STATERA
BALANCING THE GRID

East Claydon Battery Energy Storage System (BESS)

Environmental Statement

Noise & Vibration

December 2023

Contents

1 INTRODUCTION

1.1.1 A noise and vibration assessment has been undertaken, and this noise and vibration chapter of the Environmental Statement (ES) has been prepared, by RPS on behalf of Statera Energy Limited (SEL), for a development comprising a battery storage facility with associated infrastructure, including access, drainage and landscaping (the 'Proposed Development') on land to the south of East Claydon National Grid substation in Buckinghamshire (the 'Site').

1.1.2 It should be noted that the original ES chapter was prepared by RPS in September 2023. The ES chapter, as it currently stands, has been updated as required by Mayer Brown in December 2023.

1.1.3 The layout of the Proposed Development comprises the following plant: battery containers, transformers, inverters, and associated substation.

1.1.4 ES Volume 2 comprises the Noise and Vibration component of the ES and comprises this chapter and associated appendices. This ES chapter presents the assessment of noise and vibration impacts during the construction, operational and decommissioning phases for the Proposed Development. The assessments presented with this ES chapter were undertaken based upon appropriate information on the Proposed Development and relevant manufacturer's data.

1.1.5 They key aspects for the EIA with regards to noise and vibration for this project are:

- **Site Preparation and Construction Effects:** Noise and vibration from plant, activities and traffic associated with the Site Preparation and Construction of the Proposed Development on existing Noise and Vibration Sensitive Receptors (NVSRs)
- **Operational Effects:** Noise and Vibration from the operation of the Proposed Development including noise from any mechanical plant associated with the Proposed Development on the NVSRs.

1.1.6 This ES chapter begins by setting out the planning policy and legislative context for the assessment, followed by the methodology and significance criteria used to assess the likely noise and vibration effects. A description of the baseline conditions is provided; the likely effects are described and any proposed mitigation measures that prevent, reduce or offset any significant adverse effects on the adjacent NVSRs are provided. The significance of the potential noise emissions after these measures have been employed are also provided.

2 SUMMARY OF POLICY, GUIDANCE AND STANDARDS

2.1 National Planning Policy

2.1.1 The National Planning Policy Framework (NPPF) [1] adopted in 2012 in England outlines the Government's planning policies and requirements for the planning system. The NPPF forms a material consideration in planning decisions and hence should be complied with for planning permission to be granted.

2.1.2 Further details on the NPPF can be found in Appendix C.

2.2 Noise Policy Statement for England 2010

2.2.1 The Noise Policy Statement for England (NPSE)[2] sets out the long-term vision of Government, which aims to promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development.

2.2.2 Further details on the NPSE can be found in Appendix C.

2.3 Planning Practice Guidance - Noise

2.3.1 Planning Practice Guidance on Noise (PPG-N)[3] provides guidance to local planning authorities to ensure effective implementation of the planning policy set out in the National Planning Policy Framework. The PPG-N suggests that planning authorities should ensure that unavoidable noise emissions are controlled, mitigated or removed at source and establish appropriate noise limits for extraction in proximity to noise sensitive properties.

2.3.2 The PPG-N reiterates general guidance on noise policy and assessment methods provided in the NPPF, NPSE and British Standards and contains examples of acoustic environments commensurate with various effect levels. Paragraph 006 of the PPG-N explains that:

2.3.3 "The subjective nature of noise means that there is not a simple relationship between noise levels and the impact on those affected. This will depend on how various factors combine in any particular situation."

2.3.4 Further details on the PPG-N can be found in Appendix C.

2.4 Local Planning Policy

2.4.1 Buckinghamshire Council has adopted the local development plan contained within the document "Vale of Aylesbury Local Plan (VALP) 2013 – 2033, September 2021"[4] for the area within which the site is located.

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[1] Department for Communities and Local Government, March 2012. National Planning Policy Framework. HMSO

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

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

[4] Buckinghamshire council www.aylesburyvaledc.gov.uk/valp

2.4.2 With regards to noise the policy **NE5** states the following:

"*Noise pollution*

Significant noise-generating developments will be required to minimise the impact of noise on the occupiers of proposed buildings, neighbouring properties and the surrounding environment. Applicants may be required to submit a noise impact study or to assess the effect of an existing noise source upon the proposed development, prior to the determination of a planning application.

Developments likely to generate more significant levels of noise will be permitted only where appropriate noise attenuation measures are incorporated which would reduce the impact on the surrounding land uses, existing or proposed and sensitive human and animal receptors, to acceptable levels in accordance with Government guidance.

Where necessary, planning conditions will be imposed and / or planning obligations sought in order to specify and secure acceptable noise limits, hours or operation and attenuation measures. Planning permission for noise-sensitive development, such as housing, schools and hospitals, will not be granted if its users would be affected adversely by noise from existing uses (or programmed development) that generate significant levels of noise."

2.4.3 The assessment of the potential noise and vibration impacts has been carried out with due considerations to the local policy as outlined above.

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

2.5.1 BS 4142:2014+A1:2019 provides a method for rating industrial and commercial sound and method for assessing resulting impacts upon people. The method is applicable to fixed plant installations, sound from industrial and manufacturing process and other associated activities.

2.5.2 The rating method takes source characteristic into account, such as tonality, impulsivity, and intermittency.

2.5.3 An initial estimate of the impact of the specific sound is obtained by subtracting the measured background sound level from the rating level of the specific sound. In the context of the Standard, adverse impacts include, but are not limited to, annoyance and sleep disturbance. Typically, the greater this difference, the greater the magnitude of the impact:

- 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 an adverse impact, depending on the context.
- The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. 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.

2.5.4 Further details on BS 4142:2014+A1:2019 can be found in Appendix C.

2.6 Guideline for Community Noise

2.6.1 The World Health Organisation (WHO) published guidance on the desirable levels of environmental noise in 2000. In this document, Guidelines for Community Noise (GCN),

the following advice is provided regarding external ambient sound levels during the daytime:

"To protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 55 dB LAeq on balconies, terraces, and outdoor living areas. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound level should not exceed 50 dB LAeq. Where it is practical and feasible, the lower outdoor sound level should be considered the maximum desirable sound level for new development."

2.7 Control of Pollution Act (CoPA) 1974

2.7.1 Section 60, Part III of the CoPA refers to the control of noise on construction sites. It outlines legislation by which Local Authorities can control noise from construction sites and prevent noise disturbance.

2.7.2 British Standards (BS) 5228-1:2009+A1:2014 and BS 5228 2:2009+A1:2014 were approved within The Control of Noise (Code of Practice for Construction and Open Sites) Order 2015 as suitable guidance on appropriate methods for the control of noise from construction and open sites in exercise of the powers conferred on the Secretary of State by sections 71(1)(b), (2) and (3) of the CoPA.

2.7.3 The CoPA provides a Local Authority the power to serve a notice imposing requirements for the way in which construction works are to be carried out in their jurisdiction. This notice can specify the following:

- The plant or machinery permitted for use;
- The hours during which construction work may be undertaken;
- Limits for the emission levels of noise and vibration due to the works at any time or spatial position on site; and,
- Any other change in circumstance.

2.7.4 Section 61, Part III of the CoPA refers to prior consent for work on construction sites. It provides a method by which a contractor can apply for consent to undertake construction works in advance. Providing consent is granted, and compliance is maintained with the stated method and hours of work, no action may be taken by the Local Authority under Section 60.

2.7.5 Section 71, Part III of the CoPA refers to the preparation and approval of codes of practice for minimising noise.

2.7.6 Section 72, Part III of the CoPA refers to BPM, which is defined as:

'*In that expression, 'practicable' means reasonably practicable, having regards among other things to local conditions and circumstances, to the current state of technical knowledge and to the financial implications'. Whilst 'Means' includes 'the design, installation, maintenance and manner and periods of operation of plant and machinery, and the design, construction and maintenance of buildings and acoustic structures.'*

2.8 British Standard 5228-1&2:2009+A1:2014 – 'Code of Practice for Noise and Vibration Control on Construction and Open Sites' – Part 1 & 2: Noise and Vibration

2.8.1 The Standard provides guidance, information, and procedures for the control of noise and vibration from demolition and construction sites. BS 5228-1:2009+A1:2014 and BS 5228-2:2009+A1:2014 gained approval as guidance on appropriate methods for minimising noise from construction and open sites under the relevant sections of the CoPA 1974.

2.8.2 There are no set standards for the definition of the significance of construction noise effects. However, noise example criteria are provided in Annex E of BS 5228-1:2009+A1:2014 and vibration example criteria are provided in Annex B of BS 5228-2:2009+A1:2014.

BS 5228-1:2009+A1:2014 – Noise

2.8.3 BS 5228-1:2009+A1:2014 provides guidance on significance criteria for assessing the potential noise impacts associated with the construction phase of large projects. For the purposes of this noise assessment, the noise likely to be generated by the earthworks and construction phase, have been assessed against significance criteria established, using the BS 5228-1:2009+A1:2014 ABC Method.

2.8.4 The ABC method for determining significance criteria requires the ambient noise levels at existing sensitive receptors to be determined. The ambient noise levels at each existing receptor location are then rounded to the nearest 5 dB(A) to determine the appropriate threshold value in accordance with the category value A, B or C, as detailed in Table 2.1 below.

Table 2.1: Thresholds of Potential Significant Effect from Construction Noise at Residential Receptors in Accordance with BS5228-1:2009+A1:2014

Assessment Category and Threshold Value Period (L_{Aeq})	Threshold Value, in decibels (dB(A))		
	Category A [1]	Category B [2]	Category C [3]
Night-time (23:00 – 07:00)	45	50	55
Evenings and Weekends [4]	55	60	65
Daytime (07:00 to 19:00) and Saturday (07:00 to 13:00)	65	70	75

*[1] Category A: Threshold values to use when ambient noise levels (when rounded to the nearest 5 dB(A)) are less than this value.

*[2] Category B: Threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as Category A values.

*[3] Category C: Threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than Category A values.

*[4] 19:00 – 23:00 weekdays, 13:00-23:00 Saturdays, and 07:00-23:00 Sundays.

2.8.5 The noise level likely to be generated at the receptor during the construction phase, i.e., the ambient noise level plus construction noise, is then compared to the appropriate category value. If the noise level is greater than the appropriate category value, a significant noise impact may be registered.

2.8.6 BS 5228-1:2009+A1:2014 provides basic information and recommendations for methods of noise control relating to construction and open sites where work activities/operations generate significant noise levels. It includes sections on:

- Community Relations;
- Noise and persons on site;
- Neighbourhood nuisance;
- Project supervision; and,
- The Control of noise.

2.8.7 The annexes of BS 5228 include information on legislative background, noise sources, remedies and their effectiveness (mitigation options); current and historic sound level data for on-site equipment and site activities; significance of noise effects; calculation procedures estimating sound emissions from sites and sound level monitoring; types of piling; and air overpressure.

BS5228-2:2009+A1:2014 – Vibration

2.8.8 Guidance on the assessment of vibration from development sites is given in British Standard 5228-2:2009+A1:2014 “Code of Practice for noise and vibration control on construction and open sites – Part 2: Vibration”. BS 5228-2:2009+A1:2014 indicates that

vibration can have disturbing effects on the surrounding neighbourhood; especially where particularly sensitive operations may be taking place. The significance of vibration levels which may be experienced adjacent to a site is dependent upon the nature of the source.

2.8.9 BS 5228-2:2009+A1:2014 indicates that the threshold of perception is generally accepted to be between a peak particle velocity (PPV) of 0.14 and 0.3 mm/sec. In an urban situation it is unlikely that such vibration levels would be noticed. BS 5228-2:2009+A1:2014 also indicates that it is likely that vibrations of 1.0 mm/s in residential environments will cause complaints but can be tolerated if prior warning and explanation have been given to residents. The standard also indicates that vibrations of 10 mm/s is likely to be intolerable for any more than a very brief exposure to this level.

2.8.10 The Highways Agency Research report No. 53 “Ground Vibration caused by Civil Engineering Works” 1986 suggests that, when vibration levels from an unusual source exceed the human threshold of perception, complaints may occur. The onset of complaints due to continuous vibration is probable when the PPV exceeds 3 mm/sec.

2.8.11 BS 5228-2:2009+A1:2014 also contains information and recommendations for basic methods of vibration control arising from construction and open sites where work activities/operations generate significant levels of vibration. It includes sections on community relations; vibration and persons on site; neighbourhood nuisance; project supervision; control of vibration and measurement. BS 5228 2:2009+A1:2014 refers to BS ISO 4866:2010; BS 7385-2:1993; and BS 6472-1:2008 for further advice on the significance of vibration.

2.8.12 British Standard BS 6472:2008 “Guide to Evaluation of human exposure to vibration in buildings. Part 1: Vibration sources other than blasting” (BS 6472-1:2008) suggests that adverse comments or complaints due to continuous vibration are rare in residential situations below a PPV of 0.8 mm/sec. Continuous vibration is defined as “vibration which continues uninterrupted for either a daytime period of 16 hours or a night-time period of 8 hours”. The proposed earthworks and construction work at the site will not cause continuous vibration as defined in BS 6472-1:2008.

2.8.13 BS 5228-2:2009+A1:2014 suggests that the onset of cosmetic damage in buildings is 15 mm/sec (15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz for residential or light commercial type buildings).

2.9 Spatial Scope (Study Area)

2.9.1 There are no nationally adopted standards or guidance documents that define the study area for the noise and vibration assessments contained within this report. The study areas are different for different disciplines. The study areas for noise and vibration have been chosen specifically for this project and are based on professional judgement.

2.9.2 The study area for the construction and operational noise assessment includes the nearest NVSRs and extends to approximately 500 m from the site boundary, beyond this distance, noise levels from typical construction and operational activities are unlikely to give rise to significant effects if suitably mitigated for the closer NVSRs.

2.9.3 The study area for the assessment of construction vibration includes the nearest NVSRs and extends approximately 50 m from the site boundary. Beyond this distance, vibration levels from typical construction activities are unlikely to give rise to significant effects.

2.9.4 For noise and vibration, the assessment has been undertaken at the nearest NVSRs. It is considered that, if the noise and vibration effects are acceptable at the nearest NVSRs, then the noise and vibration effects would be acceptable at NVSRs within the wider study area.

2.10 Technical Scope

2.10.1 The following impacts have been included within the assessment:

- **Construction Noise:** A quantitative assessment has been undertaken.
- **Construction Vibration:** A qualitative assessment has been undertaken.
- **Construction Traffic Noise:** A qualitative assessment has been undertaken.
- **Operational Plant Noise:** A quantitative assessment has been undertaken.

2.10.2 The following impacts have been scoped out of this assessment.

- **Operational Traffic Noise**: During the operational phase of the Proposed Development the site is not predicted to generate a significant number of vehicle movements, therefore no significant traffic noise effects are considered likely during operation of the Proposed Development.
- **Operational Vibration**: Once constructed, the Proposed Development is unlikely to generate vibration. As such, no significant vibration effects are considered likely during the operation of the Proposed Development.
- **Operational Traffic Vibration**: Providing roads are well maintained, operational traffic vibration is unlikely to be an issue. As such, no significant traffic vibration effects are considered likely during the operation of the Proposed Development.
- **Decommissioning Noise and Vibration**: It is assumed that the activities during the decommissioning phase are similar or less than during the construction phase. It is therefore considered reasonable that noise and vibration impacts identified during the construction phase would reflect the impacts during the decommissioning phase. Similar mitigation measures incorporated during the construction phase would be implemented during decommissioning to reduce any impacts.

2.11 Baseline Characterisation

2.11.1 Baseline Conditions have been identified by undertaking:

- A desktop review of the project information (e.g. mapping, project description, etc.);
- A desktop review of available internet information (e.g., Google maps, Street view, etc.);
- A site visit (to view the site and surrounding area); and
- Baseline monitoring (to establish the baseline sound levels in and around the vicinity of the site.

2.11.2 Baseline sound monitoring was carried out from the 9th November to the 16th November 2022, comprising of three long tern sound level surveys locations. Further information is provided in the 'Baseline Conditions' Section of this report and in Appendix D. Baseline sound monitoring was carried out in accordance with BS 7445-2:1991 and other relevant guidance. Measured data has taken into account the metrological conditions during the survey to obtain a dataset which is representative of baseline sound levels for which the assessment has been derived.

2.12 Significance Criteria

Sensitivity of Receptor

2.12.1 There is no national government guidance on how the sensitivity of a NVSR should be determined for the assessment of noise and vibration effects. For this assessment, the sensitivity of the NVSRs to noise / vibration has been based on the use of the receptor (i.e., the extent to which intruding noise / vibration may be expected to interfere with the expected activities therein) and the existing levels of ambient noise / vibration, whereby NVSRs are less sensitive to noise in areas where existing ambient levels are high.

2.12.2 The semantic scale for determining the sensitivity of NVSRs in this report has been based on professional judgment and is summarised in Table 2.2 below.

Table 2.2: Sensitivity of Receptors

Sensitivity of Receptors	Description
High	Receptors where people, activities or operations are highly susceptible to noise and vibration. For example, hospital operating theatres and highly sensitive processes such as electron microscopes and some micro-electronic manufacturing equipment.
Medium	Receptors where people, activities or operations are moderately susceptible to noise and vibration. Examples include: residential, including private gardens where appropriate; quiet outdoor areas used for stationary recreation; conference facilities; theatres/auditoria/studios; schools during the daytime; hospitals/residential care homes; and places of worship.
Low	Receptors where people, activities or operations are slightly sensitive to noise and vibration, where it may cause some distraction or disturbance. Examples include: offices; sports grounds when spectator noise is not a normal part of the event and where quiet conditions are necessary (e.g. tennis, golf, bowls) and public rights of way.
Negligible	Receptors with minimal or no sensitivity to disturbance from noise and vibration. Examples include: bars/cafes/restaurants; sports grounds when spectator noise is a normal part of the event (e.g. football, rugby, athletics); factories, workshops and working environments with existing high noise levels; and night clubs.

2.12.3 The NVSRs are residential in nature and therefore have been considered within this report as medium.

Magnitude of Impact

Construction Noise

2.12.4 Construction noise impacts have been assessed with reference to BS 5228-1:2009+A1:2014. The Standard provides guidance, information, and procedures on the control of noise from construction sites and promotes a 'Best Practicable Means' (BPM) approach to control noise.

2.12.5 Noise predictions have been made using a plant list and operating methods provided by the client to ensure a robust noise assessment is undertaken. .

2.12.6 The magnitude of construction noise impacts is based on their levels relative to baseline conditions and the duration over which the impacts occur. Levels of construction noise at an individual NVSR will vary throughout the construction phase and will depend upon what activities are being carried out and how close they are to the NVSR. Whilst accepting that levels may be higher or lower on individual days, the impact magnitudes described in BS 5228-1:2009+A1:2014 are, in general, to be interpreted based on the average noise levels at the affected NVSR over a period of one month.

2.12.7 This approach is commensurate with the description of long-term average noise levels contained within BS 7445-2:1991, which suggests that the long-term time interval should be chosen so that the long-term variations in emissions from the sources and propagation conditions are covered. The Standard states that the interval is frequently of the order of several months. This assessment has considered a long-term interval of one month, commensurate with Example Method 2 of the assessment of the potential significance of construction noise effects contained within Annex E of BS 5228-1:2009+A1:2014, which states that:

> *"Noise levels generated by site activities are deemed to be potentially significant if the total noise (pre-construction ambient plus site noise) exceeds the pre-construction ambient noise by 5 dB or more, subject to lower cut-off values of 65 dB, 55 dB and 45 dB Laeq,T from site noise alone, for the daytime, evening and night-time periods, respectively; and a duration of one month or more, unless works of a shorter duration are likely to result in significant effect."*

2.12.8 The magnitude and descriptor for construction noise is provided in Table 2.3 below. The criteria in BS 5228-1:2009+A1:2014 generally apply to residential and other receptors that are classified as 'medium' sensitivity in accordance with Table 2.2 above, and therefore this scale has primarily been derived to assess impacts on receptors of medium sensitivity.

2.12.9 The references to 'disruptive' in Table 2.3 relate to the descriptor of perception at which exposures exceed the SOAEL in the PPG-N; such exposures relate to a material change in behaviour (e.g., having to keep windows closed most of the time because of the noise).

Table 2.3: Impact Magnitudes of Construction Noise

Magnitude	Description
High	Levels much greater than BS 5228 criteria and/or very disruptive

Medium	Levels exceeding BS 5228 criteria and/or disruptive
Low	Levels approaching BS 5228 criteria
Negligible	Levels less than baseline

2.12.10 Battery Storage sites have limited noise and vibration effects during construction assuming that they are well managed, and that the works are undertaken sympathetically with regard to the adjacent NVSRs. This is due to the phasing that is usually put in place for the development which limits activity, the types of plant involved, and the general plant and activities which are not significant for the builds required.

2.12.11 The contractor will be required to work in accordance with an approved Construction Environmental Management Plan (CEMP). The CEMP will set the noise and vibration control measures which the contractor will apply to minimise noise and vibration effects.

2.12.12 This report includes an assessment of the effects of constructing the various phases of the Proposed Development and identifies in outline what mitigation and control measures will be adopted to minimise any adverse effects. The methodology and control measures reflect those given in BS 5228-1/2:2009+A1:2014.

Operational Noise

2.12.13 Operation noise impacts from plant associated with the Proposed Development have been assessed with reference to BS4142:2014+A1:2019 and the significance effects described in the PPG-N, however, there is not a direct link. It is not appropriate to merely ascribe a numerical scale for the difference between the rating and background sound level to LOAEL and SOAEL because this fails to consider the context of the sound, which is a key requirement of the Standard. It is necessary to consider all pertinent factors including:

- The absolute level of the sound;
- The character and level of the residual sound compared to the character and level of the specific sound; and
- The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure internal and/or external acoustic conditions, such as:
  - Façade insulation treatment;
  - Ventilation and/or cooling that will reduce the need to have windows open so as to provide rapid or purge ventilation; and
  - Acoustic screening.

2.12.14 The magnitude and descriptor for operational plant noise is provided in Table 2.4 below. However, the significance of the effect of noise in question (i.e., whether above or below SOAEL and LOAEL) should be determined on the basis of the initial estimate of the impact magnitude of the BS4142:2014+A1:2019 assessment with reference to the examples of outcomes described within the PPG-N and after having considered the context of the sound.

Table 2.4: Impact Magnitudes of Operational Plant Noise

Magnitude	Description
High	Rating level more than 10 dB above the measured background, depending on the context
Medium	Rating level of +5 to +10 dB above the measured background, depending on the context
Low	Rating level of 0 to +5 dB above the measured background, depending on the context
Negligible	Rating less than the measured background, depending on the context

Scale and Significance of Effect

2.12.15 The assessment of effects is based the combination of the magnitude of impact and the sensitivity of a receptor. Effects are defined as either being Negligible, Minor, Moderate, Major in scale, as per the matrix provided in Table 2.5 below:

Table 2.5: Scale of Effect Matrix

Sensitivity/ Value of Receptor	Magnitude of Impact			
	High	Medium	Low	Negligible
High	Major	Major	Moderate	Minor
Medium	Major	Moderate	Minor	Negligible
Low	Moderate	Minor	Negligible	Negligible
Negligible	Minor	Negligible	Negligible	Negligible

2.12.16 The definitions of the terms used relate to the PPG-N, as described in Table C.1 of Appendix C, as follows:

- Effects of major scale are considered to be significant in EIA terms and are equivalent to the Unacceptable Adverse Effect Level (UAEL) set out in the PPG-N. Such effects should be prevented and require mitigation. These effects are likely to be material in the decision-making process.

- Effects of moderate scale are considered to be significant in EIA terms and are equivalent to the SOAEL set out in the PPG-N. Such effects should be avoided and require mitigation. These effects are likely to be material in the decision-making process.
- Effects of minor scale are not considered to be significant in EIA terms and are equivalent to the LOAEL set out in the PPG-N. Such effects should be mitigated and reduced to a minimum as far as reasonably practicable but taking account of the economic and social benefits being derived from the activity causing the noise. These effects are unlikely to be critical in the decision-making process but are important in enhancing the subsequent design of the proposed development.
- Effects of negligible scale are not considered to be significant in EIA terms and are equivalent the No Observed Effect Level (NOEL) set out in the PPG-N. These effects need no mitigation.

Assumptions and Limitations

2.12.17 In all assessments, it is good practice to consider uncertainty, which can arise from a number of different aspects of an assessment. There is a degree of uncertainty associated with: the instrumentation used in the baseline monitoring; the use of instrumentation (i.e., the measurements); the source levels used in the sound propagation model; the sound propagation model; and the subjective response of residents to the sound sources.

2.12.18 Uncertainty due to instrumentation error has been significantly reduced with the introduction of modern instrumentation and is reduced further by ensuring that all instrumentation is calibrated before and after each measurement period and is within accepted calibration intervals.

2.12.19 Every effort has been made to reduce the uncertainty of the baseline sound level measurements. Uncertainty in the baseline data has been reduced significantly by carrying out the baseline sound level survey over a period of eight days, allowing analysis of how representative the baseline data are, given the naturally varying sound level at the site.

2.12.20 If the baseline sound surveys were repeated, it is possible that the averages of the ambient and background sound levels would be slightly different; this would be due to seasonal variations and variations in repeatability/reproducibility. However, this limitation has been managed by adopting a ‘representative’ background sound level, using professional judgement. This is a standard approach and is considered to be an acceptable and robust method.

2.12.21 With regards to subjective response, the standards and guidance adopted for the assessment are based on the subjective response of the majority of the population. This is considered to be the best that can be achieved in a population of varying subjective responses, which are dependent upon a wide range of factors.

2.12.22 On the basis of the above, measures have been taken to minimise uncertainty in accordance with best practice. The information used to inform this chapter is therefore considered to provide an acceptable and robust basis for assessment.

3 BASELINE CONDITIONS

3.1 Site Description and Noise Sensitive Receptors

3.1.1 The Site is located approximately 600m west of Granborough Village. The site is bound on all side's arable farmland. National Grids East Claydon Sub-station lies approximately 390m Northwest of the proposed development. The access road runs approximately 470 m south-east before joining on Hogshaw Road.

3.1.2 The Proposed Development has the potential to affect the noise and vibration sensitive receptors (NVSRs) located at the wider area surrounding the site. The identified nearest noise sensitive receptors at the vicinity of the site are detailed in Table 3.1 below.

Table 3.1: Existing Noise and Vibration Sensitive Receptors

Noise and Vibration Sensitive Receptor	Co-ordinates		Distance from site boundary	Use	Sensitivity
	X	Y			
NVSR A	474910	225415	420 m NW	Residential	Medium
NVSR B	475983	224508	470 m SE	Residential	Medium
NVSR C	475602	224042	880 m S	Residential	Medium
NVSR D	476130	224706	420 m SE / E	Residential	Medium
NVSR E	476384	225212	480 m E	Residential	Medium

3.1.3 The NVSRs are shown on Figure 1.

3.1.4 With regards to sensitivity, all NVSRs identified above are considered to be of medium sensitivity to adverse noise effects.

4 BASELINE SURVEY

4.1 Survey Locations

4.1.1 Long-term sound monitoring was undertaken at two locations over a period of one week. Between the 9th November 2022 and the 16th November 2022.

- LT1: Located approximately 490 m to the southeast of the proposed development and approximately 10 m from Hogshaw Road adjacent to an existing hedge. Bushes and trees were 1 m to the east of the monitor. Road traffic noise from Hogshaw Road was considered to be dominant. This location is considered to be representative of the existing residential dwellings along Hogshaw Road.
- LT2: Located approximately 540 m Northeast of the proposed development, adjacent to the residential dwellings on Hollow Hill End. Bushes were approximately 2 m from the noise monitor during this measurement. Road traffic noise from Hogshaw road and the local road network was audible at this location. A weather station was also installed at this location. This location is considered to be representative of the residential dwellings at Rookey Farm and Hollow Hill End.
- LT3: Located on the northern boundary of the proposed development. This monitoring location lies approximately 600 m south-west of the National Grid East Claydon Sub-station. This location considered representative of the existing residential dwellings at Sion Hill Farm. At this location a hum from an East Claydon Sub-station was audible.

4.1.2 The above locations can be seen in Figure 1.

4.2 Instrumentation

4.2.1 Details of the instrumentation used during the survey are provided in Table 4.1below. Calibration certificates of the equipment are available upon request. Calibration of the equipment was carried out before and after measurements with no significant drift (< ±0.5 dB) observed. All sound level meters (SLMs) and calibrators are class 1 in accordance with BS EN 61672-1:2003.

Table 4.1 Instrumentation Details

Measurement Location	Make / Model	Serial Number
LT1	Class 1 – Noise monitor Rion-NL-52	998563
LT2	Class 1 – Noise monitor Rion-NL-52	998566
LT3	Class 1 – Noise monitor Rion-NL-52	998569

4.3 Weather Conditions

4.3.1 The weather conditions throughout the noise survey were recorded with a Davis weather station. The results of these measurements have been summarised below with full details

in Appendix C. Throughout the measurement period no adverse weather conditions were recorded.

Table 4.2 Summary of Weather Data

Date	Wind Speed (m/s)		Rain (mm)
	Day	Night	Day / Night
09/11/2022	3.0	-	0
10/11/2022	3.7	2.1	0
11/11/2022	2.0	3.4	0
12/11/2022	0.7	0.2	0
13/11/2022	0.2	0.2	0
14/11/2022	0.4	0.0	0
15/11/2022	1.6	0.9	0
16/11/2022	0.5	0.7	0

4.4 Subjective Description of the Noise Climate

4.4.1 The main source of sound was noted at deployment and collection of each survey and have been summarised below:

- LT1: the main source of sound that was noted at this location was road traffic noise on Hogshaw Road.
- LT2: The main source of sound that was noted at this location was noise from Hogshaw road and distant road traffic noise from the local road network. No noise from the East Claydon Substation was noted.
- LT3: The main source of sound noted at this location was from the East Claydon Substation. A consistent hum was noted along the northern boundary of the site.

4.5 Survey Results and Representative Sound Levels

4.5.1 Data was recorded on the SLM in 15-minute periods. As noted in paragraph 4.3.1, weather conditions throughout the survey were suitable and therefore, no exclusions have been made from the data.

4.5.2 The survey results from the three locations can be seen in Table 4.2 below.

4.5.3 The representative background sound levels, $L_{A90,\,T}$ have been derived through statistical analysis of the measured data. An initial estimate of the representative background sound levels at each long-term measurement positions have been derived by calculating the $L_{A90,\,T}$ level that is not exceeded for more than 25 % of the relevant day and night-time period respectively. These values have been reviewed and evaluated against the time-history graphs and histograms.

Table 4.2: Survey Results

Measurement Location	Daytime (07:00 – 23:00)				Night-time (23:00 – 07:00)	
	Avg. $L_{Aeq,12hr}$ (dB)*	Avg. $L_{Aeq,4hr}$ (dB)*	Avg. $L_{Aeq,16hr}$ (dB)*	Representative $L_{A90,15min}$ (dB)	Avg. $L_{Aeq,8hr}$ (dB)*	Representative $L_{A90,15min}$ (dB)
LT1	51	45	48	31	34	25
LT2	44	38	40	31	30	25
LT3	47	41	42	33	35	30

** logarithmic average*

4.5.4 From Table 4.2 it can be seen that the measured background sound levels at location LT3 are higher than the measurements at LT1 and LT2. This is likely due to the noise impact from East Claydon Substation. Therefore, in order to ensure a robust assessment considering a worst-case scenario, the background sound level at LT2 have been used throughout the report for the receptors, where results from LT3 would otherwise have been used.

4.6 Significant Effect Thresholds – Construction Noise

4.6.1 In line with BS5228-1:2009+A1:2014 methodology, the significant effect threshold at each NVSR can be determined based on the noise monitoring results shown in Table 4.2: Survey Results. These are shown in Table 4.3 below.

Table 4.3: BS5228-1 Significant Effect Threshold

Measurement Criteria	Noise Sensitive Receptors				
	NVSR A	NVSR B	NVSR C	NVSR D	NVSR E
Daytime (07:00 – 19:00)					
Measured Residual Sound Level (dB $L_{Aeq,12\ hrs}$)	47	51	51	51	44
Sound Level Rounded to Nearest 5 dB	50	50	50	50	45
BS 5228 Category	A	A	A	A	A
Significant Effect Threshold (dB)	65	65	65	65	65
Evening and weekends					
Measured Residual Sound Level (dB $L_{Aeq,\ 4\ hrs}$)	41	45	45	45	38
Sound Level Rounded to Nearest 5 dB	40	45	45	45	40
BS 5228 Category	A	A	A	A	A
Significant Effect Threshold (dB)	55	55	55	55	55
Night-time (23:00 – 07:00)					
Measured Residual Sound Level (dB LAeq, $_{8\ hrs}$)	35	34	34	34	30
Sound Level Rounded to Nearest 5 dB	35	35	35	35	30
BS 5228 Category	A	A	A	A	A
Significant Effect Threshold (dB)	45	45	45	45	45

5 DESCRIPTION OF WORKS – CONSTRUCTION NOISE

5.1.1 This section contains information regarding the proposed construction processes, understood to be taking place during the construction of the Proposed Development. The construction is understood to take place in three main phases:

- Phase 1: Site Preparation and construction of haul roads.
- Phase 2: Earth Works and Piling.
- Phase 3: Building and erection and installation of plant.

5.1.2 The construction activities and associated plant has been provided by the client. This information has been used to inform the noise model and assessment. The predicted construction activities are summarised in Table 5.1 below.

Table 5.1: Source sounds Level Data - Proposed Construction Operations

Source	Number	Broadband Level (dBA)	On-time	Height Above Ground Level (AGL)	Noise Source Type in Model
Phase 1 – Site Preparation					
Portable Generators	2	94	100%	1 m	Point source
Dump Trucks (empty)	5	109	50%	1.5 m	Moving Point source
Dump Trucks (Loaded)	3	102	50%	1.5 m	Moving Point source
Road sweeper	1	104	50%	1.5 m	Moving Point source
JCB	4	96	50%	1.5 m	Point source
Compactor	4	107	25%	1.5 m	Moving Point source
Phase 2: Earth Works and Piling.					
Portable Generators	1	94	100%	1 m	Point source

Dump Trucks (empty)	3	109	50%	1.5 m	Moving Point source
Dump Trucks (Loaded)	3	102	50%	1.5 m	Moving Point source
Road Sweeper	1	104	50%	1.5 m	Moving Point source
360 Excavator (Idling)	2	91	50%	1.5 m	Point source
Ready Mix Delivery (idling)	2	99	25%	1.5 m	Moving Point source
Telehandler	2	107	50%	1.5 m	Moving Point source
Piling Rig	1	115	75%	4.5 m	Point source
Vibration Compaction Plant	1	110	50%	1.5 m	Point source
Compressor	1	93	25%	1.5 m	Point Source
JCB	1	96	50%	1.5 m	Moving Point source
Phase 3: Building and erection and installation of plant.					
Telehandler	4	107	50%	1.5 m	Moving Point source
Crane	3	95	50%	1.5 m	Point source

6 MODELLING METHODOLOGY

6.1.1 Computer noise modelling in SoundPLAN v8.2 modelling software was carried out to calculate noise levels, generated at the site during both construction and operational phases of the Proposed Development, at nearby sensitive receptors. SoundPLAN modelling software enables the calculation of the propagation of multiple noise sources, across varying terrain, and allows for a more detailed calculations to be carried out to determine noise levels at Noise Sensitive Receptors (NVSRs).

6.1.2 The model predicts sound levels under light down-wind conditions based on hemispherical sound propagation with corrections for atmospheric absorption, ground effects, screening and directivity based on the procedure detailed in ISO 9613-2:1996 'Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation'.

6.2 Proposed Development Layout

6.2.1 The layout used for the site is given in Appendix D.

6.3 Assumptions and Uncertainty

Assumptions

6.3.1 The following assumptions have been used to inform the noise model:

- The noise sensitive receptors are most sensitive on the ground floor, during the daytime, and first floor during the night-time periods. Therefore, the impact of daytime noise levels has been assessed at first floor to represent the use of a typical residential dwelling.
- The proposed equipment will be maintained throughout the construction process, so noise levels generated on site is true to the noise levels used to inform the noise assessment.
- When operational, all noise sources are, as a worst case, assumed to be operational concurrently.
- The majority of ground type in the model has been set to semi-hard ground (G=0.3), to represent the worst-case scenario in rural surroundings, i.e., frozen or arid land.
- Information on the proposed equipment, provided by the client, is representative of the equipment used on site, and its acoustic performance.
- As the excavators proposed by the client are expected to move throughout the defined area, depending on the stage of the works being carried out, these have been modelled as individual point sources, located to nearest NVSRs, to represent a worst-case scenario.

Uncertainty

6.3.2 To reduce measurement uncertainty, the following measures have been implemented:

- The noise measurement locations were selected to be representative of the ambient noise levels at the Proposed Development and background sound levels at NVSRs.

- The noise levels generated by the proposed construction works were calculated using computer noise modelling, informed by client data regarding the works expected to be undertaken on site.
- The results of the noise survey were reported to the nearest 0.1 dB.
- Noise surveys were made using Class 1 integrating Sound Level Meters

7 CONSTRUCTION NOISE ASSESSMENT

7.1 Noise Modelling Results – Construction Noise

7.1.1 The noise levels generated by the proposed construction processes have been calculated at each NVSR using SoundPLAN v8.2 3D noise modelling software. The daytime and night-time noise levels, generated by the proposed construction works are summaries in Table 7.1 Table 7.1: Construction Noise Model Results (Rounded to the Nearest Integer)below: The noise model has been created assuming the plant is in the worst case locations in the north (closest to ESR).

Table 7.1: Construction Noise Model Results (Rounded to the Nearest Integer)

NVSRs	Phase 1		Phase 2		**Phase 3**	
	Daytime Ambient Noise Levels (dB $L_{Aeq,12hr}$) ground floor	Night-time Ambient Noise Levels (dB $L_{Aeq,8hr}$) First Floor	Daytime Ambient Noise Levels (dB $L_{Aeq,12hr}$) ground floor	Night-time Ambient Noise Levels (dB $L_{Aeq,8hr}$) First Floor	Daytime Ambient Noise Levels (dB $L_{Aeq,12hr}$) ground floor	Night-time Ambient Noise Levels (dB $L_{Aeq,8hr}$) First Floor
NVSR A	43	43	35	35	33	33
NVSR B	43	44	36	36	25	25
NVSR C	34	34	26	27	20	20
NVSR D	52	53	44	44	26	27
NVSR E	42	42	35	35	31	32

7.2 Assessment of Significant Effects

7.2.1 The noise modelling results, shown in Table 7.1, have been used to establish the likelihood of significant effects occurring at NVSRs from construction noise. These are determined by comparing the modelled construction noise levels with the thresholds set out in Table 2.1 The assessment of effects during Phase 1 is shown in

7.2.2 Table 7.2 below:

Table 7.2: Assessment of Significant Effects During Phase 1 of Construction Works (Rounded to the Nearest Integer)

Measurement Criteria	Noise Sensitive Receptors				
	NVSR A	NVSR B	NVSR C	NVSR D	NVSR E
Daytime (07:00 – 19:00)					
Modelled Construction Noise Levels (dB)	43	43	34	52	42
Significant Effect Threshold (dB)	65	65	65	65	65
Exceedance	-22	-22	-31	-13	-24
Evening (19:00 – 23:00)					
Modelled Construction Noise Levels (dB)					
Significant Effect Threshold (dB)	55	55	55	55	55
Exceedance					
Night-time (23:00 – 07:00)					
Modelled Construction Noise Levels (dB)	43	44	34	53	42
Significant Effect Threshold (dB)	45	45	45	45	45
Exceedance	-2	-2	-11	8	-3

7.2.3

7.2.4 Table 7.2 Shows that no significant effects are expected to occur during the site preparation works (phase 1) during the daytime period. However, during the night-time works, there is predicted to be an 8 dB exceedance at NVSR D. This is due to haul road construction activities, which have been modelled at the worst-case location, i.e., closest to NVSR D. For the majority of the project these operations will occur further from this receptor and therefore the noise impact will be significantly reduced. Furthermore, it is highly unlikely that these operations will occur during the night-time period. If these operations were to occur, the sensitivity of the receptor is medium and the magnitude of the impact is medium therefore the effect is moderate at NVSR D. These works will not occur during the night-time period, therefore the impact will be negligible and therefore the effect is negligible. The impact on all other NVSRs is negligible to low and therefore the effect is negligible to minor. These impacts are not considered to be significant.

7.2.5 Table 7.3 below summarises the assessment of construction noise associated with the Phase 2 earthworks.

Table 7.3: Assessment of Significant Effects During Phase 2 of Construction Works (Rounded to the Nearest Integer)

Measurement Criteria	Noise Sensitive Receptors				
	NVSR A	NVSR B	NVSR C	NVSR D	NVSR E
Daytime (07:00 – 19:00)					
Modelled Construction Noise Levels (dB)	35	36	26	44	35
Significant Effect Threshold (dB)	65	65	65	65	65
Exceedance	-30	-29	-39	-21	-30
Evenings and weekends					
Modelled Construction Noise Levels (dB)					
Significant Effect Threshold (dB)	55	55	55	55	55
Exceedance					
Night-time (23:00 – 07:00)					

Modelled Construction Noise Levels (dB)	35	36	27	44	35
Significant Effect Threshold (dB)	45	45	45	45	45
Exceedance	-10	-9	-18	-1	-10

7.2.6 Table 7.3 shows that no significant effects are expected to occur during Phase 2: 'Earth Works and Piling' for the proposed development. The sensitivity of the receptors is medium, and the magnitude of the impact is negligible to low, therefore the effect is negligible to low which is not significant.

7.2.7 Table 7.4 below summaries the assessment of construction noise associated with Phase 3: 'Building and erection and installation of plant'.

Table 7.4: Assessment of Significant Effects During Phase 3 of Construction Works (Rounded to the Nearest Integer)

Measurement Criteria	**Noise Sensitive Receptors**				
	NVSR A	NVSR B	NVSR C	NVSR D	NVSR E
Daytime (07:00 – 19:00)					
Modelled Construction Noise Levels (dB)	33	25	20	26	31
Significant Effect Threshold (dB)	65	65	65	65	65
Exceedance	-32	-40	-45	-39	-34
Evening and Weekends					
Modelled Construction Noise Levels (dB)					
Significant Effect Threshold (dB)	55	55	55	55	55
Exceedance					

Night-time (23:00 – 07:00)					
Modelled Construction Noise Levels (dB)	33	25	20	27	32
Significant Effect Threshold (dB)	45	45	45	45	45
Exceedance	-12	-20	-25	-18	-13

7.2.8 Table 7.4 shows that no significant effects are expected to occur during the 'Building and erection and installation of plant' phase of the development. The sensitivity of the receptor is medium, and the magnitude of the impact is negligible therefore the effect is negligible, which is not significant.

7.3 General Noise Control Measures

7.3.1 While specific mitigation measures are not required, training and best practice measures shall be implemented to ensure adverse impacts are not incurred due to negligence or improper management of the site. Therefore, the following best practice measures shall be implemented during the construction (Phases 1-3) of the Proposed Development.

Training

7.3.2 All staff will participate in an induction training session when they commence work on the Proposed Development. The induction will include a briefing on a Noise and Vibration Management Plan (NVMP), which will be submitted as part of the Construction Environment Management Plane (CEMP) with attention given to the following matters:

- Construction noise and vibration limits.
- Activities with the potential to generate high levels of noise and/or vibration.
- Noise and vibration mitigation and management procedures.
- The sensitivity of receivers to noise and vibration, and any operational requirements and constraints identified through communication and consultation.

7.3.3 Awareness of current noise and vibration matters on, or near active worksites, will be addressed during site meetings and/or 'toolbox' training sessions.

Equipment Selection

7.3.4 Some activities have the potential to exceed the noise level criteria at close receiver distances. It is essential that appropriate mitigation and management measures are identified and employed in advance of the works to avoid exceedances. When selecting construction equipment, where practicable:

7.3.5 Prioritise quieter construction methodologies (e.g., bored piling in place of drop hammer piling);

- Prioritise electric motors over diesel engines;

- Prioritise rubber tracked equipment over steel tracked equipment;
- Equipment should be suitably sized for the proposed task;
- Equipment should be maintained and fitted with exhaust silencers and engine covers; and
- Avoid tonal reversing or warning alarms (suitable alternatives may include flashing lights, broadband audible alarms or reversing cameras inside vehicles).

General Measures

7.3.6 Best Practical Means (BPM) mitigation will be implemented throughout the construction programme to minimise any noise and vibration effects where possible. This will include, but not be limited to the following:

Noise

- Keep the construction time near noise sensitive areas to a minimum.
- Carry out consultation with nearby residents. Residents should be advised of the nature and likely duration of noise generating works in advance.
- Avoid unnecessary noise, such as shouting, the use of horns, loud site radios, rough handling of material and equipment, and banging or shaking excavator buckets.
- Avoid metal on metal contact where practicable by minimising drop height of materials, such as during the erection and dismantling of scaffold and the loading and unloading of trucks.
- Tonal reversing alarms shall be prohibited on site. Suitable alternatives may include flashing lights, broadband audible alarms or reversing cameras inside vehicles.
- Mitigate track squeal from tracked equipment, such as excavators and piling rigs. This may include tensioning and watering or lubricating the tracks regularly.
- Avoid high engine revs where practicable through appropriate equipment selection and turn engines off when idle / parked.
- Maximise the distance between the noise source and the nearest sensitive receiver by positioning fixed plant away from sensitive receivers, or orienting machinery to maximise the distance between the engine exhaust and the nearest sensitive building façade (e.g., excavators).
- Crane and secure loads using straps in preference to chains, where it is safe and practicable.
- Utilise power from the national grid in preference to generators where practicable.
- For concrete breaking, an initial perimeter saw cut should be used to reduce vibration transfer to neighbouring buildings, match the chisel/tip to the material to be broken and avoid ‘blank’ firing by engaging the material before commencing and stopping before it fires through the material.

Vibration

- Construction activities have the potential to generate high vibration levels. Vibration may be perceptible for brief periods, but the levels and effects will be heavily influenced by the contractor's proposed construction methodology. Where possible, low vibration methods should be prioritised.
- Due to the prevailing ground conditions, it is anticipated at the time of writing that most excavation can be done by ripping techniques, with limited rock breaking required. It is expected that during these activities, vibrations may be perceptible on occasion, but not significant. Effects from vibration are therefore considered to be negligible and not significant.
- Piling works are expected to be required in relation to the substation with the methodology assumed to be vibratory piling in all locations. While this piling method can generate high vibration levels, due to the distance between the piling rig and nearby NVSRs (over 200 m away at closest receptor), it is considered unlikely that piling will generate significant vibration effects at receptors. In addition, piling is expected to only be a short-term activity, therefore no long-term effects are expected. Vibration effects from piling are therefore negligible and not significant.
- Vibration associated with the proposed construction works is therefore not expected to generate any significant adverse impacts at nearby NVSRs.

8 VIBRATION

8.1.1 Construction activities have the potential to generate high vibration levels. Vibration may be perceptible for brief periods, but the levels and effects will be heavily influenced by the contractor's proposed construction methodology. Where possible, low vibration methods should be prioritised.

8.1.2 Due to the prevailing ground conditions, it is anticipated at the time of writing that most excavation can be done by ripping techniques, with limited rock breaking required. It is expected that during these activities, vibrations may be perceptible on occasion, but not significant. Effects from vibration are therefore considered to be negligible and not significant.

8.1.3 Piling works are expected to be required in relation to the substation with the methodology assumed to be vibratory piling in all locations. While this piling method can generate high vibration levels, due to the distance between the piling rig and nearby NVSRs (over 600 m away at closest receptor), it is considered unlikely that piling will generate significant vibration effects at receptors. In addition, piling is expected to only be a short-term activity, therefore no long-term effects are expected. Vibration effects from piling are therefore negligible and not significant.

8.1.4 Vibration associated with the proposed construction works is therefore not expected to generate any significant adverse impacts at nearby NVSRs.

9 OPERATIONAL NOISE ASSESSMENT

9.1.1 The noise emissions from the facility have been modelled using the SoundPLAN v8.2 environmental noise prediction software package. The model calculates the contribution from each noise source at the identified NVSR locations. The contribution from each noise source is calculated based on the octave band sound power levels and the source type (e.g. point, line, area). The model predicts noise levels under light down-wind conditions based on hemispherical propagation, atmospheric absorption, ground effects, screening and directivity based on the procedure detailed in ISO 9613-2:1996.

9.1.2 Terrain contour data have been entered in the model based on OS land contours and contours provided by the client. The ground between the site and the receiver locations has been assumed to be soft although the site area has been assumed to be hard.

9.1.3 Receivers have been modelled at ground floor level at a height of 1.5 m above local ground level (AGL) and at first floor level at a height of 4 m AGL. The maximum predicted level at either floor level has been used in the assessment.

9.1.4 The same noise modelling techniques have been used by RPS on numerous sites in the UK and worldwide and there is a high degree of confidence in the model.

9.1.5 Noise source data for the assessment has been based on information provided by the client (SEL) and manufacturer's data. The various noise sources, their numbers, the broadband sound power levels, on-times, height above local ground level and noise source types that were used in the model for this assessment are provided in Table 9.1.

Table 9.1: Source sound Level Data – Octave Band Data – Operations Noise assessment

Source	Number	Broadband Sound Power Level (L_w dBA)	On-time	Height AGL (m)	Noise Source Type in Model
Grid Transformer	4	87	100%	1.5	Point Source
Battery Containers	888	85	100 % day / 14.4 % night	1.1	Industrial building emitting from 5 sides
Battery Containers - HVAC	1 per container	65	100 % day / 14.4 % night	1.1	Industrial building emitting from 5 sides
Battery Containers - Chiller side	3 per container	63	100 % day / 14.4 % night	1.5	Point source assigned to industrial building

Inverter Transformers	74	79	50 % day / 14.4 % night	n/a	Point source; approx. 1 m above ground level
Inverter Building - air inlet	37	74	100%	1.1	Point source assigned to industrial building
Inverter Building - air outlet	37	73	100%	2	Point source assigned to industrial building
Inverter Buildings	37	82	50 % day / 14.4 % night	1	Industrial building emitting from 5 sides
Inverter Building - internal sources per building	8	91	50 % day / 14.4 % night	1	Internal point source of industrial building
* The sound power level emission from each façade of each inverter building is calculated in SoundPLAN v8.2 based on the following assumptions. The floor of each inverter building is made of concrete and the rest of the surfaces are untreated reflective surfaces.					

9.1.6 Particularly for the inverter buildings/ inverter transformer on-times, it is understood that the 50% load operation is likely to be a significant overestimate during daytime and evening, and the same applies to the 14.4% load operation during night-time operation. Therefore, this assessment is considered to be a very worst-case scenario and therefore a conservative assessment.

9.1.7 Based on review of the available data, i.e., manufacturer's data, the inverter transformers and the battery containers are considered to produce sound with broadband frequency content. The transformers produce broadband sound with a tonal component at 100 Hz and harmonics thereof.

9.1.8 The model results indicating the partial sound pressure level contribution from each individual source of noise from the site during day (D) and night (N) are presented in **Error! R eference source not found.**.

9.2 Results

9.2.1 The predicted specific sound levels due to the operation of the Proposed Development has been summarised in Table 9.2 below.

Table 9.2: Predicted Specific Sound Levels at the NVSRs

Location	Predicted Specific Sound Level, dBA	
	Day	Night
NVSR A	33	28
NVSR B	29	24
NVSR C	26	22
NVSR D	31	26
NVSR E	30	25

9.3 BS 4142:2014+A1:2019 Assessment

9.3.1 An initial estimate of impact for the assessment of the Proposed Development, undertaken in accordance with BS 4142:2014+A1:2019, is shown in Table 9.3 below for all time periods.

9.3.2 The predicted source contribution from the operational Proposed Development at all receptors is significantly lower than the existing residual sound level[5] at each receptor as shown in Table 9.3. Therefore, sound emitted from the proposed development is not expected to be readily distinctive against the residual acoustic environment and as a result no specific character penalty is considered applicable in accordance with BS4142:2014+A1:2019.

[5] Residual Sounds — 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

Table 9.3: BS 4142:2014+A1:2019 Assessment: Initial Estimate of Impact

Location	Representative Baseline Sound Levels		Specific Sound Level, dB LS	Rating Penalty, dB	Rating Level, dB LAr,Tr	Rating Level Difference, dB
	Background dB LA90,T	Residual dB LAeq,T				
Daytime						
NVSR A	33	42	33	0	33	0
NVSR B	31	48	29	0	29	-2
NVSR C	31	48	26	0	26	-5
NVSR D	31	48	31	0	31	0
NVSR E	31	40	30	0	30	-1
Night-time						
NVSR A	30	34	28	0	28	-2
NVSR B	25	30	24	0	24	-1
NVSR C	25	30	22	0	22	-2
NVSR D	25	30	26	0	26	1
NVSR E	25	35	25	0	25	0

Daytime

9.3.3 At the existing residential receptors A, B, C, D and E the predicted rating levels are equal to or below the existing background sound level during the daytime period.

9.3.4 On the basis of the above, the results of the initial estimate of impact during daytime are indicative of a low risk for adverse noise impact for NVSR A and D with no adverse impacts at NVSR B, C, and E, depending on context. The sensitivity of the receptors is medium, and the magnitude of the impact is low, therefore the significance of the effect would be minor adverse which is not considered to be a significant impact. This depends on context, which is assessed later in this section.

Night-time

9.3.5 At the existing residential receptors NVSR D the predicted rating levels are 1 dB above background sound levels during night-time. At all other receptors the predicted rating levels are equal to or below background noise level.

9.3.6 On the basis of the above, the results of the initial estimate of impact during night-time are indicative of a low risk for adverse impacts at NVSR D and E, and no adverse impacts at all other receptors, depending on context. As NVSR D and E are residential dwellings it is considered that they are of medium sensitivity to noise during the night-time periods, with a low risk of an adverse impact the effect is likely to be minor, which is not significant.

Summary

9.3.7 During the daytime period the outcome of the initial BS 4142:2014+A1:2019 assessment shows that there is a low risk of adverse impacts at the proposed residential receptor NVSR A and D. The sensitivity of the receptors is Medium, and the magnitude of the impact is low, therefore the effect would be minor adverse at NVSR A and D, which is not considered to be significant, depending on context. At all other receptors no adverse impacts are predicted during daytime or night-time.

9.3.8 During the night-time period the outcome of the initial BS 4142:2014+A1:2019 assessment shows that there is a low risk of adverse impacts at the proposed residential receptors NVSR D and E, the sensitivity of the receptors is Medium and the magnitude of the impact is low, therefore the effect would be minor adverse at NVSR D, which is not considered to be significant, depending on context. At all other receptors no adverse impacts are predicted during daytime or night-time.

9.3.9 The consideration of the context of the scenario is provided below in terms of the assessment of the absolute noise levels and the change in ambient sound due to the specific sound as addressed below.

Noise Change and Absolute Noise Level Assessment

Ambient Noise Change Assessment

9.3.10 BS 4142:2014+A1:2019 requires an assessment of the change in ambient sound level at the NVSR locations. BS 4142:2014+A1:2019 identifies the ambient sound level of 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. The ambient sound levels, with and without the site in operation, are shown in Table 9.4 below.

Table 9.4: Ambient Noise Level Change Assessment

Location	Baseline Residual Sound Level, dB LAeq,T	Specific Sound Level, dB LAeq,T	Combined Sound Level, dB LAeq,T	Change in Sound Level, dB
Daytime				
NVSR A	42	33	43	1
NVSR B	48	29	48	0
NVSR C	48	26	48	0
NVSR D	48	31	48	0
NVSR E	40	30	40	0
Night-time				
NVSR A	35	28	35	0
NVSR B	34	24	34	0
NVSR C	34	22	34	0
NVSR D	34	26	35	1
NVSR E	30	25	31	1
Figures rounded to the nearest decimal place				

9.3.12 During daytime no increase above baseline residual sound levels are likely to occur as a result of the operation of the Proposed Development at NVSRs B to E. At NVSR A an increase of 1 dB to the ambient sound level is predicted.

9.3.13 During night-time periods no increase above baseline residual sound levels are likely to occur as a result of the operation of the Proposed Development at NVSRs A to C. At NVSRs D and E an increase of 1 dB to the ambient sound level is predicted.

9.3.14 For a steady sound source with no discernible impulsive or tonal characteristics, a 3dB change is generally taken, as the minimum change which is perceptible to most people. A 1 dB increase is therefore not considered to be a perceptible change.

Absolute Noise Level Assessment

9.3.15 With regard to the sound levels presented in Table 9.4, the predicted combined ambient sound levels with the site operation will not exceed the 'World Health Organizations' (WHO) published guidance[6] for the onset of annoyance during the daytime of 55 dB $L_{Aeq\ (façade)}$ at any of the receptor. Therefore, it is considered that the magnitude of the impact is not sufficiently significant to cause daytime disturbance.

9.3.16 The level for the onset of sleep disturbance during the night-time, i.e., the 'lowest observed adverse effect level' (LOAEL) contained in additional WHO published guidance[7] is considered to be 45 dB $L_{Aeq\ (façade),}$ equivalent to a free-field level of 42 dB $L_{Aeq\ (façade)}$

9.3.17 The predicted specific and combined absolute sound levels do not exceed this threshold level at any receptor during the night-time period.

9.3.18 It is therefore considered that the combined sound level does not exceeds the WHO guideline level for night-time sleep disturbance, especially once the lack of any discernible characteristics of the sound is taken into consideration. Therefore, it is considered that the impact on sleep disturbance from the operation of the Proposed Development site during night-time will be negligible and not significant.

Discussion

9.3.19 It is the daytime periods that are of greatest concern with respect to the impact on quality of life (amenity, enjoyment of property etc.). This is because people will tend to be indoors or asleep during the night, whereas, during the day, they are more likely to be using outdoor spaces for amenity purposes.

9.3.20 With regards to the daytime periods the BS 4142:2014+A1:2019 initial estimate of impact indicates the magnitude of the impact is low and therefore the significance is minor, only at the proposed residential receptor NVSR A and at NVSR E, and no adverse impact at all other receptors, depending on the context.

9.3.21 At receptors A there is a 1 dB change in ambient sound level and at all receptors there is no change in ambient sound level during daytime. The absolute sound levels do not exceed WHO guideline noise levels for the daytime period.

9.3.22 With regards to the night-time periods the BS 4142:2014+A1:2019 initial estimate of impact indicates a low risk of adverse impact only at the proposed residential receptors NVSR D and E and no adverse impact at all other receptors, depending on the context.

9.3.23 During the night-time periods, a 1 dB increase to the ambient noise level has been predicted at NVSRs D and E with no ambient noise level increase is predicted at all other receptors.

9.3.24 Furthermore, during night-time, the absolute sound levels at the NVSRs does not exceed WHO guideline level of 42 dB L_{Aeq} (free-field) for the onset of sleep disturbance at all receptors.

9.3.25 Taking both the change in noise levels and the absolute sound levels during the day and night into account, it is considered that sound from the facility will not result in any significant adverse impacts on the quality of life of residents nearby.

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[6] Berglund, B. et al. Guidelines for Community Noise. World Health Organization. 2000.

[7] European Centre for Environment and Health. Night Noise Guidelines (NNGL) for Europe. World Health Organization. 2009.

9.3.26 On the basis of the above, it is concluded that levels of sound arising from the operation of the Proposed Development will not result in an adverse or a significant adverse impact at any of the nearby noise sensitive receptors.

9.3.27 The sensitivity of the receptors is medium, and the magnitude of the impact is negligible to low, as such the operational phase of the proposed development will have a minor effect on the NVSRs which is not considered significant in EIA terms.

9.3.28 With regard to national and local planning policy, it is considered that the results of the assessment demonstrate that the operational noise from the Proposed Development will not result in significant adverse impact to amenity at any nearby sensitive receptors.

9.3.29 It is therefore considered that the development is compliant with the requirements of the Noise Policy Statement for England (NPSE), the National Planning Policy Framework (NPPF) and Planning Practice Guidance on Noise (PPG-N), and Local Policies of Buckinghamshire Council

10 ASSESSMENT OF CUMULATIVE EFFECTS ON NOISE SENSITIVE RECEPTORS

10.1.1 Through a desk-based assessment it has been identified that there are four notable schemes which have the potential to cause a cumulative impact upon the NVSRs in combination with the Proposed Development. The cumulative schemes include a Tuckey Solar farm (Ref: 19/00983/APP), Expansion to National Grid substation at East Claydon HS2 on the local rail line, and East-west Rail.

Tuckey Solar Farm (Ref: 19/00983/APP)

10.1.2 Tuckey Solar Farm is a large solar farm which lies approximately 960 m north-east of the Proposed Development. The site consists of primarily solar panels and supporting invertors. A desk-based quantitative assessment was attempted however, no noise assessment is currently publicly available for this development.

10.1.3 Due to the nature of the Tuckey Solar Farm Development, it is highly unlikely that noise from this site will be clearly identifiable at the closest, cumulative NVSR location (NVSR A). Any noise that is audible from the proposed Tuckey Solar farm will likely be similar in nature to the existing ambient noise at NVSR A due to East Claydon Substation.

10.1.4 Therefore, it is considered that the cumulative impact will be negligible to minor and therefore not significant.

Expansion to National Grid Substation at East Claydon

10.1.5 The expansion to the National Grid Substation is currently referenced as a potential future scheme. At the time of writing no noise assessment, or details of the proposed scheme, are publicly available. With no information available on this project, the National Grid proposal is not considered as a cumulative impact within this assessment.

HS2

10.1.6 The HS2 rail line lies approximately 5 km south-west of the proposed development and closest NVSR considered within the scope of this assessment. At this distance it is highly unlikely that noise from HS2 will be audible at the existing receptors and therefore will not have cumulative impacts on the existing receptors.

East-West Rail

10.1.7 The East-West rail line lies approximately 2.5 km north the proposed development and closest NVSR considered within the scope of this assessment. At this distance it is highly unlikely that noise from East-West rail will be audible at the existing receptors and therefore will not have cumulative impacts on the existing receptors.

11 NVSR SUMMARY & CONCLUSION

11.1.1 The RPS Acoustics Team (RPS) was commissioned by Statera Energy Limited (SEL) to undertake a noise assessment for the proposed development of a Battery Energy Storage System (BESS), connected directly to the National Grid, comprising a Battery Storage facility with associated infrastructure, including access, drainage, and landscaping.

11.2 The layout of the Proposed Development comprises the following plant: battery containers, inverters, inverter transformers and substation.

11.3 An environmental sound survey was undertaken between the 9th and 16th November 2022 to establish the baseline sound levels at the nearby noise sensitive receptors (NVSRs).

11.4 A 3D noise model was built based on the proposed site layout to predict the specific sound levels from the construction and operation phase of the proposed development at the NVSRs. The 3D noise model included noise source data provided by the client and manufacturer's data.

11.5 A BS5228-1:2009+A1:2014 – Noise assessment has been undertaken to identify the potential noise impact on the noise sensitive receptors. Information regarding the likely equipment used throughout the construction process, including noise levels generated by the plant and its location have been provided by the client.

11.6 Construction noise has been assessed in three phases.

- Phase 1: Site preparation and construction of haul roads.
- Phase 2: Earth works and piling.
- Phase 3: Building erection and installation of plant.

11.7 Thresholds for the significant adverse criteria have been set out based on the results of the baseline noise survey. The results of which are summarised at Table 4.2 of this report.

11.8 The construction noise assessment established that no significant adverse effects are predicted at the existing sensitive receptor locations, with the assumption that the proposed haul road will not be built during the night-time period. However, best practice measure shall be implemented throughout the construction phase to avoid adverse noise effects being generated by lack of care and ineffective control measures.

11.9 A BS4142:2014+A1:2019 assessment was undertaken the derive an initial estimate of impact from the assessment of the operational noise from the Proposed Development.

11.10 The outcome of this initial BS4142:2014+A1:2019 assessment showed that there is a negligible to low risk of impacts at the existing sensitive receptor locations during both the daytime and night-time periods, depending on the context.

11.11 With regards to national and local planning policy it is considered that the results of the operational assessment demonstrate that Proposed Development will not result in an adverse impact to amenity of the nearby receptors.

11.12 It is therefore considered the development is compliant with the requirements of the Noise Policy Statement for England (NPSE), the National Planning Policy Framework (NPPF) and Planning Practice Guidance on Noise (PPG-N), and Local Policies of BC.

11.13 A summary of the effects established by the assessment presented in this report are presented in Table 11.1 below.

Table 11.1: Effects Scale and Significance Summary

Receptor Name	Summary of Effect Scale and Significance
Noise impact	
Construction Noise	
NVSR A	Minor Adverse (Not Significant)
NVSR B	Minor Adverse (Not Significant)
NVSR C	Negligible (Not Significant)
NVSR D	Minor Adverse (Not Significant)
NVSR E	Minor Adverse (Not Significant)
Operational Phase	
NVSR A	Minor Adverse (Not Significant)
NVSR B	Negligible (Not Significant)
NVSR C	Negligible (Not Significant)
NVSR D	Negligible (Not Significant)
NVSR E	Minor Adverse (Not Significant)

APPENDIX A – ACOUSTIC DEFINITIONS

Acoustic term	Definition
rating level, $L_{Ar,Tr}$	Specific sound level plus any adjustment for the characteristic features of the sound
background sound level, $L_{A90,T}$	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
ambient sound level, La = $L_{Aeq,T}$	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 *NOTE* The ambient sound level is a measure of the residual sound and the specific sound when present.

APPENDIX B - ACOUSTICS COMPETENCY

Lise W. Tjellesen – Technical Director – Acoustics

MEngSc Acoustics; Member of the Institute of Acoustics; Member Acoustical Society of America; Member of Danish Acoustic Society; Member of Audio Engineering Society

A.1 Lise is Technical Director of the RPS Acoustics Team with 20 years of experience in acoustics. She is a specialist acoustic consultant with a wide range of experience gained in the UK, Denmark and worldwide. She has worked with electroacoustics, psychoacoustics, architectural acoustics, vibrations and environmental acoustics. She has gained particular experience in the fields of architectural acoustics (building and room) working with the construction industry on a variety of projects, including residential, commercial, education, health and entertainment.

A.2 Lise is an expert on the subject of room acoustics and room acoustic computer simulations, as well as a leading expert on the emerging field of archaeoacoustics. She has published several papers on the above subjects and on acoustics of offices.

A.3 Lise has been involved in many BS 4142 noise assessments for both the previous and current 2014 version of BS 4142. She has given evidence at public inquiries where BS 4142 has been the primary assessment methodology. On the basis of Lise's overall experience in acoustics (particularly in relation to environmental noise) combined with particular focus on BS 4142, she is deemed competent for BS 4142 assessments.

A.4 For this project Lise has taken on the role of:

- Technical Lead and has been responsible for reviewing all deliverables.

A.5 Lise was also responsible for:

- reviewing the assessment;
- reviewing the modelling;
- reviewing and authorising the report, figures and appendices.

Lee Whitehall – Senior – Acoustics

PGDip Acoustics and Noise Control, AMIOA

A.6 Lee is an Acoustic Consultant with seven years' experience. He has completed the IOA postgraduate diploma in Acoustics and Noise control in 2018 and has been an associate Member of the Institute of Acoustics since 2016.

A.7 Lee has project managed and undertaken noise assessments for a wide range of developments in the UK and internationally has been involved in the production and review of Noise Impact Assessments for 7 years.

A.8 He has been involved in the production of BS 4142 assessments for the last seven years, using the current 2014 version of BS 4142. He is familiar with the Standard and has received training on the previous iterations of BS 4142. As such, he is considered competent for BS 4142 assessments.

A.9 For this project Lee has taken on the role of:

- Consultant responsible for carrying out the acoustic surveying.
- Consultant responsible for carrying out the acoustic modelling.

A.10 Lee was also responsible for

- downloading and processing the survey data;
- undertaking the assessment;
- reviewing the assessment;
- undertaking the modelling;
- reviewing the modelling;
- preparing the report / ES chapter, figures and appendices; and
- reviewing the report / ES chapter, figures and appendices.

reviewing the report / ES chapter, figures and appendices.

APPENDIX C – STANDARDS, GUIDANCE AND POLICY

National Planning Policy Framework

C.1 The National Planning Policy Framework (NPPF) adopted in 2012 in England outlines the Government's planning policies and requirements for the planning system. The NPPF forms a material consideration in planning decisions and hence should be complied with for planning permission to be granted.

C.2 Regarding noise, the NPPF states that the planning system should contribute to and enhance the natural and local environment by preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of noise pollution.

C.3 The planning system should therefore seek to:

- Avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;
- Mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of planning conditions;
- Recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established; and
- Identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.

C.4 To achieve these aims the NPPF refers to the Noise Policy Statement for England 2010.

Noise Policy Statement for England 2010

C.5 The Noise Policy Statement for England (NPSE) sets out the long-term vision of Government, which aims to promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development.

C.6 The NPSE outlines three aims for the effective management and control of environmental, neighbour and neighbourhood noise:

- Avoid significant adverse impacts on health and quality of life;
- Mitigate and minimise adverse impacts on health and quality of life; and
- Where possible, contribute to the improvement of health and quality of life

Planning Practice Guidance - Noise

C.7 Planning Practice Guidance on Noise (PPGN) provides guidance to local planning authorities to ensure effective implementation of the planning policy set out in the National Planning Policy Framework. The PPGN suggests that planning authorities should ensure that unavoidable noise emissions are controlled, mitigated or removed at source and establish appropriate noise limits for extraction in proximity to noise sensitive properties.

C.8 The PPGN reiterates general guidance on noise policy and assessment methods provided in the NPPF, NPSE and British Standards and contains examples of acoustic environments commensurate with various effect levels. Paragraph 006 of the PPGN explains that:

> *"The subjective nature of noise means that there is not a simple relationship between noise levels and the impact on those affected. This will depend on how various factors combine in any particular situation."*

C.9 According to the PPGN, factors that can influence whether noise could be of concern include:

- the source and absolute level of the noise together with the time of day it occurs;
- for non-continuous sources of noise, the number of noise events, and the frequency and pattern of occurrence of the noise;
- the spectral content and the general character of the noise;
- the local topology and topography along with the existing and, where appropriate, the planned character of the area;
- where applicable, the cumulative impacts of more than one source should be taken into account along with the extent to which the source of noise is intermittent and of limited duration;
- whether adverse internal effects can be completely removed by closing windows and, in the case of new residential development, if the proposed mitigation relies on windows being kept closed most of the time;
- in cases where existing noise sensitive locations already experience high noise levels, a development that is expected to cause even a small increase in the overall noise level may result in a significant adverse effect occurring even though little to no change in behaviour would be likely to occur;

- where relevant, Noise Action Plans, and, in particular the Important Areas identified through the process associated with the Environmental Noise Directive and corresponding regulations;
- the effect of noise on wildlife;
- if external amenity spaces are an intrinsic part of the overall design, the acoustic environment of those spaces; and
- the potential effect of a new residential development being located close to an existing business that gives rise to noise should be carefully considered. This is because existing noise levels from the business even if intermittent (for example, a live music venue) may be regarded as unacceptable by the new residents and subject to enforcement action. To help avoid such instances, appropriate mitigation should be considered, including optimising the sound insulation provided by the new development's building envelope. In the case of an established business, the policy set out in paragraph 182 of the NPPF should be followed.

C.10 The PPGN provides a relationship between various perceptions of noise, effect level and required action in accordance with the NPPF. This is reproduced in Table C.1 below.

C.11 The PPGN describes sound that is not noticeable to be at levels below the 'No Observed Effect Level' (NOEL). It describes exposures that are noticeable but not to the extent there is a perceived change in quality of life as below the LOAEL and need no mitigation. The audibility of sound from a development is not, in itself, a criterion to judge noise effects that is commensurate with national planning policy.

C.12 The PPGN suggests that noise exposures above the LOAEL cause small changes in behaviour. Examples of noise exposures above the LOAEL provided in the PPGN include:

- having to turn up the volume on the television;
- needing to speak more loudly to be heard;
- where there is no alternative ventilation, closing windows for some of the time because of the noise; or a potential for some reported sleep disturbance.

C.13 In line with the NPPF and NPSE, the PPGN states that consideration needs to be given to mitigating and minimising effects above the LOAEL but taking account of the economic and social benefits being derived from the activity causing the noise.

C.14 The PPG-N suggests that noise exposures above the SOAEL cause material changes in behaviour. Examples of noise exposures above the SOAEL provided in the PPGN are:

- where there is no alternative ventilation, keeping windows closed for most of the time or avoiding certain activities during periods when the noise is present; and/or
- there is a potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep.

C.15 In line with the NPPF and NPSE, the PPGN states that effects above the SOAEL should be avoided and that, whilst the economic and social benefits being derived from the activity causing the noise must be taken into account, such exposures are undesirable.

C.16 The PPGN suggests that a noise impact may be partially offset if the residents of affected dwellings have access to a relatively quiet part of their dwelling, private external amenity area and/or external public or private amenity space nearby

Table C.1: Noise Exposure Hierarchy based on the Likely Average Response

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

British Standard 4142:2014+A1:2019 'Methods for rating and assessing industrial and commercial sound'

C.18 BS 4142:2014+A1:2019 primarily provides a numerical method by which to determine the significance of sound of an industrial nature (i.e. the 'specific sound' from the proposed development) at residential NVSRs. The specific sound level may then be corrected for the character of the sound (e.g., perceptibility of tones and/or impulses), if appropriate, and it is then termed the 'rating level', whether or not a rating penalty is applied. The 'residual sound' is defined as the ambient sound remaining at the assessment location when the specific noise source is suppressed to such a degree that it does not contribute to the ambient sound.

C.19 The specific sound levels should be determined separately in terms of the $L_{Aeq,T}$ index over a period of T = 1-hour during the daytime and T = 15-minutes during the night-time. For the purposes of the Standard, daytime is typically between 07:00 and 23:00 hours, and night-time is typically between 23:00 and 07:00 hours.

C.20 BS 4142:2014+A1:2019 requires that the background sound levels adopted for the assessment is representative for the period being assessed. The Standard recommends that the background sound level should be derived from continuous measurements of normally not less than 15-minute intervals, which can be contiguous or disaggregated. However, the Standard states that there is no 'single' background sound level that can be derived from such measurements.

C.21 BS 4142:2014+A1:2019 states that measurement locations should be outdoors, where the microphone is at least 3.5 m from any reflecting surfaces other than the ground and, unless there is a specific reason to use an alternative height, at a height of between 1.2 m and 1.5 m above ground level. However, where it is necessary to make measurements above ground floor level, the measurement position, height and distance from reflecting surfaces should be reported, and ideally measurements should be made at a position 1 m from the façade of the relevant floor, if it is not practical to make the measurements at least 3.5 m from the facade.

C.22 With regards to the rating correction, paragraph 9.2 of BS 4142:2014+A1:2019 states:

> *"Consider the subjective prominence of the character of the specific sound at the noise-sensitive locations and the extent to which such acoustically distinguishing characteristics will attract attention."*

C.23 The commentary to paragraph 9.2 of BS 4142:2014+A1:2019 suggests the following subjective methods for the determination of the rating penalty for tonal, impulsive and/or intermittent specific sounds:

> *"Tonality*
>
> *For sound ranging from not tonal to prominently tonal the Joint Nordic Method gives a correction of between 0 dB and +6 dB for tonality. Subjectively, this can be converted to a rating penalty of 2 dB for a tone which is just perceptible at the noise receptor, 4 dB where it is clearly perceptible, and 6 dB where it is highly perceptible.*
>
> *Impulsivity*

A correction of up to +9 dB can be applied for sound that is highly impulsive, considering both the rapidity of the change in sound level and the overall change in sound level. Subjectively, this can be converted to a penalty of 3 dB for impulsivity which is just perceptible at the noise receptor, 6 dB where it is clearly perceptible, and 9 dB where it is highly perceptible.

NOTE 2 If characteristics likely to affect perception and response are present in the specific sound, within the same reference period, then the applicable corrections ought normally to be added arithmetically. However, if any single feature is dominant to the exclusion of the others then it might be appropriate to apply a reduced or even zero correction for the minor characteristics.

Intermittency

When the specific sound has identifiable on/off conditions, the specific sound level should be representative of the time period of length equal to the reference time interval which contains the greatest total amount of on time. … If the intermittency is readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied.

Other sound characteristics

Where the specific sound features characteristics that are neither tonal nor impulsive, nor intermittent, though otherwise are readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied."

C.24 An initial estimate of the impact of the specific sound is obtained by subtracting the measured background sound level from the rating level of the specific sound. In the context of the Standard, adverse impacts include, but are not limited to, annoyance and sleep disturbance. Typically, the greater this difference, the greater is the magnitude of the impact:

- 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 an adverse impact, depending on the context.
- The lower the rating level is relative to the measured background sound level, the less likely it is that the specific noise source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific noise source having a low impact, depending on the context.