Hayes McKenzie
Consultants in Acoustics

Hafod Road Solar

BS 4142 Noise Assessment

Report HM: 3776_R01_EXT2

27 March 2025



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Document Control

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1	05/02/25	First Draft
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1. INTRODUCTION

1.1 Hayes McKenzie Partnership Ltd (HMPL) have been commissioned by Dulas Ltd to undertake a noise assessment of electrical plant associated with a proposed solar development to the east of Johnstown, Wrexham.

1.2 As can be seen in Figure 1, the site is situated west of and adjacent to the A483 dual carriageway. In addition, the site is bounded to the west by Hafod Road, and to the south by the B5426 Bangor Road. To the north is a small residential area comprising a small number of private dwellings and Hafod House Rest Home. A disused tile works lies to the northwest, while Hafod Landfill lies to the southwest, including a landfill gas facility. Beyond the boundary of the site, aside from the properties and infrastructure mentioned, the surrounding area is primarily open countryside. The Shrewsbury to Chester railway line and the village of Johnstown lie approximately 600 m to the west.

1.3 The site's existing usage is understood to be agricultural. The proposed development comprises 13 rows of photovoltaic (PV) panels, connected via six 110 kVA solar inverters to a containerised substation and district network operator (DNO) substation. The containerised substation is proposed to house relevant electrical equipment within a container structure, alongside necessary ventilation fans. The DNO substation is assumed to be open-air, with limited sound source information. The locations of the substations, solar inverters and individual receptors are shown at Figure 2.

1.4 The assessment presented in this report is based on a combination of a desk-based assessment of predicted sound levels for proposed equipment, and an evaluation of the existing ambient and background sound levels observed during a baseline survey.

2. NOISE ASSESSMENT METHODOLOGY

2.1 Noise from electrical equipment is typically assessed in accordance with BS 4142:2014+A1:2019 *Methods for rating and assessing industrial and commercial sound*. This method primarily comprises a comparison between rating levels and background sound levels, alongside a consideration of the context.

2.2 Rating levels ($L_{Ar,Tr}$) are ordinarily determined through prediction or measurement of the specific sound levels from proposed, modified, or existing sources. Specific sound levels

are quantified as a continuous equivalent sound level (L_{Aeq}) evaluated at an assessment location over an applicable reference time period (Tr). The rating level is calculated by adding a penalty to the specific sound level where acoustic characteristics (impulsive, tonal or intermittent) are identified as likely to draw attention to the sound source. The extent of the rating penalty depends on the type and the extent of perceptibility of the characteristics at the assessment location.

2.3 Tonal characteristics are likely to be present to some degree for electrical equipment sound sources, while such sound sources are not generally anticipated to be perceptibly impulsive or intermittent such that a penalty would be justified in accordance with BS 4142.

2.4 Where the specific sound is just perceptibly tonal against the residual sound at the assessment location(s), a penalty of 2 dB would normally be applicable. Similarly, penalties of 4 dB and 6 dB would normally be applicable where the specific sound is clearly or highly perceptibly tonal at the assessment location(s), respectively.

2.5 Background sound levels ($L_{A90,T}$) are determined through analysis of measured existing sound levels at the assessment location, and represent the typical continuous underlying sound levels experienced at noise-sensitive receptor locations at given time-periods of interest. In this case, background sound levels are captured from a one-week measurement survey during March 2025 at a location representative of the identified noise-sensitive receptors in this area.

2.6 Rating levels are compared against background sound levels. The greater the difference between rating level and background sound levels, the greater the potential noise impact. A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context, while a difference of around +10 dB is likely to be an indication of a significant adverse impact. Rating levels below the background sound levels are likely to have a low impact, depending on the context.

2.7 Following the initial numerical comparison of rating and background sound levels, an evaluation of the context is required, to determine the likely effects. Greater effects than initially estimated would likely be concluded, for example, where there are very high existing ambient sound levels, where quiet areas are highly valued, or where receptors are exceptionally noise-sensitive. Lesser effects than initially estimated would likely be concluded, for example, in areas where the presence of the specific sound source is highly valued or beneficial to the local community, where the specific sound occurs infrequently or during less noise-sensitive time periods, or where absolute sound levels (both specific and background sound) are low.

3. NOISE-SENSITIVE RECEPTORS AND BASELINE ENVIRONMENT

Noise-sensitive Receptors

3.1 The surrounding area includes several noise-sensitive receptors to the north of the site, comprising Hafod Cottages, The Hollies, and Hafod House Rest Home. Hafod House Rest Home is assumed to be a residential property for the purposes of the assessment. The nearest noise-sensitive receptor is 3 The Hollies, situated approximately 60 m from the nearest PV panels and approximately 80 m from the nearest noise-generating plant item.

3.2 All of the identified nearest noise-sensitive receptors are situated less than 200 m from the A483 at their closest approach, with their land boundary extending to no greater than around 250 m from the A483.

Strategic Noise Mapping

3.3 Strategic noise mapping for this area shows daytime L_{day} ($L_{Aeq,16h}$, 07:00-23:00) sound levels of approximately 50 dB at the identified receptor locations due to the A483 (see Figure 4), with corresponding L_{night} ($L_{Aeq,8h}$, 23:00-07:00) sound levels of approximately 45 dB (see Figure 5). These are noted to be moderately high ambient sound levels for this relatively rural development site.

3.4 The ambient sound levels shown in Figure 4 and Figure 5 are noted to increase towards the south and east of the properties, where there are outdoor amenity garden areas.

Background Sound Survey

3.5 The background sound environment has been evaluated following a baseline sound survey conducted between 11th and 18th March 2025. The measurement location was selected adjacent to Hafod Road, approximately 200 m set back from the A483 and approximately 100 m south of the outdoor garden amenity area of Hafod House Rest Home, as shown in Figure 3. This location is considered to be suitably representative of (or a worst-case representation with lower sound levels than) all identified noise-sensitive receptors, for the purposes of evaluating background sound levels.

3.6 A weather station was also installed at this location, recording rainfall, wind speeds and directions, and other parameters. Low quantities of rainfall were recorded during the survey, with measurement periods excluded from analysis when rainfall was observed. Wind speeds remained low (<5 m/s) throughout the survey. Wind directions during the survey were generally northerly, with the most common wind directions being north-northwesterly and north-easterly. Wind directions were more commonly easterly

(when more favourable sound propagation from the A483 to the west might be anticipated) on 16th to 18th March, with westerly wind directions more commonly observed on other days.

3.7 Further details of the survey installation can be seen in Appendix A.

3.8 The typical ambient sound environment ($L_{Aeq,15min}$) was identified as being dominated by road traffic noise from the A483 during the daytime, evening, and night-time periods, on both weekdays and weekends, although there were some periods, particularly during the quietest parts of the night, when road traffic noise levels were low.

3.9 The sound levels observed follow a typical diurnal pattern, with higher sound levels during the daytime, and the lowest sound levels in the middle of the night. Baseline sound measurement results are shown in Table 1, showing the daily variation in average (logarithmic average) $L_{Aeq,15min}$, and average (mean) $L_{A90,15min}$ sound levels for daytime (07:00-19:00), evening (19:00-23:00), and night-time (23:00-07:00) periods respectively. The early morning (05:00-07:00) is also shown, for reference, due to a notably different sound environment occurring during this time period and to demonstrate the ambient and background sound levels that occur during the nominal night-time when daylight may occur, which is relevant for a solar development.

Table 1 –Ambient and Background Sound Levels

Period Start Date	Ambient Sound Level, $L_{Aeq,15min}$				Background Sound Level, $L_{A90,15min}$			
	Early Morning	Daytime	Evening	Night-time	Early Morning	Daytime	Evening	Night-time
11/03/2025	n/a	56*	50	52	n/a	51*	46	40
12/03/2025	58	58	53	52	53	54	49	39
13/03/2025	57	57	52	51	51	52	46	40
14/03/2025	56	58	54	50	49	52	49	38
15/03/2025	53	56	51	50	45	52	46	40
16/03/2025	54	55	54	52	47	51	48	38
17/03/2025	57	59	52	53	52	56	47	40
18/03/2025	58	58*	n/a	n/a	53	54*	n/a	n/a

*Partial daytime period due to equipment installation and collection

3.10 It is noted that there is relatively little variation observed in the daytime levels, with typically less than 5 dB variation between the highest and lowest levels. Early mornings are noted to have the highest variability, with lower L_{A90} levels at weekends (15th and 16th March) than on weekdays. Other time periods experienced similar ambient and background sound levels on all days.

3.11 It is further noted that neither ambient sound levels nor background sound levels were noticeably different on the 16th to 18th March than on other days, suggesting that the wind

direction did not have a major effect on measured sound levels during the survey.

3.12 Further evaluation of the $L_{A90,15min}$ background sound levels is presented in Table 2, showing the typical range of $L_{A90,15min}$ levels observed and the most representative background sound levels identified for each time-period.

3.13 The levels shown are determined based on professional judgement following analysis of the measurement data, including review of histogram plots for relevant time periods, and box-whisker plots and the time-history plot for relevant acoustical parameters. Relevant plots of data and further details of this analysis can be seen in Appendix A.

Table 2 –Background Sound Level Variation

Time Period	Background Sound Level, $L_{A90,15min}$		
	Lowest Typical	Most Representative	Highest Typical
Early morning (05:00-07:00)	48	49	54
Daytime (07:00-19:00)	51	52	56
Evening (19:00-23:00)	46	49	50
Night-time (23:00-07:00)	31	35	42

3.14 The 'most representative' background sound level values are adopted for the purposes of the noise assessment and are assumed to be representative of all assessment locations.

4. PREDICTED SOUND LEVELS

Sound Power Levels

Solar Inverters

4.1 Indicative solar inverter sound emissions have been provided via a technical specification document for a 110 kVA SMA Inverter model, Sunny Tripower Core2 STP 110-60. The specification indicates a maximum sound emission of 78 dB(A) at 1 m, which would include sound from any in-built cooling fans.

4.2 No frequency information is provided. However, Hayes McKenzie library sound data is available for a 350 kVA solar inverter, comprising sound pressure levels of 78 dB(A) at 1 m. The octave band sound power levels for the SMA Inverter are therefore assumed to be equivalent to the sound power levels of the 350 kVA solar inverter.

4.3 It is likely that substantially lower sound levels are produced for large periods of time, given the notably lower power rating (110 kVA compared with 350 kVA). It is likely that lower sound levels would be experienced at night, as the sound emissions are partially dependent on load, and therefore on sunlight intensity at the PV panels. However, given the potential

for early morning sunlight to occur in the nominal 'night-time' period during the summer months, this sound power data is adopted for all time periods as a worst-case assumption.

Containerised Substation

4.4 Sound emissions within and emitting from the containerised substation are likely to comprise contributions from electrical equipment and cooling fan sound sources.

4.5 Example sound power specifications for a 1 MVA transformer provides an indicative sound power level of 65 dB. However, sources wholly within the container are likely to experience a reduction in sound level from inside to outside the container. A reduction of 15 dB is assumed as a low estimate, approximately equivalent to the reduction afforded at 125 to 250 Hz by 1 mm corrugated steel.

4.6 Provisional container layout plans indicate five cooling fans set into one of the longer façades of the container, one of which is labelled HQW 355/4. Sound power levels for this type of cooling fan is available from the product manufacturer specification sheet in octave bands, with a total sound power level of 71 dB. Five such fans would have a total sound power level of 78 dB. A fire damper system and gravity louvre are also shown but are assumed not to provide any reduction in sound emissions, as a worst-case assumption.

4.7 Electrical switchgear equipment is anticipated to produce minimal continuous sound and would not contribute meaningfully to any potential noise impacts, particularly when housed within a container structure.

4.8 It is therefore likely that the cooling fans would be the dominant sound source within and emitting from the containerised substations, which are assumed as a worst-case assumption to emit sound from the eastern façade, which has a clearer line-of-sight to receptors than the alternative western façade.

DNO Substation

4.9 In the absence of specifications for the DNO substation other than an approximate land, footprint, no detailed calculation can be made based on proposed equipment, layout, or dimensions. However, it is considered likely that this substation would comprise a single high-voltage step-up transformer, likely to emit sound primarily at twice the electrical frequency, 100 Hz in this case. The DNO substation is assumed to emit the same sound power level (78 dB) as calculated for the containerised substation, but is modelled as a point source emitting its entire sound power in the 125 Hz octave band (which would include 100 Hz components), as a worst-case assumption.

Summary

4.10 Sound power levels of each source are given in Table 3.

Table 3 – Source Sound Power Levels, dB L_{Aw}

Source	Octave Band Frequency, Hz									Total A-weighted Level
	31.5	63	125	250	500	1000	2000	4000	8000	
Solar Inverter	22	37	50	66	73	84	78	77	70	86
Containerised Substation Façade	--	--	56	71	72	71	71	65	52	78
DNO Substation	--	--	78	--	--	--	--	--	--	78

3D Acoustic Modelling

4.11 Sound sources are modelled using an industry-standard 3D acoustic modelling software, iNoise, which implements ISO 9613-2:2024 *Acoustics – Attenuation of sound during propagation outdoors – Part 2: Engineering method for the prediction of sound pressure levels outdoors*. Modelled sound sources and receptors are shown in Figure 2.

4.12 Buildings structures for Hafod House and 1 and 3 The Hollies are included in the model, drawn based on background mapping, assuming a roof height of 6 m. Receiver sources are mapped onto southern façades at heights of 1.5 m and 4 m. The large outbuilding to the east of The Hollies is also included but is assumed to be non-sensitive, drawn based on background mapping data, assuming a height of 4 m.

4.13 Additional free-field receiver locations are also placed at 1.5 m height in the garden areas of 3 The Hollies and Hafod House, and at an outdoor area near the Hafod House land boundary, although this part of the property is considered to be less noise-sensitive due to the distance to identifiable amenity areas.

4.14 Ground absorption areas between Hafod Road and A483 are set to assume soft ground (absorption factor of 1), except for the areas comprising houses and hardstanding, identified based on background mapping, which are assumed to be acoustically hard (absorption factor of 0).The modelling assumptions for the sound source objects are set out in Table 4.

Table 4 – Sound Source Modelling Assumptions

Source	Source type	Dimensions	Distance to closest receptor
Solar Inverter 1.1	Point	1.5 m above local ground	165 m

Source	Source type	Dimensions	Distance to closest receptor
Solar Inverter 1.2	Point	1.5 m above local ground	145 m
Solar Inverter 1.3	Point	1.5 m above local ground	130 m
Solar Inverter 1.4	Point	1.5 m above local ground	120 m
Solar Inverter 1.5	Point	1.5 m above local ground	100 m
Solar Inverter 1.6	Point	1.5 m above local ground	80 m
Containerised Substation Façade	Façade	2.9 m height x 6.2 m length	120 m
DNO Substation	Point	1.5 m above local ground	125 m

4.15 Air absorption calculation settings are set assuming an ambient temperature of 10 ºC, relative humidity of 70%, and an ambient air pressure of 101.325 kPa.

Predicted Sound Levels

4.16 The modelling calculations result in predicted specific sound levels as shown in Table 5. Calculated sound levels are also presented as a grid map in Figure 6.

Table 5 – Predicted Sound Levels

Receiver	Floor Level	Predicted Sound Level, dB(A)
R1 – 3 The Hollies	Ground Floor (1.5 m)	40
	First Floor (4 m)	40
R2 – 3 The Hollies Garden	Ground Floor (1.5 m)	39
R3 – Hafod House	Ground Floor (1.5 m)	37
	First Floor (4 m)	38
R4 – Hafod House Garden	Ground Floor (1.5 m)	40
R5 – Hafod House Boundary	Ground Floor (1.5 m)	42

4.17 The highest contributing sound source in all cases is solar inverter 1.6, which is the northernmost inverter on the site layout plans. The two substations are predicted to provide negligible contributions to overall sound level at all receptors.

4.18 No on-time reduction is applied as a worst-case assumption, as it is assumed that for any given time period, the specific sound sources could operate continuously for extended durations.

Sound Characteristics

4.19 It is assumed that inverters, transformers, and cooling fans may emit a tonal characteristic, due to either their electrical components or rotating components. This could attract a tonal penalty, depending on the perceptibility of the sound.

4.20 Based on professional judgement from experience of similar plant items, is anticipated that where specific sound levels are notably higher than the ambient sound levels, a tonal

penalty of up to 6 dB may be applicable. A penalty of around 2-4 dB is considered likely to be applicable where specific sound levels are close to the ambient sound levels (approximately within 3 dB), and no penalty is likely to be applicable where specific sound levels are notably lower than ambient sound levels.

4.21 Based on ambient sound levels in the region of around 50 dB during the daytime and 45 dB at night, it is therefore anticipated that no penalty would likely be applicable for any time period for the specific sound levels set out in Table 5.

5. ASSESSMENT

Rating Levels

5.1 Potential daytime and evening noise impacts are considered to be most likely to occur at ground floor level, while potential night-time noise impacts, including in the early mornings, are considered to be most likely to occur at first floor level, i.e. excluding garden areas. Given that a rating penalty is considered to be unlikely to be required, the rating levels are set equal to the relevant specific sound levels in Table 5. These levels are considered to be a worst-case representative level for a particularly sunny afternoon (daytime, evening) or early morning (night-time), respectively.

Comparison of Rating and Background Sound Levels

5.2 Background sound levels and rating levels are compared for each receiver location and each time-period in Table 6.

Table 6 – Comparison of Rating and Background Sound Levels

Receiver	Time Period	Rating Level, dB	Background Sound Level	Difference
R1 – 3 The Hollies	Early morning	40	49	-9
	Daytime	40	52	-12
	Evening	40	49	-9
	Night-time	40	35	+5
R2 – 3 The Hollies Garden	Early morning	n/a	49	n/a
	Daytime	39	52	-13
	Evening	39	49	-10
	Night-time	n/a	35	n/a
R3 – Hafod House	Early morning	38	49	-11
	Daytime	37	52	-15
	Evening	37	49	-12
	Night-time	38	35	+3
R4 – Hafod House Garden	Early morning	n/a	49	n/a
	Daytime	40	52	-12
	Evening	40	49	-9

Receiver	Time Period	Rating Level, dB	Background Sound Level	Difference
	Night-time	n/a	35	n/a
R5 – Hafod House Boundary	Early morning	n/a	49	n/a
	Daytime	42	52	-10
	Evening	42	49	-7
	Night-time	n/a	35	n/a

5.3 The anticipated differences between rating levels and background sound levels are between -9 and -11 during the early mornings, between -15 and -10 dB during the daytime, between -7 and -12 during the evenings, and between +3 and +5 dB during the quiet parts of the night. These results initially suggest a low impact during the early mornings, daytimes and evenings, and potential adverse impacts during the night-time, depending on the context.

6. DISCUSSION AND CONCLUSIONS

Context

6.1 The context of the assessment is that the surrounding area has relatively high ambient sound levels due to the A483. Although the specific sound sources may be audible at times, the levels of road traffic noise in this area are such that the ambient sound levels would not be anticipated to increase noticeably due to the introduction of the proposed development.

6.2 In addition, the proposed development sound emissions will vary substantially, depending primarily on the electrical load, which is in turn dependent on ambient temperature and sunlight intensity. During the middle of the day in summer months, sound emissions are likely to be highest, whereas during cool overcast days, which are frequent in the United Kingdom, and between sunset and sunrise, reduced or no sound emissions would be anticipated.

6.3 Significantly reduced noise levels would occur during the quiet parts of the night, due to the lack of electrical load and subsequent limited requirement for cooling systems to be operational at night. Given that the difference between rating and background sound levels is a maximum +5 dB for the night-time, it is therefore considered highly unlikely that any adverse impacts would occur during the night, in practice.

6.4 Predicted noise impacts are greatest at the Hafod House outdoor boundary, which is considered to have a lower noise-sensitivity due to its distance from identifiable outdoor garden amenity areas, as well as having higher ambient sound levels.

Uncertainty

6.5 Uncertainty in the assessment is low. While the sound measurements provide only a snapshot of one week of ambient and background sound levels, the resulting data is highly consistent across the week and would not be anticipated to vary substantially at other times. The range of typical sound levels observed is narrow, with the lowest typical levels 1-4 dB lower than the most representative levels, and the highest typical levels 1-7 dB higher than the most representative levels. This variation in levels would not affect the conclusions.

6.6 Several worst-case or otherwise conservative assumptions have been adopted for the purposes of this assessment. The predicted sound levels are likely to represent a worst-case occurrence during warm sunny days, while the comparison between rating and background sound levels indicates that the only time period with any notable potential for adverse impacts is during the quiet parts of the night, when sound emissions from the site would be significantly reduced or would not occur at all.

6.7 While sound predictions and background sound levels could vary somewhat, the conclusions of the assessment are unlikely to vary as a result of these uncertainties. The uncertainties in the assessment are therefore considered to be sufficiently low that the assessment conclusions are robust.

7. RECOMMENDATIONS

7.1 No further actions are recommended. No adverse noise impacts are identified, and therefore no noise mitigation measures are recommended to be implemented.

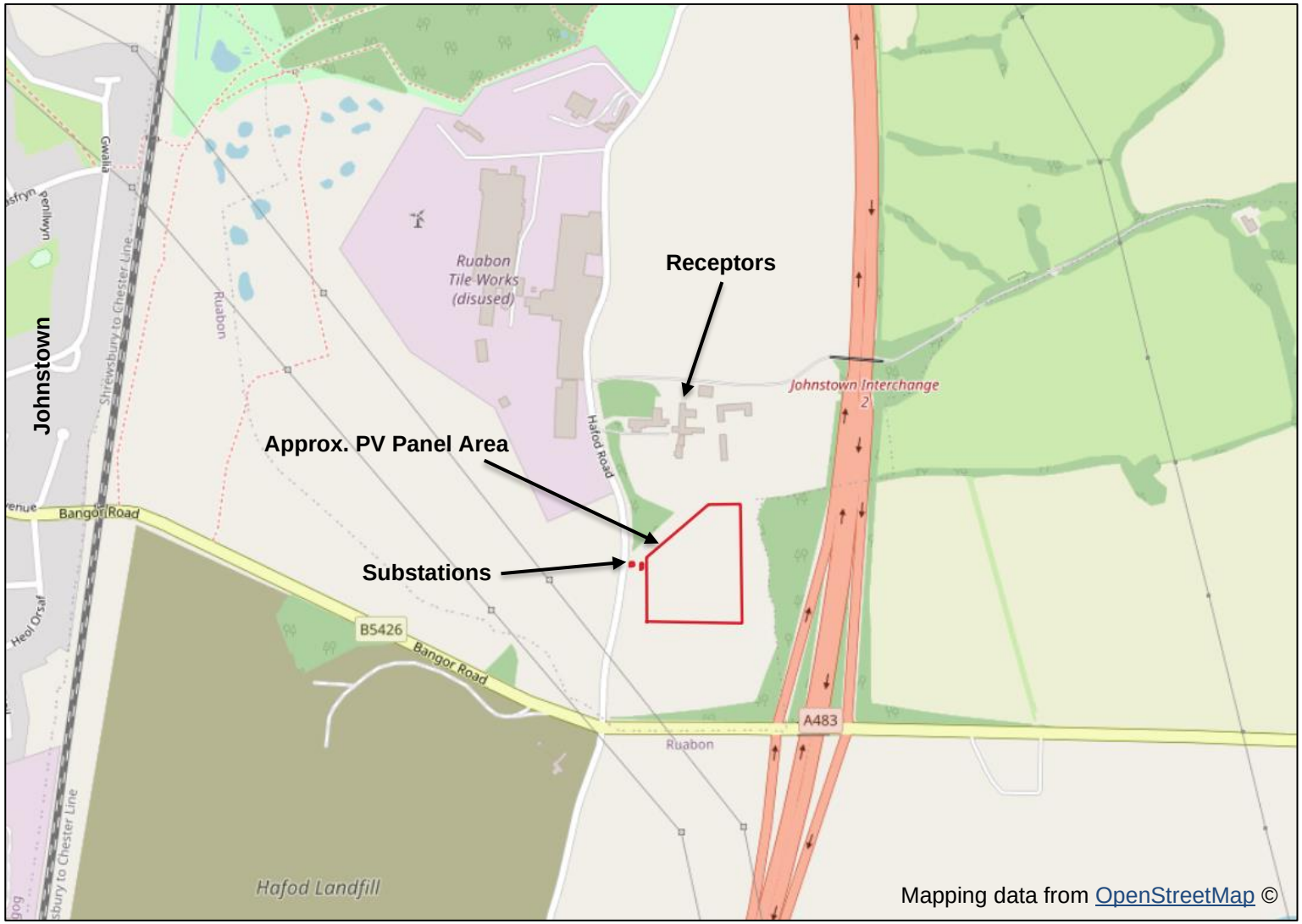


Figure 1 Wider Area Location Plan

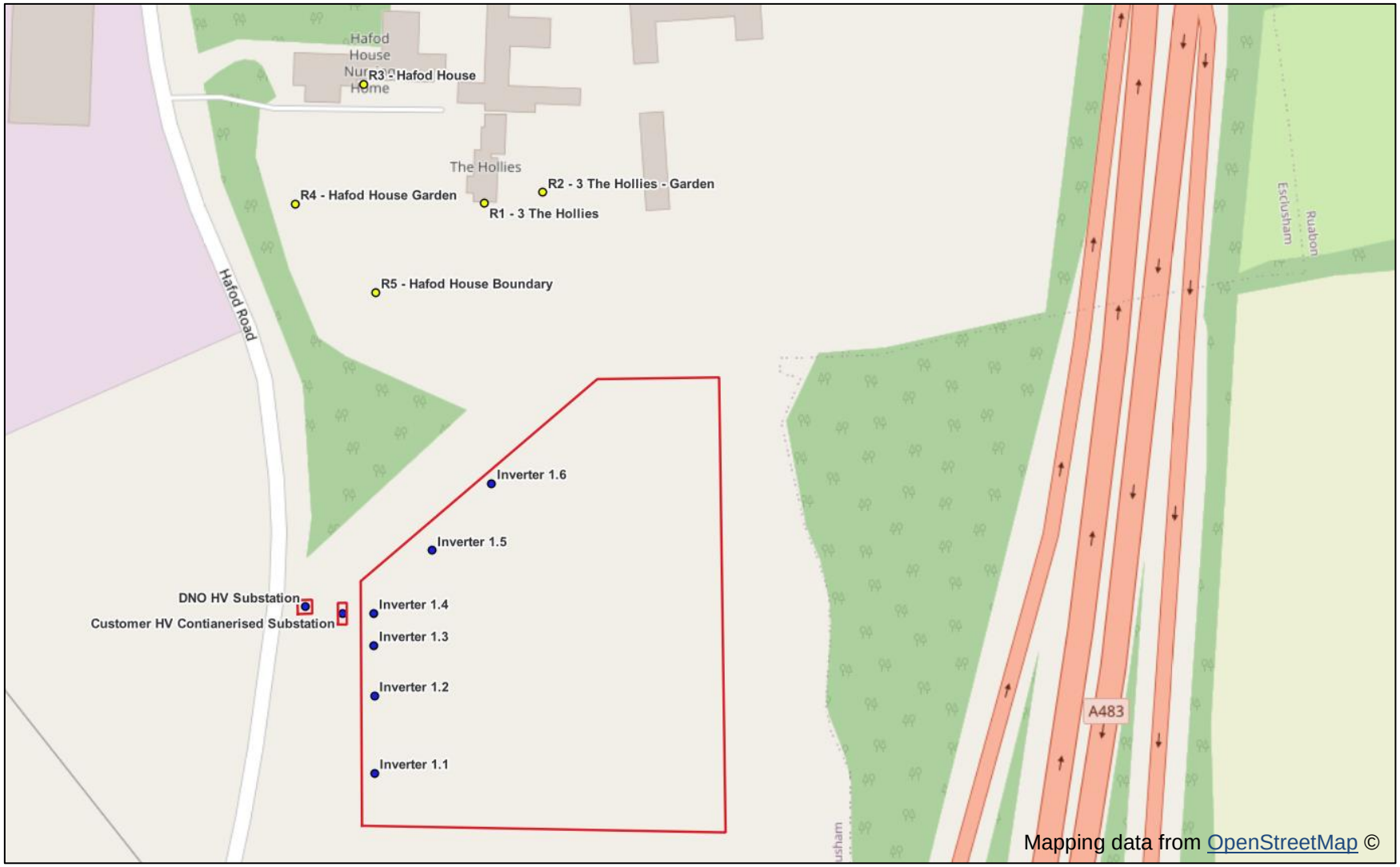


Figure 2 Modelled Sources and Receivers

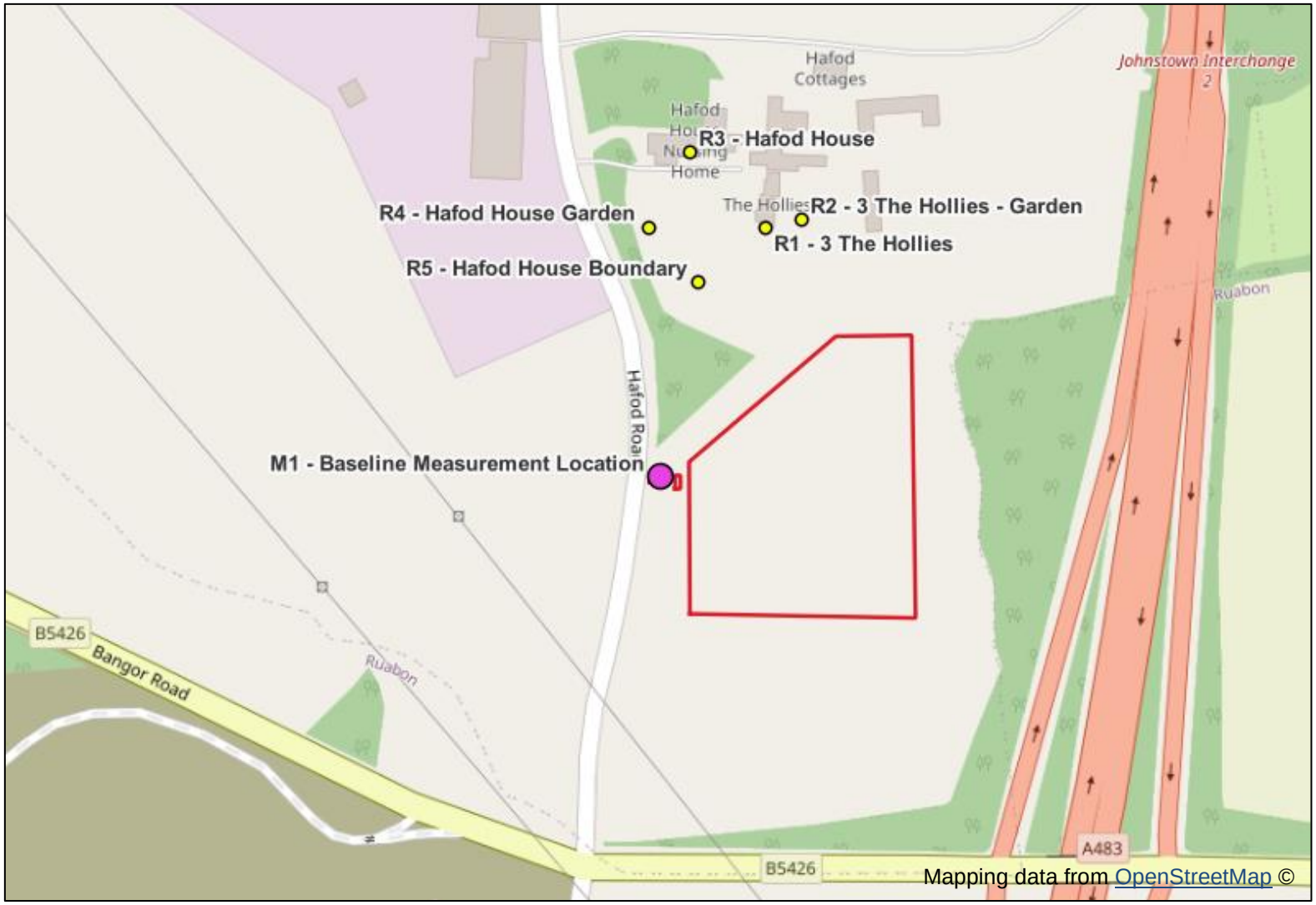


Figure 3 Baseline Measurement Location

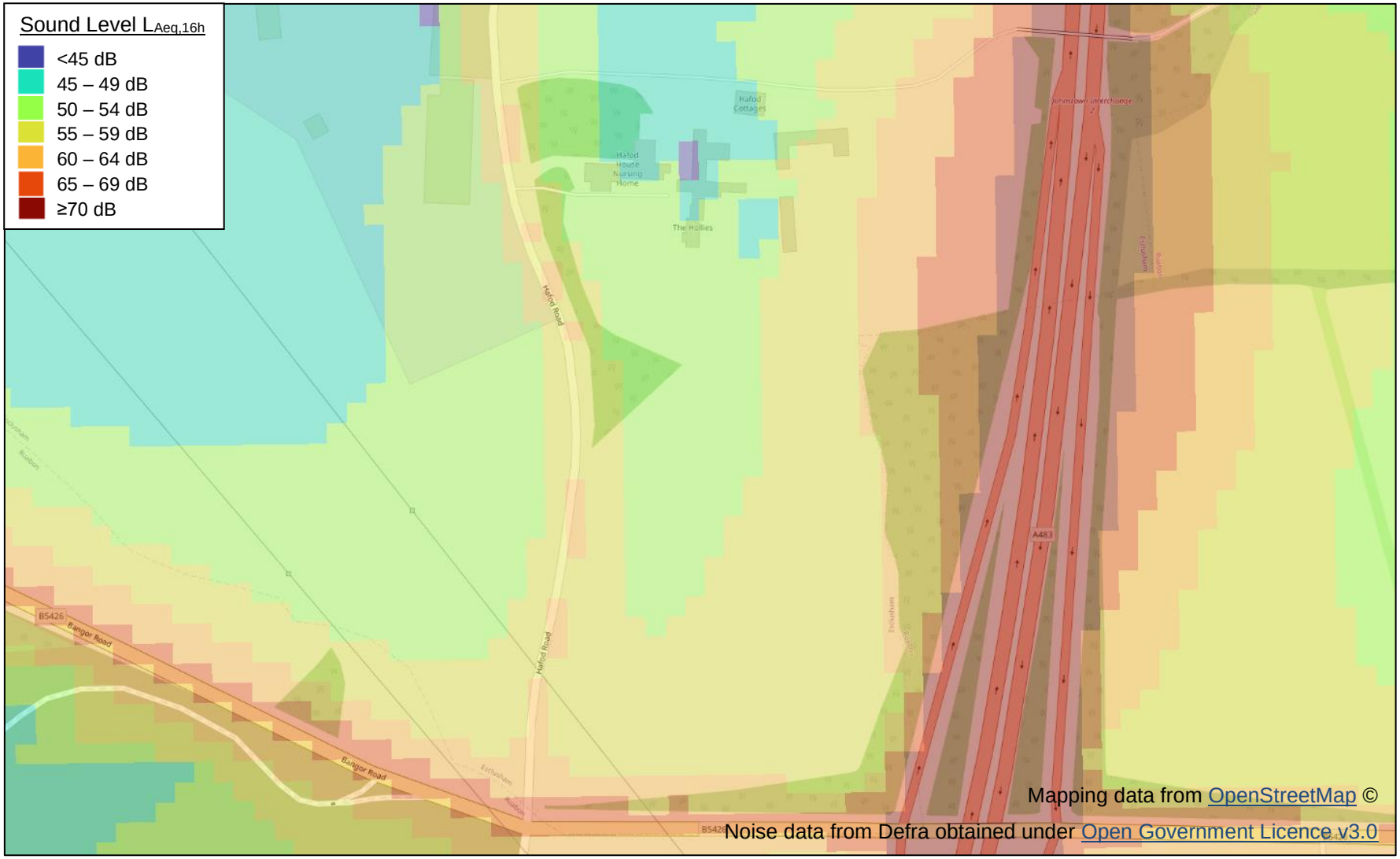


Figure 4 Round 3 Strategic Noise Mapping – Day

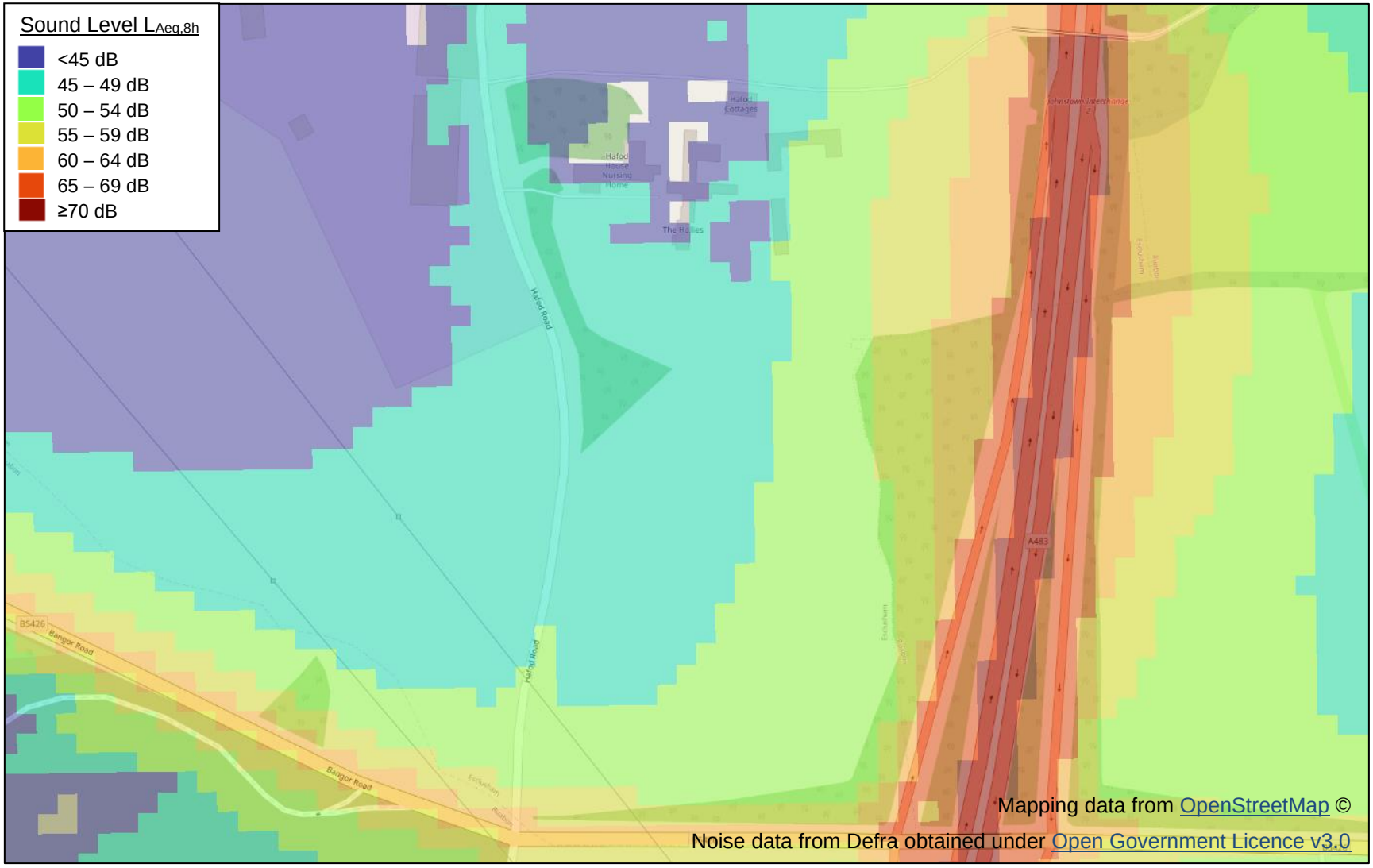


Figure 5 Round 3 Strategic Noise Mapping – Night

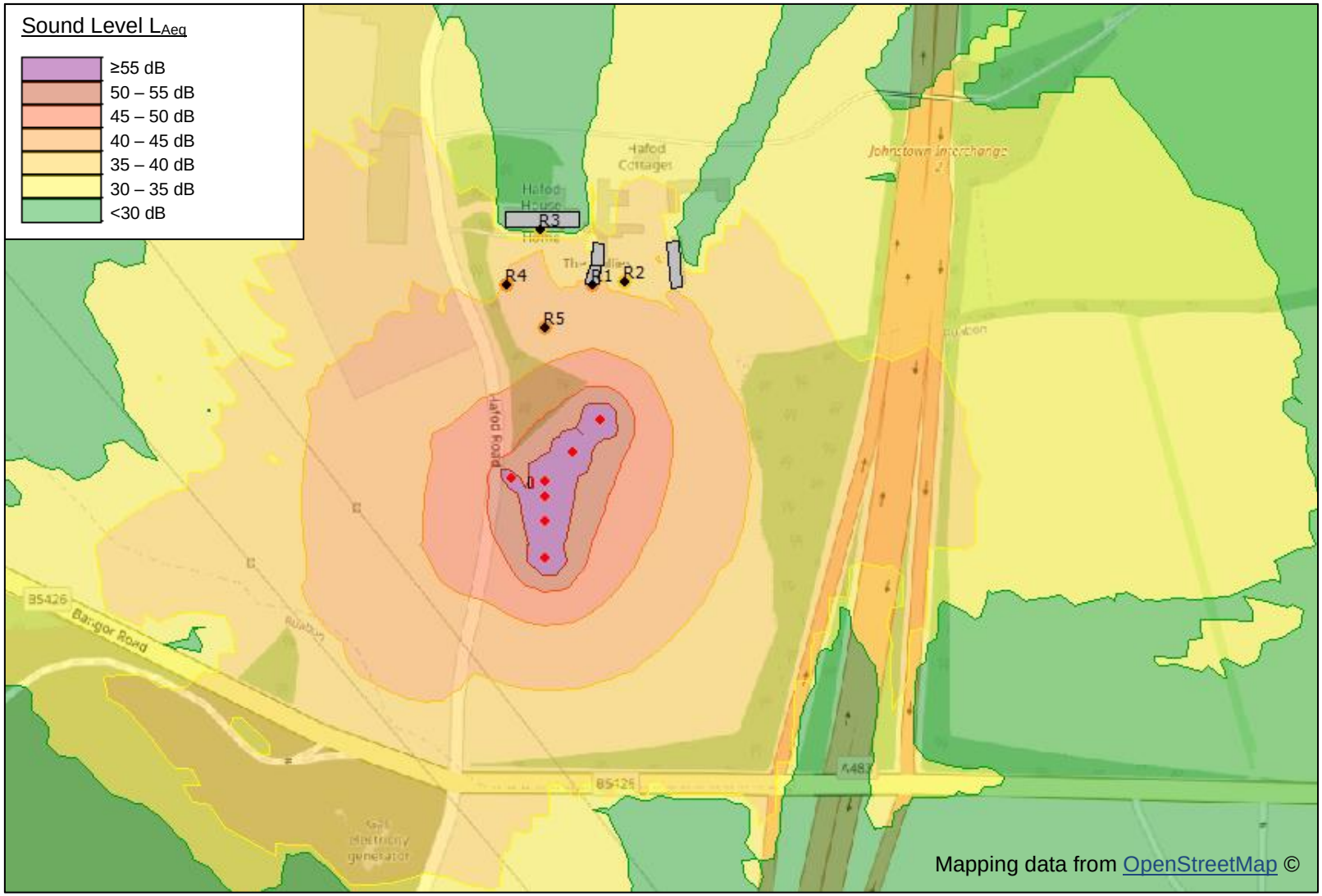


Figure 6 Predicted Specific Sound Level Grid Map

Appendix A – Baseline Sound Survey

Survey Details

Baseline sound measurements have been carried out to characterise the existing ambient and background sound environment. Measurements were conducted between 16:15 11th March and 11:15 18th March 2025.

The measurement location was selected adjacent to Hafod Road, approximately 200 m set back from the A483 and approximately 100 m south of the outdoor garden amenity area of Hafod House Rest Home, as shown in Figure 3 (within the main body of this report).

The survey was conducted using a Rion NL-52 sound level meter (serial number 3025352, laboratory verification test conducted 24/03/2023) corresponding to the Class 1 standard in BS EN 61672. Calibration checks were undertaken during installation and collection using a Brüel and Kjær 4231 Class 1 sound calibrator (serial number 00821102, laboratory verification test conducted 08/08/2024).

A start calibration level of 94.1 dB was recorded (calibrator output of 94.08 dB), with an internal calibration setting of 94.1 dB. At collection, a calibration level of 94.3 dB was recorded, indicating a drift of +0.2 dB, which is not significant. No level adjustments were made to the recordings. Calibration certificates are available upon request.

The microphones were fitted with windshields and mounted on a tripod at a height of 1.2-1.5 m, as shown in Figure 7 and Figure 9.

Sound level measurements were logged for successive 15-minute measurement intervals. To facilitate detailed data analysis where necessary, data were also recorded in 100 ms intervals, while 2-minute audio samples were recorded every 10-minutes.

A weather station was also installed adjacent to the sound level meter to record concurrent wind speeds, wind directions, and rainfall in 15-minute periods.

Weather conditions were generally mild and dry with low wind speeds (<5 m/s). Some rainfall was recorded during the night in the early hours of the 12th of March, between around 03:45 and 06:00. Data for these periods were excluded from analysis.

Wind directions during the survey were generally northerly, with the most common wind directions being north-northwesterly and north-easterly. Wind directions were more commonly easterly on 16th to 18th March, with westerly wind directions more commonly observed on other days.



Figure 7 Baseline Measurement Installation Viewpoint 1

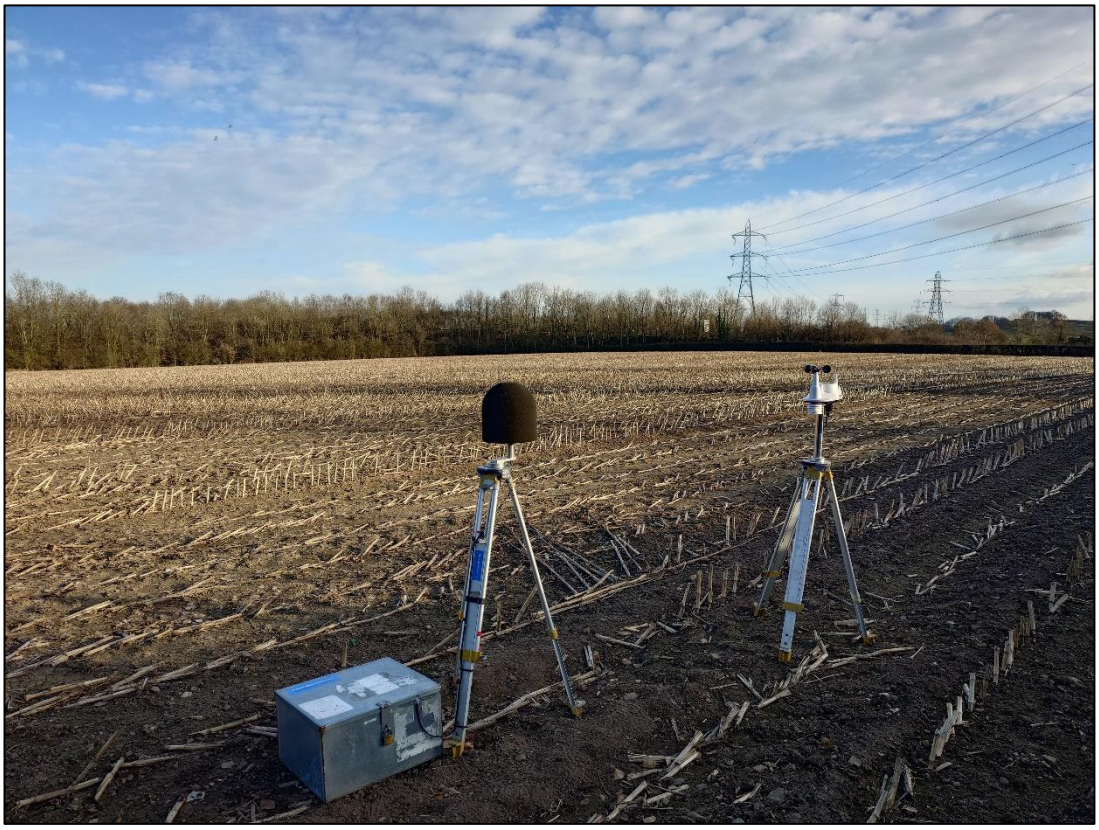


Figure 8 Baseline Measurement Installation Viewpoint 2

Measurement Data Analysis

Several methods of evaluating the measurement data were conducted, to provide a sufficiently comprehensive review of the baseline sound environment. These included manual review of the tabulated data and averages over a range of time periods, as set out in the main body of this report.

In addition, histogram plots were reviewed for the early morning (Figure 9), daytime (Figure 10), evening (Figure 11), and night-time (Figure 12), and box-whisker plots for the $L_{Aeq,15min}$ values (Figure 13) and the $L_{A90,15min}$ values (Figure 14). A time history plot of the entire measurement period, showing $L_{Amax,15min}$, $L_{Aeq,15min}$, and $L_{A90,15min}$ (Figure 15) was also reviewed.

Determination of the lowest typical background sound levels, highest typical background sound levels, and most representative background sound levels for each time-period are identified based on an evaluation of the measurement data in its broader acoustical context. In general, where histogram plots show a range of sound levels prominently more frequently occurring than other sound levels, this will define the range of lowest to highest typical background sound levels. The most representative background sound levels are usually identified as either the most commonly occurring (i.e. the mode) background sound level within the range of typical levels, or the level considered most central between the highest and lowest typical levels, accounting for any skew in the distribution of measured levels.

In addition to evaluation of histogram plots, the initially identified lowest, highest, and most representative background sound levels are further compared against the time history plot and box-whisker plots to inform and refine the judgement of these indicative values.

Raw data can be provided upon request.

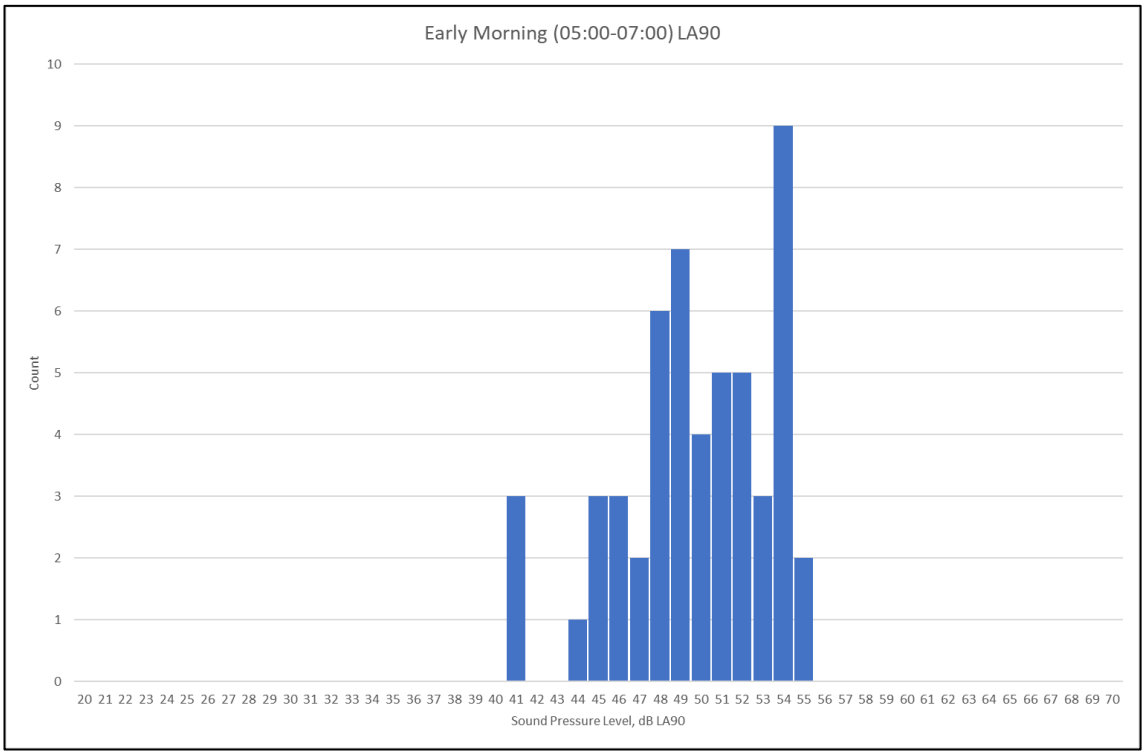


Figure 9 Early Morning $L_{A90,15min}$ Histogram

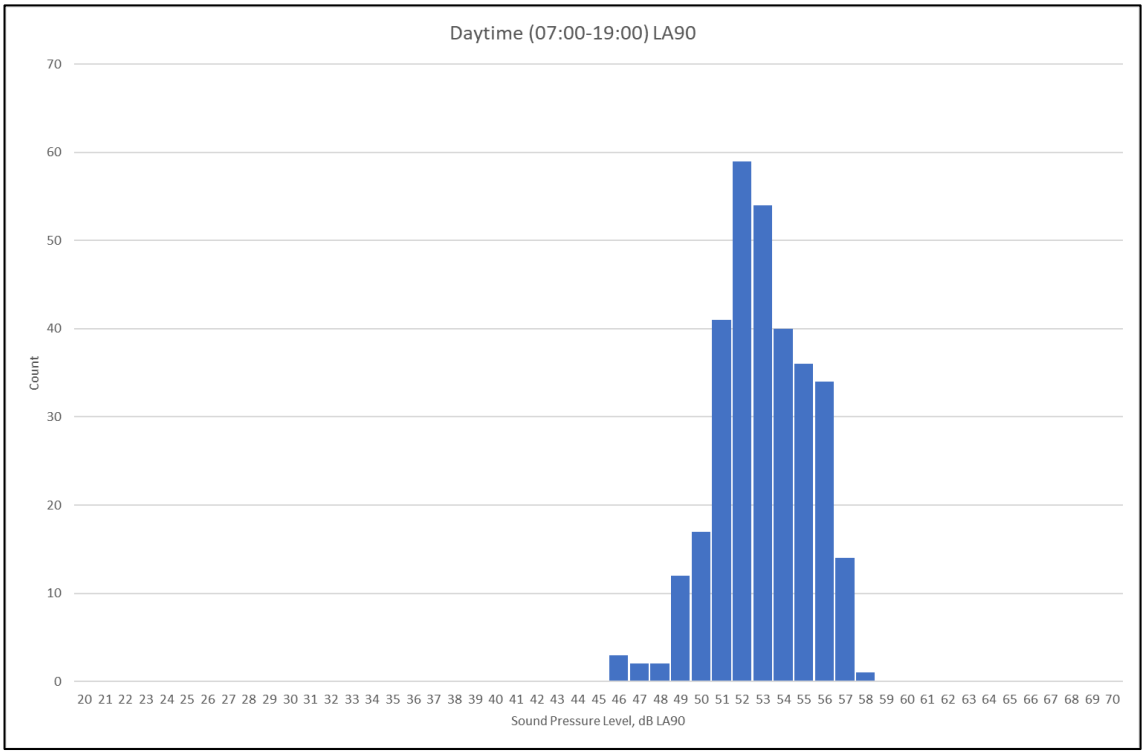


Figure 10 Daytime $L_{A90,15min}$ Histogram

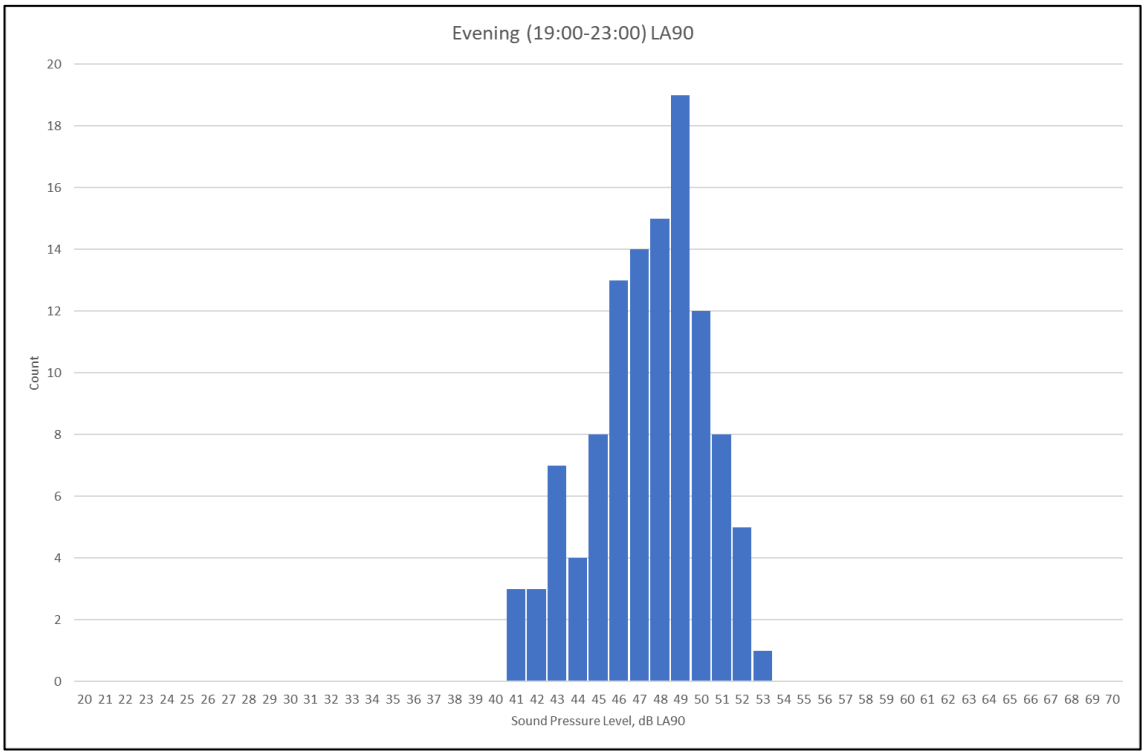


Figure 11 Evening $L_{A90,15min}$ Histogram

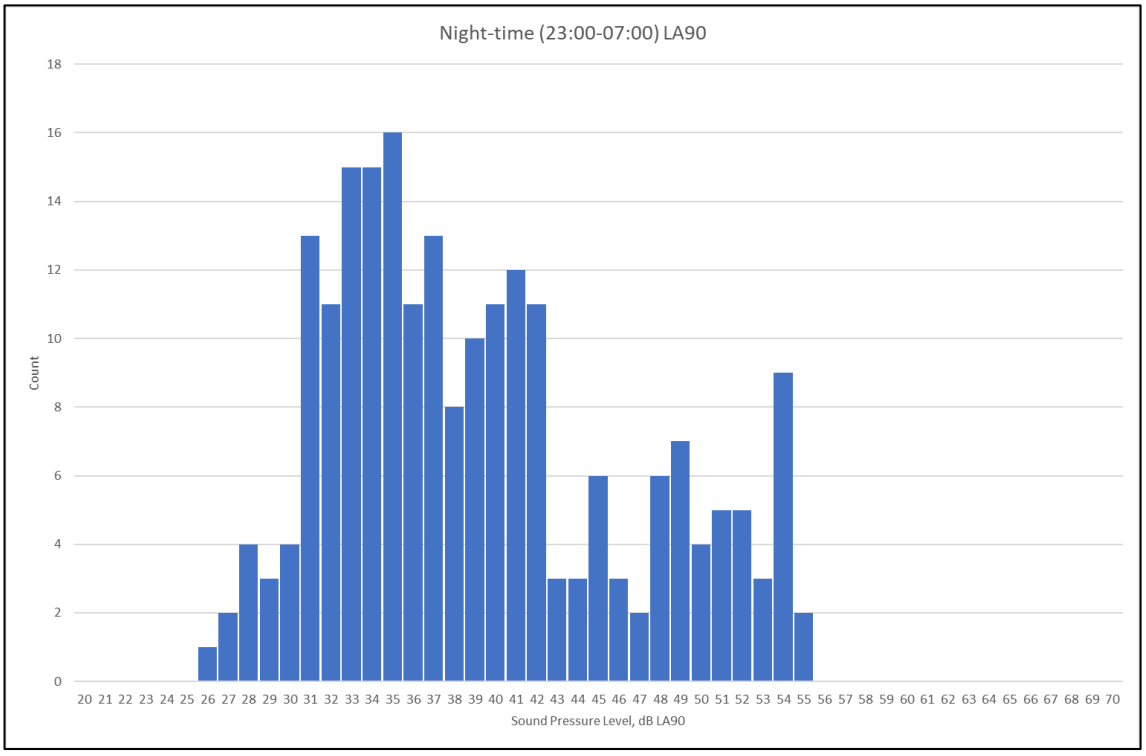


Figure 12 Night-time $L_{A90,15min}$ Histogram

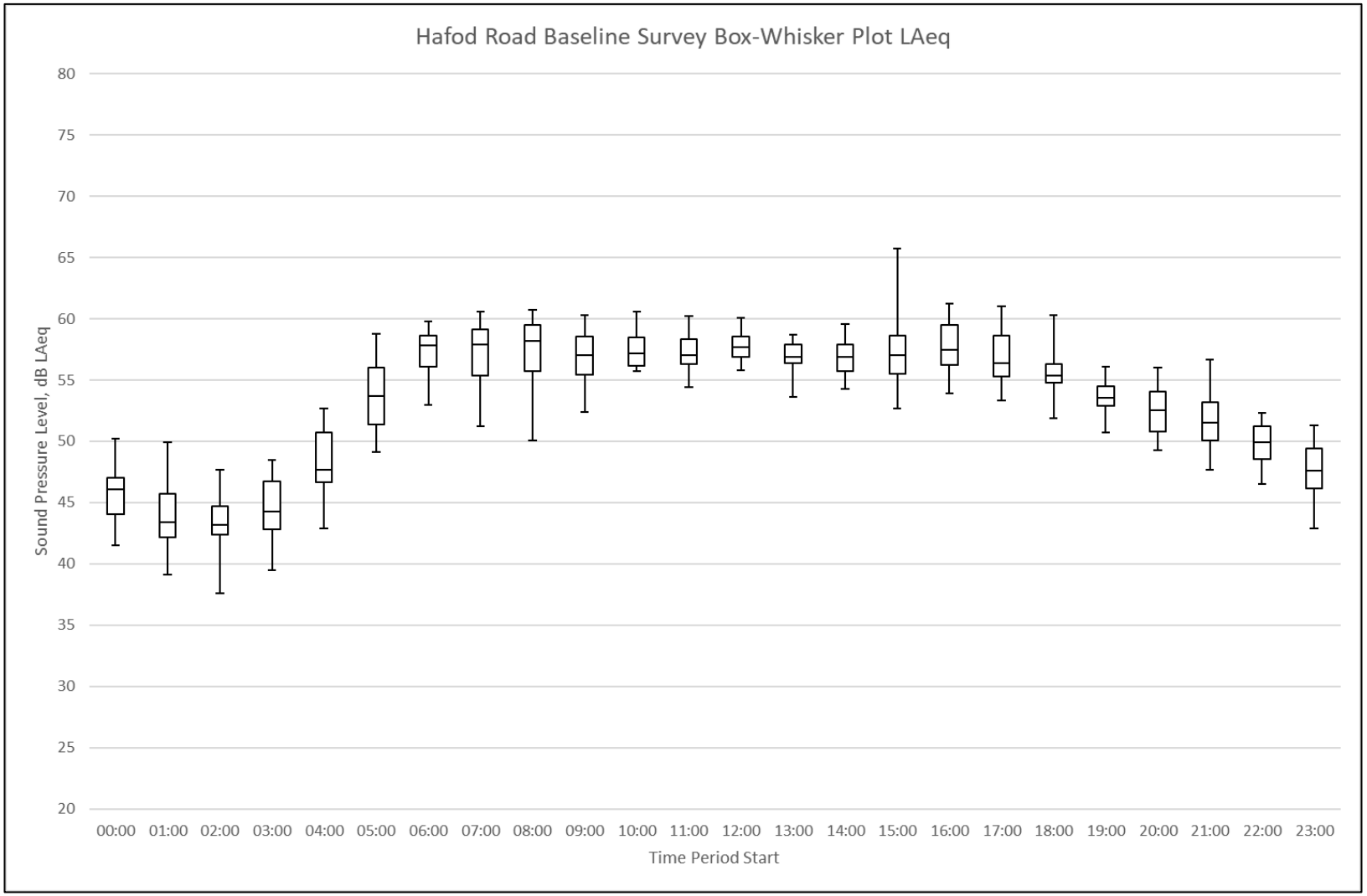


Figure 13 Whole Survey $L_{Aeq,15min}$ Box-Whisker Plot

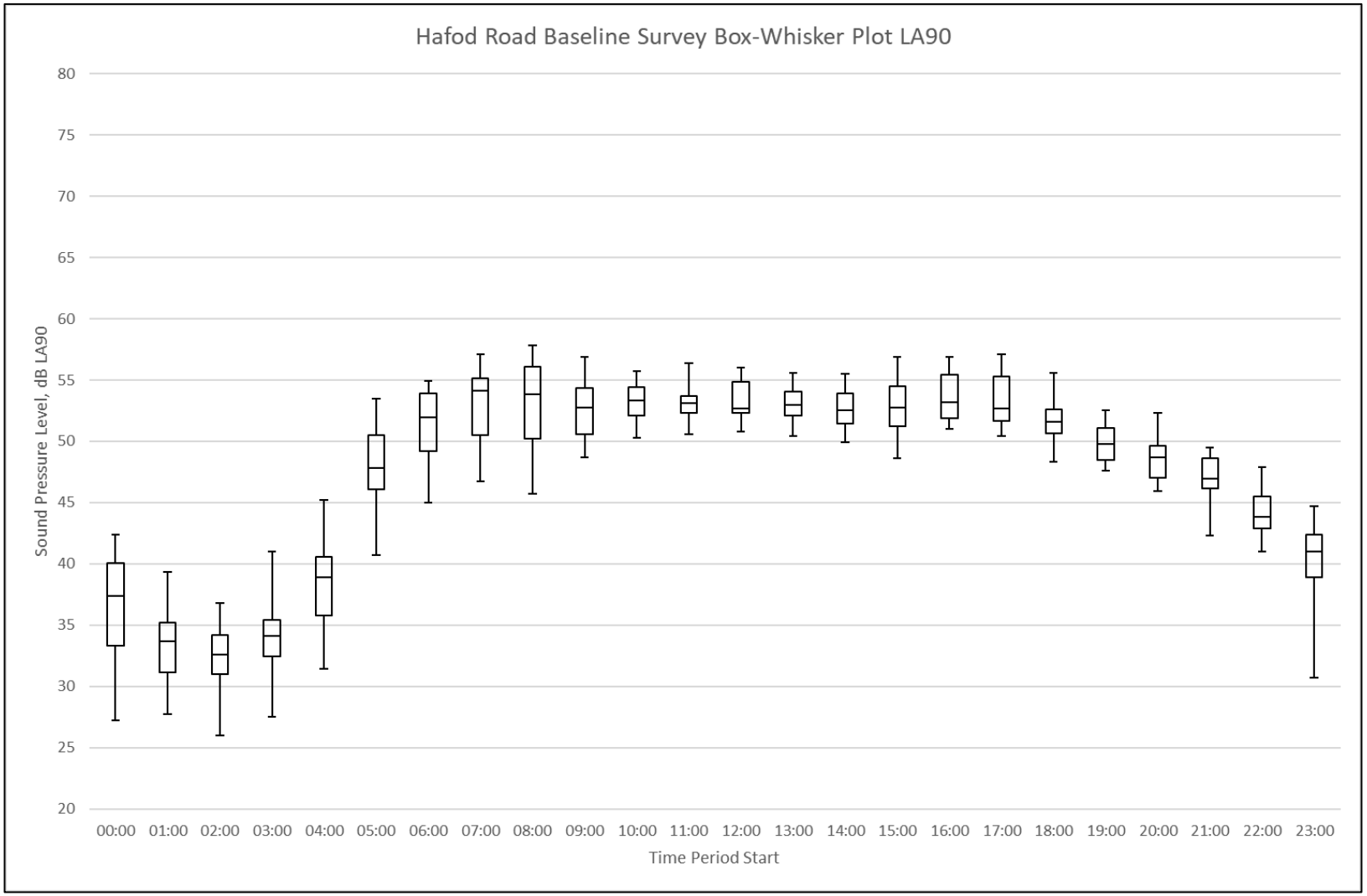


Figure 14 Whole Survey $L_{A90,15min}$ Box-Whisker Plot

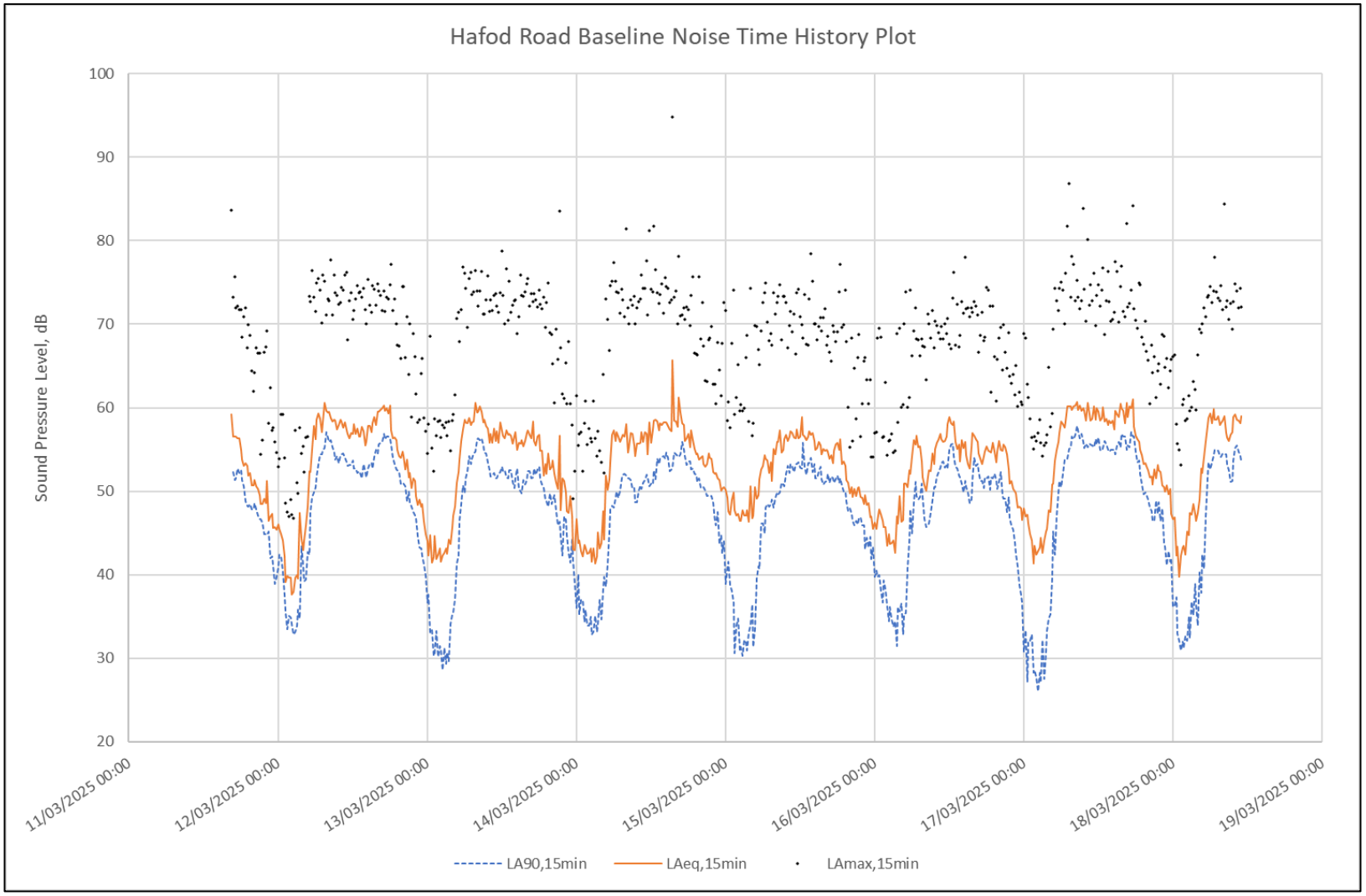


Figure 15 Whole Survey Time History Plot