BSR Energy

Solar Photovoltaic Development, South Fambridge

Noise Impact Assessment

Project No. 298029-RSK-RP-001-(00)

OCTOBER 2020

QUALITY ASSURANCE

Client:	BSR Energy
Project Name:	Solar Photovoltaic Development, South Fambridge
RSK Acoustics Project No.:	298029
Document Title:	Noise Impact Assessment Report
Document Reference:	298029-RSK-RP-001-(00)

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Document history

Rev.	Purpose Description	Author	Reviewer	Date
--	Report for internal review	JM	MU	26.10.2020
00	Report issued for comment	JM	MU	29.10.2020
01				
02				

JM – Jonathan Mart, MIOA (Principal Acoustic Consultant)
MU – Mark Underhill, 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 solar photovoltaic (PV) development on land to the east of South Fambridge, Rochford (SS4 3LS).

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 Rochford 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 2.2.

Table 2.1 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 Local Authority Consultation

Consultation was sought with Rochford District Council via email on 07 September 2020 detailing RSK's proposed approach to the survey and assessment. A response was received on 15 September 2020 by Mrs Lee Branch (Planning and Building control) stating that there were no comments to make.

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 three 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*'. 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

The site is an agricultural field which forms part of a wider agricultural holding located to the east of South Fambridge. Fambridge Road runs along the west of the site and connects the settlements of South Fambridge and Ashingdon.

Nearest receptors to the proposed development are located within the villages of South Fambridge, Ashingdon and along the surrounding road network, with the Crouch and Roach Estuaries Site of Special Scientific Interest (SSSI) located to the north.

3.2 Development Proposals

The proposals include the installation of photovoltaic (PV) panels, mounted to frames which would have a maximum height above ground level of 2.6 metres. The area of development covers approximately 107 hectares, split between three separate sites. 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 the solar panel array;
- Distribution Network Operator (DNO) point;
- Switch gear building; and
- Security fencing and CCTV installation.

3.3 Existing Receptors

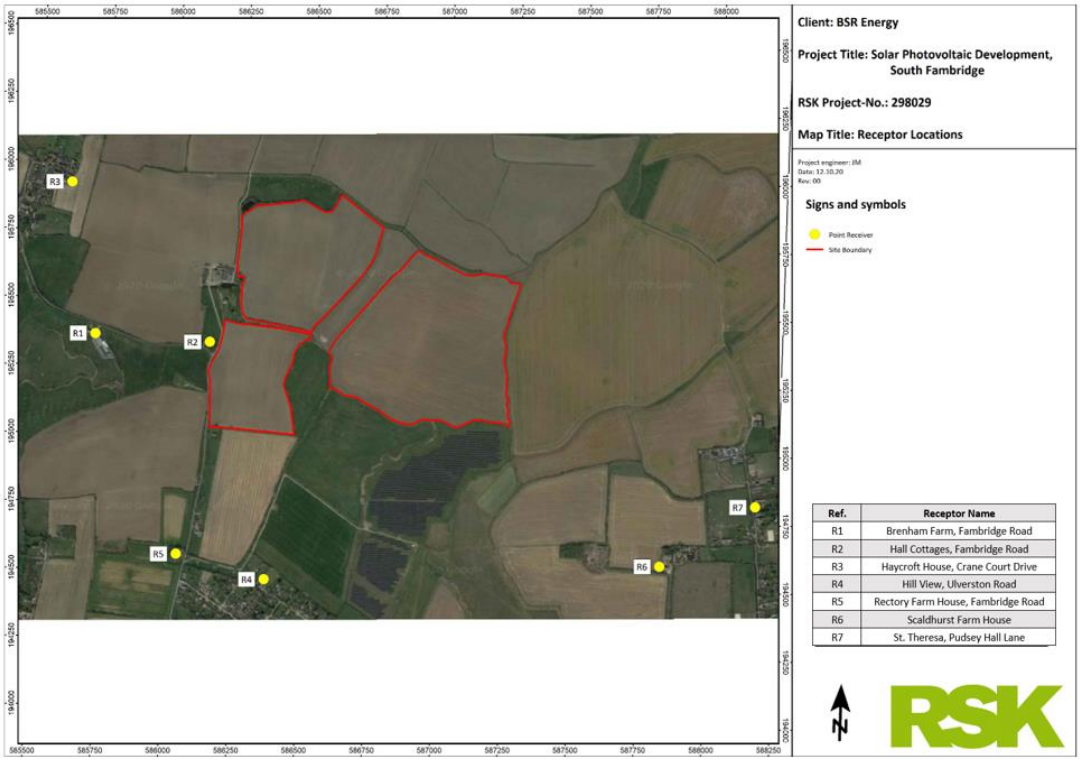
Based on aerial imagery, the following receptors have been used for assessment purposes. Receptors have been chosen based on their position to the development and where necessary, representative of a wider series of receptors within a settlement:

Table 3.1 Assessment receptor locations

Ref.	Receptor Name	Distance to Site Application Boundary
R1	Brenham Farm, Fambridge Road	440 m West
R2	Hall Cottages, Fambridge Road	35 m West
R3	Haycroft House, Crane Court Drive	600 m West
R4	Hill View, Ulverston Road	560 m South
R5	Rectory Farm House, Fambridge Road	480 m South
R6	Scaldhurst Farm House	755 m South-east
R7	St. Theresa, Pudsey Hall Lane	955 m South-east

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 Human Assessment Receptors



It should be noted that South Fambridge Hall lies immediately to the west of the development site however, the receptor has a vested interest in the project and has therefore been discounted for assessment purposes.

3.4 Ecological Receptors

To the north of the proposed development site, is ‘Crouch and Roach Estuaries’ SSSI. The distance from the northern site boundary to the SSSI is approximately 350 metres. Crouch and Roach Estuaries is a nationally important site by reason of its lowland ditch systems, saltmarshes, overwintering water-birds, and assemblages of invertebrates and vascular plants.

In order to conservatively assess the impact of construction and operational noise on the SSSI, predictions have been made based on the closest distance to the boundary of the SSSI.

4 NOISE SURVEY METHOD

4.1 Survey Measurement Details

A baseline noise survey was undertaken between Wednesday 16 September and Wednesday 23 September 2020 with the acquisition of seven days of continuous noise data. Three unattended measurements (ML1 to ML3) 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	North-west boundary	To quantify the existing noise environment at those receptors to the west of the development site.
ML2	U	South-east boundary	To quantify the existing noise environment at those receptors to the south and south-east of the development site.
ML3	U	Beyond south-west boundary	To quantify the existing noise environment at those receptors to the south-west of the development site.

** 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	197782	11/06/2019
		386770	01/10/2018
		976246	19/12/2019
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, whilst noise associated with vehicle movements along Fambridge Road 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: IROCHF4 situated in Hawkwell village – approximately 2.5 km south of the development site) and are summarised in **Table 4.3**.

Table 4.3 Summary of Weather Data

Date/Time	Average Temperature / °C	Average Wind Speed / ms^{-1}	Dominant Wind Direction	Weather Conditions
16/09/20 – 12:00	21.9	1.5	West	Dry
17/09/20 – 00:00	15.3	3.0	WSW	Dry
17/09/20 – 12:00	20.6	4.0	S	Dry
18/09/20 – 00:00	14.5	3.0	SE	Dry
18/09/20 – 12:00	20.2	4.5	S	Dry
19/09/20 – 00:00	13.3	1.2	WNW	Dry
19/09/20 – 12:00	22.8	3.6	S	Dry
20/09/20 – 00:00	14.7	3.0	WSW	Dry
20/09/20 – 12:00	23.7	2.5	SSW	Dry
21/09/20 – 00:00	13.0	2.2	W	Dry
21/09/20 – 12:00	17.7	1.3	WNW	Dry
22/09/20 – 00:00	12.5	--	--	--
22/09/20 – 12:00	25.2	3.0	W	Dry
23/09/20 – 00:00	16.9	0.1	SSW	Dry
23/09/20 – 12:00	20.4	3.0	S	Rain – 3.8mm

Note – incomplete data was provided for the period 22.09.20 at 00:00 by weather station

Weather conditions noted above are generally considered suitable for monitoring purposes in accordance with BS 7445.

Further analysis of the measured noise levels suggests that the short period of precipitation on 23 September 2020 resulted in no significant increase in noise level. The complete dataset has therefore been included and adopted for the purposes of assessment.

5 NOISE SURVEY RESULTS

Measured noise levels at unattended survey locations ML1 – ML3 are summarised in **Tables 5.1 to 5.3** below.

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)	$L_{A90,T}$	$L_{A10,T}$
16/09/2020	11:45 – 23:00	46.1	41.1 – 95.2	33.7	45.8
	23:00 – 07:00	39.1	33.9 – 81.1	25.1	34.6
17/09/2020	07:00 – 23:00	49.9	42.6 – 87.5	38.4	48.5
	23:00 – 07:00	33.5	30.4 – 58.5	23.2	29.9
18/09/2020	07:00 – 23:00	52.8	48.1 – 78.0	40.0	49.0
	23:00 – 07:00	31.8	33.4 – 60.4	24.3	31.8
19/09/2020	07:00 – 23:00	50.5	37.3 – 68.9	37.9	47.6
	23:00 – 07:00	30.0	32.3 – 54.3	22.9	30.1
20/09/2020	07:00 – 23:00	44.3	31.9 – 72.7	33.2	42.5
	23:00 – 07:00	30.4	27.2 – 63.4	19.9	26.3
21/09/2020	07:00 – 23:00	40.9	36.0 – 81.4	25.7	35.2
	23:00 – 07:00	36.5	29.7 – 70.7	21.4	29.9
22/09/2020	07:00 – 23:00	49.9	36.4 – 88.0	29.1	38.1
	23:00 – 07:00	32.1	28.0 – 62.5	22.2	30.8
23/09/2020	07:00 – 13:45	38.4	46.7 – 80.0	31.7	39.6
Average[2]	**Daytime**	**47**	**--**	**34**	**43**
	Night-time	**33**	**--**	**23**	**31**

(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 16.09.20 and 23.09.20 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)	$L_{A90,T}$	$L_{A10,T}$
16/09/2020	13:45 – 23:00	46.4	49.2 – 86.1	37.5	49.0
	23:00 – 07:00	39.8	37.5 – 77.8	28.0	37.5
17/09/2020	07:00 – 23:00	57.0	46.4 – 88.9	41.2	52.2
	23:00 – 07:00	36.2	31.9 – 74.4	23.1	31.4
18/09/2020	07:00 – 23:00	55.7	40.0 – 82.5	42.5	51.9
	23:00 – 07:00	35.4	35.8 – 64.5	26.6	35.7
19/09/2020	07:00 – 23:00	53.2	41.5 – 69.8	40.1	49.9
	23:00 – 07:00	31.5	34.2 – 61.2	23.6	32.1
20/09/2020	07:00 – 23:00	47.2	35.1 – 68.0	35.4	44.4
	23:00 – 07:00	29.2	28.4 – 62.1	19.8	26.0
21/09/2020	07:00 – 23:00	48.5	37.2 – 88.7	25.8	35.1
	23:00 – 07:00	31.5	31.3 – 64.2	21.4	30.3
22/09/2020	07:00 – 23:00	47.9	41.2 – 86.6	33.3	41.6
	23:00 – 07:00	32.8	34.8 – 60.0	24.4	32.8
23/09/2020	07:00 – 14:15	44.3	51.1 – 77.3	36.1	45.6
Average(2)	**Daytime**	**50**	**--**	**37**	**46**
	Night-time	**34**	**--**	**24**	**32**

(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 16.09.20 and 23.09.20 also included.*

Table 5.3 Noise Survey Results – Unattended location ML3

Date	Time period	Measured noise levels, dB (1)			
		$L_{Aeq,T}$	$L_{AFmax,15min}$ (range)	$L_{A90,T}$	$L_{A10,T}$
16/09/2020	15:00 – 23:00	44.5	50.0 – 84.0	32.9	45.2
	23:00 – 07:00	36.1	28.9 – 71.0	23.6	33.6
17/09/2020	07:00 – 23:00	57.3	41.3 – 91.9	35.7	49.1
	23:00 – 07:00	32.3	30.1 – 62.9	21.6	30.0
18/09/2020	07:00 – 23:00	49.4	42.7 – 75.9	35.7	48.2
	23:00 – 07:00	32.5	29.0 – 64.8	23.3	31.4
19/09/2020	07:00 – 23:00	46.7	36.9 – 80.5	33.9	45.7
	23:00 – 07:00	30.6	32.9 – 57.8	23.7	30.8
20/09/2020	07:00 – 23:00	41.7	31.9 – 69.2	30.5	42.7
	23:00 – 07:00	29.8	28.2 – 58.2	23.0	28.4
21/09/2020	07:00 – 23:00	38.5	43.0 – 60.4	31.2	39.4
	23:00 – 07:00	36.2	34.7 – 57.3	22.8	35.1
22/09/2020	07:00 – 23:00	44.1	49.4 – 70.7	37.1	44.5
	23:00 – 07:00	35.1	36.8 – 61.1	26.9	35.5
23/09/2020	07:00 – 15:15	47.4	57.9 – 73.0	39.6	48.6
Average(2)	**Daytime**	**46**	**--**	**35**	**45**
	Night-time	**33**	**--**	**24**	**32**

(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 16.09.20 and 23.09.20 also included.*

Averaged noise levels measured across the site show a maximum fluctuation of 4 dB(A) $L_{Aeq,T}$ for the daytime period and 1 dB(A) for night-time periods, with a highest daytime level ($L_{Aeq,16h(07:00-23:00)}$) of 50 dB and night-time level ($L_{Aeq,8h(23:00-07:00)}$) of 34 dB measured towards the south-east of the site at monitoring position ML2. Existing background noise levels ($L_{90,\ T}$) remained broadly consistent between all three measurement locations throughout the survey.

5.2 Derivation of Background Noise Levels

Given the development is scheduled to operate 24 hours, the representative background noise levels are provided for night-time periods only as this would understandably result

in a worse-case assessment scenario (in noise terms). The methodology detailed in BS 4142: 2014+A1: 2019 provides an example of statistical analysis to determine the representative background noise level during the night-time ($L_{A90,\ 15min}$). The following analysis adopts the methodologies applied within the aforementioned standard:

Figure 5.1 Statistical Analysis of Night-time Background Noise Levels – MP1

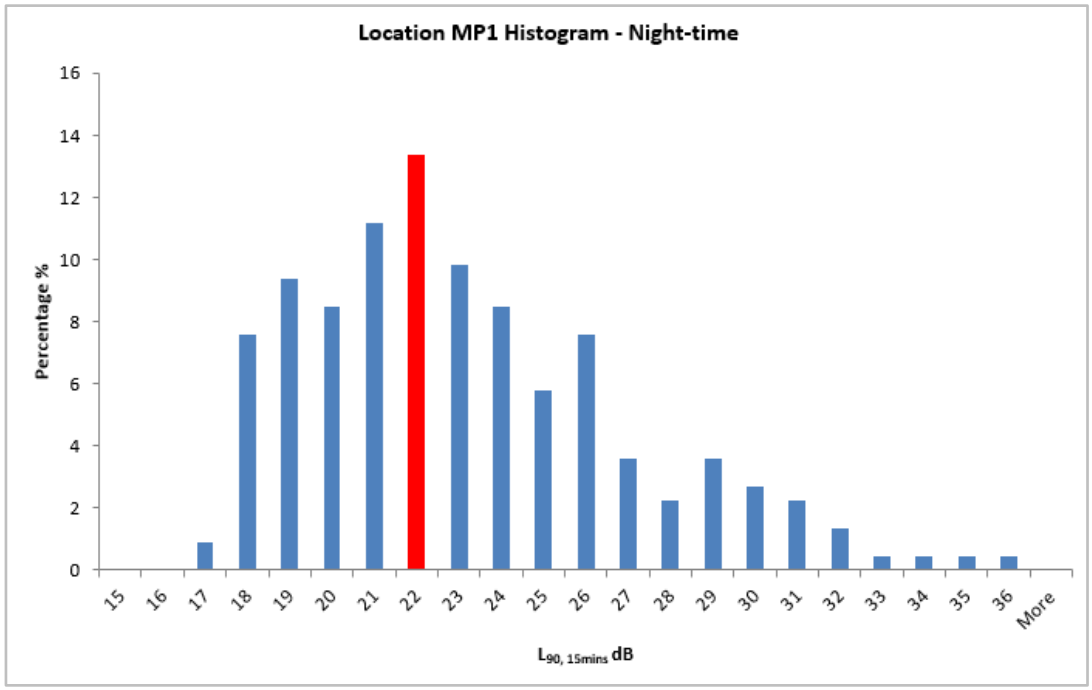


Figure 5.2 Statistical Analysis of Night-time Background Noise Levels – MP2

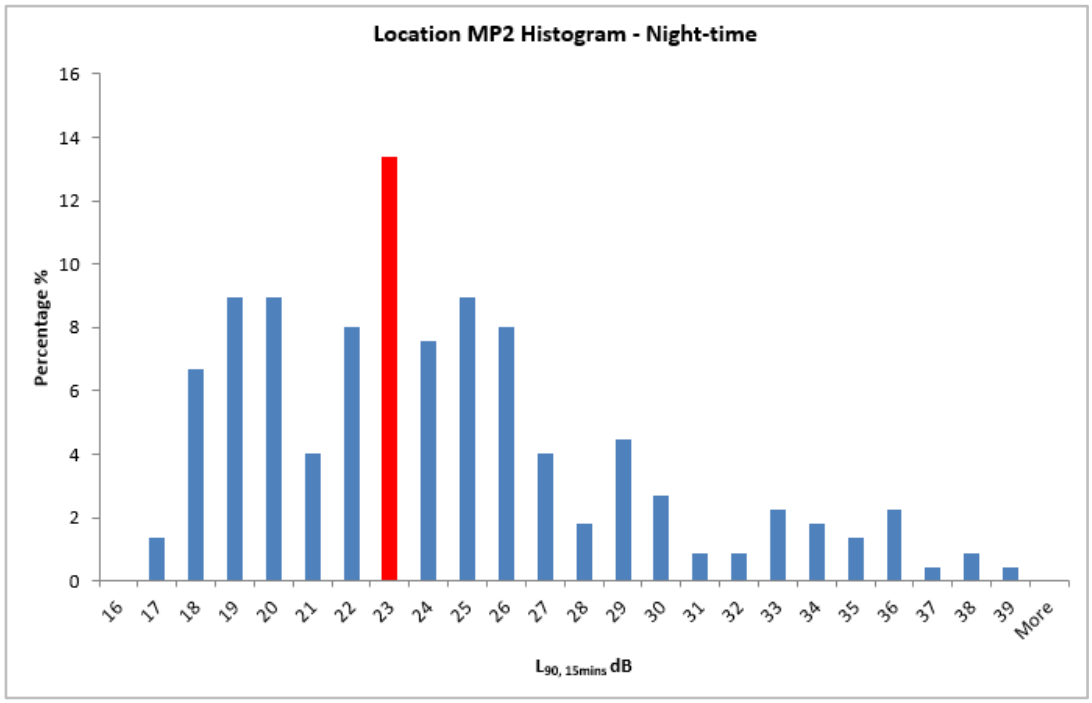
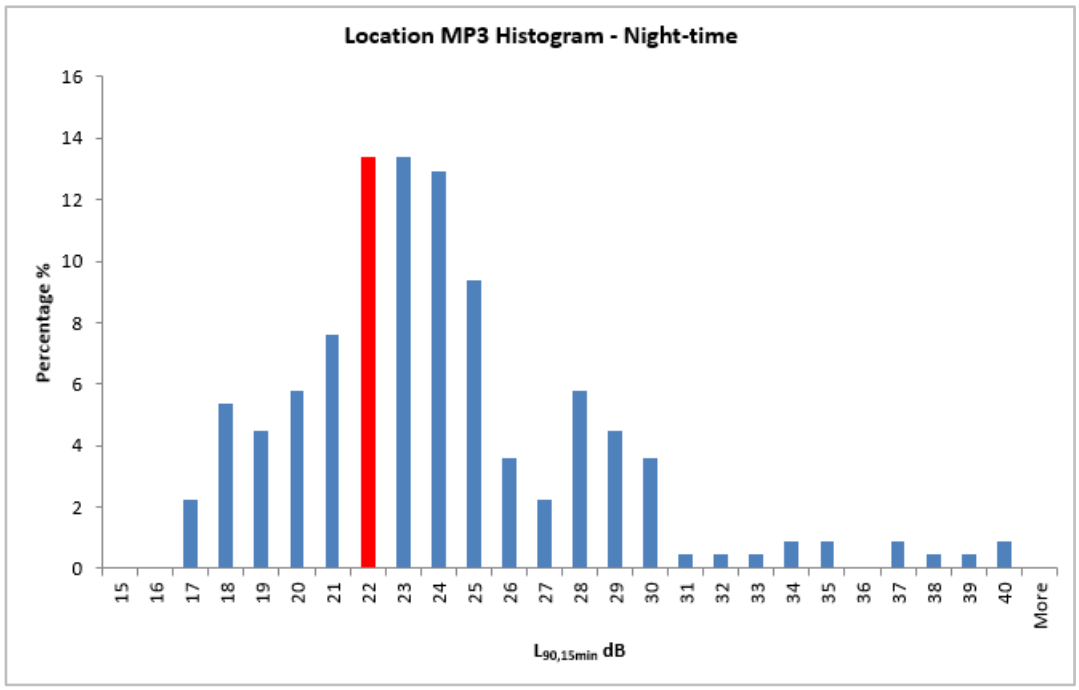


Figure 5.3 Statistical Analysis of Night-time Background Noise Levels – MP3



5.3 Derivation of Criteria

5.3.1 Construction

Human Receptors

Based on measured baseline ambient noise levels at all monitoring positions, those nearest receptors to the proposed development site would be subject to a threshold level of 65 dB(A) during standard core hours between Monday to Friday 07:00 – 19:00 and Saturday 07:00 – 13:00, in accordance with Category A values within BS 5228-1: 2009+A1: 2014. Where the site noise level (i.e construction only) exceeds 65 dB(A), then a potential significant effect is indicated (dependent on the duration and character of the impact).

It is not envisaged that construction activity would occur during evenings or weekends; an assessment during these periods has therefore been discounted.

Ecological Receptors

Noise thresholds are set based on RSK's experience of similar projects where birds may be impacted, with separate thresholds adopted for seasonal variations in behaviour. The noise thresholds represent levels above which there is likely to be significant disturbance to ornithological receptors associated with the Crouch and Roach Estuaries SSSI.

The most sensitive receptor locations during the breeding and wintering seasons are considered separately. It is not envisaged that piling would be required to construct the solar farm and therefore it would not be applicable to adopt a maximum (L_{AFmax}) noise level metric. In this case, all construction activity is based on the average noise level during the periods of construction ($L_{Aeq,T}$).

The following noise thresholds have been adopted for assessment purposes:

Table 5.4 Noise Threshold Levels for SSSI

Season	All Construction Activity, dB $L_{Aeq,T}$
Breeding (01 March to 31 August)	65
Wintering (01 September to 28 February	70

5.3.2 Operational

Human Receptors

Operational noise effects at the nearest noise sensitive receptors have been assessed according to BS 4142: 2014+ A1: 2019 and the guidance within NPSE (specifically to avoid significant adverse impacts on health and quality of life). Based upon the application of rated noise levels against the existing background noise level, it is deemed that the lowest observed adverse effect level (LOAEL) would occur where a rated noise level (L_{Ar}) at receptor is no greater than +5 dB above the background noise ($L_{A90,\ 15mins}$).

As a result, operational noise limits for the night period (deemed the most sensitive in noise terms) have been set as a rated noise level of 5 dB above the representative background level, at each receptor:

Table 5.5 Noise Threshold Levels for Human Receptors

Ref.	Receptor	Baseline Measurement Reference	Night-time Rated Noise Level Threshold, dB L_{Ar}*
R1	Brenham Farm, Fambridge Road	MP1	27
R2	Hall Cottages, Fambridge Road	MP1	27
R3	Haycroft House, Crane Court Drive	MP1	27
R4	Hill View, Ulverston Road	MP2	28
R5	Rectory Farm House, Fambridge Road	MP2	28
R6	Scaldhurst Farm House	MP3	27
R7	St. Theresa, Pudsey Hall Lane	MP3	27
** Based on the representative background noise level at receptor ($L_{A90,\ T}$) + 5 dB*			

Ecological Receptors

Given the nature of the operational elements of the plant items and limits imposed on those nearest human receptors, any impact on the SSSI would be negligible. An assessment of the ecological receptors during the operational phase has therefore been discounted.

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:

- Construction of tracks and hardstanding areas;
- Installation of mounting frames and panels;
- Construction of the inverter stations and battery storage compound.

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	Construction of tracks and hardstanding areas	79
2	Installation of mounting frames and panels	75
3	Construction of the inverter stations and battery storage compound	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.

It is deemed that there would not be sufficient levels of vibration generated during construction works to significantly impact on those nearest receptors (both human and ecological). 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

Discussions with BSR Energy have concluded that the primary source of noise emission would be the operation of the inverter stations. The role of an inverter station is to convert

DC (direct current) generated from the solar panel into AC (alternating current) for National Grid and domestic use.

The following noise levels have been assigned to the inverter stations

Table 6.3 Inverter Reference Noise Level

Item	Assumption	SPL at 10 m dB(A)
1	SMA Sunny Central UP (5-sided emitter) - 2.3 m height	63

Each plant item has been calibrated using a receiver positioned at 10 metres distance from an emitting surface (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).

Battery Energy Storage System (BESS)

In the absence of specific technical data for the proposed battery storage system, noise emission levels for the different plant items have been adopted from a storage scheme in Malmesbury, Wiltshire and included within a noise assessment report issued on 7 July 2017 for the Minety Battery Storage Project (inAcoustics, report ref. 17-182/Minety). It should be noted that the development is a 'grid scale mega storage project', one which stores the energy directly from National Grid. Although larger in scale and requiring significantly higher numbers of plant items, one single operational BESS has been adopted for the purposes of this assessment.

Table 6.4 BESS Reference Noise Levels

Item	Assumption	Total SPL@1m dB(A)
2	4x HVAC Voyager 1 with low-noise fans containerised battery set (roof source only) - 2.5 m height	63
3	1x External 2 MVA Transformer (5-sided emitter) - 2.5 m height	60

Each plant item associated with the BESS has 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).

6.5 Embedded Mitigation

Based on the unmitigated source noise data and the existing noise environment surrounding the development area, mitigation to the inverters listed in Section 6.4 would be required. For the purposes of assessment, it has been assumed that the inverters can be 'containerised' in order to provide sufficient acoustic attenuation in order to reduce source noise levels by 15 dB(A). Mitigated source noise levels have therefore adopted a sound level of 48 dB(A) at 10 metres from each inverter unit.

A number of manufacturers provide design solutions in order to reduce source noise levels from a range of electrical installations. The level of reduction required is not deemed as being significant.

7 CONSTRUCTION NOISE IMPACT

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 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	Task 3	Haul Road
R1	Brenham Farm, Fambridge Road	40	36	35	45
R2	Hall Cottages, Fambridge Road	67	60	39	56
R3	Haycroft House, Crane Court Drive	37	31	27	43
R4	Hill View, Ulverston Road	35	33	34	56
R5	Rectory Farm House, Fambridge Road	37	34	38	46
R6	Scaldhurst Farm House	25	29	22	39
R7	St. Theresa, Pudsey Hall Lane	25	27	20	39
R8	Crouch and Roach Estuaries SSSI	37	38	26	44

Task 1. Construction of tracks
Task 2. Installation of mounting frames and panels
Task 3. Construction of inverter station and BESS

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 the majority of the construction works, it is anticipated that noise levels would be below the threshold noise criteria of 65 dB $L_{Aeq, T}$. Predictions indicate that a marginal exceedance of 2 dB may occur during a short period of haul road construction (task 1), where those construction works operate at closest distance to Hall Cottages. The transient nature of these works would ensure that any potential exceedance would only occur for a short period of time, possibly only 1-2 days, and would therefore not result in any significant impacts at Hall Cottages. Where the haul road construction works operate at distances beyond 45 metres, predictions indicate that noise levels would remain within the aforementioned threshold criteria.

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

Calculations have been undertaken to a worse-case scenario, assuming that all items of plant operate 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.

8 OPERATIONAL NOISE IMPACT

8.1 Acoustic Correction

According to 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. The inverter station or BESS 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 (Appendix 2).

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

Table 8.1 Night-time Assessment

Receptor	Rated Noise Level, L_{Ar}	Representative Background Noise Level, $L_{90, 15mins}$	Excess over Background, dB
R1 - Brenham Farm, Fambridge Road	19	22	-3
R2 - Hall Cottages, Fambridge Road	26	22	+4
R3 - Haycroft House, Crane Court Drive	16	22	-6
R4 - Hill View, Ulverston Road	21	23	-2
R5 - Rectory Farm House, Fambridge Road	23	23	0
R6 - Scaldhurst Farm House	13	22	-9

Receptor	Rated Noise Level, L_{Ar}	Representative Background Noise Level, $L_{90, 15mins}$	Excess over Background, dB
R7 - St. Theresa, Pudsey Hall Lane	12	22	-10

The highest rated noise level of 26 dB L_{Ar} is predicted at Hall Cottages; this is the result of the sensitive receptor positioned at the closest distance to the development. Rated noise levels would exceed the representative night-time background sound level ($L_{A90, 15mins}$) by 4 dB at this receptor. Such a level is below the adopted noise threshold for human receptors as summarised in Table 5.5 in accordance with the requirements of NPSE.

Where the initial estimate of impact needs to be modified due to the context, BS 4142:2014+A1: 2019 advises to, *"take all pertinent factors into consideration"*, including the absolute level of sound. The primary concern during this night-time period is the potential for disturbance of residents who could be sleeping with an open window. As a result, other guidance, such as that within WHO would also be relevant. Assuming an open window reduces external to internal noise levels by 15 dB (WHO), internal noise levels would likely be in the region of 11 dB within the bedrooms of Hall Cottages; significantly below the design target criteria for sleeping at night. Such a level is a positive indication of the development having a low impact at the nearest receptor location in the context of absolute noise.

Rated operational noise levels (L_{Ar}) at the remaining residential receptors, would not exceed the representative background level at each receptor. This is a positive indication of the development having a low impact. A full tabulated assessment, in accordance with BS 4142:2014+A1: 2019 for the human receptors is provided in **Appendix 4**.

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 operation of all inverters simultaneously.

RSK's experience of similar projects and power generation schemes would indicate that operation of the BESS is only likely after discharge to the grid. For the purposes of the assessment however, the BESS has been modelled as a continuous operation.

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 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, 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 on land to the east of South Fambridge, Rochford (SS4 3LS). The assessment focuses on the construction and operational impact of the development at nearest human and ecological receptors 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 battery energy storage system (BESS). 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 along the haul road.

A construction phase assessment has been undertaken for the development. Construction activity is likely to result in a marginal exceedance of the noise threshold criteria during the construction of the haul road at Hall Cottages; this is the result of the relative short distance between this receptor and the development site. Given the nature of the construction activity, works would be transient and therefore the highest predicted noise level during haul road construction would only occur for a matter of days (possibly less). Construction noise levels would therefore not be significant.

Construction noise levels at the remaining receptor locations, including the Crouch and Roach Estuaries SSSI, would be below the adopted threshold criteria during all phases of the construction.

Predicted rated noise levels during night-time operation of the development would likely exceed the representative background sound level at Hall Cottages by 4 dB. Such a level is below the adopted noise threshold for human receptors as summarised in Table 5.5 in accordance with the requirements of NPSE. Where the initial estimate of impact needs to be modified due to the context, BS 4142 states that, *"all pertinent factors should be taken into consideration including the absolute level of sound".* In absolute terms, predicted noise from the operational phase (accounting for an open window scenario) would be significantly below the design targets for sleeping inside bedrooms (WHO), when considering the full operation of all fixed plant items. The impact of the development at Hall Cottages is therefore not considered significant, resulting in a low impact.

Noise predictions during the operational phase at all the remaining receptors would not exceed the representative background sound level. This is a positive indication that noise from the development would have a low impact.

Embedded mitigation, specifically to the inverters achieving a minimum noise reduction of 15 dB, should be implemented as part of the design. The level of reduction is not considered significant.

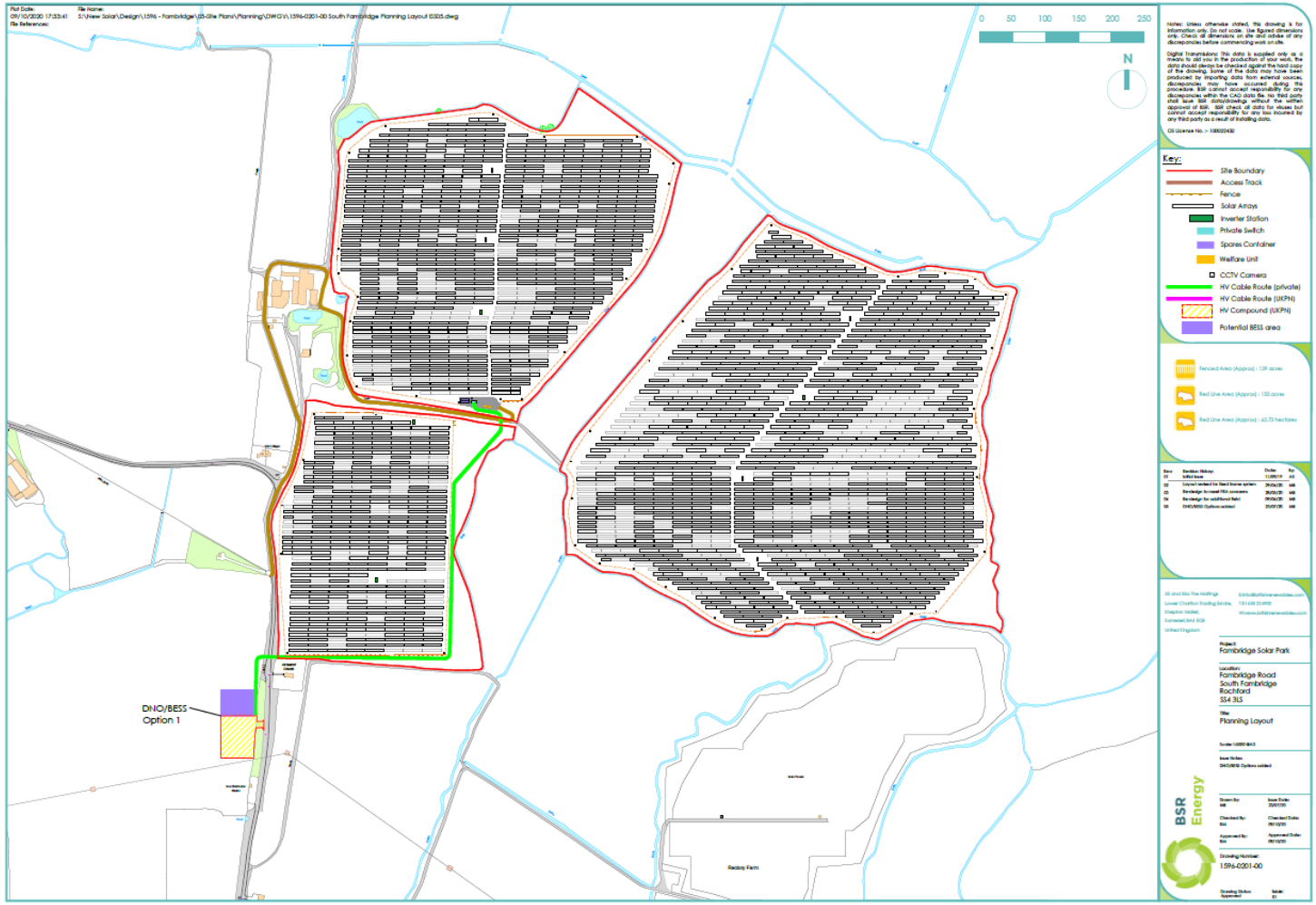
In summary, the assessment concludes that the development is considered acceptable within the relevant standards and guidance for construction and operational noise.

10 REFERENCES

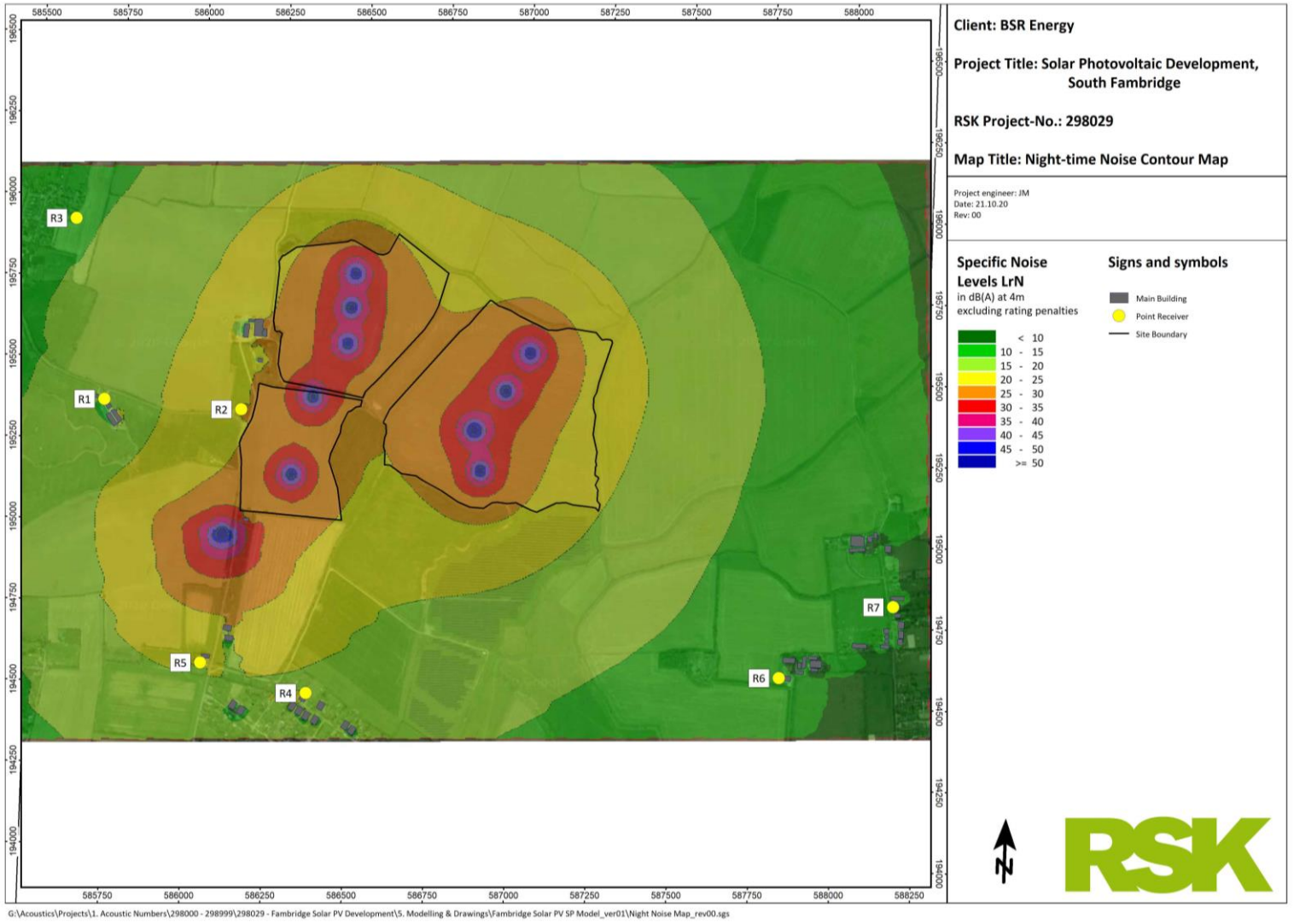
1. British Standard 4142: 2014+A1:2019, ‘Methods of rating industrial and commercial sound’ British Standards Institution.
2. British Standard 5228-1: 2009+ A1: 2014 ‘Code of practice for noise and vibration control on construction and open sites – Part 1: Noise’. British Standards Institution
3. British 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), ‘Night Noise Guidelines for Europe’. 2009

APPENDIX 1 – INDICATIVE SITE LAYOUT

Extracted from drawing No. 1596-0201-00 issued by BSR Energy on 09/10/2020



APPENDIX 2 – NIGHT-TIME NOISE CONTOURS



APPENDIX 3 – CONSTRUCTION PLANT LISTS

Task 1 – Construction of tracks							
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
Dozer	C5.15	83	20	1	0	-7	76
Tipper truck	C11.17	78	10	1	0	-10	68
Roller	C5.20	75	20	1	0	-7	68
						TOTAL	**79**

Task 2 – 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	Manufacturers data	73	10	1	0	-10	63
						TOTAL	**75**

Task 3 – Construction of inverter station and BESS							
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 – BS 4142 OPERATIONAL ASSESSMENT

Receptor 1: Brenham Farm, Fambridge Road			
Results		**Relevant Clause**	**Commentary**
Specific sound level	L_{Aeq} = 17 dB	7.3.6	Calculated sound level using approved prediction methodologies (sec. 6)
Residual sound level	--	7.3.6	Residual sound level discounted due to development not being operational
Background sound level	$L_{A90,15mins}$ = 22 dB	8.2	The background sound level was measured at a representative position to the receptor. An appropriate monitoring period was chosen to quantify the existing sound level during the proposed period of operation.
Assessment during the night-time, so reference time interval is 15 mins			
Acoustic feature correction	+2 dB	9.2	+ 2dB correction for tones which are 'just perceptible'
Rating level	(17 + 2) dB = 19 dB	9.2	
Background sound level	$L_{A90,15mins}$ = 22 dB	8.1.2 8.1.3 8.1.4	Modal value determined and representative background sound level chosen for assessment
Excess of rating of background sound level	(19 – 22) dB = -3 dB	11	
Assessment indicates low impact		**11**	
Uncertainty of the assessment	Not significant	10	See section 8.4

Receptor 2: Hall Cottages, Fambridge Road			
Results		**Relevant Clause**	**Commentary**
Specific sound level	L_{Aeq} = 24 dB	7.3.6	Calculated sound level using approved prediction methodologies (sec. 6)
Residual sound level	--	7.3.6	Residual sound level discounted due to development not being operational
Background sound level	$L_{A90,15mins}$ = 22 dB	8.2	The background sound level was measured at a representative position to the receptor. An appropriate monitoring period was chosen to quantify the existing sound level during the proposed period of operation.
Assessment during the night-time, so reference time interval is 15 mins			
Acoustic feature correction	+2 dB	9.2	
Rating level	(24 + 2) dB = 26 dB	9.2	+ 2dB correction for tones which are 'just perceptible'

Receptor 2: Hall Cottages, Fambridge Road			
Results		**Relevant Clause**	**Commentary**
Background sound level	$L_{A90,15mins}$ = 22 dB	8.1.2 8.1.3 8.1.4	Modal value determined and representative background sound level chosen for assessment
Excess of rating of background sound level	(26 – 22) dB = +4 dB	11	
Assessment indicates low impact given the absolute noise level within bedrooms		**11**	
Uncertainty of the assessment	Not significant	10	See section 8.4

Receptor 3: Haycroft House, Crane Court Drive			
Results		**Relevant Clause**	**Commentary**
Specific sound level	L_{Aeq} = 14 dB	7.3.6	Calculated sound level using approved prediction methodologies (sec. 6)
Residual sound level	--	7.3.6	Residual sound level discounted due to development not being operational
Background sound level	$L_{A90,15mins}$ = 22 dB	8.2	The background sound level was measured at a representative position to the receptor. An appropriate monitoring period was chosen to quantify the existing sound level during the proposed period of operation.
Assessment during the night-time, so reference time interval is 15 mins			
Acoustic feature correction	+2 dB	9.2	
Rating level	(14 + 2) dB = 16 dB	9.2	+ 2dB correction for tones which are 'just perceptible'
Background sound level	$L_{A90,15mins}$ = 22 dB	8.1.2 8.1.3 8.1.4	Modal value determined and representative background sound level chosen for assessment
Excess of rating of background sound level	(16 – 22) dB = -6 dB	11	
Assessment indicates low impact		**11**	
Uncertainty of the assessment	Not significant	10	See section 8.4

Receptor 4: Hill View, Ulverston Road			
Results		**Relevant Clause**	**Commentary**
Specific sound level	L_{Aeq} = 19 dB	7.3.6	Calculated sound level using approved prediction methodologies (sec. 6)
Residual sound level	--	7.3.6	Residual sound level discounted due to development not being operational

Receptor 4: Hill View, Ulverston Road			
Results		**Relevant Clause**	**Commentary**
Background sound level	$L_{A90,15mins}$ = 23 dB	8.2	The background sound level was measured at a representative position to the receptor. An appropriate monitoring period was chosen to quantify the existing sound level during the proposed period of operation.
Assessment during the night-time, so reference time interval is 15 mins			
Acoustic feature correction	+2 dB	9.2	
Rating level	(19 + 2) dB = 21 dB	9.2	+ 2dB correction for tones which are 'just perceptible'
Background sound level	$L_{A90,15mins}$ = 23 dB	8.1.2 8.1.3 8.1.4	Modal value determined and representative background sound level chosen for assessment
Excess of rating of background sound level	(21 – 23) dB = -2 dB	11	
Assessment indicates low impact		**11**	
Uncertainty of the assessment	Not significant	10	See section 8.4

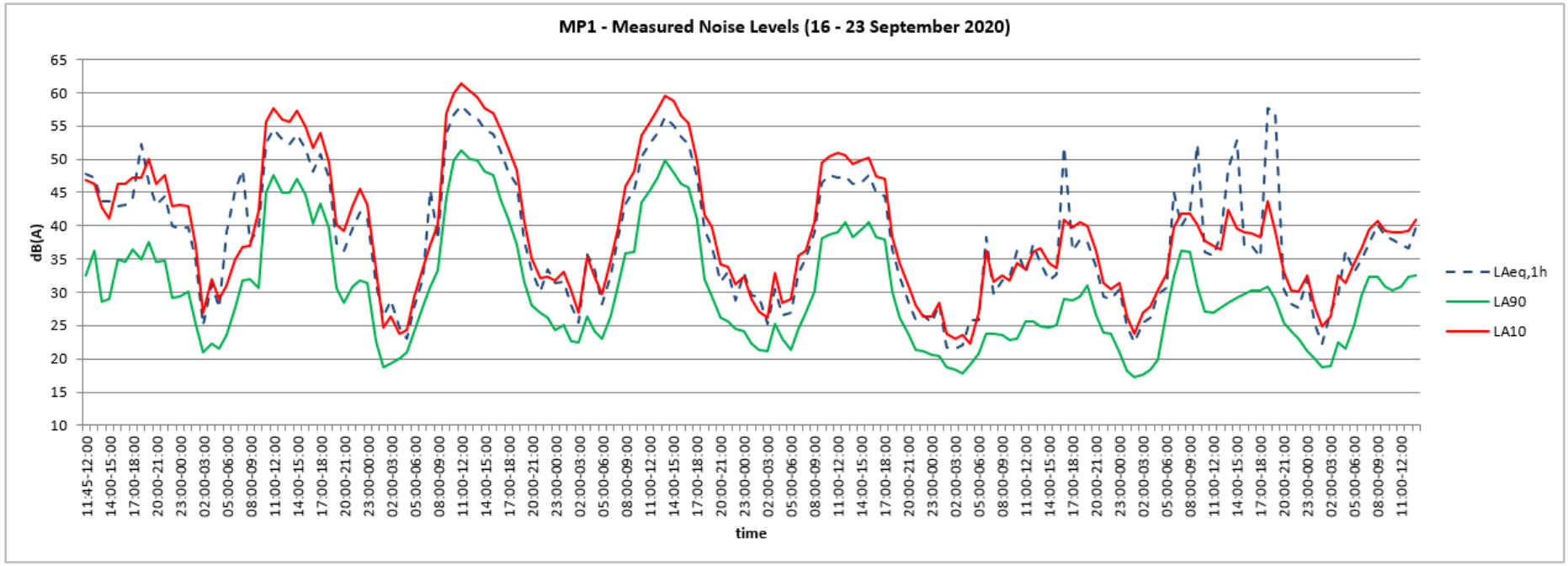
Receptor 5: Rectory Farm House, Fambridge Road			
Results		**Relevant Clause**	**Commentary**
Specific sound level	L_{Aeq} = 21 dB	7.3.6	Calculated sound level using approved prediction methodologies (sec. 6)
Residual sound level	--	7.3.6	Residual sound level discounted due to development not being operational
Background sound level	$L_{A90,15mins}$ = 23 dB	8.2	The background sound level was measured at a representative position to the receptor. An appropriate monitoring period was chosen to quantify the existing sound level during the proposed period of operation.
Assessment during the night-time, so reference time interval is 15 mins			
Acoustic feature correction	+2 dB	9.2	
Rating level	(21 + 2) dB = 23 dB	9.2	+ 2dB correction for tones which are 'just perceptible'
Background sound level	$L_{A90,15mins}$ = 23 dB	8.1.2 8.1.3 8.1.4	Modal value determined and representative background sound level chosen for assessment
Excess of rating of background sound level	(23 – 23) dB = 0 dB	11	
Assessment indicates low impact		**11**	
Uncertainty of the assessment	Not significant	10	See section 8.4

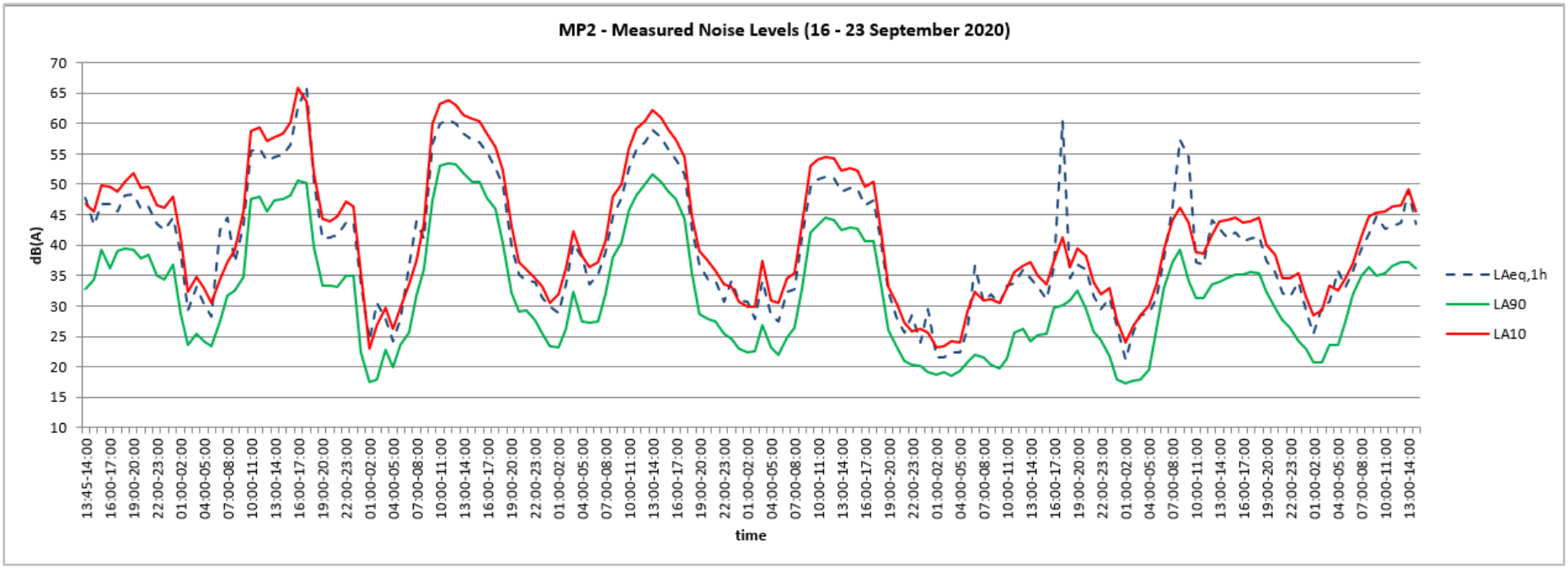
Receptor 6: Scaldhurst Farm House			
Results		**Relevant Clause**	**Commentary**
Specific sound level	L_{Aeq} = 11 dB	7.3.6	Calculated sound level using approved prediction methodologies (sec. 6)
Residual sound level	--	7.3.6	Residual sound level discounted due to development not being operational
Background sound level	$L_{A90,15mins}$ = 22 dB	8.2	The background sound level was measured at a representative position to the receptor. An appropriate monitoring period was chosen to quantify the existing sound level during the proposed period of operation.
Assessment during the night-time, so reference time interval is 15 mins			
Acoustic feature correction	+2 dB	9.2	
Rating level	(11 + 2) dB = 13 dB	9.2	+ 2dB correction for tones which are 'just perceptible'
Background sound level	$L_{A90,15mins}$ = 22 dB	8.1.2 8.1.3 8.1.4	Modal value determined and representative background sound level chosen for assessment
Excess of rating of background sound level	(13 – 22) dB = -9 dB	11	
Assessment indicates low impact		**11**	
Uncertainty of the assessment	Not significant	10	See section 8.4

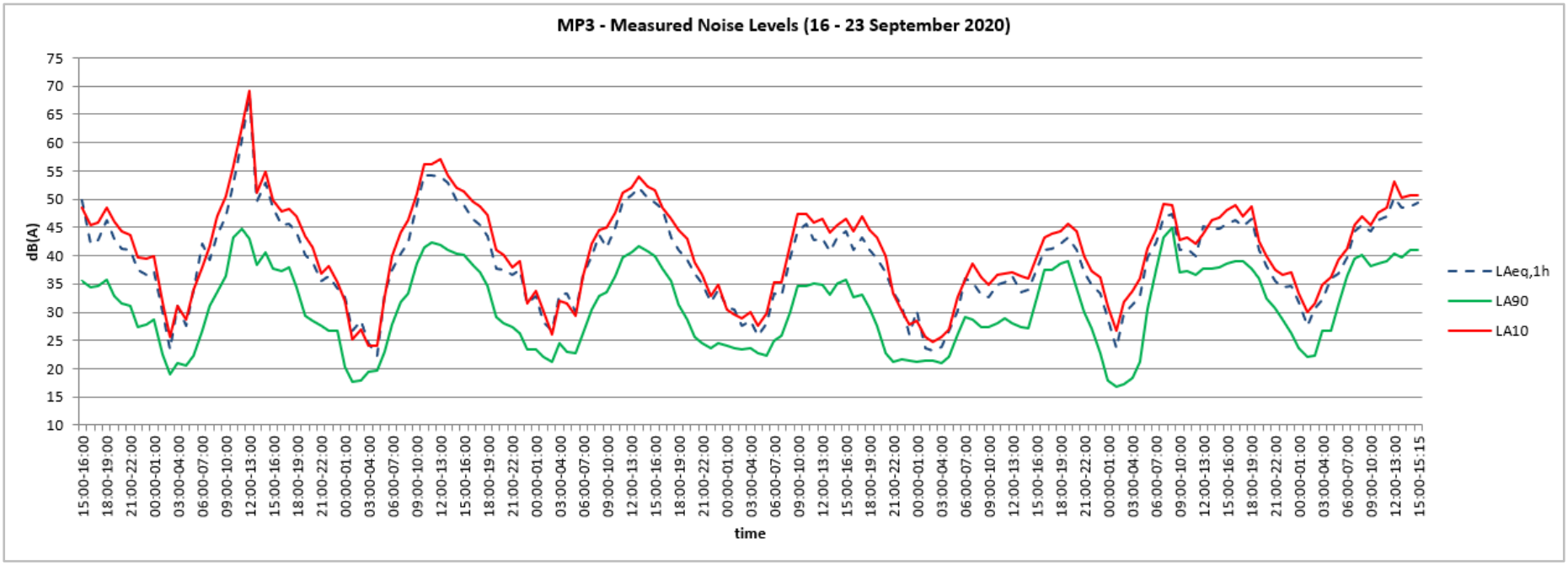
Receptor 7: St. Theresa, Pudsey Hall Lane			
Results		**Relevant Clause**	**Commentary**
Specific sound level	L_{Aeq} = 10 dB	7.3.6	Calculated sound level using approved prediction methodologies (sec. 6)
Residual sound level	--	7.3.6	Residual sound level discounted due to development not being operational
Background sound level	$L_{A90,15mins}$ = 22 dB	8.2	The background sound level was measured at a representative position to the receptor. An appropriate monitoring period was chosen to quantify the existing sound level during the proposed period of operation.
Assessment during the night-time, so reference time interval is 15 mins			
Acoustic feature correction	+2 dB	9.2	
Rating level	(10 + 2) dB = 12 dB	9.2	+ 2dB correction for tones which are 'just perceptible'
Background sound level	$L_{A90,15mins}$ = 22 dB	8.1.2 8.1.3 8.1.4	Modal value determined and representative background sound level chosen for assessment
Excess of rating of background sound level	(12 – 22) dB = -10 dB	11	
Assessment indicates low impact		**11**	

Receptor 7: St. Theresa, Pudsey Hall Lane			
Results		Relevant Clause	Commentary
Uncertainty of the assessment	Not significant	10	See section 8.4

APPENDIX 5 – NOISE SURVEY LEVELS




MP2 - Measured Noise Levels (16 - 23 September 2020)
dB(A)
time
LAeq,1h
LA90
LA10


MP3 - Measured Noise Levels (16 - 23 September 2020)
dB(A)
time
LAeq,1h
LA90
LA10

APPENDIX 6 – PHOTOGRAPHIC REPORT

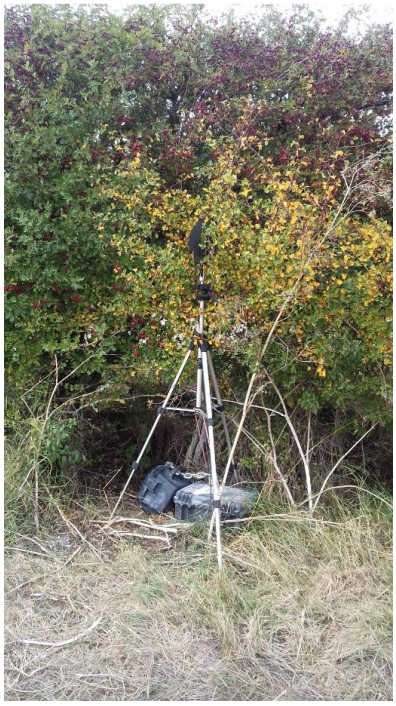


Figure A6.1 MP1 Monitoring Position and Perspective

Figure A6.2 MP2 Monitoring Position and Perspective

Figure A6.3 MP3 Monitoring Position and Perspective

APPENDIX 7 – 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.