CLEVE HILL SOLAR PARK

ENVIRONMENTAL STATEMENT

VOLUME 1 - CHAPTERS

CHAPTER 12 - NOISE AND VIBRATION

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12 NOISE AND VIBRATION

12.1 Introduction

1. This chapter of the ES evaluates the effects of the Development as described in Chapter 5: Development Description on nearby noise and vibration sensitive receptors during construction, operation and decommissioning. The aim of this assessment is to predict the levels of noise and vibration potentially produced by the Development at the nearest sensitive receptors and assess these against relevant guidelines.

2. This chapter is supported by the following figure provided in Volume 2 (DCO Document Reference 6.2.12):

   - Figure 12.1 Noise Monitoring and Assessment Locations.

3. This chapter is supported by the following Technical Appendices provided in Volume 4 (DCO Document Reference 6.4.12):

   - Technical Appendix A12.1: Survey record sheets for the noise monitoring equipment;
   - Technical Appendix A12.2: Construction Calculation Sheets – Human Receptors;
   - Technical Appendix A12.3: Piling Rig Noise Data Extract;
   - Technical Appendix A12.4: Piling Calculation Sheets – Ecological Receptors;
   - Technical Appendix A12.5: Other Construction Activities Calculation Sheets – Ecological Receptors;
   - Technical Appendix A12.6: Change in Road Traffic Noise Calculation Sheet;
   - Technical Appendix A12.7: Inverter Noise Emission Data;
   - Technical Appendix A12.8: Substation Noise Emission Data;
   - Technical Appendix A12.9: Battery Storage Noise Data; and
   - Technical Appendix A12.10: SPA Construction Noise Management Plan (SPA CNMP).

4. This chapter includes the following elements:

   - Assessment Methodology and Significance Criteria;
   - Baseline Conditions;
   - Development Design Mitigation;
   - Assessment of Potential Effects;
   - Mitigation and Residual Effects;
   - Cumulative Effect Assessment;
   - Summary of Effects; and
   - Statement of Significance.

12.1.1 Development Parameters Assessed

5. The Rochdale Envelope parameters for the Development have been considered with respect to the potential effects considered in this Chapter, and worst-case values/scenarios for this are captured by the candidate design, as set out in Chapter 5: Development Description. This chapter reports the assessment of effects associated with the candidate design, therefore.

6. Where alternative scenarios affect the assessment outcomes, the specific option used in the assessment is stated in the text.

12.1.2 Consultation

7. A summary of consultation prior to issue of the Preliminary Environmental Assessment Report (PEIR) in May 2018 is provided in Table 12.1a.

Table 12.1a Summary of Consultation Responses

Date	Consultee and Response	Applicant Response
January 2018	**PINS Scoping Opinion**	
	ES should assess noise impacts during decommissioning.	Noise effect during decommissioning assessed
	ES should clearly identify study areas used in the assessment.	Noise and vibration has been assessed at the nearest, and therefore most noise sensitive properties and at the closest boundary of the nearest ecological designations to the Development. Assuming noise levels are acceptable at these locations, effects will be acceptable at locations further from the Development. Assessment locations are shown in Figure 12.1.
	ES should consider all types of sensitive receptor, such as ecological and recreational receptors.	Assessment has been undertaken at the nearest residential receptors, which are considered to be the most sensitive in terms of noise for human receptors. Effects on ecological designations have been considered.
	ES should identify which construction activities have the potential to produce vibration, and should consider vibration from HGV vehicles during construction. The ES should explain how the level of vibration impacts have been used to identify sensitive receptors for inclusion in the assessment.	The effect of vibration has been assessed, and includes information on the assessed receptors.
	ES should explain how monitoring locations are selected and confirm when monitoring was undertaken.	Noise monitoring was undertaken at the closest noise sensitive properties surrounding the site. Details of monitoring, including how monitoring locations were selected and when monitoring was undertaken is also provided.
	SOAEL's and LOAEL's should be defined for all construction, operational and decommissioning noise and vibration matters.	SOAELs (Significant Observed Adverse Effect Levels) and LOAELs (Lowest Observed Adverse Effect Levels) have been discussed and presented in section 12.2.
	Inspectorate is content that impacts from vibration during operation and decommissioning of the Development can be scoped out of the ES	No action required.
	ES should provide details of anticipated construction working hours, including any proposed night-time working. Working hours should be incorporated into the assessment, and be consistent with the working hours specified in the dDCO.	Construction is anticipated to be undertaken during daytime periods, as identified in BS 8233 (0700 – 1900 weekdays, 0700 – 1300 weekends), subject to agreement with the Local Authority.

Date	Consultee and Response	Applicant Response
February 2018	**Steve Wilcock, Environmental Protection Team Leader, Swale Borough Council (SBC)**	
	Arcus contacted SBC to confirm the assessment methodology for the assessment. The Scoping Report was sent, along with proposed background monitoring locations, and that noise would be assessed according to BS4142:2014. SBC confirmed that proposed methodology is acceptable.	Survey undertaken as agreed with Council.

8. Table 12.1b provides a summary of Section 42 responses, since PEIR.

Table 12.1b Summary of Section 42 Consultation Responses since PIER

Date	Consultee and Response	Applicant Response
June 2018	**Canterbury City Council**	
	Relevant policies from the Development Plan are missing from the list contained in section 12.3.1 of Chapter 12.	Development control policies are included in the ES, Chapter 6: Legislative and Planning Policy Context. Policies are included in the technical ES chapters when they inform the technical assessment. The technical assessments do not draw conclusions relating to planning policy compliance; these are made in the Planning Statement (DCO Document Reference 7.4).
June 2018	**Graveney with Goodnestone Parish Council**	
	The effect of wind direction: we would like more information on the effect of wind direction and strength on noise reception. There are frequently onshore winds which would bring noise from the site (particularly during the construction phase) to inland receptors.	Noise predictions made throughout the ES are undertaken according to ISO 9613, which provides a prediction of noise levels likely to occur under conditions favourable to sound i.e. down-wind and under a moderate, ground-based temperature inversion. Predictions are therefore worst case.
	Noise and vibration from the piling of solar array support frameworks: the PEIR indicates that these structures will have to be piled some 1-2.5 metres into the ground and that there will be many thousands of them. We would like more information on the number of days and periods of the day over which piling operations will be undertaken. (PEIR pp 12-23 indicates "50% of a working day").	Construction is expected to be undertaken one field at a time, each field will be complete within 3 to 4 weeks. The assessment of piling operations includes both manoeuvring equipment, and active piling. As a conservative assumption, for the purpose of assessing piling impacts on human receptors, it is assumed that 4 pilers could operate at the same time for 50 % of the working day (i.e. actively piling for 6 hours per day). Core working hours are set out in Chapter 5 (Development Description) of the ES while the timing of construction vehicle movements is discussed within Chapter 14 (Access and Traffic). Core working hours are proposed to be between 07.00 until 19.00, Monday to Friday and 07.00 until 13.00 on a Saturday (unless in exceptional circumstances where need arises to protect plant, personnel or the environment). In addition to this, a start-up and close down period for up to an hour

Date	Consultee and Response	Applicant Response
		before and after the core working hours is proposed. This does not include the operation of plant or machinery likely to cause a disturbance.
	Noise from transformers and inverters: a development of this scale has a very large number of inverters (3532) and transformers (72). We note that in PEIR pp 12-26 the candidate transformer supplier has indicated a sound power level of 84dB(A) and the candidate inverter supplier a level of 63dB(A).	The ES includes an updated candidate design, to fit within the Rochdale Envelope. This includes 3071 inverters and 80 transformers, a reduction of 305 inverter units from those assessed as part of the PIER.
	Uncertainty over the noise and vibration impact of the proposed battery storage facility: the extent and design of this facility is unclear, even whether it will be an open storage facility or incorporated within a building. Presumably, the noise impacts of these options are very different.	Operational noise from the Development will be dependent on the noise level of the plant / equipment installed. The ES has assessed the worst case likely design, resulting in the highest noise levels at the nearest properties. Going forward, operational noise from the development will be a key consideration in the final design, particularly the substation and battery storage, however noise from these areas will be limited to the noise limits set out in this chapter of the ES, resulting in a lower impact.
	Noise and vibration from construction traffic: on Hill Head Road, Seasalter Road and on haul roads within the CHSP site. We would like more information on the number, frequency and noise impact of abnormal loads travelling at low speed.	The peak number of Heavy Goods Vehicles (HGVs) will be 80 two way movements per day, this is expected to last for around 4 weeks, occurring in week 27 of the construction programme (as set out in Chapter 14: Access and Traffic). Peak Light Goods Vehicle (LGV) movements will be 162 two way movements per day, this is expected to last for a week, around week 100 of the construction programme. Over the full 24 month construction period, average HGV movements will be 62 per day, while LGV movements are 90 per day. In terms of noise, the assessment has been undertaken based on the peak HGV movements occurring on the same day. In practice, vehicle movements will be lower than those assessed for the majority of the construction period. The noise assessment is based on the change in noise level, using the existing levels of traffic and the expected peak movements during construction. As a worst case, this is predicted to result in a 2 dB increase in noise levels from Seasalter Road during periods of peak traffic movements, which is considered a minor impact.
	Acoustic barriers and screening: we would like to know more about the design and siting of these mitigation measures.	The energy storage facility and substation will be surrounded by a c. 5 m high bund, which will provide acoustic screening to reduce impacts from these noise sources. The bund is located around the entire substation / energy storage area. Depending on the final equipment selected for installation, additional screening may be specified, in order to ensure the noise limits specified in this document are not exceeded.

Date	Consultee and Response	Applicant Response
June 2018	**GREAT Graveney**	
	Graveney is a very quiet village in a rural location. Noise and vibration are likely to significantly impact on the silence that currently exists.	This chapter assesses noise at receptor locations. The operational noise assessment is based on the background sound level, and as such accounts for the existing levels of background noise.
	…the non-technical report simply states that because of mitigation, "no significant noise and vibration effects are predicted as a result of the Development." GREAT finds this highly confusing.	The non-technical report provides a non-technical summary of the noise assessment. While the PIER and the ES sets out the assessments of predicted noise against limits, and where required specifies mitigation to meet these limits, the NTS is simply a summary stating that with appropriate mitigation, no significant effects are predicted. Detail on this and other assessments can be found in the relevant chapters of the ES.
	As is common in the phase 2 consultation information, there is a lack of detail about the battery and other electrical equipment. No information is provided about the noise and vibration levels during construction of this equipment.	The Rochdale Envelope parameters for the energy storage facility are clearly set out in ES Chapter 5 Development Description (DCO Document Reference 6.1.5). Two alternative scenarios are available for assessment, a battery powerpack solution, as included in the PEIR, and a containerised solution, similar to other energy storage sites recently deployed in the UK. There is a need to maintain flexibility but the realistic worst case design parameters included in the chapter present a robust set of parameters such that the as-built Development will have the same magnitude effects, or effects of lesser magnitude than those included in the ES.
	· How will the guiding principles from the NPSE be fully and completely taken into account in the construction and operation of the proposal?	The visions and aims of the NPSE are referred to in section 12.2.6 of the ES. These visions and aims of the NPSE should be interoperated by having regard to the shared guiding principles, listed by GREAT.
	· How were the non-human receptor points chosen, and why was a vital, precious and hugely important location missed out?	Non-human receptor points have been selected on a worst case basis, i.e. at the closest point from the SPA to the development.
	· Why does the language in the PEIR say "where possible" and "where required" instead of "will"?	Due to the nature and size of the development, along with the range of receptors assessed, a range of responses are required, including specific mitigation, which will be applied, to generic mitigation which should be applied where practicable, to reduce noise impacts to as low a level as possible.
	· How have the developers assessed the noise and vibration brought about by the traffic and the construction work? Was a recognised quality standard used to measure this and the impact? What were the results? How will this be mitigated?	The assessment of construction noise and vibration is contained within section 12.5 of this ES. The Standards used for assessing construction noise are discussed in section 12.2.1, and is best practice for the assessment of construction noise.

Date	Consultee and Response	Applicant Response
	· How has the noise and vibration brought about by the traffic and construction work (35 vehicle movements per hour?) been assessed in relation to the primary school and the school for pupils with specific learning difficulties? What was the outcome? How will this be mitigated?	In terms of EIA effects, all receptors are assumed to be of high sensitivity. In terms of construction traffic noise, during peak levels of traffic there is a predicted 2 dB increase in noise levels along Seasalter Road, which is a minor effect. Construction traffic mitigation is contained within the CTMP (ES, Technical Appendix A14.1, DCO Document Reference 6.4.14.1).
	· How have the developers assessed the effect of wind direction and strength on the solar power station? Was a recognised quality standard used to measure this and the impact? What were the results? How will this be mitigated?	Noise predictions made throughout the ES chapter 12 are undertaken according to ISO 9613, which assumes downwind propagation for all noise sources. As a worst case, it is assumed that all equipment associated with the Development could operate at the same time, at 100 % capacity, during both daytime and night-time periods.
	· The panels will be secured using piles and there will be a great number of these. Can you confirm the number (over 140,000?) and the noise levels that piling operations will generate? When, for how long, and what period of the day will this operation take place?	Construction will be undertaken one field at a time, most of which will be complete within 3 to 4 weeks. The assessment of piling operations includes both manoeuvring equipment, and active piling. As a conservative assumption, for the purpose of assessing piling impacts on human receptors, it is assumed that 4 pilers could operate at the same time for 50 % of the working day (i.e. actively piling for 6 hours per day). Core working hours are set out in Chapter 5 (Development Description) of the ES while the timing of construction vehicle movements is discussed within Chapter 14 (Access and Traffic – DCO Document Reference 6.1.14). Core working hours are proposed to be between 07.00 until 19.00, Monday to Friday and 07.00 until 13.00 on a Saturday (unless in exceptional circumstances where need arises to protect plant, personnel or the environment). In addition to this, a start-up and close down period for up to an hour before and after the core working hours is proposed. This does not include the operation of plant or machinery likely to cause a disturbance.
	· How was the noise and vibration assessed from transformers and inverters and battery storage? What would the noise levels amount to? Could this exercise be completed in view of the uncertainty about the battery storage? How will this be mitigated?	The noise and vibration from transformers, inverters and the battery storage is undertaken in sections 12.5.1 and 12.5.2. The predicted noise levels amount to a low effect at the nearest receptors.
	· How will the health and well-being of villagers be safeguarded against noise and vibrations?	Mitigation referred to in the ES, chapter 12, and technical appendix A14.1 (construction traffic management plan) will be employed to ensure noise and vibration effects from the construction and operation of the Development are not significant, in terms of EIA Regulations.

Date	Consultee and Response	Applicant Response
	What is your waste management plan, and what affect will disposal have on the traffic plan?	Traffic generation from waste has been included within the assessments of construction traffic set out in Chapter 14 (Access and Traffic). No significant residual environmental impacts from construction traffic are predicted.
June 2018	**Kent Wildlife Trust**	
	While the IECS study does state "Ambient construction noise levels should be restricted to below 70dB" nowhere can we find it this report that it concludes 70dB is a suitable threshold for significant effects on ecological designations. On the contrary, the IECS report states "...regular construction noise between 50 and 70 dB (A) are categorised as moderate as these activities can have significant effects on avifauna..." While useful as a starting point, the IECS study classified the significance of different disturbance events on birds and sought to classify the sensitivity of receptors within the area of study, it did not set universal thresholds.	The 50 dB and 70 dB thresholds are used to inform the assessments in ES Chapters 12 Noise and 9 Ornithology. The IECS study is a robust and useful indicator of the noise levels that are likely to result in disturbance events on birds.
	It is clear from the above that noise levels below 70dB can induce a behavioural change, and therefore have the potential to cause an impact. The assessment of the impacts of noise should not be based solely on what may be considered a 'moderate – high level effect' (70dB) from a single noise event. What also needs to be taken into account is the frequency of disturbance and the significance of the birds involved (species and number). Habituation is also mentioned a few times. In the absence of alternative evidence it would seem wise to assume that the SPA birds are largely unhabituated to the potential noise events, and the proximity of sources, in question. While some may become habituated, the process itself requires exposure to disturbance.	The 50 dB and 70 dB thresholds are used to inform the assessments in ES Chapters 12: Noise and 9: Ornithology (DCO Document Reference 6.1.9). Frequency of disturbance, seasonal variations in sensitivity and the species in question are all referred to in ES Chapter 9 Ornithology at section 9.2. The anticipated length of time of the construction phase in each field is also relevant and is referred to in the assessment.
	We remain unconvinced that birds will not be disturbed by construction noise and would like to see further assessment and more information on this issue.	Further assessment and more information is provided in ES Chapter 9 Ornithology in section 9.5.2 (construction phase impacts).
June 2018	**Natural England**	

Date	Consultee and Response	Applicant Response
	· Further information is requested regarding the noise impacts of the construction and demolition phases of the proposal. An assessment of the change in continuous and sporadic noise levels is necessary to be able to determine likely impacts and potential need for mitigation.	Further assessment and more information on mitigation is provided in ES Chapter 9 Ornithology in section 9.5.2 (construction phase impacts).
June 2018	**RSPB**	
	Further information regarding mitigation measures needed to minimise the impact of construction noise on the SPA land adjacent to the development site is also required before we can agree with the magnitude of this impact of the development on the designated features of The Swale SPA.	Further assessment and more information on mitigation is provided in ES Chapter 9 Ornithology in section 9.5.2 (construction phase impacts).
June 2018	**Swale Borough Council**	
	I have now had a chance to look at Chapter 12 – Noise and Vibration - and would comment as follows: I am satisfied with the survey which has taken place as it agrees with the format discussed with myself at an earlier date. - Sound Power levels of the transformer plant and other noise generating equipment has been listed and described clearly and - A survey of the background noise level at 3 selected locations carried out. The levels were then modelled and predicted at a list of residential properties and a BS 4142 noise rating level calculated at each property. The greatest difference between the specific level and background noise was +4 dB in the night time period at 1 Crown Cottages which is below the +5 dB threshold and therefore the noise is unlikely to be such that a complaint would be made. I do not raise any vibration issues. I am therefore satisfied with this study and do not therefore raise any objections regarding noise to the proposal.	The ES Chapter has been updated from the PEIR to account for a wider range of plant and equipment, and with clear proposals to mitigate noise to acceptable levels. The basis of the assessment including the methodology and guidance used remains as used in the PEIR.
June 2018	**The Faversham Society**	

Date	Consultee and Response	Applicant Response
	If developers are forced to halt work over each summer's bird nesting season and to avoid disturbing overwintering birds, it is likely that the work will be spread over perhaps three or four years. This means that for residents close to the site and those living on or using the roads leading to it, there will be unacceptable noise and disturbance caused by construction traffic to and from the site over a long period.	Further assessment and more information on mitigation is provided in ES Chapter 9 Ornithology in section 9.5.2 (construction phase impacts). The length of the construction phase is expected to be 2 years. Potentially disturbing construction activities within the fields close to the SPA are expected to be undertaken in winter, as it is anticipated that SPA species will be more sensitive to disturbance effects at the closest locations in the SPA to the Development during the breeding season. There is adequate time within the 2 year construction phase to allow this construction phase mitigation to be delivered without impacting the overall construction programme.
	The Faversham Society is also concerned about the level of disruption that will continue during the normal running of the power station. Although there is some technical detail, we have seen little intelligible analysis about the cumulative level of noise generated by the inverters, transformers, battery packs and other elements of the energy production process.	Noise during the operational phase of the development is assessed in the ES, chapter 12, section 12.5.4. The predicted noise levels assume that all equipment associated with the Development could operate at the same time, at 100 % capacity, during both daytime and night-time periods. Therefore, in practice the noise emission levels are likely to be lower than those presented in this assessment. Noise at receptor locations will be required to be lower than the limits set out in the Chapter.
	Neither is there a convincing presentation about the level of, noise, light and air quality pollution caused during the construction phase.	Construction noise is predicted and assessed in detail in the ES, chapter 12, section 12.5.1.
	Tables set out noise levels caused by construction equipment for receptor points at adjacent residential properties including at Nagden Cottages, Warehouse, Coney Banks and Crown Cottages. With the breaks over the summers for bird nesting, it is likely that the works will take up parts of three years. There is also concern about working in the winter because of wintering birds on the land that are part of the Swale Ramsar Assemblage This means that for residents close to the site, there will be noise and disturbance over a long period to the detriment of amenity.	During summer months, construction will continue at a distance at which birds will not be disturbed, which will mean that construction will not extend beyond the predicted 2 year period. Assessment of construction noise at the nearest receptors has been undertaken in the ES, chapter 12, section 12.5.1 and shows that noise from construction on human receptors will not be significant.

Date	Consultee and Response	Applicant Response
	The level of noise and disturbance is a problem for residents but is much more serious for wildlife. Construction of roads and excavation of ditches, creation of culverts, clearing of ground by removing plants and topsoil and installation of equipment would result in the whole site being unavailable as nesting habitat for ground nesting birds and feeding /foraging habitat for birds, bats and other animals and insects over a long period. Once complete, it is likely that new vegetation would not properly establish itself for at least three years. The impact of this is discussed in more detail in respect of particular species and the overall impact on the Statutory designations and local designated land that directly abuts the site.	The likely significant noise effects of the Development on human and ecological receptors are assessed in ES Chapter 12 Noise. The Development site will be constructed field by field, therefore the construction impacts will be localised at any particular point in time. Assessments of construction activities on avian and non-avian ecological receptors including habitats and species is presented in ES Chapters 8 Ecology and 9 Ornithology. ES Technical Appendix A5.2, Outline Landscape and Biodiversity Management Plan sets out how it is anticipated that new vegetation will be established and maintained.

12.2 Assessment Methodology and Significance Criteria

12.2.1 Construction Noise Legislation & Guidance

9. The following legislation and standards are of particular relevance to construction noise.

- The Control of Pollution Act 1974 (CoPA 1974);
- The Environmental Protection Act 1990 (EPA 1990); and
- BS 5228:2009 code of practice for noise and vibration control on construction and open sites.

10. The following legislation and standards are relevant for the assessment of construction effects on human receptors. A review of guidance relating to the impact of noise on ecological receptors has been undertaken in Chapter 9: Ornithology.

12.2.1.1 The Control of Pollution Act 1974 (CoPA 1974)

11. CoPA 1974 provides Local Authorities with powers to control noise and vibration from construction sites.

12. Section 60 of CoPA enables a Local Authority to serve a notice to persons carrying out construction work of its requirements for the control of site noise. This may specify plant or machinery that is or is not to be used; the hours during which construction work may be carried out; the level of noise or vibration that may be emitted; and provide for changes in circumstances. Appeal procedures are available.

13. Section 61 of CoPA allows for those carrying out construction work to apply to the Local Authority in advance for consent to carry out the works. This is not mandatory, but is often to the advantage of the developer, as once consent is issued, the Local Authority is no longer able to take action under Section 60 of CoPA 1974 or Section 80 of the EPA 1990. It does not, however, prevent nuisance action under Section 82 of the EPA 1990. The application is expected to give as much detail as possible about the works to be carried out, the methods to be used and the measures that will be taken to minimise noise and vibration.

12.2.1.2 The Environmental Protection Act 1990 (EPA 1990)

14. The EPA 1990 specifies mandatory powers available to Local Authorities in respect of any noise that either constitutes or is likely to cause a statutory nuisance, which is also defined in the Act. A duty is imposed on Local Authorities to carry out inspections to identify statutory nuisances, and to serve abatement notices against these. Procedures are also specified with regards to complaints from persons affected by a statutory nuisance.

12.2.1.3 BS 5228:2009+A1:2014 code of practice for noise and vibration control on construction and open sites

15. BS 5228:2009:A1:2014 (referred to as BS 5228) refers to the need for the protection against noise and vibration of persons living and working in the vicinity of and those working on construction and open sites. It recommends procedures for noise and vibration control in respect of construction operations. The discussion below relates mainly to Part 1- Noise, however, the recommendations of Part 2 in terms of vibration are similar.

16. The standard stresses the importance of community relations, and states that early establishment and maintenance of these relations throughout site operations will go some way towards allaying people's concerns. In terms of neighbourhood nuisance, the following factors are likely to affect the acceptability of construction noise:

- Site location, relative to the noise sensitive premises;
- Existing ambient noise levels;
- Duration of site operations;
- Hours of work;
- The attitude of local residents to the site operator; and
- The characteristics of the noise produced.

17. Recommendations are made regarding the supervision, planning, preparation and execution of works, emphasising the need to consider noise at every stage of the operation.

18. Measures to control noise are described, including:

- Control of noise at source by, *e.g.*,:
  - Substitution of plant or activities by less noisy ones;
  - Modification of plant or equipment to reduce noise emissions;
  - The use of noise control enclosures;
  - The siting of equipment and its method of use;
  - Equipment maintenance; and
- Controlling the spread of noise, *e.g.*, by increasing the distance between plant and noise-sensitive receptors or by the provision of acoustic screening.

19. The standard includes a discussion of noise control targets, and example criteria for the assessment of the significance of noise effects. These are not mandatory.

20. Methods of calculating the levels of noise resulting from construction activities are provided, as are source levels for various types of plant, equipment and construction activities.

12.2.2 Construction Assessment Methodology

12.2.2.1 Noise

21. An assessment of the potential effects of noise during construction has been carried out for the closest, and therefore most noise sensitive, residential properties and ecological designations. As the assessment of construction noise is based on fixed limits at all sensitive receptors, by predicting and assessing the level of noise at those properties

closest to the Development, it is considered that predicted levels, and therefore effects, will be lower at receptors further from the Development. The assessment is based upon typical solar farm construction activities and types and numbers of plant.

22. The following construction activities, including construction traffic associated with them, are considered to be those with the most potential to result in adverse noise effects:

- Construction of tracks and hardstanding areas;
- Installation of mounting frames (including piling);
- Installation of panels; and
- Construction of the electrical compound.

23. The distance between each noise sensitive receptor and the closest point at which each construction activity (excluding construction traffic on public roads) would occur has been identified, and used to calculate worst case noise levels using the source data and methodology described in BS 5228. These predicted levels have then been assessed against magnitude criteria derived from those suggested in BS 5228 appendix c.3.

12.2.2.2 Vibration

24. The construction activities considered are those with most potential to result in adverse vibratory effects:

- Construction Traffic Vibration;
- Piling of PV panel framework; and
- Compaction of tracks/hardstanding areas.

25. All other activities are considered to produce negligible levels of vibration and as such, do not require detailed assessment.

26. The levels of vibration at the specified receptors have been predicted using the formulae provided in Table E.1 of BS 5228. The methodology for predicting vibration at each receptor uses the distance to the construction activity and a scaling factor based on the probability of the predicted value being exceeded. The propagation of ground-borne vibration is highly complex and is depended upon the specific geology of the propagation path from source to receptor. However, the formulae provide a reasonable estimation of the level of vibration likely to be experienced in practice. The formulae give a peak particle velocity (PPV) which can be compared to magnitude criteria derived from levels specified in BS 5228, as discussed in section 12.2.3.3.

12.2.3 Construction Magnitude Criteria

12.2.3.1 Human Receptors

27. BS 5228 provides several example criteria for the assessment of noise effects from construction activities. Of those available, "Example Method 2 – 5 dB(A) Change" has been selected for the current assessment as it offers a slightly less complex procedure than Example Method 1 and is more in keeping with conventional EIA methodologies for noise than alternative methods provided, which relate to eligibility for noise insulation. Using this method, the following threshold values have been identified:

- The $L_{Aeq,period}$ level of construction noise exceeds lower threshold values of 65 dB(A) during daytime (includes 0700 to 1300 Saturday), 55 dB(A) during evenings and weekends or 45 dB(A) at night; and
- The total noise level (pre-construction ambient noise plus construction noise) exceeds the pre-construction ambient noise level by 5 dB(A) or more for a period of one month or more.

28. However, in low background noise environments, it is likely that the pre-existing ambient noise level would be significantly lower than the lower thresholds. It has therefore been

assumed that construction noise levels in excess of the lower threshold would also result in total noise levels of more than 5 dB(A) above the pre-existing ambient noise level.

29. Construction noise levels in excess of the threshold values that would occur for a period of one month or more are regarded as being of medium or large magnitude.

12.2.3.2 Ecological Receptors

30. Noise thresholds have been set based on the analysis carried out in ES Chapter 9: Ornithology. Following consultation responses, separate thresholds have been set for active piling noise, based on a L_{Amax} level as it is impulsive, and for all other construction noise based on an L_{Aeq} level.

31. The noise thresholds represent noise levels above which there is likely to be significant disturbance to ornithological receptors associated with the Swale SPA. Baseline background noise levels are not relevant to the assessment of effects on ecological receptors.

32. The most sensitive receptor locations during the breeding and wintering seasons are considered separately, and the threshold noise levels have been derived to reflect the season variation with reference to literature as set out in ES Chapter 9: Ornithology.

33. Table 12.2 summarises the relevant noise thresholds. Noise levels below this threshold are assessed as being of negligible or small magnitude, and levels above it are assessed as being of medium or large magnitude.

Table 12.2: Noise Thresholds for Ecological Receptors

Season	Receptor Location within the SPA	Active Piling Noise Threshold (dB L_{Amax})	Other Construction Noise Threshold (dB L_{Aeq})
Breeding (1 March to 31 August)	South Bank of the Swale LNR	65	65
Wintering (1 September to 28 February)	Seaward of Mean High Water Springs (MHWS)	70	70

12.2.3.3 Construction Vibration Magnitude Criteria

34. BS 5228 provides guidance on the effects of vibration, including vibration levels at which effects are be perceptible. Table 12.3 summarises this guidance.

Table 12.3: Construction Vibration Magnitude Criteria

Vibration Level (mms^{-1})	Effect
0.3	Vibration might just be perceptible in residential environments.
1.0	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.
10.0	Vibration at this level is not likely to be tolerable for any more than a very brief exposure.

35. It is considered that the above guidance translates into the following magnitude criteria for the purposes of this assessment;

- Large Magnitude – a vibration level above 10 mms^{-1};
- Medium Magnitude – a vibration level between 1 mms^{-1} and 10 mms^{-1};
- Small Magnitude – a vibration level between 0.3 mms^{-1} and 1 mms^{-1}; and
- Negligible Magnitude – a vibration level less than 0.3 mms^{-1}.

12.2.4 Construction Traffic Assessment Methodology

12.2.4.1 Noise – Human Receptors

36. Noise from construction traffic on public roads has been assessed on the basis of the change in traffic noise levels due to the addition of traffic associated with construction of the Development. Baseline traffic flows for each location have been sourced from Chapter 14: Access and Traffic. The percentage increases in all traffic and for HGVs have then been used together with the number of vehicles, proportion of HGVs and likely speed (based on the type of road) to calculate the likely change in traffic noise level due to construction traffic for the peak of the construction programme in terms of vehicle movements, using the method described in Calculation of Road Traffic Noise (CRTN)[1].

12.2.4.2 Noise – Ecological Receptors

37. Noise from construction traffic on ecological receptors is assessed based on the predicted L_{Amax} level from a 4-axel lorry. The L_{Amax} index is used to the short term, relatively intermittent, impact of haulage on receptors, especially those close to the haulage route. Typical L_{Amax} level has been sourced from BS 8233 (as a drive by maximum sound pressure level) to predict the distance at which the ecological thresholds in Table 12.2 is exceeded.

12.2.4.3 Vibration

38. Vibration from traffic can be transmitted through the ground by the interaction of the vehicle tyres and the road surface. The passage of vehicles over irregularities in the road can create locally increased levels of vibration. The Design Manual for Roads and Bridges (DMRB)[2] states that extensive research on a wide range of buildings has found no evidence of traffic induced ground borne vibration being a source of significant damage to buildings.

39. With regard to human perception, DMRB states that perceptible vibration only occurs in rare cases and notes that the normal use of a building, such as closing doors and operating domestic appliances, can produce levels of vibration similar to that of passing traffic.

40. In relation to ground-borne vibration Paragraph A5.26 of DMRB states: *"Such vibrations are unlikely to be important when considering disturbance from new roads and an assessment will only be necessary in exceptional circumstances".*

41. In order to ensure that vibration impacts are minimised, mitigation measures relating to vibration are set out in the Technical Appendix A14.1, Construction Traffic Management Plan (CTMP), sections 6.9 and 6.13. These mitigation measures include a pre-construction road survey to assess the existing condition of the road surface. Where required, repair and resurfacing will be undertaken to minimise road irregularities and therefore vibration.

42. On this basis, no effects from traffic-induced ground-borne vibration are anticipated and such effects have therefore not been considered further.

[1] Calculation of Road Traffic Noise, Department of the Environment, 1988

[2] Design Manual for Roads and Bridges, Highways Agency / Transport Scotland, Volume II Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 7 HD 213/11 , Noise and Vibration – Revision 1, November 2011.

12.2.5 Construction Traffic Noise Magnitude Criteria

12.2.5.1 Human Receptors

43. The magnitude of effects, in terms of the predicted change in traffic noise levels on public roads, expressed as $L_{A10,18hour}$ in accordance with CRTN, and based on criteria defined in DMRB[3] are defined as follows:

- Negligible: change of less than 1 dB;
- Small: change of 1 to 3 dB;
- Medium: change of 3 to 5 dB; and
- Large: change of 5 dB or more

12.2.5.2 Ecological Receptors

44. The predicted levels from construction traffic on ecological receptors are assessed against the thresholds in Table 12.2. Noise levels below this threshold are assessed as being of negligible or small magnitude, and levels above it are assessed as being of medium or large magnitude.

12.2.6 Operational Noise Guidance

45. The following planning policy, guidance and standards are of particular relevance to operational noise.

- Overarching National Policy Statement for Energy (EN-1);
- National Policy Statement on Renewable Energy Infrastructure (EN-3);
- National Planning Policy Statement for Electrical Networks (EN-5);
- The National Planning Policy Framework (NPPF);
- The Noise Policy Statement for England (NPSE);
- Planning Practice Guidance – Noise (PPGN); and
- BS4142:2014 Methods for rating and assessing industrial and commercial sound.

12.2.6.1 Overarching National Policy Statement for Energy (EN-1)

46. The overarching NPS for Energy (EN-1) was adopted in July 2011 and sets out the overall national energy policy for delivering major energy infrastructure.

47. Section 5.11.4 of EN-1 deals with effects from noise and vibration, and states;

"Where noise impacts are likely to arise from the proposed development, the applicant should include the following in the noise assessment:

- *a description of the noise generating aspects of the development proposal leading to noise impacts, including the identification of any distinctive, tonal, impulsive or low frequency characteristics of the noise;*
- *identification of noise sensitive premises and noise sensitive areas that may be affected;*
- *the characteristics of the existing noise environment;*
- *a prediction of how the noise environment will change with the proposed development;*
- *in the shorter term such as during the construction period;*
- *in the longer term during the operating life of the infrastructure;*
- *at particular times of the day, evening and night as appropriate;*

[3] Design Manual for Roads and Bridges, Highways Agency / Transport Scotland, Volume II Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 7 HD 213/11 , Noise and Vibration – Revision 1, November 2011, Table 3.1 – Classification of Magnitude of Noise Impacts in the Short Term

- *an assessment of the effect of predicted changes in the noise environment on any noise sensitive premises and noise sensitive areas; and*
- *measures to be employed in mitigating noise."*

48. The information required above is detailed within sections 12.3 (Baseline Conditions), 12.4 (Development Design Mitigation) and 12.5 (Assessment of Effects) of this chapter.

49. Paragraph 5.11.6 of EN-1 refers to the need to assess operational noise using the principles of the relevant British Standards, for example BS 4142 'Method for rating and assessing industrial and commercial sound'.

50. With regards to the decision making process, EN-1 states that the project should;

- Demonstrate good design through selection of the quietest cost-effective plant available;
- Containment of noise within buildings wherever possible;
- Optimisation of plant layout to minimise noise emissions; and
- Use landscaping, bunds or noise barriers to reduce noise transmission.

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

51. The overarching NPS for Energy (EN-3) was adopted in July 2011 and sets out the overall national energy policy for delivering renewable energy infrastructure.

52. Paragraph 2.4.2 of EN-3 refers to the need renewable energy infrastructure proposals to demonstrate noise mitigation in the design, and refers to EN-1 for guidance on the undertaking of the noise and vibration assessment.

12.2.6.3 National Planning Policy Statement for Electrical Networks (EN-5)

53. The National Policy Statement on Electricity Networks Infrastructure 5 (EN-5) was adopted in July 2011. Whilst EN-5 principally covers above-ground electricity lines of 132 kV and above, paragraph 1.8.2 confirms that EN-5 will also be relevant if the electricity network constitutes an associated development for which consent is sought, such as a generating station. EN-5 is therefore relevant to the Development, as a grid connection is proposed.

54. Noise and vibration is considered in Section 2.9 of EN-5, and refers to Section 5.11 of EN-1 with regard to generic noise considerations (reproduced in section 12.2.6.1 of this report).

55. The guidance states that audible noise effects can arise from substation equipment such as transformers, quadruple boosters and switched capacitors.

56. With regard to mitigation, the following measures are suggested:

- The positioning of lines;
- Ensuring that the appropriately sized conductor arrangement is used to minimise potential noise;
- Avoiding damage to overhead line conductors which can increase potential noise effects; and
- Ensuring conductors are kept clean and free of surface contaminants during stringing / installation.

12.2.6.4 The National Planning Policy Framework (NPPF)

57. The NPPF sets out the Government's planning policies for England, providing a framework within which local policies can be developed. The key principle of the NPPF is a presumption in favour of sustainable development. With regards to noise, the NPPF states that sustainable development can be achieved by:

- Avoiding noise giving rise to significant adverse effects on health and quality of life as a result of new development; and
- Identifying and protecting areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.

12.2.6.5 The Noise Policy Statement for England (NPSE)

58. The NPSE sets out the role and purpose of noise policy, together with the Government's Noise Policy Vision and Aims, consistent with the NPPF.

59. The aims of the NPSE require that:

- Significant adverse effects on health and quality of life are avoided, while taking into account the guiding principles of sustainable development;
- Adverse effects on health and quality of life are mitigated or minimised; and
- Where possible, noise management should seek to improve health and quality of life within the context of Government policy on sustainable development.

60. Paragraph 2.24 of the NPSE states that in relation to minimising and mitigating adverse effects:

> *"…all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development. This does not mean that such adverse effects cannot occur."*

61. The NPSE introduces the following concepts with regard to noise effects:

- No Observed Effect Level (NOEL) – 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;
- Lowest Observed Adverse Effect Level (LOAEL) – This is the level above which adverse effects on health and quality of life can be detected, but are not necessarily significant; and
- Significant Observed Adverse Effect Level (SOAEL) – This is the level above which significant adverse effects on health and quality of life occur.

62. The NPSE recognises that it is not possible to have a single set of noise levels relating to the above categories which are applicable to all sources of noise in all situations, and it is acknowledged that further research is required to increase the understanding of what may constitute a significant adverse effect on health and quality of life from noise.

12.2.6.6 Planning Practice Guidance – Noise

63. The Planning Practice Guidance – Noise (PPGN) provides advise on how planning can manage potential noise effects in a new development.

64. In terms of how to recognise when noise could be a concern, PPGN provides a table outlining perception, outcomes, effect level and action required. This table is reproduced in Table 12.4.

Table 12.4 Operational Noise Magnitude Criteria

	Perception	Examples of Outcomes	Increasing Effect Level	Action
Below the LOAEL	Not noticeable	No Effect	No Observed Effect	No specific measures required
	Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area by not such that there is a perceived change in the quality of life	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level (LOAEL)				
Between the LOAEL and SOAEL	Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude *e.g.*, turning up volume of television, speaking more loudly where these is no alternative ventilation, having to close windows for some of the time because of noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level (SOAEL)				
Above the SOAEL	Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, *e.g.*, avoiding certain activities during 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
	Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, *e.g.*, regular sleep deprivation/awakening, loss of appetite, significant medically definable harm, *e.g.*, auditory and non-auditory.	Unavoidable Adverse Effect	Prevent

12.2.6.7 BS 4142:2014 Methods for rating and assessing industrial and commercial sound

65. BS 4142:2014 (referred to as BS 4142) describes methods for rating and assessing sound in order to provide an indication its likely effect upon nearby premises (typically residential dwellings).

66. When considering the level of effect, BS 4142 emphasises the importance of the context in which a sound occurs. The standard therefore takes great care in the use of the words 'sound' and 'noise'. Sound can be measured by a sound level meter or other measuring system, whereas noise is related to a human response and is routinely described as unwanted sound, or sound that is considered undesirable or disruptive.

67. The specific sound emitted from the Development (dB, L_{Aeq}) is rated by taking into account both the level and character (i.e., tonal elements, impulsivity, intermittency and distinctiveness) of the sound. This is achieved by applying appropriate corrections to the specific sound level externally at the receptor location, which gives the rating level of the sound in question. This is then assessed against the existing prevailing background sound level (dB, L_{A90}) at that location in order to determine a likely level of effect.

68. The level by which the rating level exceeds the prevailing background sound level indicates the following potential effects:

- A difference of 10 dB or more is likely to be an indication of a significant adverse effect, depending on the context;
- A difference of around 5 dB is likely to be an indication of an adverse effect, depending on the context; and
- Where the rating level does not exceed the background level, this is an indication of the specific sound source having a low effect, depending on the context.

12.2.7 Operational Noise Assessment Methodology

69. In summary, the assessment process follows the methodology set out in BS 4142, in accordance with paragraph 5.11.6 of EN-1, which comprises:

- Identification of potential receptors;
- Measurement of existing (baseline) background noise levels at a representative selection of potential receptors;
- Prediction of specific sound from the Development at each receptor;
- Application of appropriate corrections to the specific sound to account for the level and character of the sound (i.e., the rating level); and
- Assessment of the rating level against the prevailing background sound level, taking context into account.

70. The assessment of the potential effects of noise during operation of the Development has been carried out for the closest, and therefore most noise sensitive properties.

12.2.8 Operational Noise Magnitude Criteria

12.2.8.1 Operational Noise Magnitude Criteria – Human Receptors

71. Operational noise effects at the nearest noise sensitive receptors will be assessed according to BS 4142 and the guidance from the NPSE and PPGN.

Based upon this guidance, the following BS 4142 rating differences are considered to apply:

- Below the LOAEL – a rating level below the representative background level;
- Between LOAEL and SOAEL - a rating level greater than background but less than 5 dB above background level; and
- Above the SOAEL – a rating level of more than 5 dB above the background level.

72. Operational noise limits, based on the background levels around the site are discussed in section 12.3.4. These have been set 5 dB above background level, on the assumption that anything below this level is of small magnitude. The above methodology therefore translates into the following magnitude criteria for the purposes of this assessment:

- Large Magnitude – a rating level greater than 5 dB above rating level noise limit;
- Medium Magnitude – a rating level greater than the rating level noise limit;
- Small Magnitude – a rating level between 0 and 5 dB less than the rating level noise limit; and
- Negligible Magnitude – a rating level 5 dB below the rating level noise limit.

12.2.8.2 Operational Noise Magnitude Criteria – Ecological Receptors

73. A threshold of 50 dB(A) has been set for operational noise based on analysis carried out in ES Chapter 9: Ornithology.

74. Noise levels below this threshold are assessed as being of negligible or small magnitude, and levels above it are assessed as being of medium or large magnitude.

12.2.9 Assessment of Significance

75. Significance of effects is determined by combining the sensitivity of the receptor and the magnitude of the effect. Table 12.5 shows the criteria for assessing significance of noise effects; this is relevant to both construction and operational noise. As a precautionary measure, all receptors have been assumed to be of high sensitivity. As such, only the significance criteria for high sensitivity are provided in Table 12.5.

76. For the purposes of this assessment, moderate or major effects are considered to be significant in terms of the EIA Regulations.

Table 12.5 Criteria for Assessing the Significance of Noise Effects

Sensitivity of Receptor	**Magnitude of Effect**			
	Negligible	**Small**	**Medium**	**Large**
High	Negligible	Minor	Moderate	Major

77. The inclusion of a category of noise effects which are of low magnitude and minor significance but which are not considered significant in terms of the EIA Regulations acknowledges that noise at levels lower than the criteria for the onset of significant effects may still be audible. However, such noise is unlikely to cause unacceptable level of disturbance.

12.3 Baseline Conditions

78. This section discusses the baseline information relevant to this chapter.

12.3.1 Background Sound Survey

79. In order to quantify the baseline noise conditions at the nearest sensitive human receptors, a background sound survey in line with the recommendations in BS 4142 was undertaken.

80. The nearest sensitive human receptors to the Development are:

- Nagden, a group of properties to the southwest corner of the Development site;
- Warm House, a single property to the south of the Development site; and
- Crown Cottages, a group of semi-detached houses to the east of the Development site, c. 200 m south of the electrical compound.

81. Following consultation with Swale Borough Council, it was agreed that monitoring would be undertaken at receptors at all three locations. Monitoring was therefore undertaken at the following locations, which are shown on Figure 12.1: Noise Monitoring and Assessment Locations:

- 3 Nagden Cottages;
- Warm House; and
- 1 Crown Cottages.

82. Monitoring was undertaken over 7 days (20th - 27th of February 2018) to ensure that a sufficiently representative period of background sound was measured, and included a weekend period where typically lower levels of noise are experienced. The survey was

timed to minimise the influence from higher levels of farming activity that would be undertaken later in the year.

83. Monitoring equipment considered of Class / Type 1 sound level meters housed in environmental enclosures with enhanced windshields, calibrated to traceable standards. The meters were field calibrated at the start and end of the survey period; no significant calibration drift was found (<0.2 dB). The sound level meters were set to log a range of parameters, including $L_{Aeq,1hour}$ and $L_{A90,1hour}$.

84. A weather station was installed at Warm House to measure wind speed and rainfall during the survey. Upon collection, it was found that the weather monitoring equipment had failed due to a battery issue, and as such weather data was collected from an online source[4].

85. Table 12.6 provides a summary of the baseline survey. Survey record sheets for the monitoring equipment are included in Technical Appendix A12.1.

Table 12.6 Baseline Survey

Location	Grid Reference	Description of Monitoring Location	Sound Sources Noted During Survey Visits
Nagden Cottages	604892,163835	Front amenity area of 3 Nagden Cottage – close to garage.	Some quiet flue noise from neighbouring property. Birdsong. River not audible, and no noise from road observed at time of survey.
Warm House	603827,163218	Amenity area to the front of Warm House.	Very few noise sources at this location. Some birdsong and wind in trees audible.
1 Crown Cottages	603170,163140	Amenity area to the side of 1 Crown Cottages	Some wind in trees. Noise from car repair garage audible at this location – sounds like angle grinding. Siren from adjacent substation was audible during survey, however it was advised by the resident that this is not common.

12.3.2 Contextual and Subjective Impressions

86. A subjective assessment of the sound environment around each monitoring location was undertaken during the monitoring equipment installation on the 20th February 2018. At Nagden Cottages and Warm House, the sound environment was noted to be typical of a rural environment, with main sound sources being from birds and wind in trees. No specific sound sources were audible at either location.

87. At Crown Cottages, birdsong and wind in trees was noted, however there was also some sound emitted from a car repair yard, located approximately 65 m to the northwest. At the time of the survey, sound from an angle grinder was audible within the amenity area of 1 Crown Cottages. In addition, a siren was audible from the adjacent Cleve Hill substation during the installation of the monitoring equipment.

88. While installing equipment at Nagden Cottages, a loud, explosive sound was observed. Subjectively, the noise sounded as if it had originated at some distance from Nagden, but was clearly audible. During a discussion with the resident at Nagden, it was explained

[4] https://www.wunderground.com/personal-weather-station/dashboard?ID=IKENTFAV3#history/s20180220/e20180220/mdaily

that testing at MOD Shoeburyness occasionally resulted in explosive sounds being audible. This was the only such noise observed during the site visit.

12.3.3 Data Analysis

89. BS 4142 states that caution should be exercised when making measurements in poor weather conditions such as wind speeds greater than 5 m/s^{-1} or periods of rainfall. During the survey period, no periods of heavy rainfall or high wind were recorded, so no data has been excluded due to the influence of weather. When the equipment was collected on 27 February 2018, the area had received significant snowfall. This is likely to have resulted in the low sound levels at the end of the survey period due to likely less traffic on the roads, and snow covering the windshield (26 to 27 February). As a conservative measure, these periods of low noise as a result of an unusual weather event have not been excluded.

90. Charts 12.1 to 12.3 below provide a summary of the background sound levels measured during the survey period, detailing $L_{A90,1hour}$ sound levels.

Chart 12.1 Background Sound Survey – Time History: Nagden

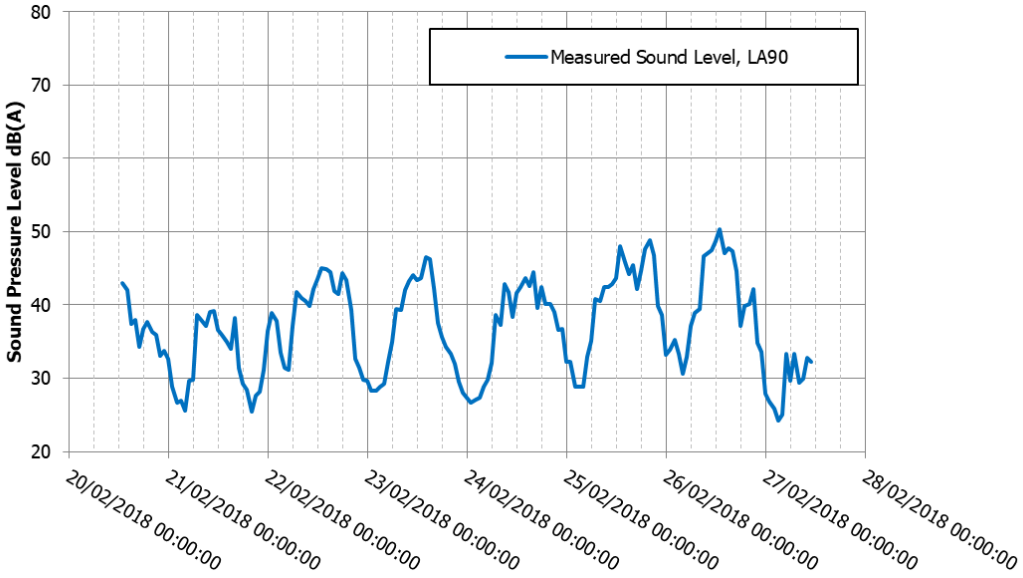


Chart 12.2 Background Sound Survey – Time History: Warm House

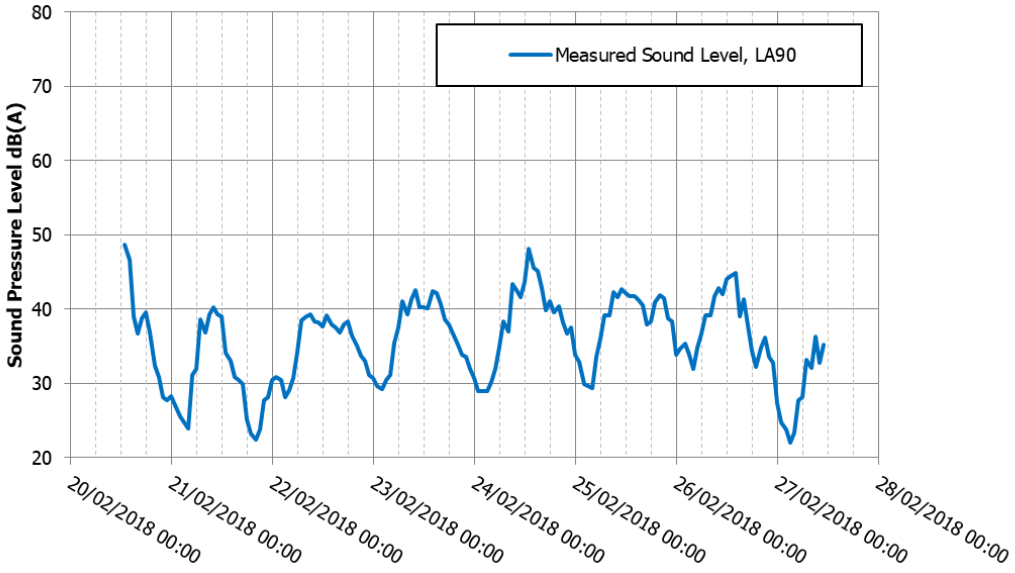
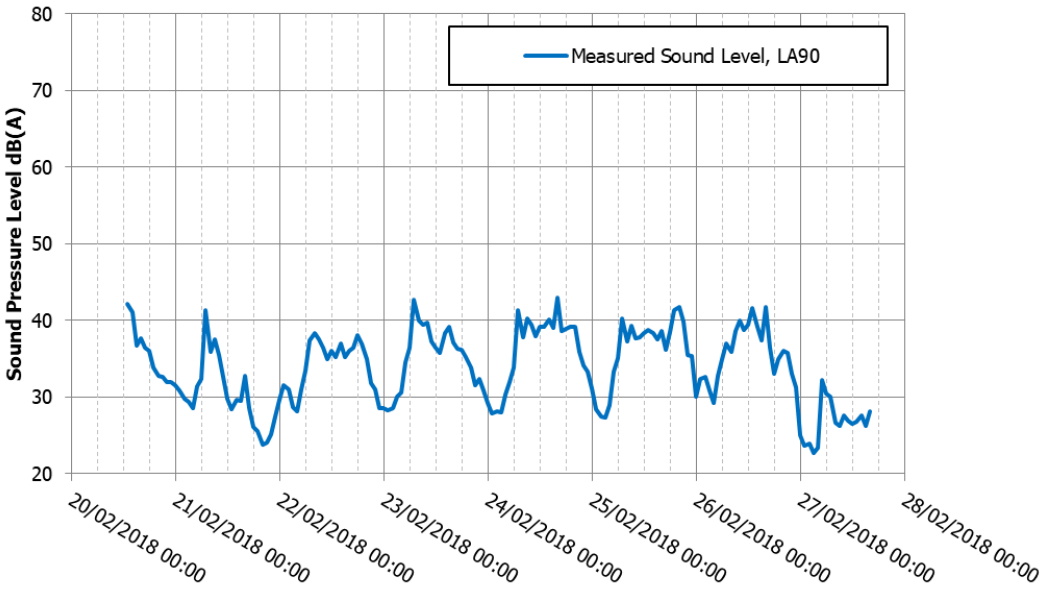


Chart 12.3 Background Sound Survey – Time History: Crown Cottages



91. Charts 12.4 to 12.9 present the range of $L_{A90,1hour}$ sound levels recorded at each monitoring location, along with the percentage of the total number of 1-hour periods for which they occurred, for daytime (0700 – 2300) and night-time (2300 – 0700) periods.

Chart 12.4 Daytime Background Sound Survey Statistical Analysis – Nagden

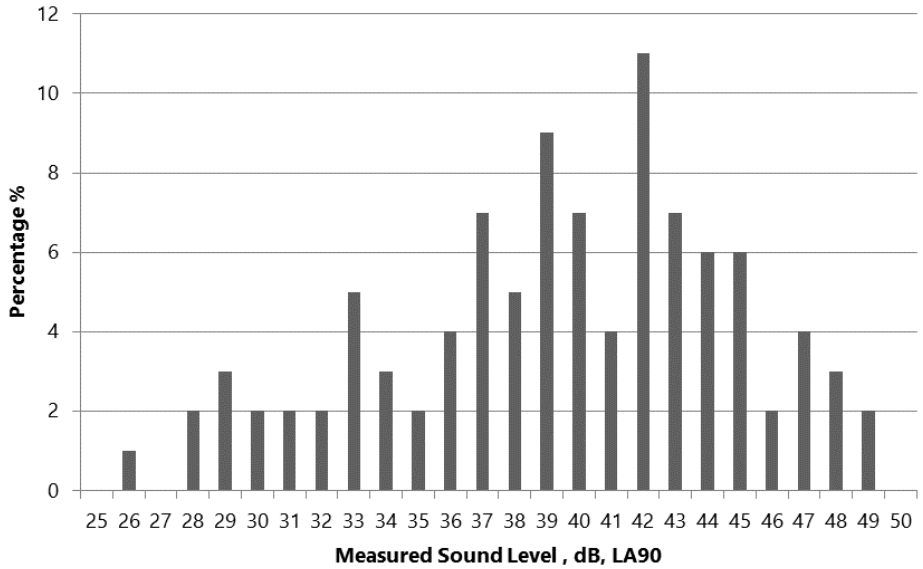


Chart 12.5 Night-time Background Sound Survey Statistical Analysis – Nagden

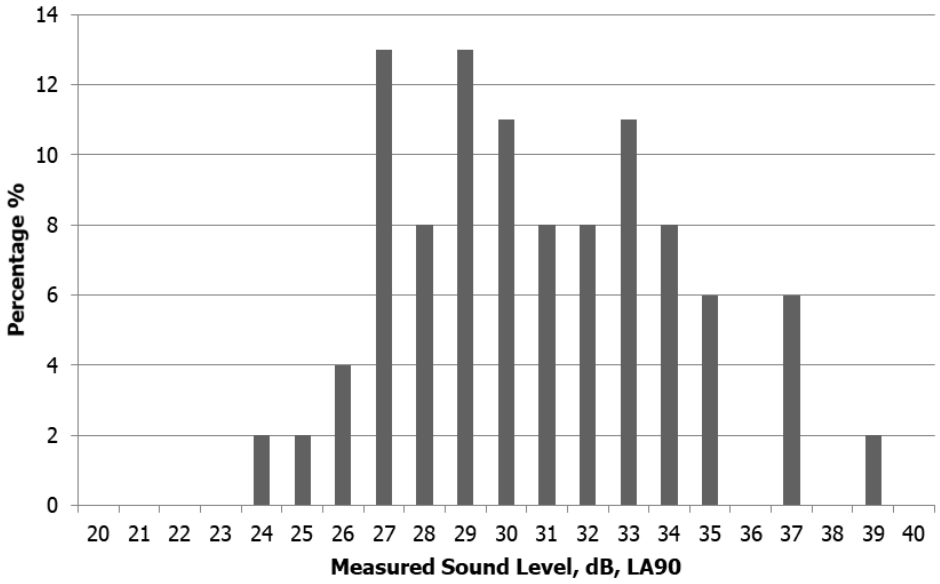


Chart 12.6 Daytime Background Sound Survey Statistical Analysis – Warm House

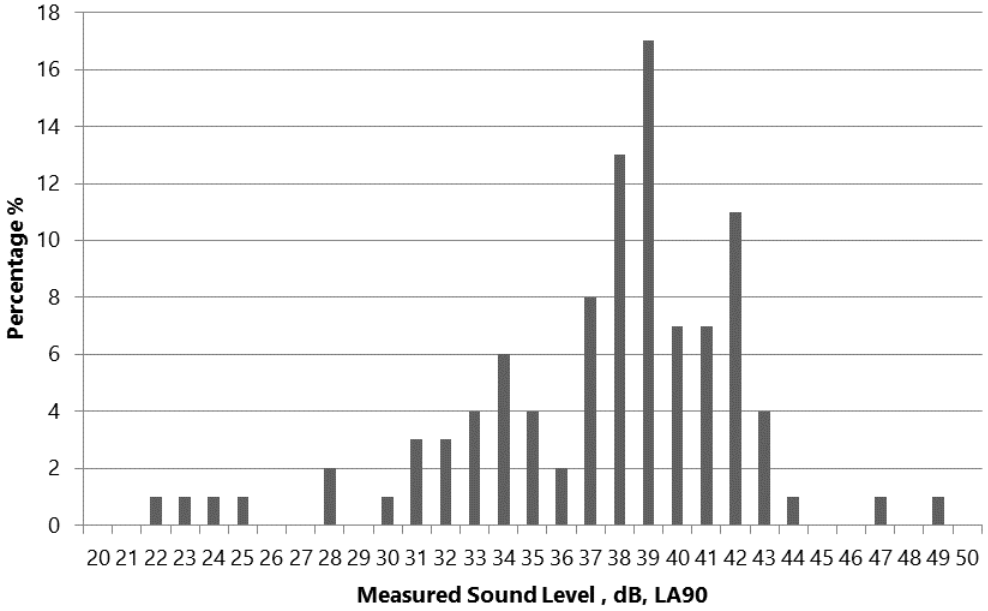


Chart 12.7 Night-time Background Sound Survey Statistical Analysis – Warm House

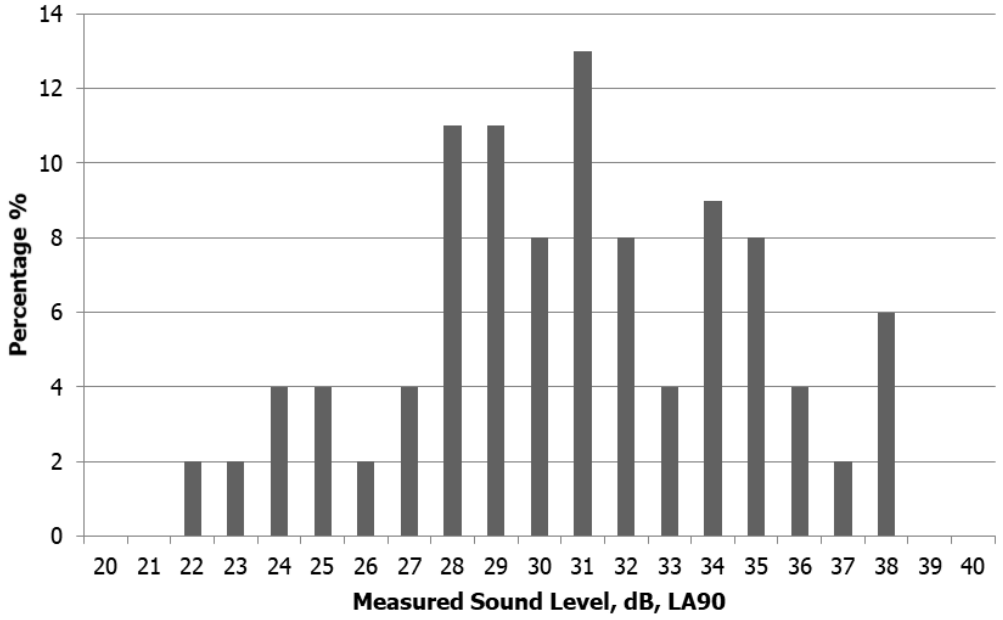


Chart 12.8 Daytime Background Sound Survey Statistical Analysis – 1 Crown Cottage

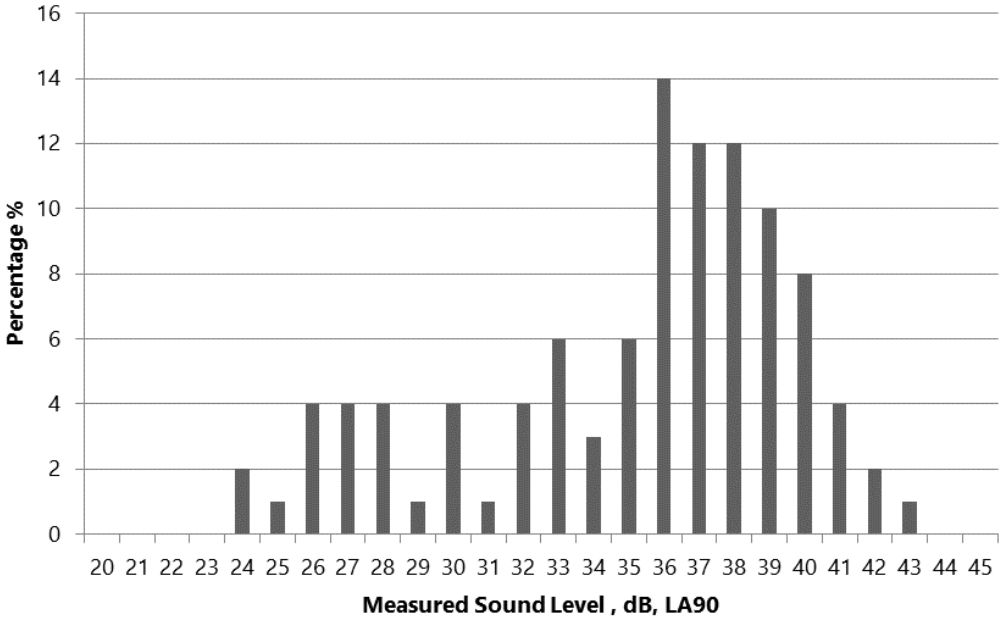
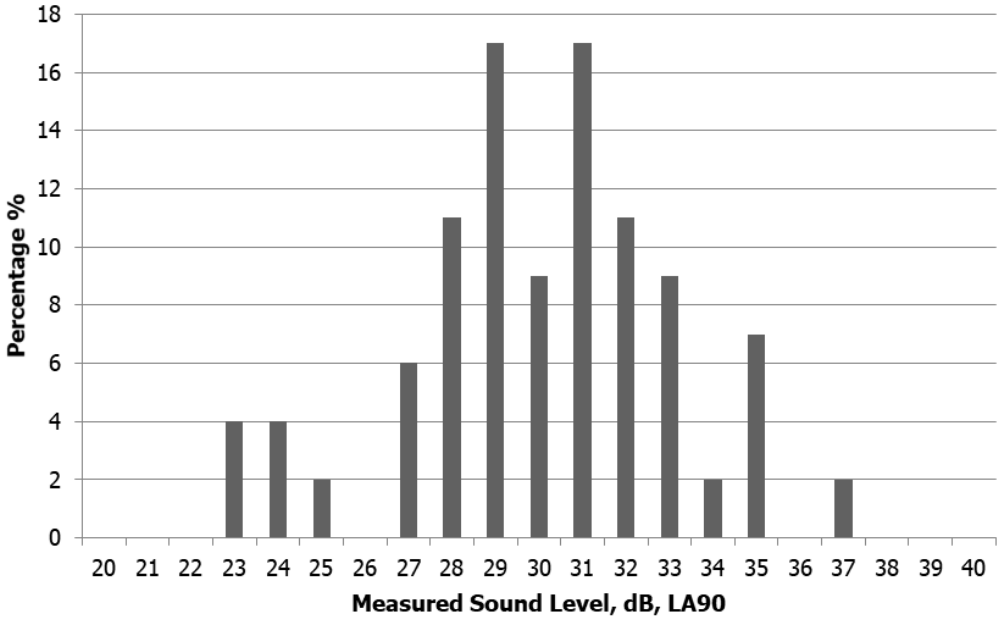


Chart 12.9 Night-time Background Sound Survey Statistical Analysis – 1 Crown Cottage



92. Table 12.7 details the mode (most common), median and mean averages for each location and time period. Based upon these results, and the spread of data presented in Charts 12.4 - 12.9, a representative background sound level has been determined for daytime and night-time periods at each receptor.

Table 12.7 Average and Representative Background Noise Levels, dB, $L_{A90,1hr}$

Location	Period	Mode	Median	Mean	Representative
Nagden	Daytime	42	40	39	39
	Night-time	27/29	31	31	29
Warm House	Daytime	39	39	38	39
	Night-time	31	31	31	31
1 Crown Cottages	Daytime	33	37	36	36
	Night-time	29/31	31	30	30

12.3.4 Operational Noise Limits

93. Based on the operational noise assessment magnitude criteria, a rating level i.e., specific sound level plus any adjustment for the characteristic features, greater than 5 dB above background will result in a moderate effect.

94. As such, operational noise limits have been set as the rating level 5 dB above the measured background level, as detailed in Table 12.8.

Table 12.8 Operational Noise Limit

Location	Period	Rating Level Noise Limit, dB L_{Aeq}
Nagden	Daytime	44
	Night-time	34
Warm House	Daytime	44
	Night-time	36
1 Crown Cottages	Daytime	41
	Night-time	35

95. Based on Table 12.8 above, where the operational rating level is above the rating level noise limit, this is considered medium / large magnitude.

12.3.5 Vibration Baseline

96. The most common sources of vibration at residential receptors (other than construction activities) are from major road and rail links, and even in these cases vibration is only experienced at a close distance. There are no such existing sources of vibration around the Development, either at the nearby residential receptors or the ecological designations, and as such levels existing vibration across the site is considered to be negligible.

12.3.6 Assessment Locations

97. This section sets out locations at which noise and vibration assessments are made.

12.3.6.1 Human Receptors

Construction Noise and Vibration

98. The properties identified in Table 12.9 are those closest to the Development, and as such should the predicted construction noise levels comply with construction noise levels at these receptors, receptors located further from the Development will also comply. The receptors identified in Table 12.9 have therefore been used for the assessment of construction noise and vibration on human receptors.

Construction Traffic Noise Receptors

99. As set out in Chapter 14: Access and Traffic, the route to be used by construction traffic to access the site is along the Strategic Road Network, where the effects of the additional traffic associated with construction of the Development will have a negligible effect on nearby receptors, and along Head Hill Road and Seasalter Road, the principal roads involved of the Local Road Network. For the purposes of assessment, Chapter 14: Access and Traffic splits Head Hill Road into two sections (north and south). These road sections are used to represent residential and other receptors of road traffic noise effects. The receptors assessed are therefore:

- Seasalter Road;
- Head Hill Road (north); and
- Head Hill Road (south).

Operational Noise

100. Residential properties located closest to the Development infrastructure were identified using address layer data and the site layout, as shown in Figure 12.1. These closest sensitive receptors are considered to be the most noise sensitive, as effects from the Development will be higher at these locations than at sensitive receptors located further from the Development.

101. In terms of noise, background sound levels measured at the three properties detailed in Table 12.7 are considered to be representative of the background noise environments at other properties in similar nearby locations. Should the predicted noise levels from the Development comply with the operational noise limits at the assessed receptors, predicted noise levels at receptors further from the Development will also comply.

102. Assessment locations are identified in Figure 12.1.

103. Table 12.9 details the locations assessed, and the operational noise limits applied.

Table 12.9 Noise Assessment Locations - Residential

Location	Easting	Northing	Operational Noise Limit Applied
Nagden Barn	603102	163224	Nagden Cottages
Nagden House	603147	163128	Nagden Cottages
Nagden Cottages	603173	163128	Nagden Cottages
Warm House	603807	163221	Warm House
Coneybank	604415	162956	Warm House
1 Crown Cottages	604873	163836	1 Crown Cottages
4 Crown Cottages	604853	163847	1 Crown Cottages
Cleve Farm	604991	163793	1 Crown Cottages

12.3.6.2 Ecological Receptors

104. As shown in Figure 8.3 (Designated Sites)(DCO Document Reference 6.2.8), the area proposed for solar panels, tracks and other new infrastructure is bounded to the north by a Site of Special Scientific Interest (SSSI), a Local Nature Reserve (LNR), Ramsar site and Special Protection Area (SPA).

105. To the north and west of the proposed solar PV module fields is the sea defence, a large earthen embankment topped with a concrete retaining wall (to the north). This embankment will reduce noise effects upon the parts of the ecological designations to the north of the embankment during all phases of the Development.

Construction Noise and Vibration

106. In order to assess the effect of construction noise and vibration on the ecological receptors, predictions have been made based on the closest point at which construction activities are proposed. These distances are detailed in Table 12.15 for two locations, just inside and just outside the sea defence, representing sensitive locations at different times of the year, as follows:

- SPA Boundary (Breeding Season 1 March to 31 August); and
- MHWS (Wintering Season 1 September to 28 February).

107. These receptors are shown in Figure 12.1.

Operational Noise

108. In order to assess the effect of operational noise on the ecological receptors, representative assessment locations have been selected on the boundary of ecological designations adjacent the Development.

109. Due to the relatively uniform layout and distribution of transformers and string inverters across the solar PV array, noise levels across the northern boundary during the operational phase will not vary substantially, so a receptor has been selected at the closest point to the nearest transformer and electrical compound (Ecological Receptor 1 identified in Table 12.9).

110. The second ecological receptor (Ecological Receptor 2) has been selected to assess the impact of operational noise on the SPA, SSSI and Ramsar site to the east of the Development.

111. A third ecological receptor point (Ecological Receptor 3) has been selected to assess the impact of operational noise on the arable reversion habitat management area (AR HMA), adjacent to the electrical compound. As discussed in Chapter 9, a 50 m buffer from the top of the bund and PV panels has been applied as it is considered unlikely that birds will use this area due to disturbance from infrastructure. Ecological Receptor 3 is used therefore to assess noise at the boundary of the 50 m buffer closest to the electrical compound and panels.

112. The three ecological receptors are detailed in Table 12.10, and can be seen in Figure 12.1.

Table 12.10 Operational Noise Assessment Locations - Ecological

Name	Easting	Northing	Ecological Designations
Ecological Receptor 1	604428	164821	SSSI, SPA, Ramsar, LNR
Ecological Receptor 2	605343	164236	SSSI, SPA, Ramsar
Ecological Receptor 3	604665	164392	AR HMA

12.4 Development Design Mitigation

113. The Development design mitigation for construction and operational noise and vibration effects are outlined below. Many of the mitigation measures comply with the specific mitigation set out in EN-1 and EN-5, and demonstrate that the aims of the NPPF and NPSE are met by ensuring that steps have been taken to mitigate and minimise adverse effects.

12.4.1 Construction Noise and Vibration

114. The measures set out below will be implemented as part of the Development and as such constitute mitigation 'embedded' in the design of the Development:

- Core working hours are proposed to be between 07.00 until 19.00, Monday to Friday and 07.00 until 13.00 on a Saturday (unless in exceptional circumstances where need arises to protect plant, personnel or the environment). In addition to this, a start-up and close down period for up to an hour before and after the core working hours is proposed. This does not include the operation of plant or machinery likely to cause a disturbance. Deliveries of plant and materials by HGV to site shall only take place by designated routes and within times agreed with the Council as agreed in the Construction Traffic Management Plan (CTMP), an outline of which is provided as Technical Appendix A14.1; and
- Where practicable, the work programme will be phased, which would help to reduce the combined effects arising from several noisy operations.

115. Application of the above measures to manage construction noise and vibration will ensure that effects are minimised as far as reasonably practicable.

12.4.2 Operational Noise

116. The measures set out below were implemented as part of the design, and as such constitute mitigation 'embedded' in the design of the Development.

- A large bund, will be built around the electrical compound, which will significantly reduce noise from the electrical compound at surrounding residential properties and ecological designations;

- Where possible, the distance from the nearest residential receptors to the substation and energy storage facility and onsite transformers and string inverters was maximised;
- Noise emissions from equipment will be a consideration in the selection of equipment, and where possible the quietest available equipment will be installed;
- Where required, manufacturer-supplied noise mitigation will be installed;
- Where possible, noise generating equipment will be enclosed / containerised;
- An appropriately-sized conductor arrangement will be selected to minimise noise;
- Damage to overhead lines will be avoided; and
- Conductors will be kept clean and free of surface contaminants during stringing / installation.

117. Application of the above embedded mitigation measures will ensure that operational effects are minimised as far as reasonable practicable.

12.4.3 Decommissioning Noise

118. The embedded mitigation measures discussed in section 12.4 will be implemented during decommissioning, and will ensure decommissioning effects are minimised as much as reasonably practicable, in compliance with the relevant legislation in force at the time.

12.5 Assessment of Likely Effects

12.5.1 Construction Noise

119. An assessment has been undertaken to provide an indication of the likely noise levels based on typical construction activities and equipment that will be used on site.

12.5.1.1 Predicted Construction Noise Levels – Human Receptors

120. Table 12.11 presents the closest distance to each construction activity of the locations for human receptors detailed in Table 12.9.

121. The distance to hardstanding and track construction has been assumed to the nearest section of spine road. Small areas of hardstanding will be constructed for the transformers, which are generally located closer to receptors (around 200 m). In this instance however, the time taken to construct these areas is likely to be less than 1 day, and is therefore negligible.

Table 12.11 Distances between Receptors and Construction Activities

Receptor	Construction Activity, Closest Distance to Receptor, m			
	Site Prep - Hardstanding and Track Construction	PV Panels (Piling and Installation of Panels)	Installation of Electrical Compound	Spine Road Usage
Nagden Barn	620	120	1635	620
Nagden House	735	160	1675	735
Nagden Cottages	800	145	1610	800
Warm House	700	80	1070	700
Coneybank	950	175	1065	950
1 Crown Cottages	85	150	280	85
4 Crown Cottages	80	170	245	80
Cleve Farm	95	175	320	95

122. The distances in Table 12.11 above assume that the potential access road located to the south of Cleve Hill Substation will be used, as a worst case assumption.

123. Details of the number and types of plant and their noise emission levels assumed for each phase of construction are provided in Technical Appendix A12.2, together with full details of the calculations carried out to predict construction noise levels. Noise modelling has been undertaken based on plant sound power levels sourced from BS 5228, except for piling rigs, where specific plant details have been used (Pauselli 500); this information is provided in Appendix A12.3. Noise data at the position of the operator is provided for two scenarios, as follows:

- Plant is operating but not piling: 88.2 dB, L_{Aeq}; and
- Plant actively piling: 110 dB, L_{Aeq}.

124. Study of the Pauselli data indicates that the operator position is approximately 1 m from the plants primary noise source (the hammer), and as such the noise levels provided are assumed to be at this distance from the equipment.

125. Predicted noise levels are based on the following assumptions:

- All plant and machinery located at the closest point to the respective receptor where a given activity would take place;
- Refuelling will take place in temporary compounds, located adjacent the spine road. Temporary compounds are assumed to be located at least 500 m from residential and ecological receptors;
- Soft ground between source and receiver;
- A total of 37[5] vehicle movements per hour along the spine road. In practice, these are the off-site movements to the construction compound, movements within the site will be lower than those assessed;
- As a worst case all vehicle movements have been assessed as HGVs. In practice, most of these movements are from LGVs;
- Typical on-time percentages for each plant item have been assumed;
- No reduction in noise due to barrier effects created by the progressive installation of the PV panels; and
- No reduction from noise as a result of topographical screening.

126. Overall, the assessment presented is considered conservative, and noise levels in practice are likely to be appreciably lower than the levels predicted.

127. The results of these calculations are summarised in Table 12.12 below. The noise level from the worst case number of two way vehicle movements has been calculated along the spine road and added to each construction activity, to determine a predicted noise level at each assessment receptor that includes both construction and haulage.

128. Only one of the assessed construction activities is anticipated to take place close to, and therefore contribute substantial noise to, each receptor at any one time.

[5] This has been calculated by taking the worst case total number of two-way vehicle movements per day (224) and dividing by the number of working hours per day (12).

Table 12.12 Predicted Construction Noise Levels Human Receptors

Receptor	Construction Activity				
	Site Prep - Hardstanding & Track Construction	**Manoeuvring Piling Plant**	**Active Piling**	**Installation of PV Panels**	**Installation of Electrical Compound**
	Predicted Noise Level, dB, $L_{Aeq(day)}$				
Nagden Barn	52.2	56.7	69.0	56.3	52.0
Nagden House	51.4	54.6	66.0	54.2	51.3
Nagden Cottages	51.0	55.0	67.0	54.6	50.9
Warm House	51.6	59.9	72.8	59.4	51.5
Coneybank	50.2	53.5	65.1	53.2	50.2
1 Crown Cottage	62.3	61.3	67.5	61.2	60.8
4 Crown Cottage	62.7	61.3	66.6	61.3	61.1
Cleve Farm	61.6	60.6	66.2	60.6	60.3

12.5.1.2 Assessment of Construction Noise on Human Receptors

129. As detailed in Table 12.12, the predicted noise levels are above the BS 5228 daytime construction noise criteria of 65 dB L_{Aeq} (see section 12.2.3.1) at all human receptors when piling activities are ongoing.

130. The predictions of noise have been based on the closest distance to each construction activity. In practice, construction will only occur at the closest point to each receiver for a short period of time before moving further away, with an associated reduction in noise levels. Based on the construction schedule, most blocks will be entirely constructed within 4 weeks.

131. Noise levels from active piling operations will fall below the 65 dB L_{Aeq} criteria at a distance of approximately 160 m from receptors. The nearest human receptor (Warm House) is located 80 m from the PV array, which means that piling operations would have to progress an additional 80 m before effects are below the 65 dB L_{Aeq} criteria. Given that most fields will be entirely constructed within 4 weeks, construction activities will not exceed the 65 dB L_{Aeq} threshold at the closest point to each receptor for more than one month, and as such the effect of construction noise upon nearby human receptors is less than medium or large magnitude (in accordance with section 12.2.3.1), and therefore of less than moderate significance and **not significant** in terms of the EIA Regulations.

12.5.1.3 Predicted Construction Noise Levels – Ecological Receptors

132. The assessment of active piling operations has been undertaken based on predicted L_{Amax} levels, while all other construction activities are based on predicted L_{Aeq} levels.

- Active piling has been assessed based on a L_{Amax} as this activity will result in high levels of impulsive noise. In addition, due to the potentially intermittent nature of active piling, it is considered appropriate to use L_{Amax} as a worst case; and
- Other construction activities (*e.g.*, engine noise, manoeuvring plant) will not emit high levels of impulsive, intermittent noise, and as such have been assessed as L_{Aeq} levels.

Active Piling Operations

133. Specific manufacturer's data on L_{Amax} levels from active piling are generally not available[6], however, L_{max} levels have been sourced from two reports where L_{max} levels from piling rigs were measured at various distances from the piling rig.

134. A report assessing the noise impact of the Yorkshire and Humber CCS Cross Country Pipeline[7] states on page 51 that:

> *"Measurements taken by AECOM of starting sheet piling operations (when typically the greatest effect occurs) at 50 m the L_{max} level is 88 dB."*

135. An investigation on the characteristics of noise generated by piling activities[8] measured the noise levels from a both hammer piling and bored piling. This report provides an L_{max} level of 97.97 dB at 15 m (Table 2 of the report).

136. Both of these measured L_{max} levels (88 dB at 50 m and 98 dB at 15 m) result in an L_{max} level of 122 dB at 1 m.

137. The thresholds for ecological receptors provided in section 12.2.3.2 use the L_{Amax} index, rather than L_{max}. The A-weighted correction factor corresponds to the human ears response to sound across the range of audible frequencies. As stated in Jackson (2010)[9], research shows that the shape of birds' audibility curves are similar to those of humans. Therefore, whilst the A-weighted frequency curve correction was not specifically designed with avian receptors in mind, it is considered appropriate for the purposes of this assessment. As such, the 122 dB L_{max} level calculated above require converting to an A-weighted level. In order to do this, an un-weighted octave-band frequency spectrum for piling was taken from the BS 5228 noise emission data[10], and scaled to 122 dB $L_{max,}$ as shown in Table 12.13.

Table 12.13: Scaled Octave-band Spectra, Piling Noise (L_{max})

Octave-band Sound Pressure Level at 10 m, Hz								Overall dB, L_{max}
63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	
115	114	111	114	116	114	109	99	122

138. The octave band data presented above was then A-weighted in Table 12.14 below to provide an overall dB, L_{Amax} level which can be used to predict the likely L_{Amax} levels at the ecological receptors.

[6] The Pauselli data provides a C-weighted peak, however this is not applicable to this assessment, and are provided for the protection of workers under the Control of Noise at Work Regulations.
[7] National Grid. Noise and Vibration, The Yorkshire and Humber (CCS Cross Country Pipeline) Development Consent Order https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN070001/EN070001-000448-6.13%20Noise%20and%20Vibration.pdf.
[8] K.M. Lisan, Investigation on Characteristics of Noise Generated by Piling Activities, Department of Civil and Environmental Engineering, Faculty of Engineering, University of Ruhuna, Galle, Sri Lanka
[9] Jackson, P. Noise Impact Assessment on Wintering Birds Anna's Road Exploration Well Site, Westby Blackpool. Spectrum Acoustics 2012.
[10] BS 5228 Emission spectra, Table C3, item 8.

Table 12.14: A-Weighted Octave-band Spectra, Piling Noise (L_{Amax})

Octave-band Sound Pressure Level at 10 m, Hz								Overall dB, L_{Amax}
63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	
89	98	102	111	116	115	110	98	120

139. The distance from the closest positions at which active piling could take place (solar PV module installation) to each ecological receptor is as follows:

- SPA boundary, most sensitive during the breeding season – 20 m; and
- MHWS, most sensitive during the wintering season – 80 m.

140. Appendix A12.4 presents full details of the calculations carried out to predict the dB, L_{Amax} level at the SPA boundary and MHWS. Table 12.15 presents a summary of these predictions.

Table 12.15: Predicted Active Piling Noise Level, dB L_{Amax}, at Ecological Receptors

Receptor	Predicted Noise Level, dB, L_{Amax}
SPA Boundary (Breeding Season 1 March to 31 August)	100.0
MHWS (Wintering Season 1 September to 28 February)	83.0

141. The above predictions are based on the following assumptions:

- Four piling rigs actively piling at the same time;
- As the L_{Amax} index has been used to assess active piling noise, it is not necessary to account for the addition of other construction noise to the piling noise levels identified;
- Maximum active piling noise source height of 6 m; and
- For calculation of noise at MHWS, an additional 5 dB reduction has been applied for the sea wall acting as a noise barrier.

Other Construction Operations

142. The distance to the closest position at which construction takes place to each ecological receptor is presented in Table 12.16.

143. For each activity, the distance to each activity is presented, as well as the closest distance to the spine road, so that the assessment takes into account both the nearest activity and on-going haulage noise.

Table 12.16: Distance Between Ecological Receptor and Construction Activity

Receptor	Construction Activity							
	Site Prep - Hardstanding & Track Construction		Manoeuvring Piling Plant		Installation of PV Panels		Installation of Electrical Compound	
	Activity	Spine Rd	Activity	Spine Rd	Activity	Spine Rd	Activity	Spine Rd
	Closest Distance to Receptor, m							
SPA Boundary (Breeding Season 1 March to 31 August)	500	500	20	500	20	500	475	180
MHWS (Wintering Season 1 September to 28 February)	560	560	80	560	80	560	535	560

144. The distances in Table 12.16 are not affected by the choice of either the northern or southern access option.

145. Appendix A12.5 presents full details of the calculations carried out to predict the dB, L_{Aeq} level at the SPA boundary and MHWS. Table 12.17 presents noise emission levels due to other construction activities at the construction-phase ecological receptors.

146. In each case the noise from each construction activity has been combined with the noise from the spine road to calculate an overall dB, L_{Aeq} at each receptor.

Table 12.17: Predicted Other Construction Noise Level, dB L_{Aeq}

Receptor	Construction Activity			
	Site Prep - Hardstanding & Track Construction	Manoeuvring Piling Plant	Installation of PV Panels	Installation of Electrical Compound
	Predicted Noise Level, dB, L_{Aeq}			
SPA Boundary (Breeding Season 1 March to 31 August)	54.5	76.7	76.0	58.0
MHWS (Wintering Season 1 September to 28 February)	50.7	60.1	59.5	51.1

147. The above predictions are based on the following assumptions:

- All plant and machinery located at the closest point to the respective receptor where a given activity will take place;
- Refuelling will take place at least 500 m from the SPA;
- 5 dB reduction has been applied to the predicted levels at MHWS to account for the sea wall;
- Soft ground between source and receiver;
- On-time for each activity is assumed to be 100%, as the threshold levels for ecological receptors do not account for the time over which activities take place; and

- No reduction in noise due to barrier effects created by the progressive installation of the solar PV modules.

12.5.1.4 Assessment of Construction Noise on Ecological Receptors

Active Piling Noise

148. The assessment of active piling noise on ecological receptors is summarised in Table 12.18 below.

Table 12.18: Assessment of Active Piling Noise Level, dB L_{Amax}

Receptor	Active Piling Noise Threshold, dB L_{Amax}	Predicted Noise Level, dB, L_{Amax}	Predicted Level above Threshold	Magnitude
SPA Boundary (Breeding Season 1 March to 31 August)	65	100	Yes	Medium / Large
MHWS (Wintering Season 1 September to 28 February)	70	83	Yes	Medium / Large

149. The effect of active piling operations upon ecological receptors is more than the active piling noise threshold, and therefore medium or large magnitude (in accordance with section 12.2.3). Noise from active piling has therefore been assessed as moderate significance and **significant** in terms of the EIA Regulations.

Other Construction Operations

150. The assessment of other construction activities on the SPA is summarised in Table 12.19 below.

Table 12.19: Assessment of Other Construction Activities on SPA Boundary, dB L_{Aeq}

Construction Activity	SPA Boundary Other Construction Noise Threshold, dB L_{Aeq}	Predicted Noise Level, dB, L_{Aeq}	Predicted Level above Threshold	Magnitude
Site Prep – Hardstanding and Track Construction	65	54.5	No	Small / Negligible
Manoeuvring Piling Plant	65	76.7	Yes	Medium / Large
Installation of PV Panels	65	76.0	Yes	Medium / Large
Installation of Electrical Compound	65	58.0	No	Small / Negligible

151. The effect of noise upon the SPA Boundary during manoeuvring piling plant and installation of PV panels is more than the other construction activity threshold, and therefore medium or large magnitude (in accordance with section 12.2.3). Noise from other construction activities has therefore been assessed as moderate significance and **significant** in terms of the EIA Regulations.

152. The assessment of other construction activities on the MHWS is summarised in Table 12.20 below.

Table 12.20: Assessment of Other Construction Activities on MHWS, dB L_{Aeq}

Construction Activity	SPA Boundary Other Construction Noise Threshold, dB L_{Aeq}	Predicted Noise Level, dB, L_{Aeq}	Predicted Level above Threshold	Magnitude
Site Prep – Hardstanding and Track Construction	70	50.7	No	Small / Negligible
Manoeuvring Piling Plant	70	60.1	No	Small / Negligible
Installation of PV Panels	70	59.5	No	Small / Negligible
Installation of Electrical Compound	70	51.5	No	Small / Negligible

153. The effect of other construction activities upon MHWS during other construction activities is less than the noise threshold, and therefore small or negligible magnitude (in accordance with section 12.2.3). Noise from other construction activities has therefore been assessed as minor significance and **not significant** in terms of the EIA Regulations.

12.5.2 Construction Vibration

12.5.2.1 Predicted Vibration Levels – Human Receptors

154. As discussed in section 12.2.2.2, potential levels of vibration from vibratory piling and compaction have been estimated using the formulae presented in BS 5228 and the distances to nearest sections of hardstanding and piling activities identified in Table 12.11.

155. Table 12.21 presents predicted Peak Particle Velocity (PPV) levels for the main vibration-inducing construction activities, at each assessed human receptor.

Table 12.21 Predicted Vibration Levels

Receptor	Construction Activity	
	Vibratory Compaction of Hardstanding	Vibratory Piling of Panel Framework
	Peak Particle Velocity, mms^{-1}	
Nagden Barn	0.02	0.15
Nagden House	0.01	0.10
Nagden Cottages	0.01	0.12
Warm House	0.01	0.27
Coneybank	0.01	0.09
1 Crown Cottages	0.29	0.11
4 Crown Cottages	0.32	0.10
Cleve Farm	0.25	0.09

12.5.2.2 Assessment of Vibration on Human Receptors

156. Vibration levels due to the use of vibratory rollers during the construction of tracks and hardstanding areas is likely to be below the level of perception at most of the assessed human receptors (0.3 mms^{-1} as set out in Table 12.3). At 4 Crown Cottages, a PPV level of 0.32 mms^{-1} is predicted during the vibratory compacting of hardstanding for the main spine road. It should be noted that the distances used in this assessment assume that the route to the south of the existing Cleve Hill Substation will be selected. Should the route to the north of the Cleve Hill Substation be selected, effects at this property will be below the level of perceptibility. In addition, where effects approach the level of perception, it is only when this activity is at its closest to a receptor, which would be for a very short time period (likely less than 1 week).

157. Vibration due to piling operations during the construction of the PV panel framework is just below the threshold for perception at Warm House, when the nearest piling activity is taking place. This will be for 1 week or less. Vibration due to piling works across the majority of the site will be below the level of perceptibility.

158. The magnitude of effect is anticipated to be negligible at all residential receptors, with the exception of a very short period at 4 Crown Cottages, which would be low for that period. The effect of vibration due to construction activities is therefore assessed as minor or negligible, and **not significant** in terms of the EIA Regulations.

12.5.2.3 Predicted Vibration Levels – Ecological Receptors

159. Table 12.22 presents predicted Peak Particle Velocity (PPV) levels for the main vibration-inducing construction activities, at the ecological receptors.

Table 12.22: Predicted Vibration Levels

Receptor	Construction Activity	Distance	Peak Particle Velocity, mms^{-1}
SPA Boundary	Vibratory compaction of hardstanding	500	0.02
	Active piling of solar PV module Framework	20	1.90
MHWS	Vibratory compaction of hardstanding	560	0.02
	Active piling of solar PV module Framework	80	0.27

12.5.2.4 Assessment of Vibration on Ecological Receptors

160. There are no specific assessment criteria for vibration on designated ecological sites.

161. However, as BS 5228 states that humans are particularly sensitive to ground-borne vibration, it may reasonably concluded that other species within the nearby ecological designation are considered to be less sensitive to such effects. It can be seen that worst-case vibration levels at the boundary of the northern ecological designation may result in a moderate effect for both piling and compacting operations. However, it should be noted that the predictions are based upon the closest point to the receptor where vibration-inducing activities will take place. At a distance of 40 m or more from the ecological designation, vibration due to such works across the majority of the site will be below the level of perceptibility at the closest, and therefore all ecological designations.

162. With regard to effects such as disturbance to burrows or nests within the ecological designations, no specific assessment criteria are available. However, BS 5228 presents a minimum PPV level of 15 mms^{-1} at which cosmetic damage may occur to residential

buildings[11] (such as cracks in plaster, etc.). Whilst not directly comparable, the worst case level of vibration at the boundary of the closest ecological designation is substantially lower than this value. On this basis, it is considered that the risk of disturbance to burrows or nests from vibration is negligible.

163. In addition, as discussed in section 12.4.1, an ECoW will be in place, and where vibration from construction is observed to be having an effect, construction can be halted and additional mitigation put in place.

164. It is therefore considered that the risk of disturbance from vibration to species utilising the designated areas is negligible and **not significant** in terms of the EIA Regulations.

12.5.3 Construction Traffic

12.5.3.1 Effects of Construction Traffic on Human Receptors

165. CRTN has been used to calculate the likely change in traffic noise levels as a result of increased traffic on the strategic access route during construction of the Development. Baseline traffic flows, and predicted increases in traffic have been obtained from Table 14.6 of Chapter 14: Access and Traffic (DCO Document Reference 6.1.14). The total traffic flow, proportion of HGVs and likely traffic speed have been used to calculate indicative noise levels[12] for the baseline conditions and worst case effects during construction.

166. Details of the calculation of the change in road traffic noise levels are contained in Technical Appendix A12.6. Construction is anticipated to start in spring 2021, and with a 24-month construction programme would last until 2023. On this basis, a future baseline year of 2022 has been used for this assessment. Table 12.23 provides a summary of the results for the estimated worst case increase in traffic flows for each location for peak traffic flows.

Table 12.23 Predicted Construction Traffic Noise Effects

Location	Peak Change in Traffic Noise Level, dB
Seasalter Road	1.6
Head Hill Road (north)	0.9
Head Hill Road (south)	0.6

167. It can be seen from Table 12.23 that for peak construction traffic flows, the predicted change in the level of road traffic noise is less than 1 dB on Head Hill Road (north and south), and as such is considered to be of negligible magnitude (in accordance with section 12.2.5). On Seasalter Road, the change is below 3 dB, and is therefore considered to be of small magnitude. As previously noted, these predicted effects are temporary, occurring during the construction phase only, and based on worst-case traffic flows. The construction traffic will vary throughout the construction phase, and therefore the effects predicted will not occur all of the time.

168. Effects from construction traffic are assessed as minor for Seasalter Road and negligible on all other roads, both of which are **not significant** in terms of the EIA Regulations.

12.5.3.2 Effects of Construction Traffic on Ecological Receptors

169. The distance at which noise thresholds for ecological receptors is exceeded have been calculated, based on a drive by maximum sound pressure level, sourced from BS 5228

[11] BS 5228-2:2009 +A1:2014, Table B2

[12] Represents a potential noise level at the roadside without taking into account effects such as the distance to receptors, ground conditions, barrier effects or reflections. As such factors remain unchanged, these can be disregarded in the estimation of noise change.

(Table C.2, item 34). The distances from the spine road at which the noise thresholds are exceeded are as follows:

- 70 dB L_{Amax} - < 35 m; and
- 65 dB L_{Amax}– < 55 m.

170. These distances are presented in Figure 5 of the Report to Inform an Appropriate Assessment (RIAA) (DCO Document Reference 5.2) which contains information on the assessment of effects on European designated areas. As shown in that figure, a small section of the ecological designation will exceed both the 65 dB L_{Amax} and 70 dB L_{Amax} thresholds around the site entrance, to the east of the Development, and at the far end of the spine road, to the west of the Development.

171. Although the thresholds are exceeded, the following should be considered:

- Impacts will be experienced only while a lorry is actively passing the ecological designation, and as such impacts are likely to be of a very short duration;
- Predictions are based on L_{Amax} level for a HGV, in practice most vehicles using the spine road will be LGV, which emit lower levels of noise;
- The section of spine road at the western extreme of the site will have far fewer vehicle passes than those at the entrance, and impacts at this location are likely to be limited to periods where Fields A, B and K are under construction; and
- The section of designation at the entrance of the site is adjacent to Seasalter Road, and as such birds using this section of the SPA will be habituated to noise from traffic.

172. In addition, construction of the Development is expected to last 2 years, and as such any impacts will be temporary.

173. Given the above, although a small section of the SPA will experience noise levels above the threshold criteria, effects from construction traffic are assessed as minor, which is **not significant** in terms of the EIA Regulations.

12.5.4 Operational Noise

174. The primary sources of noise from the operational Development are the inverters and transformers across the site in the PV array, the substation and the battery array. Noise levels from each source are discussed in the following sections.

12.5.4.1 Inverters

175. The candidate design includes 3,071 string inverters as part of the Development, which will be distributed throughout the solar PV array. The candidate unit to be installed is the Huawei SUN2000, for which the manufacturer's documentation provides a sound pressure level of 55 dB(A) at 1 m. Acoustic measurements were undertaken in a hemi-anechoic chamber, so in order to convert the sound pressure level into a sound power level, the following formula was used:

$$SWL = SPL + 20\log r + 8,$$

where SWL is the sound power level, SPL is the sound pressure level, and r is the distance at which the sound pressure was measured[13] (Appendix A12.7 Inverter Noise Emission Data). As the measurement was taken at 1 m, the calculated sound power level is 63 dB(A). Due to the high number of inverters across the site, it is not possible to input each inverter into the SoundPlan noise model. In this instance, an area source equating to the total sound power level of all the inverters was therefore input into the model over the area covered by the solar PV modules. In order to calculate a sound power level for the inverter area source, the following formula has been used:

[13] The Little Red Book of Acoustics, R.Watson & O.Downey, Page 14, 2008

$$SWL_2 = SWL_1 + 10\log(n_1/n_2),$$

where n_2 is the number of noise sources to be calculated (3,071) and n_1 is the original number of sources (1)[14]. SWL_1 is the sound power level generated by the original n_1 (63). This results in a sound power level of 98 dB(A).

176. The manufacturer's data does not contain octave-band data; the primary noise source is likely to be the inverter cooling fans, therefore a typical octave-band frequency spectrum for such a fan has been sourced from the SoundPlan database. This spectrum has then been adjusted to the overall sound power level of 98 dB(A), as shown in Table 12.24.

Table 12.24 Inverter Sound Power Level and Spectrum

	Overall Sound Power Level	**Octave Centre Band Frequency, Hz, dB**							
		63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
Sound Power Level (dB(A))	98	66	83	92	92	90	91	88	85

12.5.4.2 Transformers

177. The candidate design includes 80 transformers across the site. The candidate transformer supplier (Efacec) has advised that these units have a sound pressure level of 75 dB(A) at 1 m. No octave band data is available, so at this stage the sound level for the transformers have been set at 100 Hz to meet 75 dB(A) at 1 m.

12.5.4.3 Substation and Energy Storage Facility

178. Sound power levels for candidate substation equipment has been provided by Xero Energy, the Developer's electrical engineering consultants (Appendix A12.8 Substation Noise Emission Data). Table 12.25 details the equipment along with the sound power level for each item. Where a range of sound power levels has been provided, the highest level has been used as part of this assessment.

Table 12.25 Substation Plant Noise – Sound Power Levels

Equipment Description	**Sound Power Level, dB(A)**
400 kV Transformer (ONAN) Natural Cooling	80 - 83
400 kV Transformer (ONAF) Fan Cooling	97 - 100
Earthing and Auxiliary Transformer (x2)	65
Reactive Compensation System & Cooling	80 - 90
Harmonic Filter Compound	95
400 kV Switchgear[15]	-
Corona Discharge (wet weather only)	60
Building Climate Control systems, HVAC unit	75
33 kV Substation Transformer (x 130)	65

179. As discussed in Chapter 5, Development Design, there are two potential options for the energy storage facility in the candidate design, a battery pack solution and a containerised solution. For the battery pack solution, the electrical contractor has advised sound pressure levels of 82.5 dB(A) at 1 m for the battery and 70 dB(A) at 1 m for the

[14] The Little Red Book of Acoustics, R.Watson & O.Downey, Page 41, 2008
[15] Silent in operation, although it will emit an impulsive noise when operating for faults in the system or for switching for planned maintenance or other operations.

inverter cabinets (as detailed in Appendix A12.8). Based on these levels, predictions at the nearest receptors indicate that mitigation will be required.

180. In the absence of manufacturer's data, predictions have been made based on a containerised unit, which will contain both the batteries and inverters. Manufacturer's data for these units is contained in Technical Appendix A12.9 Battery Storage Noise Emission Data. As can be seen, the batteries are quoted as having an audible noise level of 60 dB at 3 m, while the inverters have an audible noise level of 70 dB at 1 m. No octave data is available.

181. A noise level of 60 dB at 3 m (from the batteries) is generally equivalent to 70 dB at 1m (as per the inverter). As both the batteries and the inverter are to be housed within the same container, a level of 73 dB at 1 m (i.e. 70 dB + 70 dB) has been used as the modelled sound pressure level for the battery storage containers.

182. No octave-band data is provided for the battery storage batteries or inverters, and as such these units have been modelled as a dB(Z) level (i.e. un-weighted) set at 100 Hz, which is typical of a substation operating on a 50 Hz AC grid.

183. No octave-band data is available at this stage for the substation and battery storage equipment. A typical fan spectrum taken from the SoundPlan library has been used for the 400 kV Transformer Fan Cooling. For all other noise sources, sound levels have been set at 100 Hz, which is typical of a substation operating on a 50 Hz AC grid.

12.5.4.4 Rating Corrections

184. BS 4142 states that corrections should be applied in order to account for certain acoustic features which have the potential to increase the level of effect at nearby dwellings.

185. The three acoustic features to be considered in the application of rating corrections are as follows:

- Impulsivity: The character of the sound from the Development will generally be low level and constant sound, with no rapid change in the level or character of noise. It is therefore considered that no impulsive penalty is required;
- Tonal elements: Octave band data is not available for many of the plant items. Due to the types of plant items to be installed however, it is likely that tonal elements may be perceptible at the nearest noise sensitive receptors. As such a 2 dB penalty for tonal characteristics is considered appropriate; and
- Intermittency: It is considered that the plant items will not have identifiable on/off conditions, with many items operating at gradually varying loads relative to both the intensity of light incident upon the solar panels and the air temperature. It is therefore considered that intermittency will not be readily distinctive against the residual sound.

186. In light of the above, a total correction of 2 dB is considered appropriate to derive the rating level for the Development at the receptors.

12.5.4.5 Modelling Assumptions

187. The rating levels at the nearest noise-sensitive properties have been calculated in SoundPlan, using the environmental noise propagation model ISO 9613-2:1996 – Acoustics; Attenuation of sound during propagation outdoors – Part 2: General method of calculation[16] for both daytime and night-time periods.

188. The ISO 9613-2 method predicts the level of sound at a receptor by taking the octave-band sound power level spectrum of the source, and applying a number of attenuation factors that determine the resulting rating level at the receptor location. The

[16] ISO 9613-2:1996 Acoustics; Attenuation of sound during propagation outdoors – Part 2: General method of calculation.

ISO 9613-2 method employed provides a prediction of noise levels likely to occur under conditions favourable to sound i.e. down-wind and under a moderate, ground-based temperature inversion, and is therefore considered a conservative approach.

189. The following parameters were used in the prediction model:

- Atmospheric conditions of 10°C and 70% relative humidity;
- The 400 kV transformers have been modelled at a height of 3.3 m, as stated in Appendix A12.8. All other noise sources have been modelled at 2.5 m;
- A ground factor of G=1 (soft ground); and
- A receiver height of 1.5 m (approximating head height within the amenity areas of the assessed dwellings).

190. Whilst the solar PV modules make no noise themselves, they will likely act as noise barriers, reducing noise from the string inverters (which are located beneath the modules) and on site transformers. The actual level of noise reduction offered by the modules is highly dependent on the precise angles and positioning of panels relative to the noise sources and receptor locations. As such, the modules themselves have not been included in the noise propagation model in order to ensure a conservative assessment.

191. Sunrise can occur from around 04:45 BST in mid-summer in Kent. The operation of the on-site inverters and transformers will be related to both the intensity of light incident upon the solar panels and the air temperature. To ensure a conservative assessment, the inverters and transformers have been included within the night-time assessment – to cover the periods between 04:45 and 07:00.

12.5.4.6 Assessment of Operational Noise on Human Receptors

192. An assessment of the likely effect, as shown in Table 12.26, has been made based upon the difference between rating levels and the rating level noise limit, determined in section 12.3.4.

Table 12.26 Assessment of Effects

Receptor	Specific Level, dB(A)	Rating Level, dB(A)	Rating Level Noise Limit, dB L_{Aeq}	Margin, dB	Magnitude of Effect
Daytime (0700 – 2300)					
Nagden Barn	35	37	44	-7	Negligible
Nagden House	34	36	44	-8	Negligible
Nagden Cottages	33	35	44	-9	Negligible
Warm House	38	40	44	-4	Small
Coneybank	37	39	44	-5	Small
1 Crown Cottages	43	45	41	4	Medium
4 Crown Cottages	38	40	41	-1	Small
Cleve Farm	42	44	41	3	Medium
Night-time (2300 – 0700)					
Nagden Barn	35	37	34	3	Medium
Nagden House	34	36	34	2	Medium
Nagden Cottages	33	35	34	1	Medium
Warm House	38	40	36	4	Medium

Receptor	Specific Level, dB(A)	Rating Level, dB(A)	Rating Level Noise Limit, dB L_{Aeq}	Margin, dB	Magnitude of Effect
Coneybank	37	39	36	3	Medium
1 Crown Cottages	43	45	35	10	Large
4 Crown Cottages	38	40	35	5	Medium
Cleve Farm	42	44	35	9	Large

193. It should be noted that the above assessment incorporates a number of worst case assumptions, including all noise sources being fully operational throughout the night-time period. Many of the noise sources will be dependent on the level of sunlight, and therefore load, and the batteries are likely only to be used for electricity export during peak demand periods. As such, the night-time noise levels are likely to be substantially lower in practice.

194. During daytime periods the level of noise due to the operation of the Development is predicted to be 4 dB above the rating level noise limit at 1 Crown Cottages and Cleve Farm.

195. During night-time periods, the worst-case predicted level of noise at all receptors is above the rating level noise limit, and as such is of medium / large magnitude.

196. These effects (both medium and large significance) are **significant** in terms of the EIA Regulations.

12.5.4.7 Assessment of Operational Noise on Non-Human Receptors

197. As the three identified receptor locations detailed in Table 12.10 relate to ecological designations rather than human receptors, the predicted noise levels at these locations must be considered in context in order to determine the likelihood of a significant effect.

198. The predicted noise level at these locations is as follows;

- Ecological Receptor 1 – 43 dB(A); and
- Ecological Receptor 2 – 42 dB(A); and
- Ecological Receptors 3 – 52 dB(A).

199. Operational noise from the Development will not contain any impulsive noise which could cause sudden disturbance to birds in the ecological designations. Furthermore, the ecological designations are already subject to increased noise levels, due to the presence of the Cleve Hill Substation and the existing agricultural baseline. This is likely to have resulted in a degree of habituation of the species within the designated area to anthropogenic noise.

200. As can be seen, the operational noise levels are predicted to be 2 dB above the 50 dB(A) significance criteria for operational noise.

201. The effect of operational noise on the identified ecological receptors is therefore assessed as medium, and **significant** in terms of the EIA Regulations.

12.5.4.8 Conservatism in the Assessment of Operational Noise

202. Whilst the PV panels make no noise themselves, they will likely act as noise barriers, reducing noise from the string inverters and transformers across the site. The actual level of noise reduction offered by the panels is highly dependent on the precise angles and positioning panels relative to the noise sources and receptor locations. As such, the PV panels themselves were not included in the noise propagation model in order to ensure a conservative assessment.

203. Noise from the string inverters and transformers is dependent on the level of sunlight incident on the panels, and as such noise unlikely to be emitted from these items during the majority night-time periods. However, sunrise can occur from around 04:45 in Kent and predictions during night-time periods therefore include the string inverters and transformers to ensure a conservative assessment.

204. Operation of the battery units has been modelled as continuous. However, typically, batteries used for electricity storage connected to the grid are used intermittently, charging when they are not full and during periods of peak supply to the grid, and discharging during periods of peak demand on the grid. Overall this is expected to be substantially less than continuous operation.

205. It is considered that overall, the assumptions made in this assessment are likely to result in an over-prediction of noise levels, and that, as a result, the uncertainties inherent in the assessment will have no effect on the outcome of the assessment or will reduce the magnitude of effects.

12.5.5 Decommissioning

206. Any predicted noise effects arising from decommissioning will be similar in nature and no greater than those predicted for the construction phase, as outlined above. There are therefore likely significant effects as a result of decommissioning which require mitigation.

12.6 Mitigation Measures and Residual Effects

12.6.1 Construction Phase

12.6.1.1 Human Receptors

207. The Development design and embedded mitigation measures are such that noise and vibration effects have been found to be **not significant** at the identified human receptors for all construction activities, and no further mitigation is specifically proposed.

12.6.1.2 Ecological Receptors

208. Identified noise thresholds will not be exceeded during construction. Where mitigation is required to achieve this, examples of such mitigation are provided below. As set out in section 12.6.4 below, prior to commencement of construction, the proposed construction plant and methods will be subject to a revised noise assessment, to demonstrate how noise thresholds will be met.

Piling Noise

209. As discussed in section 12.5.1, the predicted noise levels during active piling has the potential to result in significant effects at the SPA Boundary and MHWS. Significant effects are also predicted during other construction activities at the SPA Boundary.

210. In order to reduce noise at ecological receptors during active piling operations, a 10 dB reduction in noise levels should be achieved through implementation of one (or more) of the following:

- Selection of quieter equipment than that assessed;
- Use of pile hammer shrouds;
- Use of pile press rather than hammer; or
- Use of acoustic quilts, barriers or water jackets.

211. The implementation of mitigation to reduce noise from active piling will result in residual effects of 90 dB L_{Amax} at the SPA Boundary, and 73 dB L_{Amax} at MHWS. The predictions are based on 4 pilers actively piling at the same time.

212. During the winter period, only 3 dB further mitigation is required in order to meet the noise thresholds. This could be achieved by, for example, using only 2 pilers when within

30 m of nearest point of the solar PV modules to the ecological designations. This would reduce the noise levels at the MHWS to 70 dB L_{Amax}, i.e., at the threshold level during the winter period. As such, with appropriate mitigation, it is demonstrated that active piling can be undertaken during winter periods without exceeding the noise thresholds.

213. Based upon the above, noise levels in excess of 65 dB, L_{Amax} are anticipated at the SPA Boundary during the breeding season, and could extend approximately 330 m into the SPA. For piling within the breeding season (summer), alternative solutions are required in order to meet the noise thresholds. These are set out under the Ecological Receptor Mitigation Measures heading below.

Other Construction Noise

214. As set out in section 12.5.1, unmitigated, the noise from manoeuvring piling plant and installation of PV panels (i.e., those activities undertaken adjacent to the SPA Boundary), could result in significant effects during the breeding season. These effects could extend approximately 45 m into the SPA.

215. No significant effects are predicted at the MHWS (applicable during the winter period) from other construction activities.

Ecological Receptor Mitigation Measures

216. In order to address the potentially significant effects identified above for the SPA Boundary (applicable during the breeding season only), mitigation is required. This may include (for example):

- The use of quieter plant and equipment than modelled here;
- Modelling and application of noise mitigation measures, similar to those given as examples for piling noise above;
- The ECoW overseeing work undertaken adjacent to the northern boundary of the site and observing ornithological responses to inform any further action; and/or
- Applying set-back distances at which specific construction activities can take place during the breeding season.

217. Application of these mitigation measures is expected to deliver noise reductions sufficient that predicted noise levels at receptor locations (as identified in Table 12.19) would be below the 65 dB threshold (as applicable during the breeding season). Depending on the availability of sufficiently quiet plant and equipment, it is possible that certain construction activities will need to be restricted in the areas closest to The Swale SPA during the breeding season in order to avoid exceeding the noise thresholds identified.

218. The noise thresholds for ecological receptors and a summary of the assessment of construction effects is contained within the Outline SPA CNMP which accompanies this application as Technical Appendix A12.10.

219. As set out in section 12.6.4, below, the SPA CNMP will be updated prior to construction setting out the final mitigation options based on the equipment planned to be used on site. This is likely to be a combination of the above example measures.

Residual Effects

220. For construction during the winter period (1st September to 28th February), assuming that the mitigation measures detailed above are implemented, noise and vibration effects will be **not significant** at the identified ecological designations.

221. For construction during the breeding season (1st March to 31st August), mitigation measures beyond those set out in this section are required to reduce construction noise to a not significant level. There is a commitment, above, to not exceed noise thresholds at the identified ecological receptor locations during the construction period. Options for the construction process are therefore to carry out construction close to the breeding

season receptors during the winter period only, or to implement effective mitigation measures to reduce noise levels at source more than is set out above.

222. On this basis, residual significance for noise and vibration effects during construction would be **not significant** in terms of the EIA Regulations.

12.6.2 Operational Phase

12.6.2.1 Human Receptors

223. As outlined in section 12.3.4, rating level noise limits at nearby human receptors have been calculated based on background noise levels. As detailed in section 12.5.4, predicted operational noise levels at the nearest receptors exceed the operational noise limits, and as such have been assessed as having moderate / major significance effects. As such, mitigation is required to ensure noise levels during the operational phase do not result in significant impacts.

224. It should be noted that all predictions as part of this assessment are based on a number of worst case assumptions, as detailed in section 12.5.4.8. In practice, many items will be used intermittently, e.g., batteries, which will charge when not full and during peak supply to the grid, and discharging during periods of peak demand on the grid. Overall this is expected to be substantially less than continuous operation.

225. Given the flexibility in the design of the Development, there are numerous approaches to meeting the required noise levels at receptor locations:

- By relocating some of the noise sources;
- By operating according to a structured programme designed to reduce noise at receptor locations (e.g., avoiding two noise sources operating simultaneously);
- By selecting plant with lower noise emission ratings than those assessed; and/or
- By providing noise insulation around the plant.

226. The plant items to be installed will take up different amounts of the noise budget, i.e. the noise limit. Some items selected for installation may have lower noise emissions that those assessed, and as such this may free up noise budget for other sources of noise, providing that the overall limit is not exceeded. In addition, where mitigation is required, some items may have relatively simple measures available, such as:

- Orientating noise emission points away from receptors;
- Fitting of manufacturer supplied mitigation, i.e., silencers, etc.; or
- Siting noisy equipment behind other site infrastructure such as substation building, etc.

227. These measures may free up noise budget for other noise sources where mitigation is relatively more difficult to achieve.

228. In order to determine which elements of the Development result in high levels of noise at the nearest receptors, predictions have been undertaken of the various elements of the Development in isolation, as follows:

- Solar PV Array (i.e. inverters and transformers);
- Energy Storage; and
- Electrical Substation.

229. As a general guide, the contribution from each of the above elements should be 5 dB below the noise limit in isolation, so that in combination the noise limit is not exceeded.

Solar PV Array

230. The predicted noise level from the solar PV array in isolation is shown in Table 12.27.

Table 12.27 Predicted Noise Level from Solar PV Array Only

Receptor	Specific Level, dB(A)	Rating Level, dB(A)	Rating Level Noise Limit, dB L_{Aeq}	Margin, dB
Daytime (0700 – 2300)				
Nagden Barn	31	33	44	-11
Nagden House	29	31	44	-13
Nagden Cottages	27	29	44	-15
Warm House	33	35	44	-9
Coneybank	29	31	44	-13
1 Crown Cottages	29	22	41	-19
4 Crown Cottages	29	31	41	-10
Cleve Farm	25	27	41	-14
Night-time (2300 – 0700)				
Nagden Barn	31	33	34	-1
Nagden House	29	31	34	-3
Nagden Cottages	27	29	34	-5
Warm House	33	35	36	-1
Coneybank	29	31	36	-5
1 Crown Cottages	29	22	35	-13
4 Crown Cottages	29	31	35	-4
Cleve Farm	25	27	35	-8

231. As can be seen in Table 12.27 above, in isolation, the inverters and transformers associated with the PV panels result in rating levels below the rating level noise limit, and as such would be assessed as having a small / negligible impact during these periods.

232. Predicted noise levels approach the noise limit during night time periods at Nagden Barn and Warm House, and as such noise from the solar PV array takes up a significant portion of the noise budget at these properties. The solar PV modules, and consequently their inverters and transformers, will only be in operation during night time hours (23:00 – 07:00) in the peak of summer, in good weather, for part of this time after sunrise (sunrise at its earliest is 04:45) and even then will be mostly the eastern-facing modules (half of the total), hence even when operating in these hours, the noise generated will be lower than that modelled. Once a final design, with inverter model and transformer model, has been specified, these could be modelled in detail to establish potential exceedances in the absence of further mitigation. Noise from the transformers is higher than that from the inverters, so that in order to free up additional noise budget for the other elements of the Development, i.e., battery storage and substation, noise levels from transformers nearest the properties should be mitigated.

233. Noise from transformers is generally caused by the cooling system, for which several mitigation measures are available, including:

- Acoustic silencers installed on inlet / extract ventilation;
- Cooling fans located within transformer enclosures;
- Extract ventilation orientated away from receptors;
- Relocation of transformers to maximise distance to nearest receptors; or

- Selection of transformer unit with lower noise emission levels than that assessed.

234. The implementation of one, or several, of the mitigation measures above is anticipated to result in at least 5 dB reduction (i.e. from 75 dB(A) at 1 m to 70 dB(A) at 1 m) in noise levels, which would free up more of the noise budget for the other equipment items to be installed on site.

Energy Storage

235. As discussed in Chapter 5, the energy storage may not be constructed / installed at the same time as the electrical compound and PV array, however sufficient noise budget will need to be available for this element.

236. The predicted noise level from the battery storage in isolation is shown in Table 12.28.

Table 12.28 Predicted Noise Level from Battery Storage Only

Receptor	Specific Level, dB(A)	Rating Level, dB(A)	Rating Level Noise Limit, dB L_{Aeq}	Margin, dB
Daytime (0700 – 2300)				
Nagden Barn	31	33	44	-11
Nagden House	31	33	44	-11
Nagden Cottages	29	31	44	-13
Warm House	34	36	44	-8
Coneybank	34	36	44	-8
1 Crown Cottages	38	40	41	-1
4 Crown Cottages	34	36	41	-5
Cleve Farm	39	41	41	0
Night-time (2300 – 0700)				
Nagden Barn	31	33	34	-1
Nagden House	31	33	34	-1
Nagden Cottages	29	31	34	-3
Warm House	34	36	36	0
Coneybank	34	36	36	0
1 Crown Cottages	38	40	35	5
4 Crown Cottages	34	36	35	1
Cleve Farm	39	41	35	6

237. As can be seen in Table 12.28 above, in isolation, the battery storage element results in rating levels above the rating level noise limit during night-time periods, and as such would be assessed as having a medium / large magnitude effect, of moderate / major significance.

238. Given that the energy storage element exceeds the rating level noise limit in isolation, it is necessary for mitigation to be implemented to reduce the noise effects.

239. The noise level provided for the transformers associated with the energy storage is significantly lower than that for the batteries and inverters, and as such mitigation should be applied to the containers housing the batteries and inverters. Mitigation measures include, in addition to those set out in section 12.4.2:

- Acoustic silencers installed on inlet / extract ventilation;
- Cooling fans located within container units;
- Container units to include acoustic insulation (e.g., mineral rockwool) to prevent noise breakout;
- Extract ventilation orientated away from receptors; or
- Selection of battery storage unit with lower noise emission levels than that assessed.

240. The implementation of one, or several, of the mitigation measures above would be required to reduce noise levels to below the rating level noise limit. For the purpose of this assessment, a 13 dB reduction (i.e., from 73 dB(A) at 1 m (per unit) to 60 dB(A) at 1 m (per unit)) has been applied, which would free up more of the noise budget for the other equipment items to be installed on site.

Electrical Substation

241. The predicted noise level from the various items in the electrical compound in isolation is shown in Table 12.29.

Table 12.29 Predicted Noise Level from Electrical Substation Only

Receptor	Specific Level, dB(A)	Rating Level, dB(A)	Rating Level Noise Limit, dB L_{Aeq}	Margin, dB
Daytime (0700 – 2300)				
Nagden Barn	29	31	44	-13
Nagden House	29	31	44	-13
Nagden Cottages	29	31	44	-13
Warm House	32	34	44	-10
Coneybank	33	35	44	-9
1 Crown Cottages	42	44	41	3
4 Crown Cottages	34	36	41	-5
Cleve Farm	39	41	41	0
Night-time (2300 – 0700)				
Nagden Barn	29	31	34	-3
Nagden House	29	31	34	-3
Nagden Cottages	29	31	34	-2
Warm House	32	34	36	-2
Coneybank	33	35	36	-1
1 Crown Cottages	42	44	35	9
4 Crown Cottages	34	36	35	1
Cleve Farm	39	41	35	6

242. As can be seen in Table 12.29 above, in isolation, the electrical substation element results in rating levels above the rating level noise limit during both daytime and night-time periods, and as such would be assessed as having a medium / large magnitude effect, of moderate / major significance.

243. Given that the electrical substation element exceeds the rating level noise limit in isolation, it is necessary for mitigation to be implemented to reduce the noise effects.

244. As shown in Table 12.29, 4 Crown Cottages experiences the highest levels of noise from the electrical substation. In order of impact, the contribution from each element of the electrical substation is presented below:

- 400 kV Transformer Fan Cooling – 33 dB(A);
- Harmonic Filters – 26 dB(A);
- Reactive Compensation Yard – 23 dB(A);
- 400 kV Transformer Natural Cooling – 16 dB(A);
- Building Climate Control – < 10 dB(A); and
- Earthing and Auxiliary Transformer – < 10 dB(A).

245. Based upon the above levels, mitigation is not required for the 400 kV Transformer Natural Cooling, Building Climate Control or the Earthing and Auxiliary Transformer.

246. As shown in Table 12.25, the reactive compensation yard has a proposed sound power level of between 80 and 90 dB(A). Modelling to date has been undertaken based upon a 90 dB(A) unit. In this instance a mitigation measure could be to select a unit limited to 80 dB(A).

247. With regards to the Harmonic Filters and 400 kV Transformer Fan Cooling, mitigation measures could include, in addition to the embedded mitigation set out in section 12.4.2:

- Selection of harmonic filter / transformer fan cooling units with lower noise emission levels than that assessed;
- Extract ventilation orientated away from receptors;
- Acoustic attenuators fitted to extract cooling (unlikely to be an option for harmonic filters); and / or
- Acoustic screening / enclosures fitted around noise emitting elements.

248. The implementation of one, or several of the above mitigation measures on the harmonic filters and transformer fan cooling would be required to reduce noise from electrical substation at the nearest receptors. For the purpose of this assessment, a 10 dB reduction has been assumed for the harmonic filter, and a 12 dB reduction assumed for the transformer fan cooling.

Summary of Mitigation Measures

249. Based on the data provided, mitigation required to ensure the rating level noise limit at each receptor is not exceeded is summarised as:

- Solar PV Array Transformers – 5 dB reduction;
- Containers housing battery storage and inverters – 13 dB reduction;
- Reactive Compensation Yard – 10 dB reduction;
- Harmonic Filters – 10 dB reduction; and
- 400 kV Transformer Fan Cooling – 12 dB reduction.

250. Mitigation methods for achieving the reductions summarised above are presented in this section. The mitigation set out are not intended to be prescriptive, but to present examples that would achieve the required noise reductions at receptor locations.

251. As discussed, the various elements of the Development will take different amounts of the noise budget, and the reductions above are indicative of the levels that will be achieved to ensure that the Development does not exceed the noise limits detailed in section 12.3.4. In addition, these mitigation measures assume all plant is operational continuously, this is unlikely to occur in practice, and as such the reductions presented above are a worst case.

252. This assessment will be updated and provided to Swale Borough Council in the form of an updated operational noise assessment report, as manufacturer's data and additional design information becomes available, to ensure that the mitigation reduces operational noise levels to below the rating noise limit.

Residual Effects

253. Table 12.30 below presents the residual effects following implementation of mitigation measures achieving the reductions in the Summary of Mitigation section.

Table 12.30 Assessment of Residual Effects

Receptor	Specific Level, dB(A)	Rating Level, dB(A)	Rating Level Noise Limit, dB L_{Aeq}	Margin, dB	Magnitude of Effect
Daytime (0700 – 2300)					
Nagden Barn	30	32	44	-12	Negligible
Nagden House	29	31	44	-13	Negligible
Nagden Cottages	27	29	44	-15	Negligible
Warm House	33	35	44	-9	Negligible
Coneybank	30	32	44	-12	Negligible
1 Crown Cottages	32	34	41	-7	Negligible
4 Crown Cottages	29	31	41	-10	Negligible
Cleve Farm	32	34	41	-7	Negligible
Night-time (2300 – 0700)					
Nagden Barn	30	32	34	-2	Small
Nagden House	29	31	34	-3	Small
Nagden Cottages	27	29	34	-5	Small
Warm House	33	35	36	-1	Small
Coneybank	30	32	36	-4	Small
1 Crown Cottages	32	34	35	-1	Small
4 Crown Cottages	29	31	35	-4	Small
Cleve Farm	32	34	35	-1	Small

254. The Applicant will continue to work with substation and battery storage plant manufacturers and suppliers to ensure that sufficient noise mitigation can be incorporated into the design, and that noise emissions due to the equipment selected for installation are such that the noise levels specified in Table 12.8 are achieved, resulting in, at worst, a minor effect, which would be **not significant** under the EIA Regulations.

12.6.2.2 Ecological Receptors

255. As discussed in section 12.5.4, operational noise levels are predicted to be above the 50 dB(A) threshold at ecological receptor 3.

Mitigation Measures

256. The mitigation required at human receptors is greater than for ecological receptors, so the example mitigation measures detailed in section 12.6.2.1 have been applied.

Residual Effects

257. The predicted noise level at the ecological receptors, following the application of the example mitigation measures detailed in section 12.6.2.1, is as follows.

258. The predicted noise level following mitigation is, at the locations of the ecological receptors, as follows:

- Ecological Receptor 1 – 37 dB(A); and
- Ecological Receptor 2 – 32 dB(A); and
- Ecological Receptors 3 – 42 dB(A).

259. As can be seen, the operational noise levels are predicted to be 8 dB below the 50 dB(A) significance criteria, following implementation of mitigation to achieve the rating level noise limit at human receptors.

260. The effect of operational noise on the identified ecological receptors is therefore assessed as negligible, and **not significant** in terms of the EIA Regulations.

12.6.3 Decommissioning

261. Decommissioning effects would be of a similar nature to that of construction and will be managed through the best practice measures detailed in section 12.6.1 or other guidance or legislation relevant at the time.

262. Following mitigation, residual effects during decommissioning would be not significant in terms of the EIA Regulations.

12.6.4 Summary and Mitigation Control

263. Mitigation is required in order for effects to be not significant, as set out above. An example of mitigation that would lead to noise levels being below the relevant limits at all receptors, and hence having no significant effects, is set out in sections 12.6.1 and 12.6.2.

264. In order to ensure that such mitigation is implemented and give confidence that it will be effective, prior to the start of construction, the predictions of noise levels will be repeated based on the actual detailed design, specific models of plant and specific mitigation measures. This will be required to show that predicted noise levels are below the relevant rating level noise limit. It is anticipated that this report would be submitted to, and to be agreed by, Swale Borough Council, prior to the commencement of construction.

265. This control measures allows the Applicant to select technology at the time of procurement, whilst ensuring noise and vibration levels at receptor locations are not significant.

12.7 Cumulative Effects

266. Details of the closest cumulative developments are provided in Table 2.2 of Chapter 2: Environmental Impact Assessment. No developments have been identified within 1 km of the sources of identified noise-creating activities associated with the Development. Given this distance, based on professional judgement, no cumulative effects are anticipated.

12.8 Summary of Likely Effects

267. An assessment of potential noise and vibration effects has been carried out for the construction, operational and decommissioning phases of the Development, with a summary provided in Table 12.31.

Table 12.31 Summary of Effects

Predicted Effect	Mitigation	Residual Effect
Construction Phase		
Noise effects on human receptors	None (other than measures embedded in the design of the Development).	No significant effects
Noise effects on ecological receptors	An ECoW will oversee work undertaken adjacent to the northern boundary of the site and monitor responses to inform any further action. Avoiding activities which would exceed the identified noise thresholds in areas where they are modelled to exceed those identified noise thresholds (i.e., piling activities during breeding season). Modelling and application of noise mitigation measures, similar to those given as examples for piling noise above. Applying set-back distances at which construction activities can take place at different times of the year. Use of quieter plant and equipment than modelled. Certain construction activities will need to be restricted in the areas closest to The Swale SPA during the breeding season in order to avoid exceeding the noise thresholds identified. The assessment of construction noise on ecological receptors will be updated prior to construction setting out the final mitigation options based on the equipment planned to be used on site. This is likely to be a combination of the above example measures.	No significant effects
Vibration effects on human receptors	None (other than measures embedded in the design of the Development).	No significant effects
Vibration effects on non-human receptors		No significant effects
Construction traffic		No significant effects
Operational Phase		
Noise effects on human receptors Noise Effects on Non-human receptors	Given the flexibility in the design of the Development, there are numerous approaches to meeting the required noise levels at receptor locations, including: • Relocation of noise sources • Operating according to a structured programme designed to reduce noise at receptor locations • Selection of plant with lower noise emission ratings than those assessed	No significant effects

Predicted Effect	Mitigation	Residual Effect
	• Providing noise insulation around the plant i.e., acoustic screening, enclosures etc. • Orientation of noise emission points away from receptors • Fitting of manufacturer supplied mitigation i.e. silencers etc. • Siting noisy equipment behind other site infrastructure • Acoustic silencers installed on inlet / extract ventilation • Cooling fans located within transformer enclosures • Container units to include acoustic insulation (e.g. mineral rockwool) to prevent noise breakout	
Decommissioning Phase		
Similar in nature and no greater than those predicted for the construction phase	Best practice measures detailed in section 12.6.1 or other guidance or legislation relevant at the time	No significant effects

12.9 Statement of Significance

268. This chapter has assessed the significance of potential noise and vibration effects during the construction, operational and decommissioning phases, and concludes that, with appropriate mitigation, there would be no significant noise or vibration effects in terms of the EIA Regulations.

269. In order to ensure that such mitigation is implemented and give confidence that it will be effective, prior to the start of construction, the predictions of noise levels at receptors will be repeated based on the actual detailed design, specific models of plant and specific mitigation measures. This will be required to show that predicted noise levels are below the relevant rating level noise limit. It is anticipated that this report would be submitted to, and to be agreed by, Swale Borough Council, prior to the commencement of construction.