11 NOISE

11.1 INTRODUCTION

This chapter of the EIAR assesses the effects of the Proposed Development from noise impacts. The Proposed Development refers to all elements of the application for the proposed Tirawley Wind Farm (**Chapter 2: Development Description**). The assessment considers the potential effects during the following phases of the Proposed Development:

- Construction of the Proposed Development
- Operation of the Proposed Development
- Decommissioning of the Proposed Development

The Proposed Development refers to all elements of the application for the construction and operation of the Wind Farm including the grid connection, road traffic to the Wind Farm Site, and the 110 kV Substation (**Chapter 2: Development Description**).

This chapter of the EIAR is supported by the Figures in **Volume III** and following Technical Appendices documents provided in **Volume IV** of this EIAR:

- **Technical Appendix 11.1:** Photos of noise monitors in-situ
- **Technical Appendix 11.2**: Methodology for calculating wind shear, different hub heights and standardising hub height wind speed
- **Technical Appendix 11.3**: Derived background noise levels, background plus 5 trendline with the predicted noise levels against a noise limit of 43dB(A) at each receptor
- **Technical Appendix 11.4**: SoundPlan noise outputs
- **Technical Appendix 11.5**: Calibration certificates of noise instruments
- **Technical Appendix 11.6**: Candidate turbine manufacturer's noise emission data

11.1.1 Statement of Authority

Irwin Carr Consulting is based in County Down. The company has a proven track record in noise impact assessments throughout the UK and Ireland, with extensive knowledge of the issues in relation to noise from wind energy developments. Mark Burke and Shane Carr carried out the noise modelling in this assessment and contributed to the report. Mark is a Consultant in Irwin Carr Consulting, primarily responsible for environmental noise and noise monitoring. He has experience working in both the public and private sectors having previously obtained a BSc (Hons) Degree in Environmental Health. Shane is a Director in Irwin Carr Consulting, primarily responsible for environmental noise and noise modelling. He has over 22 years' experience working in both the public and private sectors having previously obtained a BSc (Hons) Degree in Environmental Health and a Post-Graduate

Diploma in Acoustics. Shane has been responsible for undertaking and reviewing noise impact assessments on numerous large scale wind farms throughout the UK and Ireland.

Brendan O'Reilly has a Master's degree in noise and vibration from Liverpool University and has over 40 years' experience in noise and vibration control (and many years' experience in preparation of noise impact statements) and has been a member of a number of professional organisations. Brendan was a co-author and project partner (as a senior noise consultant) in 'Environmental Quality Objectives Noise in Quiet Areas' administered by the EPA. Brendan has considerable experience in the assessment of noise impact and has compiled studies for over 100 wind farm developments throughout Ireland, north and south. Brendan carried out the baseline study.

11.1.2 Acoustic Terminology

Sound is simply the pressure oscillations that reach our ears. These are characterised by their amplitude, measured in decibels (dB), and their frequency, measured in Hertz (Hz). Noise is unwanted or undesirable sound, it does not accumulate in the environment, is transitory, fluctuates, and is normally localised. Environmental noise is normally assessed in terms of A-weighted decibels, dB (A), when the 'A weighted' filter in the measuring device elicits a response which provides a good correlation with the human ear. The criteria for environmental noise control are of annoyance or nuisance rather than damage. In general, a noise level is liable to provoke a complaint whenever its level exceeds by a certain margin, the pre-existing noise level or when it attains an absolute level. A change in noise level of 3 dB (A) is 'barely perceptible', while an increase in noise level of 10 dB (A) is perceived as a twofold increase in loudness. A noise level in excess of 85 dB (A) gives a significant risk of hearing damage. Construction and industrial noise sources are normally assessed and expressed using equivalent continuous levels, LAeq[1]. Wind turbine source noise is generally expressed in Leq dBA and in sound power levels (LWA dB). Sound power level is a measure of the noise source while sound pressure level is a measurement taken at a distance from the noise source carried out with a noise meter.

Operational wind turbine noise is assessed using the LA90[2] descriptor, which allows reliable measurements to be made without corruption from relatively loud transitory noise events from other sources. The LA90 should be used for assessing both the wind energy development

[1] L_{Aeq} is defined as being the A-weighted equivalent continuous steady sound level that has the same sound energy as the real fluctuating sound during the sample period and effectively represents a type of average value.

[2] LA90, or L90dBA is defined as the noise level equaled or exceeded for 90% of the measurement interval and with wind farm noise the interval used is 10 minutes.

noise and background noise as stated in the 2006 and 2019 (draft) Irish wind energy development guidelines. As discussed in ETSU-R-97[3] the LA90 is 1.5-2.5 dBA less than the LAeq measured over the same period. In this assessment, the difference between LAeq and LA90 is given as 2 dBA which is best practice and the value most commonly applied in wind farm assessments in Ireland. Wind turbine noise levels are given as sound power levels (LWA) dB at integer wind speeds up to maximum LWA levels. **Table 11.1** gives a comparison of noise levels in our everyday environment.

Table 11.1: Comparison of sound pressure level in our Environment[4]

Source/Activity	Indicative noise level dBA
Threshold of hearing	0
Rural night-time background	20-50
Quiet bedroom	35
Wind farm at 350 m	35-45
Busy road at 5 km	35-45
Car at 65 km/hr at 100 m	55
Busy general office	60
Conversation	60
Truck at 50 km/hr at 100 m	65
Inside a typical shopping centre	70-75
Inside a modern car at around 90 km/hr	75-80
Passenger cabin of jet aircraft	85
City Traffic	90
Pneumatic drill at 7 m	95
Jet aircraft at 250 m	105
Threshold of pain	140

11.1.3 Assessment Structure

This Chapter contains the following sections:

- Assessment Methodology and Significance Criteria – a description of the methods used in baseline surveys and in the assessment of the significance of effects
- Baseline Description - a description of the baseline noise of the area surrounding the Proposed Development based on the results of surveys, desk information and consultations, and a summary of any information required for the assessment that could not be obtained
- Assessment of Potential Effects - identifying the ways in which noise receptors could be affected by the Proposed Development, including a summary of the measures taken during design of the Proposed Development to minimise noise effects

[3] ETSU-R-97, The Assessment & Rating of Noise from Wind Farms, June 1996

[4] Fact sheet published by the Australian Government (Greenhouse Office) and the Australian Wind Energy Association

- Mitigation Measures and Residual Effects - a description of measures recommended to off-set potential negative effects and a summary of the significance of the effects of the Development after mitigation measures have been implemented
- Cumulative Effects – identifying the potential for effects of the Proposed Development to combine with those from other wind farm developments
- Summary of Effects
- Statement of Significance

11.2 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

11.2.1 Assessment Methodology

This assessment has involved the following elements, further details of which are provided in the following sections:

- Legislation and guidance review
- Desk study, including review of available maps and published information
- Site walkover
- Evaluation of potential effects
- Evaluation of the significance of these effects
- Identification of measures to avoid and mitigate potential effects

11.2.2 Description of Effects

The significance of effects of the proposed development is described in accordance with the EPA guidance document '*Guidelines on the information to be contained in the Environmental Impact Assessment Reports (EIAR), EPA May 2022'*. The details of the methodology for describing the significance of effects are provided in Table 3.4: Section 3.7.3 of the aforementioned EPA 2022 document.

11.2.3 Relevant Legislation and Guidance

The noise assessment is carried out in accordance with the guidance contained in the following documents:

- Wind Energy Development Guidelines (WEDG)[5] (the 2006 Guidelines)
- Recent 2022 An Bord Pleanála Decisions on Noise Limits
- WHO 2018 Environmental Noise Guidelines for European Region (WHO 2018)
- Draft Revised Wind Energy Development Guidelines December 2019 (DRWEDG 2019)

[5] Department of Environment, Heritage and Local Government: Wind Energy Development Guidelines, Guidelines for Planning Authorities 2006 Energy

- A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise including Supplementary Guidance Note 4: Wind Shear'6 (the IOA Good Practice Guide)
- ISO 19967 Acoustics-Description and Measurement of Environmental Noise - Part 1: Basic Quantities and Procedures (ISO 1996)
- ETSU-R-978: The Assessment & Rating of Noise from Wind Farms (ETSU-R-97)
- Institute of Acoustics Amplitude Modulation Working Group[9], WSP Turbine AM Review[10] and IEC 61400[11]
- Guidance Note for Noise: License Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)[12]
- National Roads Authority (NRA) Guidelines for the Treatment of Noise and Vibration in National Road Schemes, 2004
-

11.2.3.1 Wind Energy Development Guidelines 2006

The following are a number of key extracts from the 2006 Guidelines in relation to noise impact:

General Noise Impact

"*Noise impact should be assessed by reference to the nature and character of noise sensitive locations*."

"*Separate noise limits should apply for day-time and for night-time*"

"Noise limits should be applied to external locations and should reflect the variation in both turbine source noise and background noise with wind speed."

Measurement Units

"The descriptor [LA90 10min] which allows reliable measurements to be made without corruption from relatively loud transitory noise events from other sources, should be used for assessing both wind energy development noise and background noise."

[6] Institute of Acoustics (2013) A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise
[7] ISO 1996/1- Acoustics-Description and Measurement of Environmental Noise - Part 1: Basic Quantities and Procedures
[8] ETSU-R-97: Acoustics-The Assessment & Rating of Noise from Wind Farms: ETSU for the DTI, UK, 1996
[9] IOA Noise Working Group (Wind Turbine Noise) Amplitude Modulation Working Group, Final Report, A Method for Rating Amplitude Modulation in Wind Turbine Noise, August 2016
[10] Wind Turbine AM Review, Phase 2 Report, Department of Energy & Climate Change, WSP/Parsons Brinckerhoff, August 2016
[11] IEC Technical Specification 61400-11-2 Wind energy generation systems – Part 11-2: Acoustic noise measurement techniques – Measurement of wind turbine sound characteristics in receptor position, 2024
[12] Guidance Note for Noise: Licence Application, Survey and Assessments in relation to Scheduled Activities (NG4), Environmental Protection Agency Office of Environmental Enforcement (OEE), January 2016

Specific Noise Limits

"Noise limits should be applied to external locations and should reflect the variation in both turbine source noise and background noise with wind speed."

"In general, a lower fixed limit of 45 dB(A) or a maximum increase of 5 dB(A) above background noise at nearby noise sensitive locations is considered appropriate to provide protection to wind energy development neighbours.

However, in very quiet areas, the use of the margin of 5 dB(A) above the background noise at nearby noise sensitive properties is not necessary to offer a reasonable degree of protection and may unduly restrict wind energy developments. Instead in low noise environments where background noise is less than 30 dB(A), it is recommended that the daytime level of LA90,10min of the wind energy development noise should be limited to an absolute level within the range 35-40 dB(A)".

"During the night the protection of external amenity becomes less important and the emphasis should be on preventing sleep disturbance. A fixed limit of 43 dB(A) will protect sleep inside properties during the night"

The 2006 Guidelines do not specify daytime or night-time hours. However, it is considered good practice to follow the framework given in ETSU-R-97 and IOA Good Practice Guide where daytime and night-time hours are specified. The limits are based on the prevailing background noise level for 'quiet daytime' periods, defined in ETSU-R-97 as:

- Quiet waking hours or quiet day-time periods are defined as:
  - All evenings from 18:00 to 23:00 hrs
  - Saturday afternoon from 13:00 to 18.00 hrs and all-day Sunday 07:00 to 18:00 hrs
- Night-time is defined as 23:00 to 07:00 hrs

11.2.3.2 An Bord Pleanála

2022 An Bord Pleanála Decision

A recent decision by ABP for a wind farm (ABP-309306-21, dated 26th September 2022) gave noise limits in accordance with the 2006 Guidelines and were as follows:

(a) between 7am and 11pm:
  (i) the greater of 5 dB(A) L90,10 min above background noise levels, or 45 dB(A) L90, 10 min, at wind speeds of 5m/s or greater,
  (ii) 40 dB(A) L90, 10 min, at all other wind speeds.

(b) 43 dB(A) L90,10 min at all other times

where wind speeds are measured at 10 metres above ground level.

11.2.3.3 World Health Guidelines (WHO) 2018

The most recent WHO 2018 Guidelines: 'Environmental Noise Guidelines for the European Region' gives a recommendation limit of 45 dB Lden which is based on low quality evidence. This is an annual average noise level, based on wind speed and direction in the vicinity of the Wind Farm Site with no specific limits for night.

11.2.3.4 Draft Revised Wind Energy Development Guidelines 2019 (DRWEDG 2019)

There have been a number of draft guidelines over the years with the latest one being in December 2019. The DRWEDG 2019 guidelines, currently in draft format are subject to significant public and stakeholder consultation and liable to change, in line with best practice.

A tender has been issued by the Department of Environment, Climate and Communications to review and re-draft the Wind Energy Development Guidelines. This process has yet to be completed.

This assessment is based on the current guidance outlined in **Section 11.2.3.1**.

11.2.4 Desk Study

The locations for noise monitoring were selected by inspection of Site layout maps and by identifying the nearest receptors surrounding the wind turbines. The Noise Study Area has been defined such that the predicted results have been included for all residential receptors within 2 km of the Wind Farm Site.

The eight noise monitoring locations are considered representative of the local noise environment.

11.2.5 Acquisition and Analysis of Background Noise Data

The 2006 Guidelines, ETSU-R-97 and the IOA Good Practice Guide recommend the measurement and use of wind speed data, against which background noise measurements are correlated. The IOA Good Practice Guide Supplementary Guidance Note 4[13]. (**Technical Appendix 11.2**) gives the methodology to account for wind shear, calculation to hub height and to standardise 10 m height wind speed.

[13] IOA, A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise-Supplementary Guidance Note 4: Wind Shear

A LiDAR positioned within the Wind Farm Site during the noise survey was used for wind data measurements over 10-minute intervals.

The wind speed at the 76.5 m hub height of the proposed wind turbines was then standardised to 10 m height wind speed with the wind speed plotted against the 10-minute background noise data to derive a best fit polynomial curve.

11.2.6 Prediction of Wind Turbine Noise Levels

The predicted noise levels are based on the methodology given in the IOA Good Practice Guide. Noise level calculations are based on ISO 9613-2[14] which provides a prediction of noise levels likely to occur under worst-case down-wind conditions.

There are numerous models for predicting noise from a point source and some of these models are specifically used for the prediction of noise from wind farms. In this noise assessment the SoundPLAN software package was used to calculate the noise level at the receptors. The propagation model calculates the predicted sound pressure levels by taking the source sound power level for each turbine in their respective octave bands and subtracting a number of attenuation factors according to the following formula:

$$\text{Predicted Octave Band Noise level} = LW + D - (A_{geo} + A_{atm} + A_{gr} + A_{br} + A_{mis})$$

The predicted octaves from each of the turbines are summed to give the predicted noise level expressed as dBA.

No allowance has been made for the character of noise emitted by the turbines, however in general the emissions from wind turbines are broadband in nature. In the unlikely event of a turbine exhibiting clearly tonal components at any receptor, the turbine would be turned down or stopped until such tonality is ameliorated. A guarantee will be required in the procurements of the turbine to be used onsite, stating that there should be no clearly tonal or impulsive components audible at any noise sensitive receptor location.

A_{geo} –Geometric Spreading

Geometric (spherical) spreading from a simple free-field point source results in attenuation over distance according to:

$$Lp = Lw - (20 \log R + 11)$$

Where:

[14] ISO 9613-2 Acoustics -Attenuation of sound during propagation outdoors, Part 2: General Method of Calculation

Lp = sound pressure level
Lw = sound power level
R = distance from the turbine to receiver
D – Directivity Factor

The directivity factor allows for adjustment where the sound radiated in the direction of the receptor is higher than that for which the sound power level is specified. In this case, the sound power levels are predicted as worst case propagation conditions, i.e. all receptors are assumed to be in downwind conditions.

A_{gr} - Ground Effects

Ground effect is the result of sound reflected by the ground interfering with the sound propagating directly from the turbine to receiver. The prediction of ground effects is complex and depends on the source height, receiver height, propagation height between the source and receiver and the intervening ground conditions.

Ground conditions are described according to a variable defined as G, which varies between 0 for hard ground and 1 for soft ground. Although in reality the ground is predominately porous, it has been modelled as mixed 50 % hard and 50 % porous corresponding to a ground absorption coefficient of 0.5. Our predictions have been carried out using a source height corresponding to the proposed height of the turbine nacelle, a receiver height of 4 m and an assumed ground factor of G=0.5 as recommended in the IOA Good Practice Guide.

A_{bar}- Barrier Attenuation

The effect of a barrier (including a natural barrier) between a noise source and receptor is that noise will be reduced according to the path difference (difference between the direct distance between source to receptor and distance between source and receptor over the barrier). The reduction is relative to the frequency spectrum of the sound and may be predicted according to the method given in ISO 9613. In practice, barriers can become less effective in downwind conditions. A barrier can be very effective when it lies within a few metres of the receptor. In the prediction model, zero attenuation is given for barrier effects, which is a worst-case scenario setting.

A_{atm} - Atmospheric Absorption

Sound emergence through the atmosphere is attenuated by conversion of sound energy to heat. This energy is dependent on the temperature and relative humidity of the air, but only

weakly on ambient pressure through which the sound is travelling and is frequency dependent, with increasing attenuation towards higher frequencies. The attenuation by atmospheric absorption A_{atm} in decibels during propagation through distance in metres is given by:

$A_{atm} = d \times \alpha$,

α = atmospheric absorption coefficient in dBm^{-1}

d = distance from turbine

Values of α from ISO 9613 Part 1, corresponding to a temperature of 10 ^{0}C and a relative humidity of 70 % has been used for these predictions and are given in **Table 11.2** below. These values are recommended in the IOA Good Practice Guide.

Table 11.2: Frequency dependent atmospheric attenuation coefficients (dB/m)

Octave Band Centre Frequency (Hz)	63	125	250	500	1k	2k	4k	8k
Atmospheric Absorption Coefficient (dB/m)	0.0001	0.0004	0.001	0.0019	0.0037	0.0097	0.0328	0.117

A_{misc} – Miscellaneous Other Effects

ISO 9613 includes effects of propagation through foliage, industrial plants and housing as additional attenuation effects. These have not been included here and any such effects are unlikely to significantly reduce noise levels below those predicted.

The ISO 9613-2 standard calculates under downwind propagation conditions and therefore predicts the average downwind sound pressure level at each dwelling. The model assumes that the wind is directly downwind from each turbine to each dwelling. The prediction model is calculated as a worst-case scenario.

The predicted noise levels $L_{Aeq\ 10min}$ are converted to the required $L_{A90,10min}$ by subtracting 2 dBA.

11.2.7 Aerodynamic Modulation or Aerodynamic Noise

Aerodynamic noise originates from the flow of air over, under and around the blades and is generally broadband in character. It is directly linked to the movement of the rotors through the air and will occur to varying degrees whenever the turbine blades move. Aerodynamic noise is generally both broadband i.e. it does not contain a distinguishable note or tone, and of random character, although the level is not constant and fluctuates in time with the movement of the blades. The dominant character of such aerodynamic noise is therefore normally a

'swish' type of sound, which is familiar to most people who have stood near to a large wind turbine.

The sound level of aerodynamic noise from wind turbine blades is not completely steady but is modulated (fluctuates) in a cycle of increased and then reduced level, sometimes called "*blade swish*", typically occurring in step with the angle of rotation of the blades and so being periodic at the rotor's rotational speed – for typical commercial turbines, this is at a rate of around once or twice per second. This phenomenon is known as Amplitude Modulation of Aerodynamic Noise or more succinctly by the acronym AM. In some situations, however, the modulation characteristics can change in character to the point where it can potentially give rise to increased annoyance.

In early wind turbine designs, where the rotor was positioned downwind of the tower, a pronounced 'beat' was audible as each blade passed through the turbulent wake shed from the tower. However, this effect does not exist for the upwind rotor designs found on the majority of modern wind farms where the air flow to the blades is not interrupted by the tower structure. Instead, it seems that aerodynamic modulation is due to fluctuation of the primary mechanisms of aerodynamic noise generation.

The most recent information in relation assessing AM comes in the IEC TS 61400-11. The scope of this document includes an assessment of the sound characteristics of the noise and relies on the Institute of Acoustics Reference Method (IoA RM) to quantify the AM level along with the WSP Phase 2 Report which identified a penalty scheme as shown **Plate 11.1** below.

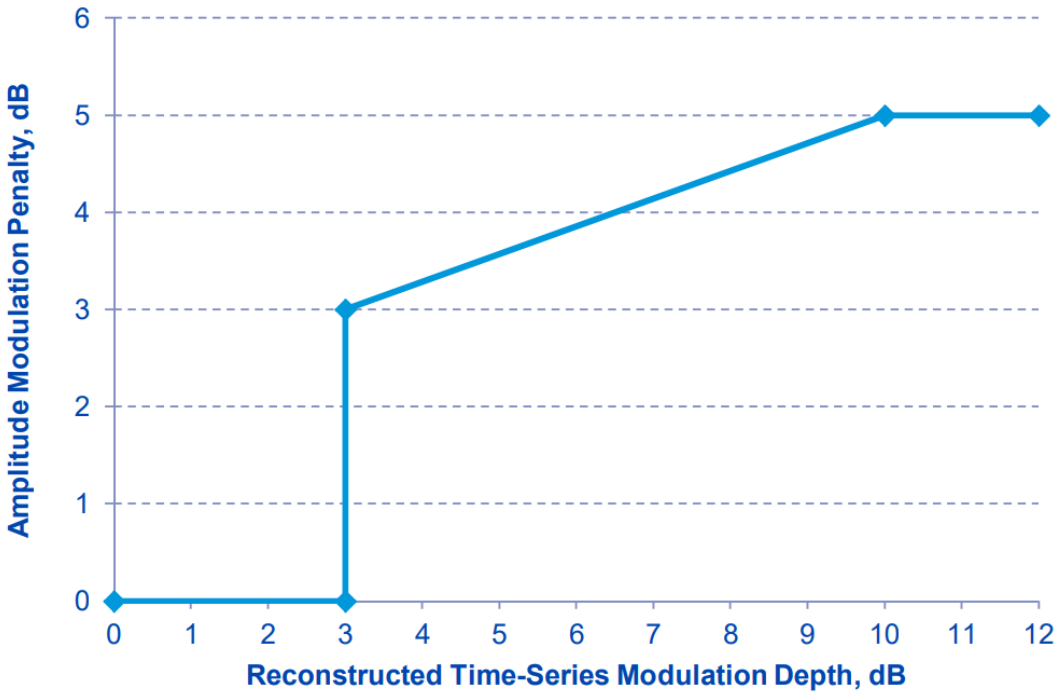

Plate 11.1: Proposed Penalty Scheme

Current scientific knowledge is such that AM cannot be predicted at the planning stage, but can only be measured once the wind farm becomes operational.

The methodology contained within the IoA RM and IEC 61400 allows quantification of all aspects of AM and the penalty scheme identified above allows quantifivation of the mitigation required, if any. An appropriate penalty can be added onto the measured LA90 noise level, to ensure overall noise levels comply with the applicable noise limit.

11.2.8 Infrasound and Low Frequency Noise and Vibration

There is always low frequency (or infrasound) noise present in the ambient quiet background. It is generated by natural sources such as road traffic, wind effects through air and vegetation, wave motion, water flow in streams and rivers. There are also low frequency emissions from many sources found in modern life, such as household appliances (e.g., washing machines, air conditioners, fridges, heating systems, boilers, burners, heat pumps, extraction systems, electric or battery clocks, sky box, etc.). Other sources include water flowing through pipes within your home and in water flow from municipal water supply. Vibration of elements of structures (low frequency, less than 20 Hz) can be generated by local activity in one's home by way of normal routine activity, like climbing stairs, walking on the floor, closing doors etc. When sitting in a moving vehicle very high levels of low frequency vibration/sound is experienced.

The frequency range of audible noise is in the range of 20 to 20,000 Hz and low frequency noise is generally from about 2 to 200 Hz with infrasound typically of frequencies below 20 Hz. There appears to be little or no agreement about the biological effects of low frequency noise on human health and there is evidence to suggest that there are no serious consequences to people's health from infrasound exposure.

A study of low frequency noise (infrasound) and vibration around a modern wind farm was carried out for ETSU and reported in ETSU W/13/00392/REP – '*Low Frequency Noise and Vibration Measurements at a Modern Wind Farm*'[15]. The results showed levels of infrasound to be below accepted thresholds of perception even on the Site. Furthermore, a document prepared for the World Health Organisation, states that *"there is no reliable evidence that infrasound below the hearing threshold produce physiological or psychological effects".*

Significant research carried out on low frequency noise has been in the area of blasting (air overpressure) which falls into a very low frequency range (2-20 Hz), although with a considerably higher magnitude. Interestingly most microphones recording air-overpressure (low frequency sound) is linear down to 2 Hz with a range that does not go below a level of 88 dB, as below that value trigger can occur from relatively low wind speeds (a gust of wind at 9 m/s equates to an air overpressure of 133 dB).

The level of ground vibration from the operation of the wind farms is below human threshold of 0.2 mm/s[16] at the base of a turbine.

South Australian Environment Protection Authority (EPA) Infrasound Study

A report released in January 2013 by the South Australian EPA[17] found that the level of infrasound from wind turbines is insignificant and no different to any other sources of noise, and that the worst contributors to household infrasound are air-conditioners, traffic and noise generated by people. The study included several houses in rural and urban areas, houses both adjacent to a wind farm and away from turbines and measured the levels of infrasound with the wind farms operating and also switched off. There were no noticeable differences in the level of infrasound under all these different conditions. In fact, the lowest levels of infrasound were recorded at one of the houses closest to a wind farm, whereas the highest levels were found in an urban office building. The South Australian study found: '*the*

[15] ETSU W/13/00392/REP – '*Low Frequency Noise and Vibration Measurements at a Modern Wind Farm*'.
[16] Wiss, J. F., and Parmelee, R. A.. (1974) Human Perception of Transient Vibrations, "*Journal of Structural Division*", ASCE, Vol 100, No. S74, PP. 773-787
[17] http://www.epa.sa.gov.au/environmental_info/noise/wind_farms

contribution of wind turbines to the measured infrasound levels is insignificant in comparison with the background level of infrasound in the environment'.

Massachusetts Institute of Technology (MIT)

A report by an Independent Expert Panel prepared for Massachusetts Department of Health (2012)[18] consisted of a panel that included seven individuals with backgrounds in public health, epidemiology, toxicology, neurology and sleep medicine, neuroscience, and mechanical engineering, all of which were considered independent experts from academic institutions. The report found that *"there is insufficient evidence that the noise from wind turbines is directly (i.e., independent from an effect on annoyance or sleep) causing health problems or disease'* and '*available evidence shows that infrasound levels near wind turbines cannot impact the vestibular system"*.

Technical Research Centre of Finland

A long-term study into so-called "wind turbine syndrome"[19] health problems supposedly caused by low-frequency sound from spinning blades has concluded that this "infrasound" has absolutely no physical impact on the human body.

The study conducted by the Technical Research Centre of Finland (VTT) and others, commissioned by the Finnish government, found that infrasound sound waves with frequencies below the range of human hearing cause no measurable changes in the human body, and cannot in any way be detected by the human ear.

Infrasound measurements were taken inside and outside local dwellings near two Finnish wind farms, as well as inside the facilities and beyond them, for 308 days.

Measurements showed that the infrasound levels in rural areas with wind farms were about the same as levels in a regular urban environment.

"Infrasound samples representing the worst-case scenarios were picked out from the measurement data and used in the listening tests," said VTT.

[18] Infrasound Does Not Explain Symptoms Related to Wind Turbines, Finnish Government, June 2020, https://www.vttresearch.com/en/news-and-ideas/vtt-studied-health-effects-infrasound-wind-turbine-noise-multidisciplinary

[19] Report by Leigh Collins, 21st April 2020 on a study commissioned by the Finnish Government into infrasound and wind turbine syndrome

"The participants in the listening tests were divided into two groups based on how they reported wind turbine infrasound related symptoms: people who suffered from those and people who never had symptoms."

"The participants were unable to make out infrasonic frequencies in wind turbine noise, and the presence of infrasound made no difference to how annoying the participants perceived the noise, and their autonomous nervous system did not respond to it. There were no differences between the results of the two groups."

11.2.9 Guidance Note for Noise: License Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)

It is a requirement of the Environmental Protection Agency to ensure that relevant licensed activities do not result in significant impact on the environment; this includes noise impact on the human environment. The Environmental Protection Agency (EPA) has produced a relevant guidance document NG4[20].

When an Agency licence includes conditions relating to noise emissions, this would normally entail specified numerical noise limits which are not to be exceeded. These limits may apply to individual sources of noise on the site itself, at the boundary of the site or at the nearest Noise Sensitive Location (NSL).

The setting of noise limits at any or all of these locations may be required, and the assignment of such limits will be decided during the licensing process for the facility. All reasonably practicable measures should be adopted at licensed facilities to minimise the noise impact of the activity, and BAT should be used in the selection and implementation of appropriate noise mitigation measures and controls.

While BAT must be applied on a case-by-case basis, the noise attributable solely to on-site activities, expressed as a free field value at any NSL, should not generally exceed the values given below.

- Daytime (07:00 to 19:00hrs) – 55 dB $L_{Ar,T}$
- Evening (19:00 to 23:00hrs) – 50 dB $L_{Ar,T}$
- Night-time (23:00 to 07:00hrs) – 45 dB $L_{Aeq,T}$

[20] Guidance Note for Noise: Licence Application, Survey and Assessments in relation to Scheduled Activities (NG4), Environmental Protection Agency Office of Environmental Enforcement (OEE), January 2016

11.2.10 Field Work

Baseline noise monitoring was undertaken during two measurement periods, firstly between 20th April and 16th May 2023 and secondly between 22nd September 2023 and 12th October 2023 at the locations shown in **Technical Appendix 11.1**. Two continuous measurement periods were undertaken in order to gather sufficient wind speed monitoring data, which was completed over the same period at the same 10-minute intervals using a Lidar located on Site. Noise data was recorded for a representative range of wind speeds during the monitoring period.

11.2.11 Consultation

Consultation was carried out with landowners who were familiar with the Wind Farm Site. Access to the nearest dwellings was carried out with permission from the householders / landowners.

11.2.12 Noise Assessment Methodology

In summary, the assessment process comprised:

- Identification of potential receptors, i.e., houses and other potentially noise-sensitive locations;
- Measurement of existing background noise levels at representative locations close to the Wind Farm Site;
- Prediction of the noise levels from wind turbines received at each receptor; and
- Comparison of the predicted noise levels with noise limits.

Potential receptors in the area around the Proposed Development were initially identified from Ordnance Survey maps, google maps, EPA maps and Site visits. Background measurements were carried out at the locations shown in **Technical Appendix 11.1**.

The method of measuring background noise is described in ISO 1996 and ETSU-R-97. In practice, it means carrying out continuous monitoring of background noise levels at receptors for a period that includes a range of wind speeds which correspond to the maximum sound power of the candidate turbines being proposed which is usually 3 to 4 weeks duration. The candidate turbine assessed reaches maximum sound power level at a mean wind speed of 8 m/s at 10 m height and generates the highest noise level for that turbine specification.

The method of predicting noise levels of wind turbines at receptors is discussed in **Section 11.2.3.2**. This method was applied to the calculations for both contour plots and individual receptor predictions.

It is standard practice to predict noise levels for a reference wind speed and to adjust these for other wind speeds, according to the variation in sound power level with wind speed.
For EIA purposes of the EIA technical assessment, one candidate turbine has been considered. The Vestas V117, 4.3 megawatts (MW) operating in Mode PO2, with serrated trailing edge (STE), has been selected with a hub height of 76.5m. The tip of the blades with STE lowers noise emissions without reducing energy output, and the selected turbine will have STE as standard. The worst-case sound power level at each wind speed from 4 m/s to 12 m/s was input into the noise model.

A copy of the manufacturers performance specification for the turbines used in the assessment when operating in Mode PO2 with STE is given in the **Technical Appendix 11.6**.

The prediction modelling is based on the turbines operating at full power and all turbines fitted with STE which reduces noise emissions of each turbine. The IOA Good Practice Guide recommends that an uncertainty value is required to be added to the turbine emission data prior to modelling. Depending on the type of manufacturer's data, the uncertainty value will range from 0 to 2 dBA. However, as no uncertainty is given in the manufacturer's data sheet, an uncertainty value of 2 dBA is applied in line with the IOA GPG. **Table 11.3** and **Table 11.6** presents the noise emission data for the turbine type up to maximum sound power output at varying wind speed at 76.5 m hub height. **Table 11.4** and **Table 11.7** presents the maximum sound power output at varying wind speed (presented at standardised 10m height) for the turbine type with a hub height of 76.5 m. A value of 2 dBA is subtracted to account for conversion from LAeq to LA90 which is best practice.

Table 11.3: Noise Emission Data, Vestas V117-4.3 MW, STE at Maximum Sound Power (LWA dB) at Hub Height (76.5 m) at varying wind speeds

Hub Height Wind Speed, ms^{-1}	4	5	6	7	8	9	10	11	12
Sound Power Level, dB LWA at Varying Wind Speeds	92.2	94	97	100	102.8	105.1	106	106	106
Uncertainty added and conversion of LAeq to LA90	92.2	94	97	100	102.8	105.1	106	106	106

Table 11.4: Noise Emission Data, Vestas V117-4.3 MW, STE at Maximum Sound Power (LWA dB) at Standardised 10m Height wind Speed

Standardised 10m Height Wind Speed ms^{-1}	4	5	6	7	8	9	10	11	12
Sound Power Level dB LWA derived from 76.5m hub height	95.5	99.6	103.4	105.7	106	106	106	106	106
Uncertainty added and Conversion of LAeq to LA90	95.5	99.6	103.4	105.7	106	106	106	106	106

The octave band values are given in **Table 11.5** for the V117–4.3 MW with uncertainty values and conversion for LAeq to LA90 added as input to the prediction model.

Table 11.5: Octave Band Spectrum of Vestas V117-4.3 MW, STE at Maximum Sound Power (LWA dB) at 12 m/s wind speed

Octave Band Frequency (Hz)	63	125	250	500	1k	2k	4k	8k	L_{WA}
Sound Power Level, dB LWA at max sound power level	86.4	93.5	98.2	100.5	100.4	97.8	92.9	85.4	**106.0**
Uncertainty added to octaves and conversion of LAeq to LA90	86.4	93.5	98.2	100.5	100.4	97.8	92.9	85.4	

There shall also be an onsite battery energy storage system (BESS) erected on the site, in a close proximity to the proposed 110 kV substation. The proposed BESS shall contain 20 battery containers with associated transformers and inverters.

The final equipment manufacturer has yet to be confirmed, but there will be two main components onsite which will generate noise. The maximum noise levels that will be generated are presented below with the noise levels associated with the ancillary equipment presented in **Table 11.9.**

Table 11.9: Frequency Spectrum Octave Data

Octave Band Frequency (Hz)	63	125	250	500	1k	2k	4k	8k	L_{WA}
Battery Container	48.8	57.9	67.4	74.8	79.0	75.2	70.0	59.9	**82**
Inverter Unit & Transformer	55.7	71.1	73.6	74.1	74.7	76.8	80.5	70.1	**84**

11.2.12.1 Noise Limits

The method of deriving operational noise limits, described in **Section 11.2.2.1,** is based on the Wind Energy Development Guidelines 2006 and lower limits specified in a recent An

Bord Pleanála decision, described in **Section 11.2.3.2**. The noise limits for the Tirawley Wind Farm are designed to meet the limits outlined by ABP (ABP-309306-21, dated 26th September 2022) in accordance with the 2006 Guidelines and were as follows:

(c) between 7am and 11pm:

(iii) the greater of 5 dB(A) L90,10min above background noise levels, or 45 dB(A) L90, 10min, at wind speeds of 5m/s or greater,

(iv) 40 dB(A) L90, 10min, at all other wind speeds.

(d) 43 dB(A) L90,10min at all other times

where wind speeds are measured at 10 metres above ground level. Where properties are financially involved, a 45dB(A) L90,10min limit can be applied.

11.2.13 Construction Assessment Methodology

11.2.13.1 Relevant Guidance

There is no published national guidance relating to the maximum permissible noise level that may be generated during the construction phase of a project. However National Roads Authority (NRA) give limit values which are acceptable (the NRA Guidelines)[21]. Guidance to predict and control noise is also given in BS 5228:2009-1+A12014, *Code of Practice for Noise and Vibration Control on Construction and Open Sites* (two parts) where Part 1 deals with Noise[22].

11.2.13.1.1 NRA Guidelines for the Treatment of Noise and Vibration in National Road Schemes

The NRA Guidelines provide noise limits which are acceptable and states, where it is deemed necessary to predict noise levels associated with construction noise, that this should be done in accordance with BS 5228.

[21] National Roads Authority, *Guidelines for Noise and Vibration in National Road Schemes.*
[22] BS 5228-1: 2009 Code of Practice for Noise and Vibration Control on Construction and Open Sites: *Code of Practice for Basic Information and Procedures for Noise Control*.

11.2.13.1.3 BS 5228: 2009-1A; 2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites

Part 1 of BS 5228 deals with noise prediction and control. It recommends procedures for noise control in respect of construction operations. The standard stresses the importance of community relations, and states that early establishment and maintenance of the relations throughout the carrying out of Site operations will go some way towards allaying people's concerns. Some of the more relevant factors that are likely to affect the acceptability of construction noise are:

- The attitude of local residents to the Proposed Development
- Site location relevant to noise sensitive receptors
- Duration of Site operations
- Hours of work
- The characteristics of the noise produced.

Recommendations are made regarding the supervision, planning, preparation and execution of works, emphasising the need to consider noise at every stage of the activity. Measures to control noise are described including:

Control of noise at source by, e.g.

- Substitution of plant or activities for less noisy ones
- Modification of plant or equipment by less noisy ones
- Using noise control enclosures
- Siting of equipment and its method of use
- Maintenance of equipment
- Controlling the spread of noise by increasing distance between plant and receptors, or by the provision of acoustic screening

Example criteria for the assessment of the significance of noise effects are also given, although these are not mandatory.

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

11.2.13.2 Construction and Decommissioning Noise Assessment Methodology

The NRA guidelines for construction noise which are considered acceptable are given in **Table 11.9**.

Table 11.9: Noise levels that are considered acceptable based on the NRA guidelines

Day / Times	Guideline Limits
Monday to Friday 07:00 – 19:00hrs 19:00 – 22:00hrs	 70dB LAeq, (1h) and LAmax 80dB *60dB LAeq, (1h) and LAmax 65dB*
Saturday 08:00 – 16:30hrs	 65dB LAeq,1h and LAmax75dB
Sunday and Bank Holidays 08:00 – 16:00hrs	 *60dB LAeq,1h and LAmax 65dB*

*Construction at these times, other than required by an emergency works, will normally require explicit permission from the relevant local authority, in this case Mayo County Council.

Construction Times for the Proposed Development

The construction times for this Proposed Development are:
Monday to Friday: 07.00 to 19.00 hrs, Saturday 08.00 to 13.00 hrs with no work on Sunday, or Bank Holidays.

Part 1 of BS 5228 provides several example criteria for the assessment of the significance of noise effects from construction activities. Noise levels generated by construction activities are considered significant if:

- The LAeq, period level of construction noise exceeds lower threshold values of 65 dB during daytime, 55 dB during evenings and weekends or 45 dB at night.
- The total noise level (pre-construction ambient noise plus construction noise) exceeds the pre-construction noise level by 5 dB or more for a period of one month or more
  .

Construction noise from wind farm development, or decommissioning is not considered an intensive activity. The main noise sources will be associated with the construction of the Turbine Foundations and Turbine Hardstands. Lesser noise source activity will be construction of Site Access Tracks, Temporary Construction Compounds, turbine erection and the construction of a 110 kV electrical substation.

Decommissioning will likely involve the remediation of Turbine Hardstand Areas and Turbine Foundations, where they will be covered in topsoil and allowed to revegetate. Site Access Tracks will likely be left in-situ for use by the landowners. Underground Internal Wind Farm Cables will be removed, and the ducting left in-situ. Therefore, the decommissioning phase is likely to be shorter and less intrusive than the construction phase with the resultant effects being less.

All workers associated with the Proposed Development will be subject to the Health and Safety Authority Guidance[23] which states that for noise exposure noise levels likely to exceed 80 dBA (expressed as Lep,d 8 hour dBA) there is the potential of risk of damage to hearing. All workers onsite will be given guidance on how to comply with the 'First Action Level'.

11.2.14 Evaluation of Potential Effects

The potential impacts of construction are evaluated by comparing the predicted noise levels against the guideline limits given in **Table 11.9:** Noise levels that are considered acceptable based on the NRA guidelines**,** and sample criteria in Part 1 of BS 5228 in **Section 11.2.12.2**. The potential operational impacts are evaluated by comparing the predicted noise levels against the day and night-time noise limits given in **Section 11.3.6**. The predicted noise levels are calculated according to the IOA Good Practice Guide as detailed in **Section 11.2.6** and potential impacts are assessed against the noise limits at the nearest receptors.

11.2.14.1 Sensitivity

The sensitivity of the Proposed Development during construction is based on the guideline values in **Table 11.9:** Noise levels that are considered acceptable based on the NRA guidelines**,** and sample criteria in Part 1 of BS 5228. The sensitivity of the Proposed Development during operation is based on the values in **Section 11.3.4** and **Section 11.4.2**.

11.2.14.2 Magnitude

The magnitude of potential impacts of construction is based on the values in **Table 11.14.** The magnitude of the Proposed Development during operation is based on the values in **Table 11.15**.

[23] Noise - Frequently Asked Questions - Health and Safety Authority (hsa.ie)

11.2.14.3 Significance Criteria

The significance of construction is based on the potential impacts based on the predicted values and compliance with the guideline limits in **Table 11.9** and sample criteria in Part 1 of BS 5228.

The significance of the potential impacts of the Proposed Development have been assessed by taking into account the noise limits at receptors and the degree to which compliance has been met.

11.3 BASELINE DESCRIPTION

11.3.1 Identification of Potential Receptors

A number of predictions were prepared for the layout of the Wind Farm. Based on the initial layout, potential noise-sensitive receptors, including occupied and un-occupied dwellings, were identified from maps. Receptor locations were verified through visits to the area surrounding the Proposed Development.

11.3.2 Selection of Baseline Noise Survey Locations

Eight baseline noise survey locations were selected on the basis of their locations relative to the turbine layout.

11.3.3 Baseline Noise Survey

Baseline noise measurements were carried out continuously during two periods, firstly between 20th April and 16th May 2023, and again between 22nd September and 12th October 2023 at the receptor locations given in **Table 11.10** (Photos of monitors in-situ in **Technical Appendix 11.1**).

Table 11.10: Baseline Noise Survey

Location	ITM Reference	Description of Location
NML 1 – H7	514628E, 834072N	Monitor located approximately 8m from the end of the house with the main noise sources being low levels off traffic flow and wind effects on vegetation.
NML 2 - H37	516337E, 832024N	Monitor located approximately 35m from the rear of the house with the main noise sources being traffic on nearby roads and local domestic activity.
NML 3A	515513E, 833755N	Monitor located approximately 10m from the end of the house with the main noise sources being low levels of traffic flow, farming activity and wind effects on vegetation.
NML 5 – H103	516678E, 834560N	Monitor located approximately 5m from the old school in proximity to this receptor, with the main

Location	ITM Reference	Description of Location
		noise sources being traffic on local roads and low level farming activity.
NML 7 - Quarry	517084E, 837579N	The main noise sources being distant noise from the sea, low level traffic flow and farming activity.
NML 8 - H108	517041E, 835575N	Monitor located approximately 5m from the end of the house with the main noise sources being distant noise from the sea, low level traffic flow and wind effects on vegetation.
NML 9 - H19	513601E, 835338N	Monitor located approximately 5m from the end of the house with the main noise sources being traffic on local roads and low level farming activity.
NML 831 - H14	516653E, 832742N	Monitor located approximately 5m from the end of the house with the main noise sources being traffic flow on nearby roads.

The survey was carried out in accordance with ISO 1996, ETSU-R-97 and the IOA Good Practice Guide with the following implemented:

- Measurement of background noise levels at 10-minute intervals was undertaken using Type 1 instruments.
- Concurrent measurements of noise and mean wind were made at 10-minute intervals with the mean wind speed recorded from a LiDAR on the Proposed Development Site. The methodology is given in **Section 11.2.5**.
- The background noise measurement recorded continuously included 10-minute intervals, as LA90, 10min along with a series of other parameters including LAeq,10min.
- Noise measurements were recorded at a height of 1.2-1.5m above ground level and more than 5m from any reflective surface, other than the porous ground.
- An electronic rain gauge was installed onsite at NML 8 - H108 to monitor rainfall at 10-minute intervals over the duration of the noise survey. Rain data which impacted on noise levels were removed from the noise data set prior to analysis.
- The standardised 10m wind speed was plotted against the time synchronised background noise levels using a best-fit polynomial line.

11.3.3.1 Instrumentation Used

The following instrumentation was used in the baseline survey measurements:

- Larson Davis Precision Integrating Sound Level Analyser/Data logger with 1/2" Condenser Microphones. Microphone was fitted with double skin windscreens based on that specified in W/31/00386/REP 'Noise Measurements in Windy Conditions[24]'.
- Calibration Type: Larson Davis Precision Acoustic Calibrator.

[24] W/31/00386/REP 'Noise Measurements in Windy Conditions'.

- Rain Gauge Type: TR-525met tipping bucket rain gauge, 0.2mm pulse with LOGBOX datalogger3

All acoustic instrumentation was calibrated before and after the survey and the drift of calibration was less than 0.3 dB, which is within accepted guidelines. Calibration certificates of the acoustic instruments are included in **Technical Appendix 11.5**.

11.3.4 Prevailing Background Noise Levels

Table 11.11 gives the background noise levels obtained from quiet daytime and night-time measurement periods at the baseline measurement locations. The main noise sources are low road traffic noise from the R314 and R315, and some low intensity agriculture activity in the surrounding farms. The area is not defined as a low noise environment as the background is above 30 dB LA90 for most locations at all wind speeds, with the exception of some levels below 30 dB at low wind speeds.

Table 11.11: Prevailing Background Noise Level

Monitoring Location	Prevailing Background (B/G) noise levels LA90dB, 10min Standardised Mean 10 m Height Wind Speed, (m/s)									
		4	5	6	7	8	9	10	11	12
NML 1 – H7	Day	28.7	29.1	29.8	30.9	32.3	34.1	36.3	38.9	38.9
	B/G+5	33.7	34.1	34.8	35.9	37.3	39.1	41.3	43.9	43.9
NML 1 – H7	Night	23.5	24.5	25.6	27.0	28.6	30.4	32.5	34.8	37.4
	B/G+5	28.5	29.5	30.6	32.0	33.6	35.4	37.5	39.8	42.4
NML 2 - H37	Day	29.3	29.4	29.9	30.8	32.0	33.6	35.5	37.8	37.8
	B/G+5	34.3	34.3	34.9	35.8	37.0	38.6	40.5	42.8	42.8
NML 2 - H37	Night	29.1	31.8	34.6	37.1	39.2	40.6	41.2	40.6	40.6
	B/G+5	34.1	36.8	39.6	42.1	44.2	45.6	46.2	45.6	45.6
NML 3A	Day	29.2	29.3	29.8	30.6	31.8	33.4	35.3	37.5	37.5
	B/G+5	34.2	34.3	34.8	35.6	36.8	38.4	40.3	42.5	42.5
NML 3A	Night	24.8	25.3	26.2	27.4	28.9	30.7	32.9	35.3	38.0
	B/G+5	29.8	30.3	31.2	32.4	33.9	35.7	37.9	40.3	43.0
NML 5 – H103	Day	28.3	28.5	29.1	30.3	32.1	34.4	37.2	40.5	40.5
	B/G+5	33.3	33.5	34.1	35.3	37.1	39.4	42.2	45.5	45.5
NML 5 – H103	Night	25.2	26.1	27.4	29.1	31.1	33.6	36.3	39.5	43.0
	B/G+5	30.2	31.1	32.4	34.1	36.1	38.6	41.3	44.5	48.0
	Day	28.0	28.9	30.1	31.7	33.6	35.8	38.3	41.2	44.3

NML 7 – Quarry	B/G+5	33.0	33.9	35.1	36.7	38.6	40.8	43.3	46.2	49.3
NML 7 - Quarry	Night	28.3	29.0	30.0	31.3	32.8	34.6	36.6	39.0	41.5
	B/G+5	33.3	34.0	35.0	36.3	37.8	39.6	41.6	44.0	46.5
NML 8 - H108	Day	29.8	29.9	30.2	30.7	31.5	32.5	33.6	35.0	36.7
	B/G+5	34.8	34.8	35.2	35.7	36.5	37.5	38.6	40.0	41.7
NML 8 - H108	Night	27.3	27.5	27.9	28.7	29.9	31.3	33.2	35.4	37.9
	B/G+5	32.3	32.3	32.9	33.7	34.9	36.3	38.2	40.4	42.9
NML 9 - H19	Day	23.5	23.9	24.9	26.6	29.0	32.0	35.7	40.0	40.0
	B/G+5	28.5	28.9	29.9	31.6	34.0	37.0	40.7	45.0	45.0
NML 9 - H19	Night	23.2	23.9	25.1	26.6	28.5	30.9	33.6	36.7	40.3
	B/G+5	28.2	28.9	30.1	31.6	33.5	35.9	38.6	41.7	45.3
NML 831 - H14	Day	28.8	28.7	29.0	29.6	30.5	31.8	33.4	35.3	35.3
	B/G+5	33.8	33.7	34.0	34.6	35.5	36.8	38.4	40.3	40.3
NML 831 - H14	Night	26.4	26.5	26.9	27.6	28.7	30.1	31.9	33.9	36.3
	B/G+5	31.4	31.5	31.9	32.6	33.7	35.1	36.9	38.9	41.3

Technical Appendix 11.3 of this chapter plots the derived background noise levels, background plus 5 trendline with the predicted noise levels against a noise limit of 45d B(A) at each receptor.

11.3.5 Noise Assessment Locations

The monitoring locations were chosen so that the distance was sufficient to ensure no noise contribution from any other operating wind turbines.

Should the predicted operational noise levels from the Proposed Development comply with the requirements of the 2006 Guidelines at the closest receptors, it may be assumed that the predicted noise levels at receptors further away from the Proposed Development will also comply, due to the attenuation of turbine noise levels with distance. The location is given in **Table 11.14.**

11.3.6 Noise Limits

The noise limits for the Proposed Development are based on the limits contained within the Wind Energy Development Guidelines 2006 and on the background levels obtained in **Table 11.11**. A lower fixed limit of 45 dBA for daytime has been applied, whilst also considering the lowest background noise levels obtained at the location of NML 831 - H14 used as the basis

for the assessment at all receptors with a limit of 43 dBA being applied for the night-time period. Where receptors are financially involved, a 45 dBA limit can be applied.

Table 11.12: Derived Background Day and Night Noise Levels used in Assessment

Monitoring Location	Prevailing Background (B/G) noise levels LA90dB, 10min Standardised Mean 10 m Height Wind Speed, (m/s)							
		4	5	6	7	8	9	10
NML831 - H14	Day	28.8	28.7	29.0	29.6	30.5	31.8	33.4
	B/G+5	33.8	33.7	34.0	34.6	35.5	36.8	38.4
Noise Limit		45	45	45	45	45	45	45
NML831 - H14	Night	26.4	26.5	26.9	27.6	28.7	30.1	31.9
	B/G+5	31.4	31.5	31.9	32.6	33.7	35.1	36.9
Noise Limit		43	43	43	43	43	43	43

11.3.7 Ambient Sound Levels

For the purposes of the NG4 assessment the measured daytime and night-time ambient sound levels are presented in **Table 11.13**.

Table 11.13: Measured average day, evening and night-time ambient sound levels

Scenario	Daytime Noise Criterion, dB $L_{Ar,T}$ (07:00 to 19:00hrs)	Evening Noise Criterion, dB $L_{Ar,T}$ (19:00 to 23:00hrs)	Night-time Noise Criterion, dB $L_{Ar,T}$ (23:00 to 7:00hrs)
NML 1 – H7	44.5	39.4	34.1
NML 2 – H37	47.1	42.9	36.6
NML 3A	46.8	39.2	35.0
NML 5 – H103	45.9	38.8	36.0
NML 7 – Quarry	40.3	36.5	34.7
NML 8 – H108	42.2	36.7	33.8
NML 9 – H19	44.8	38.3	35.5
NML 831 – H14	43.7	40.3	34.2

11.3.8 Development Design Mitigation

The candidate turbine model, the V117 will be fitted with STE as standard which is best practice. A serrated extension of the trailing edge to the rotor blades mitigates noise emissions by effectively breaking up the turbulence on the tooth flanks into smaller eddies. The intensity of the pressure fluctuations is reduced which mitigates the noise emissions. Since the intensity

of the noise emissions is largely dependent on the flow speed, STE are only installed on the outer rotor blade area where the rotary speed is the highest. For the candidate turbine selected for the EIA technical assessment, the Vestas V117, STE reduces the noise level by 2.5 dBA.

11.4 ASSESSMENT OF POTENTIAL EFFECTS

11.4.1 Construction Noise

11.4.1.1 Construction and Decommissioning Noise Levels

As has been previously stated, the construction process associated with wind farms is not considered intensive and is temporary works most of which is carried out a considerable distance from receptors. The main noise sources will be associated with the construction of the Turbine Foundations, Turbine Hardstands, Grid Connection and compound, with lesser sources being the construction of the onsite 110kV Electrical Substation. The main construction traffic to the Wind Farm Site will be during a very short period where ready-mix trucks deliver concrete for the turbine bases. While delivery of material from local quarries for upgrade of Site Access Tracks, Turbine Hardstands, Temporary Storage Compounds and 110 kV Electrical Substation will be for longer periods but will be of less intensity, generating lower levels of noise along the routes. During delivery of materials, trucks will access the Wind Farm Site from a different route than leaving the Wind Farm Site, thereby reducing traffic noise at receptors along the local road network. The delivery of turbines by large trucks travelling at very low speed will generate very low levels of noise at receptors along the Turbine Delivery Route (TDR).

It is not possible to specify the precise noise levels of emissions from the construction equipment until such time as a contractor is chosen and construction plant has been selected. However, **Table 11.13** indicates typical construction range of noise levels for this type of activity (levels from author's database and BS 5228). Predictions are made for receptors nearest to the turbine bases / hardstands activity, compound development and for receptors at varying distance from the Grid Connection route.

Table 11.13: Typical Noise Levels from Construction Works

Activity	L_{Aeq} at 10m
General Construction (pile driving, ready-mix trucks pouring concrete)	70-84 dBA
Tracked excavator removing topsoil, subsoil for foundation	80- 87 dBA
Rock breaker and excavator loading	82-89 dBA

Vibrating rollers including tipping material	76-86 dBA
Grid Connection: Trenching Tracked excavator 14t, pneumatic breaker, vibratory roller 71t, tractor	71-74 dBA
Excavator loading / tipping, excavator and Vibratory roller	80- 87 dBA

The difference in noise levels between two locations can be calculated as:

$$\mathbf{L}_{p2} - \mathbf{L}_{p1} = 10 \log (R_2 / R_1)^2 - (A_{atm} + A_{gr} + A_{br} + A_{mis})$$
$$= 20 \log (R_2 / R_1) - (A_{atm} + A_{gr} + A_{br} + A_{mis})$$

where:

L_{p1} = sound pressure level at location 1

L_{p2} = sound pressure level at location 2

R_1 = distance from source to location 1

R_2 = distance from source to location 2

and where:

A_{atm} = Attenuation due to air absorption

A_{gr} = Attenuation due to ground absorption

A_{br} = Attenuation provided by a barrier

A_{mis} = Attenuation provided by miscellaneous other effects

In the calculations attenuation by A_{atm}, A_{gr} and A_{mis} is taken as 3 dBA where distances are more than 200 m from a source and as zero within 200 m - amelioration by barriers is not accounted for.

Table 11.14 gives the noise levels predicted from construction activity at varying distances. The main noise sources are assumed to be the construction of the Turbine Foundations, Turbine Hardstands and Grid connection. The development of the Site Access Tracks, construction of the new onsite 110 kV Electrical Substation, works on the Substation and Site Control Building will also take place, however the noise levels associated with this activity will be lower and of shorter duration than other works. The main road traffic noise will be associated with the delivery of ready-mix concrete for Turbine Foundations.

Road traffic is dealt with under a sub-heading **'Traffic and Transport'** in **Chapter 17**.

The maximum construction noise levels associated with the Proposed Development and Grid Connection are listed in **Table 11.14.** At receptor locations further away, noise levels will be less than that predicted. Works associated with Decommissioning will be no more than the levels predicted in **Table 11.14**.

Table 11.14: Predicted Construction Noise Levels

Activity taken as 100% per hour	Distance of Activity (m)	LAeq dB 1hr range
General Construction (pile driving, ready-mix trucks pouring concrete)	501 m to H4	33-47 dBA
Tracked excavator removing topsoil, subsoil for foundation	501 m to H4	43-50 dBA
Rock breaker and excavator loading at nearest turbine T2	501 m to H4	45-52dBA
Vibrating rollers including tipping material set down area close to T2	501 m to H4	39-49 dBA
Grid Connection: Trenching Tracked excavator 14t, pneumatic breaker, vibratory roller 71t, tractor	At varying distances along route: 15 m 20 m 40 m 80 m	 64.5-67.5 dBA 62-65 dBA 56-59 dBA 49.9-52.9 dBA
Construction of compound (loading / tipping, excavator and Vibratory roller)	501 m to H4	43-50 dBA

Construction Traffic

The delivery of turbines to the Wind Farm Site will generate low level traffic noise as the vehicles carrying the turbines will move slowly along the local roads where impact is expected to be greatest. The main construction noise generated by traffic to and from the Wind Farm Site will be due to ready-mix trucks delivering concrete with trucking of spoil being carried out at the same time. The concrete pour for each individual turbine will be required to be completed in a short a period as possible (usually within 10 hours).

Each turbine will require approximately 920 m^3 of concrete while each ready-mix truck has a capacity of 6 m^3. This results in 153 loads of concrete and 306 truck movements for each turbine. For delivery of concrete the timeframe envisaged for each turbine concrete pour is taken as 8-10 hrs. This equates to an average of 31-38 deliveries per hour.

The general expression for predicting the 1 hr LAeq alongside a haul road used by single engine items of mobile plant is:

$L_{Aeq} = L_{WA} - 33 + 10\log_{10}Q - 10\log_{10}V - 10\log_{10}d$

where:

L_{WA} = the sound power level of the truck, in decibels (dB);

Q = 38, the number of vehicles per hour;

V = 60, the average vehicle speed, in kilometres per hour (km/h);

d = the distance of receiving position from the centre of haul road, in metres (m).

LAeq = 105-33 +10log38 – 10log60 – 10log20 = 57 LAeq 1hr.

At 10 m from the roadside the noise levels equate to 60 LAeq 1hr. The trucking for the concrete pour will extend for a total of 18 days (1 day for each turbine). In practice the levels generated by truck movement should be lower than predicted due to the smooth surface on the local roads.

Grid Connection-Cable laying along road by trenching

Cable laying and trenching will occur along the Grid Connection route from the Onsite 110kV Substation to the Tawnaghmore 110 kV Substation which means maximum levels will pertain no more than 0.5 days equivalent (4 hours) at any single receptor.

Construction noise levels are based on continuous operation. In practice, most plant will operate at a maximum level for short intervals.

11.4.1.2 Assessment of Construction Noise

The higher levels predicted are from the Grid Connection and delivery of concrete for Turbine Foundations. These maximum noise levels will persist for no more than 4 hours at any receptor. All predicted noise levels are well within NRA guidelines given as acceptable and effects are considered slight. Construction noise is a temporary activity.

All activity is predicted without additional mufflers, or without topographic screening. The maximum road traffic noise which is generated by ready-mix trucks delivering concrete for Turbine Foundations will be short term and of 21 days' duration. The predicted noise levels are well within the NRA guidelines given as acceptable and are therefore considered as not significant.

Ground vibration from rock breaking will be below the threshold of sensitivity to humans of 0.2mm/s peak particle velocity at all receptors[25]. The effects of noise and vibration from onsite construction activities are therefore considered not significant.

11.4.1.3 Description of Effects - Construction

The criteria for description of effects for all construction noise activity and the potential worst-case effects, at the nearest receptors is given below.

Table 11.15: Description of Effects - Construction

Quality	Significance	Duration
Negative	Not Significant	Temporary

11.4.1.4 Decommissioning

Noise effects during the decommissioning phase of the Proposed Development are likely to be of a similar nature to that during construction but of shorter duration. It is likely that Site Access Tracks and Turbine Foundations (excluding plinths) will be left in place and covered over with topsoil unless there are environmental reasons to remove. Any legislation, guidance, or best practice relevant at the time of decommissioning will be complied with.

11.4.1.5 Description of Effects - Decommissioning

The criteria for description of effects for all decommissioning noise activity and the potential worst-case effects, at the nearest receptors is given below.

Table 11.16: Description of Effects - Decommissioning

Quality	Significance	Duration
Negative	Not Significant	Temporary

11.4.2 Predicted Operational Noise Levels

Table 11.17 gives the predicted noise levels at the nearest receptors to the Proposed Development at varying wind speeds for each receptor location. A noise contour map of the 18 no. turbine Proposed Development at maximum sound power output at a wind speed of 12 ms-1 at 10 m height is presented in **Technical Appendix 11.4**. The contour map in **Technical Appendix 11.4** assumes that all turbines are simultaneously downwind to each location all of the time (continuously) which results in an overprediction of the noise levels.

[25] Wiss, J. F., and Parmelee, R. A. (1974) Human Perception of Transient Vibrations, "*Journal of Structural Division*", ASCE, Vol 100, No. S74, PP. 773-787

Table 11.17: Predicted Noise Levels as LA90 at Varying Wind Speeds from the Proposed Development

	ING	ING	4m/s	5m/s	6m/s	7m/s	8m/s	9+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA	dBA
H1*	515110	837466	38.3	42.4	46.2	48.5	48.8	48.8
H2*	515526	833767	35.3	39.4	43.2	45.5	45.8	45.8
H3	516107	834819	30.5	34.6	38.4	40.7	41	41
H4	515947	834836	31	35.1	38.9	41.2	41.5	41.5
H5	516227	836339	34.5	38.6	42.4	44.7	45	45
H6	514628	834072	33.5	37.6	41.4	43.7	44	44
H7	513577	835455	31.2	35.3	39.1	41.4	41.7	41.7
H8	516241	833804	30.5	34.6	38.4	40.7	41	41
H9*	515489	833504	32.6	36.7	40.5	42.8	43.1	43.1
H10	515575	835060	32	36.1	39.9	42.2	42.5	42.5
H11	513526	835513	30.8	34.9	38.7	41	41.3	41.3
H12*	515450	832962	33.4	37.5	41.3	43.6	43.9	43.9
H13	515080	831996	30.3	34.4	38.2	40.5	40.8	40.8
H14	515456	833467	32.7	36.8	40.6	42.9	43.2	43.2
H15	513601	835338	30.7	34.8	38.6	40.9	41.2	41.2
H16	516561	837118	33.5	37.6	41.4	43.7	44	44
H17	515886	834729	30.9	35	38.8	41.1	41.4	41.4
H18*	515019	834112	32.7	36.8	40.6	42.9	43.2	43.2
H19	517530	838028	30.7	34.8	38.6	40.9	41.2	41.2
H20	513391	835822	30.2	34.3	38.1	40.4	40.7	40.7
H21	517553	837950	30.7	34.8	38.6	40.9	41.2	41.2
H22	517556	837865	31	35.1	38.9	41.2	41.5	41.5
H23	516320	834718	29.4	33.5	37.3	39.6	39.9	39.9
H24	515390	832068	29.6	33.7	37.5	39.8	40.1	40.1
H25	517622	837746	30.2	34.3	38.1	40.4	40.7	40.7
H26	517552	838096	30	34.1	37.9	40.2	40.5	40.5
H27	515559	834678	31.5	35.6	39.4	41.7	42	42
H28	515805	834702	31.1	35.2	39	41.3	41.6	41.6

	ING	ING	4m/s	5m/s	6m/s	7m/s	8m/s	9+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA	dBA
H29	516744	836946	32	36.1	39.9	42.2	42.5	42.5
H30	514721	837259	32.2	36.3	40.1	42.4	42.7	42.7
H31	517581	838054	29.9	34	37.8	40.1	40.4	40.4
H32	516774	835227	28.8	32.9	36.7	39	39.3	39.3
H33	513365	835996	30	34.1	37.9	40.2	40.5	40.5
H34	515641	832856	31.1	35.2	39	41.3	41.6	41.6
H35	517606	838071	29.5	33.6	37.4	39.7	40	40
H36	516764	835557	29.9	34	37.8	40.1	40.4	40.4
H37	514091	836904	29.9	34	37.8	40.1	40.4	40.4
H38	517490	838353	28.9	33	36.8	39.1	39.4	39.4
H39	515462	834716	31.5	35.6	39.4	41.7	42	42
H40	516384	834641	29	33.1	36.9	39.2	39.5	39.5
H41	513902	836884	29.4	33.5	37.3	39.6	39.9	39.9
H42	517583	838226	28.9	33	36.8	39.1	39.4	39.4
H43	515398	834709	31.7	35.8	39.6	41.9	42.2	42.2
H44	517725	837501	28.6	32.7	36.5	38.8	39.1	39.1
H45	517434	838443	28.6	32.7	36.5	38.8	39.1	39.1
H46	517697	837346	28.6	32.7	36.5	38.8	39.1	39.1
H47	516822	835130	28.1	32.2	36	38.3	38.6	38.6
H48	514129	833845	30.4	34.5	38.3	40.6	40.9	40.9
H49	517741	837449	28.4	32.5	36.3	38.6	38.9	38.9
H50	517762	837602	28.4	32.5	36.3	38.6	38.9	38.9
H51	517663	838130	28.7	32.8	36.6	38.9	39.2	39.2
H52	517766	837561	28.3	32.4	36.2	38.5	38.8	38.8
H53	517762	837501	28.2	32.3	36.1	38.4	38.7	38.7
H54	517767	837579	28.3	32.4	36.2	38.5	38.8	38.8
H55	517742	837383	28.2	32.3	36.1	38.4	38.7	38.7
H56	515873	833236	29.8	33.9	37.7	40	40.3	40.3
H57	516625	836322	31.3	35.4	39.2	41.5	41.8	41.8

	ING	ING	4m/s	5m/s	6m/s	7m/s	8m/s	9+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA	dBA
H58	517758	837737	28.4	32.5	36.3	38.6	38.9	38.9
H59	513235	835631	28.4	32.5	36.3	38.6	38.9	38.9
H60	517632	838261	28.3	32.4	36.2	38.5	38.8	38.8
H61	517638	837109	28.4	32.5	36.3	38.6	38.9	38.9
H62	514190	836978	29.8	33.9	37.7	40	40.3	40.3
H63	517742	837283	28.1	32.2	36	38.3	38.6	38.6
H64	517457	838516	27.8	31.9	35.7	38	38.3	38.3
H65	516738	836261	30.5	34.6	38.4	40.7	41	41
H66	517836	837697	27.6	31.7	35.5	37.8	38.1	38.1
H67	517806	837295	27.5	31.6	35.4	37.7	38	38
H68	516697	836380	30.8	34.9	38.7	41	41.3	41.3
H69	517489	838569	27.2	31.3	35.1	37.4	37.7	37.7
H70	516975	835388	27.8	31.9	35.7	38	38.3	38.3
H71	517798	837225	27.5	31.6	35.4	37.7	38	38
H72	515557	831893	26.9	31	34.8	37.1	37.4	37.4
H73	517792	837189	27.5	31.6	35.4	37.7	38	38
H74	517729	837077	27.6	31.7	35.5	37.8	38.1	38.1
H75	514818	831687	26.8	30.9	34.7	37	37.3	37.3
H76	513130	835959	27.7	31.8	35.6	37.9	38.2	38.2
H77	516817	836244	29.9	34	37.8	40.1	40.4	40.4
H78	517748	838272	27.2	31.3	35.1	37.4	37.7	37.7
H79	517791	837155	27.4	31.5	35.3	37.6	37.9	37.9
H80	514340	837065	29.9	34	37.8	40.1	40.4	40.4
H81	513118	835991	27.6	31.7	35.5	37.8	38.1	38.1
H82	517804	837142	27.2	31.3	35.1	37.4	37.7	37.7
H83	514941	831643	26.4	30.5	34.3	36.6	36.9	36.9
H84	513221	836506	26.9	31	34.8	37.1	37.4	37.4
H85	513108	836017	27.5	31.6	35.4	37.7	38	38
H86	516952	834926	26.5	30.6	34.4	36.7	37	37
H87	517884	837289	26.9	31	34.8	37.1	37.4	37.4

	ING	ING	4m/s	5m/s	6m/s	7m/s	8m/s	9+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA	dBA
H88	514595	831709	26.5	30.6	34.4	36.7	37	37
H89	513105	836024	27.5	31.6	35.4	37.7	38	38
H90	517910	837382	26.8	30.9	34.7	37	37.3	37.3
H91	516865	836247	29.6	33.7	37.5	39.8	40.1	40.1
H92	516678	834560	27.2	31.3	35.1	37.4	37.7	37.7
H93	515173	831629	26.1	30.2	34	36.3	36.6	36.6
H94	517945	837469	26.6	30.7	34.5	36.8	37.1	37.1
H95	516609	833595	26.4	30.5	34.3	36.6	36.9	36.9
H96	517041	835575	27.8	31.9	35.7	38	38.3	38.3
H97	515971	838486	29.7	33.8	37.6	39.9	40.2	40.2
H98	516040	838493	29.6	33.7	37.5	39.8	40.1	40.1
H99	517816	838358	26.3	30.4	34.2	36.5	36.8	36.8
H100	517798	838402	26.2	30.3	34.1	36.4	36.7	36.7
H101	516953	836216	29.1	33.2	37	39.3	39.6	39.6
H102	513352	834999	27.7	31.8	35.6	37.9	38.2	38.2
H103	516624	833488	26	30.1	33.9	36.2	36.5	36.5
H104	515505	831678	25.5	29.6	33.4	35.7	36	36
H105	514472	831653	25.6	29.7	33.5	35.8	36.1	36.1
H106	517382	836605	27.7	31.8	35.6	37.9	38.2	38.2
H107	516958	834700	26.1	30.2	34	36.3	36.6	36.6
H108	516958	834683	26.1	30.2	34	36.3	36.6	36.6
H109	513032	836295	26.5	30.6	34.4	36.7	37	37
H110	516551	833308	26	30.1	33.9	36.2	36.5	36.5
H111	516041	838580	28.9	33	36.8	39.1	39.4	39.4
H112	513331	834901	27.5	31.6	35.4	37.7	38	38
H113	514539	831580	25.2	29.3	33.1	35.4	35.7	35.7
H114	517409	836575	27.5	31.6	35.4	37.7	38	38
H115	517850	838466	25.5	29.6	33.4	35.7	36	36
H116	518085	837658	25.3	29.4	33.2	35.5	35.8	35.8

	ING	ING	4m/s	5m/s	6m/s	7m/s	8m/s	9+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA	dBA
H117	513005	836321	26.2	30.3	34.1	36.4	36.7	36.7
H118	517191	835471	26.6	30.7	34.5	36.8	37.1	37.1
H119	517007	836317	28.9	33	36.8	39.1	39.4	39.4
H120	516947	834602	26	30.1	33.9	36.2	36.5	36.5
H121	513228	834982	27	31.1	34.9	37.2	37.5	37.5
H122	515945	831977	25.2	29.3	33.1	35.4	35.7	35.7
H123	516052	832172	25.5	29.6	33.4	35.7	36	36
H124	516884	834471	26	30.1	33.9	36.2	36.5	36.5
H125	516855	834435	26.2	30.3	34.1	36.4	36.7	36.7
H126	517096	836244	28.3	32.4	36.2	38.5	38.8	38.8
H127	513225	834907	26.9	31	34.8	37.1	37.4	37.4
H128	518160	837673	24.7	28.8	32.6	34.9	35.2	35.2
H129	514056	831821	25	29.1	32.9	35.2	35.5	35.5
H130	517099	836299	28.3	32.4	36.2	38.5	38.8	38.8
H131	513091	836799	24.8	28.9	32.7	35	35.3	35.3
H132	518014	836990	25.2	29.3	33.1	35.4	35.7	35.7
H133	517606	836550	26.4	30.5	34.3	36.6	36.9	36.9
H134	513969	831910	25	29.1	32.9	35.2	35.5	35.5
H135	518001	836934	25.3	29.4	33.2	35.5	35.8	35.8
H136	517915	838590	24.5	28.6	32.4	34.7	35	35
H137	513187	834847	26.6	30.7	34.5	36.8	37.1	37.1
H138	517212	836384	27.9	32	35.8	38.1	38.4	38.4
H139	517994	836903	25.3	29.4	33.2	35.5	35.8	35.8
H140	518017	836930	25.2	29.3	33.1	35.4	35.7	35.7
H141	517992	836890	25.3	29.4	33.2	35.5	35.8	35.8
H142	513079	836852	24.6	28.7	32.5	34.8	35.1	35.1
H143	517990	836877	25.3	29.4	33.2	35.5	35.8	35.8
H144	517989	836869	25.2	29.3	33.1	35.4	35.7	35.7
H145	518108	837076	24.9	29	32.8	35.1	35.4	35.4
H146	517987	836860	25.2	29.3	33.1	35.4	35.7	35.7

	ING	ING	4m/s	5m/s	6m/s	7m/s	8m/s	9+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA	dBA
H147	518208	837768	24.4	28.5	32.3	34.6	34.9	34.9
H148	518212	837742	24.4	28.5	32.3	34.6	34.9	34.9
H149	518212	837845	24.4	28.5	32.3	34.6	34.9	34.9
H150	518010	836858	25.1	29.2	33	35.3	35.6	35.6
H151	514113	831661	24.3	28.4	32.2	34.5	34.8	34.8
H152	518117	837019	24.7	28.8	32.6	34.9	35.2	35.2
H153	517388	836374	27	31.1	34.9	37.2	37.5	37.5
H154	513062	836905	24.3	28.4	32.2	34.5	34.8	34.8
H155	518114	837000	24.7	28.8	32.6	34.9	35.2	35.2
H156	516958	834382	25.6	29.7	33.5	35.8	36.1	36.1
H157	513103	834713	25.9	30	33.8	36.1	36.4	36.4
H158	517296	836339	27.4	31.5	35.3	37.6	37.9	37.9
H159	518255	837722	24.2	28.3	32.1	34.4	34.7	34.7
H160	518102	836959	24.8	28.9	32.7	35	35.3	35.3
H161	518268	837758	24.1	28.2	32	34.3	34.6	34.6
H162	518273	837769	24	28.1	31.9	34.2	34.5	34.5
H163	517873	838787	23.8	27.9	31.7	34	34.3	34.3
H164	518250	837922	24	28.1	31.9	34.2	34.5	34.5
H165	513062	834658	25.6	29.7	33.5	35.8	36.1	36.1
H166	516818	833276	24.4	28.5	32.3	34.6	34.9	34.9
H167	518279	837790	24	28.1	31.9	34.2	34.5	34.5
H168	517935	838746	23.7	27.8	31.6	33.9	34.2	34.2
H169	515858	831578	23.4	27.5	31.3	33.6	33.9	33.9
H170	518171	838358	23.9	28	31.8	34.1	34.4	34.4
H171	513708	837466	25.7	29.8	33.6	35.9	36.2	36.2
H172	518134	838497	23.6	27.7	31.5	33.8	34.1	34.1
H173	513017	836992	23.7	27.8	31.6	33.9	34.2	34.2
H174	518256	838176	23.7	27.8	31.6	33.9	34.2	34.2
H175	517925	838830	23.4	27.5	31.3	33.6	33.9	33.9

	ING	ING	4m/s	5m/s	6m/s	7m/s	8m/s	9+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA	dBA
H176	517769	838987	23.3	27.4	31.2	33.5	33.8	33.8
H177	517370	836081	26.6	30.7	34.5	36.8	37.1	37.1
H178	516288	832086	23.8	27.9	31.7	34	34.3	34.3
H179	517344	836221	26.9	31	34.8	37.1	37.4	37.4
H180	517385	836061	26.5	30.6	34.4	36.7	37	37
H181	518067	838701	23.2	27.3	31.1	33.4	33.7	33.7
H182	517378	836158	26.7	30.8	34.6	36.9	37.2	37.2
H183	516334	832143	23.7	27.8	31.6	33.9	34.2	34.2
H184	513704	831940	23.8	27.9	31.7	34	34.3	34.3
H185	516834	833111	24	28.1	31.9	34.2	34.5	34.5
H186	518315	838186	23.4	27.5	31.3	33.6	33.9	33.9
H187	512996	837073	23.4	27.5	31.3	33.6	33.9	33.9
H188	517402	836199	26.6	30.7	34.5	36.8	37.1	37.1
H189	516765	832999	24.1	28.2	32	34.3	34.6	34.6
H190	517625	836280	25.7	29.8	33.6	35.9	36.2	36.2
H191	518215	838553	23	27.1	30.9	33.2	33.5	33.5
H192	516021	831560	22.7	26.8	30.6	32.9	33.2	33.2
H193	517457	835933	25.9	30	33.8	36.1	36.4	36.4
H194	516337	832024	23.3	27.4	31.2	33.5	33.8	33.8
H195	517465	835870	25.8	29.9	33.7	36	36.3	36.3
H196	516381	832122	23.4	27.5	31.3	33.6	33.9	33.9
H197	517966	838934	22.7	26.8	30.6	32.9	33.2	33.2
H198	517593	836238	25.8	29.9	33.7	36	36.3	36.3
H199	517440	836173	26.4	30.5	34.3	36.6	36.9	36.9
H200	512952	837097	23.1	27.2	31	33.3	33.6	33.6
H201	512675	836558	23.7	27.8	31.6	33.9	34.2	34.2
H202	518089	838799	22.7	26.8	30.6	32.9	33.2	33.2
H203	517905	839004	22.7	26.8	30.6	32.9	33.2	33.2
H204	513796	838073	23.5	27.6	31.4	33.7	34	34

	ING	ING	4m/s	5m/s	6m/s	7m/s	8m/s	9+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA	dBA
H205	518071	838854	22.6	26.7	30.5	32.8	33.1	33.1
H206	517486	836057	26	30.1	33.9	36.2	36.5	36.5
H207	513730	837683	24.4	28.5	32.3	34.6	34.9	34.9
H208	517812	839121	22.5	26.6	30.4	32.7	33	33
H209	517497	836093	26	30.1	33.9	36.2	36.5	36.5
H210	517231	834307	24.2	28.3	32.1	34.4	34.7	34.7
H211	518054	838917	22.4	26.5	30.3	32.6	32.9	32.9
H212	517509	836126	26	30.1	33.9	36.2	36.5	36.5
H213	516125	831552	22.2	26.3	30.1	32.4	32.7	32.7
H214	517922	839074	22.3	26.4	30.2	32.5	32.8	32.8
H215	517355	834419	23.9	28	31.8	34.1	34.4	34.4
H216	517856	839139	22.2	26.3	30.1	32.4	32.7	32.7
H217	518030	838990	22.2	26.3	30.1	32.4	32.7	32.7
H218	517431	834508	23.7	27.8	31.6	33.9	34.2	34.2
H219	513533	831954	22.9	27	30.8	33.1	33.4	33.4
H220	517735	839237	22.2	26.3	30.1	32.4	32.7	32.7
H221	516653	832742	23.9	28	31.8	34.1	34.4	34.4
H222	513667	837855	23.6	27.7	31.5	33.8	34.1	34.1
H223	513685	831661	22.4	26.5	30.3	32.6	32.9	32.9
H224	517822	839198	22.1	26.2	30	32.3	32.6	32.6
H225	517791	839223	22.1	26.2	30	32.3	32.6	32.6
H226	515679	831145	21.5	25.6	29.4	31.7	32	32
H227	517504	834526	23.4	27.5	31.3	33.6	33.9	33.9
H228	517793	839268	21.9	26	29.8	32.1	32.4	32.4
H229	513657	838098	22.8	26.9	30.7	33	33.3	33.3
H230	513622	837938	23.2	27.3	31.1	33.4	33.7	33.7
H231	518095	839027	21.8	25.9	29.7	32	32.3	32.3
H232	517878	839229	21.8	25.9	29.7	32	32.3	32.3
H233	517789	839294	21.8	25.9	29.7	32	32.3	32.3

	ING	ING	4m/s	5m/s	6m/s	7m/s	8m/s	9+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA	dBA
H234	517378	834152	23.5	27.6	31.4	33.7	34	34
H235	513569	831714	22.1	26.2	30	32.3	32.6	32.6
H236	518078	839073	21.7	25.8	29.6	31.9	32.2	32.2
H237	517596	834627	23.4	27.5	31.3	33.6	33.9	33.9
H238	518005	839159	21.6	25.7	29.5	31.8	32.1	32.1
H239	518050	839123	21.6	25.7	29.5	31.8	32.1	32.1
H240	517571	834542	23.4	27.5	31.3	33.6	33.9	33.9
H241	513951	831241	21.3	25.4	29.2	31.5	31.8	31.8
H242	515424	830951	20.8	24.9	28.7	31	31.3	31.3
H243	517868	839303	21.5	25.6	29.4	31.7	32	32
H244	517644	834629	23.3	27.4	31.2	33.5	33.8	33.8
H245	517599	834519	23.2	27.3	31.1	33.4	33.7	33.7
H246	513643	838342	22	26.1	29.9	32.2	32.5	32.5
H247	517980	839253	21.3	25.4	29.2	31.5	31.8	31.8
H248	516877	832711	22.9	27	30.8	33.1	33.4	33.4
H249	517711	834681	23.1	27.2	31	33.3	33.6	33.6
H250	516673	832142	22.1	26.2	30	32.3	32.6	32.6
H251	517666	834544	23	27.1	30.9	33.2	33.5	33.5
H252	516393	831529	21	25.1	28.9	31.2	31.5	31.5
H253	517503	834090	22.9	27	30.8	33.1	33.4	33.4
H254	516757	832459	22.6	26.7	30.5	32.8	33.1	33.1
H255	516938	832711	22.6	26.7	30.5	32.8	33.1	33.1
H256	515561	830891	20.3	24.4	28.2	30.5	30.8	30.8
H257	512604	834248	22.9	27	30.8	33.1	33.4	33.4
H258	513452	831612	21.3	25.4	29.2	31.5	31.8	31.8
H259	517973	839365	20.8	24.9	28.7	31	31.3	31.3
H260	512440	836921	21.8	25.9	29.7	32	32.3	32.3
H261	512569	834235	22.7	26.8	30.6	32.9	33.2	33.2
H262	513585	838498	21.3	25.4	29.2	31.5	31.8	31.8
H263	513247	831945	21.5	25.6	29.4	31.7	32	32

	ING	ING	4m/s	5m/s	6m/s	7m/s	8m/s	9+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA	dBA
H264	517571	833961	22.5	26.6	30.4	32.7	33	33
H265	517825	839498	20.8	24.9	28.7	31	31.3	31.3
H266	514677	830757	19.8	23.9	27.7	30	30.3	30.3
H267	512406	836941	21.7	25.8	29.6	31.9	32.2	32.2
H268	517813	834607	22.6	26.7	30.5	32.8	33.1	33.1
H269	516499	831484	20.5	24.6	28.4	30.7	31	31
H270	517862	839512	20.6	24.7	28.5	30.8	31.1	31.1
H271	516513	831474	20.4	24.5	28.3	30.6	30.9	30.9
H272	513257	831765	21	25.1	28.9	31.2	31.5	31.5
H273	517866	834632	22.5	26.6	30.4	32.7	33	33
H274	515833	830871	19.8	23.9	27.7	30	30.3	30.3
H275	516912	832406	21.8	25.9	29.7	32	32.3	32.3
H276	512351	836995	21.3	25.4	29.2	31.5	31.8	31.8
H277	515552	830724	19.3	23.4	27.2	29.5	29.8	29.8
H278	517807	839629	20.2	24.3	28.1	30.4	30.7	30.7
H279	515967	830898	19.6	23.7	27.5	29.8	30.1	30.1
H280	512327	837015	21.2	25.3	29.1	31.4	31.7	31.7
H281	513505	838660	20.5	24.6	28.4	30.7	31	31
H282	513233	837955	21.8	25.9	29.7	32	32.3	32.3
H283	512284	836976	21.2	25.3	29.1	31.4	31.7	31.7
H284	517503	837983	31.2	35.3	39.1	41.4	41.7	41.7

**(FI) – Financially Involved*

11.4.3 Operational Noise Assessment

The assessment was made of the predicted operational noise levels from the Proposed Development based on the limits described in **Section 11.2.3.1** in the 2006 Guidelines and taking into consideration the recent 2021 An Bord Pleanála decision described in **Section 11.2.3.2.**

As can be seen from **Table 11.18** that the predicted noise levels are higher than the daytime noise limit of 45 dB at two receptors at certain wind speeds.

However, it has been confirmed by the applicant that one of the dwellings in exceedance of the 45 dB limit, H1, is a disused vacant dwelling and is under the control of the Developer. As part of the planning application, permission is sought for it to be converted and used as an operations building for the lifespan of the Proposed Development (**Section 2.6.8**). In addition, there is 1 dwelling, H2, located approximately 320 m southwest from AT01. This property is under the control of the Developer, and the owner is a financial beneficiary of the Proposed Development. The owner has confirmed that this property will remain unoccupied for the operational lifespan of the Proposed Development. These dwellings have not been included in this assessment.

The predicted noise levels are higher than the night-time noise limit of 43 dB at seven receptors, at various wind speeds – H5, H6, H9, H12, H14, H16 and H18.
It has been confirmed by the applicant that two of these receptors are financially involved with the Proposed Development, H12 and H18, to which a 45dB limit may be applied. Therefore, there are no exceedances at these receptors.

The predicted noise levels are lower than the noise limits at the remaining receptors, at all wind speeds, and are therefore compliant with the noise limits and are not significant in terms of EIA.

The predicted noise levels assume that all turbines are directly down-wind to nearest receptors.

Table 11.18: Margin between Predicted Noise Levels and 45 dBA Noise Limit

	ITM	ITM	4m/s	5m/s	6m/s	7m/s	8m/s	9+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA	dBA
H1*	515110	837466	-4.7	-0.6	3.2	5.5	5.8	5.8
H2*	515526	833767	-7.7	-3.6	0.2	2.5	2.8	2.8
H3	516107	834819	-12.5	-8.4	-4.6	-2.3	-2	-2
H4	515947	834836	-12	-7.9	-4.1	-1.8	-1.5	-1.5
H5	516227	836339	-8.5	-4.4	-0.6	1.7	2	2
H6	514628	834072	-9.5	-5.4	-1.6	0.7	1	1
H7	513577	835455	-11.8	-7.7	-3.9	-1.6	-1.3	-1.3
H8	516241	833804	-12.5	-8.4	-4.6	-2.3	-2	-2
H9	515489	833504	-10.4	-6.3	-2.5	-0.2	0.1	0.1
H10	515575	835060	-11	-6.9	-3.1	-0.8	-0.5	-0.5
H11	513526	835513	-12.2	-8.1	-4.3	-2	-1.7	-1.7
H12*	515450	832962	-9.6	-5.5	-1.7	0.6	0.9	0.9
H13	515080	831996	-12.7	-8.6	-4.8	-2.5	-2.2	-2.2
H14	515456	833467	-10.3	-6.2	-2.4	-0.1	0.2	0.2
H15	513601	835338	-12.3	-8.2	-4.4	-2.1	-1.8	-1.8
H16	516561	837118	-9.5	-5.4	-1.6	0.7	1	1
H17	515886	834729	-12.1	-8	-4.2	-1.9	-1.6	-1.6
H18*	515019	834112	-10.3	-6.2	-2.4	-0.1	0.2	0.2
H19	517530	838028	-12.3	-8.2	-4.4	-2.1	-1.8	-1.8
H20	513391	835822	-12.8	-8.7	-4.9	-2.6	-2.3	-2.3
H21	517553	837950	-12.3	-8.2	-4.4	-2.1	-1.8	-1.8
H22	517556	837865	-12	-7.9	-4.1	-1.8	-1.5	-1.5
H23	516320	834718	-13.6	-9.5	-5.7	-3.4	-3.1	-3.1
H24	515390	832068	-13.4	-9.3	-5.5	-3.2	-2.9	-2.9
H25	517622	837746	-12.8	-8.7	-4.9	-2.6	-2.3	-2.3
H26	517552	838096	-13	-8.9	-5.1	-2.8	-2.5	-2.5
H27	515559	834678	-11.5	-7.4	-3.6	-1.3	-1	-1
H28	515805	834702	-11.9	-7.8	-4	-1.7	-1.4	-1.4
H29	516744	836946	-11	-6.9	-3.1	-0.8	-0.5	-0.5

	ITM	ITM	4m/s	5m/s	6m/s	7m/s	8m/s	9+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA	dBA
H30	514721	837259	-10.8	-6.7	-2.9	-0.6	-0.3	-0.3
H31	517581	838054	-13.1	-9	-5.2	-2.9	-2.6	-2.6
H32	516774	835227	-14.2	-10.1	-6.3	-4	-3.7	-3.7
H33	513365	835996	-13	-8.9	-5.1	-2.8	-2.5	-2.5
H34	515641	832856	-11.9	-7.8	-4	-1.7	-1.4	-1.4
H35	517606	838071	-13.5	-9.4	-5.6	-3.3	-3	-3
H36	516764	835557	-13.1	-9	-5.2	-2.9	-2.6	-2.6
H37	514091	836904	-13.1	-9	-5.2	-2.9	-2.6	-2.6
H38	517490	838353	-14.1	-10	-6.2	-3.9	-3.6	-3.6
H39	515462	834716	-11.5	-7.4	-3.6	-1.3	-1	-1
H40	516384	834641	-14	-9.9	-6.1	-3.8	-3.5	-3.5
H41	513902	836884	-13.6	-9.5	-5.7	-3.4	-3.1	-3.1
H42	517583	838226	-14.1	-10	-6.2	-3.9	-3.6	-3.6
H43	515398	834709	-11.3	-7.2	-3.4	-1.1	-0.8	-0.8
H44	517725	837501	-14.4	-10.3	-6.5	-4.2	-3.9	-3.9
H45	517434	838443	-14.4	-10.3	-6.5	-4.2	-3.9	-3.9
H46	517697	837346	-14.4	-10.3	-6.5	-4.2	-3.9	-3.9
H47	516822	835130	-14.9	-10.8	-7	-4.7	-4.4	-4.4
H48	514129	833845	-12.6	-8.5	-4.7	-2.4	-2.1	-2.1
H49	517741	837449	-14.6	-10.5	-6.7	-4.4	-4.1	-4.1
H50	517762	837602	-14.6	-10.5	-6.7	-4.4	-4.1	-4.1
H51	517663	838130	-14.3	-10.2	-6.4	-4.1	-3.8	-3.8
H52	517766	837561	-14.7	-10.6	-6.8	-4.5	-4.2	-4.2
H53	517762	837501	-14.8	-10.7	-6.9	-4.6	-4.3	-4.3
H54	517767	837579	-14.7	-10.6	-6.8	-4.5	-4.2	-4.2
H55	517742	837383	-14.8	-10.7	-6.9	-4.6	-4.3	-4.3
H56	515873	833236	-13.2	-9.1	-5.3	-3	-2.7	-2.7
H57	516625	836322	-11.7	-7.6	-3.8	-1.5	-1.2	-1.2
H58	517758	837737	-14.6	-10.5	-6.7	-4.4	-4.1	-4.1
H59	513235	835631	-14.6	-10.5	-6.7	-4.4	-4.1	-4.1

	ITM	ITM	4m/s	5m/s	6m/s	7m/s	8m/s	9+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA	dBA
H60	517632	838261	-14.7	-10.6	-6.8	-4.5	-4.2	-4.2
H61	517638	837109	-14.6	-10.5	-6.7	-4.4	-4.1	-4.1
H62	514190	836978	-13.2	-9.1	-5.3	-3	-2.7	-2.7
H63	517742	837283	-14.9	-10.8	-7	-4.7	-4.4	-4.4
H64	517457	838516	-15.2	-11.1	-7.3	-5	-4.7	-4.7
H65	516738	836261	-12.5	-8.4	-4.6	-2.3	-2	-2
H66	517836	837697	-15.4	-11.3	-7.5	-5.2	-4.9	-4.9
H67	517806	837295	-15.5	-11.4	-7.6	-5.3	-5	-5
H68	516697	836380	-12.2	-8.1	-4.3	-2	-1.7	-1.7
H69	517489	838569	-15.8	-11.7	-7.9	-5.6	-5.3	-5.3
H70	516975	835388	-15.2	-11.1	-7.3	-5	-4.7	-4.7
H71	517798	837225	-15.5	-11.4	-7.6	-5.3	-5	-5
H72	515557	831893	-16.1	-12	-8.2	-5.9	-5.6	-5.6
H73	517792	837189	-15.5	-11.4	-7.6	-5.3	-5	-5
H74	517729	837077	-15.4	-11.3	-7.5	-5.2	-4.9	-4.9
H75	514818	831687	-16.2	-12.1	-8.3	-6	-5.7	-5.7
H76	513130	835959	-15.3	-11.2	-7.4	-5.1	-4.8	-4.8
H77	516817	836244	-13.1	-9	-5.2	-2.9	-2.6	-2.6
H78	517748	838272	-15.8	-11.7	-7.9	-5.6	-5.3	-5.3
H79	517791	837155	-15.6	-11.5	-7.7	-5.4	-5.1	-5.1
H80	514340	837065	-13.1	-9	-5.2	-2.9	-2.6	-2.6
H81	513118	835991	-15.4	-11.3	-7.5	-5.2	-4.9	-4.9
H82	517804	837142	-15.8	-11.7	-7.9	-5.6	-5.3	-5.3
H83	514941	831643	-16.6	-12.5	-8.7	-6.4	-6.1	-6.1
H84	513221	836506	-16.1	-12	-8.2	-5.9	-5.6	-5.6
H85	513108	836017	-15.5	-11.4	-7.6	-5.3	-5	-5
H86	516952	834926	-16.5	-12.4	-8.6	-6.3	-6	-6
H87	517884	837289	-16.1	-12	-8.2	-5.9	-5.6	-5.6
H88	514595	831709	-16.5	-12.4	-8.6	-6.3	-6	-6

	ITM	ITM	4m/s	5m/s	6m/s	7m/s	8m/s	9+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA	dBA
H89	513105	836024	-15.5	-11.4	-7.6	-5.3	-5	-5
H90	517910	837382	-16.2	-12.1	-8.3	-6	-5.7	-5.7
H91	516865	836247	-13.4	-9.3	-5.5	-3.2	-2.9	-2.9
H92	516678	834560	-15.8	-11.7	-7.9	-5.6	-5.3	-5.3
H93	515173	831629	-16.9	-12.8	-9	-6.7	-6.4	-6.4
H94	517945	837469	-16.4	-12.3	-8.5	-6.2	-5.9	-5.9
H95	516609	833595	-16.6	-12.5	-8.7	-6.4	-6.1	-6.1
H96	517041	835575	-15.2	-11.1	-7.3	-5	-4.7	-4.7
H97	515971	838486	-13.3	-9.2	-5.4	-3.1	-2.8	-2.8
H98	516040	838493	-13.4	-9.3	-5.5	-3.2	-2.9	-2.9
H99	517816	838358	-16.7	-12.6	-8.8	-6.5	-6.2	-6.2
H100	517798	838402	-16.8	-12.7	-8.9	-6.6	-6.3	-6.3
H101	516953	836216	-13.9	-9.8	-6	-3.7	-3.4	-3.4
H102	513352	834999	-15.3	-11.2	-7.4	-5.1	-4.8	-4.8
H103	516624	833488	-17	-12.9	-9.1	-6.8	-6.5	-6.5
H104	515505	831678	-17.5	-13.4	-9.6	-7.3	-7	-7
H105	514472	831653	-17.4	-13.3	-9.5	-7.2	-6.9	-6.9
H106	517382	836605	-15.3	-11.2	-7.4	-5.1	-4.8	-4.8
H107	516958	834700	-16.9	-12.8	-9	-6.7	-6.4	-6.4
H108	516958	834683	-16.9	-12.8	-9	-6.7	-6.4	-6.4
H109	513032	836295	-16.5	-12.4	-8.6	-6.3	-6	-6
H110	516551	833308	-17	-12.9	-9.1	-6.8	-6.5	-6.5
H111	516041	838580	-14.1	-10	-6.2	-3.9	-3.6	-3.6
H112	513331	834901	-15.5	-11.4	-7.6	-5.3	-5	-5
H113	514539	831580	-17.8	-13.7	-9.9	-7.6	-7.3	-7.3
H114	517409	836575	-15.5	-11.4	-7.6	-5.3	-5	-5
H115	517850	838466	-17.5	-13.4	-9.6	-7.3	-7	-7
H116	518085	837658	-17.7	-13.6	-9.8	-7.5	-7.2	-7.2
H117	513005	836321	-16.8	-12.7	-8.9	-6.6	-6.3	-6.3
H118	517191	835471	-16.4	-12.3	-8.5	-6.2	-5.9	-5.9

	ITM	ITM	4m/s	5m/s	6m/s	7m/s	8m/s	9+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA	dBA
H119	517007	836317	-14.1	-10	-6.2	-3.9	-3.6	-3.6
H120	516947	834602	-17	-12.9	-9.1	-6.8	-6.5	-6.5
H121	513228	834982	-16	-11.9	-8.1	-5.8	-5.5	-5.5
H122	515945	831977	-17.8	-13.7	-9.9	-7.6	-7.3	-7.3
H123	516052	832172	-17.5	-13.4	-9.6	-7.3	-7	-7
H124	516884	834471	-17	-12.9	-9.1	-6.8	-6.5	-6.5
H125	516855	834435	-16.8	-12.7	-8.9	-6.6	-6.3	-6.3
H126	517096	836244	-14.7	-10.6	-6.8	-4.5	-4.2	-4.2
H127	513225	834907	-16.1	-12	-8.2	-5.9	-5.6	-5.6
H128	518160	837673	-18.3	-14.2	-10.4	-8.1	-7.8	-7.8
H129	514056	831821	-18	-13.9	-10.1	-7.8	-7.5	-7.5
H130	517099	836299	-14.7	-10.6	-6.8	-4.5	-4.2	-4.2
H131	513091	836799	-18.2	-14.1	-10.3	-8	-7.7	-7.7
H132	518014	836990	-17.8	-13.7	-9.9	-7.6	-7.3	-7.3
H133	517606	836550	-16.6	-12.5	-8.7	-6.4	-6.1	-6.1
H134	513969	831910	-18	-13.9	-10.1	-7.8	-7.5	-7.5
H135	518001	836934	-17.7	-13.6	-9.8	-7.5	-7.2	-7.2
H136	517915	838590	-18.5	-14.4	-10.6	-8.3	-8	-8
H137	513187	834847	-16.4	-12.3	-8.5	-6.2	-5.9	-5.9
H138	517212	836384	-15.1	-11	-7.2	-4.9	-4.6	-4.6
H139	517994	836903	-17.7	-13.6	-9.8	-7.5	-7.2	-7.2
H140	518017	836930	-17.8	-13.7	-9.9	-7.6	-7.3	-7.3
H141	517992	836890	-17.7	-13.6	-9.8	-7.5	-7.2	-7.2
H142	513079	836852	-18.4	-14.3	-10.5	-8.2	-7.9	-7.9
H143	517990	836877	-17.7	-13.6	-9.8	-7.5	-7.2	-7.2
H144	517989	836869	-17.8	-13.7	-9.9	-7.6	-7.3	-7.3
H145	518108	837076	-18.1	-14	-10.2	-7.9	-7.6	-7.6
H146	517987	836860	-17.8	-13.7	-9.9	-7.6	-7.3	-7.3
H147	518208	837768	-18.6	-14.5	-10.7	-8.4	-8.1	-8.1

	ITM	ITM	4m/s	5m/s	6m/s	7m/s	8m/s	9+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA	dBA
H148	518212	837742	-18.6	-14.5	-10.7	-8.4	-8.1	-8.1
H149	518212	837845	-18.6	-14.5	-10.7	-8.4	-8.1	-8.1
H150	518010	836858	-17.9	-13.8	-10	-7.7	-7.4	-7.4
H151	514113	831661	-18.7	-14.6	-10.8	-8.5	-8.2	-8.2
H152	518117	837019	-18.3	-14.2	-10.4	-8.1	-7.8	-7.8
H153	517388	836374	-16	-11.9	-8.1	-5.8	-5.5	-5.5
H154	513062	836905	-18.7	-14.6	-10.8	-8.5	-8.2	-8.2
H155	518114	837000	-18.3	-14.2	-10.4	-8.1	-7.8	-7.8
H156	516958	834382	-17.4	-13.3	-9.5	-7.2	-6.9	-6.9
H157	513103	834713	-17.1	-13	-9.2	-6.9	-6.6	-6.6
H158	517296	836339	-15.6	-11.5	-7.7	-5.4	-5.1	-5.1
H159	518255	837722	-18.8	-14.7	-10.9	-8.6	-8.3	-8.3
H160	518102	836959	-18.2	-14.1	-10.3	-8	-7.7	-7.7
H161	518268	837758	-18.9	-14.8	-11	-8.7	-8.4	-8.4
H162	518273	837769	-19	-14.9	-11.1	-8.8	-8.5	-8.5
H163	517873	838787	-19.2	-15.1	-11.3	-9	-8.7	-8.7
H164	518250	837922	-19	-14.9	-11.1	-8.8	-8.5	-8.5
H165	513062	834658	-17.4	-13.3	-9.5	-7.2	-6.9	-6.9
H166	516818	833276	-18.6	-14.5	-10.7	-8.4	-8.1	-8.1
H167	518279	837790	-19	-14.9	-11.1	-8.8	-8.5	-8.5
H168	517935	838746	-19.3	-15.2	-11.4	-9.1	-8.8	-8.8
H169	515858	831578	-19.6	-15.5	-11.7	-9.4	-9.1	-9.1
H170	518171	838358	-19.1	-15	-11.2	-8.9	-8.6	-8.6
H171	513708	837466	-17.3	-13.2	-9.4	-7.1	-6.8	-6.8
H172	518134	838497	-19.4	-15.3	-11.5	-9.2	-8.9	-8.9
H173	513017	836992	-19.3	-15.2	-11.4	-9.1	-8.8	-8.8
H174	518256	838176	-19.3	-15.2	-11.4	-9.1	-8.8	-8.8
H175	517925	838830	-19.6	-15.5	-11.7	-9.4	-9.1	-9.1
H176	517769	838987	-19.7	-15.6	-11.8	-9.5	-9.2	-9.2
H177	517370	836081	-16.4	-12.3	-8.5	-6.2	-5.9	-5.9

	ITM	ITM	4m/s	5m/s	6m/s	7m/s	8m/s	9+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA	dBA
H178	516288	832086	-19.2	-15.1	-11.3	-9	-8.7	-8.7
H179	517344	836221	-16.1	-12	-8.2	-5.9	-5.6	-5.6
H180	517385	836061	-16.5	-12.4	-8.6	-6.3	-6	-6
H181	518067	838701	-19.8	-15.7	-11.9	-9.6	-9.3	-9.3
H182	517378	836158	-16.3	-12.2	-8.4	-6.1	-5.8	-5.8
H183	516334	832143	-19.3	-15.2	-11.4	-9.1	-8.8	-8.8
H184	513704	831940	-19.2	-15.1	-11.3	-9	-8.7	-8.7
H185	516834	833111	-19	-14.9	-11.1	-8.8	-8.5	-8.5
H186	518315	838186	-19.6	-15.5	-11.7	-9.4	-9.1	-9.1
H187	512996	837073	-19.6	-15.5	-11.7	-9.4	-9.1	-9.1
H188	517402	836199	-16.4	-12.3	-8.5	-6.2	-5.9	-5.9
H189	516765	832999	-18.9	-14.8	-11	-8.7	-8.4	-8.4
H190	517625	836280	-17.3	-13.2	-9.4	-7.1	-6.8	-6.8
H191	518215	838553	-20	-15.9	-12.1	-9.8	-9.5	-9.5
H192	516021	831560	-20.3	-16.2	-12.4	-10.1	-9.8	-9.8
H193	517457	835933	-17.1	-13	-9.2	-6.9	-6.6	-6.6
H194	516337	832024	-19.7	-15.6	-11.8	-9.5	-9.2	-9.2
H195	517465	835870	-17.2	-13.1	-9.3	-7	-6.7	-6.7
H196	516381	832122	-19.6	-15.5	-11.7	-9.4	-9.1	-9.1
H197	517966	838934	-20.3	-16.2	-12.4	-10.1	-9.8	-9.8
H198	517593	836238	-17.2	-13.1	-9.3	-7	-6.7	-6.7
H199	517440	836173	-16.6	-12.5	-8.7	-6.4	-6.1	-6.1
H200	512952	837097	-19.9	-15.8	-12	-9.7	-9.4	-9.4
H201	512675	836558	-19.3	-15.2	-11.4	-9.1	-8.8	-8.8
H202	518089	838799	-20.3	-16.2	-12.4	-10.1	-9.8	-9.8
H203	517905	839004	-20.3	-16.2	-12.4	-10.1	-9.8	-9.8
H204	513796	838073	-19.5	-15.4	-11.6	-9.3	-9	-9
H205	518071	838854	-20.4	-16.3	-12.5	-10.2	-9.9	-9.9
H206	517486	836057	-17	-12.9	-9.1	-6.8	-6.5	-6.5

	ITM	ITM	4m/s	5m/s	6m/s	7m/s	8m/s	9+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA	dBA
H207	513730	837683	-18.6	-14.5	-10.7	-8.4	-8.1	-8.1
H208	517812	839121	-20.5	-16.4	-12.6	-10.3	-10	-10
H209	517497	836093	-17	-12.9	-9.1	-6.8	-6.5	-6.5
H210	517231	834307	-18.8	-14.7	-10.9	-8.6	-8.3	-8.3
H211	518054	838917	-20.6	-16.5	-12.7	-10.4	-10.1	-10.1
H212	517509	836126	-17	-12.9	-9.1	-6.8	-6.5	-6.5
H213	516125	831552	-20.8	-16.7	-12.9	-10.6	-10.3	-10.3
H214	517922	839074	-20.7	-16.6	-12.8	-10.5	-10.2	-10.2
H215	517355	834419	-19.1	-15	-11.2	-8.9	-8.6	-8.6
H216	517856	839139	-20.8	-16.7	-12.9	-10.6	-10.3	-10.3
H217	518030	838990	-20.8	-16.7	-12.9	-10.6	-10.3	-10.3
H218	517431	834508	-19.3	-15.2	-11.4	-9.1	-8.8	-8.8
H219	513533	831954	-20.1	-16	-12.2	-9.9	-9.6	-9.6
H220	517735	839237	-20.8	-16.7	-12.9	-10.6	-10.3	-10.3
H221	516653	832742	-19.1	-15	-11.2	-8.9	-8.6	-8.6
H222	513667	837855	-19.4	-15.3	-11.5	-9.2	-8.9	-8.9
H223	513685	831661	-20.6	-16.5	-12.7	-10.4	-10.1	-10.1
H224	517822	839198	-20.9	-16.8	-13	-10.7	-10.4	-10.4
H225	517791	839223	-20.9	-16.8	-13	-10.7	-10.4	-10.4
H226	515679	831145	-21.5	-17.4	-13.6	-11.3	-11	-11
H227	517504	834526	-19.6	-15.5	-11.7	-9.4	-9.1	-9.1
H228	517793	839268	-21.1	-17	-13.2	-10.9	-10.6	-10.6
H229	513657	838098	-20.2	-16.1	-12.3	-10	-9.7	-9.7
H230	513622	837938	-19.8	-15.7	-11.9	-9.6	-9.3	-9.3
H231	518095	839027	-21.2	-17.1	-13.3	-11	-10.7	-10.7
H232	517878	839229	-21.2	-17.1	-13.3	-11	-10.7	-10.7
H233	517789	839294	-21.2	-17.1	-13.3	-11	-10.7	-10.7
H234	517378	834152	-19.5	-15.4	-11.6	-9.3	-9	-9
H235	513569	831714	-20.9	-16.8	-13	-10.7	-10.4	-10.4
H236	518078	839073	-21.3	-17.2	-13.4	-11.1	-10.8	-10.8

	ITM	ITM	4m/s	5m/s	6m/s	7m/s	8m/s	9+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA	dBA
H237	517596	834627	-19.6	-15.5	-11.7	-9.4	-9.1	-9.1
H238	518005	839159	-21.4	-17.3	-13.5	-11.2	-10.9	-10.9
H239	518050	839123	-21.4	-17.3	-13.5	-11.2	-10.9	-10.9
H240	517571	834542	-19.6	-15.5	-11.7	-9.4	-9.1	-9.1
H241	513951	831241	-21.7	-17.6	-13.8	-11.5	-11.2	-11.2
H242	515424	830951	-22.2	-18.1	-14.3	-12	-11.7	-11.7
H243	517868	839303	-21.5	-17.4	-13.6	-11.3	-11	-11
H244	517644	834629	-19.7	-15.6	-11.8	-9.5	-9.2	-9.2
H245	517599	834519	-19.8	-15.7	-11.9	-9.6	-9.3	-9.3
H246	513643	838342	-21	-16.9	-13.1	-10.8	-10.5	-10.5
H247	517980	839253	-21.7	-17.6	-13.8	-11.5	-11.2	-11.2
H248	516877	832711	-20.1	-16	-12.2	-9.9	-9.6	-9.6
H249	517711	834681	-19.9	-15.8	-12	-9.7	-9.4	-9.4
H250	516673	832142	-20.9	-16.8	-13	-10.7	-10.4	-10.4
H251	517666	834544	-20	-15.9	-12.1	-9.8	-9.5	-9.5
H252	516393	831529	-22	-17.9	-14.1	-11.8	-11.5	-11.5
H253	517503	834090	-20.1	-16	-12.2	-9.9	-9.6	-9.6
H254	516757	832459	-20.4	-16.3	-12.5	-10.2	-9.9	-9.9
H255	516938	832711	-20.4	-16.3	-12.5	-10.2	-9.9	-9.9
H256	515561	830891	-22.7	-18.6	-14.8	-12.5	-12.2	-12.2
H257	512604	834248	-20.1	-16	-12.2	-9.9	-9.6	-9.6
H258	513452	831612	-21.7	-17.6	-13.8	-11.5	-11.2	-11.2
H259	517973	839365	-22.2	-18.1	-14.3	-12	-11.7	-11.7
H260	512440	836921	-21.2	-17.1	-13.3	-11	-10.7	-10.7
H261	512569	834235	-20.3	-16.2	-12.4	-10.1	-9.8	-9.8
H262	513585	838498	-21.7	-17.6	-13.8	-11.5	-11.2	-11.2
H263	513247	831945	-21.5	-17.4	-13.6	-11.3	-11	-11
H264	517571	833961	-20.5	-16.4	-12.6	-10.3	-10	-10
H265	517825	839498	-22.2	-18.1	-14.3	-12	-11.7	-11.7

	ITM	ITM	4m/s	5m/s	6m/s	7m/s	8m/s	9+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA	dBA
H266	514677	830757	-23.2	-19.1	-15.3	-13	-12.7	-12.7
H267	512406	836941	-21.3	-17.2	-13.4	-11.1	-10.8	-10.8
H268	517813	834607	-20.4	-16.3	-12.5	-10.2	-9.9	-9.9
H269	516499	831484	-22.5	-18.4	-14.6	-12.3	-12	-12
H270	517862	839512	-22.4	-18.3	-14.5	-12.2	-11.9	-11.9
H271	516513	831474	-22.6	-18.5	-14.7	-12.4	-12.1	-12.1
H272	513257	831765	-22	-17.9	-14.1	-11.8	-11.5	-11.5
H273	517866	834632	-20.5	-16.4	-12.6	-10.3	-10	-10
H274	515833	830871	-23.2	-19.1	-15.3	-13	-12.7	-12.7
H275	516912	832406	-21.2	-17.1	-13.3	-11	-10.7	-10.7
H276	512351	836995	-21.7	-17.6	-13.8	-11.5	-11.2	-11.2
H277	515552	830724	-23.7	-19.6	-15.8	-13.5	-13.2	-13.2
H278	517807	839629	-22.8	-18.7	-14.9	-12.6	-12.3	-12.3
H279	515967	830898	-23.4	-19.3	-15.5	-13.2	-12.9	-12.9
H280	512327	837015	-21.8	-17.7	-13.9	-11.6	-11.3	-11.3
H281	513505	838660	-22.5	-18.4	-14.6	-12.3	-12	-12
H282	513233	837955	-21.2	-17.1	-13.3	-11	-10.7	-10.7
H283	512284	836976	-21.8	-17.7	-13.9	-11.6	-11.3	-11.3
H284	517503	837983	-11.8	-7.7	-3.9	-1.6	-1.3	-1.3

**(FI) – Financially Involved*

A noise contour map of the cumulative effects of all 18 no. turbines is presented with a maximum sound power output at a wind speed of 12 ms^{-1} at 10 m height in **Technical Appendix 11.4**. The contour map in **Technical Appendix 11.4** assumes that all turbines are simultaneously downwind at the same time to each location which results in an overprediction of the noise levels.

There are eighty six properties within 5 dB of the 43 dB night-time limit, when all of the turbines are operating at their maximum noise levels. There is an inherent conservatism in the prediction noise modelling when it is carried out in line with ETSU-R-97 and the IoAGPG. Scientific papers referenced within the IOAGPG note that predicted noise levels are in the

region of 2dB more conservative than the measured levels taken during post compliance monitoring.

The turbines to be installed on this site are able to operate in various modes. If specific conditions arise that AM is generated, the operator can amend the operating mode to sufficiently mitigate the generation of AM or reduce the overall noise level in compensation to achieved set noise limits.

11.4.4 Cumulative Effects Assessment

There is one single operational turbine in operation within 2km of the Proposed Development. However, it is of a domestic scale and attached to a residential receptor already included in our model (H40). Therefore, this turbine has not been included. No other wind turbines are located within 2 km of the Proposed Development. Therefore, a cumulative assessment is not required.

11.4.5 Battery Energy Storage System – Predicted Noise Levels

The predicted noise levels (LAeq to the nearest dB) at each receptor location are presented in **Table 11.19**.

Table 11.19: Predicted Operational Noise Levels - BESS

House ID	ITM	ITM	Predicted Noise Impacts LAeq, 1hr, dB
	Easting	Northing	
H1*	515110	837466	2.5
H2*	515526	833767	36.2
H3*	516107	834819	24.5
H4	515947	834836	24.5
H5	516227	836339	8.3
H6	514628	834072	17.8
H7	513577	835455	6.9
H8	516241	833804	37.2
H9*	515489	833504	34.2
H10	515575	835060	21.9
H11	513526	835513	6.5
H12	515450	832962	25.8

House ID	ITM Easting	ITM Northing	Predicted Noise Impacts LAeq, 1hr, dB
H13	515080	831996	17.6
H14	515456	833467	33.2
H15	513601	835338	7.3
H16	516561	837118	4.1
H17	515886	834729	25.7
H18*	515019	834112	26.2
H19	517530	838028	0
H20	513391	835822	5
H21	517553	837950	0
H22	517556	837865	0
H23	516320	834718	24.9
H24	515390	832068	18.9
H25	517622	837746	0.2
H26	517552	838096	0
H27	515559	834678	25.6
H28	515805	834702	26
H29	516744	836946	4.7
H30	514721	837259	2.9
H31	517581	838054	0
H32	516774	835227	18.8
H33	513365	835996	4.3
H34	515641	832856	27.1
H35	517606	838071	0
H36	516764	835557	16.7
H37	514091	836904	3.2
H38	517490	838353	0
H39	515462	834716	24.8
H40	516384	834641	25.4
H41	513902	836884	2.8
H42	517583	838226	0

House ID	ITM Easting	ITM Northing	Predicted Noise Impacts LAeq, 1hr, dB
H43	515398	834709	24.6
H44	517725	837501	5.3
H45	517434	838443	0
H46	517697	837346	5.9
H47	516822	835130	19.3
H48	514129	833845	13.9
H49	517741	837449	5.5
H50	517762	837602	4.9
H51	517663	838130	0
H52	517766	837561	5
H53	517762	837501	5.3
H54	517767	837579	5
H55	517742	837383	5.7
H56	515873	833236	33.9
H57	516625	836322	12.5
H58	517758	837737	4.4
H59	513235	835631	4.9
H60	517632	838261	0
H61	517638	837109	7
H62	514190	836978	3.1
H63	517742	837283	6.1
H64	517457	838516	0
H65	516738	836261	12.6
H66	517836	837697	4.4
H67	517806	837295	5.9
H68	516697	836380	12.1
H69	517489	838569	0
H70	516975	835388	17
H71	517798	837225	6.2

House ID	ITM Easting	ITM Northing	Predicted Noise Impacts LAeq, 1hr, dB
H72	515557	831893	17.9
H73	517792	837189	6.4
H74	517729	837077	6.9
H75	514818	831687	14.9
H76	513130	835959	3.6
H77	516817	836244	12.6
H78	517748	838272	0
H79	517791	837155	6.5
H80	514340	837065	3
H81	513118	835991	3.5
H82	517804	837142	6.5
H83	514941	831643	15.0
H84	513221	836506	2.3
H85	513108	836017	3.4
H86	516952	834926	15.4
H87	517884	837289	5.8
H88	514595	831709	14.3
H89	513105	836024	3.4
H90	517910	837382	5.4
H91	516865	836247	12.5
H92	516678	834560	20.0
H93	515173	831629	15.5
H94	517945	837469	5
H95	516609	833595	25
H96	517041	835575	15.7
H97	515971	838486	0
H98	516040	838493	0
H99	517816	838358	0
H100	517798	838402	0
H101	516953	836216	12.5

House ID	ITM Easting	ITM Northing	Predicted Noise Impacts LAeq, 1hr, dB
H102	513352	834999	7.1
H103	516624	833488	24.4
H104	515505	831678	16.4
H105	514472	831653	13.5
H106	517382	836605	9.6
H107	516958	834700	16.7
H108	516958	834683	16.8
H109	513032	836295	2.3
H110	516551	833308	24.3
H111	516041	838580	0
H112	513331	834901	7.3
H113	514539	831580	13.4
H114	517409	836575	9.7
H115	517850	838466	0
H116	518085	837658	4.1
H117	513005	836321	2.2
H118	517191	835471	15.1
H119	517007	836317	11.8
H120	516947	834602	17.4
H121	513228	834982	6.6
H122	515945	831977	18.8
H123	516052	832172	20.4
H124	516884	834471	18.7
H125	516855	834435	19.1
H126	517096	836244	12.0
H127	513225	834907	6.7
H128	518160	837673	3.9
H129	514056	831821	8.3
H130	517099	836299	11.7

House ID	ITM Easting	ITM Northing	Predicted Noise Impacts LAeq, 1hr, dB
H131	513091	836799	1.0
H132	518014	836990	6.6
H133	517606	836550	9.3
H134	513969	831910	8.3
H135	518001	836934	6.8
H136	517915	838590	0
H137	513187	834847	6.7
H138	517212	836384	11.0
H139	517994	836903	6.9
H140	518017	836930	6.8
H141	517992	836890	7.0
H142	513079	836852	0.9
H143	517990	836877	7.0
H144	517989	836869	7.0
H145	518108	837076	6.0
H146	517987	836860	7.1
H147	518208	837768	3.5
H148	518212	837742	3.6
H149	518212	837845	3.3
H150	518010	836858	6.9
H151	514113	831661	8.4
H152	518117	837019	6.1
H153	517388	836374	10.6
H154	513062	836905	0.7
H155	518114	837000	6.2
H156	516958	834382	18.6
H157	513103	834713	6.5
H158	517296	836339	11.0
H159	518255	837722	3.6
H160	518102	836959	6.3

House ID	ITM Easting	ITM Northing	Predicted Noise Impacts LAeq, 1hr, dB
H161	518268	837758	3.4
H162	518273	837769	3.4
H163	517873	838787	0.0
H164	518250	837922	2.9
H165	513062	834658	6.4
H166	516818	833276	21.0
H167	518279	837790	3.3
H168	517935	838746	0
H169	515858	831578	15.9
H170	518171	838358	0.0
H171	513708	837466	0.4
H172	518134	838497	0.0
H173	513017	836992	0.3
H174	518256	838176	0
H175	517925	838830	0
H176	517769	838987	0
H177	517370	836081	12.1
H178	516288	832086	19.3
H179	517344	836221	11.5
H180	517385	836061	12.1
H181	518067	838701	0
H182	517378	836158	11.7
H183	516334	832143	19.7
H184	513704	831940	7.3
H185	516834	833111	20.0
H186	518315	838186	0
H187	512996	837073	0
H188	517402	836199	11.4
H189	516765	832999	19.8

House ID	ITM Easting	ITM Northing	Predicted Noise Impacts LAeq, 1hr, dB
H190	517625	836280	10.3
H191	518215	838553	0
H192	516021	831560	15.8
H193	517457	835933	12.0
H194	516337	832024	18.8
H195	517465	835870	12.3
H196	516381	832122	19.4
H197	517966	838934	0
H198	517593	836238	10.5
H199	517440	836173	11.4
H200	512952	837097	0
H201	512675	836558	0.5
H202	518089	838799	0
H203	517905	839004	0
H204	513796	838073	0
H205	518071	838854	0
H206	517486	836057	11.6
H207	513730	837683	0
H208	517812	839121	0
H209	517497	836093	11.5
H210	517231	834307	16.6
H211	518054	838917	0
H212	517509	836126	11.3
H213	516125	831552	15.7
H214	517922	839074	0
H215	517355	834419	15.3
H216	517856	839139	0
H217	518030	838990	0
H218	517431	834508	14.4
H219	513533	831954	6.6

House ID	ITM Easting	ITM Northing	Predicted Noise Impacts LAeq, 1hr, dB
H220	517735	839237	0
H221	516653	832742	22.9
H222	513667	837855	0
H223	513685	831661	6.2
H224	517822	839198	0
H225	517791	839223	0
H226	515679	831145	13.2
H227	517504	834526	13.9
H228	517793	839268	0
H229	513657	838098	0
H230	513622	837938	0
H231	518095	839027	0
H232	517878	839229	0
H233	517789	839294	0
H234	517378	834152	15.9
H235	513569	831714	6
H236	518078	839073	0
H237	517596	834627	12.9
H238	518005	839159	0
H239	518050	839123	0
H240	517571	834542	13.4
H241	513951	831241	10
H242	515424	830951	11.9
H243	517868	839303	0
H244	517644	834629	12.6
H245	517599	834519	13.2
H246	513643	838342	0
H247	517980	839253	0
H248	516877	832711	20.4

House ID	ITM Easting	ITM Northing	Predicted Noise Impacts LAeq, 1hr, dB
H249	517711	834681	12.0
H250	516673	832142	18.7
H251	517666	834544	12.7
H252	516393	831529	15.3
H253	517503	834090	15.0
H254	516757	832459	20.6
H255	516938	832711	19.4
H256	515561	830891	11.7
H257	512604	834248	4.7
H258	513452	831612	5.2
H259	517973	839365	0
H260	512440	836921	0
H261	512569	834235	4.5
H262	513585	838498	0
H263	513247	831945	6.9
H264	517571	833961	14.7
H265	517825	839498	0
H266	514677	830757	9.8
H267	512406	836941	0
H268	517813	834607	11.6
H269	516499	831484	14.8
H270	517862	839512	0
H271	516513	831474	14.7
H272	513257	831765	4.9
H273	517866	834632	11.2
H274	515833	830871	11.7
H275	516912	832406	19.5
H276	512351	836995	0
H277	515552	830724	10.8
H278	517807	839629	0

House ID	ITM Easting	ITM Northing	Predicted Noise Impacts LAeq, 1hr, dB
H279	515967	830898	11.8
H280	512327	837015	0
H281	513505	838660	0
H282	513233	837955	0
H283	512284	836976	0
H284	517503	837983	0

11.4.6 Battery Energy Storage System – Impact Assessment

The predicted noise levels were compared with the guidance documents identified in **Section 11.2.3** above.

11.4.6.1 NG4

There are a number of steps involved in confirming the assessment under the NG4 guidance:

- **Step 1: Quiet Area Screening of the Development Location**

The location of the proposed development should be screened in order to determine if it is to be located in or near an area that could be considered a 'Quiet Area' in open country according to the Agency publication Environmental Quality Objectives - Noise in Quiet Areas. This will involve determining if the following criteria are satisfied:

- At least 3 km from urban areas with a population >1,000 people;
- At least 10 km from any urban areas with a population >5,000 people;
- At least 15 km from any urban areas with a population >10,000 people;
- At least 3 km from any local industry;
- At least 10 km from any major industry centre;
- At least 5 km from any National Primary Route, and;
- At least 7.5 km from any Motorway or Dual Carriageway

The proposed site is located within 3 km of Ballycastle. Therefore, the site is not considered a quiet area.

- **Step 2: Baseline Environmental Noise Survey**

Noise measurements were carried as detailed in **Section 11.3** above.

- **Step 3: Screen Areas of Low Background Noise**

For all areas not identified as Quiet Areas in Step 1, the existing background noise levels measured during the environmental noise survey should be examined to determine if they satisfy the following criteria:

- Average Daytime Background Noise Level ≤40 dB L_{AF90}, and;
- Average Evening Background Noise Level ≤35 dB L_{AF90}, and;
- Average Night-time Background Noise Level ≤30 dB L_{AF90}.

It can be seen that the noise levels presented in **Section 11.3.7** are greater than the limit levels for the day, evening and night-time periods, therefore, the vicinity of the site is not considered to be a low background noise area.

- **Step 4: Determine Appropriate Noise Criteria**

Based on the information in Step 1-3 above the site is not a quiet area or area of low background noise level. The recommended noise for the site is defined within the "All other Areas" criteria i.e. 55 dB daytime, 50 dB evening and 45 dB night-time, as shown in **Table 11.22** below.

Table 11.22: Proposed Impact of Directivity Assessment at receptors in exceedance (12 m/s)

Scenario	Daytime Noise Criterion, dB $L_{Ar,T}$ (07:00 to 19:00hrs)	Evening Noise Criterion, dB $L_{Ar,T}$ (19:00 to 23:00hrs)	Night-time Noise Criterion, dB $L_{Ar,T}$ (23:00 to 7:00hrs)
Quiet Area	Noise from the licensed site to be at least 10d B below the average daytime background noise level measured during the baseline noise survey	Noise from the licensed site to be at least 10 dB below the average evening background noise level measured during the baseline noise survey	Noise from the licensed site to be at least 10 dB below the average night-time background noise level measured during the baseline noise survey
Areas of Low Background Noise	45 dB	40 dB	35 dB
All other Areas	55 dB	50 dB	45 dB

11.5 MITIGATION MEASURES AND RESIDUAL EFFECTS

11.5.1 Construction and Decommissioning Noise Mitigation

No significant construction noise effects have been identified. Therefore, no specific mitigation measures are required. However, general guidance for controlling construction noise through the use of good practice given in BS 5228 will be followed. Construction and

decommissioning of the Proposed Development shall be limited to working times given and any controls incorporated in any planning permission.

During the decommissioning phase of the Proposed Development, noise levels are likely be no more than predicted in **Table 11.14,** however, it is envisaged that decommissioning will be of shorter duration. Any legislation, guidance or best practice relevant at the time of decommissioning will be complied with. Construction and decommissioning is a temporary day time activity.

11.5.1.1 Residual Construction and Decommissioning Effects

The residual effects are the same as the construction and decommissioning effects identified in this assessment.

11.5.2 Operational Noise Mitigation

The Proposed Development has been designed to comply with the 2006 noise Guidelines and noise limits attached as conditions to recent 2021 An Bord Pleanála decisions. The operational noise emissions from the Proposed Development exceeds the daytime noise limit of 45 dB at one receptors at certain wind speeds

However, it has been confirmed by the applicant that one of the dwellings in exceedance of the 45 dB limit, H1, is a disused vacant dwelling and is under the control of the Developer. As part of the planning application, permission is sought for it to be converted and used as an operations building for the lifespan of the Proposed Development (**Section 2.6.8**). In addition, there is 1 dwelling, H2, located approximately 320 m southwest from AT01. This property is under the control of the Developer, and the owner is a financial beneficiary of the Proposed Development. The owner has confirmed that this property will remain unoccupied for the operational lifespan of the Proposed Development. These dwellings have not been included in this assessment.

The predicted noise levels exceed the night-time noise limit of 43 dB at five receptors, at various wind speeds – H5, H6, H9, H14 and H16.

Therefore, mitigation measures are required for exceedances at these receptors. These mitigation measures have been detailed in **Section 11.5.4** below. In addition, all turbines will have STE fitted as standard to reduce noise emission levels.

11.5.2.1 Residual Operational Effects

The residual effects are the same as the operational effects identified in this assessment.

11.5.3 Cumulative Effects

There were no additional wind turbines located within 2km of the Proposed Development.

11.5.4 Directivity

The predictions made using ISO 9613-2 are "worst-case" conditions, which reflect the scenario where the source to receiver propagation is always in a downwind direction. When considering cumulative impacts from wind turbines the IOA GPG, the predicted noise levels were reduced by 2 dB when the wind was in the region 80-90° from downwind, with a 10 dB reduction to the predicted noise levels when in an upwind direction. A typical directivity plot is presented in **Plate 10.2** below.

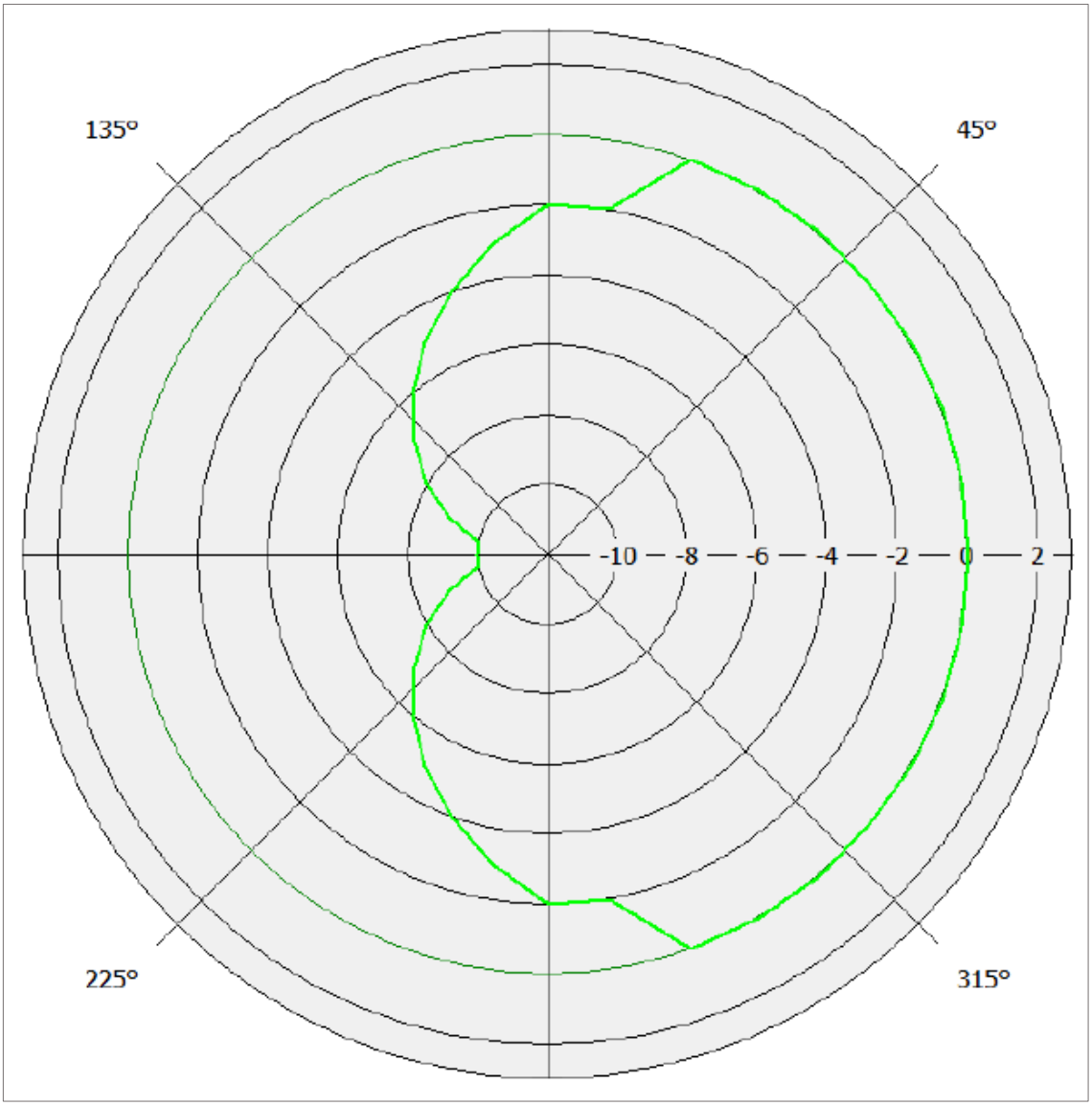

Plate 10.2: Directivity plot for westerly wind direction

The predicted noise levels from the proposed turbines were previously assessed with a slight downward breeze in all directions. However, it would be rational to predict the impact of the turbines when the wind is blowing from certain wind directions as it is possible that the predicted levels may not exceed the noise limits at receptor properties, particularly when the turbines are downwind from the properties.

11.5.4.1 Vestas V117 – Candidate

Table 11.19: Proposed Impact of Directivity Assessment at receptors in exceedance (12m/s)

Wind Direction (Blowing Towards)	H5	H6	H9	H14	H16
0	44.8	42.5	42	42.2	42.8
45	44.2	40.8	41	41.4	41.9
90	43	39.2	40.7	41.2	41.1
135	42.1	40.3	40.3	40.4	40.6
180	40.6	42	40.8	40.4	41.1
225	41.3	43.4	40.7	40.2	41.8
270	42.9	43.2	41.6	41.3	43.1
315	44	43	42.6	42.6	43.3

11.5.4.2 Curtailment – Vestas V117

It can be seen from **Table 11.19** above that when directivity is considered, there are no exceedances of the 45 dB daytime limit. However, there are exceedances of the night-time limit of 43 dB at three receptors after considering directivity:

- H5 with three wind directions after considering directivity
- H6 with two wind directions after considering directivity
- H16 with two wind directions after considering directivity

Therefore, it is necessary for a curtailment strategy to be developed to ensure the proposed development will comply with the limits set out above. The candidate turbine, the Vestas V117

4.3 MW, operating in Mode PO2, is a power mode of the Vestas V117 4.2 MW turbine. Therefore, certain turbines shall be operated in Sound Optimized Modes SO1 and SO2 of the Vestas V117 4.2 MW, during certain conditions.

Optimized Mode SO1 has a lower maximum Sound Power Level at hub height of 105 dB, compared to the maximum Sound Power Level of 106 dB when the proposed turbines are operating in Mode 0. Sound Optimized Mode SO2 has a lower maximum Sound Power Level at hub height of 103 dB, compared to the maximum Sound Power Level of 106 dB when the proposed turbines are operating in Mode 0. This curtailment strategy shall ensure compliance with the 43 dB night-time limit and shall be implemented during the following conditions:

- Turbines AT10, AT11 and AT12 shall be operated in Sound Optimized Mode SO2 during night-time period, from wind speeds of 7-12 m/s and for wind blowing towards the East.
- Turbines AT10 and AT11 shall be operated in Sound Optimized Mode SO2 during night-time period, from wind speeds of 7-12 m/s and for wind blowing towards the North-East.
- Turbine AT5 shall be operated in Sound Optimized Mode SO1 during night-time period, from wind speeds of 7-12 m/s and for wind blowing towards the South-West.
- Turbines AT5 and AT18 shall be operated in Sound Optimized Mode SO1 during night-time period, from wind speeds of 7-12 m/s and for wind blowing towards the South.
- Turbine AT11 shall be operated in Sound Optimized Mode SO2, and Turbines AT12, AT16 and AT18 shall be operated in Sound Optimized Mode SO1 during night-time period, from wind speeds of 7-12 m/s and for wind blowing towards the South-East.

A copy of the manufacturers performance specification for the turbines used in the assessment when operating in Modes SO1 and SO2 with STE is given in the **Technical Appendix 11.6**. The reduction as a result of this strategy can be seen in **Table 11.20** below.

Table 11.20: Impact of Curtailment Strategy at Receptors in exceedance of 43 dB(A)

Receptor	Wind Direction (Blowing Towards)	Predicted Noise Level from Directivity (dBA)	Predicted Noise Level from Curtailment Strategy (dBA)	Reduction (dBA)
H5	North-East	44.2	42.7	1.5
	East	44.8	43	1.8
	South-East	44	43	1

H6	South	43.2	42.8	0.4
	South-West	43.4	43	0.4
H16	South-East	43.3	42.7	0.6
	South	43.1	42.8	0.3

A noise contour map of the curtailment strategy of all turbines is presented with a maximum sound power output at a wind speed of 12 m/s at 10 m height in **Technical Appendix 11.4**.

11.5.5 Description of Effects – Operational Noise

The criteria for description of effects for all operational noise activity and the potential worst-case effects, at the nearest receptors is given below.

Table 11.21: Description of Effects – Operational Noise

Quality	Significance	Duration
Negative	Not Significant	Long Term

11.6 SUMMARY OF EFFECTS

Table 11.22 below summarises the Effects.

Table 11.22: Summary of Effects

	Quality	Significance	Duration
Construction noise	Negative	Not Significant	Temporary
Operational Noise	Negative	Not Significant	Long Term
Decommissioning Noise	Negative	Not Significant	Temporary

11.7 STATEMENT OF SIGNIFICANCE

This Section has assessed the significance of the potential effects of the Proposed Development during operation, construction and decommissioning.

The effects of noise from the operation of the Proposed Development has been assessed using 2006 Guidelines with the methodology described in ETSU-R-97, the IOA Good Practice Guide and the NG4 Guidance document. Noise levels during operation of the Proposed Development have been predicted using the best practice of calculation technique. They have been compared with the noise limits in the 2006 Guidelines, recent 2021 An Bord Pleanála limits and the NG4 Guidance document and found to be compliant. There has been a consultation process in relation to the revision of the 2019 Wind Energy Development Guidelines. This document provided the basis for a discussion on amendments of the noise limits applicable to wind turbine developments. It is understood that there will be revisions to the draft consultation documents, however a mitigation strategy to incorporate a reduction in sound power level outputs with respect to directionality can be put in place to comply with any specific variation in noise limit levels if new more restrictive guidelines are adopted. All turbines have software incorporated so that the sound power levels can be reduced by direction and energy output.

The noise levels predicted at the nearest receptors are orders of magnitude below the level at which risk of hearing damage, or indeed negative health effects are possible.

Noise during construction of the Proposed Development and decommissioning will be managed to comply with best practice, legislation and guidelines current at that time so that effects are not significant.