Tween Bridge Solar Farm

A Nationally Significant Infrastructure Project in the Energy Sector

Preliminary Environmental Information Report

Chapter 13 – Noise and Vibration

October 2023

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13. Noise and Vibration

13.1. Introduction

13.1.1. This chapter of the working draft PEIR assesses the potential significant noise and vibration effects of The Scheme on the local environment.

13.1.2. This assessment reports on the baseline and Scheme design information available at the time of writing this working draft PEIR. The PEIR will be updated as further assessments become available including any update to the baseline in the next iteration of the PEIR which will be presented as part of the statutory pre-application consultation. Consultation responses received to date and the Scoping Opinion adopted by the Planning Inspectorate (on behalf of the Secretary of State) on 13 March 2023 have been taken into account during the preparation of this chapter and are discussed in detail below. The assessment has been undertaken by Ion Acoustics Ltd.

13.1.3. This chapter is supported by the following figures (note, these figures are provided within the text of this chapter):-

- **Figure 13.1** - Identified Noise Sensitive Receptors
- **Figure 13.2** – Predicted Daytime Noise Levels
- **Figure 13.3** – Predicted Night-time Noise Levels
- **Figure 13.4** – Daytime Operational Noise Levels
- **Figure 13.5** – Night-time Operational Noise Levels

13.1.4. Baseline and assessment work is ongoing, it is anticipated that the following information will be made available for the next iteration of the PEIR: -

- Consultation with host LPAs to agree baseline monitoring methodology and identify any additional noise sensitive receptors, for example permanent canal moorings.
- Consideration of Cumulative Impacts
- Preparation of an Outline Construction Environmental Management Plan
- Confirmation of any additional noise impacts associated with the scheme.

13.2. Consultation

13.2.1. Outside the EIA Scoping Opinion received March 2023 (Appendix 1.1), no further consultation has been undertaken. Consultation will be required to agree details of the baseline noise survey and agree on the noise sensitive receptors where assessment will be undertaken. This will be detailed within the next iteration of the PEIR.

13.2.2. At this stage only residential receptors have been chosen because only a preliminary assessment of operational noise has been undertaken. Once all receptors have been identified,

further assessment will be undertaken and the noise and vibration effects at any additional receptors will be detailed in the next iteration of the PEIR.

13.2.3. In terms of ecological receptors, the assessment criteria is on a case by case basis and can vary from species. the assessment criteria will be developed with further discussions with the local authority and relevant stake holders. This assessment criteria and further assessments will be detailed in the next iteration of the PEIR.

13.3. Assessment Approach

Methodology

13.3.1. This section of the chapter summarises the assessment methodologies used in the production of this chapter.

Construction & Decommissioning Noise

13.3.2. British Standard (BS) 5228:2009+A1 'Code of Practice for Noise and Vibration Control on Construction and Open Sites' does not provide specific limits for construction and decommissioning noise, but it does define methods of assessing the significance. The standard also provides practical information on construction noise and vibration reduction measures promoting a 'Best Practice Means' approach to control noise and vibration. A method for determining the sound levels associated with construction activities is also detailed and considers the numbers and types of equipment operating, their associated Sound Power Level (L_W), and the distance to receptors, along with the effects of any screening.

13.3.3. The assessment of construction and decommissioning noise will be based on the 'Lowest Observable Adverse Effect Level' (LOAEL) and the 'Significant Observable Adverse Effect Level' (SOAEL) thresholds detailed in Table 13.1 and derived from Annex E of BS 5228-1. The LOAEL levels are the 'lower cut offs' identified in BS 5288 and the SOAEL levels are the levels identified that, if exceeded for 'significant' periods of time (either continuously or sporadically) could result in 'widespread community disturbance, or interfere with activities or sleep'.

13.3.4. BS 5228 also states that the SOAEL levels should not be exceeded for a period of 10 or more days of working in any 15 consecutive days or for a total number of days exceeding 40 in any six consecutive months.

13.3.5. Construction working hours will be agreed with the local authorities and will form part of the CEMP associated with the construction works. It is noted that it is likely that directional drilling will be required, and, if required, undertaken outside of conventional working hours based on the requirements of National Rail and the National Highways. In the event of works outside of the agreed working hours, permission should be gain from the relevant local authority prior to works starting.

Table 13.1 Adverse Effect Levels – Construction and decommissioning Noise

Adverse Effect Level	Day	Sound Level $L_{Aeq,T}$ (dB)
SOAEL	Monday to Friday	75
	Saturdays	
LOAEL	Monday to Friday	65
	Saturdays	

13.3.6. These limits are higher than normal noise limits to protect amenity because it is recognized that construction does involve some unavoidable noise and is temporary. Irrespective of the limits, the contractor will be expected to use best practicable means to reduce noise and a construction environmental management plant (CEMP) will be prepared.

Construction Vibration

13.3.7. The simplest approach to quantify vibration effects is to use the concept of peak particle velocity (PPV) as measured outside the building. BS 5228 suggests that for construction activities, it is considered more appropriate to provide guidance in terms of the PPV, since this parameter is likely to be more routinely measured based upon the more usual concerns over potential building damage.

13.3.8. The assessment of construction vibration is based on the LOAEL and SOAEL thresholds detailed in Table 13.2. The LOAEL corresponds to a level which 'might be just perceptible in residential environments'.

13.3.9. The SOAEL for construction vibration corresponds to a level which in residential environments would cause complaint, but can be tolerated if prior warning and explanation has been given to residents. In the event that non-residential receptors are identified, i.e. retail, employment, educational and health receptors, these adverse effect levels can also be implemented.

Table 13.2: Adverse Effect Levels – Construction Vibration

Adverse Effect Level	Peak Particle Velocity (PPV mm/s)
SOAEL	1
LOAEL	0.3

Construction Traffic

13.3.10. Increased traffic noise may be an issue during construction with the delivery of construction material and the panels and other components etc. There will be no significant change in traffic (and therefore traffic related noise impacts) during the operational phase as detailed in Chapter 12: Transport and Access.

13.3.11. The Technical Memorandum, Calculation of Road Traffic Noise (CRTN) (Department of Transport and Welsh Office, 1988) document details an empirical prediction methodology for the calculation of road traffic noise. Factors within the calculation include vehicle flow, speed, road gradient and road surface construction.

13.3.12. The Design Manual for Roads and Bridges LA 111 Noise and Vibration (Rev 2) sets out the methodology for assessing and quantifying the potential noise impacts associated with changes to the local road network.

13.3.13. Offsite traffic noise impacts would be deemed to be significant if a short-term increase in the predicted traffic noise level occurs in excess of 3dB(A).

Operational Noise

13.3.14. For this project, operational noise levels will be predicted using ISO 9613-2. The calculation methodology includes consideration of a number of pertinent factors including distance propagation, screening, airborne absorption etc.

13.3.15. The calculations will be made using the IMMI noise modelling software which is known to faithfully employ the calculation protocols.

13.3.16. The standard method for the assessment of commercial and industrial noise affecting noise sensitive receptors is British Standard BS 4142. The methodology typically derives the significance of the noise impact from the difference between the plant noise under consideration and the background sound level as represented by the L_{A90} parameter, determined in the absence of the plant noise.

13.3.17. To assess the significance of the impact, noise limits will be set in terms of the BS 4142 rating level and derived from the results of the baseline noise survey. Table 13.3 sets out the anticipated adverse effect level. BS 4142 is described in more detail below in Section 13.3.33.

Table 13.3 Operational Noise Adverse Effect Level

Operational Noise Criteria	Adverse Effect Level
Rating noise level less than noise limit	NOAEL
Rating noise level equal to noise limit	LOAEL
Rating noise level less than or equal to noise limit +5dB	--
Rating noise level less than or equal to noise limit +10dB	SOAEL

Assessment of Significance

13.3.18. In accordance with the NPPF, and the NPSE, , the LOAEL and SOAEL have been proposed for each noise and vibration source which has been assessed.

13.3.19. The noise and vibration effects have been defined in accordance with the significance criteria presented in Chapter 2: EIA Methodology. Based on the descriptions of the adverse effect levels in the PPG for noise, recommended actions for each significance level have been provided. The significance level is the same for all the potential noise effect at all identified receptors. The noise and vibration significance criteria are presented in Table 13.4.

Table 13.4 EIA Significance Level and Noise and Vibration Adverse Effect Level

EIA Significance Level	*Noise and Vibration Adverse Effect Level*	*Impact and Action (to be applied to potential effects)*
Major	SOAEL	Noise and Vibration causes a material change in behaviour and/or attitude. This level should be avoided.
Moderate	-	Noise and Vibration can be heard and causes small changes in behaviour or attitude. Noise should be mitigated and reduced to a minimum.
Minor	LOAEL	Noise and Vibration can be heard but does not cause a change in behaviour or attitude. No specific mitigation measures are required.
Negligible	NOEL	Noise and Vibration has no effect. No specific measures required.

Legislative and Policy Framework

The Energy National Policy Statements (NPS).

13.3.20. The energy National Policy Statements (NPS) set out the government's policy for the delivery of energy infrastructure and provide the legal framework for planning decisions. They were first designated and published in 2011.

13.3.21. The NPS do not provide limits and specific guidance for the assessment of acoustic Impacts however, policies EN-1, EN-3, EN-5 and the Habitats Regulations Assessment (HRA) document do reference acoustics and offer generic advice without specific criteria.

Draft Energy National Policy Statements (NPS).

Overarching National Policy Statement for Energy (EN-1)

Section 5.12 Noise and Vibration states:

The Government's policy on noise is set out in the Noise Policy Statement for England.

It promotes good health and good quality of life through effective noise management. Similar considerations apply to vibration, which can also cause damage to buildings. In this section, in line with current legislation, references to "noise" below apply equally to the assessment of impacts of vibration….

Noise resulting from a proposed development can also have adverse impacts on wildlife and biodiversity. Noise effects of the proposed development on ecological receptors should be assessed by the Secretary of State in accordance with the Biodiversity and Geological Conservation section of this NPS at Section 5.4. This should consider underwater noise and vibration especially for marine developments. Underwater noise can be a significant issue in the marine environment, particularly in regard to energy production.

Factors that will determine the likely noise impact include:

- *the inherent operational noise from the proposed development, and its characteristics*
- *the proximity of the proposed development to noise sensitive premises (including residential properties, schools and hospitals) and noise sensitive areas (including certain parks and open spaces)*
- *the proximity of the proposed development to quiet places and other areas that are particularly valued for their soundscape or landscape quality*
- *the proximity of the proposed development to sites where noise may have an adverse impact on protected species or other wildlife*

National Policy Statement for Renewable Energy Infrastructure (EN-3)

13.3.22. In terms of noise and vibration EN-3, the policy does not provide limits and specific guidance for the assessment of acoustic impacts however, the document does reference acoustics and offer generic advice without specific criteria.

National Planning Policy

13.3.23. In March 2012 the 'National Planning Policy Framework' (NPPF) was introduced as the current planning policy guidance in England. This document was last revised in September 2023. The document is generally not prescriptive and does not provide noise criteria. Instead, it places the onus on local authorities to develop their own local plans and policies.

'174 Planning policies and decisions should contribute to and enhance the natural and local environment by: ……..

e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability……..'

The document further states that:

'185. Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of

the site or the wider area to impacts that could arise from the development. In doing so they should:

a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;

b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason…'

Noise Policy Statement for England (NPSE)

13.3.24. The Noise Policy Statement for England (NPSE) sets out the government's policy on environmental, neighbourhood and neighbour noise for England. The policy sets out three aims:

- *"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."*

13.3.25. The NPSE introduces the following terms which are also used in the NPPF:

'NOEL – No Observed Effect Level

This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.

LOAEL – Lowest Observed Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected.

SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur.'

13.3.26. However, neither the NPSE nor the NPPF defines numeric bounds for NOEL, LOAEL or SOAEL. The limits of each effect level should be defined for each situation and location.

13.3.27. Further Government planning advice is available online. The online guidance refers to the NPPF and NPSE and presents a noise assessment hierarchy table to provide further information on the boundaries between NOEL, LOAEL and SOAEL. This is shown below in Table 13.5.

Table 13.5: Noise Assessment Hierarchy Table

Perception	Examples of Outcomes	Increasing Effect Level	Action
No Observed Effect Level			
	No Effect	No Observed Effect	No specific measures required
No Observed Adverse Effect Level			
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			
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			
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

The Control of Pollution Act

13.3.28. The Control of Pollution Act (CoPA) 1974 covers a wide range of environmental pollution including noise. Parts of the Act have been superseded by the Environmental Protection Act 1990.

13.3.29. Section 60 of CoPA relates to the 'Control of Noise on Construction Sites' and Section 61 relates to obtaining 'Prior Consent for Work on Construction Sites'. These parts of the Act are often used in conjunction with other standards to determine acceptable noise levels in relation to construction, hours of operation and specific working methods or mitigation.

13.3.30. A Section 61 application outlines the proposed construction works, hours of operation and a mitigation plan to reduce noise and vibration impact through the use of Best Practicable Means. It allows prior consent to be agreed between the contractor and the council and assists with protecting the contractor from legal action being taken under Section 60 of CoPA or Section 80 of the Environmental Protection Act 1990.

The Environmental Protection Act

13.3.31. The Environmental Protection Act (EPA) 1990 requires local authorities to investigate noise complaints from premises (land and buildings) and vehicles, machinery or equipment in the street. This includes noise arising from construction sites.

13.3.32. If the local authority is satisfied that noise from a development amounts to a statutory nuisance then the authority must serve an abatement notice on the person responsible or in certain cases the owner or occupier of the property. The notice may require that the noise or nuisance is completely stopped or limited to certain times of the day.

BS4142: 2014 +A1: 2019 – Assessment Principles

13.3.33. The standard method for assessing noise of a commercial or industrial nature affecting housing, is British Standard BS 4142 "Method for rating and assessing industrial and commercial sound". A BS 4142 assessment is typically made by determining the difference between the industrial noise under consideration and the background sound level as represented by the L_{A90} parameter, determined in the absence of the industrial noise. The L_{A90} parameter is defined as the level exceeded for 90% of the measurement time, representing the underlying noise in the absence of short duration noise events such as dog barks or individual cars passing.

13.3.34. The industrial noise under consideration is assessed in terms of the ambient noise level, LAeq, but a character correction penalty can be applied where the noise exhibits certain characteristics such as distinguishable tones, impulsiveness or, if the noise is distinctively intermittent. The ambient noise level, LAeq is defined as the steady-state noise level with the same energy as the actual fluctuating sound over the same time period. It is effectively the average noise level during the period. The industrial noise level (L_{Aeq}) with the character correction (if necessary) is known as rating level, L_{Ar}, and the difference between the background noise and the rating level is determined to make the BS 4142 assessment. The standard then states:

a) "Typically, the greater the difference, the greater the magnitude of the impact.

b) A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context.

c) A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context.

d) The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound 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."

13.3.35. The standard outlines a number of methods for defining appropriate 'character corrections' to determine the rating levels to account for tonal qualities, impulsive qualities, other sound characteristics and/or intermittency.

13.3.36. The standard also highlights the importance of considering the context in which a sound occurs. The standard indicates that factors including the absolute sound level, the character of the sound, the sensitivity of the receptor and the existing acoustic character of the area should be considered when assessing the noise impact. The absolute sound level is of particular importance where the measured background sound levels are low, which is typically taken as L_{A90} 30dB and below. In regard to low sound levels, the standard states:

"Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night."

Scoping Criteria

13.3.37. The following noise and vibration comments were provided in the Planning Inspectorate Scoping Opinion dated 13 March 2023.

Table 13.6 Extract of aspect-based scoping table from Scoping Opinion for Tween Bridge Solar Farm

ID	REF	MATTER	INSPECTORS COMMENTS	APPLICANT RESPONSE
3.12.1	**Paras 11.28 and 11.41**	**Construction/Decommissioning noise and vibration assessment (including traffic)**	The Scoping Report proposes to scope out an assessment of impacts from construction noise on the basis that the noise is temporary and occurs during the day. Impacts from vibration are not specifically sought to be scoped out, nor are potential impacts described. No substantial evidence has been provided to suggest that noise or vibration impacts during construction would not be significant. The Inspectorate also notes the potential for construction noise impacts on ecological receptors including SPA/ Ramsar bird qualifying features. The Inspectorate does not agree that these matters can be scoped out. The ES should assess noise and vibration impacts arising from construction and decommissioning activities (including traffic) which are likely to result in significant effects. The assessment should include information on predicted construction and decommissioning traffic movements, traffic routing, noise and vibration emissions and distances from receptors. Any proposed mitigation measures (such as the proposed use of a push-piling rig rather than impact-driven piles) should be described and their delivery secured through the DCO or other legal mechanism.	**Noise and Vibration Sensitive Receptors, both residential and non-residential will be identified appropriately. Proposed criteria will apply to all identified receptors . During the assessment stage, potential noise and vibration effects will be assessed at all the identified receptors.**

Limitations to the Assessment

13.3.38. At this stage the equipment and technology on The Scheme is not known. The need for flexibility in design, layout, and technology is acknowledged in a number of National Policy Statements to

address uncertainties inherent to a scheme Therefore, a preliminary assessment of worse case operational noise has been undertaken based on assumptions made regarding the noise generating assets to be used on site . It should also be noted that a baseline survey will be required to measure the currently baseline noise climate to appropriately derive operational noise limits at the identified noise sensitive receptors when these are formally agreed.

13.3.39. To present a worse case assessment at this stage, the operational noise from the site will be assessed against absolute noise limits which are low enough to protect amenity irrespective of the background noise. It is likely that these limits will be revised upwards on completion of the baseline survey as many locations will have higher background noise levels due to road traffic noise. Absolute noise limits can be derived from BS 8223: 2014 and WHO community noise guidance.

13.3.40. This assessment has been undertaken at the residential receptors identified at this stage. Once all relevant residential and non-residential receptors are identified and agreed with the local authorities, further assessment of operational noise and construction noise will be undertaken. This will be detailed in the next iteration of the PEIR.

13.4. Baseline Conditions

Site Description and Context

13.4.1. The site broadly lies between the settlements of Thorne and Crowle, occupying separate parcels of land within a relatively flat agricultural landscape predominantly in arable use. The Scheme's development parcels are dissected by several major roads and routes, including the M180 motorway, the A18, the South Humberside Main Line railway route and Stainforth & Keadby Canal.

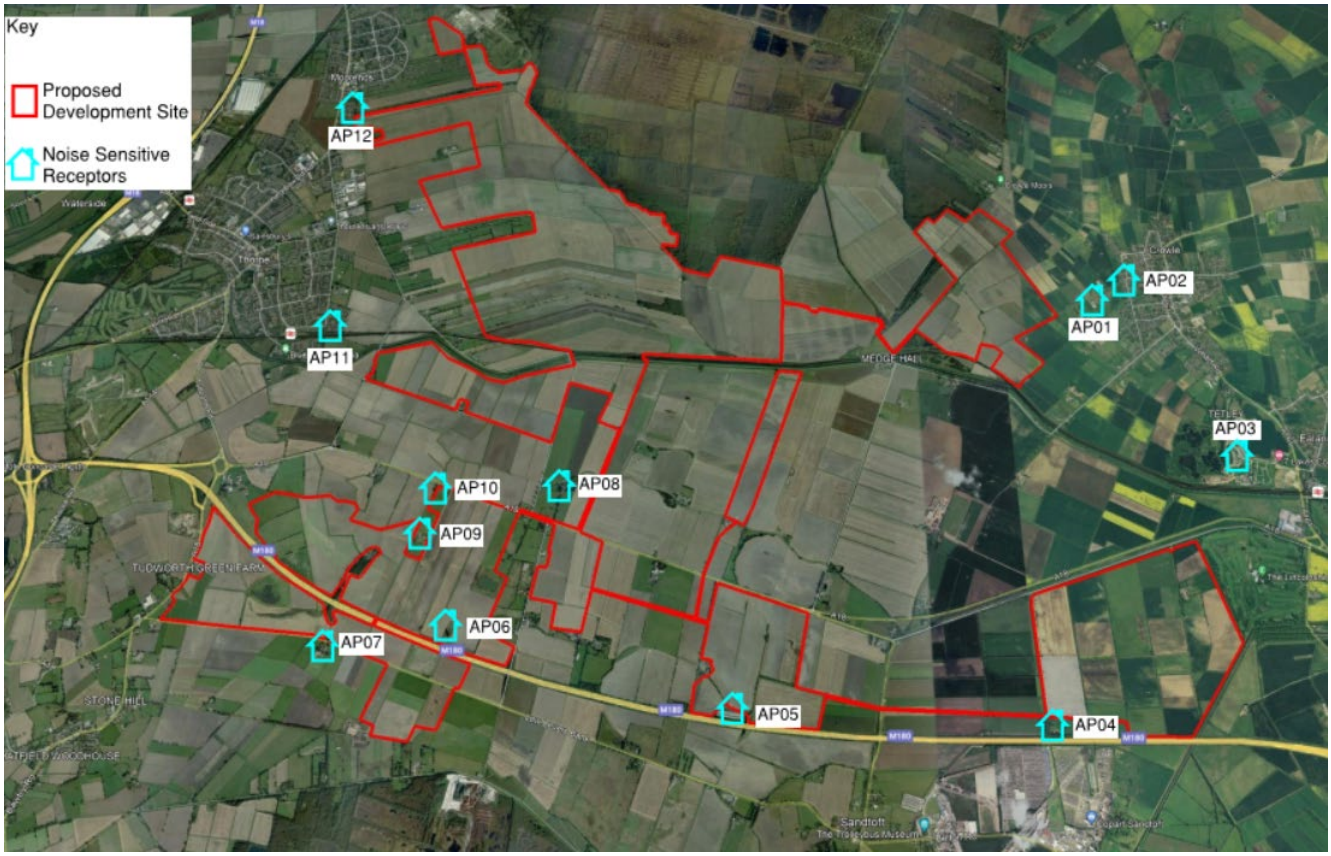
13.4.2. Numerous other minor roads cross the landscape connecting scattered residential properties and farmsteads, many of which lie adjacent or in proximity to the site. Tween Bridge Wind Farm lies in the northern part of the site.

Noise Sensitive Receptors

13.4.3. For the purposes of the assessment of potential noise impacts associated with the proposed development, a study area of 1km from the site boundary has been utilised. Due to the size of the scheme, a selection of receptors has been identified. These receptors represent the closest noise sensitive receptors. At this stage only residential receptors have been identified. Ecological receptors and any non-residential will be identified in agreement with the local planning authority. These receptors will be chosen to represent the closest noise sensitive receptors.

13.4.4. Noise sensitive receptors in the local area which are to be considered have been identified and are presented in Figure 13.1 below. Due to the size of the scheme, a selection of receptors have been identified.

Figure 13.1 Identified Noise Sensitive Receptors



13.4.5. The assessment positions (AP01 etc) shown above have been chosen to represent the closest noise-sensitive receptors. Table 13.7 below defines the receptors, along with the OS grid reference and approximate distance to the boundary of the site.

Table 13.7 Identified Noise Sensitive Receptors

Proposed Assessment Point	Description	Easting	Northing	Approx. Distance to site boundary (m)
AP01	2 Marsh Road	476637	412851	425
AP02	Dwellings Along Windsor Road	476935	412923	740
AP03	Holiday Homes at 7 Lakes Holiday Park	477501	411175	780
AP04	Woodcarr Farm	475925	408927	110
AP05	Goodcop Cottage	473408	408992	65
AP06	Crow Tree Farm	470958	409638	100
AP07	Stoupers Gate Farm	469913	409541	100
AP08	Green Bank	471567	410755	100
AP09	Tolstem House	470611	410497	100
AP10	Steam House	470753	410958	50
AP11	Dwellings Along St Georges Rd	469699	412472	470
AP12	Dwellings Along Wilkinson Ave	469568	414677	30

13.4.6. Consultation will be undertaken with the host LPAs to agree and finalize the noise sensitive receptors to be considered. These receptors will be reported in the next iteration of the PEIR.

Baseline Survey Information

13.4.7. At this stage, background noise monitoring has not been undertaken. However as the site is within the vicinity of two major roads (M180 and the M18) some information on the predicted noise levels in the area is available from Government noise maps which show noise levels (dB L_{Aeq}) from major roads accounting for the traffic flows and local topography. The predicted noise levels for the L_{Aeq} parameter are shown on the Extrium website for the 16-hour day and 8-hour night. Figures 13.2 and 13.3 show the daytime and night time noise maps respectively.

Figure 13.2 Predicted Daytime Noise Levels - (Contains public sector information licensed under the Open Government Licence v3.0. Copyright © 2019 Extrium Ltd)

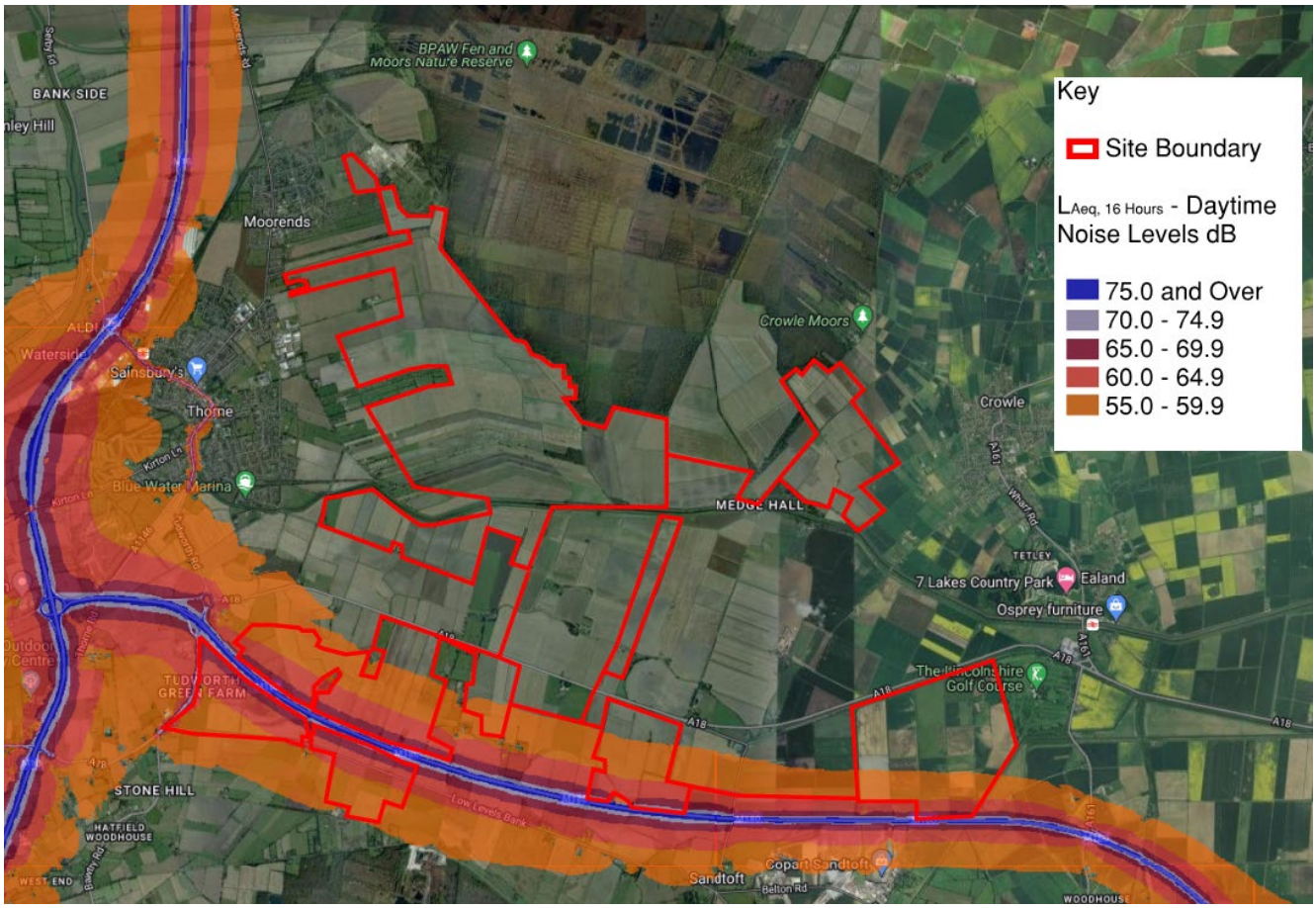
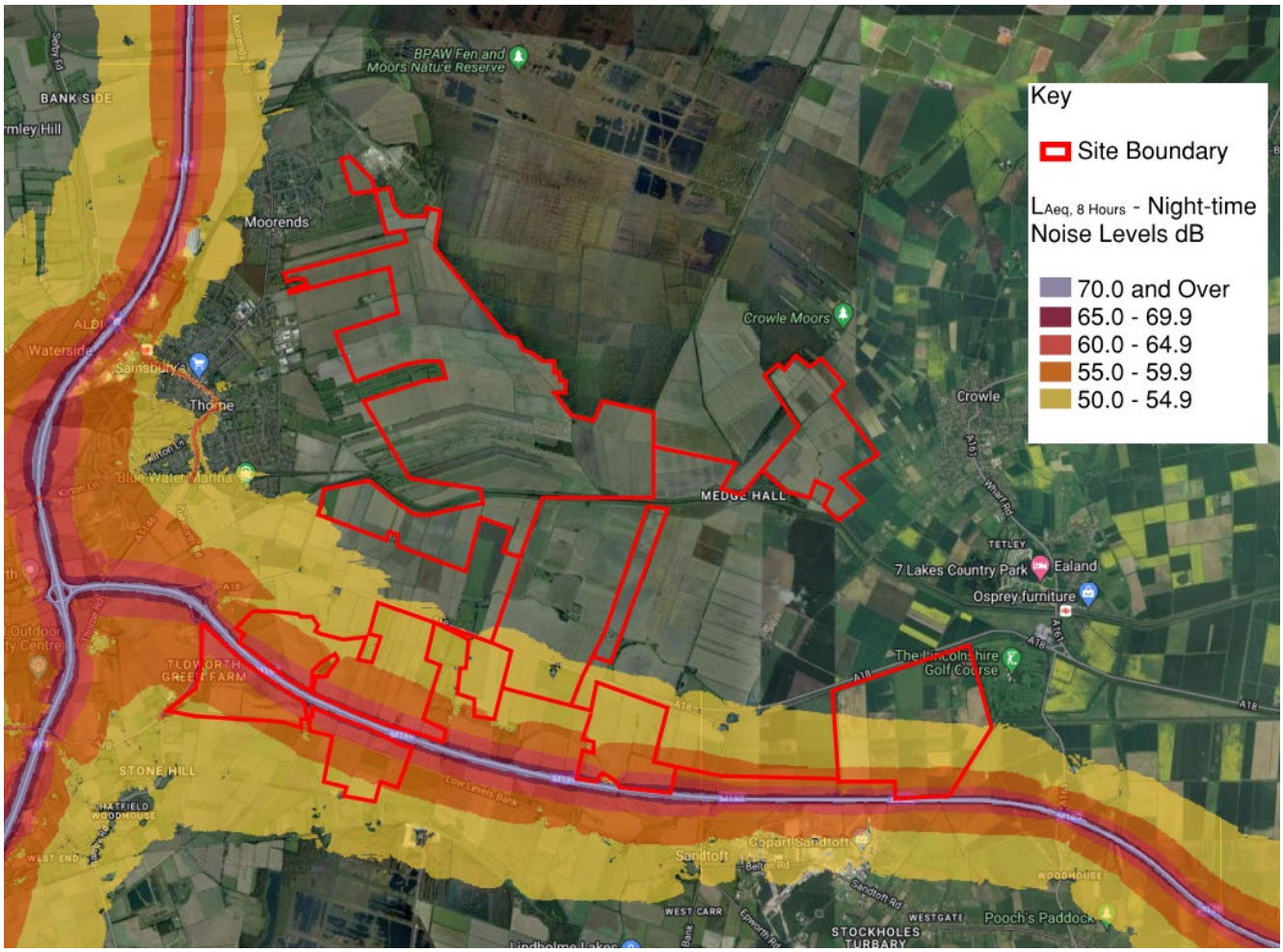


Figure 13.3 Predicted Night-time Noise Levels - (Contains public sector information licensed under the Open Government Licence v3.0. Copyright © 2019 Extrium Ltd)



13.4.8. It is shown that the noise levels across the site will most likely be dominated by road traffic noise from the local road network. Noise levels are likely to be higher at most of the identified noise sensitive receptors. The receptors identified towards the west of Crowle (i.e. AP01 – AP03 …) are likely to experience less noise from the M180 and the M18 and therefore background noise levels could be lower and result in a more stringent noise limit.

13.4.9. In addition, there is an operational wind farm on part of the site. This will also affect baseline noise levels although any wind turbine noise will vary with wind speed and direction as well as the distance to the turbines. Review of the planning conditions attached to the wind farm has indicated that at low windspeeds (4 ms^{-1}) the wind farm is has a minimum noise limit of 41.1 dB L_{a90} across the site. As this is a relatively high background noise level, this is an indication that measured noise level across the site, and at the noise sensitive receptor would not significantly differ from this level.

13.4.10. A baseline noise survey will be undertaken at a later date to accurately measure the baseline noise climate for the derivation of appropriate noise limits.

13.4.11. It is not proposed to carry out a baseline vibration survey as this is not typically relevant. Any vibration effects (e.g. during construction) can be assessed against absolute noise limits e.g. those in BS 5228-2.

Future Baseline

13.4.12. Due to the nature of the site, e.g. within the vicinity to main road infrastructure and adjacent to existing wind turbines. It is possible that the noise climate could marginally change in the future. The baseline noise survey to be undertaken will be representative of the current baseline across the site however, is it also deemed that the noise levels will not significantly change throughout the life of the development and therefore, the noise levels that will be measured across site are representative of the future baseline and no additional noise impacts will be present due to the change in the baseline noise climate.

Noise Limits.

13.4.13. At the time that noise sensitive receptors are formally agreed with the LPA, a baseline noise survey will be undertaken at locations representative of the agreed noise sensitive receptors to measure the background noise levels and appropriately derive operational noise levels.

13.4.14. For the purpose of the assessment presented in this PEIR, operational noise levels will be assessed against the absolute noise limits set which are low enough to protect amenity irrespective of the background noise. It is likely that these limits will be revised upwards on completion of the baseline survey as many locations will have higher background noise levels due to road traffic noise. Absolute noise limits can be derived from BS 8223: 2014 and WHO community noise guidance. Future baseline scenario will also be assessed in the subsequent ES and this may include the baseline whereby the Tween Bridge Wind Farm is decommissioned during the operational lifetime of the Scheme.

BS 8233: 2014 and WHO criteria

13.4.15. British Standard BS 8233: 2014 and the World Health Organisation (WHO) also provide external noise criteria to protect residential amenity. These are detailed in Table 13.8 below.

Table 13.8: WHO / BS 8233: 2014 Guideline Noise Levels

Location	Critical Health Effect	07:00 to 23:00	23:00 to 07:00
Outside Bedroom Windows	Sleep Disturbance (Windows Open)	--	45dB $L_{Aeq, 8hours}$ [(1)]
Amenity Spaces (Garden / Patios)	Moderate Annoyance	50 dB $L_{Aeq, 16\ Hours}$ [(2)]	--
	Serious Annoyance	55 dB $L_{Aeq, 16\ Hours}$ [(2)]	
Notes: [(1)] From WHO Community Noise Guidelines (1999) [(2)] BS 8233: 2014 and WHO Community Noise Guidelines			

13.4.16. The WHO guideline of 45 dB $L_{Aeq, 8hr}$ represents an 8-hour L_{Aeq} outside noise-sensitive rooms to prevent sleep disturbance. The WHO limit is a level at 1m from the façade. Therefore, equivalent free field level would be approximately 3dB lower, that is 42 dB L_{Aeq}. The limits apply to relatively anonymous noises without character such as traffic noise.

Absolute Noise Level Assessment Criteria

13.4.17. In the interim, in advance of a background noise survey,. to ensure the proposed development is not a significant or prohibiting factor in achieving the relevant WHO guideline values at sensitive receptors, noise generated by the development should aim to be approximately 10dB below the guidance levels in the table above. Therefore, an interim noise limit 32 dB L_{Ar} can be adopted for the night-time period and this will ensure that sleep is protected.

13.4.18. During the daytime it is unlikely that typical background noise levels will be below 35 dB L_{A90} and therefore an interim daytime limit can be set at 35 dB L_{Ar}. This limits will ensure The Scheme is considered to be consistent with a rating of a low impact in accordance with BS 4142 and no observed adverse effect (NOAEL) according to the NPPF.

13.4.19. Table 13.9 below summarises the noise limits to be utilized in this assessment operational noise.

Table 13.9 Absolute Noise Limits

Assessment Period, T	Noise Limit dB (L_{Ar})	Significance Level
Daytime (07:00 – 23:00)	35	LOAEL
Night-time (23:00 – 07:00)	32	LOAEL

13.5. Assessment of Likely Significant Effects

Construction

13.5.1. The construction phase of the scheme has the potential to cause short-term audible noise at nearby receptors. Noise impacts are likely to vary through the construction phases. Activities most likely to generate disturbance include:

- site establishment including ground works. This may include works for site access roads and hard standings and construction of solar panel support structures; and,
- construction traffic – increases in road traffic movements on the surrounding road network due to construction traffic have the potential to generate short-term noise impacts at receptor locations.

13.5.2. A qualitative assessment of construction noise in line with BS5228 will be undertaken, considering potential noise levels from typical construction processes, noise limits and control measures that could be implemented at the closest residential properties should it be necessary.

13.5.3. A predictive assessment of construction phase traffic impacts will be undertaken in line with CRTN and DMRB LA111, with the relative change in noise level during each month of the construction phase compared with the existing traffic flow on local roads.

13.5.4. Effects on specific identified receptors during the construction phase are expected to be short-term in duration, although the exact duration over which the construction phase will occur at each receptor is not yet known. Instead, a number of worst-case predictions are made for the installation of the frame supports based on the minimum distances and data used in other assessments of this nature. Construction noise will also be covered within the scope of a Construction Environmental Management Plan (CEMP) and mitigation developed once the specifics of the programme are known and understood.

Operation

13.5.5. A computer noise model has been constructed using the IMMI noise modelling software to calculate the operational noise levels at the identified noise sensitive receptors. Within the modelling software, propagation of noise will be calculated in accordance with ISO 9613-2 with the following input parameters:

- Downwind propagation (noise levels under crosswind and upwind conditions will be less).
- Soft ground between the noise source and the receiver locations (G = 1.0),
- Average, ambient air temperature of 10°C and 70% Relative Humidity;

Noise Data

13.5.6. At this stage, the specifics of the noise generating equipment are unknown, however based on the indicative information provided, the assessment of operational noise will be undertaken to include the following noise generating assets:

- 122 No. Solar Central Inverters with Inverter Skids (transformers)
- 144 No. Battery Storage Containers
- 144 No Battery Transformers
- 1 No. main RWE Substation
- 5 No. Satellite RWE Substation

13.5.7. It should be noted that an EV charging hub is also proposed as part of the wider development. At this stage the EV charging hub has not been assessed. This will be presented in the next iteration of the PEIR.

13.5.8. As the project design progresses and the technical data becomes establish throughout the design process of the application, more relevant and accurate noise data will be used in the noise model to reflect the stages of the design process.

13.5.9. However, at this stage assumptions have been made of the likely noise levels produced by the noise generating assets. These are assumptions are based on library data from similar/typical solay and battery energy storage sites.

13.5.10. The noise data for these sources used in the computer model is described below. Note that the actual equipment provided may differ from this.

Solar Central Inverter and Inverter Skids

13.5.11. There are 122 localized central inverter and inverter skid stations around the site, specific models for which are yet to be decided. Therefore, typical noise data has been selected for the inverter and inverter skids found around the site based on previous experience with similar sites. Table 13.10 gives a fairly noisy sound power spectrum for the selected inverter units. It should be possible to select units quieter than this.

Table 13.10: Octave band spectra of example inverter unit

Noise Source	Sound Power Levels in Octave Bands, Hz dB							L_{WA}, dB
	63	125	250	500	1000	2000	4000	
Central Inverter and Inverter Skid	89	87	90	88	84	81	86	91

13.5.12. A single number A-weighted value of 78 dB has been used for the transformers located adjacent to each invertor, this value has also been selected as a worst-case scenario with the understanding that if this proposed lay out meets noise emission targets then the final design should, in theory, have an operational margin for error.

Battery Storage Containers

13.5.13. The batteries are containerized and it is likely that the noise from the batteries themselves would not be perceptible, however HVAC units are used to control the internal temperature/environment within the containers do generate noise.

13.5.14. For the purposes of this assessment the SunGrow ST2752-UX battery and HVAC system have been used. The sound power level presented below represents typical energy from individual HVAC units, and therefore this total level should be met for each HVAC unit selected.

Table 13.11: HVAC Units Sound Power Level Spectrum

Noise Source	Sound Power Levels in Octave Bands, Hz dB							L_{WA}, dB
	63	125	250	500	1000	2000	4000	
HVAC per Battery unit	77	69	76	75	77	78	70	82

13.5.15. The noise levels detailed above represent the HVAC units operating at 100%. This is considered to be a rare occurrence, generally during extremes of temperature. Due to the conservative estimates presented it forms a robust assessment for operating installation.

Power Transformers

13.5.16. The battery units around the BESS area include two power transformer / inverter units, the noise data chosen for this assessment is based on SunGrow SC5000-UD Transformer/Inverter units. These will operate during both the charging and discharging phases.

13.5.17. In order to properly calculate noise levels typical spectra expected from inverter units has been used to assume octave band noise levels from the manufacturer's data. The spectra used is presented within Table 13.13:

Table 13.12 – Typical octave band spectra of inverter units

Noise Source	Sound Power Levels in Octave Bands, Hz dB							L_{WA}, dB
	63	125	250	500	1000	2000	4000	
Typical Inverter Spectrum	84.3	86.9	87.2	86.8	81.2	78.5	78.9	88

RWE Substation and Satellite RWE Substation

13.5.18. There are many electrical components within the potential substations however, based on the previous experience and measured data for similar Electrical Substations, it most likely that the power transformers are the dominant sources.

13.5.19. Based on internal library information from measured data, Table 13.14 sets out the chosen octave band sound power level for the transformers within the proposed substations.

Table 13.14: Octave band spectra of example substation inverter units

Noise Source	Sound Power Levels in Octave Bands, Hz dB							L_{WA}, dB
	63	125	250	500	1000	2000	4000	
HV Substation Transformer	90.8	87	92.8	88.3	73.7	64.2	63.1	88

13.6. Operational Assessment

Modelling Scenarios

13.6.1. To carry out the assessment, two scenarios have been modelled as follows:

- Daylight Hours with Solar Farm Operations
    - Noise generating assets including: Central Inverters with Inverter Skid, Containerised Battery Units (HVACs), and Battery Power Conversion Units
- Night-time Sensitive Hours With Batteries Operation:
    - Noise generating assets including: Containerised Battery Units (HVACs) and Battery Power Conversion Units

13.6.2. The daylight operation therefore represents the worst-case with all sources operating at 100% duty (full power).

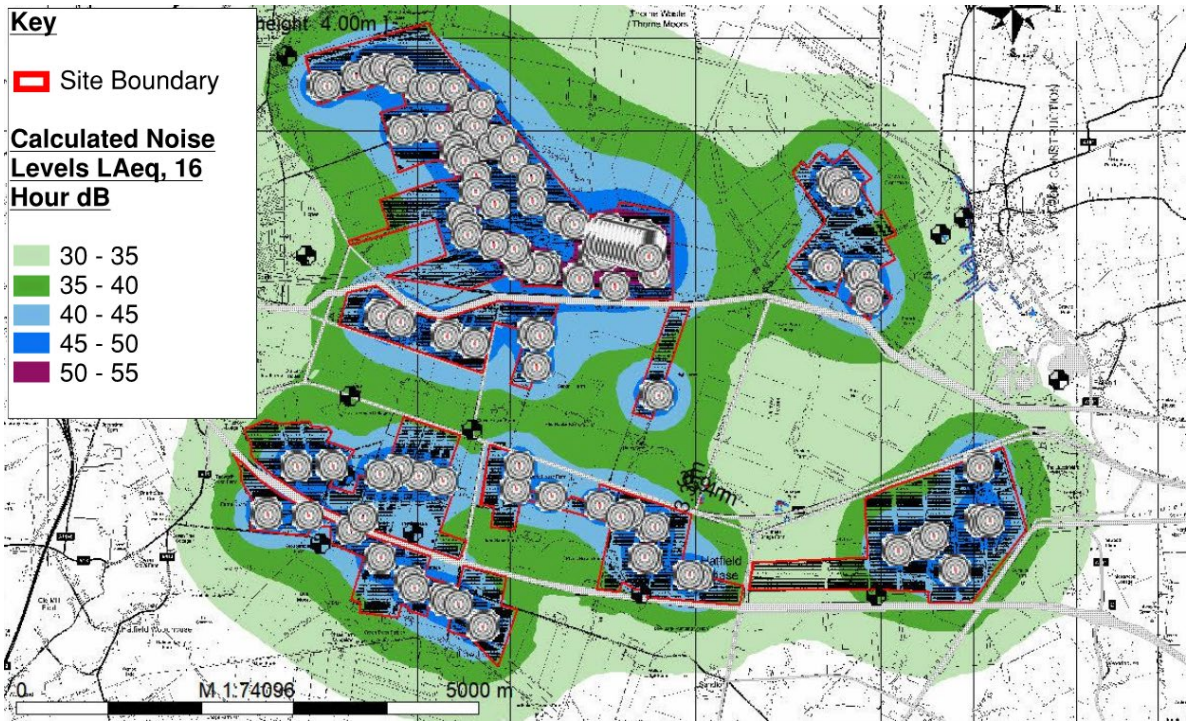
13.6.3. Although it is possible that the solar farm could operate in the early morning periods that would normally be considered to be part of the night, it would not operate at the most-sensitive periods of the night-time nor at 100% capacity.

13.6.4. Therefore, the night-time scenario considers only the containerized battery units and battery store transformers.

Daytime Operational Noise Assessment

13.6.5. The noise predictions are presented in the first instance as a noise contour plot in Figure 13.4 below, showing the predicted specific noise levels (dB L_{Aeq}) and the nearest houses. The contours assume that all equipment is running at full capacity, which is only likely to occur in the middle of a sunny day when all plant is operating at 100%.

Figure 13.4: Indicative Daytime Noise Contour Plot, dB LAeq



13.6.6. In addition, the specific noise level has been calculated at the assessment points identified in Table 13.7.

13.6.7. In terms of the assessment as per BS 4142, the rating level will be calculated from the predicted specific noise level. In this instance a +2dB correction has been applied in the calculations below on the premise that any tonal content could be 'just perceptible'.

13.6.8. In addition to the above, the proposed development will not generate any other identifiable characteristics i.e. intermittency, impulses and/or 'other' characteristics. To that end, no other character corrections have been applied in the calculation of the rating noise level.

13.6.9. The solar farm will only operate during daylight hours, with full capacity reached around the middle of the day on a sunny day. However, as indicated above, the solar farm could feasibly operate, during the summer months, before 07:00 hours. The predicted noise levels are given in Table 13.15.

Table 13.15: Daytime Operational Noise Assessment

Assessment Point	Description	Predicted (Specific) level, dB L_{Aeq}	Rating level* dB L_{Ar}	Rating Noise Target dB L_{Ar}	Difference, dB
AP01	2 Marsh Road	33	35	35	0
AP02	Dwellings Along Windsor Road	30	32	35	-3
AP03	Holiday Dwellings at 7 Lakes Holiday park	25	27	35	-8
AP04	Woodcarr Farm	37	39	35	4
AP05	Goodcop Cottage	40	42	35	7
AP06	Crow Tree Farm	41	43	35	8
AP07	Stoupers Gate Farm	41	43	35	8
AP08	Green Bank	39	41	35	6
AP09	Tolstem House	47	49	35	14
AP10	Steam House	37	39	35	4
AP11	Dwellings Along St Georges Rd	33	35	35	0
AP12	Dwellings Along Wilkinson Ave	37	39	35	4

13.6.10. The results presented in Table 13.15 indicate that the noise generated by the scheme has the potential to exceed the assessment criteria based on the absolute noise level limits. It is important to note that the noise limits that will be derived from the baseline noise survey would likely be higher than the noise limit of 35 dB L_{Ar}. However predicted noise levels exceeding 40 dB(A) may be problematic and mitigation will need to be considered. It is likely this can be achieved by increasing separation distances to the noisy equipment, selection of quieter equipment and if appropriate noise barriers. Note in some cases the solar panels can provide some shielding. This has not been taken into account in the current iteration of the model.

13.6.11. The current unmitigated effect at the majority of the identified noise sensitive receptors is minor – moderate.

13.6.12. It is reiterated, that the noise levels assumes all plant and equipment is operating at 100% duty (full power). While it is possible that the solar equipment might be operational early in the morning it would not be operating at 100% and therefore the operation scenario presented above is unlikely to occur during the normal night period 23.00 to 07.00 and not when people are trying to get to sleep.

Night-time Operational Noise Assessment

13.6.13. For the typical night-time scenario, only sources around the battery store area would be operating. These are far from residential areas and there will be only a negligible impact. The noise contour is shown below in Figure 13.5.

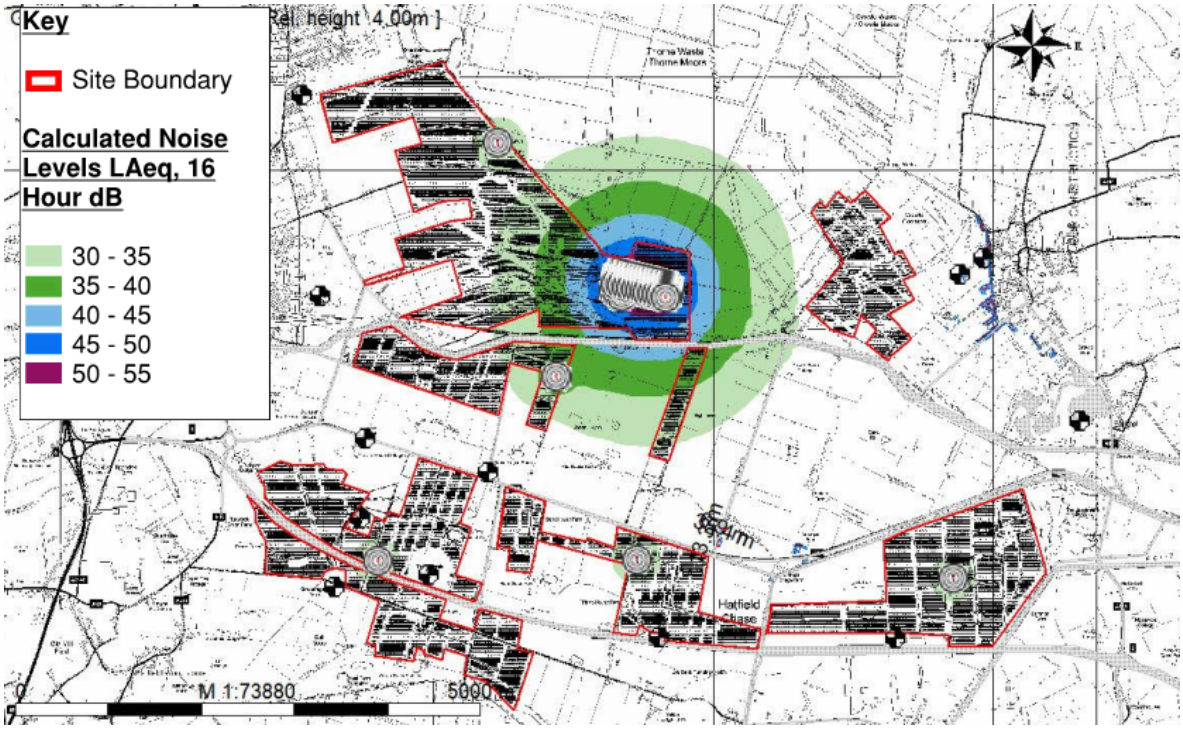


Figure 13.5: Indicative Night-time Noise Contour Plot, dB L_{Aeq}

13.6.14. As shown in Figure 13.5, all of the identified receivers fall below the 30 dB(A) contour line. In addition, the specific noise level has been calculated at the assessment points including +2dB correction has been applied in the calculations below on the premise that any tonal content could be 'just perceptible'. The predicted noise levels are given in Table 13.16.

Table 13.16: Night-time Operational Noise Assessment

Assessment Point	Description	Predicted (Specific) level, dB L_{Aeq}	Rating level* dB LAr	Rating Noise Target (dB L_{Ar})	Difference, dB
AP01	2 Marsh Road	20	22	32	-10
AP02	Dwellings Along Windsor Road	18	20	32	-12
AP03	Holiday Dwellings at 7 Lakes Holiday park	12	14	32	-18
AP04	Woodcarr Farm	19	21	32	-11
AP05	Goodcop Cottage	21	23	32	-9
AP06	Crow Tree Farm	22	24	32	-8
AP07	Stoupers Gate Farm	22	24	32	-8
AP08	Green Bank	25	27	32	-5
AP09	Tolstem House	23	25	32	-7
AP10	Steam House	20	22	32	-10
AP11	Dwellings Along St Georges Rd	19	21	32	-11
AP12	Dwellings Along Wilkinson Ave	16	18	32	-14

13.6.15. The results presented in Table 13.16 indicate that the noise generated by the battery storage facility in operation is of a very low level and is below the proposed night-time noise target.

13.6.16. In terms of the noise exposure hierarchy table (Table 13.3 above), noise generated by the battery storage facility during night-time operation would, at worst, be at the no observed adverse effect level: where noise may be audible but not result in a change in the quality of life. Based on the results of the assessment and the guidance provided in Section 3, no further mitigation measures are required in terms of night-time noise this is a negligible effect.

13.7. Mitigation, Enhancement and Residual Effects

Mitigation by Design

Construction Noise and Vibration

13.7.1. British Standard BS 5228: Parts 1 and 2 provides the basic code of practice for the management of construction noise for the proposed scheme site.

13.7.2. The following advice is based upon guidance provided in BS 5228 and will be applied as appropriate through a Construction Environmental Management Plan (CEMP), as part of the embedded mitigation and good practice of the site, in order to minimise noise and vibration from the deconstruction and construction activities affecting noise sensitive receptors.

- Appropriate operational hours, likely to exclude work during the night-time and during Sundays and public holidays;
- Ensuring the use of quiet working methods, the most suitable plant and reasonable hours of working for noisy operations, where reasonably practicable;
- Locating noisy plant and equipment as far away as reasonably possible and where practicable, carry out loading and unloading in these areas;
- Screening plant to reduce noise which cannot be reduced by increasing the distance between the source and the receiver (i.e. by installing noisy plant and equipment behind large site buildings);
- Compressors should be fitted with properly lined and sealed acoustic enclosures where environmental noise disturbance may arise, and these should be kept closed whenever the machines are in use;
- Orientating plant that is known to emit noise strongly in one direction so that the noise is directed away from dwellings, where possible;
- Closing acoustic covers to engines when they are in use or idling;
- Work to keep local residents informed of the proposed working schedule, where appropriate, including the times and duration of any abnormally noisy activity that may cause concern; and
- Lowering materials slowly, whenever practicable, and not dropping them.

<u>Operational Noise Mitigation.</u>

13.7.3. In such instances an acoustic barrier could be utilized to reduce noise levels from the battery storage. The acoustic barrier must be imperforate, well-sealed at the junction with the floor (no air gaps) and with a superficial mass of at least 12 kg/m2 for effective noise control.

13.7.4. Other elements such as inverters can be containerized with some noise control treatment including attenuators to any fans. The current design features centralized inverters but If string inverters are used there inverters tend to be inherently screened by the solar panels themselves. The screening effect of the panels can be included in the computer model if string inverters are used.

Summary of Mitigation

Table 13.17: Mitigation

Ref	Measure to avoid, reduce or manage any adverse effects and/or to deliver beneficial effects	How measure would be secured		
		By Design	By S.106	By Requirements
1	CEMP	X		X--
2	Acoustic Noise Barrier	X		X--
3	Selection of appropriate plant	X		
4	Maximise separation distances, based on noise of selected plant	X		

Enhancements.

13.7.5. In terms of noise and vibration, it is unlikely that this project would provide any enhancements to the local area. However noise levels are already high due to the road traffic noise sources.

Residual Effects

13.7.6. The short-term effects of the construction phase would be controlled through the CEMP and may include some of the mitigation measures that would be suggested in the Technical ES chapter. This will ensure the noise impacts during the construction phase are suitably controlled and there are no residual effects due to the short-term nature of the construction phase.

13.7.7. Noise during the operational phase will be designed to be within the Lowest Observed Adverse Effect Level and will negligible. Given the conservative nature of the assessment to be undertaken, there will likely be no significant residual noise effects.

13.8. Cumulative and In-Combination Effects

13.8.1. A full list of consented and active projects will be considered within the next iteration of the PEIR.

13.9. Summary

Introduction

13.9.1. This chapter of the PEIR identifies the potential effects of The Scheme in terms of noise and vibration.

Baseline Conditions

13.9.2. An environmental noise survey will be undertaken as part of the full technical works to ascertain the current noise climate of the site and the results will be used to derive appropriate noise limits at the identified noise sensitive receptors.

Likely Significant Effects

13.9.3. An assessment of the potential construction noise and vibration effects will be undertaken when a phase program is known. This will be presented in the next iteration of the PEIR. Construction noise and vibration is temporary in nature, and it is anticipated that, with the use of the CEMP, the impacts will not be adverse.

13.9.4. In terms of the operational noise impact, it is likely that, with the use of required mitigation measures, the noise levels will not exceed the proposed noise limits and should result in a negligible impact.

Conclusion

13.9.5. With use of ongoing mitigation measures in place as described, The Scheme is unlikely to result in a significant adverse effects on any of the identified noise sensitive receptors.

13.9.6. **Table 13.18** in currently unpopulated. Following the assessment of construction/decommission phase and the operation phase the summary of effects will be reported. .

Table 13.18: Summary of Effects, Mitigation and Residual Effects

Receptor / Receiving Environment	Description of Effect	Nature of Effect	Sensitivity Value	Magnitude of Effect	Geographical Importance	Significance of Effects	Mitigation / Enhancement Measures	Residual Effects
Construction								
Identified Noise Sensitive Receptors	Noise	Temporary/Direct	High	Not Applicable'	Local	Likely Negligible	CEMP	Negligible
Identified Noise Sensitive Receptors	Vibration	Temporary/Direct	High	Not Applicable'	Local	Likely Negligible	CEMP	Negligible
Operation								
Identified Noise Sensitive Receptors	Noise	Permanent/Direct	High	Not Applicable'	Local	Minor – Moderate	Acoustic Barriers, Separation Distances and Noise Generating Equipment Selection	Negligible
Cumulative and In-Combination								
Not yet assessed								