Chimmens Solar Farm

Acoustic Impact Assessment

Ref	05009-6627768

Revision History

Issue	Date	Name	Latest changes
01	23/10/2023	Artem Khodov	First Created

Contents

1 Introduction

This report contains an assessment of the acoustic impact of the proposed Chimmens Solar Farm in terms of operational impacts. 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 includes determining the baseline and predicting sound levels due to the proposed development in order to assess the level of impact in accordance with relevant planning guidance.

2 Planning Policy, Guidance & Standards

2.1 National Planning Policy Framework

Within England, the treatment of noise is defined in the planning context by the National Planning Policy Framework (NPPF) [1] which details the Government's planning policies and how these are expected to be applied. The NPPF provides advice on the role of the planning system in helping to prevent and limit the adverse effects of noise, stating that planning policies and decisions should aim to avoid noise giving rise to significant adverse impacts, whilst at the same time mitigating and reducing to a minimum other adverse impacts on health and quality of life. At this point the NPPF refers to the Noise Policy Statement for England (NPSE) [2] which provides guidance on the categorisation of impact levels.

2.2 Noise Policy Statement for England

The Noise Policy Statement for England (NPSE) sets out the long-term vision of Government noise policy: to promote good health and quality of life through effective noise management within the context of sustainable development. In order to balance noise impacts against the economic and social benefits of the activity under consideration, NPSE defines three categories of effect level:

· 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.

· Significant Observed Adverse Effect Level (SOAEL): the level above which effects on health and quality of life become significant.

2.3 National Planning Practice Guidance

National Planning Practice Guidance (NPPG) [3] puts the effect levels defined by NPSE into greater context by explaining how such noise levels might be perceived, providing examples of outcomes based on likely average response, and advising on appropriate actions. These are reproduced in Table 1 below.

Table 1 - Noise Exposure Hierarchy

Response	Examples of Outcomes	Increasing Effect Level	Action
Not present	No Effect	No Observed Effect	No specific measures required
No Observed Effect Level (NOEL)			
Present and not intrusive	Noise can be heard, but does not cause any change in behaviour, attitude or other physiological response. Can slightly affect the acoustic character of the area but not such that there is a change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level (LOAEL)			
Present and intrusive	Noise can be heard and causes small changes in behaviour, attitude or other physiological response, e.g., turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a small actual or 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., avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. 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, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress, e.g., regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g., auditory and non-auditory.	Unacceptable Adverse Effect	Prevent

2.4 National Policy Statements

In addition to the aforementioned guidance, which is applicable to all forms of environmental noise, specific guidance relating to nationally significant energy infrastructure has been published by the Department of Energy and Climate Change (DECC). Whilst the proposed development is not of a scale that would be deemed nationally significant, the relevant National Policy Statements are informative in that they suggest an assessment methodology that would be considered appropriate for the type of development being proposed.

The Overarching National Policy Statement for Energy (EN-1) [4] outlines the need for new electricity capacity from renewable sources as the country transitions to a low carbon electricity system. However, referring back to the NPSE, EN-1 recognises the potential for energy infrastructure to impact on health and quality of life if it results in excessive noise. It goes on to say that where noise impacts are likely to arise, they should be assessed according to the principles of the relevant British Standards.

Of the examples provided, BS 4142 [5] and BS 8233 [6] relate to operational sound. BS 4142 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. BS 8233 provides guidance on the control of noise for new buildings or those undergoing refurbishment. It does not provide guidance on assessing the effect of changes in external noise levels on occupants of existing buildings.

The National Policy Statement for Electricity Networks Infrastructure (EN-5) [7], relevant to the transmission and distribution parts of the electricity network along with any associated infrastructure, such as substations and converter stations, again points to the appropriateness of BS4142 in assessing the acoustic impact of such projects. The inverters and transformers deployed as part of the proposed project are examples of infrastructure of this kind.

2.5 Consultation with Sevenoaks District Council

The Environmental Health section of Sevenoaks Council have been consulted to ensure that this acoustic assessment meets their requirements. In an email from Sean Mitchel (case officer), dated 18/05/2023, the council recommend the following noise criteria:

- A noise assessment undertaken in accordance with BS:4142(2014+A1:2019), to the residential properties nearest to the proposed site.
- The details of the sound power levels of the inverters should be cited.
- The details of the locations of the equipment, which is included in the planning application.

Measured sound pressure levels ($L_{Aeq,\ 15\ min}$, dB and $L_{A90,\ 15\ min}$, dB) were used to undertake an acoustic impact assessment in accordance with BS 4142:2014+A1:2019. The locations of the measurements made by the nearest residential properties are shown in Appendix B.1.

3 Methodology

3.1 Overview

An assessment in accordance with BS 4142:2014+A1:2019 has been undertaken in order to determine the acoustic impact of the proposed development. This approach is consistent with the guidance provided in the National Policy Statements published by DECC for this type of development, as well as with requirements of Sevenoaks District Council. BS 4142 lends itself well to an assessment in accordance with NPPF, NPSE and NPPG as it allows the level of impact to be ascertained.

3.2 Baseline Conditions

In order to complete a BS 4142 assessment of the proposal, 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, 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

The ISO 9613-2 [8] propagation model shall be used to predict the specific sound levels due to the proposed development at nearby residential properties. The propagation model takes account of sound attenuation due to geometric spreading and atmospheric absorption. The assumed temperature and relative humidity are 10 ˚C and 70 % respectively.

Ground effects are also taken into account by the propagation model, with a ground factor of 1 adopted to reflect porous ground between the site and the assessment locations. A 4 m receiver height shall be used. The effect of surface features such as buildings, trees or solar panels 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.

3.4 Assessment

Once the specific sound levels due to the proposed new sound source have been predicted the rating level of the sound can be calculated, it is this which is compared to the existing background sound level to determine the level of impact. The rating level is obtained by adding any penalties due to character that may be applicable to the predicted specific sound level.

Table 2 details how the difference between the rating sound level and background sound level is used to come to a judgement about the level of impact under BS 4142, although it is noted that any assessment is context specific. These criteria relate well with the categories defined by NPSE: with the background sound level representing the NOEL, 5 dB above background representing the LOAEL and 10 dB above background the SOAEL.

Table 2 - BS 4142 Assessment Criteria

Rating Level	BS 4142 Assessment
Below background	Indicates low impact
<5 dB above background	Indicates minor impact
≥5 dB above background	Indicates adverse impact
≥10 dB above background	Indicates significant adverse impact

Depending upon the diurnal variation in the background sound level, and the times when the proposed new sound source is scheduled to operate, it may be appropriate to undertake separate assessments for certain times of day e.g., day and night.

4 Baseline Data

4.1 Details of the Survey

Baseline sound levels were determined in a survey undertaken by Mae'r Davis - an independent acoustic consultant, who is also a Member of the Institute of Acoustics (MIOA), between 13 July 2023 and 21 July 2023. The survey was undertaken prior to the start of school holidays, to ensure the most representative background sound levels. The survey locations are shown on the map in Figure 1 (Appendix B1).

Three Rion NL-52 sound level meters were used. The meters are certified as meeting IEC 61672-1:2013 [9] 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 meter was 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 campaign. Maximum detected drift was 0.1 dB which is appropriate. All instrumentation had been subject to laboratory calibration traceable to national standards within the previous 12 months, with the calibration dates and references provided in Table 3.

Table 3 - Instrumentation Records

	Meter 1	Meter 2	Meter 3
Type	Rion NL-52	Rion NL-52	Rion NL-52
Serial No.	01198675	00976188	00420711
Calibration Certificate No.	UCRT23/1172	UCRT23/1167	UCRT23/1420
Date of Issue	08/02/2023	07/02/2023	27/03/2023
Microphone Serial No.	21911	12082	03508
Preamp Serial No.	22092	76305	10744
Calibrator type	Rion NC-75	Rion NC-75	Rion NC-75
Calibrator Serial No.	34134633	34134633	34134633
Calibrator Cert. No.	UCRT23/1171	UCRT23/1171	UCRT23/1171

During the survey at location 1, the background acoustic environment was dominated by road traffic from the M20. Other background sound sources included insects, bird song and farm animals. At location 2 the background acoustic environment comprised of farm vehicles, distant road noise and bird song. At location 3 the dominant sound sources were road traffic and bird song.

Data has been excluded during the analysis of the survey results to remove periods of atypical background sound levels, such as noise from Brands Hatch Circuit. The schedule of track activity has been received from Brands Hatch management, and all time periods when the track was in operation were excluded from the measurements, to allow for a more conservative assessment of representative background sound levels during quieter periods, when the track is not affecting the background sound levels.

During the survey, the track was in operation during times shown in Table 4. All these periods have been excluded from the survey analysis.

Table 4 - Brands Hatch race track times of operation

Date	Time of track activity on Brands Hatch
13 July 2023	9:00 - 17:00
14 July 2023	9:00 - 17:00
15 July 2023	9:00 - 18:30
16 July 2023	9:00 - 18:30
17 July 2023	9:00 - 20:00
18 July 2023	9:00 - 20:00
19 July 2023	9:00 - 17:00
20 July 2023	No track activity
21 July 2023	9:00 - 17:00

Weather conditions during the survey were predominantly dry weather with occasional sunny spells. A weather station was used to measure meteorological conditions during the survey. There was little rain during the survey, and the temperature ranged between 10°C and 24°C.

Wind speed, measured at microphone height was under 5 m/s for most of the survey. Time periods when the wind speeds were higher than 5 m/s were excluded from the survey.

Rainfall was measured using a rain gauge, installed on site. All time periods when rain was picked up were excluded from the survey.

4.2 Survey Results

Time histories recorded during the survey at each location are shown in Appendix B.2. The average residual sound levels ($L_{Aeq,\ 15mins}$) measured during day and night time at each location are shown in Table 5.

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 5.

Table 5 - Survey Results

Survey location	Residual Sound Level, $L_{Aeq,\ 15\ min}$, dB		Background Sound Level, $L_{A90,\ 15\ min}$, dB	
	Daytime (07:00-23:00)	Nighttime (23:00-07:00)	Daytime (07:00-23:00)	Nighttime (23:00-07:00)
1	49	47	40	39
2	48	44	44	40
3	45	42	35	33

The background sound levels measured at location 1 are representative of the houses where the dominant source of background sound in M20 motorway. Levels measured at location 2 are considered to be representative of houses on School lane and Mussenden Lane. Background sound levels representative of the properties located to the north-west of the site, were measured at location 3.

The assessment was undertaken to 16 residential premises located close to the site. These are the closest and worst-affected premises to the proposed site.

The houses used for the assessment are shown in Figure 11 in Appendix B.4. The house numbers, coordinates, as well as representative measured acoustic data for each house are presented in Table 6. The coordinate system used is the British National Grid (EPSG 27700).

Table 6 - Baseline Data

House ID	X/m	Y/m	Day Background Sound Level / L_{A90} dB	Night Background Sound Level / L_{A90} dB	Day Residual Sound Level / L_{Aeq} dB	Night Residual Sound Level / L_{Aeq} dB
H01	557094	165960	44	40	48	44
H02	557001	165823	35	33	45	42
H03	558011	165859	35	33	45	42
H04	557480	166670	40	39	49	47
H05	557848	165894	40	39	49	47
H06	556296	167441	40	39	49	47
H07	557087	166030	35	33	45	42
H08	557812	167036	40	39	49	47
H09	556912	165838	44	40	48	44
H10	557840	165838	40	39	49	47
H11	556672	167595	40	39	49	47
H12	557924	166352	40	39	49	47
H13	557938	166506	44	40	48	44
H14	555660	167108	44	40	48	44
H15	558006	166315	44	40	48	44
H16	556328	167553	40	39	49	47

5 Assessment

5.1 Equipment Generating Sound

The main sources of sound within the proposed development are the 15 inverters, with a corresponding 5 MVA transformer next to each inverter located on the hardstandings. On each hardstanding there are also 2 battery storage containers making 30 total containers.

A 60MVA grid transformer is located in the substation. All equipment is assumed to be operating at all times, during daytime and nighttime.

Acoustic emission data for the proposed equipment is detailed in Table 7. The data corresponds to the maximum acoustic emission for each device as advised by the manufacturer. Predictions based on this data therefore represent the worst case, when the site is operating at maximum capacity.

Table 7 - Acoustic Emission Data

Equipment	Sound Power Level, dB(A)
Inverter	96
5MVA transformer	76
Battery Storage Container	82
60MVA Grid Transformer	91

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 receptor. The penalties can be applied for “attention catching features” such as tonality, impulsivity, intermittency, and other distinguishable characteristics.

The cumulative impact of sound from all the equipment on nearby receivers has been assessed in third octaves in accordance with the objective method provided in Annex C of BS 4142:2014+A1:2019. Results of this assessment show that at all considered receptors the sound generated by the proposed equipment will not contain tones.

The broadband 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.

As a result, the rating level will be equal to the specific sound level.

5.3 Predicted Acoustic Impact

Predicted rating levels at nearby properties are detailed in Table 8 for day and nighttime periods respectively. Due the assumption that all equipment is operating at all times, the day and nighttime rating levels are equal.

The rating level is then compared to the background sound levels from Table 6 to give the potential impact at each location, results of this are also shown in Table 8. An illustrative sound footprint for the proposed development showing the predicted specific sound level during the day and night is provided in Figure 11 in Appendix B. The predicted maximum specific sound level at any house is 35 dB $L_{Aeq, Tr}$.

Table 8 - 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)	Daytime (07:00-23:00)	Night time (23:00-07:00)
H01	32	32	-12	-8	Low	Low
H02	30	30	-5	-3	Low	Low
H03	25	25	-10	-8	Low	Low
H04	35	35	-5	-4	Low	Low
H05	27	27	-13	-12	Low	Low
H06	32	32	-8	-7	Low	Low
H07	33	33	-2	0	Low	Low
H08	28	28	-12	-11	Low	Low
H09	30	30	-14	-10	Low	Low
H10	27	27	-13	-12	Low	Low
H11	33	33	-7	-6	Low	Low
H12	29	29	-11	-10	Low	Low
H13	29	29	-15	-11	Low	Low
H14	25	25	-19	-15	Low	Low
H15	28	28	-16	-12	Low	Low
H16	31	31	-9	-8	Low	Low

Table 8 shows the predicted rating level is not exceeding the background sound levels at any of the residential properties, at any time.

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.

6 Conclusion

An assessment of the acoustic impact of the proposed Chimmens Solar Farm has been undertaken in accordance with BS 4142:2014+A1:2019.

At all times at all houses the predicted impact is low. No adverse impacts are predicted to occur.

7 References

[1] Department for Levelling Up, Housing and Communities, *National Planning Policy Framework*, 2023.

[2] Department for Environment, Food and Rural Affairs, *Noise Policy Statement for England (NPSE)*, 2010.

[3] Department for Communities and Local Government, *National Planning Practice Guidance*, 2019.

[4] Department of Energy and Climate Change, *Overarching National Policy Statement for Energy (EN-1)*, 2011.

[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, *Guidance on sound insulation and noise reduction for buildings, BS 8233:2014*, 2014.

[7] Department of Energy and Climate Change, *National Policy Statement for Electricity Networks Infrastructure (EN-5)*, July 2011.

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

[9] International Organisation for Standardisation, *Electroacoustics – Sound level Meters – Part1: Specifications, IEC61672-1:2013*

Appendix A – Experience and Qualifications

Author:

Name	Artem Khodov
Experience	Senior Acoustic Analyst, Renewable Energy Systems, 2023-Present Senior Acoustic Engineer, Sandy Brown Ltd, 2021-2022 Acoustic Engineer, Sandy Brown Ltd, 2017- 2021
Qualifications	MIOA, Member of the Institute of Acoustics MSc Acoustical Engineering, University of Southampton BEng Mechanical Engineering, VIA University College BEng Automation Engineering, HAMK University of Applied Sciences

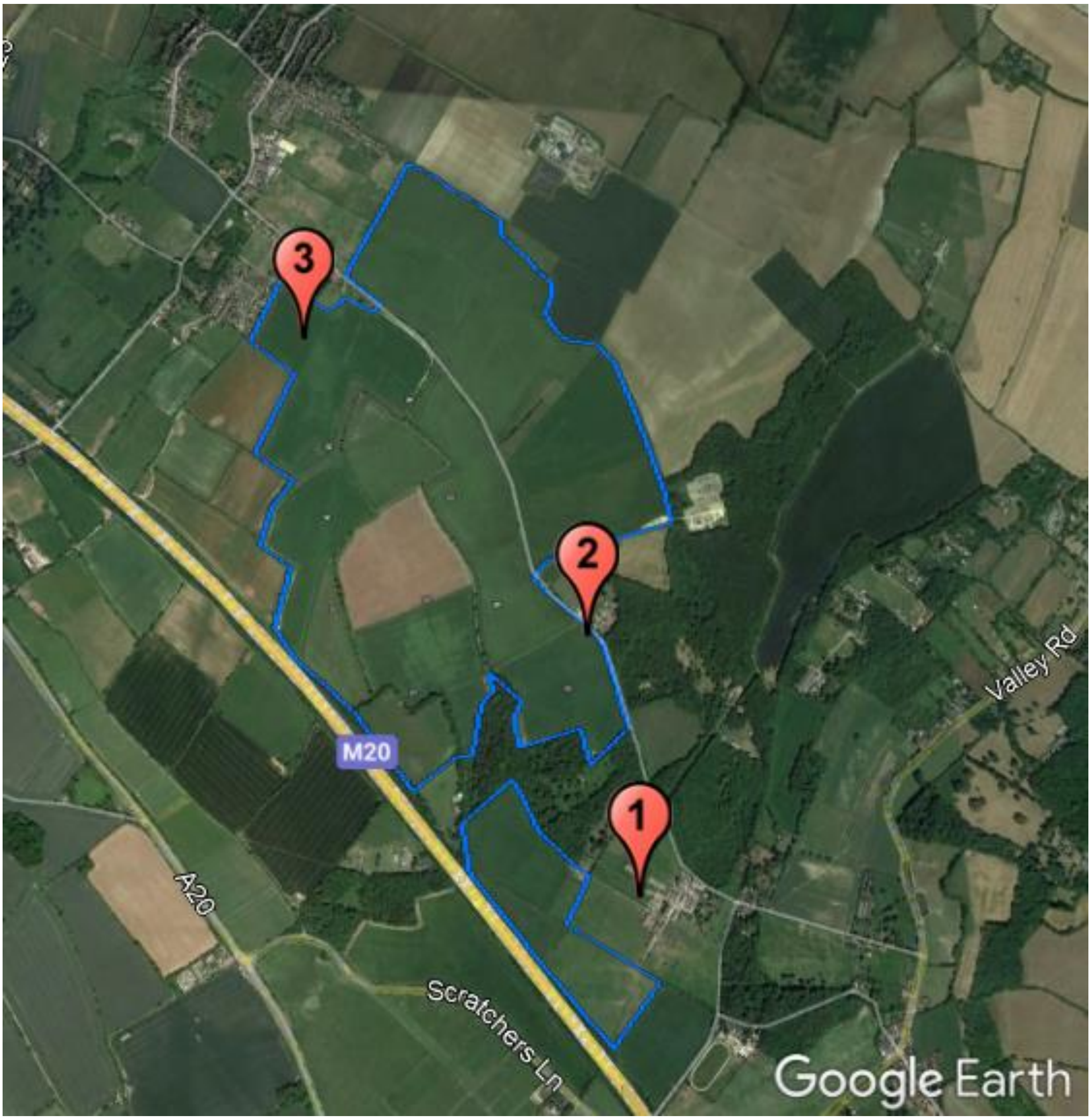
Checker/Approver:

Name	Dr Jeremy Bass
Experience	Head of Specialist Services/Senior Technical Manager, Renewable Energy Systems, 2000-Present Technical Analyst/Senior Technical Analyst, Renewable Energy Systems, 1990-2000 Foreign Exchange Researcher, Mechanical Engineering Laboratory, Tsukuba, Japan, 1989-1990 Research Associate, Energy Research Unit, Rutherford Appleton Laboratory, 1986-1989
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



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B.2 Measured Time Histories

Figure 2 - Time History of Measurements Taken at Location 1

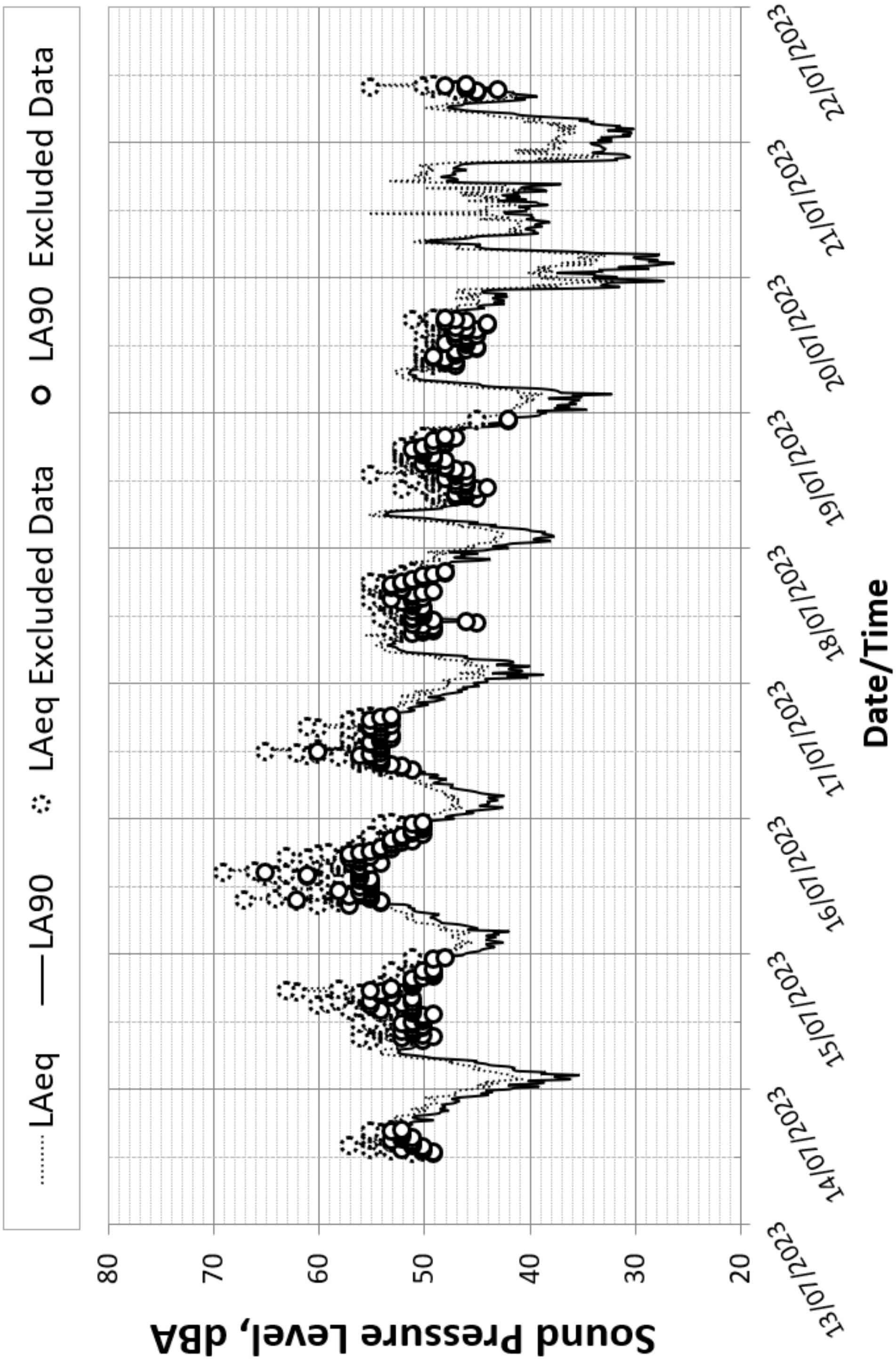


Figure 3 - Time History of Measurements Taken at Location 2

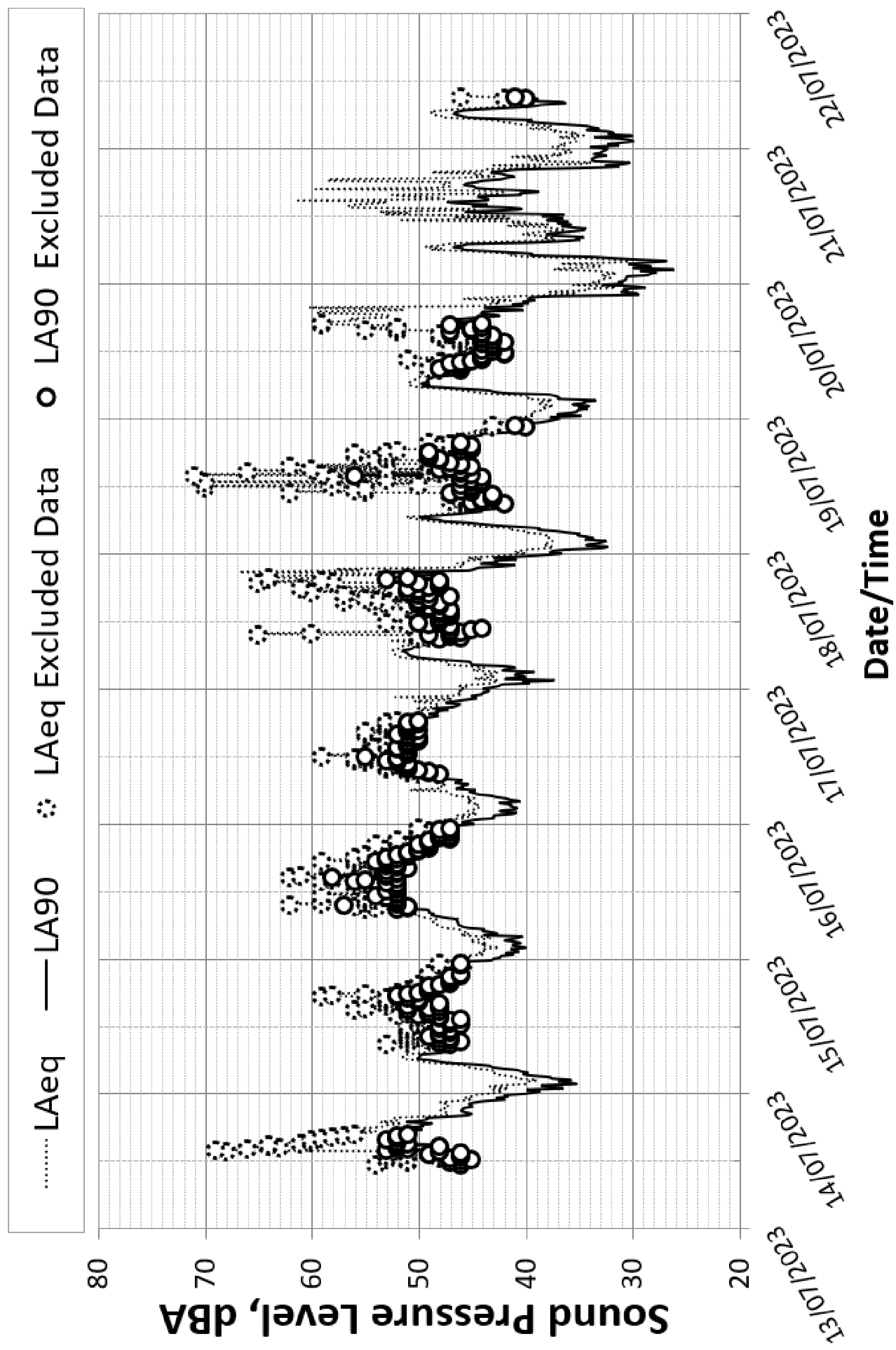
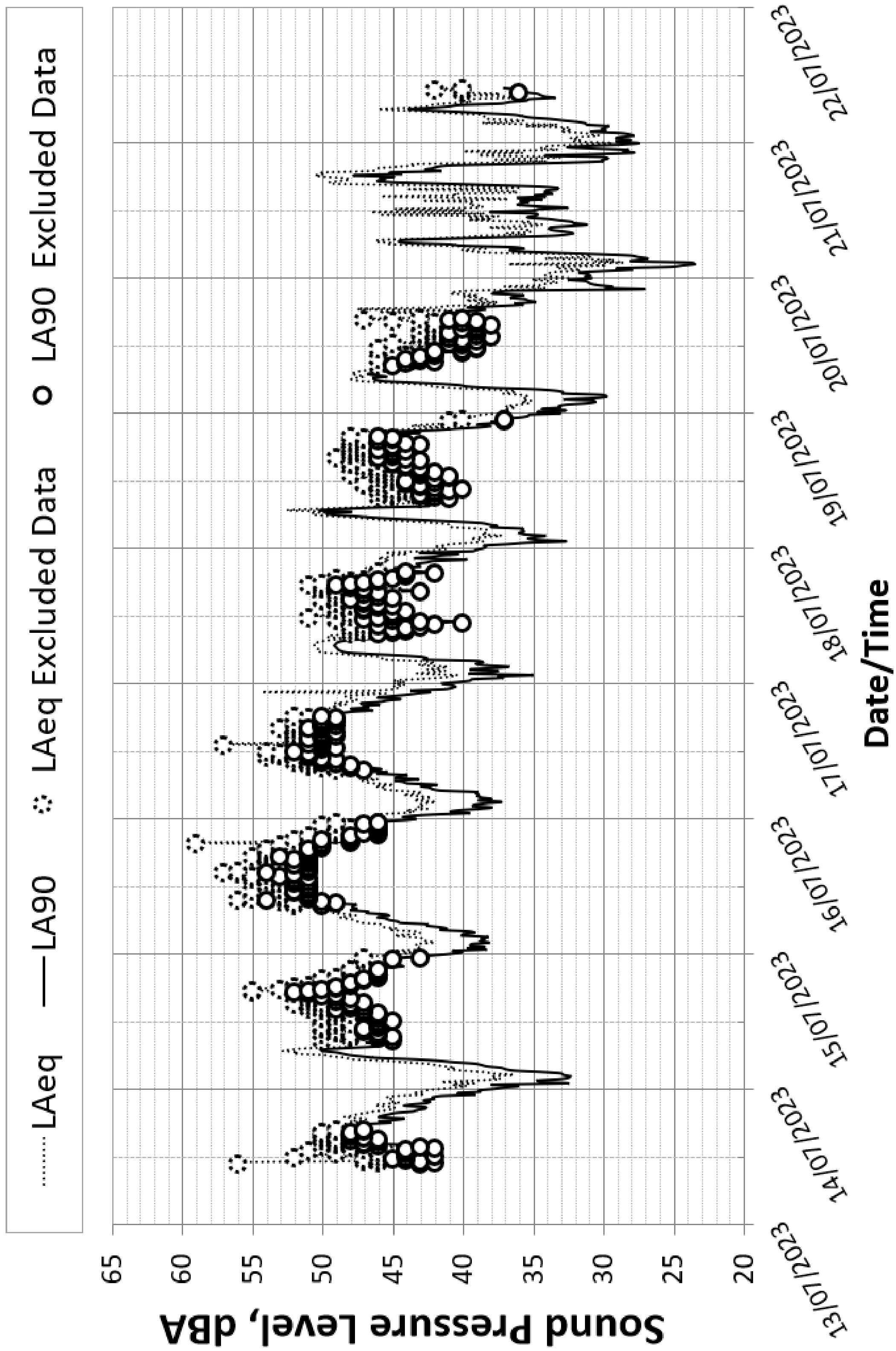


Figure 4 - Time History of Measurements Taken at Location 3



B.3 Histograms of background sound levels

B.3.1 Monitoring Location 1

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

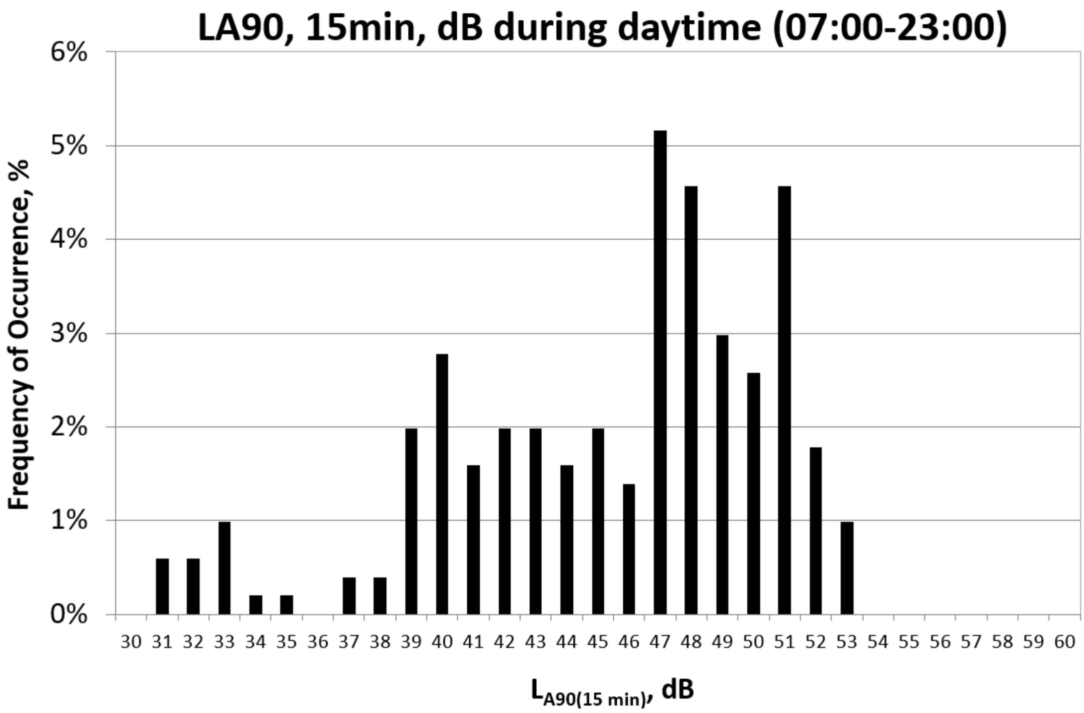
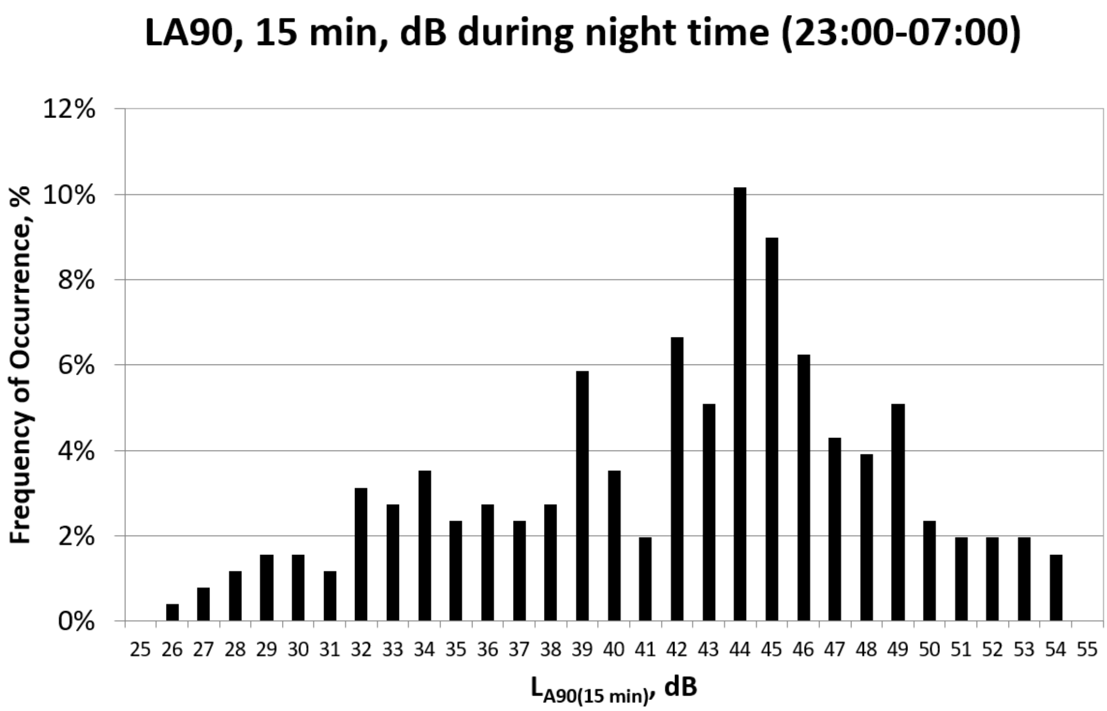


Figure 6 - Histogram of Night Time $L_{A90,\ 15\ Min}$, dB, Measured During Night Time at Measurement Location 1



B.3.2 Monitoring location 2

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

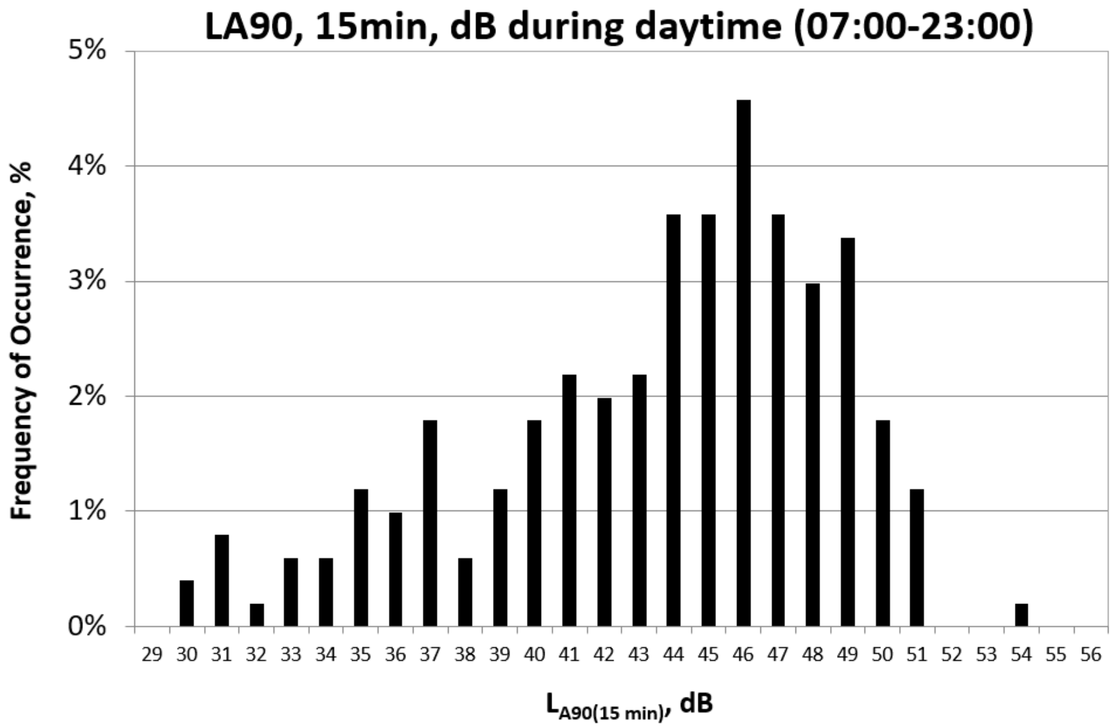
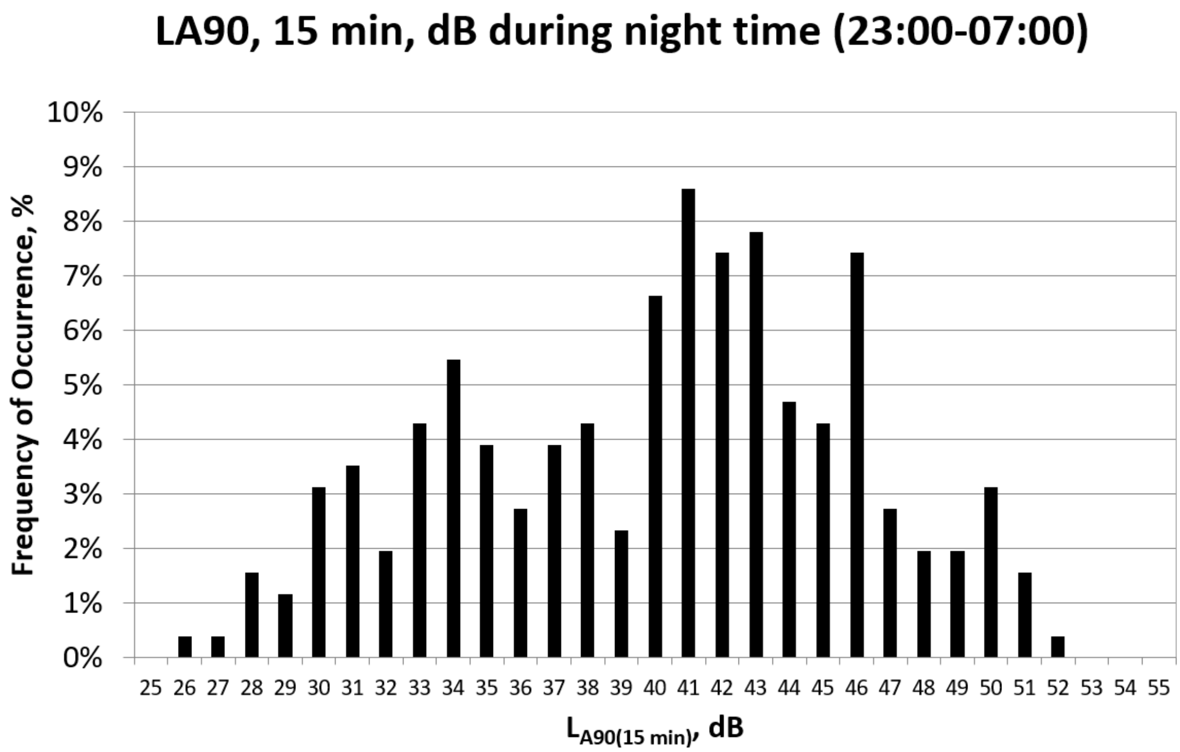


Figure 8 - Histogram of Night Time $L_{A90,\ 15\ Min}$, dB, Measured During Night Time at Measurement Location 2



B.3.3 Monitoring Location 3

Figure 9 - Histogram of Daytime $L_{A90,\ 15\ Min}$, dB, Measured During Daytime at Measurement Location 3

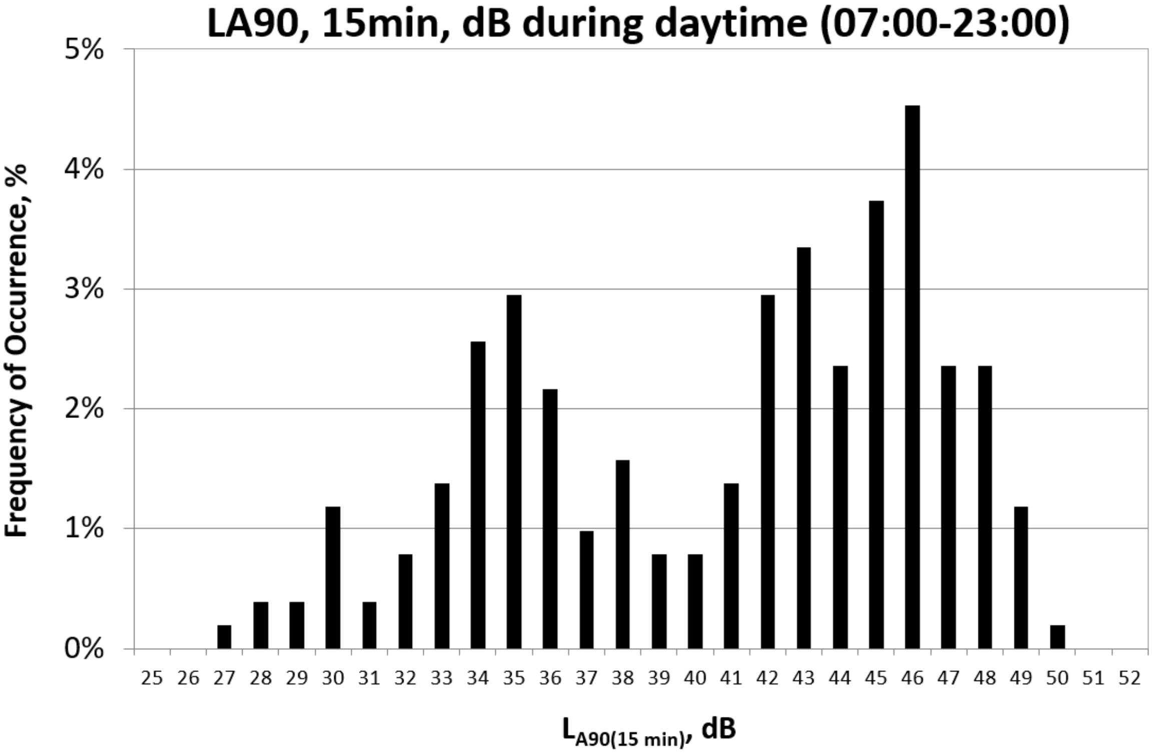
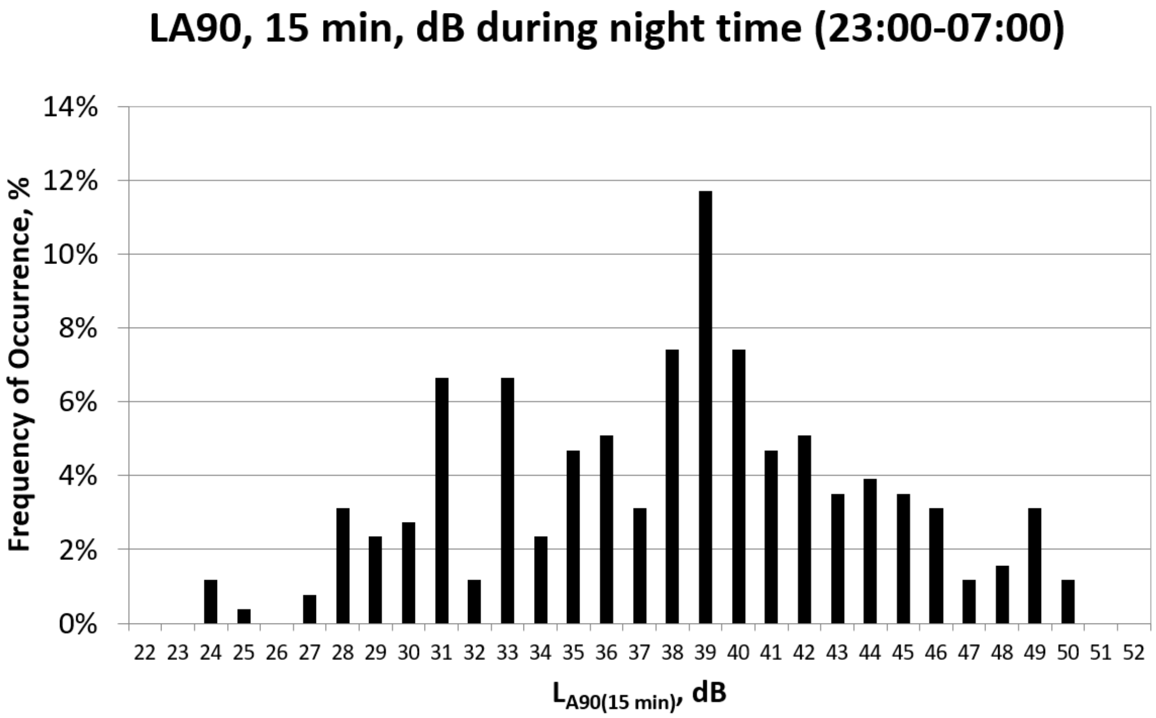
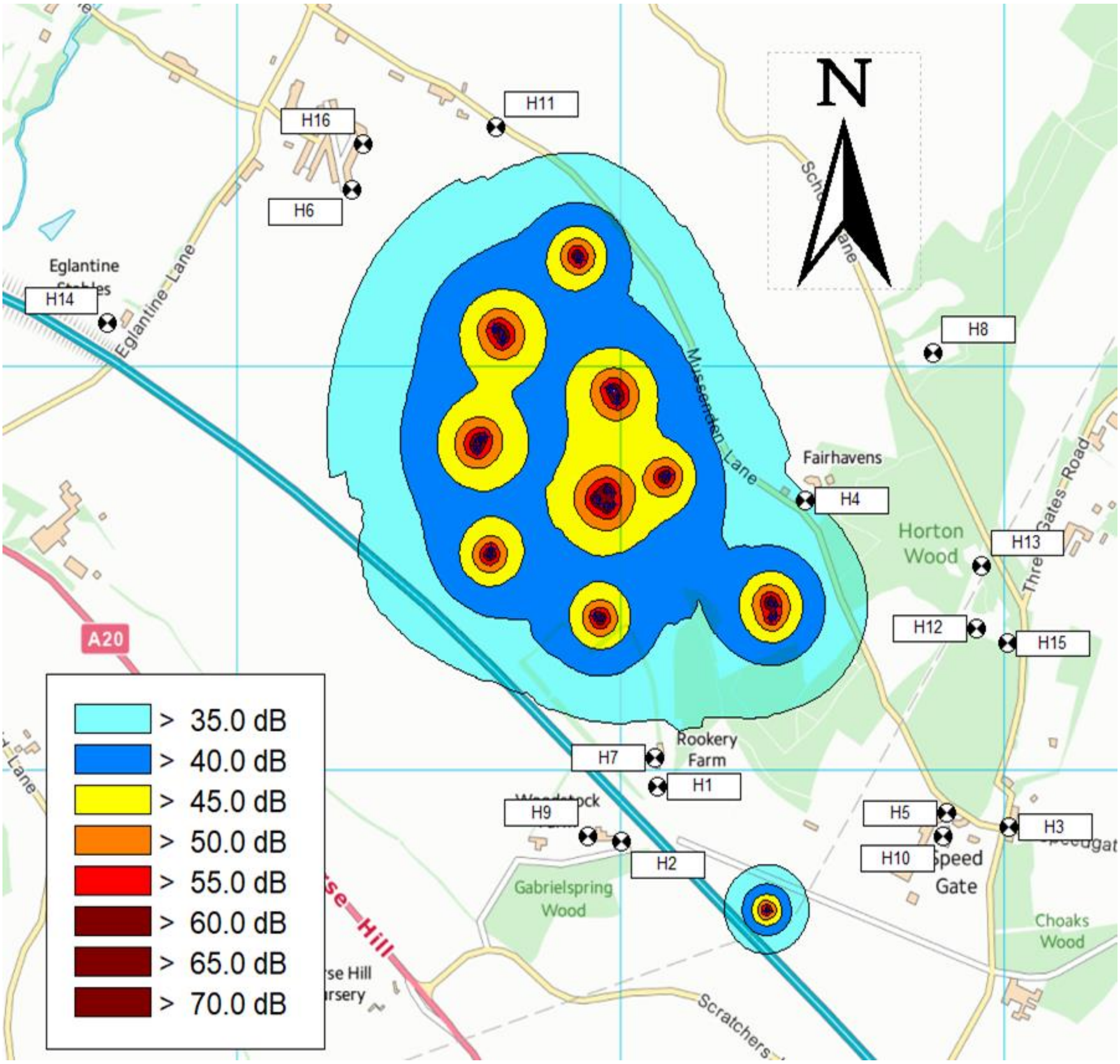


Figure 10 - Histogram of Night Time $L_{A90,\ 15\ Min}$, dB, Measured During Night Time at Measurement Location 3



B.4 Predicted Acoustic Footprint

Figure 11 - Predicted operational acoustic footprint of the site ($L_{Aeq,Tr}$ dB)



Appendix C – Photos

C.1 Background sound survey locations

Figure 12 - Background Sound Monitor at Location 1

Figure 13 - Background Sound Monitor at Location 2

Figure 14 - Background Sound Monitor at Location 3

Appendix D - Suggested Planning Condition Wording

The facility shall be designed and operated to ensure that the rating level shall be less than the background sound level plus 5 dB(A) during the day and at night outside the nearest residential properties (as identified in RES report *05009-6605350* dated 18/10/2023) when determined in accordance with BS 4142:2014+A1:2019.