
**THREE OAKS RENEWABLE
ENERGY PARK
EXTENSION**

**Environmental
Statement Chapter 9: Noise and
Vibration**

MAY 2026



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9 Noise and Vibration

Introduction

- 9.1 This chapter provides an assessment of the noise and vibration impact of the proposed Three Oaks Renewable Energy Park Extension (hereafter referred to as the Proposed Development). The operational noise assessment has been carried out according to the Energy Technology Support Unit (ETSU) report ETSU-R-97 (The Working Group on Noise from Wind Turbines, 1996) and the Institute of Acoustics' (IoA) Good Practice Guide (IoA GPG) (2013). This is the approved assessment method stated in Government guidance for onshore wind turbines (GOV.UK, 2015). The ETSU guidance advises on noise limits for wind turbines which are thought to:
- “offer a reasonable degree of protection to wind farm neighbours, without placing unreasonable restrictions on wind farm development”.*
- 9.2 This chapter has been prepared by Gavin Irvine from Ion Acoustics Ltd for Three Oaks REP Extension Ltd (the Applicant). Gavin Irvine is a Director of Ion Acoustics, a Member of the Institute of Acoustics, and has worked on wind turbine noise assessments for over 30 years. In accordance with the Town and Country Planning (Environmental Impact Assessment) Regulations 2017, a statement outlining the relevant expertise and qualifications of competent experts providing this Environmental Statement (ES) is provided in Appendix 1.1 (Statement of Expertise) – Volume 4.
- 9.3 A baseline noise survey was carried out in October / November 2025 to determine the prevailing background noise levels in the area. The noise survey has been used to derive operational noise limits for the wind farm based on the background noise levels and ETSU-R-97 / IoA GPG guidance.
- 9.4 Noise predictions for operation of the Proposed Development are presented here based on noise data for the candidate model, a Vestas V117 4.2 MW wind turbine with a 91.4 m hub height (149.9 m to blade tip). The predictions have been carried out according to BS ISO 9613-2 with input parameters and limitations specified in the IoA GPG.
- 9.5 Noise can also be generated during the construction period from the excavation and construction of the turbine foundations, trenches for cables, the construction of new access tracks and hard standings and from the erection of the turbines themselves. Noise from the transportation of construction materials and turbine components will also occur on the access tracks and local roads. Therefore, this chapter includes an assessment of noise and vibration during construction (including the effect of construction transportation movements on local roads). Noise during decommissioning is also considered.
- 9.6 In addition, a Construction Environmental Management Plan (CEMP) (which will be in accordance with Appendix 2.1 (outline CEMP) – Volume 4)) will be prepared for agreement with the local authority and secured by condition.
- 9.7 It is proposed that construction activities would be limited to between 07:00 and 19:00 Monday to Saturday, with no construction work expected on Sundays or Bank Holidays. Any works outside of these times (such as when turbine component parts are delivered to site, or when conducting specialist activities such as continuous concrete pours which cannot be stopped

prior to completion) would need to be approved in writing by the Council, unless in an emergency situation.

Consultation

- 9.8 The Applicant contacted East Riding of Yorkshire Council (the Council) as part of a pre-application advice request (Ref 25/10744/STPREP) in August 2025. Separately, Gavin Irvine from Ion Acoustics contacted the Council's Environmental Health Department in September 2025 by email to discuss the noise survey locations and assessment generally.
- 9.9 Table 9.1 below summarises relevant consultation undertaken, the relevant points made and responses.

Table 9.1 Consultation Summary

Reference	Comment	Response
East Riding of Yorkshire Council	A background noise assessment is required to demonstrate compliance with ETSU-R-97 day and night-time noise limits.	This has been done.
	All assessments and calculations should be undertaken in accordance with ISO 9613-2:1996 'and the latest guidance published by the Institute of Acoustics (Good Practice Guide).	The assessment follows this guidance.
	The acoustician should demonstrate that they have chosen representative locations for their monitoring in line with the above conditions and ETSU-R-97.	Three monitoring locations have been chosen to represent: 1) the nearest residential locations; 2) properties in Thornholme and 3) a more distant location where road traffic noise is less of an influence on background sound levels.
	Construction Phase of the Development: Noise during the construction phase of the development will also have to be considered, together with consideration of noise from the substation/s.	A construction noise assessment is provided. The Proposed Development will use the substation for the consented Three Oaks Renewable Energy Park. This is considered as part of the future baseline.

Legislation, Policy, Guidance and Standards

Legislation

- 9.10 The assessment of wind turbine noise is not covered by any particular legislation. Note however the Control of Pollution Act 1974 includes certain clauses relating to the construction noise including Section 60 which gives local authorities certain powers to control construction

noise and Section 61 where the contractor can seek authorisation for construction works by setting out method statements and predicted noise levels.

Policy

9.11 The following planning policy documents are relevant:

- The National Planning Policy Framework (NPPF);
- The Noise Policy Statement for England (NPSE);
- Online Planning Practice Guidance for Renewable Energy; and
- The East Riding of Yorkshire Council Local Plan Update.

National Planning Policy Framework (NPPF)

9.12 In March 2012 the 'National Planning Policy Framework' was introduced as the current planning policy guidance in England. This document was last updated in February 2025. The document is generally not prescriptive and does not provide noise criteria. Instead, it places the onus on local authorities to develop their own local plans and policies as follows:

"187. Planning policies and decisions should contribute to and enhance the natural and local environment by:

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

9.13 The document further states that:

"198. Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

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

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

Noise Policy Statement for England

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

- “avoid significant adverse impacts on health and quality of life;
- mitigate and minimise adverse impacts on health and quality of life; and
- where possible, contribute to the improvement of health and quality of life.”

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

“NOEL – No Observed Effect Level

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

LOAEL – Lowest Observed Adverse Effect Level

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

SOAEL – Significant Observed Adverse Effect Level

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

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

Planning Practice Guide for Renewable Energy

9.17 The GOV.UK (2015) online planning practice guidance provides specific guidance on noise and wind turbines in a paragraph entitled “How are noise impacts of wind turbines assessed?”. This states:

“The report, ETSU-R-97: The assessment and rating of noise from wind farms should be used by local planning authorities when assessing and rating noise from wind energy developments. Good practice guidance on noise assessments of wind farms has been prepared by the Institute of Acoustics. The Department for Energy Security and Net Zero accept that it represents current industry good practice and endorses it as a supplement to ETSU-R-97.”

East Riding Local Plan Update

9.18 Section 6 of East Riding Local Plan Update includes a section on supporting renewable energy. Specifically, paragraph 6.75 states:

“Proposals should also ensure they are located at an appropriate distance from noise sensitive uses, such as housing and quiet leisure-based uses, to ensure that increases in ambient noise levels are acceptable. The prevailing noise standards (e.g. BS4142 or ETSU-R-97), and any current best practice/ guidance (e.g. from the Institute of Acoustics), should be used, giving consideration to the level of existing background noise in the area.”

Guidance and Standards

9.19 The following guidance documents have been taken into account in preparing this noise assessment:

- ETSU-R-97;
- The Institute of Acoustics Good Practice Guide;
- BS ISO 9613-2: 2024 Attenuation of Sound During Propagation Outdoors;
- British Standard 5228 Parts 1 and 2; and
- The Design Manual for Roads and Bridges LA111.

ETSU-R-97 The Assessment & Rating of Wind Turbine Noise

9.20 ETSU Report ETSU-R-97 published in September 1996 is still the appropriate guidance recommended by the Government to derive noise limits for assessing wind turbine noise.

9.21 The ETSU limits are set in terms of the L_{A90} noise parameter. This is defined as the noise level exceeded for 90% of the measurement time. It is taken to represent the 'background noise', that is the underlying noise level in the absence of short-term events. This unit was chosen to assess and the baseline and turbine noise, which is fairly steady, because extraneous short-term events such as discrete car passes, and aircraft do not usually affect the L_{A90} index. For wind turbine noise, the L_{A90} noise parameter is typically 2 dB less than the L_{Aeq} parameter. The L_{Aeq} can be regarded as an average noise level over a time period.

9.22 The ETSU report provides a method for assessing wind turbine noise and in particular, the setting of external noise limits which are either:

- relative to the background noise (L_{A90} dB); or
- fixed when background noise levels are otherwise very low.

9.23 In most rural locations, the background noise depends on the wind speed. For rural environments, the "fixed" part of the ETSU limit usually applies at low wind speeds. At high wind speeds, noise from wind in the trees and flowing over local features such as roofs can be considerable and is often sufficient to mask the sound of wind turbines. Therefore, it is often at lower wind speeds that the turbines are more audible.

9.24 The ETSU-R-97 limits set relative to background noise levels are derived separately for 'amenity hours' daytime periods and for the night-time, defined as 11pm to 7am. The amenity hours (AH) daytime periods are chosen to reflect periods when people might be outside in their gardens and are defined as:

- All evenings from 6pm to 11pm;
- Saturday afternoons from 1pm to 11pm; and
- All day Sunday (7am to 11pm).

9.25 For the daytime AH periods, the suggested noise limits are 35 to 40 dB L_{A90} or 5 dB above the prevailing background, whichever is the greater. A degree of judgment is required in

determining the fixed limit within the 35 to 40 dB L_{A90} range and ETSU-R-97 states that this will depend on:

- The number of dwellings in the neighbourhood of the wind farm;
- The effect of noise limits on the number of kWh generated; and
- The duration and level of exposure.

- 9.26 For night-time periods, the ETSU noise limit is 43 dB L_{A90} or 5 dB above the background, whichever is the greater. The 43 dB L_{A90} limit was derived from a sleep disturbance limit of 35 dB L_{Aeq} (internally) with an allowance of 10 dB for the attenuation of an open window to derive the corresponding external noise level and with 2 dB subtracted to account for the use of the L_{A90} noise index rather than the L_{Aeq} .
- 9.27 The ETSU-R-97 night-time limit was partly based on the previous World Health Organisation (WHO) internal noise standard of 35 dB L_{Aeq} . Since the publication of ETSU-R-97, a later WHO document 'Guidelines for Community Noise' reduced the internal night-time noise standard to 30 dB L_{Aeq} "to avoid negative effects on sleep". The same WHO guidelines recommend that "*at night-time, outside sound levels approx. 1 metre from facades of living spaces should not exceed 45dB L_{Aeq} , so that people may sleep with bedroom windows open*". This was based on a reduction of 15 dB for the sound level difference between the inside and outside with an open window. The WHO 45 dB L_{Aeq} external noise limit at 1m from a façade translates to a limit of 42 dB L_{Aeq} in free-field conditions, away from the façade, and is equivalent to 40 dB L_{A90} for wind turbine noise. This more stringent limit based on 40 dB L_{A90} has been adopted here.
- 9.28 Where audible tones are present in the noise spectrum, ETSU-R-97 stipulates that a tonal penalty of up to 5 dB be added to the turbine noise levels. The magnitude of the tonal penalty depends on the audibility of the tone. Modern turbines are designed to suppress tones and therefore it is not appropriate to add any margins to the predictions to account for potential tones. A tonal warranty can be obtained from the turbine supplier.

Institute of Acoustics Good Practice Guide

- 9.29 In May 2013, the IoA published the 'Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (IoA GPG)'. The document was prepared with the purpose of agreeing current good practice in the application of the ETSU-R-97 methodology to wind turbine schemes. The document was prepared by a specialist working group and reviewed by a peer group of professionals working in a variety of relevant disciplines. A discussion of ETSU-R-97 noise limits was excluded from the remit of the working group as these are a matter of Government policy.
- 9.30 The IoA GPG clarified a number of issues relating to noise surveys, noise predictions and on assessing cumulative noise levels.
- 9.31 For noise surveys, the document requires wind shear to be taken into account in the assessment. The preferred method of ensuring this is to measure the wind speed at the turbine hub-height and then convert the data to 10 m height using the standard log-law equation. This ensures that the turbine sound power levels are referenced to the background noise levels derived using the same wind shear assumption. The survey carried out followed this guidance.
- 9.32 The IoA GPG also confirms that ISO 9613-2 should be used for wind turbine noise predictions, with certain stipulations and limitations. This standard is discussed below with supplementary

information on the attenuation factors provided in Appendix 9.1 (ISO 9613-2 Prediction Parameters) – Volume 4.

- 9.33 The IoA GPG identifies various strategies for cumulative assessments. The following principles apply:
- Where a new wind farm is predicted to have noise levels within 10 dB of an existing wind farm, then a cumulative assessment is necessary;
 - For existing wind farms, the cumulative predictions must consider the consented limits under which the scheme can operate; and
 - Whenever a cumulative situation is encountered, the noise limits for an individual wind farm should be determined in such a way that no cumulative excess of the total ETSU-R-97 noise limit would occur.
- 9.34 Cumulative noise levels are discussed in paragraph 9.126.
- 9.35 The IoA GPG should be regarded as a refinement of the ETSU-R-97 guidance to ensure consistency. The Government recommends the use of the document for assessing wind turbines and this assessment follows this guidance.

BS ISO 9613-2: 2024

- 9.36 ETSU-R-97 does not prescribe a calculation method for predicting wind turbine noise. However, in accordance with the Institute of Acoustics Good Practice Guide described above, this study has used BS ISO 9613-2: 2024 'Attenuation of sound during propagation outdoors', with specified input parameters and refinements and in accordance with the IoA GPG.
- 9.37 The propagation model, described in Part 2 of the Standard, allows noise levels to be predicted for short-term downwind conditions, i.e. for wind blowing from the proposed turbine towards the houses. This provides a typical worst-case scenario. When the wind is blowing in the opposite direction, that is when a house is upwind of the turbine, noise levels will be reduced by as much as 10 dB.
- 9.38 Noise from wind turbines is reduced by distance, atmospheric losses, screening effects and other "miscellaneous" losses. Noise levels can be increased or reduced by the interaction of the sound waves with the ground. The ISO propagation model calculates the predicted sound pressure level at a specified distance by taking the sound power level in octave frequency bands and subtracting a number of attenuation factors according to the various losses and the ground effect as described above. The noise level in each octave band can be represented by equation1 below:

$$(1) \text{ Predicted Noise Level } L_{90} = L_{W(eq)} + D - A_{geo} - A_{atm} - A_{gr} - A_{bar} - A_{misc} - 2 \text{ dB}$$

- 9.39 The calculation is carried out for each octave frequency band and then the predicted octave band levels are summed together to give the overall A-weighted predicted sound level. Distance loss (or A_{geo} in the equation above) is the most significant factor. The correction of 2 dB is used to convert the L_{Aeq} levels, as used to describe the turbine sound power, to the L_{A90} parameter, used in the ETSU assessment. Further detail on the attenuation factors and the ISO 9613-2 calculation is provided in Appendix 9.1 (ISO 9613-2 Prediction Parameters) – Volume 4.

British Standard BS 5228 Parts 1 and 2

- 9.40 British Standard (BS) 5228:2009+A1 'Code of Practice for Noise and Vibration Control on Construction and Open Sites' is in two parts: Part 1 covers noise and Part 2 covers vibration. Part 1 does not provide specific limits for construction and decommissioning noise, but it does define methods calculating construction noise and assessing the significance. Information on expected vibration levels from various activities are also provided. The standard also provides practical information on construction noise and vibration reduction measures promoting a 'Best Practicable Means' approach to control noise and vibration.

Design Manual for Roads and Bridges LA111

- 9.41 The Design Manual for Roads and Bridges LA 111 Noise and Vibration sets out the methodology and significance criteria for assessing and quantifying the potential noise impacts associated with changes to the local road network.

Assessment Methodology and Significance Criteria

Construction Noise

- 9.42 A method for calculating noise levels associated with construction activities is provided in BS 5228 which considers the numbers and types of equipment operating, their associated Sound Power Level (L_W), the "on-time" within a working day and the distance to receptors, along with the effects of any screening.
- 9.43 The change in noise levels due to construction traffic has been calculated and compared with the assumed traffic flow for the base year. Information on traffic has been taken from Chapter 8 (Traffic and Transport) – Volume 2. The methodology described in the Calculation of Road Traffic Noise (CRTN) (1988) is used. This provides two equations to describe the increase in noise levels associated with construction traffic, referred to below as Equations 2 and 3:

(2) Increase due to increased flow: $10 \log \left(\frac{q_1}{q_2} \right)$

(3) Increase due to percentage HGVs: $10 \log \left(1 + \frac{5p_1}{v} \right) - 10 \log \left(1 + \frac{5p_0}{v} \right)$

- 9.44 In the equations above, q_1 and q_0 are traffic flows (for all vehicles) and p_1 and p_0 are the percentage of heavy goods vehicles in both cases with and without the development. The parameter v is the traffic speed (in km/h).

Construction Vibration

- 9.45 The simplest approach to quantify vibration impacts is to use the peak particle velocity (PPV) as measured outside the receptor. Part 2 of BS 5228 suggests that for construction activities, it is considered more appropriate to provide guidance in terms of the PPV, since this parameter is usually linked to concerns over potential building damage.

Decommissioning Noise and Vibration

- 9.46 Noise and vibration during decommissioning can potentially result in similar impacts to construction noise and vibration and can be assessed using the same methodology.

Operational Noise

- 9.47 To carry out a noise assessment in accordance with ETSU-R-97 and the IoA GPG, the following steps are required:
- Specify the number and locations of the wind turbines;
 - Carry out initial predictions based on manufacturer's data;
 - Identify the locations of the nearest, or most noise sensitive, receptors;
For locations within the 35 dB L_{A90} contour, determine the daytime amenity hours and night-time background noise levels from measurements at a representative sample of the nearest properties, whilst collecting concurrent wind speed data from the site following ETSU-R-97 guidance;
 - Determine the daytime and night-time noise limits from the measured background noise data. For this application the lower ETSU-R-97 daytime limit of 35 dB L_{A90} or 5 dB above the background noise is imposed. A flat 40 dB L_{A90} limit is applied for the night-time in line with the lower WHO sleep disturbance threshold;
 - Calculate the noise levels using ISO 9613-2 owing to the operation of the wind turbines as a function of site wind speed at the nearest properties;
 - Compare the calculated noise immission levels with the derived ETSU-R-97 noise limits and assess determine compliance with the relevant limits;
 - Where required, identify potential mitigation measures including changes to layout, turbine type and the use of low noise modes; and
 - Identify any cumulative noise issues associated with other existing, consented schemes in the planning system and if necessary, reconsider mitigation.
- 9.48 The study area has been set at approximately 2 km from the turbines and includes the 30 dB L_{A90} noise contour and the residences in Haisthorpe, Thornholme and Burton Agnes. The nearest location in Rudston is also considered. See Figure 9.1, (Noise Contours (dB L_{A90}) at Rated Power) – Volume 3.
- 9.49 Cumulative effects from other wind turbine schemes are to be assessed in accordance with the guidance in the IoA GPG.

Significance Criteria

Construction and Decommissioning Noise

- 9.50 The assessment of construction and decommissioning noise effects have been based on the Lowest Observed Adverse Effect Level (LOAEL) and the Significant Observed Adverse Effect Level (SOAEL) thresholds detailed in Table 9.2 below and derived from Annex E of BS 5228-1. The LOAEL levels are the 'lower cut offs' identified in BS 5228. Noise levels above the SOAEL threshold could result in 'widespread community disturbance or interfere with activities or sleep' and are deemed a significant effect, if exceeded for 'significant' periods of time (either continuously or sporadically).

Table 9.2 Construction / Decommissioning Noise

Adverse Effect Level	Period (Daytime)	Sound Level dB L _{Aeq}
SOAEL	Monday to Saturday	75
LOAEL	Monday to Saturday	65

- 9.51 BS 5228 also states that a significant effect i.e. noise above the SOAEL threshold should not be exceeded for a period of 10 or more days of working in any 15 consecutive days or for a total number of days exceeding 40 in any six consecutive months.
- 9.52 Construction working hours are detailed above. Some limited works may require to be undertaken outside of these hours. This might include extended concrete pours, erection of turbine blades in low wind speed conditions (often at night) and any out-of-hours transport movements of turbine components agreed with the highway authorities. In the event of works to be carried out, outside of the agreed working hours, permission will be sought from the Council setting out the construction hours and any exceptional mechanisms.

Increase in Traffic Noise

- 9.53 The magnitude of any change in traffic noise on roads can be assessed according to the Design Manual for Roads and Bridges (DMRB) (Standards for Highways, 2020). This gives the following guidance in Table 9.3 for the magnitude of the impact in respect of short-term changes in traffic for noise sensitive receptors such as that occurring during the construction phase.

Table 9.3 Significance Criteria for Short-term Increase in Traffic Noise

Change in Traffic Noise Level	Impact	Adverse Effect Level
Less than 1.0 dB	Negligible	NOEL
≥ 1.0 to < 3.0 dB	Minor	LOAEL
≥ 3.0 to < 5.0 dB	Moderate	SOAEL
5.0 dB or more	Major	

- 9.54 Again, a significant adverse effect would only be determined if a Moderate or Major impact occurs for more than 15 consecutive days or for more than 40 days in any six consecutive months.

Construction Vibration

- 9.55 The simplest approach to quantify vibration impacts is to use the peak particle velocity (PPV) as measured outside the building. Part 2 of BS 5228 and DMRB LA 111 suggests that for construction activities, it is considered more appropriate to provide guidance in terms of the PPV, since this parameter is usually linked to concerns over potential building damage. These are set out in Table 9.4.

Table 9.4 Construction and Decommissioning Vibration Thresholds

Adverse Effect Level	Magnitude of Construction Vibration PPV mm/s	Subjective Effect
SOAEL	1.0 mm/s PPV	May cause complaint but will not cause building damage and can be tolerated with advance warning.
LOAEL	0.3 mm/s PPV	Vibration Just Perceptible

- 9.56 Again, a significant adverse effect would only be determined if a Moderate or Major impact occurs for more than 15 consecutive days or for more than 40 days in any six consecutive months.

Operational Noise

- 9.57 Neither ETSU-R-97 nor the associated IoA GPG provide significance criteria. Instead, the ETSU-R-97 noise limits provide a pass/fail test whereby meeting the ETSU-R-97 noise limits will be regarded as Not Significant (below the Significant Observed Adverse Effect Level, SOAEL) and an exceedance of these given as a Significant effect. It is noted in this context that the lower ETSU-R-97 daytime limit (35 dB LA90 or the background noise + 5 dB whichever is the greater) is adopted. This is consistent with avoiding moderate and major impacts.

Assumptions and Limitations

- 9.58 The assessment has been carried out in accordance with best practice as defined by ETSU-R-97 and the Institute of Acoustics Good Practice Guide. The latter was written to reduce uncertainty and to ensure consistency in wind turbine assessments. The calculation method described in the IoA GPG (ISO 9613-2) is stated to have a typical accuracy of ± 3 dB but with the input parameters and restrictions stated. The method is described as obtaining realistic wind turbine noise levels. It is assumed that the turbine blades are fitted with serrated trailing edges to minimise noise levels.
- 9.59 The baseline measurements are also subject to uncertainty and the assessment for Haisthorpe Hall was made on the basis of two weeks data rather than four weeks. Additional data has been lost due to rainfall and periods when the SODAR was unable to determine a reading. Notwithstanding, data collected is compliant with requirements of the IoA GPG for the representative wind speed range. This ensures a robust assessment.
- 9.60 The construction noise and vibration assessment is also subject to uncertainty but the assessment is regarded as very much a worst-case as it is assumed all the construction equipment is located at the nearest possible position to the receptor whereas it will generally be distributed across the site.
- 9.61 In general, any limitations and assumptions are unlikely to affect the outcome of the assessment.

Baseline Conditions and Receptors

- 9.62 The Proposed Development is in a semi-rural area and the nearest locations are either farms or properties in Haisthorpe, Thornholme and Burton Agnes. Traffic noise from the A614 road to Bridlington is a significant source of noise, especially for properties close to the road. Some road noise from the B1253 to the north was audible on setting up the equipment at Manor House Farm. Agricultural activity would also be expected to be heard occasionally although the survey was carried out at a time of the year when there was less farming activity.
- 9.63 There is a small wind turbine at Tuft Hill Farm to the south-west of Manor House Farm. This was not audible at Manor House Farm during set up or collection.
- 9.64 A noise survey was carried out at three locations to determine noise limits for the wind farm. The equipment was set up on 14th October 2025 and collected on 12th November 2025. A visit to the site was made on 29th October 2025 to change batteries and check the calibration.
- 9.65 An AQ510 SODAR Unit was set up by Solar Wheel on the site for the monitoring period to measure wind speed and direction. The SODAR unit was operational from 16th October 2025, so the valid period for the data processing was from 16th October to 12th November 2025.

Measurement Details

- 9.66 The monitoring locations, equipment used and various relevant details are set out in Table 9.5.

Table 9.5 Noise monitoring locations and measurement details

Location	Easting	Northing	Meter	Comments
Manor House Farm	509705	466859	Rion NL52	The monitor was set up on an area of grass close to the house but outside of the main garden and set back from the road the same distance as the house.
East End Farm	511728	463973	Rion NL52	The monitor was set up in a paddock behind the house in a location partially shielded from traffic noise by the house. A tipping bucket rain gauge was also set up in this location. Noise levels at this location are representative of the noise climate at the nearest house in Thornholme, namely, Eastfield to the east of the monitoring location.
Haisthorpe Hall	512663 ,	465010	Larson-Davis LD820	The monitor was set up initially in a field by the Haisthorpe Hall. However, the resident of the hall later granted access to his garden and therefore the monitor was moved on 29 th October to a location in the garden. Traffic noise from the A614 was

Location	Easting	Northing	Meter	Comments
				audible in both locations alongside the noise of the wind in the trees.

- 9.67 For Haisthorpe Hall, only the data logged during the second two-week period within the grounds of Haisthorpe Hall has been used as this is clearly more representative of the conditions at the dwelling. This is also the more sheltered location and therefore has lower noise levels.
- 9.68 The noise monitoring positions are also shown on the noise contour plot Figure 9.1, (Noise Contours (dB L_{A90}) at Rated Power) – Volume 3. Photos of the measurement positions are provided in Appendix 9.2 (Photos of Noise Monitoring Locations) – Volume 4.
- 9.69 The sound level meters were set-up to log various noise levels (dB L_{Aeq}, dB L_{A90}, etc) in 10-minute periods. The microphones were fitted with double-skin windshields in accordance with the recommendations of the IoA GPG and mounted on a pole or on tripods at a height of 1.2-1.5 m above ground level. The time clocks of the sound level meters were synchronised with British Summer Time (BST) at the start of the survey. The clocks changed on 26th October to Greenwich Mean Time (GMT) and the results have been adjusted so that data is averaged within the relevant amenity hours (AH) and night-time periods. The monitors at Manor Farm and East End Farm were also set up to record 1-minute audio samples. This can be useful to assist in the identification of noise sources during the post-processing but is not essential for assessment purposes.
- 9.70 The equipment was calibrated using a Brüel & Kjær Type 4231 sound level calibrator on site. The difference in calibration levels did not exceed 0.3 dB at any location which is within accepted tolerances. The meters and calibrator are calibrated to national standards biennially and annually respectively in line with the recommendations of the IoA GPG and were within their respective calibration periods. Calibration charts for the equipment are provided in Appendix 9.3 (Calibration Charts) – Volume 4.

Determination of the Standardised Wind Speed

- 9.71 For the noise survey, wind speed and direction measurements were made using an AQSystem AQ510 SODAR unit installed on the site at approximate Ordnance Survey grid reference 510894, 465812. A tipping bucket rain gauge was set up at East End Farm to log rainfall.
- 9.72 The Institute of Acoustics' Good Practice Guide requires that wind shear on the site be considered in noise assessments. Therefore, the use of the standardised wind speed at 10 m height is required. This can be derived from the hub height wind speed according to the log law equation describing the variation in wind speed with height above ground (see the equation below) and with the ground roughness set at 0.05m.

$$v_{10} = v_{hh} \times \left(\frac{\ln \left[\frac{10}{z_0} \right]}{\ln \left[\frac{hh}{z_0} \right]} \right)$$

- 9.73 Where v_{10} and v_{hh} are wind speeds at heights of 10 m and hub height respectively, and z_0 is the standard ground roughness length (0.05 m).
- 9.74 The SODAR provides measurements of wind speeds at various heights including 90 m which is close to the turbine hub height (91.4 m) and not significantly different. For this site, the wind speed at 90 m was taken directly from the SODAR data and corrected to the standardised wind speed at 10 m height using the equation above.
- 9.75 The use of the standardised wind speed ensures that both the background noise measurements and predicted wind turbine sound levels are described with the same wind speed reference, i.e. at 10 m height but derived from the hub height wind speed using the same equation. This method allows for wind shear to be factored directly into the background noise measurements to reduce the uncertainties due to the wind shear experienced on site as recommended by the Institute of Acoustics' Good Practice Guide. The wind speed and direction during the survey is shown in Appendix 9.4 (Wind Speed & Direction During Survey) – Volume 4.

Data Processing

- 9.76 The measured noise level, standardised wind speed and rain data have been correlated to obtain time history plots showing the daily variation of noise, wind speed and rainfall. Further inspections of the data have been carried out and in some cases the audio data has been used to identify and exclude spurious noises which are not regarded as typical. Therefore, noise from fireworks, where audible, was excluded on November 5th and 8th. However generally there were few such periods identified.
- 9.77 The valid data (without rain and other spurious events) from the time history plots has been sorted into data sets for the ETSU daytime and night-time periods and then plotted to obtain scatter plots showing the variation of background noise versus the standardised wind speed for the ETSU-R-97 daytime AH and night periods. These scatter plots are shown in Appendix 9.5. (Noise and Wind Speed Scatter Plots) – Volume 4. Best-fit trendlines are plotted for background noise values. Noise samples recorded during rain and any spurious samples are also shown on the scatter plots although these are not included in trendline for the prevailing background noise. The predicted noise level for the property is also shown. The background noise values (L_{A90} dB) calculated from the derived trendlines are presented in Table 9.6 for standardised wind speeds from 4 to 11 m/s at 10 m height.

Table 9.6 Prevailing Background Noise Levels from Survey (AH = Amenity Hours)

Location	Period	Prevailing Background Noise Levels dB L _{A90} at Standardised Wind Speeds (m/s) at 10 m Height							
		4	5	6	7	8	9	10	11
Haisthorpe Hall	AH Day	36.1	36.0	36.7	38.3	40.3	42.8	45.4	48.2
	Night	28.6	30.0	32.3	35.1	38.3	41.7	45.0	48.1
East End Farm	AH Day	38.2	39.0	40.2	41.6	43.2	45.0	46.9	48.9
	Night	27.0	29.2	31.9	34.9	38.1	41.3	44.3	47.1
Manor House Farm	AH Day	24.2	26.1	28.6	31.4	34.6	37.8	40.9	43.7
	Night	20.8	22.8	25.5	28.8	32.4	36.3	40.1	43.7

- 9.78 At all locations noise levels are influenced by wind, and noise levels at wind speeds of 10 m/s and above exceed 40 dB L_{A90}. The results for the (daytime amenity hours) at East End Farm and at Haisthorpe Hall are also affected by traffic noise and there is a noticeable difference between the daytime amenity hours (AH) and night-time noise levels. There is also considerable scatter evident in the scatter plots as the AH periods include evenings, Saturday afternoons and Sunday daytime and traffic noise level would be expected to be variable.
- 9.79 Manor House Farm is however much further from the A614 road and noise levels are significantly lower and more consistent. There is also only a small difference here between the daytime AH and the night-time data with reduced scatter in the data. This indicates that noise levels at this location are predominantly determined by the wind speed, although there is a small effect of traffic noise during the day.
- 9.80 Noise limits will be set in relation to these results in accordance with ETSU-R-97. The lower daytime limit is adopted (35 dB L_{A90} or the background noise level +5 dB(A) whichever is the higher). At night a flat limit of 40 dB L_{A90} has been imposed for the reasons discussed above. This is lower than the 43 dB L_{A90} permitted under ETSU-R-97. Note it is not proposed to increase turbine noise levels at night even though a higher limit may sometimes be derived.

Baseline Evolution

- 9.81 It is not expected that the baseline will change significantly in the coming years although there may be seasonal variations.
- 9.82 The consented Three Oaks Renewable Energy Park including the battery storage area and substation will be built out and operational ahead of the Proposed Development but predicted noise levels from this were very low and less than 30 dB L_{A90} at the nearest locations, which are in Haisthorpe. This is lower than the measured baseline noise levels and therefore operation of consented Three Oaks Renewable Energy Park (including the substation relied upon for the Proposed Development (see Chapter 2 (Project and Site Description) – Volume 2 for further information)) will not significantly affect the baseline noise levels.
- 9.83 The baseline descriptions above represent the year 2025. Appendix 4.1 (Climate Projection) – Volume 4 of the ES provides an overview of the likely changes in climatic conditions at the site resulting from climate change across the lifespan of the Proposed Development. It is not

considered that the climatic projection identified would have a material impact upon the condition of the baseline as identified in this chapter.

Primary & Tertiary Mitigation

Primary Mitigation

- 9.84 The layout of the wind farm has been developed to include separation distances between the turbines and residential properties to avoid overbearing effects and reduce noise levels. The wind turbine blades will be provided with trailing edge serrations to reduce noise levels. Modern turbines are designed to suppress tones and therefore it is not appropriate to add any margins to the predictions to account for potential tones. The manufacturer of the wind turbines procured for the site will be required to provide a warranty to ensure sound power levels will not exceed a certain value and that tones are also controlled. These are examples of primary mitigation. Tertiary mitigation is not relevant for this site.

Assessment of effects

Construction / Decommissioning

Onsite Construction Noise

- 9.85 The typical plant likely to be used on site for construction activities comprises: various excavators (30/40 tonne, and 10/20 tonne), a tracked bulldozer, dump trucks, vibrating rollers and two cable laying vehicles. This equipment would be used to build the access tracks and hardstandings etc.
- 9.86 Two cranes would be used to erect the turbines, typically one of 500-600 tonne capacity and one of 100-200 tonne capacity. Concrete mixer trucks would also make regular trips to the site during foundation construction. Concrete will be poured by a mobile concrete pump. Various deliveries on flatbed trucks would be made e.g. steel reinforcement, carrying cables, building materials and the turbine components during the construction period. Note also that as the ground conditions are unknown, using impact-driven piles as part of the turbine foundations cannot be ruled out and is thus considered as part of this assessment.
- 9.87 For decommissioning, it is assumed the concrete bases are broken out to below ground level using a hydraulic breaker attached to an excavator and the calculations are based on this activity.
- 9.88 In carrying out the noise predictions, it has been assumed that all plant involved with track construction, hardstandings and turbine bases are located at the nearest possible location to each property; that is, the nearest turbine base location or the nearest part of an access track. It should be noted that this is unlikely to occur in practice, but gives very much worst-case noise levels. The plant assumed for each activity at each construction location is shown in Table 9.7.

Table 9.7 Construction Equipment

Location / Activity	Item	No. of Items
Construction Compound/Hard Standing Access Roads	Excavator	3
	Dozer	1
	Rollers	2
	Flat Beds	2
	Dump Truck	3
Excavate Turbine Bases	Excavator	2
	Dump Truck	3
	Rollers	2
	Dozer	1
Concrete Turbine Foundations	Impact Piling Rig (If Required)	1
	Concrete Pump	1
	Concrete Mixer	2
	Poker Vibrators	2
	Flat Bed Lorries	2
Erect Turbines	Flat Bed Lorries	2
	600 tonne Crane	1
	200 tonne Crane	1
Decommissioning	Dump Truck	3
	Excavator	2
	Dozer	1
	Excavator with Breaker	1

9.89 For the calculations, the soft ground equation in BS 5228 has been used throughout with no topographical barrier attenuation. BS5228 allows an adjustment for the percentage of the day that the plant items operate to calculate the overall noise from a site. This is indicated in Table 9.8.

Table 9.8 Typical On-site Construction Equipment

Plant	BS 5228 Reference	No. of Items	Noise Level at 10m from source (dB L _{Aeq})	On-Time (% of the working day)
25 tonne Excavator	C2 19	3	77	50
30-40 tonne Excavator	C2 14	1	79	50
Excavator with Breaker	C1 1	1	92	80
Roller	C2 37	2	79	70
20 tonne Dozer	C2 12	2	81	30
29 tonne Dump Truck	C2 30	3	79	30

Impact Piling Rig (Hydraulic)	C3 1	1	89	80
Concrete Pump/Mixer	C4 28	3	75	70
Poker Vibrator	C4 33	2	78	80
Tracked Mobile Crane (e.g. 600 tonne)	C4 50	1	71	30
Tracked Mobile Crane (e.g. 100-200 tonne)	C4 52	1	75	30
Flat Bed / Hiab	C4 53	2	77	30

- 9.90 The results of the construction noise predictions are summarised in Table 9.9 below. The nearest properties to the north-west, south and east are considered for the duration of the construction. The property 'Safety Cottage' has also been included in addition to Eastfield in Thornholme as these are the nearest locations to the proposed widening of the site access road at the junction with the A614. Noise levels at all other locations will be lower than shown.

Table 9.9 Predicted Noise Levels from on-site construction activity

Activity	Predicted Noise Level dB L _{Aeq}			
	Haisthorpe Hall	Safety Cottage	Eastfield	Manor House Farm
Access tracks, hardstandings	40	67	65	36
Impact Piling (If Required)	44	41	42	40
Excavate Turbine Bases	40	37	37	35
Concrete Turbine Bases	39	36	37	35
Erect Turbines (Cranes)	32	29	29	27

- 9.91 It can be seen from the table above that noise levels generated during construction are generally low. Noise levels at the most easterly properties in Thornholme may briefly exceed the LOAEL threshold (65 dB L_{Aeq}) during the widening of the site access road from the A614 however this will be a short-term effect only for a very limited period. Noise levels do not exceed the SOAEL threshold. There will be no significant adverse impact of noise during construction.

Construction Vibration

- 9.92 Some levels of ground-borne vibration may be generated by activities such as installing impact drive piles (if required). However, the separation distances involved would attenuate the levels of vibration to imperceptible levels at the receptors, resulting in no significant impacts.
- 9.93 Given the above, no further assessment of ground-borne construction vibration has been undertaken in this chapter

Noise and vibration from Construction Traffic

- 9.94 In this case the site access is directly from the A614 which is a fairly busy road. Using the data in Chapter 8 (Traffic and Transport) – Volume 2 of this ES, the increase in noise has been predicted using equations (2) and (3) above. For the base year there is a daily flow of 404 HGVs through Thornholme within a total flow of 10,165 vehicles (AADT). In the peak construction period, there will be a total of 95 additional vehicles with 67 HGVs using this section. The calculated increase in traffic noise is less than 1 dB and negligible. The same is true for all other route segments and therefore negligible noise from construction traffic is insignificant.
- 9.95 It is possible that HGVs may generate some perceptible vibration when passing close to existing houses, but only where existing HGV traffic would already do so. Given the number of additional HGVs is small compared with the existing traffic there will be no vibration impact. Therefore, vibration from the development will be below the SOAEL.

Decommissioning

- 9.96 The worst-case noise levels during decommissioning would be expected to occur when breaking out the above-ground part of the turbine bases. A prediction for this activity is detailed in Table 9.10 below.

Table 9.10 Predicted Noise Levels from on-site decommissioning activity

Activity	Predicted Noise Level dB L _{Aeq}			
	Haisthorpe Hall	Safety Cottage	Eastfield	Manor House Farm
Decommissioning	47	44	45	42

- 9.97 Noise levels at all receptors are generally low and do not exceed the LOAEL threshold. There will be no significant adverse impact during decommissioning from noise or vibration.

Operation

- 9.98 Computer noise modelling software (IMMI) implementing the BS ISO 9613-2: 2024 methodology described above has been used to predict noise levels from the wind turbines. The following modelling assumptions have been made in line with the current agreed best practice described in the Institute of Acoustics Good Practice Guide:
- Downwind conditions to reflect the worst-case in terms of propagation;
 - A +2 dB margin is applied to the turbine sound power data to account for uncertainty;
 - mixed ground absorption ($G=0.5$) is assumed with a receiver height of 4 metres;
 - ambient air temperature of 10 °C and 70% relative humidity;
 - barrier attenuation where applicable (e.g., from terrain ridges) is limited to 2 dB;
 - there is no allowance made for attenuation from forestry or shielding from structures; and
 - the +3 dB valley correction has been applied where the condition is met.

- 9.99 To carry out the modelling, the terrain information has been obtained from Ordnance Survey data and imported into the model.

Turbine Noise Levels

- 9.100 The candidate turbine for the Proposed Development comprises six Vestas V117 wind turbines with a 91.4 m hub height (149.9 m to blade tip). The turbine blades should be fitted with serrated trailing edges (STE) to reduce noise levels.
- 9.101 The variation in noise with the standardised wind speed at 10 m height is set out below in Table 9.11. The manufacturer's data sheet is provided in Appendix 9.6 (Vestas V117 Sound Power Data) – Volume 4. An uncertainty factor of +2 dB has been added to the noise data to account for uncertainty.

Table 9.11 Sound Power Levels for Vestas V117 4.2 MW turbines with STE

Turbine	A-Weighted Sound Power Levels dB $L_{WA(eq)}$ at Standardised Wind Speeds (m/s) at 10 m Height							
	4	5	6	7	8	9	10	11
V117 4.2 MW with STE	98.0	102.2	106.0	107.9	108.0	108.0	108.0	108.0

- 9.102 It can be seen in Table 9.11 above that the turbine sound power output is flat above a wind speed of 8 m/s at 10m height. Therefore, there will be no increase in sound level above 8 m/s and it is not necessary to obtain background noise data at high wind speeds.
- 9.103 To carry out the predictions, a frequency spectrum must be used. The octave band frequency spectrum of the Vestas V117 Turbine with STE has been obtained from the manufacturer's data sheet. This has been corrected to a maximum sound power level of 108.0 dB including +2 dB uncertainty. The spectrum used in the calculations is shown in Table 9.12 below.

Table 9.12 Sound Power Levels for Vestas V117 4.2 MW turbines with STE

Turbine	Overall Sound Power dB L_{WA}	A-Weighted Sound Power Levels dB $L_{WA(eq)}$ at Octave Band Centre Frequencies, Hz							
		63	125	250	500	1000	2000	4000	8000
V117 4.2 MW	108.0	88.3	95.5	100.3	102.6	102.4	99.7	94.6	86.9

- 9.104 For commercial reasons, it is not possible to state which turbine will definitely be used at this stage. The final choice of turbine will depend on many factors, including compliance with the noise limits established within this chapter. The options will be studied carefully by the developer and turbine supplier when the turbines are procured and will be selected to be compliant with the planning noise limits.

Predicted Turbine Noise Levels

- 9.105 The noise predictions have been carried out in the first instance as a noise contour plot for the Vestas V117 turbine. The contour plot is shown in Figure 9.1, (Noise Contours (dB L_{A90}) at Rated Power) – Volume 3. It can be seen that most locations are outside the 35 dB L_{A90} contour (which is the lowest ETSU-R-97 noise limit) except for the nearest locations in Haisthorpe and Thornholme. A more detailed analysis is required for locations within the 35 dB L_{A90} contour, with the predictions compared with the background noise and limits derived in relation to the background at various wind speeds.
- 9.106 The predictions have been carried out to selected noise-sensitive receptors representing the nearest locations in Haisthorpe, Thornholme, Burton Agnes and Rudston. The results are shown in Table 9.13 for noise levels at rated power (8-10 m/s at 10 m height). The approximate grid reference and plan distance to the nearest turbine is also stated. These locations are also shown in Figure 9.1.

Table 9.13 Predicted Wind Turbine Noise Levels at Selected Receptors

Location	Easting	Northing	Noise Level at Rated Power dB L _{A90}	Distance (m) to nearest Turbine
Haisthorpe Hall	512663	465010	37.5	939 m (T6)
Home Farm	512636	464884	37.2	961 m (T6)
Rose Cottage	512680	464924	37.0	985 m (T6)
White House Farm	512710	464810	36.4	1061 m (T6)
Low Farm	512754	464570	35.2	1226 m (T6)
Breeze Farm	512733	464620	35.5	1180 m (T6)
Eastfield	511780	464004	36.5	1190 m (T5)
Safety Cottage	511867	463983	36.1	1244 m (T5)
East End Farm	511728	463973	36.5	1201 m (T5)
West End	511280	463734	35.6	1223 m (T4)
Park Farm	510706	463291	32.5	1556 m (T4)
Manor House Farm	509715	466823	33.1	1432 m (T1)

- 9.107 For the properties within the 35 dB L_{A90} noise contour and for Manor House Farm where noise monitoring was also carried out, a more detailed analysis can be carried out to assess noise levels against the ETSU-R-97 daytime and night-time limits. For this analysis the lower ETSU-R-97 daytime limit (35 dB L_{A90} or 5 dB above background, whichever is greater) is assumed and a night-time limit based on a flat 40 dB L_{A90} limit. The daytime limit is capped at 45 dB L_{A90} at high wind speeds.
- 9.108 The results are set out in Tables 9.14 to 9.16 for the three noise monitoring locations. A margin of compliance is given with a positive value indicating compliance with the limit.

Table 9.14 ETSU-R-97 Analysis for Haisthorpe Hall

Haisthorpe Hall	Noise Levels dB L _{A90} at Standardised Wind Speeds (m/s) at 10 m Height							
	4	5	6	7	8	9	10	11
Predicted Turbine Noise Levels	27.5	31.7	35.5	37.4	37.5	37.5	37.5	37.5
Daytime Assessment								
Background Noise	36.1	36.0	36.7	38.3	40.3	42.8	45.4	48.2
Lower ETSU Daytime Limit	41.1	41.0	41.7	43.3	45.0	45.0	45.0	45.0
Margin of Compliance	13.6	9.3	6.2	5.9	7.5	7.5	7.5	7.5
Night-time Assessment								
Background Noise	28.6	30.0	32.3	35.1	38.3	41.7	45.0	48.1
ETSU-R-97 Night Limit based on 40 dB(A)	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
Margin of Compliance	12.5	8.3	4.5	2.6	2.5	2.5	2.5	2.5

9.109 Haisthorpe Hall has the highest turbine levels of the Haisthorpe properties. It is also furthest from the road and partially sheltered from road traffic noise by the intervening farms. Therefore, as turbine noise levels meet the limits at Haisthorpe Hall, other locations in Haisthorpe will also be meet the noise limits.

9.110 For properties in Thornholme within the 35 dB L_{A90} contour, the highest noise levels occur at East End Farm and Eastfield to the east of the village. The baseline noise levels measured at East End Farm have been used to provide an assessment of Eastfield which is next door and has similar noise levels but must meet the standard ETSU-R-97 noise limits. The analysis is set out below.

Table 9.15 ETSU-R-97 Analysis for Eastfield / East End Farm

Eastfield / East End Farm	Noise Levels dB L _{A90} at Standardised Wind Speeds (m/s) at 10 m Height							
	4	5	6	7	8	9	10	11
Predicted Turbine Noise Levels (Eastfield)	26.5	30.7	34.5	36.4	36.5	36.5	36.5	36.5
Daytime Assessment								
Background Noise (East End Farm)	38.2	39.0	40.2	41.6	43.2	45.0	46.9	48.9
Lower ETSU Daytime Limit	43.2	44.0	45.0	45.0	45.0	45.0	45.0	45.0
Margin of Compliance	16.7	13.3	10.5	8.6	8.5	8.5	8.5	8.5
Night-time Assessment								
Background Noise (East End Farm)	27.0	29.2	31.9	34.9	38.1	41.3	44.3	47.1

Eastfield / East End Farm	Noise Levels dB L _{A90} at Standardised Wind Speeds (m/s) at 10 m Height							
	4	5	6	7	8	9	10	11
ETSU-R-97 Night Limit based on 40 dB(A)	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
Margin of Compliance	13.5	9.3	5.5	3.6	3.5	3.5	3.5	3.5

9.111 The results above indicate compliance with a good margin. Eastfield represents the nearest property in Thornholme and therefore as compliance is achieved here all other properties in Thornholme will also be acceptable.

9.112 Noise levels at the nearest locations in Burton Agnes and Rudston are outside the 35 dB L_{A90} contour and therefore are acceptable irrespective of the background noise. Nevertheless, an assessment for Manor House Farm is given below for completeness.

Table 9.16 ETSU-R-97 Analysis for Manor House Farm

Manor House Farm	Noise Levels dB L _{A90} at Standardised Wind Speeds (m/s) at 10 m Height							
	4	5	6	7	8	9	10	11
Predicted Turbine Noise Levels	23.1	27.3	31.1	33.0	33.1	33.1	33.1	33.1
Daytime Assessment								
Background Noise	24.2	26.1	28.6	31.4	34.6	37.8	40.9	43.7
Lower ETSU Daytime Limit	35.0	35.0	35.0	36.4	39.6	42.8	45.0	45.0
Margin of Compliance	11.9	7.7	3.9	3.4	6.5	9.7	11.9	11.9
Night-time Assessment								
Background Noise	20.8	22.8	25.5	28.8	32.4	36.3	40.1	43.7
ETSU-R-97 Night Limit based on 40 dB(A)	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
Margin of Compliance	16.9	12.7	8.9	7.0	6.9	6.9	6.9	6.9

9.113 In summary, noise levels are comfortably within the ETSU-R-97 noise limits in all cases. There is no significant impact from operational noise.

Other Operational Noise Effects

Vibration, Low Frequency Noise and Infrasound

9.114 Vibration from wind turbines has been measured by extremely sensitive measurement equipment such as seismic arrays but in terms of human perception, measured vibration levels

are well below perception thresholds even on the actual wind turbine sites. There is, therefore, no impact from operational vibration as a result of wind turbine developments.

- 9.115 Infrasound, low frequency noise and vibration are often reported as noise issues in the media. Infrasound is usually defined as sound below 20Hz, whereas the frequency range for low frequency sound is often taken to be from 10Hz to 200Hz.
- 9.116 Infrasound and low frequency noise can be measured from wind turbines. However various studies have found no evidence of health effects from infrasound or low frequency sound.
- 9.117 The Institute of Acoustics Statement on Wind Farm Noise Assessment from December 2024 indicates that there is no need for IoA members to assess Vibration, Low Frequency Noise or Infrasound as the absolute noise levels are too low to trigger adverse effects. These are therefore scoped out of assessment within this ES due to the unlikelihood of significant effects.

Amplitude Modulation

- 9.118 Since 2005 / 2006 a phenomenon known as Amplitude Modulation (AM) has been found to be a factor in some noise complaints in ways not anticipated by ETSU-R-97. ETSU-R-97 described blade swish, which is a form of AM, but is only heard relatively close to the turbines. The term Other Amplitude Modulation (OAM) is sometimes used to differentiate low frequency, far-field amplitude modulation from blade swish, but it is not necessary to make a distinction when considering the effect at residential properties.
- 9.119 AM is defined as periodic fluctuations in the level of audible noise from a wind turbine (or wind turbines), the frequency of the fluctuations being related to the blade passing frequency of the turbine rotor(s). For a three-bladed turbine rotating at 20 revolutions per minute (rpm), this equates to a fluctuation in noise once per second. The wind industry trade body, Renewable UK, in December 2013 published research into AM. This included theoretical research on mechanisms causing the problem and subjective tests to determine a dose-response relationship. More recently, the IoA has published an agreed numerical rating method and a further Government-commissioned report by WSP PB (GOV.UK, 2016) has considered how the issue might be addressed in respect of planning.
- 9.120 The IoA AM rating method has been adopted in the WSP report, with recommendations on how a penalty mechanism might be incorporated into a planning condition. The wording of a possible planning condition was agreed between various noise consultants and published in Acoustics Bulletin; however, the form and application of any penalty scheme is not agreed, and the wording of a planning condition has yet to be approved in any Government guidance.
- 9.121 Although, at present it is not possible to assess the likelihood of AM occurring at the planning stage, it has been successfully controlled where it has occurred and the published IoA rating mechanism and the emergence of a possible planning condition indicates that there are mechanisms for controlling AM. No further consideration is therefore given to AM within this assessment.

Secondary Mitigation

Construction Noise and Vibration

- 9.122 The proposed CEMP see Appendix 2.1 (outline CEMP) – Volume 4, (which includes detail on the control of construction noise and vibration which will be managed via a site specific construction noise management plan (CNMP)) is an example of secondary mitigation which will be provided and secured by condition.

Operational Noise

- 9.123 Although turbine noise levels are well within the applicable limits, it is possible that wind turbine noise will be audible at a low level under certain downwind conditions especially during the night when traffic noise levels are lower. However, noise levels are well below sleep disturbance thresholds. The assessments above demonstrate that the scheme will comply with an ETSU noise condition and therefore there is no requirement for secondary mitigation for operational noise.

Assessment of Residual Effects

Construction / Decommissioning Noise

- 9.124 There will be residual effects from construction and decommissioning noise, but they will be no worse than identified in the initial assessment of effects and are not significant.

Operation

- 9.125 The residual effects remain as assessed above in the section on Predicted Turbine Noise Levels and are not significant.

Cumulative Effects

- 9.126 A list other wind turbine schemes is available in Appendix 4.2 (Long List of Cumulative Schemes) – Volume 4. Typically, only those within 2 km of the Proposed Development are of interest, however schemes beyond 2 km were also reviewed where a potential cumulative interaction could arise. The nearest operational wind farm to the Proposed Development is Fraithorpe at over 3 km from Haithorpe. At such a distance, there will be no significant cumulative effects from this scheme.
- 9.127 In addition, there is an existing Endurance 50 kW turbine at Tuft Hill Farm. This is a small turbine some 1740 m from Manor House Farm. Permission has been obtained to replace this turbine with a reconditioned Vestas V29 model with a sound power level of around 100 dB L_{WA} including uncertainty. Predicted noise levels from distance propagation alone are less than 25 dB L_{A90} at Manor House Farm and therefore there will be no cumulative impact from this turbine.

- 9.128 There is another small turbine at Denby Farm, Rudston which has just been granted permission to a replacement (Ref 25/03235/PLF). This is approximately 3 km from Manor House Farm and again not significant.
- 9.129 Planning consent has been obtained for the two large wind turbines at the eastern end of the Carnaby Industrial Estate. Planning permission was granted in 2010 but no turbines have been installed and the current status is unclear although a technical start has been carried out in respect of construction works to site access. The Environmental Statement for the Carnaby turbines indicates that predicted noise levels of around 38 dB LA90 at a location in Carnaby (Brookfield Close). Consequently, noise levels in Haisthorpe will be less than 35 dB LA90. This may not be 10 dB below the predicted noise levels from the Proposed Development, however any cumulative effect will be small and it is further noted that receptors in Haisthorpe would be sited in between the two schemes such that the worst-case conditions (that is downwind propagation) cannot occur for the two schemes at the same time. In practice any cumulative effect will be negligible and not significant.
- 9.130 In respect of other developments there is a consented extension to Haisthorpe Water Treatment some 350 m east of Haisthorpe Hall. The extension includes for new nitrate removal plant and salt separators and associated equipment. The noise report submitted with the application indicates low predicted sound levels for 21 and 19 dB(A) at the nearest residential location in Haisthorpe (the Cottage, East Back Side). These are very low sound levels well below the background noise levels and there will be no cumulative noise effect.
- 9.131 There are no other developments identified within Appendix 4.2 (Long List of Cumulative Schemes) – Volume 4 which would result in cumulative effects either in respect of noise from construction traffic or operational noise. Therefore, there are no significant cumulative effects from other schemes in the area and further consideration of cumulative effects is not necessary.

Summary and Conclusions

- 9.132 An assessment has been made of the noise impact of the Proposed Development during the construction and operational and decommissioning phases. The operational noise assessment has been undertaken according to ETSU-R-97 and the IoA GPG. These are the guidance documents recommended in Government planning advice for onshore wind turbines. In terms of operational noise, the development can meet noise limits based on the measured background noise locations which are representative of the nearest receptors. Noise levels at all other locations are very low in absolute terms. No significant environmental effects, including cumulative effects, associated with operational noise at any stage of the Proposed Development are identified.
- 9.133 Noise during construction and decommissioning will be insignificant for activity on the main wind farm site. Some audible noise will occur from the transportation of construction material and wind farm components however this is predicted to be negligible when compared with baseline traffic flows. Construction noise can be managed with a CEMP.

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