Killymallaght Battery Energy Storage System

Acoustic Impact Assessment

Ref	05195-7683485

Revision History

Issue	Date	Name	Latest changes	File References
01	04/04/2024	Lucy Connor	First Created	05195-7567092 05195-7600834
02	03/05/2024	Lucy Connor	Updated Layout	05195-7567092 05195-7792062
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Contents

1 Introduction

This report provides an assessment of the acoustic impact of the proposed Killymallaght Battery Storage System (the 'Proposed Development'), in terms of operational impacts. One Associate and two Members of the Institute of Acoustics have been involved in its production. Details of their experience and qualifications can be found in Appendix A.

The scope of this assessment is to determine the representative baseline background sound levels at properties neighbouring the Proposed Development. Then, predicted sound levels will be compared to these baseline levels in order to assess the potential impact in accordance with relevant planning guidance.

2 Planning Policy, Guidance & Standards

2.1 Noise Policy Statement for Northern Ireland (NPSNI)

The Noise Policy Statement for Northern Ireland (NPSNI) [1] sets out the long-term vision of Government noise policy which is to: '1. Avoid or mitigate significant adverse impacts on health and quality of life; 2. Mitigate and minimise adverse impacts on heath and quality of life; and 3. Where possible, contribute to the improvement of health and quality of life.'. In order to weigh noise impacts against the economic and social benefits of the activity under consideration, the NPSNI defines three categories of effect levels:

- No Observed Effect Level (NOEL) - noise levels below this have no detectable effect on health and quality of life.
- Lowest Observed Adverse Effect Level (LOAEL) - the level above which adverse effects on health and quality of life can be detected; and,
- Significant Observed Adverse Effect Level - the level above which effects on health and quality of life become significant.

2.2 Strategic Planning Policy Statement for Northern Ireland (SPPS)

The SPPS for Northern Ireland [2] provides current policy regarding planning matters, referencing the NPSNI discussed above for further information. The document references noise throughout in respect of development that could generate noise and the positioning of new residential development near to existing noise generating facilities. Specific guidance is provided within Annex A of the document where it is stated that planning authorities '… should seek to reach balanced decisions that consider noise issues alongside other relevant material considerations, including the wider benefits of the particular proposal'.

2.3 Planning Policy Statement 18 (PPS 18) - Renewable Energy

Planning Policy Statement 18 - Renewable Energy [3] '… sets out the [Department of Environments] planning policy for development that generates energy from renewable resources and that requires

the submission of a planning application. The document points to the Best Practice Guidance to PPS 18 for further information.

2.4 Best Practice Guidance to PPS18 - Renewable Energy

The introduction to the current Best Practice Guidance to PPS 18 [4], as amended in 2019, states that the '… guidance contained in Best Practice Guidance to PPS 18 - Renewable Energy will continue to have effect (where relevant) unless and until such guidance is updated, revised or replaced by new Departmental guidance on this planning issue'. The guidance details the potential impacts associated with a variety of renewable energy development, with noise impacts from wind energy development being considered in some details and the assessment methodology detailed within BS 4142:2014+A1:2019 [5] (as discussed below in Section 2.5) being referenced in respect of noise associated with planned biomass facilities. There is no suggested assessment methodology for determining impacts associated with battery energy storage facilities, however, based on experience, the BS 4142:2014+A1:2019 assessment methodology would also apply in this respect.

2.5 BS 4142 Methods for Rating and Assessing Industrial & Commercial Sound

BS 4142:2014+A1:2019 describes methods for rating and assessing sound of an industrial or commercial nature. Outdoor sound levels are used to assess the likely effects on people who might be inside or outside a residential property via the comparison of the pre-existing background sound levels with the predicted/modelled sound associated with the introduction of a particular development, known as the 'rating' level, which also accounts for any distinguishing characteristics of the emitted sound.

To determine a value for the background sound level at a specific assessment point, a series of measurements are made at a location at, or representative of, a dwelling or receptor of interest. The standard requires that the background sound measurements (dB $L_{A90,\,T}$ – the sound level exceeded for 90% of the time, or the lowest 10 % of sound, for the reference time period, T) should be measured during times when the sound source in question could or will be operating and that the individual measurement intervals should not normally be less than 15-minutes in length. The objective is then to determine a justifiable representative background sound level for time periods of interest via statistical analysis and/or observations of the data set collected. The standard states that the representative background sound level '… should not automatically be assumed to be either the minimum or modal value'.

The 'rating' level is defined as the 'specific' sound level (dB L_{Aeq} – the equivalent continuous sound level) plus any corrections for the presence tones (i.e., whines, whistles, or hums), impulsive character (i.e., banging, crashing, or tapping), intermittency, or other sound characteristics (distinctiveness against the residual acoustic environment) in the sound generated by the source in question. In instances where the sound is unlikely to have a specific character at the assessment location then the rating level can be assumed to equal to the 'specific' sound level. Where corrections are required, a number of decibels are added to the specific sound level to determine the rating level.

The defined representative background sound level(s) and rating level(s) are then compared to determine the possible impact whilst also considering the context in which the industrial or commercial

sound source occurs in relation to other sound sources and the existing character of the area. Table 1 provides a summary of expected impacts when comparing background sound levels and rating levels. These criteria relate well with the categories defined by the NPSNI.

Table 1 - BS 4142 Assessment Criteria

Rating Level	BS 4142 Assessment
Below background	Indicates low impact, depending on the context
<5 dB above background	Indicates minor impact, depending on the context
≥5 dB above background	Indicates adverse impact, depending on the context
≥10 dB above background	Indicates significant adverse impact, depending on the context

Further to the above, it may not be appropriate or proportionate to undertake a full assessment in accordance with the BS 4142 standard [5], particularly when the sound level associated with the new source is particularly low at neighbouring receptors and/or is expected to be much lower than the existing background sound levels. The previous version of BS 4142 [6] stated that this version of the standard is not appropriate for use in instances where background and rating sound levels are very low and that '… background noise levels below about 30 dB and rating levels below about 35 dB are considered to be very low'.

2.6 World Health Organisation Guidelines for Community Noise

The World Health Organisation (WHO) Guidelines for Community Noise [7] recommend sound levels intended to minimise health impacts. In practice the guidelines specify absolute limits for sound levels in specific environments. The guidance informs many standards and general guidance relating to the protection of external and internal amenity in relation to the impacts of sound.

The guidelines state that overall internal night-time sound levels should not be above 30 dB L_{Aeq} within bedrooms such that people may sleep with minimal disturbance while the windows are open and it is stated that this corresponds to an external night-time noise level of 45 dB L_{Aeq}, when assuming a 15 dB attenuation in noise levels externally to internally. Furthermore, the guidance recommends that daytime external noise levels should not exceed 50 dB L_{Aeq} to protect the majority of people from being moderately annoyed and that levels '…during the evening and night should be 5–10 dB lower than during the day'.

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

British Standard BS 8233:2014 [8] provides information on the design of buildings to ensure they have internal acoustic environments appropriate to their functions. The standard specifies guideline indoor ambient sound levels for buildings for different activities, locations and times of day and states that it is desirable that these guideline values are not exceeded. Therefore, in practice the guidelines specify absolute limits for sound levels in specific environments. Informed by WHO Guidelines for Community Noise [7], the most conservative applicable values specified are those conducive to sleeping or daytime resting in a house bedroom where the internal sound level should not exceed 30 dB $L_{Aeq,\ 8\ hour}$ at night.

If a 15 dB reduction is assumed for attenuation through an open window, then a maximum outdoor sound level of 45 dB $L_{Aeq,\ 8\ hour}$ is applicable.

3 Methodology

3.1 Overview

An assessment in accordance with BS 4142:2014+A1:2019 [5] has been undertaken in order to determine the acoustic impact of the Proposed Development. This approach is consistent with the guidance discussed in Section 2.

3.2 Baseline Conditions

In order to complete a BS 4142 assessment of the Proposed Development, the background sound level at the times when the new sound source is intended to be operational should be measured. The background sound level is defined as the A-weighted sound pressure level that is exceeded for 90 % of the measurement time interval T, or $L_{A90,T}$.

Measurements should be made at a location that is representative of the assessment locations, the time interval should be sufficient to obtain a representative value, and the duration should be long enough to reflect the range of background sound levels over the period of interest.

Precautions should be taken to minimise the influence on the results from sources of interference. Weather conditions that may affect the measurements should be recorded and an effective wind shield used to minimise turbulence at the microphone.

A statistical analysis, following the example given by BS 4142, should be used to determine an appropriate background sound level for the analysis from the range of results obtained.

3.3 Propagation

A sound propagation model of the Proposed Development and the surroundings has been developed using CadnaA[1] noise modelling software. The ISO 9613-2 [7] propagation model is referenced by BS 4142:2014+A1:2019 as a validated methodology and shall be used to predict the specific sound levels due to the Proposed Development at nearby residential properties, incorporating various assumptions and factors which are considered appropriate for use here:

- The various sound-emitting equipment to be installed as part of the Proposed Development have been modelled as point sources with various heights (see Table 2), taken from manufacturer documentation.
- Soft ground conditions have been applied (i.e., a ground factor of 1) as representative of the farmland surrounding the Proposed Development.
- The receptors have been assigned a height of 4 m above ground level.

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

- Atmospheric attenuation corresponding to a temperature and relative humidity of 10˚C and 70% respectively, as defined within ISO 9613-1 [9], which represents relatively low levels of sound absorption in the atmosphere.
- A 4 m high acoustic fence of suitable mass and density, surrounding the equipment compound, is included in the model. This provides a reduction in the specific sound levels at the receptor locations of 2 - 3 dB $L_{Aeq, Tr}$.
- The topography of the site and surroundings has been included within the model.

Table 2 - Sound Source Heights (m)

Equipment	Height (m)
PCS	1.25
Transformer	2
BESS	1.45

The acoustic fence may not be required to be as high as 4 m in practice, as the equipment is expected to have substantially reduced sound emissions compared to those used in this assessment when the equipment is procured, should the site be granted planning consent.

The effect of surface features such as buildings, trees or other objects is not included in the model. There is a level of conservatism built into the model as a result of the adoption of these settings.

ISO 9613-2 is a downwind propagation model. Where conditions less favourable to sound propagation occur, such as when the assessment locations are crosswind or upwind of the proposed development, the sound levels would be expected to be less, and the downwind predictions presented here would be regarded as conservative, i.e., greater than those likely to be experienced in practice.

4 Baseline Data

4.1 Survey Details

Baseline sound levels were determined in a survey undertaken by RES between 7th March 2024 and 19th March 2024. The survey positions are shown on the map in Figure 1 (Appendix B).

Two Rion NL-52 sound level meters were used. The meters are certified as meeting IEC 61672-1 [10] Class 1 precision standards. The microphone was approximately 1.2 m above ground level and an outdoor wind shield supplied by the manufacturer was used.

The sound level meters were placed away from reflective surfaces and vegetation as shown in the photos in Appendix C. The equipment was field calibrated at the start and end of the survey. No drift was detected. All the sound level meters had been subject to laboratory calibration traceable to national standards within the previous 24 months and the sound calibrator within the previous 12 months. The calibration dates and references are provided in Table 3.

Table 3 - Instrumentation Records

	Meter 1	Meter 2
Type	Rion NL-52	Rion NL-52
Serial No.	00721031	00610207
Calibration Certificate No.	*UCRT23/2232*	UCRT24/1086
Date of Issue	18-Sept-2023	17-Jan-2024
Microphone Serial No.	21981	24815
Preamp Serial No.	22137	10201
Calibrator type	Rion NC-74	Rion NC-74
Calibrator Serial No.	34315132	34315132
Calibrator Cert. No.	*UCRT23/2386*	*UCRT23/2386*

During the survey at location 1, the background acoustic environment was dominated by high winds and semi-regular traffic on Trench Road. Additional sound sources included bird song, and trees/foliage rustling in the wind. Similarly, the background acoustic environment at Location 2 was dominated by wind and semi-regular traffic on Trench Road. Additionally, there was distant agricultural/mechanical noise and an occasional gun shot. However, it is not expected that these latter sound sources will affect the L_{A90} levels.

A weather station was used to measure meteorological conditions during the survey. All data which was recorded during wind speeds exceeding 5 m/s was removed from the dataset. There was very occasional light rainfall. Data measurements which occurred during these periods were also removed from analysis. The temperature ranged from around 1°C to 14°C.

4.2 Survey Results

Time series recorded during the survey at each location are shown in Appendix B.2. The average residual (dB $L_{Aeq,\ 15mins}$) and background (dB $L_{A90,\ 15mins}$) sound levels measured during day and night-time at each location are shown in Table 4.

In accordance with BS 4142:2014+A1:2019 representative background sound levels need to be determined from statistical analysis of measured L_{A90} levels. Histograms of measured background sound levels are shown in Appendix B.3, and derived representative background sound levels are shown in Table 4.

Table 4 - Survey Results

Survey Location	Residual Sound Level, dB $L_{Aeq, 15\ min}$		Background Sound Level, dB $L_{A90, 15\ min}$	
	Daytime (07:00-23:00)	Night-time (23:00-07:00)	Daytime (07:00-23:00)	Night-time (23:00-07:00)
1	46	37	38	32
2	46	35	35	32

Location 2 is representative of the receivers to the northeast of the site. The receptors to the south of the site are most suitably represented by the data gathered at Location 1. Background levels measured at Location 2 have been assigned to the receivers to the northwest of the site to ensure conservative results as this measurement location is the quietest of the two.

This report presents an assessment at the 16 most relevant affected receptors.

The houses used for the assessment are shown in Figure 8 in Appendix B.4. The house numbers, coordinates, as well as representative measured acoustic data for each house are presented in Table 5. The coordinate system used is the Irish National Grid TM65 (EPSG 29902).

Table 5 - Baseline Data

House ID	X/m	Y/m	Daytime Background Sound Level, dB L_{A90}	Night-time Background Sound Level, dB L_{A90}	Daytime Residual Sound Level, dB L_{Aeq}	Night-time Residual Sound Level, dB L_{Aeq}
H2	242569	410873	35	32	46	35
H20	242053	409946	38	32	46	37
H22	241840	410513	35	32	46	35
H124	241927	409893	38	32	46	37
H128	242566	409752	38	32	46	37
H184	242098	409814	38	32	46	37
H188	242511	410645	35	32	46	35
H197	242511	410864	35	32	46	35
H208	242537	410681	35	32	46	35
H217	241961	409826	38	32	46	37
H250	242600	410909	35	32	46	35
H320	242028	409913	38	32	46	37
H328	242557	409875	38	32	46	37
H357	241854	410544	35	32	46	35
H359	241644	409674	38	32	46	37
H366	241663	410451	35	32	46	35

5 Assessment

The sound emissions from the Proposed Development have been predicted, and compliance with the criteria set out in Section 2 has been assessed.

5.1 Sound Generating Equipment

The main sources of sound within the Proposed Development are the 16 Power Conversion System (PCS) units. There are also 8 MV transformers located between every two inverters. There are 64 BESS units which also generate sound. The equipment is assessed as being operational at all times.

The sound power level data for representative equipment to be installed as part of the Proposed Development are provided in Table 6. The overall levels correspond to the maximum sound emission for each of the equipment as provided by the equipment manufacturer. The propagation modelling therefore represents a conservative scenario and actual sound levels would be expected to be lower when the site is not operating at maximum capacity.

Table 6 – Overall Sound Power Levels, dB L_{WA}

Equipment	Sound Power Level, dB L_{WA}
PCS	80
Transformer	79
BESS	68

This information is based on a combination of manufacturer data and RES's experience of typical equipment.

5.2 Acoustic Feature Correction

In accordance with BS 4142:2014+A1:2019, penalties can be applied to the predicted specific sound level to achieve the rating level at each receptor. The penalties can be applied for "attention catching features" such as tonality, impulsivity, intermittency, and other distinguishable characteristics.

A penalty of 2 dB has been added to the specific dB L_{Aeq} levels to account for low levels of tonality in the equipment. The dB $L_{Ar,\,T}$ rating level is therefore equivalent to the dB L_{Aeq} + 2 dB.

The sound generated by the proposed equipment is not expected to be intermittent or impulsive, due to the equipment operating consistently. Changes to sound pressure levels due to load changes will be gradual and will not result in attention catching characteristics. There are no other specific sound feature characteristics expected to be present which would be readily distinctive against the residual acoustic environment.

5.3 Predicted Acoustic Impact

The potential impact is described as 'low' if the rating level is less than the background sound level; 'minor' is it is less than 5 dB above background sound level; 'adverse' if it is 5 dB or more above background; and 'significant adverse' if 10 dB or more above.

The assessment indicates that the predicted noise impact from the Proposed Development at the nearest neighbouring residences is low for daytime periods and for night-time periods.

Predicted rating levels at nearby properties are detailed in Table 7. The rating level is then compared to the background sound levels from Table 4 to give the potential impact at each location, results of this are also shown in Table 7. Illustrative sound footprints for the proposed development are provided in Appendix B. The predicted maximum specific sound level at any house is 23 dB $L_{Aeq,\ Tr}$, and consequently the maximum rating level at any house is 25 dB $L_{Ar,\ Tr}$, accounting for the 2 dB tonality penalty.

Table 7 - BS 4142 Assessment Results

House ID	Rating Level, dB $L_{Ar,\ Tr}$	Rating vs Background, dB		Potential Impact	
		Daytime (07:00-23:00)	Night-time (23:00-07:00)	Daytime (07:00-23:00)	Night-time (23:00-07:00)
H2	21	-14	-11	low	low
H20	22	-16	-10	low	low
H22	22	-13	-10	low	low
H124	22	-16	-10	low	low
H128	19	-19	-13	low	low
H184	20	-18	-12	low	low
H188	25	-10	-7	low	low
H197	22	-13	-10	low	low
H208	24	-11	-8	low	low
H217	21	-17	-11	low	low
H250	20	-15	-12	low	low
H320	21	-17	-11	low	low
H328	18	-20	-14	low	low
H357	23	-12	-9	low	low
H359	17	-21	-15	low	low
H366	21	-14	-11	low	low

BS 4142 recognises the importance of the context in which a sound occurs. It states that the impact 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.

A level of conservatism has been built into the assessment to compensate for the potential impact of uncertainty. The predicted sound levels presented in this assessment, and the sound footprint shown in Figure 8, reflect this. The amenity of nearby residents can be protected by the imposition of a planning condition relating to sound. A suggested appropriate form of wording for such a condition is provided in Appendix D.

Overall, based on the acoustic modelling assumptions and assessment results presented, the sound emitted by the Proposed Development can be considered not significant in terms of technical advice provided by the Northern Irish Government.

6 Conclusion

An assessment of the acoustic impact of the proposed Killymallaght Battery Energy Storage System has been undertaken in accordance with BS 4142:2014+A1:2019.

During both the daytime and night-time, the predicted impact is low at all houses. Therefore, no adverse impacts are predicted to occur at any time of day.

7 References

[1] Department of the Environment, “Noise Policy Statement for Northern Ireland,” September 2014.

[2] Department of the Environment, “Strategic Planning Policy Statement for Northern Ireland (SPPS),” September 2015.

[3] Department of the Environment, “Planning Policy Statement 18 'Renewable Energy',” Belfast, August 2009.

[4] Department for Infrastructure, “Best Practice Guidance to PPS 18 'Renewable Energy',” 01 August 2009.

[5] The British Standards Institution, *Methods for rating and assessing industrial and commercial sound, BS 4142:2014+A1:2019,* 2014 (Amended 2019).

[6] The British Standards Institution, Method for rating industrial noise affecting mixed residential and industrial areas, BS 4142:1997, 1997.

[7] World Health Organisation, *Guidelines for Community Noise,* March 1999.

[8] The British Standards Institution, *Guidance on sound insulation and noise reduction for buildings, BS 8233:2014,* 2014.

[9] International Organisation for Standardisation , Acoustics - Attenuation of Sound During Propagation Outdoors - Part 1: Calculation of Absorption of Sound by the Atmosphere ISO 9613-1:1993, 1993.

[10] International Electrotechnical Commission, “Electroacoustics - Sound level meters - Part 1: Specifications,” 30 September 2013.

[11] International Organisation for Standardisation, *Acoustics - Attenuation of Sound During Propagation Outdoors, Part 2: General Method of Calculation ISO 9613-2:1996,* 1996.

Appendix A Experience and Qualifications

Author:

Name	Lucy Connor
Experience	Acoustic Specialist, Renewable Energy Systems, 2024-Present
Qualifications	AMIOA, Associate Member of the Institute of Acoustics MSc Acoustics and Music technology, University of Edinburgh BSc Mathematics and Statistics, University of Strathclyde

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Qualifications	MIOA, Member of the Institute of Acoustics BSc Audio Technology, University of Salford

Approver:

Name	Dr Jeremy Bass
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Qualifications	MIOA, Member of the Institute of Acoustics MInstP, Member of the Institute of Physics PhD, The Potential of Combined Heat & Power, Wind Power & Load Management for Cost Reduction in Small Electricity Supply Systems, Department of Applied Physics, University of Strathclyde BSc Physics, University of Durham

Appendix B Figures

B.1 Background Sound Monitoring Locations

Figure 1 - Background Sound Monitoring Locations

B.2 Measured Time Series Plots

Figure 2 - Time Series of Measurements Taken at Location 1

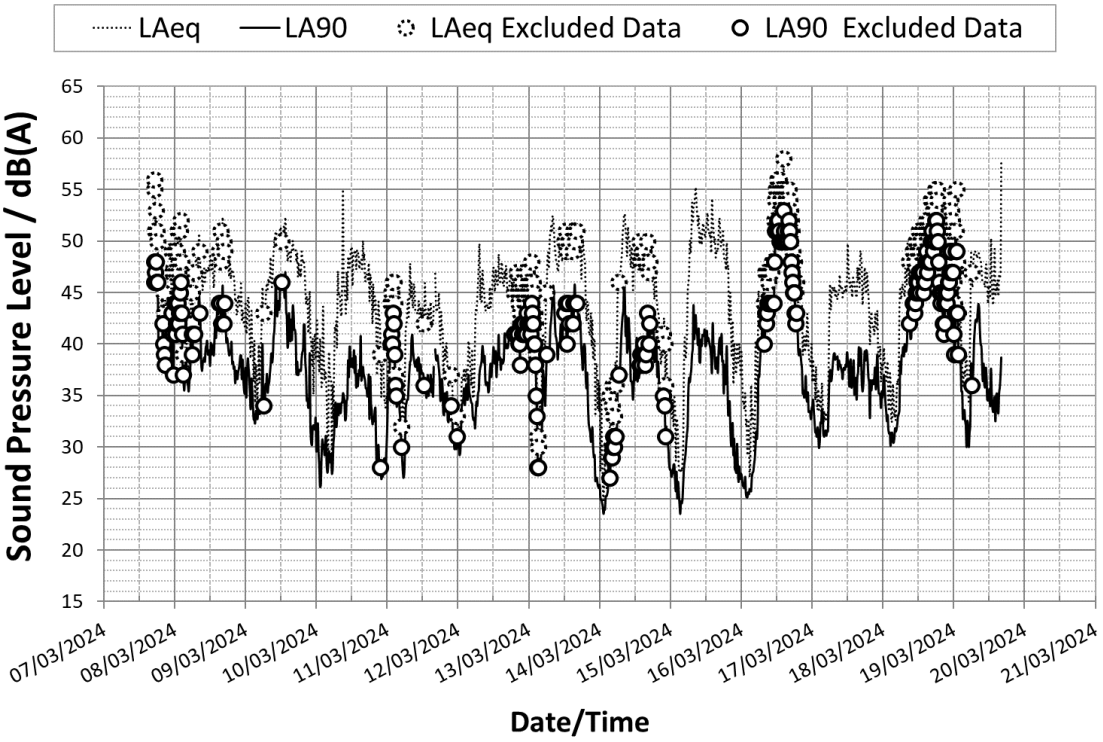
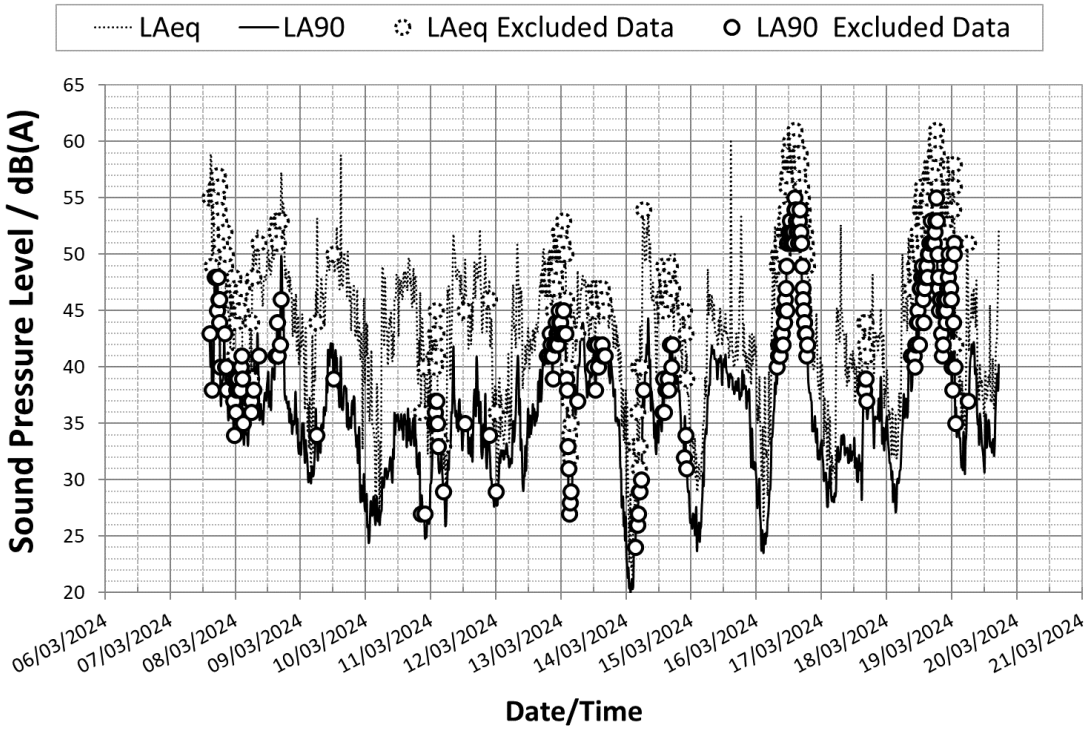


Figure 3 - Time Series of Measurements Taken at Location 2



B.3 Histograms of Background Sound Levels

B.3.1 Monitoring Position 1

Figure 4 - Histogram of Daytime $L_{A90,\ 15\ Min}$, dB, Measured During Daytime at Measurement Position 1.

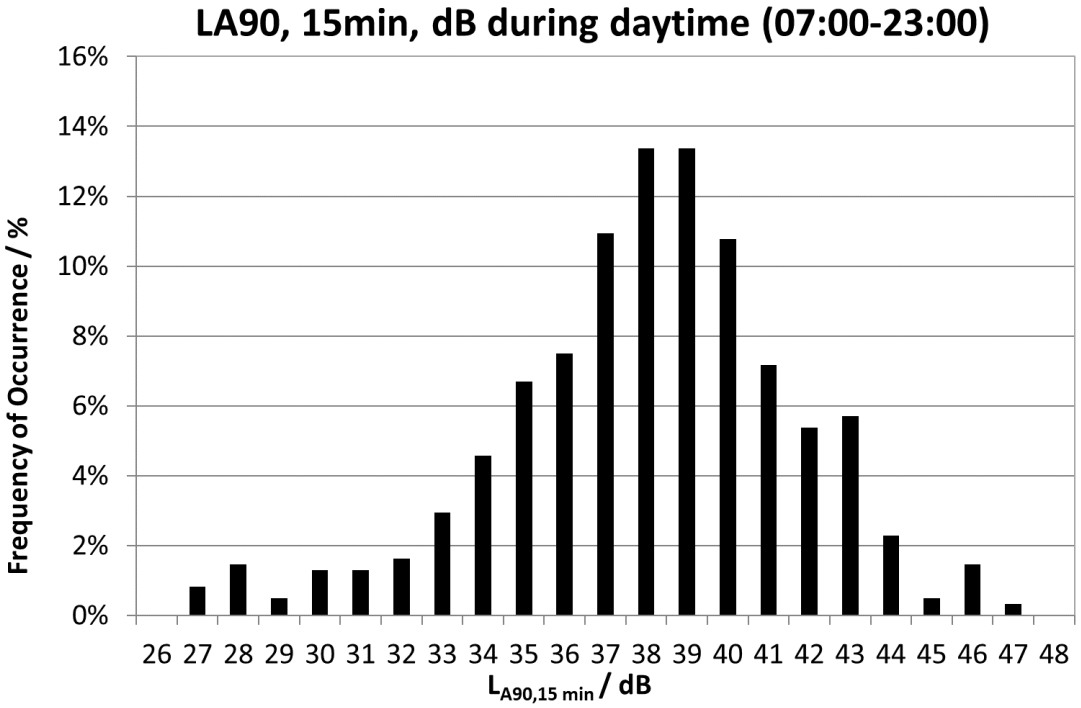
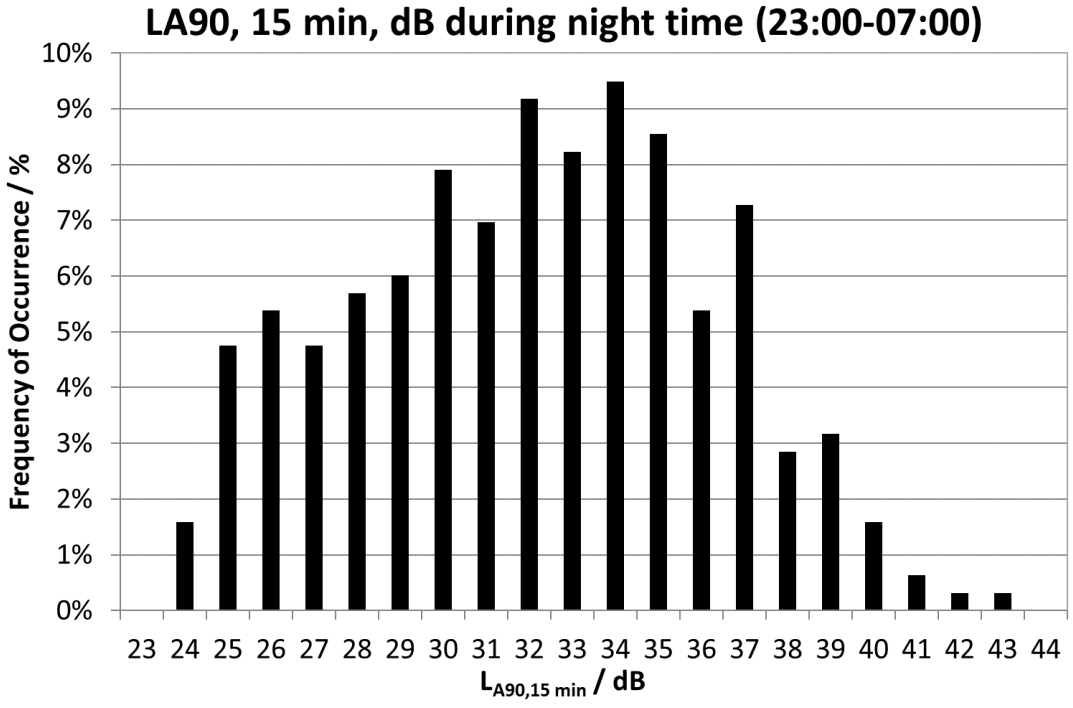


Figure 5 - Histogram of Nighttime $L_{A90,\ 15\ Min}$, dB, Measured During Nighttime at Measurement Position 1.



B.3.2 Monitoring Position 2

Figure 6 - Histogram of Daytime $L_{A90,\ 15\ Min}$, dB, Measured During Daytime at Measurement Position 2.

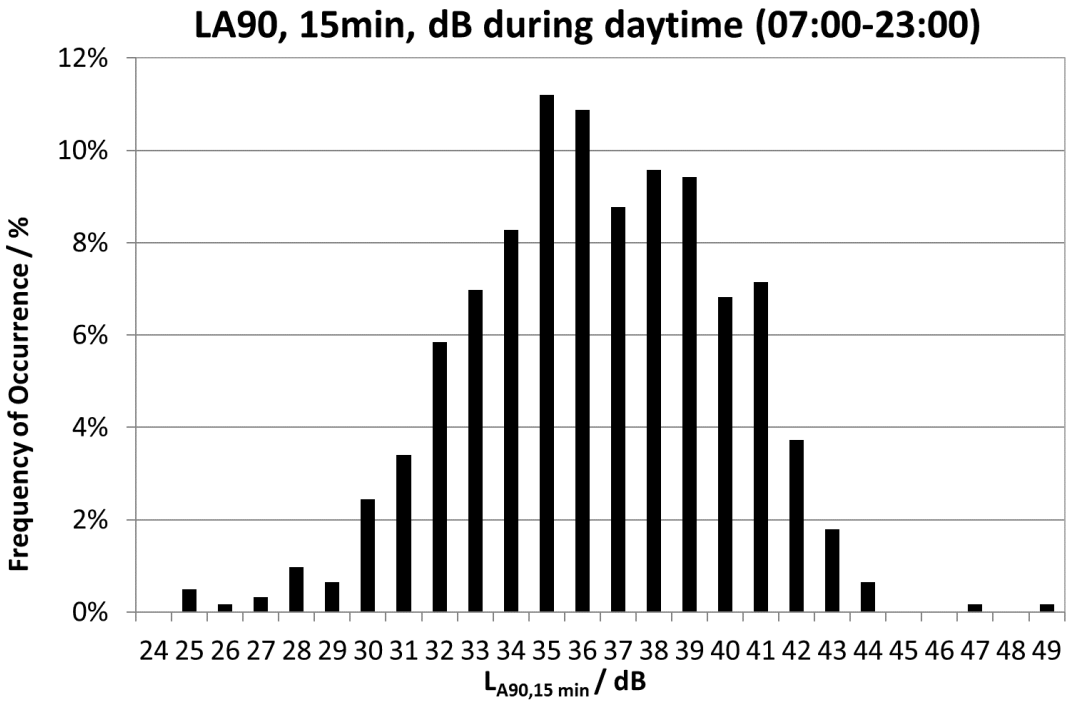
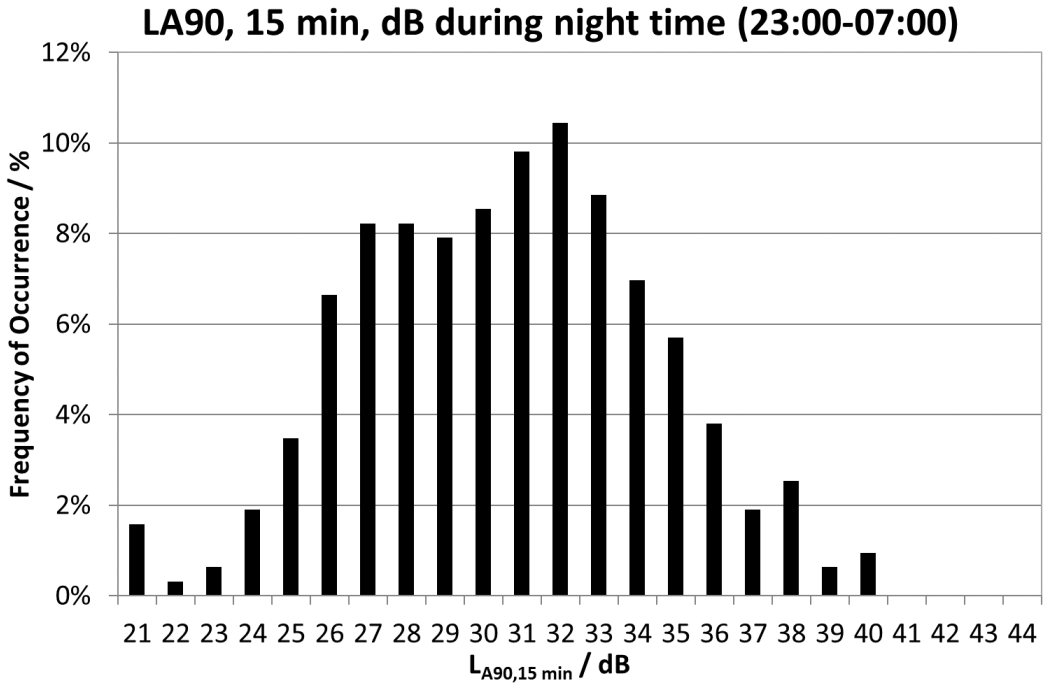
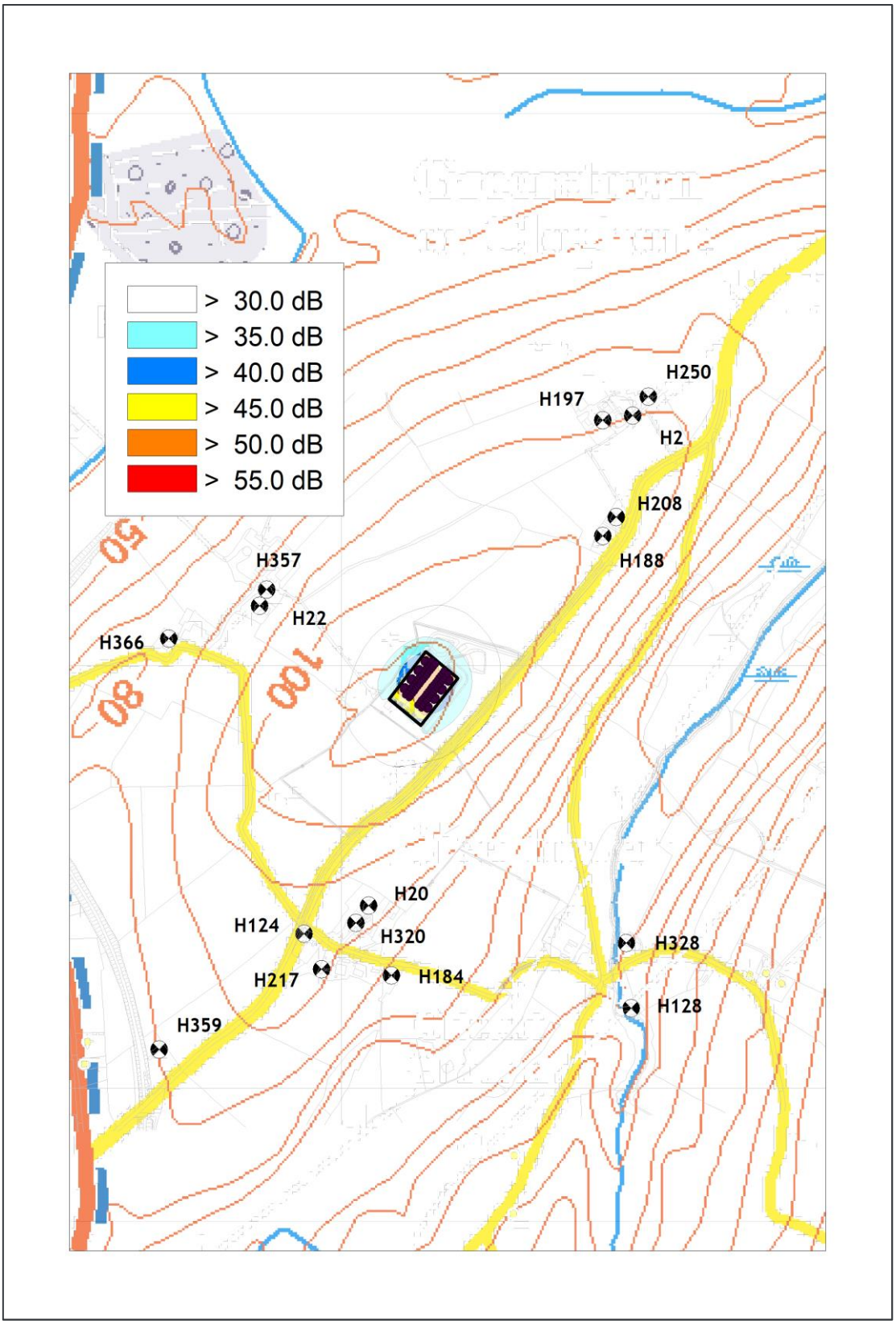


Figure 7 - Histogram of Night-Time $L_{A90,\ 15\ Min}$, dB, Measured During Night-Time at Measurement Position 2



B.4 Predicted Acoustic Footprint

Figure 8 - Predicted operational acoustic footprint of the site ($L_{Aeq,Tr}$ dB)



Appendix C Photos

C.1 Background Sound Survey Positions

Figure 9 - Background Sound Monitor at Location 1

Figure 10 - Background Sound Monitor at Location 2

Appendix D Suggested Planning Condition Wording

Killymallaght Battery Energy Storage System shall be designed and operated to ensure that the resulting rating level $L_{Ar,Tr}$ external to any neighbouring residential property, determined using the BS 4142:2014+A1:2019 methodology, shall not exceed the background sound level plus 5 dB for both daytime and night-time periods.