liaise with the public."*

- Use of broadband type reverse alarms for mobile plant (i.e. avoiding tonal `beeper' type alarms).
- Sensible routing of the construction plant to minimise noise relative to the nearest residential properties.
- Careful choice of plant to minimise noise generation (e.g. hire of fixed plant with acoustic enclosures).
- Ensure all plant is regular maintained and correctly fitted with effective silencers / any relevant acoustic hoods etc.
- Maximise distance between any significant noise source and receptor locations.
- Plant switched off when not in use.

7.0 CONCLUSIONS

- 7.1 The Proposed Development has been assessed in terms of noise impact during construction and operational periods. This report has been undertaken to provide technical support to the planning application for the Proposed Development.
- 7.2 The results of baseline noise monitoring over a weekend monitoring period at three locations (in areas providing a representative assessment of background sound level) in the vicinity of sensitive receptors indicate that representative background sound levels between 0700-2300 hours at the monitoring position was shown to vary between 42dB and 50dB LA90. During night-time periods the background levels were established as 35dB to 42dB LA90.
- 7.3 Typical site operating noise levels have been established from empirical library data of typical containerised battery storage sets and ancillary plant to provide input data for the noise model.

Mitigation Measures to Control Noise

- 7.4 In order to achieve reasonable and appropriate noise contribution levels at the nearest receptors to the site the following example of noise mitigation is included. It should be noted that there is more than one design that could achieve the design limits:
- (i) The ground floor positioned battery units would need to be housed within a container that provides a reduction in noise level for **each** unit not to exceed a design level of 75dB(A) Leq_{15mins} @ 1m at maximum load. This includes any HVAC systems associated with the battery containers.
 - (ii) The first floor (upper positioned) battery units would need to be housed within a container that provides a reduction in noise level for **each** unit not to exceed a design level of 70dB(A) Leq_{15mins} @ 1m at maximum load. This includes any HVAC systems associated with the battery containers.
 - (iii) Inverters would also be in containers or in the open, designed to a level not exceeding 75dB(A) Leq_{15mins} @ 1m at maximum load.
 - (iv) The switchgear container would be designed not to exceed 70dB(A) @ 1m Leq_{15mins} at maximum load.
 - (v) The transformers designed to a level not exceeding 65dB(A) @ 1m Leq_{15mins} at maximum load.
- 7.5 The predicted noise contribution from the application site using ISO9613-2 methodology and CadnaA noise modelling software with assumed noise mitigation measures show rating noise levels from Site to range between 30dB and 38dB LAeq during maximum site operations.
- 7.6 The BS4142 assessment shows that with appropriate mitigation the Proposed Development can be designed to comply with relevant noise guidance and standards. The impact at other receptor positions would be lower than that predicted for the chosen receptors.

- 7.7 In terms of absolute levels, the predicted highest noise contributions from the proposed site operations are shown to be well below residual sound levels and therefore in context noise levels would not be significant.
- 7.8 Absolute levels are below WHO guidelines for general daytime amenity levels, night-time levels for sleep disturbance and internal room design criteria according to BS8233: 2014 assuming windows open.
- 7.9 The predicted residual noise levels from the site have been calculated based on an example of noise mitigation measures designed to achieve a specific design level. This design limit would form part of the purchasing specification when the plant supplier is defined.
- 7.10 Noise from construction activities would not be significant and best practice would be applied according to BS5228-1:2009+A1:2014 to minimise noise.
- 7.11 The assessment concludes that the Proposed Development can be designed to operate such that it complies with all appropriate and relevant noise standards and guidance.

REFERENCES

BS 7445:2003 Description and measurement of environmental noise.

BS 4142: 2014+A1:2019 'Methods for rating and assessing industrial and commercial sound'

BS 8233:2014 'Guidance on sound insulation and noise reduction for buildings'

Guidelines for Community Noise – World Health Organisation: April 1999

Noise Policy Statement for England (NPSE) – March 2010

Department for Communities and Local Government: National Planning Policy Framework: February 2019

World Health Organisation: Night Noise Guidelines for Europe': 2009

BS5228-1:2009+A1:2014 'Code of practice for noise control on construction and open sites'

ISO 9613-2: 1996 'Acoustics – Attenuation of Sound During Propagation Outdoors

National Planning Practice Guidance ("NPPG") – July 2019

FIGURES

Figure 1: Baseline Noise Monitoring Locations, Receptor Positions & Site Location

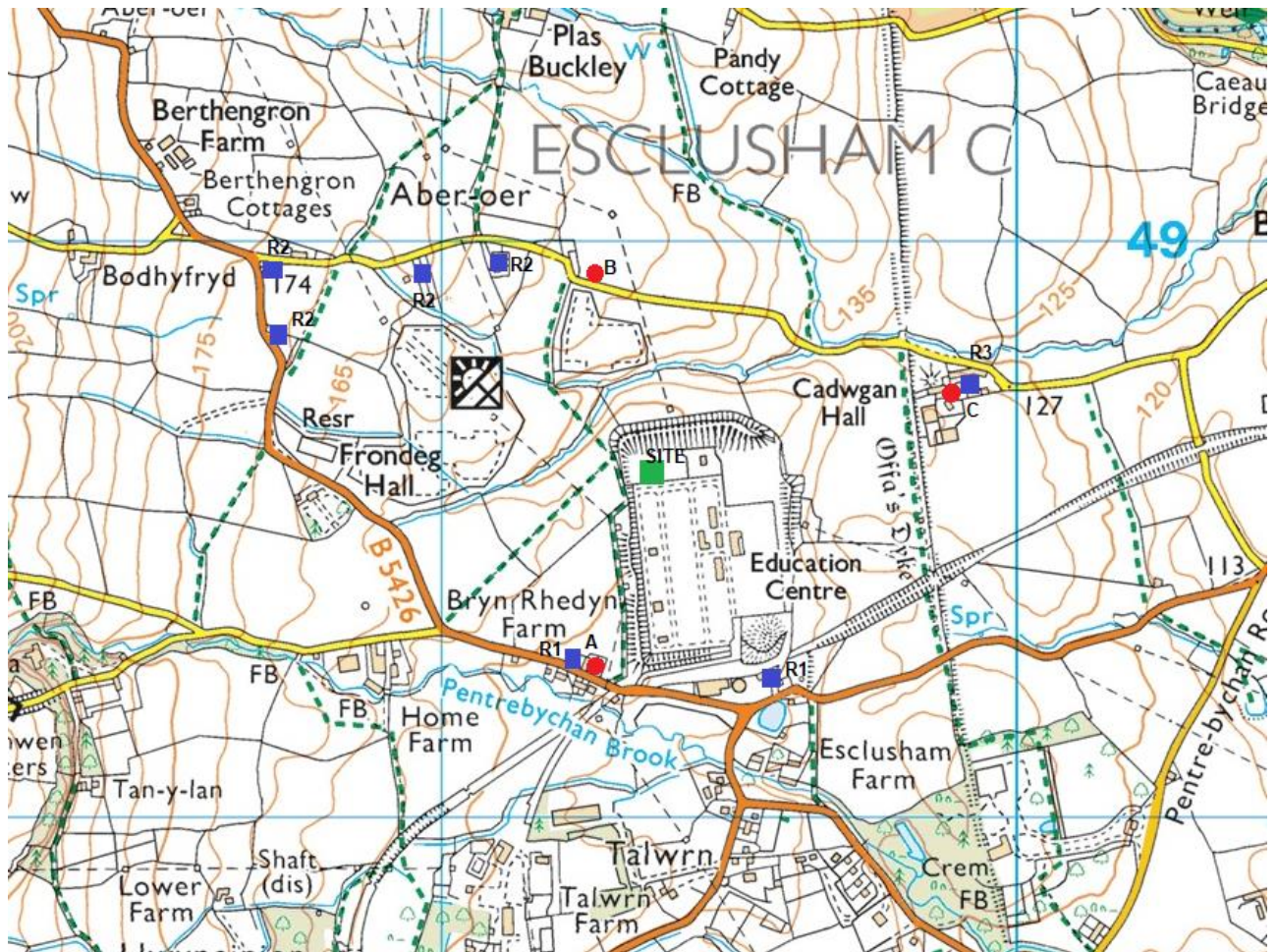
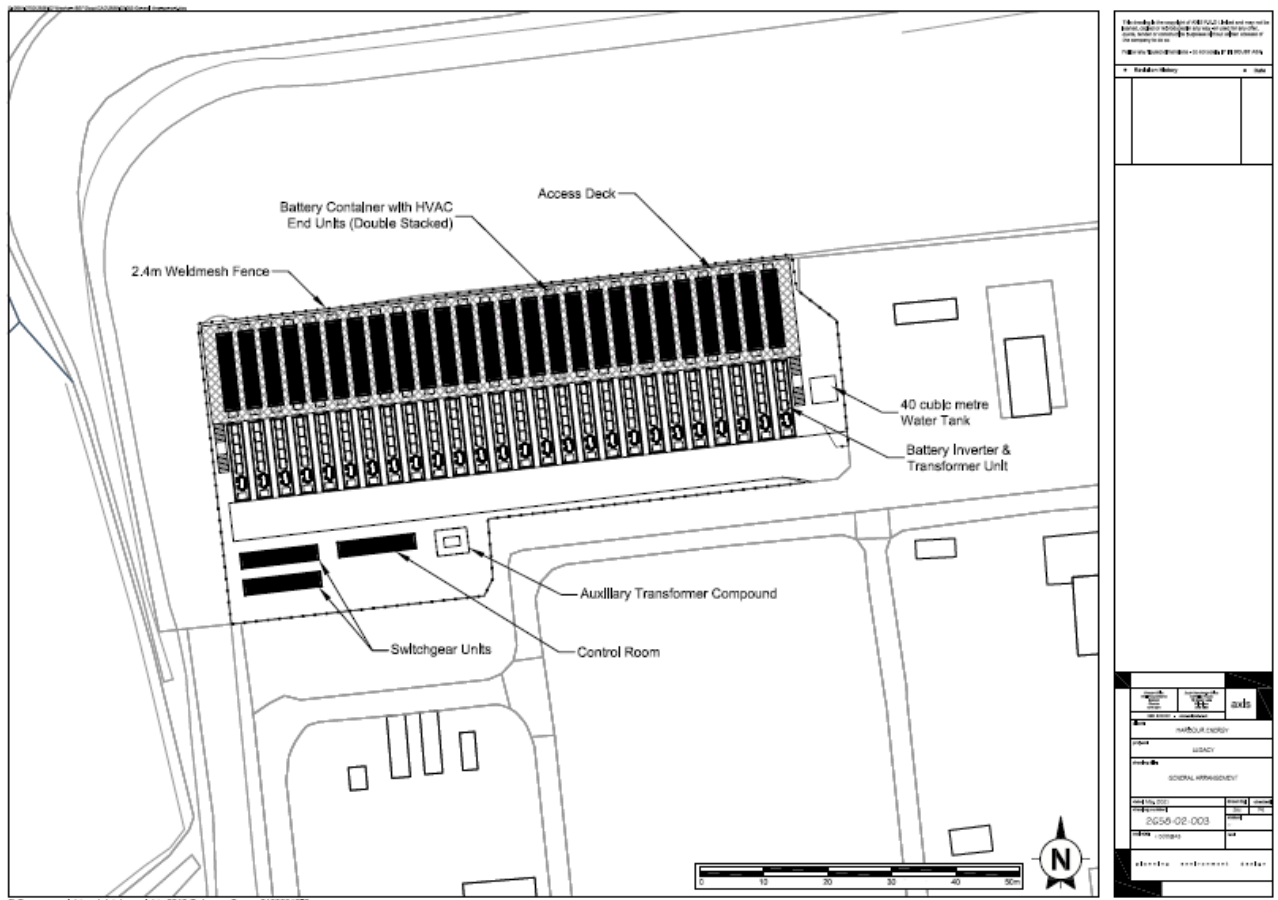


Figure 2: Layout of Site



Appendix 1

BASIC ACOUSTIC TERMINOLOGY

Sound is produced by mechanical vibration of a surface, which sets up rapid pressure fluctuations in the surrounding air.

Sound Pressure Level is a measurement of the size of these pressure fluctuations. It is expressed in decibels (dB) on a logarithmic scale. Each 3 dB increase in sound pressure level represents a doubling of the sound energy. The threshold of hearing is approximately 0 dB.

The rate at which the pressure fluctuations occur determines the pitch or frequency of the sound. The frequency is expressed in Hertz (Hz), that is, cycles per second. The human ear is sensitive to sounds from about 20 Hz to 20,000 Hz. Although sound can be of one discrete frequency - a 'pure tone' - most noises are made up of many different frequencies.

The human ear is more sensitive to some frequencies than others, and modern instruments can measure sound in the same 'subjective' way. This is the basis of the A- weighted sound level dB(A), normally used to assess the effect of noise on people. The dB(A) weighting emphasises or reduces the importance of certain frequencies within the audible range.

Noise Measurement

The measurement of sound pressure level is only really meaningful where the level of noise is constant. In the typical industrial environment noise levels can vary widely and sometimes short duration high levels of noise are interspersed with periods of relative quiet. The most widely used means of 'averaging' the noise over a period of time is the Equivalent Continuous Sound Level. Normally written as L_{Aeq} this value takes into account both the level of noise and the length of time over which it occurs. There are many meters available which are capable of measuring L_{Aeq} by electronic integration over the measurement period.

The L_{Aeq} or A-weighted equivalent continuous noise level is a measure of the total noise energy over a stated time period and includes all the varying noise levels and re-expresses as an 'average', allowing for the length of time for which each noise level was presented.

The L_{An} parameters are defined as the noise levels which are exceeded for n% of the monitoring period, thus, for example, the L_{A90} parameter is the noise level exceeded for 90% of the 15-minute period, i.e. 13.5 minutes. The L_{A50} parameter is the noise level exceeded for 50% of the hourly period, i.e. 30 minutes, etc. The L_{max} parameter is the maximum RMS A-weighted noise level occurring during the measurement period.

The definition in layman's terms is given below for terminology used in the measurement and results obtained during the survey work.

A-weighting: Normal hearing covers the frequency (pitch) range from about 20Hz to 20,000 Hz but sensitivity of the ear is greatest between about 500Hz and 5000Hz. The "A-weighting" is an electrical circuit built into noise meters to mimic this characteristic of the human ear.

Ambient noise: The totally encompassing sound in a given situation at a given time usually composed of sound from many sources near and far.

Attenuation: Noise reduction

Background noise: The general quiet periods of ambient noise when the noise source under investigation is not there.

Decibel (dB): The unit of measurement for sound based on a logarithmic scale. 0dB is the threshold of normal hearing; 140dB is the threshold of pain. A change of 1dB is only detectable under controlled laboratory conditions.

dB(A) [decibel A weighted]: Decibels measured on a sound level meter incorporating a frequency weighting (A weighting) serves to distinguish sounds of different frequency (or pitch) in a similar way to how the human ear responds. Measurements in dB(A) broadly agrees with an individual's assessment of loudness. A change of 3dB(A) is the minimum perceptible under normal everyday conditions, and a change of 10dB(A) corresponds roughly to doubling or halving the loudness of sound.

dB(C): [decibel C weighted]: Frequency weighting which does not alter low frequency octave band levels by very much compared to 'A' weighting. Similar to linear reading (i.e. linear does not alter frequency spectra at all)

Frequency (Hz): The number of sound waves to pass a point in one second.

L_{Aeq}: This is a noise index used to describe the "average" level of a noise that varies with time (T). It allows for the different sensitivities of the human ear to different frequencies (pitch), and averages fluctuating noise levels in a manner which correlates well with human perceptions of loudness.

L_{A10,T}: This noise index gives an indication of the upper limit or peak levels of the fluctuating noise. It is the "A weighted" noise level exceeded for 10 per cent of the specified measurement period (T). e.g. If the measurement period was over 10 hours and the L_{A10} reading was say 60dB, then this means that for 1 hour out of 10 the level went above 60dB.

L_{A90,T}: This noise index gives an indication of the lower limit or levels of the fluctuating noise. It is the "A weighted" noise level exceeded for 90 per cent of the specified measurement period (T). e.g. If the measurement period was over 10 hours and the L_{A90} reading was say 50dB, then this means that for 9 hours out of 10 the level went above 50dB.

L_{Amax}: This is the highest 'A' weighted noise level recorded during a noise measurement period.

Residual noise: The ambient noise remaining at a given position in a given situation when the noise source under investigation is not there.

Specific noise: The noise source under investigation for assessing the likelihood of complaints

Examples of typical noise levels

Source/Activity	Indicative noise level [dB(A)]
Threshold of hearing	0
Rural night-time background	20-40
Quiet bedroom	35
Wind farm at 350m	35-45
Busy road at 5km	35-45
Car at 65km/h at 100m	55
Busy general office	60
Conversation	60
Truck at 50km/h at 100m	65
City Traffic at 5m	75-85
Pneumatic drill at 7m	95
Jet aircraft at 250m	105
Threshold of pain	140

Appendix 2

Baseline Sound Survey Results

Noise Survey Results

Date: Wednesday 26th February 2020

Location: Land at Legacy Site, Rhostyllen

Client: Harbour Energy

Project: GPP Facility

Data: **Baseline Sound Survey: A) Southwest of Site**

Instrumentation: Cirrus 171A Real Time Analyser (G061253)

Calibration: 94dB

TABLE 1

Start Time	Run Time (mins.)	LAeq (dB)	LA10 (dB)	LA90 (dB)	LAmix (dB)	Observations
12:00	15:00	53.0	56.0	48.0	66.2	
12:15	15:00	50.8	52.8	47.1	64.7	
12:30	15:00	50.2	51.8	45.7	66.0	
12:45	15:00	51.3	53.8	46.9	67.6	
13:00	15:00	50.7	53.6	45.5	65.0	
13:15	15:00	48.9	51.4	44.3	62.0	
13:30	15:00	50.3	52.2	45.8	70.5	
13:45	15:00	52.5	54.8	47.8	68.2	
14:00	15:00	51.4	53.7	47.1	69.6	
14:15	15:00	50.8	53.6	46.4	62.0	
14:30	15:00	51.0	53.9	45.6	64.5	
14:45	15:00	50.5	53.5	45.7	65.5	
Log Average 1200-1500		51.0	53.5	46.4	62-71	
Average 1200-1500		51.0	53.4	46.3	62-71	

Noise Survey Results

Date: Wednesday 26th February 2020

TABLE 2

Location: Land at Legacy Site, Rhosyllen

Client: Harbour Energy

Project: GPP Facility

Data: **Baseline Sound Survey: A) Southwest of Site**

Instrumentation: Cirrus 171A Real Time Analyser (G061253)

Calibration: 94dB

Start Time	Run Time (mins.)	LAeq (dB)	LA10 (dB)	LA90 (dB)	LAmx (dB)	Observations
15:00	15:00	49.8	52.0	45.7	67.2	
15:15	15:00	50.1	53.7	45.1	62.2	
15:30	15:00	50.4	53.4	44.3	66.8	
15:45	15:00	47.8	50.8	42.4	63.5	
16:00	15:00	47.8	51.3	42.2	62.0	
16:15	15:00	49.2	53.3	42.4	63.4	
16:30	15:00	50.4	54.2	41.8	67.0	
16:45	15:00	49.5	52.6	41.7	68.9	
17:00	15:00	49.6	52.1	41.3	70.2	
17:15	15:00	50.2	54.5	42.2	62.5	
17:30	15:00	48.7	52.6	41.9	67.0	
17:45	15:00	50.0	52.7	42.2	69.1	
18:00	15:00	47.2	49.5	41.9	68.1	
18:15	15:00	46.9	49.3	41.5	63.4	
18:30	15:00	45.5	46.0	41.5	63.6	
18:45	15:00	44.6	43.2	41.4	62.6	
19:00	15:00	48.8	51.2	41.8	66.5	
19:15	15:00	46.0	47.1	41.6	63.0	
19:30	15:00	44.0	43.5	41.7	60.1	
19:45	15:00	45.1	44.9	41.6	62.0	
20:00	15:00	44.9	45.0	41.4	59.8	
20:15	15:00	44.4	43.0	41.2	62.6	
20:30	15:00	43.3	42.4	41.0	61.5	
20:45	15:00	46.0	47.5	41.0	61.4	
21:00	15:00	44.7	43.7	41.0	64.6	
21:15	15:00	42.6	43.2	41.0	54.8	
21:30	15:00	43.5	42.4	40.9	60.3	
21:45	15:00	44.1	43.1	40.8	63.5	
22:00	15:00	41.5	42.2	41.0	45.9	
22:15	15:00	41.8	42.3	41.1	49.4	
22:30	15:00	44.5	42.2	41.0	63.9	
22:45	15:00	41.3	41.6	40.8	49.9	
Log Average 1500-2300		47.2	49.8	42.0	46-70	
Average 1500-2300		46.4	47.7	41.8	46-70	

Noise Survey Results

Date: Wednesday 26th - Thursday 27th February 2020

Location: Land at Legacy Site, Rhosyllen

TABLE 3

Client: Harbour Energy

Project: GPP Facility

Data: **Baseline Sound Survey: A) Southwest of Site**

Instrumentation: Cirrus 171A Real Time Analyser (G061253)

Calibration: 94dB

Start Time	Run Time (mins.)	LAeq (dB)	LA10 (dB)	LA90 (dB)	LAmix (dB)	Observations
23:00	15:00	43.1	43.4	40.7	45.1	
23:15	15:00	44.3	43.5	40.7	59.1	
23:30	15:00	43.1	43.4	40.7	53.9	
23:45	15:00	43.8	43.5	40.6	54.3	
00:00	15:00	43.2	43.8	40.6	50.8	
00:15	15:00	45.8	43.4	40.4	64.9	
00:30	15:00	42.7	42.9	40.4	52.3	
00:45	15:00	45.2	46.6	40.4	62.1	
01:00	15:00	52.4	55.4	43.1	66.2	
01:15	15:00	47.4	48.0	40.5	63.2	
01:30	15:00	43.5	44.1	40.8	46.7	
01:45	15:00	43.7	44.5	41.1	45.5	
02:00	15:00	43.8	44.1	41.4	48.1	
02:15	15:00	45.9	48.2	41.7	49.8	
02:30	15:00	44.6	45.9	40.0	54.5	
02:45	15:00	47.1	47.6	44.0	66.6	
03:00	15:00	47.2	47.6	44.8	58.9	
03:15	15:00	46.2	47.0	43.5	58.4	
03:30	15:00	46.0	46.3	43.6	62.0	
03:45	15:00	46.8	47.3	43.8	58.6	
04:00	15:00	43.9	45.2	40.7	57.5	
04:15	15:00	42.0	42.5	39.3	52.6	
04:30	15:00	41.0	41.4	38.6	51.7	
04:45	15:00	41.2	42.0	38.3	50.8	
05:00	15:00	41.3	42.4	38.1	51.2	
05:15	15:00	43.3	44.3	39.5	51.7	
05:30	15:00	44.3	45.5	39.6	50.8	
05:45	15:00	45.1	46.2	39.9	59.6	
06:00	15:00	45.7	46.2	42.2	65.5	
06:15	15:00	53.4	53.5	43.6	75.6	
06:30	15:00	49.9	53.4	43.5	62.7	
06:45	15:00	49.4	52.8	42.5	67.2	
Log Average 2300-0700		46.4	47.8	41.5	42-76	
Average 2300-0700		45.2	46.0	41.2	42-76	
Average 1045-2300		49.5	52.0	44.7	46-71	

Noise Survey Results

Date: Thursday 27th February 2020

Location: Land at Legacy Site, Rhosyllen

Client: Harbour Energy

Project: GPP Facility

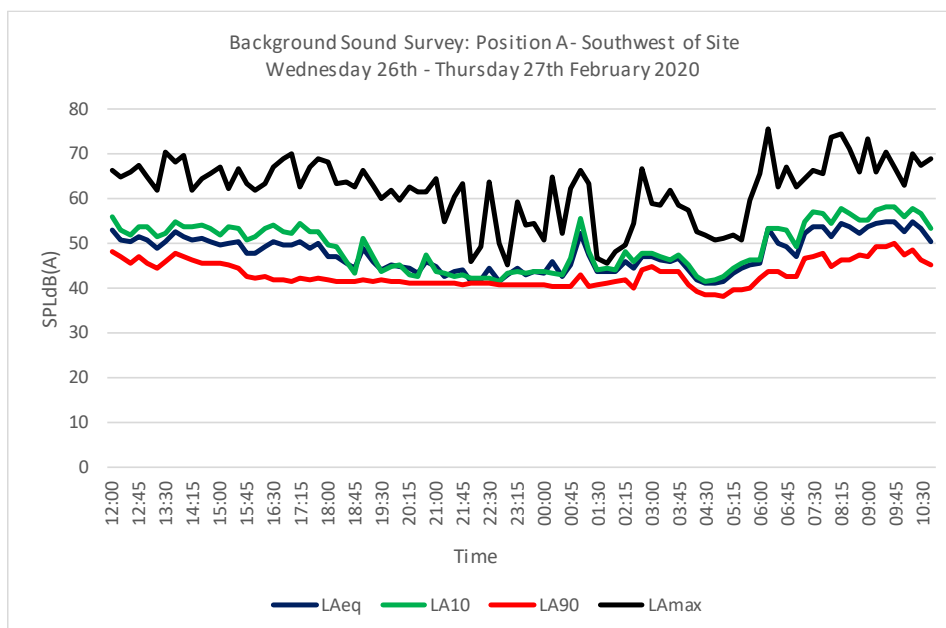
Data: **Baseline Sound Survey: A) Southwest of Site**

Instrumentation: Cirrus 171A Real Time Analyser (G061253)

Calibration: 94dB

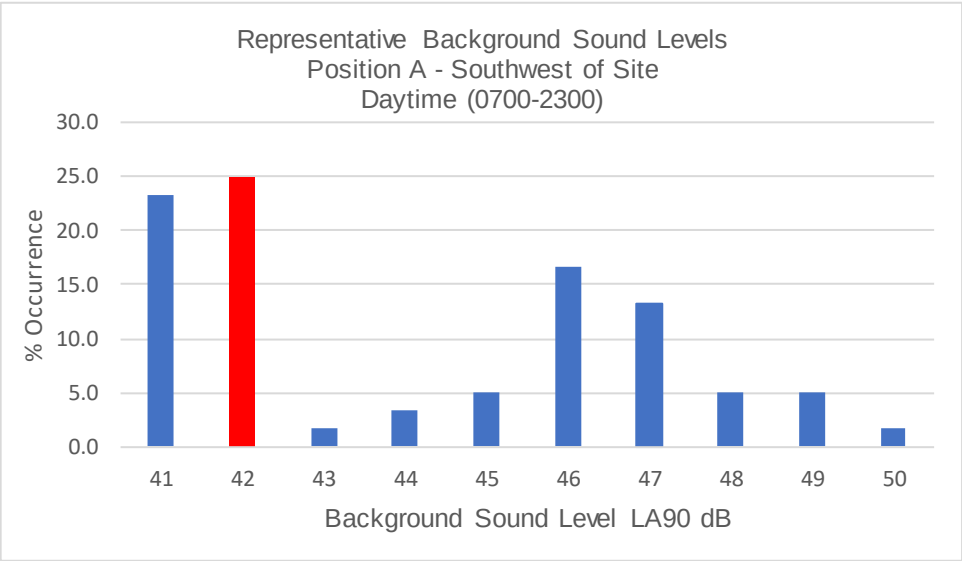
TABLE 4

Start Time	Run Time (mins.)	LAeq (dB)	LA10 (dB)	LA90 (dB)	LAmix (dB)	Observations
07:00	15:00	47.1	49.1	42.5	62.8	
07:15	15:00	52.1	54.7	46.8	64.4	
07:30	15:00	53.7	57.0	47.0	66.2	
07:45	15:00	53.6	56.5	47.9	65.6	
08:00	15:00	51.4	54.3	44.7	73.6	
08:15	15:00	54.5	57.8	46.4	74.4	
08:30	15:00	53.6	56.8	46.1	71.1	
08:45	15:00	52.1	55.1	47.4	66.0	
09:00	15:00	53.6	55.1	47.0	73.3	
09:15	15:00	54.5	57.3	49.3	66.0	
09:30	15:00	55.0	58.0	49.1	70.6	
09:45	15:00	55.0	58.0	49.9	67.2	
10:00	15:00	52.7	55.8	47.4	63.0	
10:15	15:00	54.9	57.8	48.5	69.9	
10:30	15:00	53.5	56.5	46.4	67.3	
10:45	15:00	50.5	53.3	45.3	69.0	
Log Average 0700-1100		53.3	56.2	47.3	63-74	
Average 0700-1100		53.0	55.8	47.0	63-74	
Overall Log Average		49.2	52.0	43.6	46-74	



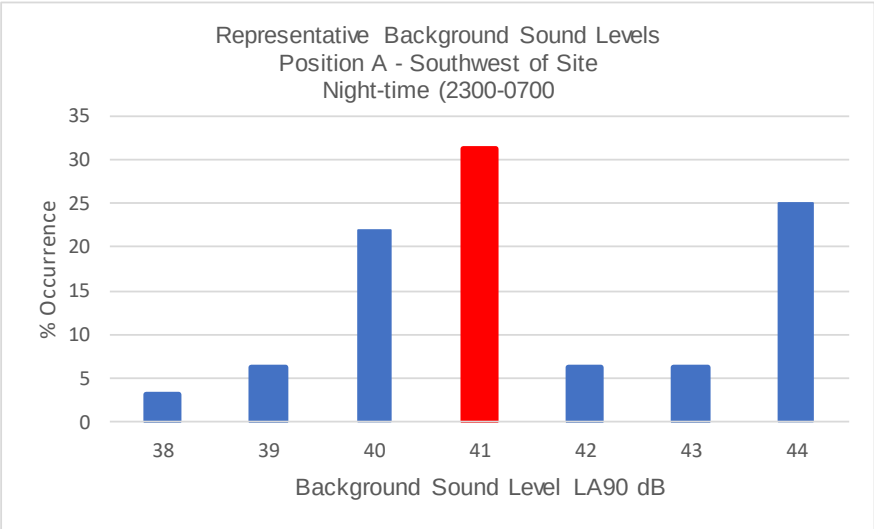
LA90 % Occurrence

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



Noise Survey Results

Date: Wednesday 26th February 2020

Location: Land at Legacy Site, Rhostyllen

Client: Harbour Energy

Project: GPP Facility

Data: **Baseline Sound Survey: B) Northwest of Site**

Instrumentation: Norsonic 116 Integrating Sound Level Meter (27342)

Calibration: 94dB

TABLE 5

Start Time	Run Time (mins.)	LAeq (dB)	LA10 (dB)	LA90 (dB)	LAmix (dB)	Observations
11:45	15:00	45.3	47.0	42.5	63.6	
12:00	15:00	45.8	46.9	41.5	56.3	
12:15	15:00	48.7	52.3	42.0	70.8	
12:30	15:00	45.4	46.5	41.6	64.4	
12:45	15:00	49.2	46.0	41.8	79.3	
13:00	15:00	44.3	45.8	41.6	61.6	
13:15	15:00	46.2	48.1	42.2	65.3	
13:30	15:00	44.8	46.3	41.5	65.4	
13:45	15:00	46.2	49.3	41.9	59.9	
14:00	15:00	44.7	46.2	42.3	60.6	
14:15	15:00	48.1	45.8	41.5	79.3	
14:30	15:00	50.9	49.4	41.5	72.0	
14:45	15:00	44.8	45.9	42.3	63.7	
Log Average 1145-1500		47.0	47.8	41.8	56-79	
Average 1145-1500		46.5	47.4	41.9	56-79	

Noise Survey Results

Date: Wednesday 26th February 2020

TABLE 6

Location: Land at Legacy Site, Rhosyllen

Client: Harbour Energy

Project: GPP Facility

Data: **Baseline Sound Survey: B) Northwest of Site**

Instrumentation: Norsonic 116 Integrating Sound Level Meter (27342)

Calibration: 94dB

Start Time	Run Time (mins.)	LAeq (dB)	LA10 (dB)	LA90 (dB)	LAmx (dB)	Observations
15:00	15:00	47.7	49.5	42.7	65.9	
15:15	15:00	46.1	48.9	42.3	63.7	
15:30	15:00	51.2	50.6	43.2	75.4	
15:45	15:00	49.4	48.0	42.4	74.0	
16:00	15:00	46.0	47.2	43.3	62.8	
16:15	15:00	46.3	47.2	42.8	67.0	
16:30	15:00	48.1	50.0	43.6	64.3	
16:45	15:00	49.3	52.1	43.4	66.9	
17:00	15:00	48.9	51.1	44.2	63.7	
17:15	15:00	46.3	47.8	42.8	65.7	
17:30	15:00	44.7	46.0	42.6	52.3	
17:45	15:00	45.2	46.3	43.2	55.9	
18:00	15:00	43.8	45.0	42.1	54.1	
18:15	15:00	43.8	44.8	42.0	51.4	
18:30	15:00	44.9	46.2	42.6	54.4	
18:45	15:00	44.5	45.8	42.0	57.1	
19:00	15:00	43.6	45.0	41.2	51.9	
19:15	15:00	42.2	43.4	40.4	52.1	
19:30	15:00	46.1	45.4	41.6	76.2	
19:45	15:00	42.8	43.7	40.8	57.7	
20:00	15:00	41.9	43.2	39.6	54.3	
20:15	15:00	41.7	43.6	39.0	52.4	
20:30	15:00	41.8	43.6	38.8	59.0	
20:45	15:00	40.2	41.5	38.0	53.5	
21:00	15:00	39.9	41.4	37.4	53.1	
21:15	15:00	40.8	42.3	38.5	51.3	
21:30	15:00	40.3	42.0	37.8	53.1	
21:45	15:00	41.5	43.3	38.3	57.9	
22:00	15:00	39.8	41.5	37.2	50.8	
22:15	15:00	39.6	40.9	37.0	55.2	
22:30	15:00	39.4	41.4	36.3	54.5	
22:45	15:00	39.0	40.7	36.2	48.7	
Log Average 1500-2300		45.2	46.5	41.3	49-76	
Average 1500-2300		44.0	45.3	40.7	49-76	

Noise Survey Results

Date: Wednesday 26th - Thursday 27th February 2020

Location: Land at Legacy Site, Rhostyllen

TABLE 7

Client: Harbour Energy

Project: GPP Facility

Data: **Baseline Sound Survey: B) Northwest of Site**

Instrumentation: Norsonic 116 Integrating Sound Level Meter (27342)

Calibration: 94dB

Start Time	Run Time (mins.)	LAeq (dB)	LA10 (dB)	LA90 (dB)	LAmix (dB)	Observations
23:00	15:00	38.6	40.1	35.8	51.5	
23:15	15:00	39.6	40.7	35.9	55.5	
23:30	15:00	40.5	41.9	35.9	59.0	
23:45	15:00	37.8	39.6	34.6	53.4	
00:00	15:00	39.3	41.8	34.7	57.8	
00:15	15:00	37.4	39.2	34.4	52.6	
00:30	15:00	36.7	38.7	33.4	50.3	
00:45	15:00	36.2	37.6	33.7	51.1	
01:00	15:00	37.9	39.4	33.4	57.6	
01:15	15:00	36.3	38.3	33.2	49.7	
01:30	15:00	37.1	38.9	33.3	52.2	
01:45	15:00	38.7	40.3	35.0	56.2	
02:00	15:00	38.6	41.1	35.1	53.3	
02:15	15:00	38.5	40.7	34.0	52.0	
02:30	15:00	37.9	39.8	34.8	50.6	
02:45	15:00	36.9	39.0	33.5	52.8	
03:00	15:00	41.0	44.6	33.4	55.7	
03:15	15:00	41.0	44.3	34.8	52.1	
03:30	15:00	40.2	42.8	35.4	56.0	
03:45	15:00	40.4	42.7	36.6	58.3	
04:00	15:00	39.6	42.2	34.8	52.3	
04:15	15:00	39.7	42.5	35.6	50.0	
04:30	15:00	40.2	42.7	36.1	54.0	
04:45	15:00	41.0	43.3	37.0	52.1	
05:00	15:00	41.6	43.8	37.6	50.8	
05:15	15:00	42.2	44.6	37.9	53.6	
05:30	15:00	42.7	44.5	39.7	54.9	
05:45	15:00	42.1	44.3	38.9	54.2	
06:00	15:00	45.4	47.6	41.7	55.2	
06:15	15:00	45.5	47.3	42.8	55.3	
06:30	15:00	46.8	48.6	43.5	57.0	
06:45	15:00	46.8	48.7	44.0	58.6	
Log Average 2300-0700		41.2	43.3	37.6	46-57	
Average 2300-0700		40.1	42.2	36.3	46-57	
Average 1145-2300		46.2	47.2	41.6	49-79	

Noise Survey Results

Date: Thursday 27th February 2020

Location: Land at Legacy Site, Rhosyllen

Client: Harbour Energy

Project: GPP Facility

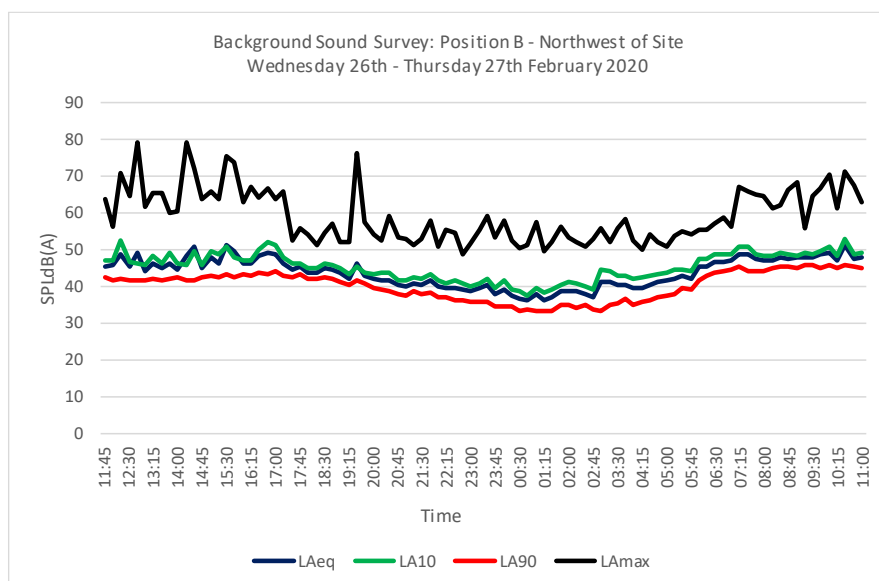
Data: **Baseline Sound Survey: B) Northwest of Site**

Instrumentation: Norsonic 116 Integrating Sound Level Meter (27342)

Calibration: 94dB

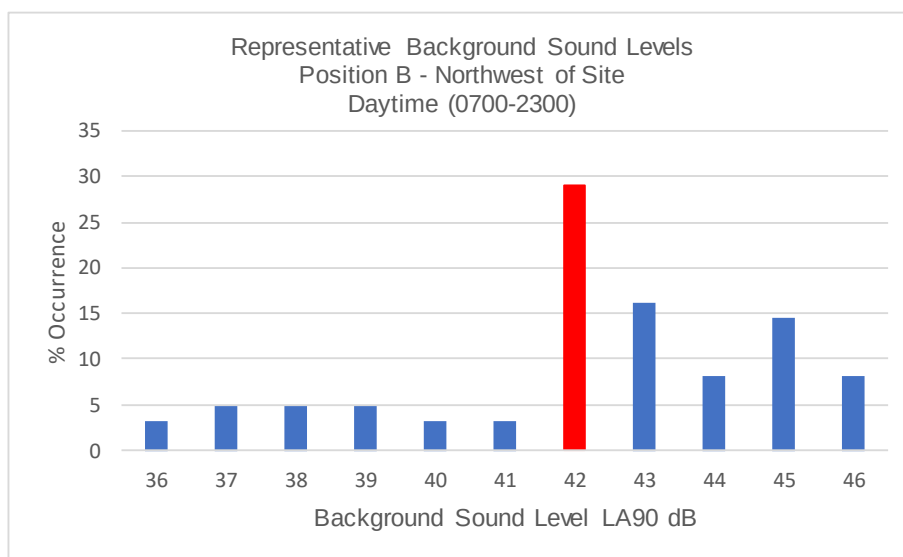
TABLE 8

Start Time	Run Time (mins.)	LAeq (dB)	LA10 (dB)	LA90 (dB)	LAmx (dB)	Observations
07:00	15:00	47.0	48.5	44.5	56.2	
07:15	15:00	48.7	50.8	45.3	67.1	
07:30	15:00	48.7	50.6	44.3	65.8	
07:45	15:00	47.5	48.9	44.3	65.0	
08:00	15:00	46.9	48.3	44.2	64.6	
08:15	15:00	47.2	48.4	45.1	61.3	
08:30	15:00	47.8	49.0	45.5	61.9	
08:45	15:00	47.6	48.7	45.4	66.3	
09:00	15:00	47.9	48.5	45.1	68.4	
09:15	15:00	47.7	49.2	45.6	55.7	
09:30	15:00	47.7	48.6	45.6	64.4	
09:45	15:00	48.9	49.4	45.0	66.7	
10:00	15:00	49.1	50.6	45.8	70.5	
10:15	15:00	46.9	48.2	44.8	61.4	
10:30	15:00	51.4	52.7	45.9	71.1	
10:45	15:00	47.5	48.9	45.3	67.6	
11:00	15:00	48.0	49.2	45.0	62.9	
Log Average 0700-1115		48.1	49.5	45.1	56-71	
Average 0700-1115		48.0	49.3	45.1	56-71	
Overall Log Average		46.6	47.8	42.8	49-79	



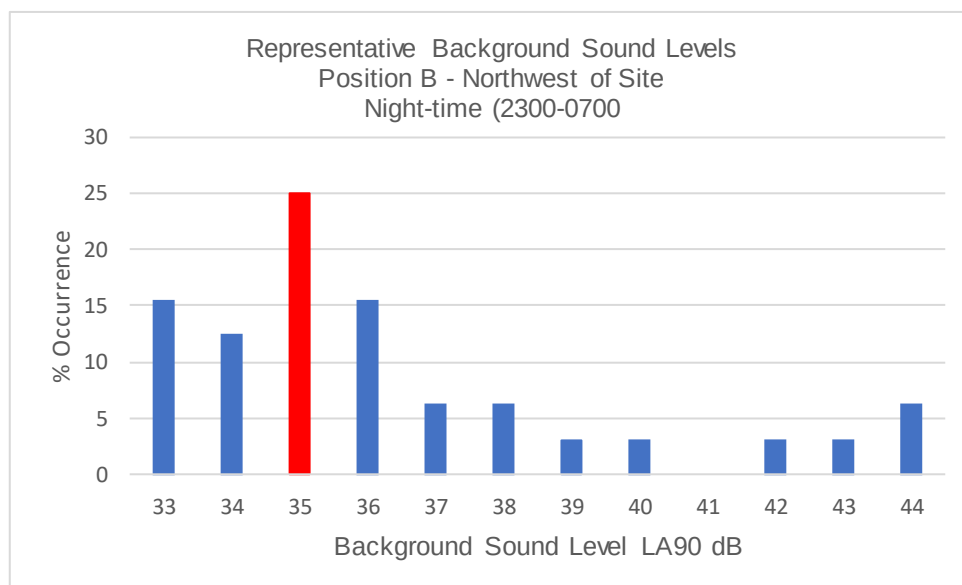
LA90 % Occurrence

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



Noise Survey Results

Date: Wednesday 26th February 2020

Location: Land at Legacy Site, Rhostyllen

Client: Harbour Energy

Project: GPP Facility

Data: **Baseline Sound Survey: C) Farm Northeast of Site**

Instrumentation: Cirrus 171B Real Time Analyser (G056142)

Calibration: 94dB

TABLE 9

Start Time	Run Time (mins.)	LAeq (dB)	LA10 (dB)	LA90 (dB)	LAmx (dB)	Observations
12:00	15:00	59.2	58.6	45.1	85.1	
12:15	15:00	55.8	58.3	46.4	69.5	
12:30	15:00	57.7	60.5	50.9	73.2	
12:45	15:00	58.9	60.9	54.3	75.0	
13:00	15:00	54.8	56.5	46.1	73.4	
13:15	15:00	46.2	48.8	39.3	65.1	
13:30	15:00	51.1	54.4	43.2	61.9	
13:45	15:00	49.9	52.9	43.8	63.4	
14:00	15:00	55.5	60.0	46.3	67.5	
14:15	15:00	59.5	61.8	53.7	74.3	
14:30	15:00	60.2	61.9	54.2	71.8	
14:45	15:00	58.1	59.7	54.4	75.1	
Log Average 1200-1500		57.0	59.0	50.6	62-85	
Average 1200-1500		55.6	57.9	48.1	62-85	

Noise Survey Results

Date: Wednesday 26th February 2020

TABLE 10

Location: Land at Legacy Site, Rhosyllen

Client: Harbour Energy

Project: GPP Facility

Data: **Baseline Sound Survey: C) Farm Northeast of Site**

Instrumentation: Cirrus 171B Real Time Analyser (G056142)

Calibration: 94dB

Start Time	Run Time (mins.)	LAeq (dB)	LA10 (dB)	LA90 (dB)	LAmx (dB)	Observations
15:00	15:00	57.5	60.1	42.0	71.0	
15:15	15:00	50.3	53.0	39.6	73.7	
15:30	15:00	58.8	59.3	57.9	71.1	
15:45	15:00	58.5	60.0	51.8	75.1	
16:00	15:00	53.5	53.9	51.4	65.2	
16:15	15:00	57.0	59.2	52.4	76.6	
16:30	15:00	56.6	59.2	52.3	74.2	
16:45	15:00	54.6	56.0	52.3	65.0	
17:00	15:00	56.5	58.8	51.2	75.3	
17:15	15:00	53.1	53.9	52.1	61.4	
17:30	15:00	56.9	59.5	49.8	74.4	
17:45	15:00	54.3	56.1	51.8	68.8	
18:00	15:00	58.9	61.4	52.2	73.9	
18:15	15:00	61.6	62.2	59.4	71.0	
18:30	15:00	58.8	59.2	56.1	74.0	
18:45	15:00	55.6	57.6	37.4	65.8	
19:00	15:00	57.5	58.4	54.2	60.0	
19:15	15:00	58.5	58.8	58.2	60.7	
19:30	15:00	60.7	62.7	58.5	70.9	
19:45	15:00	61.9	62.8	59.2	68.0	
20:00	15:00	61.0	62.4	58.6	69.9	
20:15	15:00	58.8	58.9	58.5	65.5	
20:30	15:00	58.7	58.9	58.4	60.5	
20:45	15:00	50.0	58.3	36.5	65.1	
21:00	15:00	38.1	39.5	35.9	50.8	
21:15	15:00	39.0	40.8	36.8	48.0	
21:30	15:00	36.4	38.1	33.8	52.1	
21:45	15:00	37.3	39.0	34.7	53.6	
22:00	15:00	37.5	38.9	35.4	51.5	
22:15	15:00	39.4	41.3	35.9	57.8	
22:30	15:00	38.5	40.3	35.0	48.6	
22:45	15:00	37.4	39.6	34.2	53.0	
Log Average 1500-2300		56.7	58.2	54.0	48-77	
Average 1500-2300		52.3	54.0	47.9	48-77	

Noise Survey Results

Date: Wednesday 26th - Thursday 27th February 2020

Location: Land at Legacy Site, Rhostyllen

TABLE 11

Client: Harbour Energy

Project: GPP Facility

Data: **Baseline Sound Survey: C) Farm Northeast of Site**

Instrumentation: Cirrus 171B Real Time Analyser (G056142)

Calibration: 94dB

Start Time	Run Time (mins.)	LAeq (dB)	LA10 (dB)	LA90 (dB)	LAmix (dB)	Observations
23:00	15:00	42.8	44.4	37.4	49.8	
23:15	15:00	47.6	45.5	42.9	67.7	
23:30	15:00	44.2	44.8	43.0	61.6	
23:45	15:00	44.6	45.4	43.6	52.4	
00:00	15:00	45.9	45.3	43.6	69.0	
00:15	15:00	44.9	45.4	43.7	62.3	
00:30	15:00	44.4	44.4	43.1	66.9	
00:45	15:00	46.6	46.3	43.8	65.0	
01:00	15:00	48.3	50.6	44.6	64.1	
01:15	15:00	45.5	46.4	43.3	61.5	
01:30	15:00	46.0	44.9	43.3	66.7	
01:45	15:00	47.8	45.6	43.1	67.6	
02:00	15:00	44.3	45.0	43.4	51.3	
02:15	15:00	44.2	44.8	43.2	50.4	
02:30	15:00	44.7	45.2	43.9	53.6	
02:45	15:00	45.3	45.7	44.2	55.4	
03:00	15:00	45.0	45.5	44.4	53.1	
03:15	15:00	45.2	45.6	44.6	58.0	
03:30	15:00	45.1	45.5	44.5	55.8	
03:45	15:00	45.1	45.5	44.5	53.1	
04:00	15:00	45.0	45.2	44.0	60.4	
04:15	15:00	45.3	45.6	44.3	57.7	
04:30	15:00	50.3	50.3	44.9	67.2	
04:45	15:00	50.2	50.8	45.1	65.5	
05:00	15:00	46.3	46.1	44.4	66.3	
05:15	15:00	46.7	46.8	44.7	64.9	
05:30	15:00	41.6	45.5	34.8	56.3	
05:45	15:00	37.4	39.1	34.5	49.9	
06:00	15:00	45.0	42.6	35.8	69.1	
06:15	15:00	52.8	57.9	36.4	66.9	
06:30	15:00	58.7	61.1	44.6	76.2	
06:45	15:00	58.8	60.0	47.3	67.2	
Log Average 2300-0700		49.4	51.0	43.5	50-76	
Average 2300-0700		46.4	47.0	42.8	50-76	
Average 1045-2300		56.9	58.6	52.6	44-85	

Noise Survey Results

Date: Thursday 27th February 2020

Location: Land at Legacy Site, Rhosyllen

TABLE 12

Client: Harbour Energy

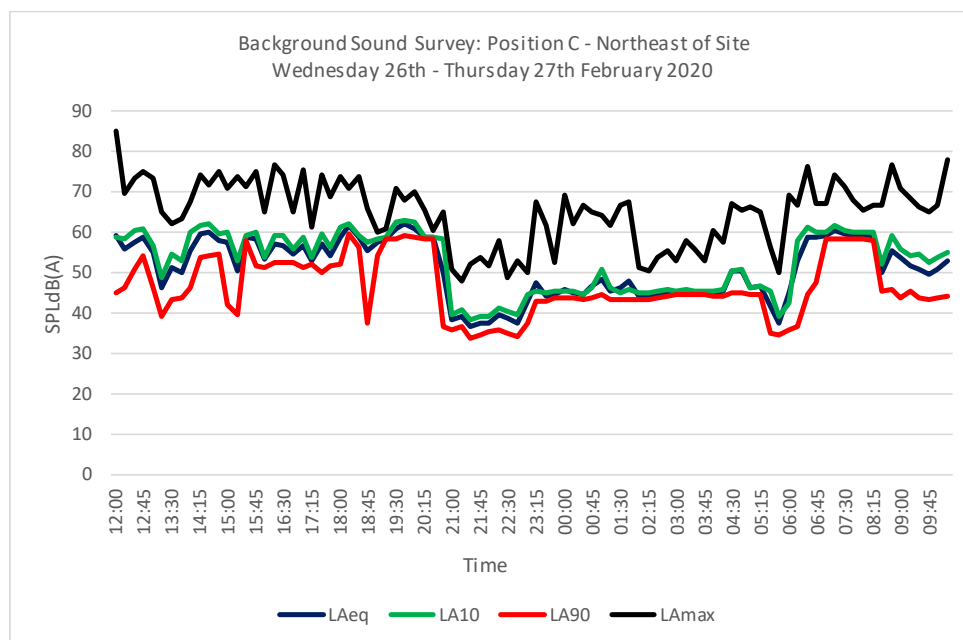
Project: GPP Facility

Data: **Baseline Sound Survey: C) Farm Northeast of Site**

Instrumentation: Cirrus 171B Real Time Analyser (G056142)

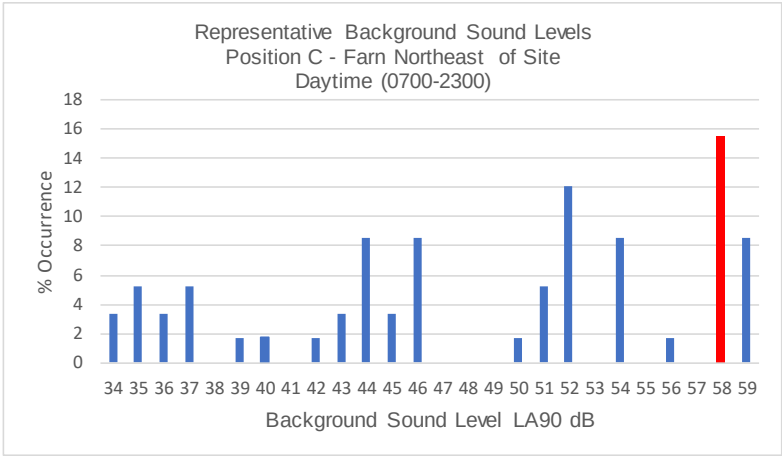
Calibration: 94dB

Start Time	Run Time (mins.)	LAeq (dB)	LA10 (dB)	LA90 (dB)	LAmix (dB)	Observations
07:00	15:00	59.2	60.2	58.3	67.0	
07:15	15:00	60.3	61.8	58.2	74.1	
07:30	15:00	59.6	60.6	58.4	71.4	
07:45	15:00	59.0	59.9	58.2	68.1	
08:00	15:00	59.1	59.9	58.3	65.5	
08:15	15:00	59.0	60.1	58.1	66.6	
08:30	15:00	49.9	52.2	45.5	66.7	
08:45	15:00	55.5	59.1	45.6	76.6	
09:00	15:00	53.6	56.0	43.7	70.7	
09:15	15:00	51.6	54.3	45.4	68.4	
09:30	15:00	51.0	54.7	43.7	66.1	
09:45	15:00	49.7	52.6	43.1	65.2	
10:00	15:00	50.8	53.9	43.6	66.5	
10:15	15:00	52.8	55.0	44.2	78.1	
Log Average 0700-1030		56.7	58.2	54.8	65-78	
Average 0700-1030		55.1	57.2	50.3	65-78	
Overall Log Average		53.7	55.4	50.3	44-85	



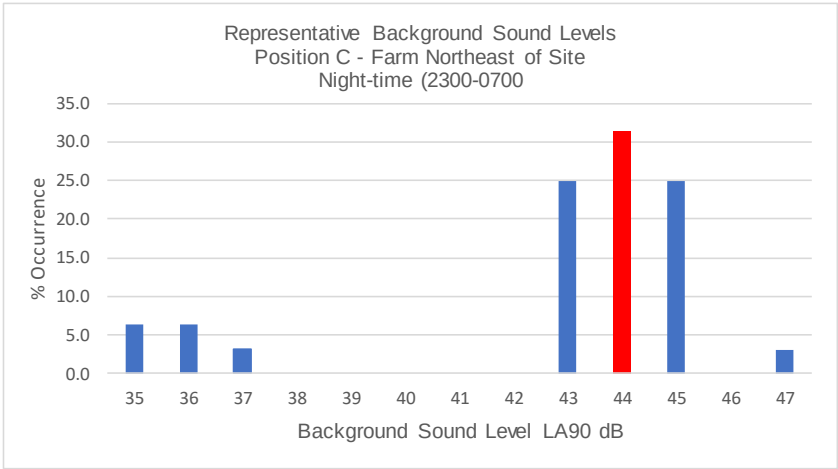
LA90 % Occurrence

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



Appendix 3

Noise Mapping Results

Noise Map 1: Noise from BSF operations (with noise mitigation measures)



Appendix 4

Consultant's Experience & Qualifications

**Consultant: Dean Robert Kettlewell - MSc MIOA MAE I.Eng
(Director - Principal Acoustic Consultant)**

Précis

As Director and Principal Acoustic Consultant with Noise & Vibration Consultants Ltd, Dean has over 35 years background experience in a wide range of issues relating to environmental, industrial and commercial noise and vibration assessment. He currently manages corporate and unit specific contracts for:

- Assessment of Environmental & Industrial Noise
- Environmental Noise Impact Assessments
- Expert Witness representation for Deafness and 'Vibration White Finger' Claims
- Integrated Pollution Prevention and Control (IPPC) Applications
- Industrial Noise Assessment and Control
- Planning Issues for Residential and Commercial Development
- Noise at Work Regulations Assessments
- Building Acoustics and Sound Insulation Tests
- Wind Farm Noise Impact Assessments
- Entertainment Noise Assessment and Control
- Architectural Acoustics
- Specialist knowledge in the Design of Noise Control Systems
- Ground borne vibration measurement and assessment
- Project Management of Noise Control Systems
- Hand-arm Vibration Assessments

Relevant Work Experience

Director & Principal Consultant - Noise & Vibration Consultants Ltd	2001- to date
Senior Acoustic Consultant - Vibrock Limited	1998 - 2001
Associate & Principal Acoustic Consultant - John Savidge & Associates	1994 - 1998
Technical Manager – LBJ Limited (Noise Control Division)	1990 - 1994
Technical Engineer/Technical Manager (1988) - Vibac (Noise Control) Ltd	1982 - 1990

Qualifications and Education

M.Sc. Applied Acoustics (Derby University – Distinction)
HNC Electrical & Electronic Engineering
IOA Diploma in Acoustics & Noise Control
IOA Certificate in Law and Administration
Certificate of Competence in Workplace Noise Assessment
Certificate of Competence in Ground Vibration Monitoring

Affiliations: Member of Institute of Acoustics (MIOA)
 Member of Academy of Experts (MAE)
 Member of Association of Noise Consultants (ANC)
 Incorporated Engineer (I.Eng)

