BSR Energy

Solar Photovoltaic Development, Preston Farm

Noise Impact Assessment

Project No. 298187-RSK-RP-001-(00)

JUNE 2021

QUALITY ASSURANCE

Client:	BSR Energy
Project Name:	Solar Photovoltaic Development, Preston Farm
RSK Acoustics Project No.:	298187
Document Title:	Noise Impact Assessment Report
Document Reference:	298187-RSK-RP-001-(00)

RSK Environment (RSK) has prepared this report for the sole use of the client showing reasonable skill and care, for the intended purposes as stated in the agreement under which this work completed. The report may not be relied upon by any party without the express agreement of the client and RSK. No other warranty, expressed or implied, is made as to the professional advice included in this report.

Where any data supplied by the client or from other sources have been used, it has been assumed that the information is correct. No responsibility can be accepted by RSK for inaccuracies in the data supplied by any other party. The conclusions and recommendations in this report assume that all relevant information has been supplied by those bodies from whom it was requested.

Document history

Rev.	Purpose Description	Author	Reviewer	Date
--	Report for internal review	NP	JM	03.06.2021
00	Report issued for comment	NP	JM	04.06.2021
01				
02				
03				

NP – Nathan Parker, AMIOA (Acoustic Consultant)
JM – Jonathan Mart, MIOA (Associate Director)

 Where field investigations have been carried out, these have been restricted to a level of detail required to achieve the stated objectives of the work. This work has been undertaken in accordance with the quality management system of RSK Environment.

CONTENTS

1 INTRODUCTION

1.1 Overview

RSK Environment Ltd has been instructed by ADAS, on behalf of BSR Energy, to undertake a noise assessment to evaluate the operational impact of a proposed 28 MW solar photovoltaic (PV) development at Preston Farm, southwest of Basingstoke (Preston Candover), Hampshire (RG25 2DS).

The assessment benefits from a baseline noise survey, undertaken at positions representative of those nearest receptors, to determine typical background noise levels during both daytime and night-time periods. Monitoring was carried out over a period of seven days; with approval sought and agreed with Basingstoke and Deane District Council, prior to RSK's attendance.

This report describes the assessment methodology and the baseline conditions currently prevailing across the application site to evaluate the suitability of the proposed development.

1.2 Objectives

The noise assessment aims to:

- Quantify and report the prevailing noise climate at nearest receptors to the development;
- Present relevant impact assessment thresholds from local and national guidelines;
- Predict the construction and operational noise from the development at nearest receptors;
- Assess predicted noise levels against the relevant noise impact thresholds; and
- Specify noise mitigation measures where necessary.

1.3 Exclusions

Operational traffic movements from the development have not been determined, however given the type of operation, operational traffic movements from vehicles entering and exiting the site are not likely to have a significant impact on existing flows across the network. Impacts from development related traffic have not been quantified.

Vibration generation from the development (operational and construction) and its impact on nearby residents will be minimal and therefore has been discounted from the assessment.

2 REGULATORY FRAMEWORK

2.1 National Planning Policy Framework (NPPF): 2019

The National Planning Policy Framework (NPPF) (published March 2012 & updated February 2019) is the means by which noise is considered within the planning regime. The NPPF does not contain assessment criteria, instead providing a series of policies, giving local authorities the flexibility in meeting the needs of local communities. The NPPF states:

"Planning policies and decisions should contribute to and enhance the natural and local environment by […] 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."

"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."*

"Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed."

2.2 Noise Policy Statement for England (NPSE): March 2010

The Noise Policy Statement for England is published by the Department for Environment, Food and Rural Affairs (Defra) and sets out the approach to noise within the Government's sustainable development strategy. There are two established concepts from toxicology that are currently being applied to noise impacts (for example, by the World Health Organisation). They are:

- *"NOEL - No Observed Effect Level - This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.*
- *LOAEL - Lowest Observed Adverse Effect Level - This is the level above which adverse effects on health and quality of life can be detected.*

Extending these concepts for the purpose of this NPSE leads to the concept of a Significant Observed Adverse Effect Level.

- *SOAEL - Significant Observed Adverse Effect Level - This is the level above which significant adverse effects on health and quality of life occur."*

The three aims of the NPSE are stated as:

- avoid significant adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development;
- mitigate and minimise adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development; and
- where possible, contribute to the improvement of health and quality of life through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.

2.3 British Standard (BS) 7445-1,-2,-3 'Description and measurement of environmental noise. Guide to quantities and procedures'

The three-part standard BS 7445 provides the framework within which environmental noise should be quantified. Part 1 (2003) provides a guide to quantities and procedures and Part 2 (1991) provides a guide to the acquisition of data pertinent to land use. Part 3 (1991) provides a guide to the application of noise limits.

BS 7445 also refers to a further standard, BS EN 61672, which prescribes the equipment necessary for such measurements. Whilst BS 7445 does not prescribe the meteorological conditions under which noise measurements should or should not be taken, it does (part 2, paragraph 5.4.3.3) recommend that in order:

"…to facilitate the comparison of results (measurements of noise from different sources), it may be necessary to carry out measurements under selected meteorological conditions which are reproducible and correspond to quite stable propagation conditions."

These conditions include:

- Wind speed not exceeding 5 m/s (measured at a height of 3 to 11 m above the ground);
- No strong temperature inversions near the ground; and
- No heavy precipitation.

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

This Standard sets out techniques to predict and assess the likely noise effects from construction works, based on detailed information on the type and number of plant items being used, their location, and the length of time they are in operation.

The standard provides example criteria for the assessment of the significance of noise effects. Such criteria are concerned with fixed noise limits and changes in ambient noise levels.

Annex E of BS 5228 provides guidance on how to assess the significance of construction noise on residential and commercial sensitive receptors. Section E.3 details The ABC Method, which describes criteria for assessment based on noise being of significant level when exceeding absolute limit levels.

Table 2.1 Threshold of significance effect at dwellings (BS 5228 Table E.1)

Assessment category and threshold value period (L_{Aeq})	Threshold value (dB(A))		
	Category A [A]	Category B [B]	Category C [C]
Night-time (23.00 – 07.00)	45	50	55
Evening and weekends [D]	55	60	65
Daytime (07.00 – 19.00) and Saturdays (07.00 – 13.00)	65	70	75
NOTE 1 A significant effect has been deemed to occur if the L_{Aeq} noise level arising from the site exceeds the threshold level for the category appropriate to the ambient noise level. NOTE 2 If the ambient noise level exceeds the threshold values given in the table (i.e. the ambient noise levels is higher than the above values), then a potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3 dB due site noise. NOTE 3 Applied to residential receptors only.			
[A] Category A: Threshold values to use when ambient noise levels (when rounded to the nearest 5dB(A)) are less than these values [B] Category B: Threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as the category A values [C] Category C: Threshold values to use when the ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values. [D] 19.00 – 23.00 weekdays, 13.00-23.00 Saturdays and 07.00 – 23.00 Sundays.			

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

BS 4142:2014+A1:2019 describes the methods for rating and assessing noise of an industrial or commercial nature applicable for the purpose of assessing sound at existing dwellings, through the determination of a rating level of an industrial or commercial noise source. The standard includes the following:

- Sound for industrial and manufacturing processes;
- Sound from fixed installations which comprise mechanical and electrical plant and equipment;

- Sound from the loading and unloading of goods and materials at industrial and/or commercial premises; and
- Sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from the premises or processes, such as that from forklift trucks, or that from train of ship movements on or around an industrial and/or commercial site.

Where certain acoustic features are present at the assessment location, a character correction should be applied to the specific sound level to give the rating level to be used in the assessment. The difference between the background noise level and the noise rating (including any penalties) is then calculated.

- 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 adverse impact depending on the context.
- 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.

As indicated above, the significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs. BS4142 states than '*An effective assessment cannot be conducted without an understanding of the reason(s) for the assessment and the context in which the sound occurs/will occur. When making assessments and arriving at decisions, therefore, it is essential to place the sound in context*'.

Where the initial estimate of the impact needs to be modified due to the context, all pertinent factors should be taken into account, including:

- The absolute level;
- The character and level of the residual sound; and
- The sensitivity of the receptor and whether dwellings will already (or likely) to incorporate design measures that secure good internal and/or outdoor acoustic conditions, such as: i) façade insulation treatments, ii) ventilation and/or cooling, and iii) acoustic screening.

2.6 World Health Organisation Guidelines

The World Health Organisation (WHO) Guidelines for Community Noise was published in 2000 as a response to a need for action together with a generic need for improvements in legislation at a national level. Although not legislation, this document provides general guidance and guidelines which have been set for different health effects, using the lowest noise level that produces an adverse health effect in specific human environments. The guideline levels which are relevant to this assessment are set out in Table 2.3.

Table 2.3 WHO Guidelines for Community Noise Levels

Specific Environment	Critical health effect(s)	$L_{Aeq,T}$ (dB)	Time base, T (hours)	$L_{AF,max}$ (dB)
Outdoor Living Area	Serious annoyance, daytime and evening	55	16	-
	Moderate annoyance, daytime and evening	50		
Dwelling, indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	16	-
Inside bedrooms	Sleep disturbance, night-time	30	8	45[(a)]
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	8	60

[(a)] *Should not exceed 45 dB L_{AFmax} more than 10-15 times a night*

2.7 Basingstoke and Deane 'Noise Assessments and Reports for Planning Applications: Guidance note for developers and consultants'

This technical guidance note on noise assessments was issued by the Environmental Protection Team at Basingstoke and Deane Council to assist developers, agents and their consultants where noise is a consideration for any proposed development.

In relation to the assessment of new sources of an industrial or commercial nature, the Council sets out the updated BS 4142 as the governing guidance. In order to prevent a potential increase in ambient and background noise levels over time, generated by the cumulative effect of future developments, the guidance states:

'*As such, to protect existing noise levels and prevent creeping levels as a starting point, noise from new sources should be no greater than 5dB below the existing background level at the most sensitive period when the plant will be operated (e.g. evening, nights and weekends)*.'

Regarding construction noise, Appendix 5 of the Guidance summarises the aim of the document and defines the key elements expected to be incorporated to the Construction Noise Management Plan (CNMP), in order to avoid details when submitting a planning applications where construction noise is expected to be particularly significant.

2.8 Local Authority Consultation

Consultation was sought with Basingstoke and Deane District Council via email on 05 May 2021 detailing RSK's proposed approach to the survey and assessment. A positive response was received the same day by Mrs Sonya Hildebrandt (Senior Environmental Health Officer) with no comments made to the proposed methodology.

The agreed methodology included:

- A baseline noise survey carried out at the nearest noise sensitive receptors (or close to where access permits) to establish the existing noise levels at the site. The extent of the survey would allow for up to four unattended noise monitoring positions (for a minimum monitoring period of 96 hours) comprising of environmental noise measurements (background and ambient) aimed to

characterise the existing noise environment, encompassing both a typical weekday and weekend periods (daytime and night);

- An assessment of noise from the proposed facility would be undertaken to the requirements of BS 4142:2014+A1:2019 '*Methods for rating and assessing industrial and commercial sound*' and Basingstoke and Deane's '*Guidance note for developers and consultants – Noise assessments and reports for planning applications'*. Calculations would be undertaken to enable noise predictions of the proposed facility to be compared against the background noise level ($L_{A90,T}$). Source levels from manufacturers data or a similar solar PV facility would be used as basis of predictions, including any rating penalties to those sources where appropriate. Should the predicted rating noise levels exceed the background level, outline mitigation measures would be identified to offset any adverse impacts.

3 PROPOSED DEVELOPMENT

3.1 Site Location and Description

Preston Farm is located approximately 10 km southwest of Basingstoke, with the site for the proposed development positioned approximately 1.12 km to the north west of the settlement of Preston Candover. The site comprises three agricultural fields orientated broadly east to west demarcated by boundary hedgerows containing trees and hedgerows.

The site is accessed via the B3046 to the south, and further internal roads within the Preston Farm site. These internal roads comprise of metalled and part metalled surfaces which extend through the agricultural land. In addition, a number of rights of way lie within the vicinity of the site.

The nearest residential property, Breach Farm is positioned to the north of the site. Further properties at a further distance include Fawkners to the east, Tulls Hill to the south east, and Manor Farm to the west.

3.2 Development Proposals

The development proposals are for the erection of a solar photovoltaic (PV) array extending across three fields, with a total installed capacity to generate up to 28 MW.

The proposals would comprise of solar panels mounted to frames which would have a maximum height above ground level of 2.6 metres. The area of development covers approximately 49 hectares (120 acres), split between three separate sites housing the array panels with a smaller substation area built to the south east of the site which will include a Distribution Network Operator (DNO) and a private switchgear, a welfare unit, and a spare container. The proposed development site is illustrated in Appendix 1.

The plant shall be capable of operating for a continuous period and would operate for 24 hours. The proposals consist of the following elements:

- Inverter stations positioned within each solar panel array at approximately 1 metre above ground;
- Transformer stations distributed at both sides of transformer access tracks within the solar panel areas;
- Distribution Network Operator (DNO) building;
- Switch gear building;
- Welfare unit;
- Spares container; and
- Security fencing and CCTV installation.

3.3 Existing Receptors

Based on aerial imagery, the following receptors have been used for assessment purposes. Receptors have been chosen based on their position to the development and where necessary, representative of a wider series of receptors within a settlement:

Table 3.1 Assessment Receptor Locations

Ref.	Receptor Name	Distance to Site Application Boundary
R1	Breach Farm	550 m North
R2	Fawkners	1500 m East
R3	Tulls Hill	1000 m South-east
R4	Manor Farm	2000 m West

A map showing the wider site boundary and location of the sensitive receptors considered in the assessment is presented in **Figure 3.1**.

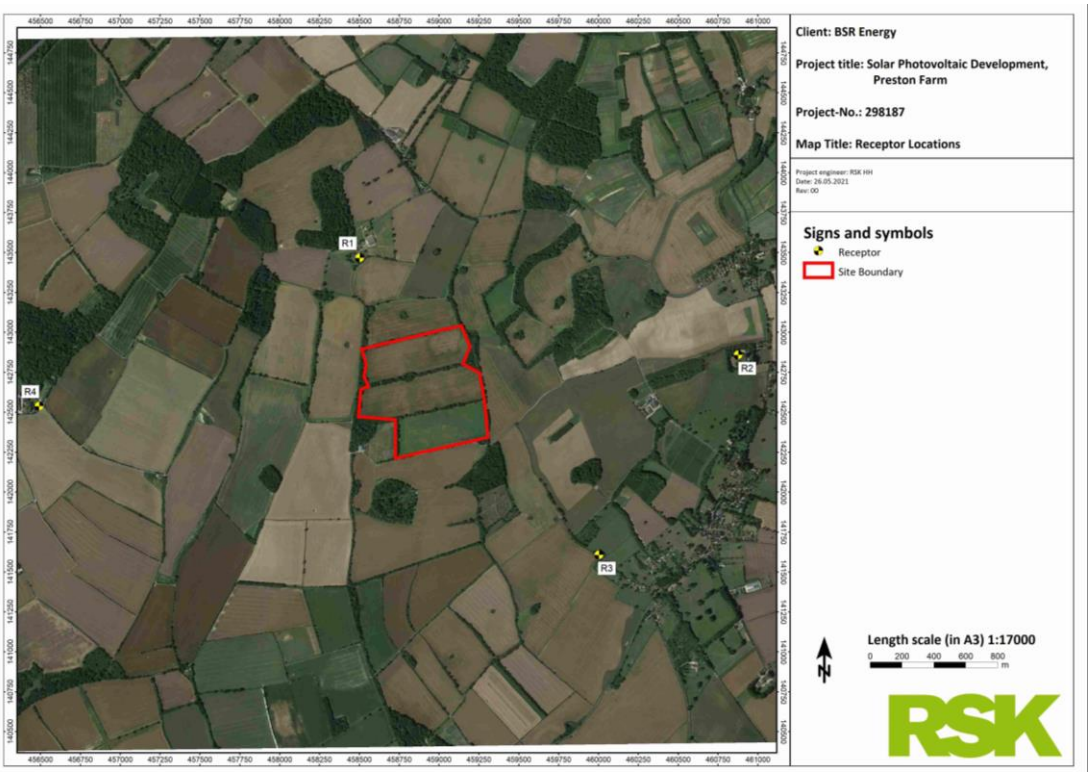


Figure 3.1 Site Boundary and Assessment Receptors

4 NOISE SURVEY METHOD

4.1 Survey Measurement Details

A baseline noise survey was undertaken between Thursday 20 May and Thursday 27 May 2021 with the acquisition of seven days of continuous noise data. Four unattended measurements (ML1 to ML4) were undertaken over a representative midweek and weekend period at representative positions along or adjacent to the development boundary.

Discussions with BSR Energy prior to and during installation were had to agree the most appropriate locations, taking into account the site constraints, security and accessibility of the monitoring equipment. It was deemed not possible to install the noise meters within the demise of the nearest sensitive receptors and therefore positions were chosen based on their proximity to those receptors and also to ensure security of the monitoring equipment. Observations made during installation determined that the noise environment at the monitoring positions were indeed consistent with that witnessed at the nearest receptor locations.

A description of the measurement position and rationale is provided in **Table 4.1**:

Table 4.1 Measurement Location Details

No.	Type*	Location	Rationale
ML1	U	Northern Boundary	To provide a representative baseline measurement at R1 (Breach Farm)
ML2	U	Eastern Boundary	To provide a representative baseline measurement at R2 (Fawkners)
ML3	U	Southern Boundary	To provide a representative baseline measurement at R3 (Tulls Hills)
ML4	U	Eastern Boundary	To provide a representative baseline measurement at R4 (Manor Farm)

** U – unattended*

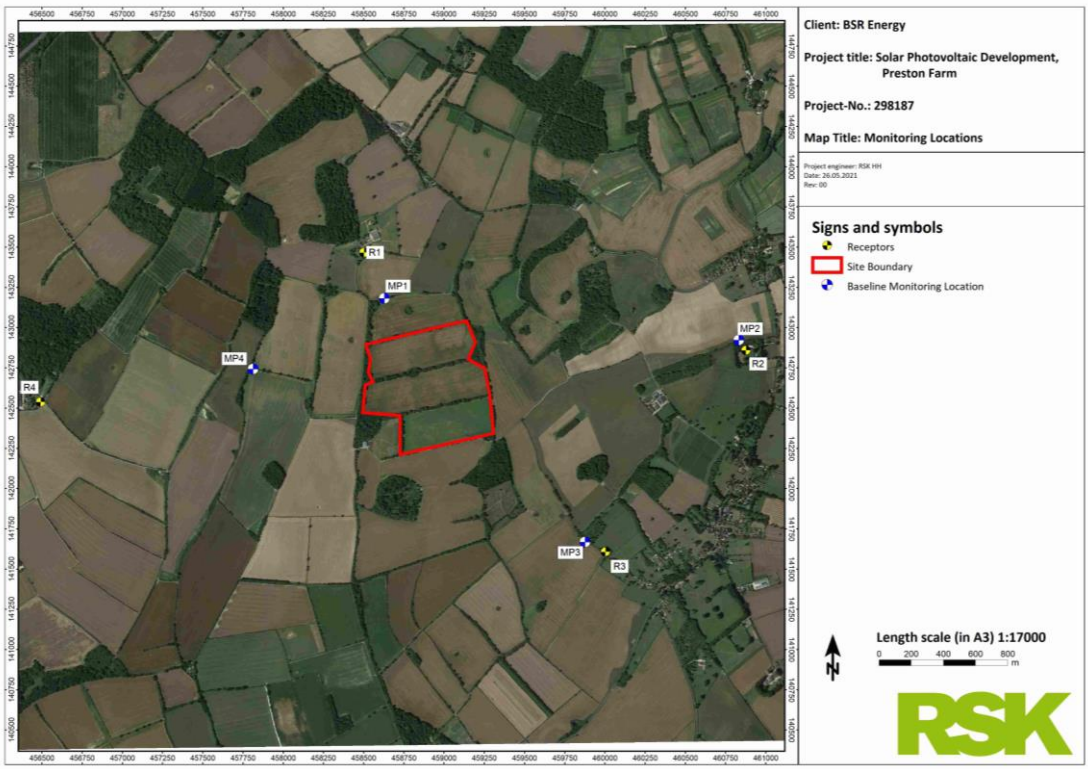


Figure 4.1 Measurement Locations

4.2 Survey Equipment

Noise monitoring was undertaken using the following equipment:

Table 4.2 Monitoring Equipment

Equipment	Type	Serial number	Calibration date
Class 1 Sound Level Meter	Rion NL-52	976246	19/12/2019
		976250	19/12/2019
		1043373	15/04/2021
		643029	06/11/2019
Acoustic Calibrator	Rion NC-74	34291338	23/06/2020

All measurements were undertaken in free field conditions with the microphone positioned away from reflecting surfaces and at 1.5 metres above the ground height to the requirements of BS 7445.

The calibration of each sound level meter was checked before and after the measurements, using the acoustic calibrator at 94 dB at 1 kHz; no significant calibration drift was noted.

The sound level meters used conform to the requirements of *BS EN 61672-1: 2013 Electroacoustics. Sound level meter, Specifications*. The calibrator used conforms to the requirements of *BS EN 60942: 2018 Electroacoustics, Sound calibrators*. The equipment used has a calibration history that is traceable to a certified calibration institution.

Measurements were logged in continuous 15-minute integration periods and obtained using a combination of broadband and one-third octave frequency indices; L_{Aeq}, L_{A10}, L_{A90} and L_{Amax}.

4.3 Noise Environment

The noise environment across the measurement locations were subjectively noted to be largely quiet, with little influence from road traffic or commercial noise sources, owing to the remote location of the proposed development site. Intermittent agricultural activity associated with farm operations was noted by RSK personnel, and occasional overhead aircraft movements were also noted. Noise associated with vehicle movements along the B3046 was noted at measurement location ML3 (south-west boundary). To a lesser extent the noise environment was also affected by bird song and leaf rustle.

4.4 Weather Conditions

Representative weather conditions of the area during the monitoring period were obtained from *www.wunderground.com* (Station ID: INORTHWA17 situated in North Waltham village – approximately 4.2 km north of the development site) and are summarised in **Table 4.3**.

Table 4.3 Summary of Weather Data

Date/Time	Average Temperature / ºC	Average Wind Speed / ms^{-1}	Dominant Wind Direction	Weather Conditions / Precip. Accum.
20/05/21 – 12:00	12.6	1.0	South-east	Light rain – 1.78mm
21/05/21 – 00:00	10.5	1.1	North-east	Light rain – 1.27mm
21/05/21 – 12:00	11.5	1.1	South-west	Light rain – 1.27mm
22/05/21 – 00:00	9.6	1.0	West	Light rain – 0.25mm
22/05/21 – 12:00	11.6	0.2	South-west	Light rain – 1.02mm
23/05/21 – 00:00	6.1	0.1	South-west	Light rain – 1.02mm
23/05/21 – 12:00	12.4	0.4	South-west	Rain – 10.9mm
24/05/21 – 00:00	10.6	0.1	South-west	Light rain – 1.78mm
24/05/21 – 12:00	11.2	0.5	South-west	Light rain – 0.25mm
25/05/21 – 00:00	7.2	0.1	South-west	Dry
25/05/21 – 12:00	12.8	0.6	North-west	Light rain – 2.29mm
26/05/21 – 00:00	8.6	0.1	South-west	Dry
26/05/21 – 12:00	15.2	0.2	West	Dry
27/05/21 – 00:00	8.1	0.1	SSW	Dry
27/05/21 – 12:00	17.9	0.4	South-west	Dry

Further analysis of the continuous weather data, in conjunction with audio recording at ML1, indicates several periods of unfavourable weather conditions (i.e. precipitation, and/ or high winds above 5 $m.s^{-1}$) during the monitoring period. As such, these periods have subsequently been removed from the analysis and have not been used to inform the assessment. The data omitted from the analysis is as follows:

- 20 May 2021: 17:00 - 18:30 and 23:00 - 07:00;
- 21 May 2021: 07:30 - 11:15
- 23 May 2021: 19:30 - 22:00.

5 NOISE SURVEY RESULTS

Measured noise levels at unattended survey locations ML1 – ML4 are summarised in **Tables 5.1 to 5.4** below.

Due to a power regulation fault at monitoring location ML2, it was not possible to retrieve a full dataset at this location. The reduced dataset is provided in Table 5.2 for comparative purposes; data from this monitoring location has subsequently not been used to inform the assessment.

5.1 Long Term Monitoring

Table 5.1 Noise Survey Results – Unattended location ML1

Date	Time period	Measured noise levels, dB (1)			
		$L_{Aeq,T}$	$L_{AFmax,15min}$ (range)	$L_{A90,T}$	$L_{A10,T}$
20/05/2021	13:45 – 23:00	56	65 - 75	59	65
	23:00 – 07:00	53	62 - 77	56	62
21/05/2021	07:00 – 23:00	51	50 - 72	51	57
	23:00 – 07:00	45	39 - 75	42	47
22/05/2021	07:00 – 23:00	44	39 - 76	41	49
	23:00 – 07:00	40	35 - 72	38	44
23/05/2021	07:00 – 23:00	53	48 - 76	52	57
	23:00 – 07:00	40	39 - 68	38	43
24/05/2021	07:00 – 23:00	47	44 - 78	46	54
	23:00 – 07:00	46	42 - 79	43	48
25/05/2021	07:00 – 23:00	47	39 - 81	43	50
	23:00 – 07:00	44	35 - 74	41	45
26/05/2021	07:00 – 23:00	51	35 - 86	46	55
	23:00 – 07:00	46	28 - 75	35	42
27/05/2021	07:00 – 11:15	52	46 - 90	45	56
Average(2)	**Daytime**	**52**	**--**	**48**	**55**
	Night-time	**47**	**--**	**39**	**47**

(1) *$L_{Aeq,T}$ values are the logarithmic average of $L_{Aeq,15min}$ samples, and the $L_{A10,T}$ and $L_{A90,T}$ are the arithmetic average of $L_{A10,15min}$ and $L_{A90,15min}$ samples.*

(2) *Arithmetic average of derived daytime 16hr and night-time 8hr values. Part time periods on 20.05.21 and 27.05.21 also included.*

Table 5.2 Noise Survey Results – Unattended location ML2

Date	Time period	Measured noise levels, dB (1)			
		$L_{Aeq,T}$	$L_{AFmax,15min}$ (range)	$L_{A90,T}$	$L_{A10,T}$
20/05/2021	16:30 – 17:30	52	53 - 84	44	52
27/05/2021	13:30 – 15:30	46	57 - 84	32	44
Average	**Daytime**	**49**	**--**	**37**	**47**
	Night-time	**N/A**	**--**	**N/A**	**N/A**

(1) *$L_{Aeq,T}$ values are the logarithmic average of $L_{Aeq,15min}$ samples, and the $L_{A10,T}$ and $L_{A90,T}$ are the arithmetic average of $L_{A10,15min}$ and $L_{A90,15min}$ samples.*

Table 5.3 Noise Survey Results – Unattended location ML3

Date	Time period	Measured noise levels, dB (1)			
		$L_{Aeq,T}$	$L_{AFmax,15min}$ (range)	$L_{A90,T}$	$L_{A10,T}$
20/05/2021	13:45 – 23:00	62	68 - 83	53	65
	23:00 – 07:00	62	67- 80	52	64
21/05/2021	07:00 – 23:00	62	60 - 83	51	63
	23:00 – 07:00	46	47 - 65	38	48
22/05/2021	07:00 – 23:00	43	37 - 85	32	41
	23:00 – 07:00	35	33 - 61	28	34
23/05/2021	07:00 – 23:00	57	51 - 77	45	56
	23:00 – 07:00	40	39 - 67	32	39
24/05/2021	07:00 – 23:00	48	41 - 73	38	47
	23:00 – 07:00	41	34 - 73	32	38
25/05/2021	07:00 – 23:00	47	36 - 78	37	46
	23:00 – 07:00	36	32 - 63	30	35
26/05/2021	07:00 – 23:00	54	33 - 98	32	44
	23:00 – 07:00	38	30 - 68	25	34

Date	Time period	Measured noise levels, dB (1)			
		$L_{Aeq,T}$	$L_{AFmax,15min}$ (range)	$L_{A90,T}$	$L_{A10,T}$
27/05/2021					
	07:00 – 14:30	42	46 - 71	33	44
Average(2)	**Daytime**	**57**	**--**	**40**	**51**
	Night-time	**53**	**--**	**34**	**41**

(1) *$L_{Aeq,T}$ values are the logarithmic average of $L_{Aeq,15min}$ samples, and the $L_{A10,T}$ and $L_{A90,T}$ are the arithmetic average of $L_{A10,15min}$ and $L_{A90,15min}$ samples.*

(2) *Arithmetic average of derived daytime 16hr and night-time 8hr values. Part time periods on 20.05.21 and 27.05.21 also included.*

Table 5.4 Noise Survey Results – Unattended location ML4

Date	Time period	Measured noise levels, dB (1)			
		$L_{Aeq,T}$	$L_{AFmax,15min}$ (range)	$L_{A90,T}$	$L_{A10,T}$
20/05/2021	14:45 – 23:00	59	62 - 90	50	60
	23:00 – 07:00	57	63 - 75	50	59
21/05/2021	07:00 – 23:00	58	52 - 80	51	60
	23:00 – 07:00	46	45 - 73	39	47
22/05/2021	07:00 – 23:00	47	43 - 77	36	45
	23:00 – 07:00	41	42 - 73	34	41
23/05/2021	07:00 – 23:00	56	56 - 79	47	57
	23:00 – 07:00	44	45 - 76	36	43
24/05/2021	07:00 – 23:00	49	46 - 81	40	49
	23:00 – 07:00	45	44 - 76	40	44
25/05/2021	07:00 – 23:00	49	42 - 80	39	47
	23:00 – 07:00	48	40 - 80	36	42
26/05/2021	07:00 – 23:00	49	41 - 81	35	45
	23:00 – 07:00	45	34 - 78	27	37
27/05/2021	07:00 – 11:45	49	52 - 88	30	46
Average(2)	**Daytime**	**54**	**--**	**41**	**51**

Date	Time period	Measured noise levels, dB (1)			
		$L_{Aeq,T}$	$L_{AFmax,15min}$ (range)	$L_{A90,T}$	$L_{A10,T}$
	Night-time	**50**	**--**	**35**	**45**

(1) *$L_{Aeq,T}$ values are the logarithmic average of $L_{Aeq,15min}$ samples, and the $L_{A10,T}$ and $L_{A90,T}$ are the arithmetic average of $L_{A10,15min}$ and $L_{A90,15min}$ samples.*

(2) *Arithmetic average of derived daytime 16hr and night-time 8hr values. Part time periods on 20.05.21 and 27.05.21 also included.*

Averaged noise levels measured across the site show a maximum fluctuation of 5 dB(A) $L_{Aeq,T}$ for the daytime period and 6 dB(A) for night-time periods, with a highest daytime level ($L_{Aeq,16h(07:00-23:00)}$) of 57 dB and night-time level ($L_{Aeq,8h(23:00-07:00)}$) of 53 dB measured towards the south of the site at monitoring position ML3.

5.2 Derivation of Background Noise Levels

Given the development is scheduled to operate 24 hours, the representative background noise levels are provided for day and night-time periods. The methodology detailed in BS 4142: 2014+A1: 2019 provides an example of statistical analysis to determine the representative background noise level during the daytime ($L_{A90,\ 1hr}$) and night-time ($L_{A90,\ 15min}$). The following analysis adopts the methodologies applied within the aforementioned standard:

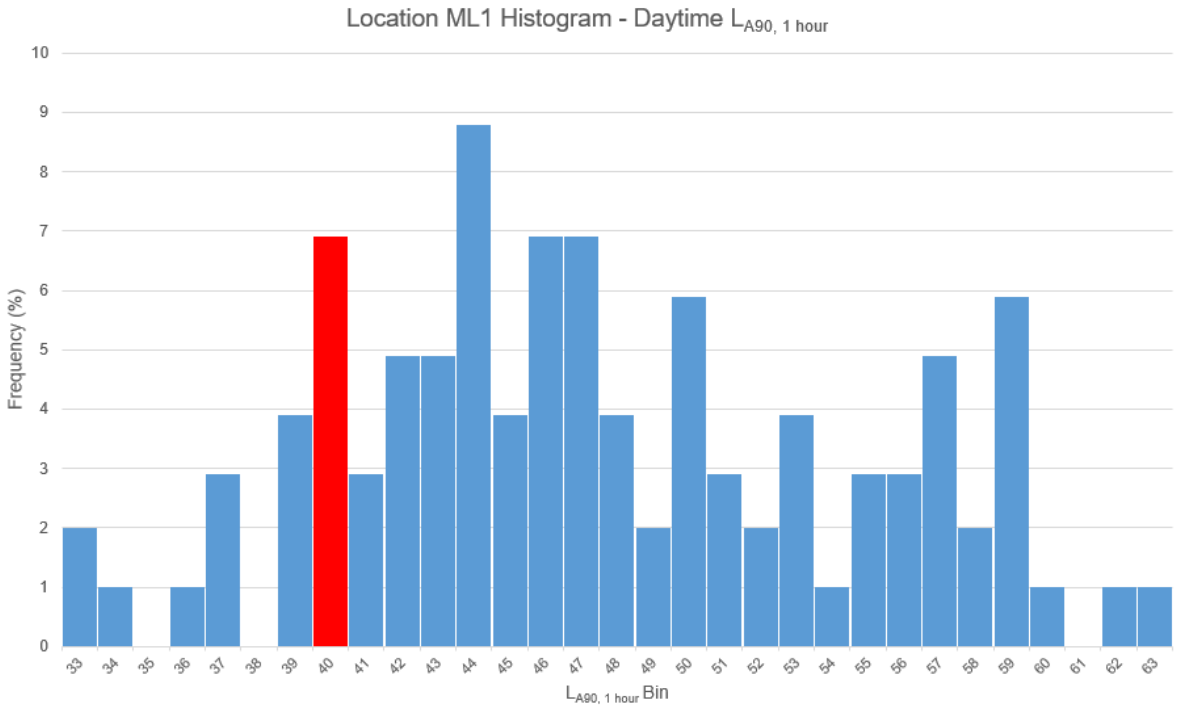


Figure 5.1 Statistical Analysis of Daytime Background Noise Levels – ML1

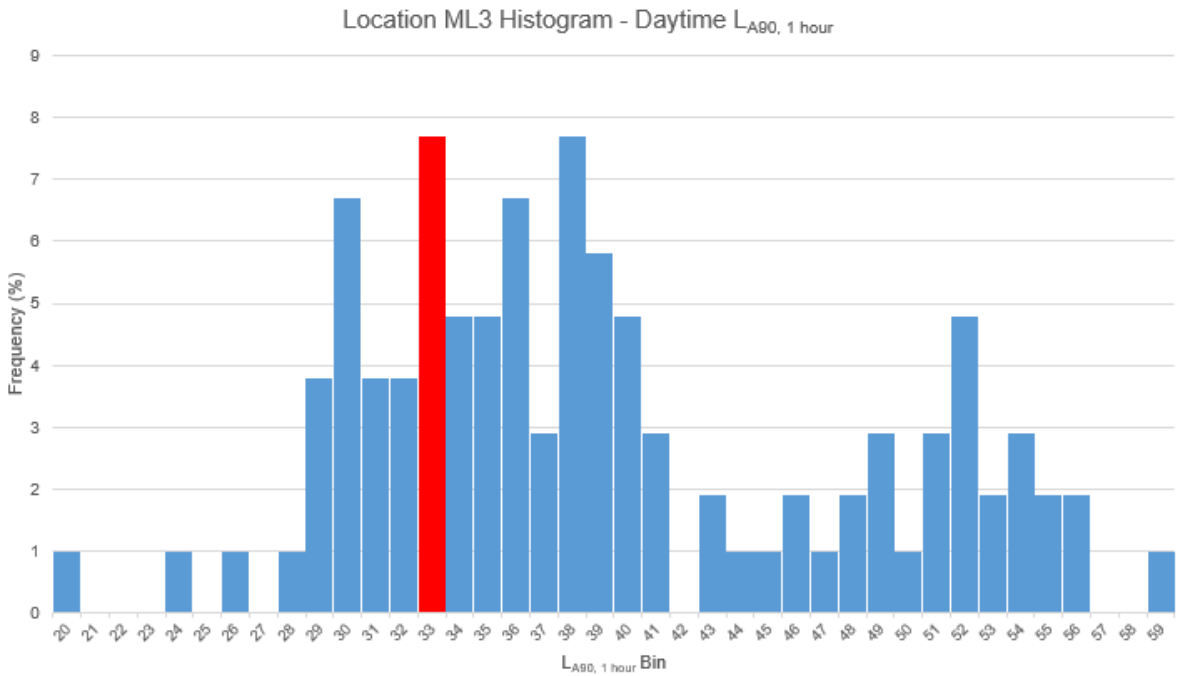


Figure 5.2 Statistical Analysis of Daytime Background Noise Levels – ML3

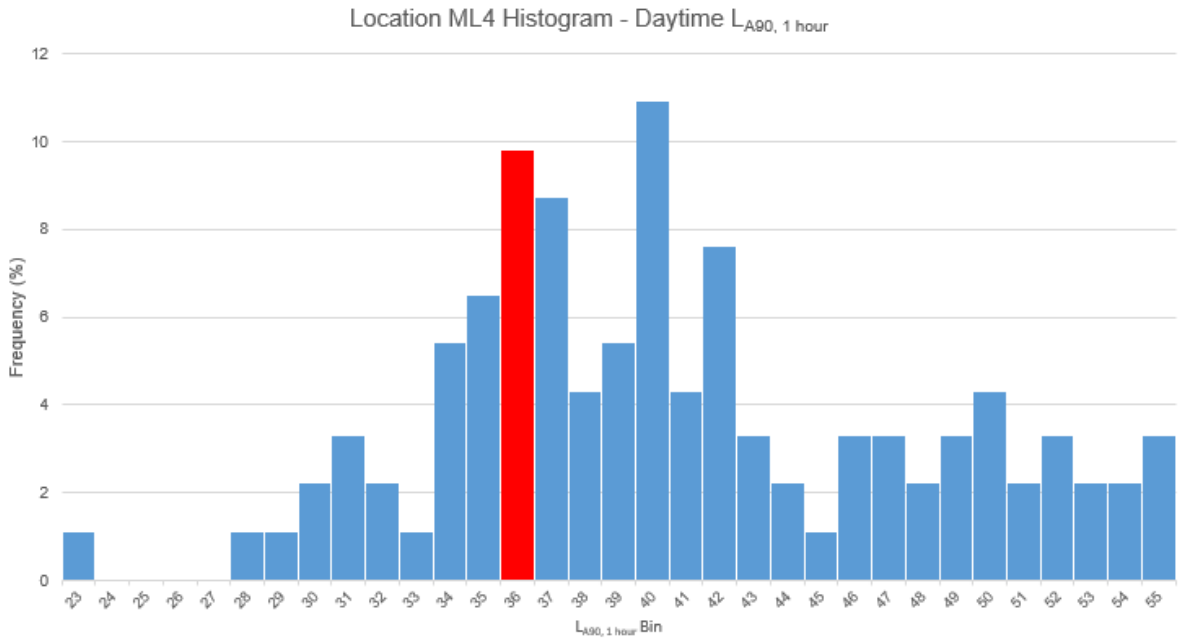


Figure 5.3 Statistical Analysis of Daytime Background Noise Levels – ML4

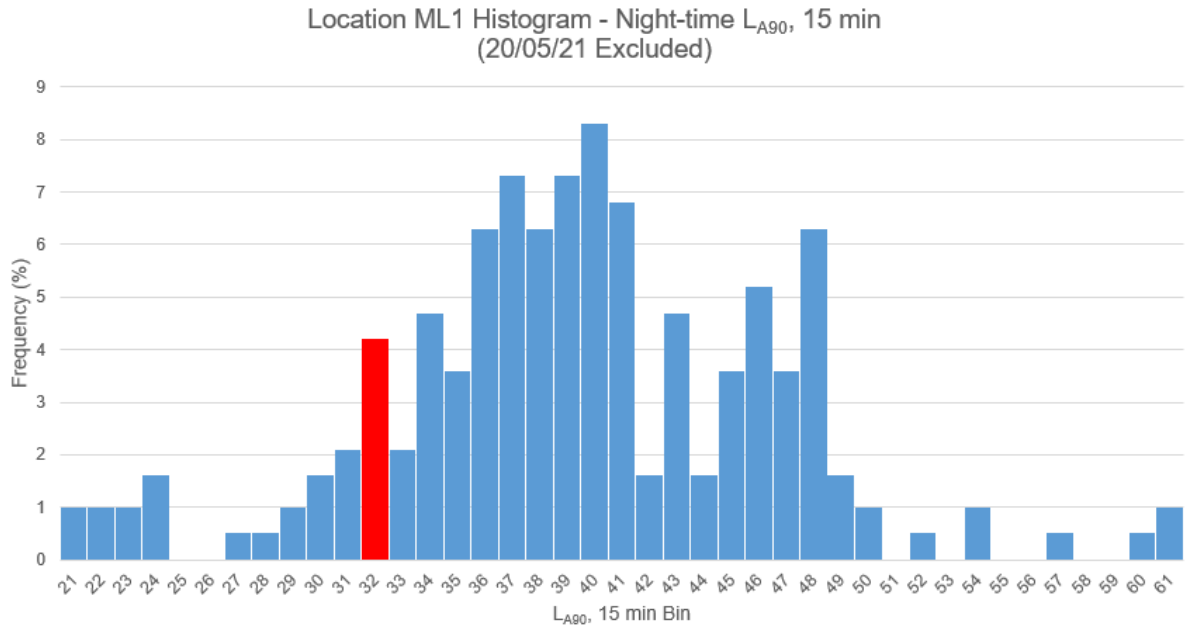


Figure 5.4 Statistical Analysis of Night-time Background Noise Levels – ML1

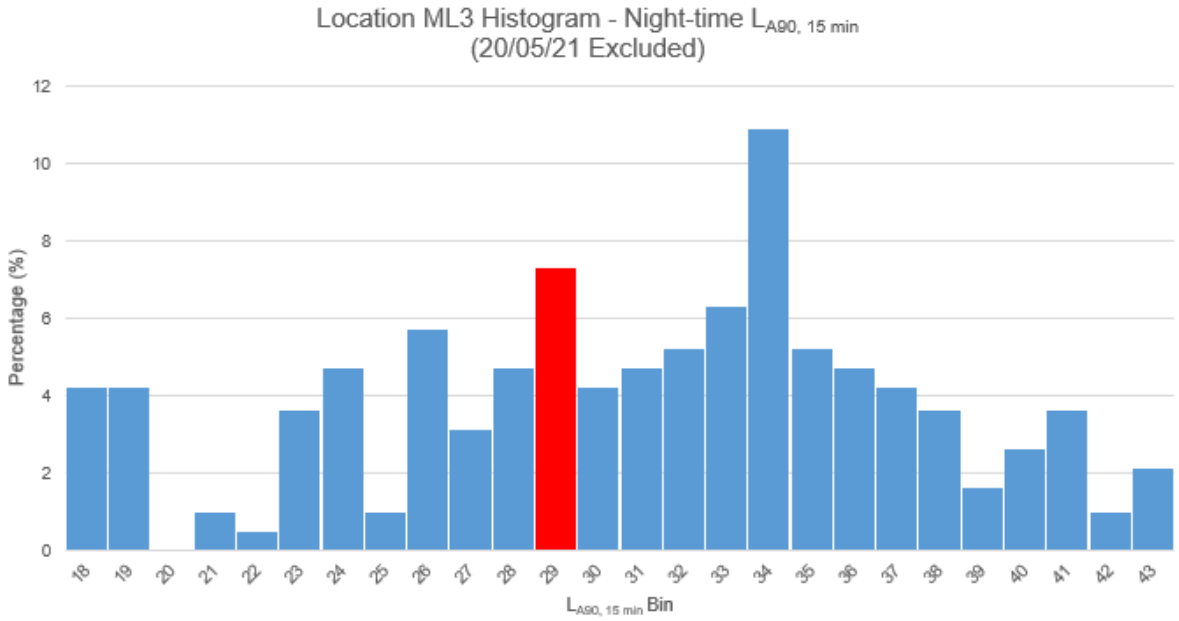


Figure 5.5 Statistical Analysis of Night-time Background Noise Levels – ML3

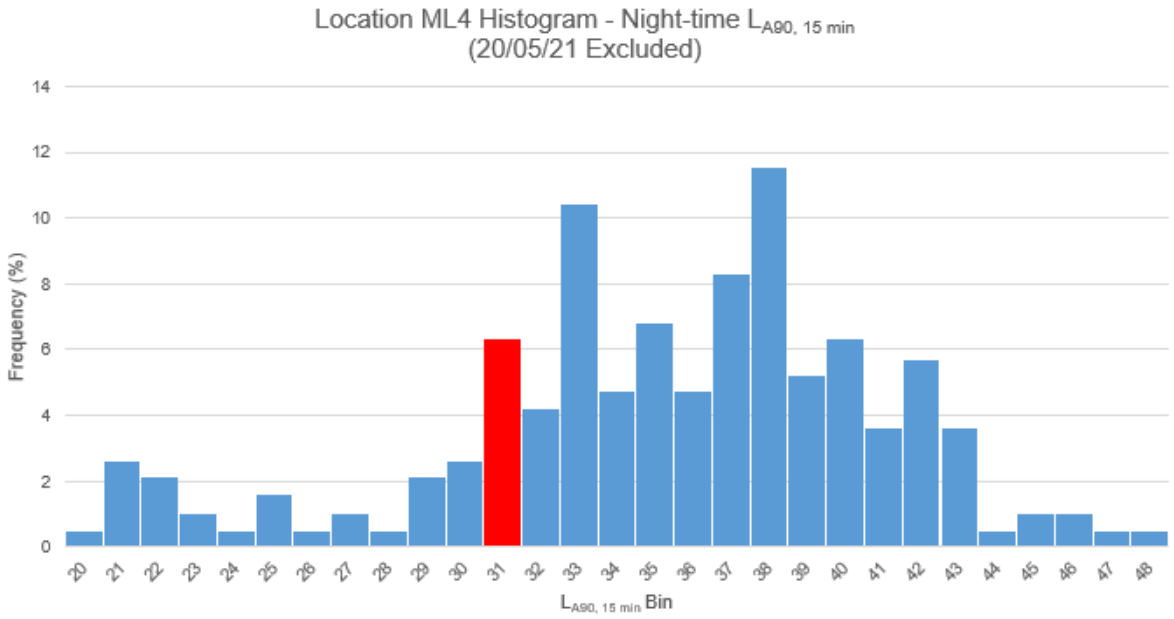


Figure 5.6 Statistical Analysis of Night-time Background Noise Levels – ML4

6 NOISE MODELLING

6.1 Overview

A computer noise model of the proposed development has been constructed using SoundPLAN v8.2, based on the indicative site layout presented in **Appendix 1**.

Input data in the form of sound pressure levels from the noise emitting items of plant (during the operational phase), has been provided by BSR Energy.

The noise predictions are based on International Standard ISO 9613-2:1996 *'Attenuation of sound during propagation outdoors – general method of calculation'*. ISO 9613 provides a method for the prediction of noise levels in the community from sources of known sound emission.

The noise prediction method described in ISO 9613 is suitable for a wide range of engineering applications where the noise level outdoors is of interest. The noise source(s) may be moving or stationary and the method considers the following major mechanisms of noise attenuation:

- Geometrical divergence (also known as distance loss or geometric damping);
- Atmospheric absorption;
- Ground effect;
- Reflection from surfaces; and
- Screening by obstacles, barriers and buildings.

6.2 Modelling Parameters

The ISO 9613-2 method predicts noise levels under meteorological conditions favourable to noise propagation from the sound source to the receiver, such as downwind propagation, or equivalently, propagation under a moderate ground-based temperature inversion as commonly occurs at night.

The model has been set up using the following parameters:

Table 6.1 Modelling Parameters

Item	Setting
Algorithms	Source noise - ISO 9613-2:1996 '*Attenuation of sound during propagation outdoors – general method of calculation'*. Construction noise – BS 5228-1: 2009+ A1: 2014 *'Code of practice for noise and vibration control on construction and open sites – Part 1: Noise'*
Ground Absorption	Acoustically hard (assumed 0.1 coefficient) – built-up areas and water surface. Acoustically soft (assumed 0.9 coefficient) – undeveloped and vegetation areas.
Meteorological Conditions	10 degrees Celsius. 70% humidity. Wind from source to receiver.

Item	Setting
Façade Corrections	A free-field level predicted value at 1 metre from each receptor façade is taken into consideration for the purpose of the assessment.
Receptor Height	Ground Floor 1.5 metres and first floor 4 metres above ground.
Source Modelling	See Section 6.3 and 6.4.
Terrain	LiDAR DTM with a 2-metre resolution has been imported into the model.
Site Layout	Digitised based on site layout as per Appendix 1.

6.3 Construction Source Noise Data

The following construction activities are considered to be those with the potential to result in adverse noise effects:

- Installation of mounting frames and panels;
- Construction of the substation and compound areas;
- HGV movements along the access track (for site deliveries, operations etc.).

In the absence of specific project information, the above construction tasks have been assigned an indicative list of the likely plant items. These plant lists have been used to predict the likely noise level during the construction phase. The plant items used in the assessment are provided in **Table 6.2** and reproduced in **Appendix 3**.

Table 6.2 Construction Source Noise Levels

Item	Task	Total Noise Level (L_p) at 10 m dB(A)
1	Installation of mounting frames and panels	75
2	Construction of the substation and compound areas	76

In the absence of construction traffic flows, an estimate of 5 HGVs (10 movements) per hour (truck pass-by sound power level of 108 L_{WA}) operating at 15 mph, has been utilised for the assessment of construction related traffic noise for each task.

It is deemed that there would not be sufficient levels of vibration generated during construction works to significantly impact on those nearest receptors. Potential vibration generating activities would produce negligible levels and as such, have been discounted for the purposes of assessment.

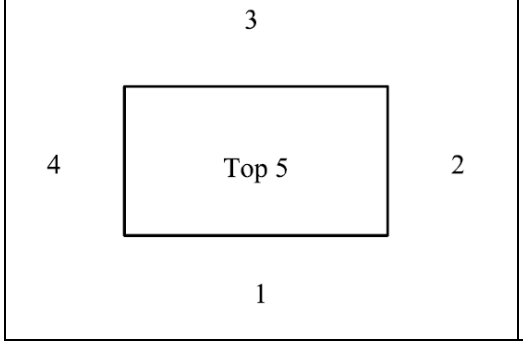
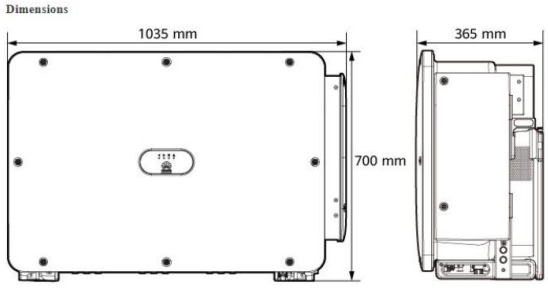
6.4 Operational Source Noise Data (unmitigated)

Inverter Stations (Array Location)

Discussions with BSR Energy have concluded that the primary source of noise emission would be the operation of the inverter stations, which would be positioned at one side of each row of the solar panels. The role of an inverter station is to convert DC (direct current) generated from a cluster of solar panels into AC (alternating current) for National Grid and domestic use.

The following noise levels have been assigned to the inverter stations, based on the acoustics test section within *'IEC60721-3-4 4K4H Environment Test Report'* document:

Table 6.3 Inverter Reference Noise Level

Item	Type	SPL at 1m dB(A)
1	Huawei SUN2000-185KTL (5-sided emitter)	62
		

The inverter element has been calibrated using a receiver positioned at 1 metre distance from each of the five emitting surfaces (horizontally and vertically) and at 1.5 metres height relative to the ground level to achieve the reference noise levels summarised above. All plant items have been incorporated as an outdoor source continuously in operation (steady state regime with 100% operational capacity).

Transformer Stations (Array Location)

These plant items would be distributed at either side along the access roads within the solar farm, every certain number of panel rows, as shown in Appendix 1.

A sound power of 58 dB L_{WA} corresponding to a 1600 kVA unit according to DIN EN 50588 has been assigned to each side of a 5-sided emitter of 3.2 metres height.

DNO Switchgear and Private Switchgear buildings

One distribution network operator (DNO) Switchgear Station and one Private Switchgear Station will be located to the south-east of the proposed development site, as shown with Appendix 1. No noise data has been provided for the switchgear buildings, and therefore an indicative sound pressure level of 65 dB(A) at 1 m from the façade has been assigned to each side of a 5-sided emitter station at 3.2 metres height.

Table 6.4 Switchgear Noise Levels

Item	Type	SPL@1m dB(A)
1	DNO Switchgear Station	65
2	Private Switchgear Station	65

Both switchgear buildings have been calibrated using a receiver positioned at 1 metre distance from an emitting surface and at 1.5 metres from ground level for any vertical area source and 1 metre above roof level (roof source). All plant items have been incorporated as an outdoor source continuously in operation (steady state regime with 100% operational capacity).

7 CONSTRUCTION NOISE

7.1 Predicted Noise Levels

A construction noise impact assessment has been undertaken adopting the calculations for mobile plant items and the movement of lorries along the haul road, to the requirements of BS 5228-1: 2009+ A1: 2014 '*Code of practice for noise and vibration control on construction and open sites – Part 1: Noise'*.

Individual tasks and plant items likely to be required in order to construct the development have been derived from RSK's experience of similar projects. At this stage, the exact type and number of plant items is unknown however, the total noise levels are not expected to deviate significantly from those assumed within this assessment. Plant lists, to inform the noise predictions are provided in **Appendix 3**.

Construction noise predictions for those individual task items for a full daytime period (construction core hours) are provided in **Table 7.1**.

Table 7.1 Construction Noise Assessment – Individual Tasks

Ref.	Activity	Predicted Noise Level, dB $L_{Aeq, T}$		
		Task 1	Task 2	Haul Road
R1	Breach Farm	31	33	20
R2	Fawkners	23	24	32
R3	Tulls Hill	26	27	25
R4	Manor Farm	20	21	12

Task 1. Installation of mounting frames and panels
Task 2. Construction of the substation and compound areas
Integration period T assume standard core hours Mon-Fri 08:00-18:00 and Sat 08:00-13:00.

7.2 Construction Assessment

The assessment of construction noise against the threshold criteria has adopted the principles of the 'ABC Method' within the aforementioned BS 5228 standard. The baseline noise levels indicated that all receptors would fall within the lowest Category A criteria for construction work during standard core hours (Monday to Friday 07:00 – 19:00 and Saturday 07:00 – 13:00).

For all of the proposed construction works, it is anticipated that noise levels would be below the threshold noise criteria of 65 dB $L_{Aeq, T}$. Predictions indicate a highest predicted noise level at Breach Farm of 33 dB $L_{Aeq, T}$ as a result of the construction of the inverter stations (task 2).

Predictions indicate that the noise impact from construction related activity would be significantly below the lowest adopted threshold of 65 dB $L_{Aeq, 12hrs}$.

Calculations have been undertaken to a worse-case scenario, assuming that all items of plant operate simultaneously at the closest possible point to each of the receptor locations, with direct line of sight between source and receiver. In reality, this is unlikely to be the case and absolute worst case predicted levels may only last for a short period of time due to the transient nature of the works.

7.3 Construction Noise and Vibration Management

Although predicted construction noise levels fall below the category A criteria of the 'ABC method' as detailed within BS 5228, it is recommended that the contractor shall, in so far as is reasonably practicable, control and limit noise levels. Best Practicable Means (BPMs) shall be employed at all times.

Details of the site activities and steps to minimise noise are set out in the following sections. Measures to be considered in implementing BPMs will be consistent with the recommendations of BS 5228-1:2009+A1: 2014 'Code of practise for noise and vibration and open sites'.

7.3.1 Control of Construction Vehicles

The following details a number of mitigation measures and best practice details which should be utilised during the movement of construction vehicles and HGV's:

- Choice of routes and programming for the transport of construction materials, spoil and personnel;
- Contact will be made with local authorities, where required to ensure that planned designated routes are set in place to minimise disturbance;
- Vehicle weight limits will be taken into consideration and permits obtained from transport authorities if warranted;
- Site speed limits will be set to minimise noise and vibration levels if required;
- Efforts will be taken to reduce numbers of staff/operative cars, and crew buses will be utilised where practicable;
- Deliveries should be carried out within the time limits set by consented conditions and local agreements;
- All vehicles and mechanical plant used for the purpose of the work shall be fitted with effective exhaust silencers and shall be maintained in good and efficient working order and operated to minimise noise emissions;
- All machines in intermittent use shall be shut down in the intervening periods between work or throttled down to a minimum;
- Lorry engines will be switched off when vehicles are stationary;
- As far as reasonably practicable, noise from reversing alarms will be managed through the following hierarchy of techniques:
    - The site layout will be designed to limit and where reasonably practicable, avoid the need for the reversing of vehicles. Measures will be undertaken to ensure that drivers are familiar with the worksite layout.
    - Banksmen will be utilised to avoid the use of reversing alarms.
    - Reversing alarms incorporating one of more of the features listed below or any other comparable system will be used where reasonably practicable:
        - Highly directional sounders;
        - Use of broad band signals;
        - Self adjusting output sounders; and

- Flashing warning lights.

  - Reversing alarms will be set to the minimum output noise level required for health and safety compliance.

- Toolbox talks will be carried out to ensure that the all site staff is aware of their environmental responsibilities and of the sensitivities of the vicinity. These will also ensure that Best Practicable Means of control are delivered on the site.

7.3.2 Control of Construction Activities

Best Practicable Means (BPM) should be employed at all times to minimise noise and vibration. The following general measures are recommended to control noise and vibration:

- Careful selection of plant and construction methods. Only plant conforming to relevant national, EU or international standards, directives and recommendations on noise and vibration emissions will be used;
- Design and use of site enclosures, housing and temporary stockpiles, where practicable and necessary, to provide acoustic screening at the earliest opportunity. Where practicable, doors and gates shall not be located opposite occupied noise-sensitive buildings. The mechanisms and procedures for opening doors/gates will minimise noise, as far as reasonably practicable;
- Careful programming so that activities which may generate significant noise are planned with regard to local occupants and sensitive receptors.
- Each item of plant used on the project will comply with the noise limits quoted in the relevant European Commission Directive 2000/14/EC/United Kingdom Statutory Instrument (SI) 2001/1701 (as amended). A register of plant and equipment and statutory certification will be completed for each construction zone;
- The recommendations set out in BS5228 shall be adopted with regard to noise and vibration mitigation options. Where alternative authoritative guidance and procedures are thought to be more appropriate and have been agreed in advance with the relevant local authority, these may be adopted in place of the aforementioned;
- Where relevant, all compressors and generators shall be “sound reduced” models fitted with properly lined and sealed acoustic covers which shall be kept closed whenever the machines are in use, and all pneumatic percussive tools shall be fitted with mufflers or silencers of the type recommended by the manufacturers;
- All machines in intermittent use shall be shut down in the intervening periods between work or throttled down to a minimum;
- Noise emitting equipment which is required to run continuously shall be housed in a suitable acoustic enclosure;
- As far as practicable, demolition shall be carried out using equipment that breaks concrete in bending in preference to percussive methods;
- Plant and equipment liable to create noise and/or vibration whilst in operation will, as far as reasonably practicable, be located away from sensitive receptors and away from walls reflecting towards sensitive receptors;

- Materials for working shall be delivered during core hours (08:00-18:00 Monday to Friday and 0800-1300 Saturdays) and be placed as close as possible to the work area for which they are required;
- Where reasonably practicable, fixed items of construction plant should be electrically powered in preference to diesel or petrol driven;
- Machines in intermittent use should be shut down or throttled down to a minimum during periods between work. Static noise emitting equipment operating continuously will be housed within suitable acoustic enclosure, where appropriate. Doors on plant and equipment will be kept closed;
- All generators and compressors will be 'sound reduced' models fitted with acoustic lining/sealed acoustic covers where appropriate;
- All ancillary pneumatic percussive tools will be fitted with mufflers or silencers as recommended by the manufacturer;
- Best practicable means will be used to control the potential impact of soil relaxation on surrounding properties; and
- Toolbox talks will be carried out to ensure that the all site staff is aware of their environmental responsibilities and of the sensitivities of the vicinity. These will also ensure that Best Practicable Means of control are delivered on the site.

7.3.3 Neighbour Notification

The following neighbour notification procedures will be followed during the operational works:

- Prior to work commencing, the Contractor will liaise with Local Environmental Officer in order to discuss their methods of working and measures planned to minimise disruption throughout the construction works;
- Occupiers of nearby properties shall be informed in advance of the works taking place where relevant, including the duration and likely noise and vibration impacts (compaction and piling activities). In the case of work required in response to an emergency, the local authority and local occupiers shall be advised as soon as reasonably practicable that emergency work is taking place. Potentially affected occupiers will also be notified of the helpline number;
- The Contractor should appoint a responsible person to liaise with stakeholders in order to keep them informed of matters likely to affect them;
- Prior to site work commencing (at least one week before the works or a change in works), neighbours will be informed of:
    - The start date;
    - The duration and nature of the project;
    - The principal stages of the project;
    - Possible impacts; and
    - Details of contact names and numbers of appropriate site personnel.

- The names and contact details of appropriate site personnel should be forwarded to Local Environmental Officer;
- The contractor will take into account consultation responses received from the neighbours and will have regard to any reasonable requests by the relevant local authority.

7.3.4 Complaints Procedure

Any external complaint being received in regard to noise or vibration disturbance arising from the construction works shall be logged and immediately investigated by the Environmental Manager in conjunction with the Site Manager. Where necessary, temporary actions will be taken in order to reduce noise levels until further assessment can be carried out. The investigation will look at BPM and the construction methodology used at the time of complaint.

Details from the complaint and all activities undertaken on site will be recorded and remedial actions taken where necessary. Any operational procedures affected by the re-assessment of impacts following the complaint investigation will be reviewed and approved by the Site Manager.

7.3.5 Noise Monitoring Procedure

Should noise monitoring be requested or required during the works, the following outline procedure would apply:

- Attended noise monitoring should be undertaken at nearest sensitive receptors (where access permits);
- Dependent on the measured noise levels, assessment against pre-determined noise criteria and the assessment of future noise inducing activities (based on programme and plant items), this monitoring schedule would be reviewed after a period of 1 year;
- The noise survey should be carried out during standard construction working hours (08:00 – 18:00 Monday to Fridays) for a minimum of one hour ($L_{Aeq, 1hr}$) per location and where possible be representative of those worse case activities (i.e. with special attention to those works involving the continuous use of noisy plant or situated at close proximity to sensitive receptors). One-hour measurements ($L_{Aeq, 1hr}$) should be assessed against the applicable noise criteria to assess compliance. Where activities change involving significant alterations to plant items and equipment, further measurements would be considered;
- The noise monitoring results will be used to assess compliance with the applicable noise criteria (*i.e.* 65 dB $L_{Aeq, T}$ midweek);
- In the event of complaints due to site activities, an investigation would be sought as soon as possible and where appropriate, additional noise monitoring would be conducted at closest position to the complainant's location in order to quantify site noise emissions and assess compliance;
- Noise measurements should be undertaken by a suitably qualified and competent person, affiliated to the Institute of Acoustics (IOA);
- All measurements should be undertaken in free field conditions, representative of those closes receptors, with the microphone positioned away from reflecting

surfaces and at 1.5 metres above ground height to the requirements of British Standard BS 7445-1:2003 *'Description and measurement of environmental noise. Guide to quantities and procedures*';

- Noise monitoring should be carried out during appropriate weather conditions, namely:
  - wind speed not exceeding 5 m/s (measured at a height of 3 to 11 m above the ground);
  - no strong temperature inversions near the ground; and
  - no heavy precipitation.
- The sound level meter proposed would be Class 1, with suitable traceable calibration history, and conform to the requirements of BS EN 61672-1: 2013 '*Electroacoustics – Sound level meters. Specifications*'. Field measurements would comprise of A-weighted broadband indices, to include L_{Aeq}, and L_{Amax};
- The calibration of the sound level meter would be checked before and after the measurements, using the acoustic calibrator at 94 dB (1 kHz); with any calibration drift noted. The acoustic calibrator would conform to the requirements of BS EN IEC 60942:2018 *'Electroacoustics. Sound calibrators'*;
- Detailed notes of observations made during the monitoring would be recorded, suitable to distinguish between construction and non-construction noise sources. Weather conditions would also be noted during the survey;
- The noise survey results would be analysed and assessed against the aforementioned noise criteria. The results would be compiled and included within a technical note, suitable for submission to the Local Planning Authority within one week (7 days) of the monitoring.

8 OPERATIONAL NOISE IMPACT

8.1 Acoustic Correction

As stated within BS 4142:2014+A1: 2019, where certain features of the specific noise level can increase the significance of impact of a sound level, a character correction is applied to provide a rated noise level. The characteristics of a sound that are likely to cause an increase in the significance of impact are tonality, impulsivity, intermittency or other characteristic features such as an identifiable 'hiss'.

Taking the above acoustic features into consideration, the application of rating penalties is as follows:

- Tonality - Octave band data is not available for the plant items. Due to the nature of the electrical and mechanical components to be installed however, it is likely that tonal elements may be 'just perceptible' at the nearest noise sensitive receptors. As such a 2 dB penalty for tonal characteristics has been applied;
- Impulsivity - The character of the sound from plant items will generally be of low level and constant, with no rapid change in the level or character of noise. It is therefore considered unnecessary to apply an impulsive correction; and
- Intermittency - It is considered that the plant items will not have identifiable on/off conditions, with many items operating at varying loads relative to both the intensity of light incident upon the solar panels and the air temperature. It is therefore considered unnecessary to apply an intermittency correction.

Based on information provided by the client and lack of octave band data to reference potential tones, the subjective method has been applied to correct the specific noise by +2 dB for a tone which is 'just perceptible' at the noise receptor. Operational plant items are unlikely to emit sources of noise which are either impulsive or intermittent in nature and therefore no further corrections have been applied.

8.2 Operational Assessment

The rated noise level (inclusive of penalty corrections) from site activity has been predicted as the contribution (energetic sum) of all active sources within the proposed development. This scenario provides a conservative interpretation of the resulting noise levels at receptor.

A noise criteria of 5 dB below the measured existing background noise level has been adopted, as specified within Basingstoke and Deane Council's technical guidance note 'Noise assessments and reports for planning applications: Guidance note for developers and consultants' for noise from new noise sources.

Due to the incomplete dataset at ML2, the representative background levels used for the assessment at R2 – Tulls Hill have been adopted from the measured data at location ML3. Both measurement locations ML2 and ML3 were at a comparable distance from the B3046, and the representative background noise levels derived at ML3 were the lowest of the long term measuring locations, thus providing for a conservative assessment.

An assessment of predicted rated noise levels, against the representative background noise at closest residential receptors are summarised in **Table 8.1**. Operational noise contours are provided in **Appendix 2**.

Table 8.1 Daytime Noise Assessment

Receptor	Rated Noise Level, L_{Ar}	Representative Background Noise Level, $L_{90, 1hr}$	Adopted Noise Criteria, dB	Excess over adopted noise criteria, dB
R1 - Breach Farm	21	40	35	-14
R2 - Fawkners	15	33	28	-13
R3 - Tulls Hill	17	33	28	-11
R4 - Manor Farm	12	36	31	-19

Table 8.2 Night-time Noise Assessment

Receptor	Rated Noise Level, L_{Ar}	Representative Background Noise Level, $L_{90, 15mins}$	Adopted Noise Criteria, dB	Excess over adopted noise criteria, dB
R1 - Breach Farm	21	32	27	-6
R2 - Fawkners	15	29	24	-9
R3 - Tulls Hill	17	29	24	-7
R4 - Manor Farm	12	31	26	-14

The highest rated noise level of 21 dB L_{Ar} is predicted at Breach Farm; this is the result of the sensitive receptor positioned at the closest distance to the development. Rated noise levels are 14 dB(A) below the adopted noise criteria of 35 dB(A) (i.e 5 dB below existing background sound level ($L_{A90, 1hr}$)). Rated operational noise levels (L_{Ar}) at the remaining residential receptors, would not exceed the adopted criteria of 5 dB(A) below the existing background level during daytime operations.

Predicted noise levels during night-time operations would be at their highest at Breach Farm. A rated noise level of 21 dB L_{Ar} is 6 dB(A) below the adopted noise criteria of 27 dB(A) at night. Likewise, rated operational noise levels (L_{Ar}) at the remaining residential receptors, would not exceed the adopted criteria of 5 dB(A) below the existing background level during night-time operations.

8.3 Conservatism in the Assessment

Whilst the solar panels emit no noise, they would likely act as a partial noise barrier in reducing plant emission levels from the inverters across the site. The actual level of noise reduction would be dependent on the positioning and angle of the panels and for this reason, the panels were not included in the noise model.

Operation of the inverters would be dependent on the level of sunlight incident on the panels. Noise is therefore unlikely to be emitted from these items during the majority of the night-time period however, operation of the inverters at night has still been included within the assessment. Furthermore, the assessment accounts for all array equipment simultaneously.

Given the conservatism outlined above, it is reasonable to assume that operational noise levels associated with the development are likely to be an over-prediction of the realistic noise levels experienced at sensitive receptors.

8.4 Uncertainty

BS 4142:2014+A1: 2019 requires that the assessment considers the level of uncertainty in the data and associated calculations. Consideration of the uncertainty can enable a

more informed decision regarding the likely significance of impact, within the context of assessment.

It is accepted that uncertainty may arise from all levels of measurement and assessment and reasonably practicable steps have been made at all stages with the aim of reducing uncertainty.

The following measures have been taken to reduce uncertainty:

- Background sound level measurements have been obtained at representative assessment locations over a duration of seven days to fully characterise the existing residual environment during the intended operational hours of the proposed development;
- The assessment has given consideration to a full operational scenario, with all plant items operating 24 hours a day during daytime and night. Representative background levels obtained at daytime and night have been utilised to inform the assessment;
- Use of monitoring equipment in accordance with section 5 of BS 4142: 2014+A1: 2019, using Class 1 instrumentation;
- Measurement procedures followed in accordance with section 6 of BS 4142: 2014+A1: 2019 with all precautions taken to minimise interference; and
- Specific sound levels have been calculated to the requirements of ISO 9613-2: 1996 which is the widely accepted procedure for the calculation of sound propagation (including favourable wind conditions from source to receiver). The development has yet to be built therefore, the assessment is informed by comparison of the predicted rated noise levels against the representative background levels at each receptor in accordance with section 7 of BS 4142: 2014+A1: 2019.

Given the measures outlined above and the magnitude of predicted operational levels in the context of the existing local noise environment, it is considered that the uncertainty does not have any significance on the outcome of the assessment.

9 CONCLUSIONS

A noise impact assessment has been undertaken based on the proposed solar photovoltaic (PV) development at Preston Farm, southwest of Basingstoke (Preston Candover), Hampshire (RG25 2DS). The assessment focuses on the construction and operational impact of the development at nearest receptor locations to the requirements of BS 5228-1: 2009+A1: 2014 and BS 4142: 2014+A1: 2019.

A baseline noise survey encompassing the analysis of continuous data (7 days) has been used to determine representative background noise levels at those closest existing receptors to the site, through statistical analysis.

A computer noise model has been developed which incorporates the proposed operational plant items, including inverters and transformers. Predictions account for the cumulative operation of all plant items simultaneously during a worse-case night-time assessment period. Similarly, construction noise levels have been predicted incorporating a number of construction tasks and HGV movements.

Construction activity is likely to result in predicted noise levels below the adopted threshold criteria at nearest residential receptors. In addition, construction noise levels at the remaining receptor locations, would be below the adopted threshold criteria during all phases of the construction.

Predicted rated noise levels during daytime and night-time operation of the proposed development would not exceed the adopted criteria (in line with local authority requirements) of 5 dB below the representative background sound level at nearby sensitive receptors.

In summary, the assessment concludes that the development is considered acceptable within the relevant standards and guidance for construction and operational noise.

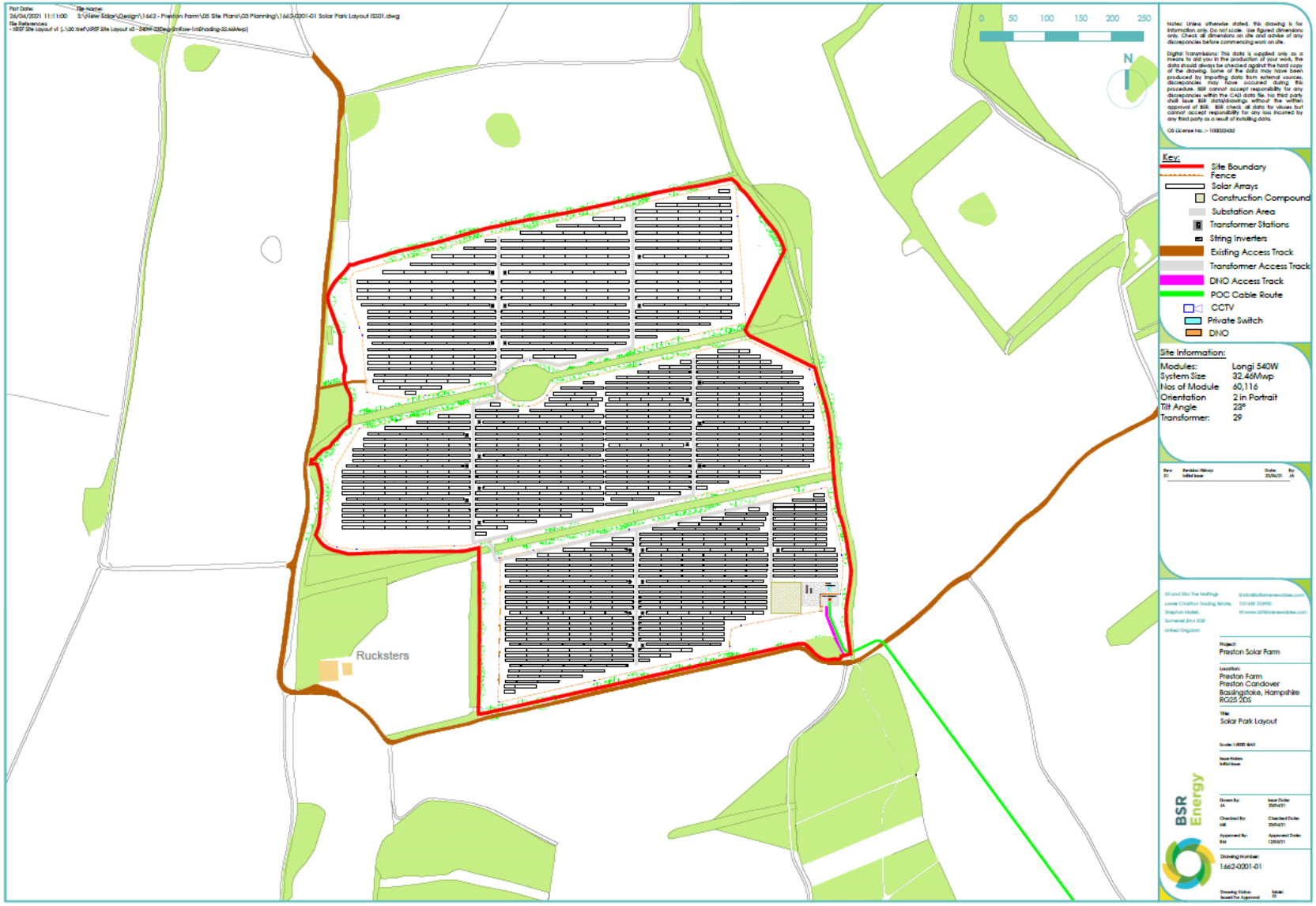
10 REFERENCES

1. British Standard 4142: 2014+A1:2019, 'Methods of rating industrial and commercial sound' British Standards Institution.
2. British Standard 5228-1: 2009+ A1: 2014 'Code of practice for noise and vibration control on construction and open sites – Part 1: Noise'. British Standards Institution
3. British Standard 7445-1: 2003, 'Description and measurement of environmental noise – Part 1: Guide to quantities and procedures'. British Standards Institution.
4. British Standard 8233: 2014, 'Sound insulation and noise reduction in buildings – code of practice'. British Standards Institution.
5. ISO 9613-2:1996 'Attenuation of sound during propagation outdoors – general method of calculation'. International Organization for Standardization.
6. National Planning Policy Framework – Department for Communities and Local Government. March 2012 (as amended February 2019)
7. Noise Policy Statement for England (NPSE). DEFRA, 2010.
8. World Health Organization (WHO), 'Guidelines for Community Noise', 1999.
9. Noise Assessments and Reports for Planning Applications, Guidance Note for Developers and Consultants. Basingstoke and Deane Council.

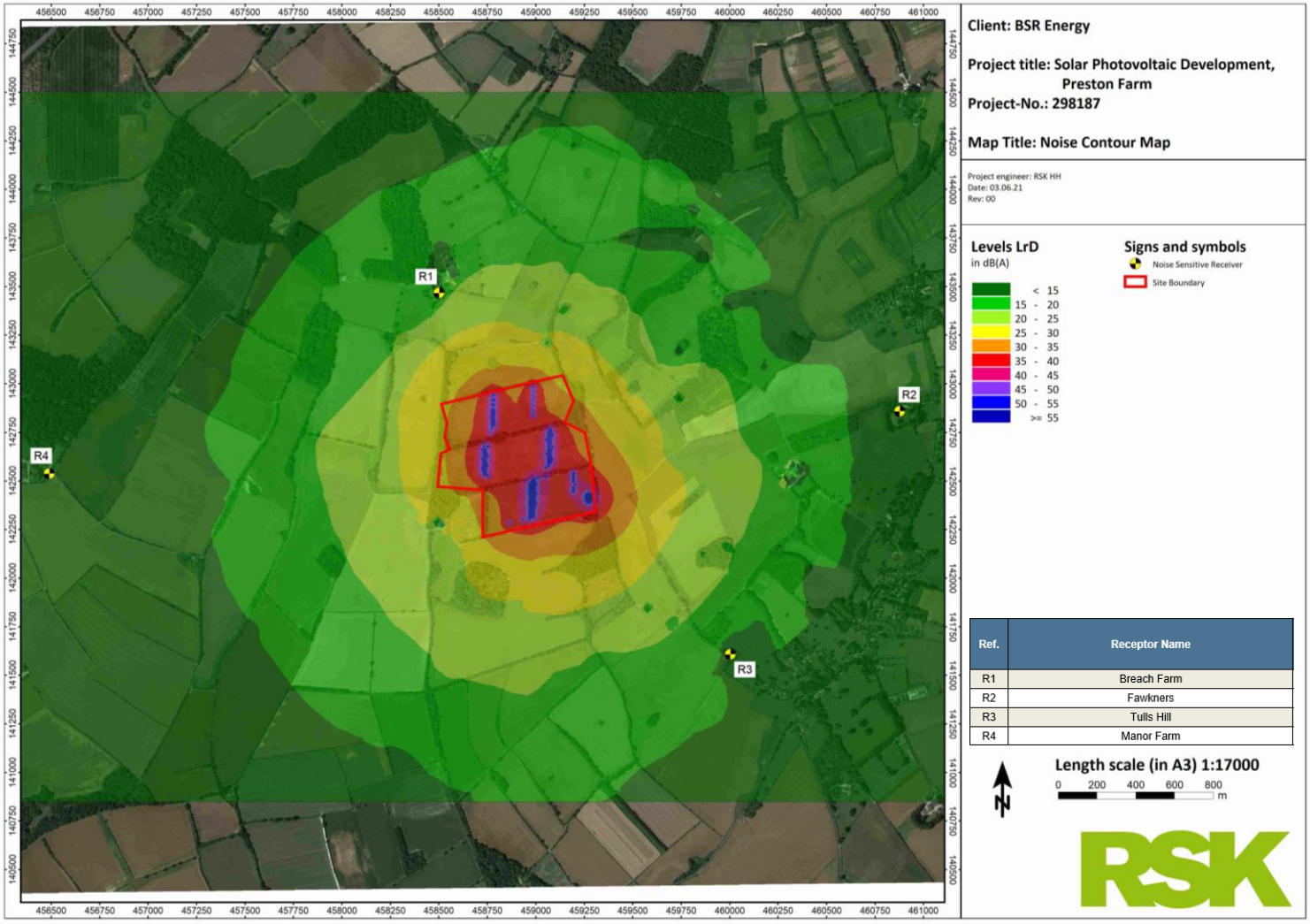
APPENDIX 1 – INDICATIVE SITE LAYOUT AND LOCATION MAP

Extracted from drawing No. 1662-0200-05 'Site location Plan' issued by BSR Energy dated 22/04/2021

Extracted from drawing No. 1662-0201-01 'Solar Park Layout' issued by BSR Energy dated 12/05/2021



APPENDIX 2 – NOISE CONTOUR MAP



APPENDIX 3 – CONSTRUCTION PLANT LISTS

Task 1 – Installation of mounting frames and panels							
Plant	**Plant Ref**	**L_p (at 10 m) dB(A)**	**On-Time %**	**No. of Plant**	**Screening (dB)**	**Total Correction (dB)**	**Total L_p (at 10 m) dB(A)**
Excavator	C5.18	80	20	1	0	-7	73
Delivery lorry	C2.34	80	10	1	0	-10	70
Telehandler	C2.35	71	20	1	0	-7	64
Impact wrench	Manufacturer's data	73	10	1	0	-10	63
						TOTAL	**75**

Task 2 – Construction of the substation and compound areas							
Plant	**Plant Ref**	**L_p (at 10 m) dB(A)**	**On-Time %**	**No. of Plant**	**Screening (dB)**	**Total Correction (dB)**	**Total L_p (at 10 m) dB(A)**
Excavator	C5.18	80	20	1	0	-7	73
Roller	C5.20	75	20	1	0	-7	68
Delivery lorry	C2.34	80	10	1	0	-10	70
Wheeled crane	C4.43	70	10	1	0	-10	60
						TOTAL	**76**

APPENDIX 4 – MEASURED NOISE LEVELS

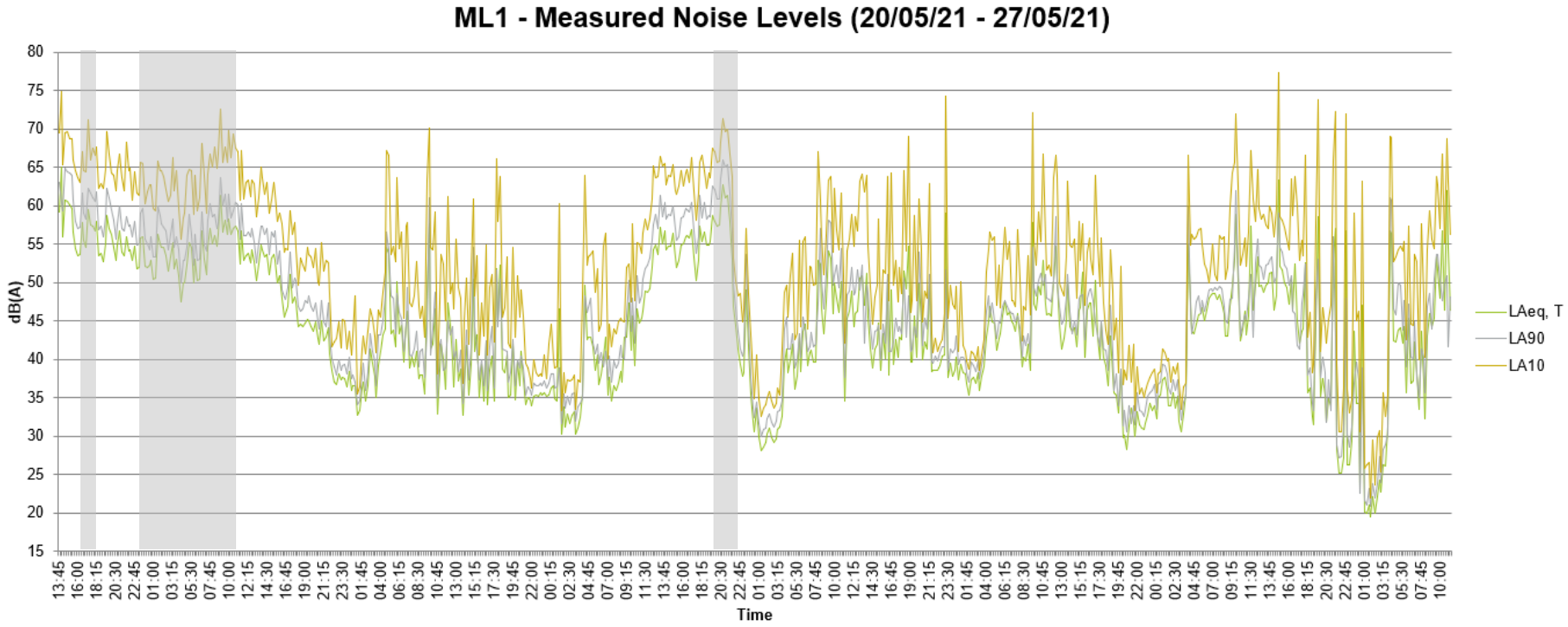


Figure A4.1 Measured Noise Levels at Location ML1

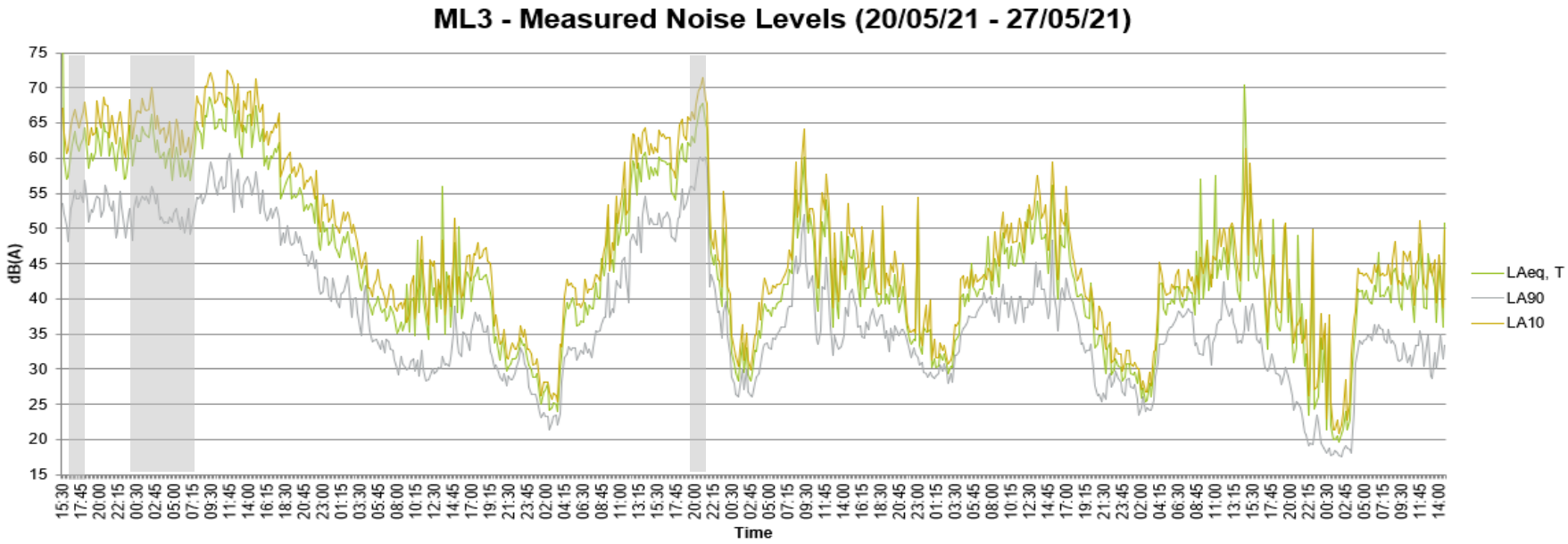


Figure A4.2 Measured Noise Levels at Location ML3

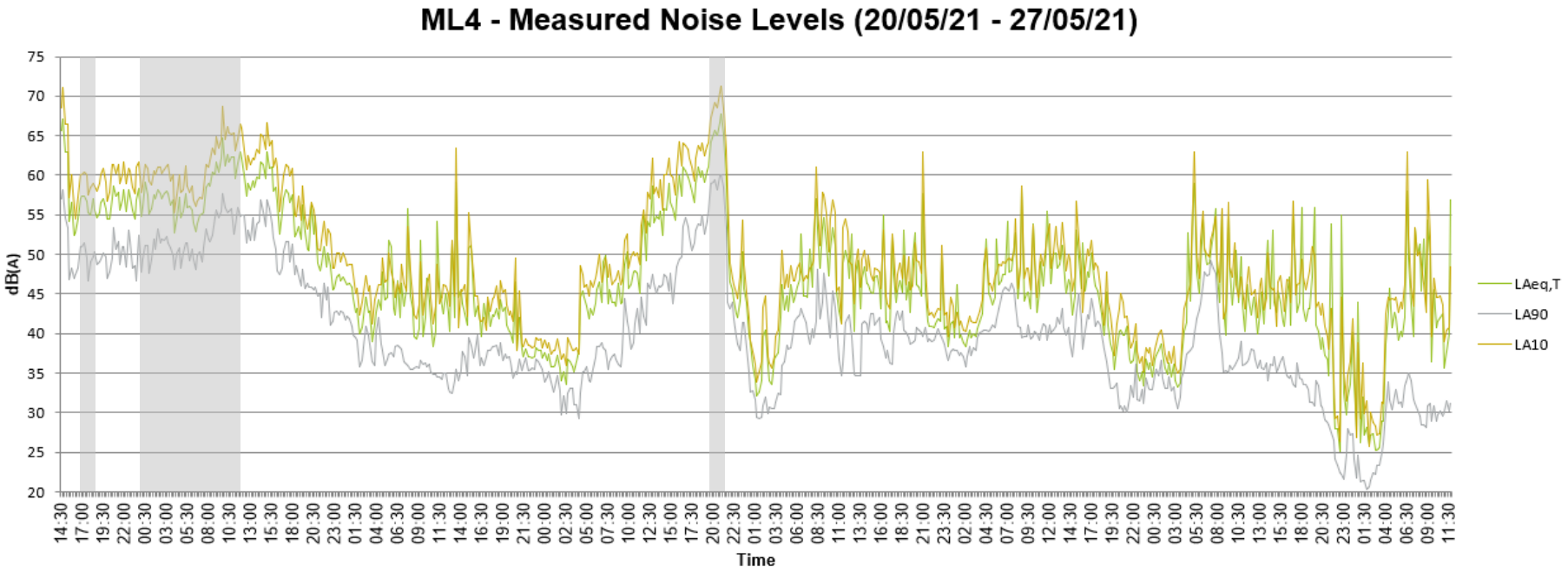


Figure A4.3 Measured Noise Levels at Location ML4

APPENDIX 5 – PHOTOGRAPHIC REPORT

Figure A5.1 ML1 Monitoring Position

Figure A5.2 ML2 Monitoring Position

APPENDIX 5 – PHOTOGRAPHIC REPORT (CONT.)

Figure A5.3 ML3 Monitoring Position

Figure A5.4 ML4 Monitoring Position

APPENDIX 6 – ACOUSTIC GLOSSARY

L_p - Sound Pressure Level

The basic unit of sound measurement is the sound pressure level, which is measured on a logarithmic scale and expressed in decibels (dB). The logarithmic scale makes it easier to manage the large range of audible sound pressures, and also more closely represents the way the human ear responds to differences in sound pressure:

$L_p = 20 \log_{10} (p/p_o)$

where p = RMS (root mean square) sound pressure; and

p_0 = reference sound pressure 2 x 10^{-5} Pa.

Frequency Weighting Networks

Frequency weighting networks, which are generally built into sound level meters, attenuate the signal at some frequencies and amplify it at others. The A-weighting network approximately corresponds to human frequency response to sound. Sound levels measured with the A-weighting network are expressed in dB(A). Other weighting networks also exist, such as C-weighting which is nearly linear (i.e. unweighted) and other more specialised weighting networks. Variables such as L_p and L_{eq} that can be measured using such weightings are expressed as L_{pA} / L_{pC}, L_{Aeq} / L_{Ceq} etc.

Time Weighting

Sound level meters use various averaging times for the measurement of RMS sound pressure level. The most commonly used are fast (0.125 s averaging time), slow (1 s averaging time) and impulse (0.035 s averaging time). Variables that are measures with time weightings are expressed as L_{AFmax} etc.

L_{Aeq} – Equivalent Continuous Sound Pressure Level

Sound levels tend to fluctuate, and as such an 'instantaneous' measurement like sound pressure level cannot fully describe many real-world situations. A summation can be made of the measured sound energy over a certain period, and a notional steady level can be calculated which would contain the same total energy as the fluctuating sound. This notional level is termed the equivalent continuous sound level L_{eq}. L_{eq} can be determined over any time period, which is indicated as $L_{eq,T}$ where T is the time period (e.g. $L_{eq,24h}$).

In mathematical terms, for n discrete sound level measurements, Leq is given by:

$L_{eq,T}$ = 10 log10 (t1 x 10L1/10 + t2 x 10L2/10 +… tn x 10Ln/10)/T

where t_1 = time at level L_1 dB;

t_2 = time at level L_2 dB;

and T = total time

L_{max} - Maximum Sound Pressure Level or Maximum Noise Level

This is the maximum RMS sound pressure level occurring within a specified period. The time weighting is usually specified, such as in L_{Fmax}.

L_N - Percentile or Statistical Levels

Sometimes it is useful to calculate the level which is exceeded for a certain percent of a total period. Background noise is often defined as the A-weighted sound pressure level exceeded for 90% of the specified period T, expressed $L_{90,T}$. Road traffic noise is often characterised in terms of $L_{A10,18}$

Sound Transmission via Building Façade: from inside to outside

The magnitude of the sound level transmitted from the inside of a room to the outside can be estimated by considering the direct airborne sound and the indirect transmissions via the flanking

paths. The following formula is generally used to simplify the calculation assuming a direct sound contribution only.

$L_{out}=L_{in} – R – 6$ / $L_w=L_{out}+10 * \log S$ / $L_R=Lw-20 * \log r – 11 + D$

Being L_{out} the sound level just outside the façade arising from sound transmission;
R is the sound reduction index of the façade element;
S is the area of the façade element;
L_R is the sound level at a distance *r* from the façade behaving as a point source;
D is the directivity index (D=+3 source adjacent to one reflective plane)

Sabine Acoustics for Steady State Situations: Total Sound Pressure Level

The total sound pressure level at any point in the room is the result of the combination of the direct sound pressure level and the reverberant field dependant on the source and room surfaces.

$L_{TOTAL}=L_w + 10 * \log [(Q/4.\pi.r^2)+(4/RC)]$

Being L_{TOTAL} the total sound level at any point in the room;
Q is the directivity factor;
r is the distance from the source to the façade;
RC is the room constant, which depends on the total area of the room surfaces and the averaged absorption coefficient of those surfaces.

Ambient sound

totally encompassing sound in a given situation at a given time, usually composed of sound from many sources near and far. The ambient sound comprises the residual sound and the specific sound when present.

$L_a=L_{Aeq,T}$ – Ambient sound level

Equivalent continuous A-weighted sound pressure level of the totally encompassing sound in a given situation at a given time, usually from many sources near and far, at the assessment location over a given time interval, T. The ambient sound level is a measure of the residual sound and the specific sound when present.

$L_{A90,T}$ – Background sound level

A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T, measured using time weighting, F, and quoted to the nearest whole number of decibels.

Residual sound

Ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound.

Specific sound source

Sound source being assessed.

$L_{Ar,Tr}$ – Rating level

Specific sound level plus any adjustment for the characteristic features of the sound as per BS 4142:2014+A1:2019. Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level, for example: tonality, impulsivity, intermittency or other sound characteristics that are readily distinctive against the residual acoustic environment.